EUROPEAN RESEARCH EXECUTIVE AGENCY (REA)

REA.A – Marie Skłodowska-Curie Actions & Support to Experts
A.3 – MSCA Staff Exchanges

GRANT AGREEMENT

Project 101236929 — NEXUS

PREAMBLE

This **Agreement** ('the Agreement') is **between** the following parties:

on the one part,

the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and

on the other part,

1. 'the coordinator':

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS), PIC 999997930, established in RUE MICHEL ANGE 3, PARIS 75794, France,

and the following other beneficiaries, if they sign their 'accession form' (see Annex 3 and Article 40):

2. **ISTITUTO NAZIONALE DI FISICA NUCLEARE (INFN)**, PIC 999992789, established in Via Enrico Fermi 54, FRASCATI 00044, Italy,

3. **THE SQUARE KILOMETRE ARRAY OBSERVATORY (SKAO)**, PIC 890491041, established in JODRELL BANK, MACCLESFIELD SK11 9FT, United Kingdom,

Unless otherwise specified, references to 'beneficiary' or 'beneficiaries' include the coordinator and affiliated entities (if any).

If only one beneficiary signs the grant agreement ('mono-beneficiary grant'), all provisions referring to the 'coordinator' or the 'beneficiaries' will be considered — mutatis mutandis — as referring to the beneficiary.

The parties referred to above have agreed to enter into the Agreement.

By signing the Agreement and the accession forms, the beneficiaries accept the grant and agree to implement the action under their own responsibility and in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

The Agreement is composed of:

Preamble

Terms and Conditions (including Data Sheet)

Annex 1 Description of the action[1]

Annex 2 Estimated budget for the action

Annex 2a Additional information on unit costs and contributions (if applicable)

Annex 3 Accession forms (if applicable)[2]

Annex 3a Declaration on joint and several liability of affiliated entities (if applicable)[3]

Annex 4 Model for the financial statements

Annex 5 Specific rules (if applicable)

[1] Template published on Portal Reference Documents.
[2] Template published on Portal Reference Documents.
[3] Template published on Portal Reference Documents.

TERMS AND CONDITIONS

TABLE OF CONTENTS

DATA SHEET

1. General data

Project summary:

Project summary
The nature of invisible dark matter (DM), which constitutes ~26% of the mass-energy balance of the Universe, remains a major puzzle in physics. Despite extensive searches, DM constituents remain undetected, though experiments have significantly constrained the allowed parameter space. The NEXUS project aims to advance this research by enhancing detector performance, refining instrumentation, and expanding theoretical insights through a sustainable expert network. Partnering with world-class laboratories in Europe, the USA, Canada, Australia, and South Africa, NEXUS will tackle extraordinary experimental and theoretical challenges. This research relies on Underground Laboratories (ULs), where cosmic rays are suppressed by ~1000 meters of rock, minimizing the cosmogenic backgrounds. The proposed NEXUS initiative aims to establish a global network of ULs dedicated to ground-breaking advancements in the field. The collaborative approach undertaken in NEXUS is designed to provide a dynamic environment for advances in ultra-sensitive detectors and ultra-low radiation techniques, ready to lead innovation in both the global search for rare events and cutting-edge technological development ultimately benefiting society and industry. ULs' support for research will provide: (i) effective radiation shielding; (ii) above-ground and underground support facilities, such as clean (radon-free) rooms, radio-purity assay equipment, and cryogenic equipment; (iii) material production and purification facilities; (iv) tools and methods to characterize underground facilities and related instrumentation; and (v) a unique environment for multidisciplinary research. In addition, efforts are being made to further increase instrument sensitivity to meet new challenges in rare-event research. NEXUS will pave the way for ground-breaking discoveries, fostering a deeper understanding of the universe while driving technological advancements with broad societal and industrial benefits.

Keywords:

- Dark matter, dark energy
- Fundamental interactions and fields
- High energy and particles astronomy - X-rays, cosmic rays, gamma rays, neutrinos
- Instrumentation - telescopes, detectors and techniques
- Particle physics
- Astroparticles, cosmology, underground laboratories, radioactivity, cosmic background, low background, quantum computing, modelling

Project number: 101236929

Project name: North-south EXchange for Underground Science

Project acronym: NEXUS

Call: HORIZON-MSCA-2024-SE-01

Topic: HORIZON-MSCA-2024-SE-01-01

Type of action: HORIZON TMA MSCA Staff Exchanges

Granting authority: European Research Executive Agency

Grant managed through EU Funding & Tenders Portal: Yes (eGrants)

Project starting date: fixed date: 1 January 2026

Project end date: 31 December 2029

Project duration: 48 months

Consortium agreement: Yes

2. Participants

List of participants:

N°	Role	Short name	Legal name	Ctry	PIC	Total eligible contrib.	Max grant amount
1	COO	CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	999997930	330 660.00	330 660.00
2	BEN	INFN	ISTITUTO NAZIONALE DI FISICA NUCLEARE	IT	999992789	430 860.00	430 860.00
3	BEN (IO)	SKAO	THE SQUARE KILOMETRE ARRAY OBSERVATORY	UK	890491041	10 020.00	10 020.00
4	AP	UKRI	UNITED KINGDOM RESEARCH AND INNOVATION	UK	906446474	0.00	0.00
5	AP	LSC	CONSORCIO PARA EL EQUIPAMIENTO Y EXPLOTACION DEL LABORATORIO SUBTERRANEO DE CANFRANC	ES	998502093	0.00	0.00
6	AP	SU	STELLENBOSCH UNIVERSITY	ZA	999877359	0.00	0.00
7	AP	SURF	South Dakota Science &Technology Authority	US	873610810	0.00	0.00
8	AP	UoA	THE UNIVERSITY OF ADELAIDE	AU	984570274	0.00	0.00
9	AP	UoM	UNIVERSITY OF MELBOURNE	AU	999658818	0.00	0.00
10	AP	UNISA	UNIVERSITY OF SOUTH AFRICA	ZA	990429850	0.00	0.00
11	AP	UWC	UNIVERSITY OF THE WESTERN CAPE	ZA	999883373	0.00	0.00
12	AP	WITS	UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG	ZA	998014086	0.00	0.00
13	AP	SNOLAB	QUEEN'S UNIVERSITY AT KINGSTON	CA	997151562	0.00	0.00
14	AP	UCB	UNIVERSITE LYON 1 CLAUDE BERNARD	FR	999902579	0.00	0.00
15	AP	US	SORBONNE UNIVERSITE	FR	909875521	0.00	0.00
16	AP	IMTA	INSTITUT MINES-TELECOM	FR	999849326	0.00	0.00
17	AP	UGA	UNIVERSITE GRENOBLE ALPES	FR	897379108	0.00	0.00
Total						771 540.00	771 540.00

Coordinator:

– CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)

3. Grant

Maximum grant amount, total estimated eligible costs and contributions and funding rate:

Total eligible contributions (unit, flat-rate and lump sum contributions and financing not linked to costs)	Maximum grant amount (Annex 2)	Maximum grant amount (award decision)
771 540.00	771 540.00	771 540.00

Grant form: Unit

Grant mode: Action grant

Budget categories/activity types:

- A. Contributions for seconded staff
  - A.1 Top-up allowance
  - A.5 Special needs allowance

- B. Institutional contributions
  - B.1 Research, training and networking contribution
  - B.2 Management and indirect contribution

Cost eligibility options:

- In-kind contributions eligible costs

Budget flexibility: Yes (flexibility with conditions)

4. Reporting, payments and recoveries

4.1 Continuous reporting (art 21)

Deliverables: see Funding & Tenders Portal Continuous Reporting tool

4.2 Periodic reporting and payments

Reporting and payment schedule (art 21, 22):

Reporting					Payments	
Reporting periods			Type	Deadline	Type	Deadline (time to pay)
RP No	Month from	Month to				
					Initial prefinancing	30 days from entry into force/10 days before starting date – whichever is the latest
1	1	24	Periodic report	60 days after end of reporting period	Interim payment	90 days from receiving periodic report
2	25	48	Periodic report	60 days after end of reporting period	Final payment	90 days from receiving periodic report

Prefinancing payments and guarantees:

Prefinancing payment	
Type	Amount
Prefinancing 1 (initial)	501 501.00

Reporting and payment modalities (art 21, 22):

Mutual Insurance Mechanism (MIM): Yes

MIM contribution: 5% of the maximum grant amount (38 577.00), retained from the initial prefinancing

Restrictions on distribution of initial prefinancing: The prefinancing may be distributed only if the minimum number of beneficiaries set out in the call condititions (if any) have acceded to the Agreement and only to beneficiaries that have acceded.

Interim payment ceiling (if any): 90% of the maximum grant amount

No-profit rule: n/a

Late payment interest: ECB + 3.5%

Bank account for payments:

FR7610071380000000100005672 TRPUFRP1XXX

Conversion into euros: n/a

Reporting language: Language of the Agreement

4.3 Certificates (art 24): n/a

4.4 Recoveries (art 22)

First-line liability for recoveries:

Beneficiary termination: Beneficiary concerned

Final payment: Each beneficiary for their own debt

After final payment: Beneficiary concerned

Joint and several liability for enforced recoveries (in case of non-payment):

Individual financial responsibility: Each beneficiary is liable only for its own debts (and those of its affiliated entities, if any)

Joint and several liability of affiliated entities — n/a

5. Consequences of non-compliance, applicable law & dispute settlement forum

Suspension and termination:

Additional suspension grounds (art 31)

Additional termination grounds (art 32)

Applicable law (art 43):

Standard applicable law regime: EU law + law of Belgium

Dispute settlement forum (art 43):

Standard dispute settlement forum:

EU beneficiaries: EU General Court + EU Court of Justice (on appeal)

Non-EU beneficiaries: Courts of Brussels, Belgium (unless an international agreement provides for the enforceability of EU court judgements)

Special dispute settlement forum:

– THE SQUARE KILOMETRE ARRAY OBSERVATORY (SKAO): Arbitration

6. Other

Specific rules (Annex 5): Yes

Standard time-limits after project end:

Confidentiality (for X years after final payment): 5

Record-keeping (for X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Reviews (up to X years after final payment): 2

Audits (up to X years after final payment): 2

Extension of findings from other grants to this grant (no later than X years after final payment): 2

Impact evaluation (up to X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

CHAPTER 1 GENERAL

ARTICLE 1 — SUBJECT OF THE AGREEMENT

This Agreement sets out the rights and obligations and terms and conditions applicable to the grant awarded for the implementation of the action set out in Chapter 2.

ARTICLE 2 — DEFINITIONS

For the purpose of this Agreement, the following definitions apply:

Actions — The project which is being funded in the context of this Agreement.

Grant — The grant awarded in the context of this Agreement.

EU grants — Grants awarded by EU institutions, bodies, offices or agencies (including EU executive agencies, EU regulatory agencies, EDA, joint undertakings, etc.).

Participants — Entities participating in the action as beneficiaries, affiliated entities, associated partners, third parties giving in-kind contributions, subcontractors or recipients of financial support to third parties.

Beneficiaries (BEN) — The signatories of this Agreement (either directly or through an accession form).

Affiliated entities (AE) — Entities affiliated to a beneficiary within the meaning of Article 190 of EU Financial Regulation 2024/2509[4] which participate in the action with similar rights and obligations as the beneficiaries (obligation to implement action tasks and right to charge costs and claim contributions).

Associated partners (AP) — Entities which participate in the action, but without the right to charge costs or claim contributions.

Purchases — Contracts for goods, works or services needed to carry out the action (e.g. equipment, consumables and supplies) but which are not part of the action tasks (see Annex 1).

Subcontracting — Contracts for goods, works or services that are part of the action tasks (see Annex 1).

In-kind contributions — In-kind contributions within the meaning of Article 2(38) of EU Financial Regulation 2024/2509, i.e. non-financial resources made available free of charge by third parties to a beneficiary.

[4] For the definition, see Article 190 Regulation (EU, Euratom) 2024/2509 of the European Parliament and of the Council of 23 September 2024 on the financial rules applicable to the general budget of the Union (recast) ('EU Financial Regulation') (OJ L, 2024/2509, 26.9.2024): "**affiliated entities** [are]:

(a) entities that form a sole beneficiary [(i.e. where an entity is formed of several entities that satisfy the criteria for being awarded a grant, including where the entity is specifically established for the purpose of implementing an action to be financed by a grant)];

(b) entities that satisfy the eligibility criteria and that do not fall within one of the situations referred to in Article 138(1) and 143(1) and that have a link with the beneficiary, in particular a legal or capital link, which is neither limited to the action nor established for the sole purpose of its implementation".

Fraud — Fraud within the meaning of Article 3 of EU Directive 2017/1371[5] and Article 1 of the Convention on the protection of the European Communities' financial interests, drawn up by the Council Act of 26 July 1995[6], as well as any other wrongful or criminal deception intended to result in financial or personal gain.

Irregularities — Any type of breach (regulatory or contractual) which could impact the EU financial interests, including irregularities within the meaning of Article 1(2) of EU Regulation 2988/95[7].

Grave professional misconduct — Any type of unacceptable or improper behaviour in exercising one's profession, especially by employees, including grave professional misconduct within the meaning of Article 138(1)(c) of EU Financial Regulation 2024/2509[8].

Applicable EU, international and national law — Any legal acts or other (binding or non-binding) rules and guidance in the area concerned.

Portal — EU Funding & Tenders Portal; electronic portal and exchange system managed by the European Commission and used by itself and other EU institutions, bodies, offices or agencies for the management of their funding programmes (grants, procurements, prizes, etc.).

CHAPTER 2 ACTION

ARTICLE 3 — ACTION

The grant is awarded for the action **101236929** — **NEXUS** ('action'), as described in Annex 1.

ARTICLE 4 — DURATION AND STARTING DATE

The duration and the starting date of the action are set out in the Data Sheet (see Point 1).

CHAPTER 3 GRANT

ARTICLE 5 — GRANT

5.1 Form of grant

[5] Directive (EU) 2017/1371 of the European Parliament and of the Council of 5 July 2017 on the fight against fraud to the Union's financial interests by means of criminal law (OJ L 198, 28.7.2017, p. 29).

[6] OJ C 316, 27.11.1995, p. 48.

[7] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

[8] 'Professional misconduct' includes, in particular, the following: violation of ethical standards of the profession; wrongful conduct with impact on professional credibility; breach of generally accepted professional ethical standards; false declarations/misrepresentation of information; participation in a cartel or other agreement distorting competition; violation of IPR; attempting to influence decision-making processes by taking advantage, through misrepresentation, of a conflict of interests, or to obtain confidential information from public authorities to gain an advantage; incitement to discrimination, hatred or violence or similar activities contrary to the EU values where negatively affecting or risking to affect the performance of a legal commitment.

The grant is an action grant[9] which takes the form of a unit grant.

5.2 Maximum grant amount

The maximum grant amount is set out in the Data Sheet (see Point 3) and in the estimated budget (Annex 2).

5.3 Funding rate

Not applicable

5.4 Estimated budget, budget categories and forms of funding

The estimated budget for the action is set out in Annex 2.

It contains the estimated eligible contributions for the action (unit contributions), broken down by participant and budget category.

Annex 2 also shows the types of contributions (forms of funding)[10] to be used for each budget category.

The details on the calculation of the unit contributions will be explained in Annex 2a.

5.5 Budget flexibility

The budget breakdown may be adjusted — without an amendment (see Article 39) — by transfers of units between participants, as long as this does not imply any substantive or important change to the description of the action in Annex 1. Transfers between budget categories are not allowed.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE CONTRIBUTIONS

6.1 General eligibility conditions

The **general eligibility conditions** for the unit contributions are the following:

(a) the units must:

- be actually used or produced by the beneficiary in the period set out in Article 4 (with the exception of units relating to the submission of the final periodic report, which may be used or produced afterwards; see Article 21)

- be necessary for the implementation of the action and

(b) the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 20).

6.2 Specific eligibility conditions for each budget category

For each budget category, the **specific eligibility conditions** are as follows:

[9] For the definition, see 183(2)(a) EU Financial Regulation 2024/2509: '**action grant**' means an EU grant to finance "an action intended to help achieve a Union policy objective".

[10] See Article 125 EU Financial Regulation 2024/2509.

A. Contributions for seconded staff

Contributions for seconded staff (A.1 Top-up allowance and A.5 Special needs allowance) are eligible, if they fulfil the general eligibility conditions and are calculated as unit contributions in accordance with the method set out in Annex 2a, and if:

for A.1 Top-up allowance:

(a) the number of units declared:

(i) corresponds to the number of months spent by the seconded staff on the research and innovation activities and

(ii) does not exceed the maximum number of months (per seconded staff member) set out in the call conditions

(b) the seconded staff comply with the following conditions:

(i) be seconded full-time

(ii) be — at the date of secondment — one of the following:

- a doctoral candidate (i.e. not in possession of a doctoral degree[11])
- a post-doctoral researcher (i.e. in possession of a doctoral degree), or
- administrative, managerial or technical staff supporting research and innovation activities under the action, and

(iii) have been — at the date of secondment — actively engaged in or linked to research and innovation activities for at least 1 month at the sending:

- beneficiary (or an associated partner linked to the beneficiary and located in the same country) or
- associated partner

(c) the secondments comply with the following conditions:

(i) last at least 1 month (per seconded staff member)

(ii) be between different countries

(iii) for secondments within the EU Member States or Horizon Europe associated countries: be between different sectors (academic and non-academic)[12], except for interdisciplinary secondments, which are limited to a maximum of 1/3 of the total months spent on research and innovation activities under the action

[11] As defined in the call conditions.

[12] For secondments from an associated partner linked to the beneficiary: only the sector (academic or non-academic) of the beneficiary counts, i.e. the associated partner linked to the beneficiary will be considered to belong to the same sector as the beneficiary.

(iv) for secondments from an EU Member State or Horizon Europe associated country: be from a beneficiary (or associated partner linked to the beneficiary) established in a EU Member State or Horizon Europe associated country to an associated partner established in a non-associated non-EU country, and

(v) for secondments to an EU Member State or Horizon Europe associated country: be from an associated partner established in an eligible non-associated non-EU country to a beneficiary (or associated partner linked to the beneficiary) established in a EU Member State or Horizon Europe associated country

(d) the contributions have been fully incurred for the benefit of the seconded staff

This condition is met if they have been fully used for the seconded staff member for whom they are claimed.

for A.5 Special needs allowance:

(a) they are used for seconded staff members with disabilities whose long-term physical, mental, intellectual or sensory impairments are certified by a competent national authority and of such nature that their participation in the action would not be possible without the special needs items or services

(b) the special needs items or services are not already covered from another source (such as social security or health insurance)

(c) the number of units declared corresponds to the number of special needs units that were needed for implementing the action.

B. Institutional contributions

Institutional contributions (B.1 Research, training and networking contribution and B.2 Management and indirect contribution) are eligible, if they are calculated as unit contributions in accordance with the method set out in Annex 2a, and if the top-up allowance is eligible.

6.3 Ineligible contributions

'Ineligible contributions' are:

(a) units that do not comply with the conditions set out above (see Article 6.1 and 6.2)

(b) units implemented during grant agreement suspension (see Article 31) and

(c) units for activities already funded under other EU grants (or grants awarded by an EU Member State, non-EU country or other body implementing the EU budget), except for the following case:

(i) Synergy actions: not applicable

(d) other:

(i) country restrictions for eligible costs: not applicable.

6.4 Consequences of non-compliance

If a beneficiary declares unit contributions that are ineligible, they will be rejected (see Article 27).

This may also lead to other measures described in Chapter 5.

CHAPTER 4 GRANT IMPLEMENTATION

SECTION 1 CONSORTIUM: BENEFICIARIES, AFFILIATED ENTITIES AND OTHER PARTICIPANTS

ARTICLE 7 — BENEFICIARIES

The beneficiaries, as signatories of the Agreement, are fully responsible towards the granting authority for implementing it and for complying with all its obligations.

They must implement the Agreement to their best abilities, in good faith and in accordance with all the obligations and terms and conditions it sets out.

They must have the appropriate resources to implement the action and implement the action under their own responsibility and in accordance with Article 11. If they rely on affiliated entities or other participants (see Articles 8 and 9), they retain sole responsibility towards the granting authority and the other beneficiaries.

They are jointly responsible for the *technical* implementation of the action. If one of the beneficiaries fails to implement their part of the action, the other beneficiaries must ensure that this part is implemented by someone else (without being entitled to an increase of the maximum grant amount and subject to an amendment; see Article 39). The *financial* responsibility of each beneficiary in case of recoveries is governed by Article 22.

The beneficiaries (and their action) must remain eligible under the EU programme funding the grant for the entire duration of the action. Unit contributions will be eligible only as long as the beneficiary and the action are eligible.

The **internal roles and responsibilities** of the beneficiaries are divided as follows:

(a) Each beneficiary must:

(i) keep information stored in the Portal Participant Register up to date (see Article 19)

(ii) inform the granting authority (and the other beneficiaries) immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 19)

(iii) submit to the coordinator in good time:

- the prefinancing guarantees (if required; see Article 23)

- the financial statements and certificates on the financial statements (CFS) (if required; see Articles 21 and 24.2 and Data Sheet, Point 4.3)

- the contribution to the deliverables and technical reports (see Article 21)
- any other documents or information required by the granting authority under the Agreement

(iv) submit via the Portal data and information related to the participation of their affiliated entities.

(b) The coordinator must:

(i) monitor that the action is implemented properly (see Article 11)

(ii) act as the intermediary for all communications between the consortium and the granting authority, unless the Agreement or granting authority specifies otherwise, and in particular:

- submit the prefinancing guarantees to the granting authority (if any)
- request and review any documents or information required and verify their quality and completeness before passing them on to the granting authority
- submit the deliverables and reports to the granting authority
- inform the granting authority about the payments made to the other beneficiaries (report on the distribution of payments; if required, see Articles 22 and 32)

(iii) distribute the payments received from the granting authority to the other beneficiaries without unjustified delay (see Article 22).

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including affiliated entities).

However, coordinators which are public bodies may delegate the tasks set out in Point (b)(ii) last indent and (iii) above to entities with 'authorisation to administer' which they have created or which are controlled by or affiliated to them. In this case, the coordinator retains sole responsibility for the payments and for compliance with the obligations under the Agreement.

Moreover, coordinators which are 'sole beneficiaries'[13] (or similar, such as European research infrastructure consortia (ERICs)) may delegate the tasks set out in Point (b)(i) to (iii) above to one of their members. The coordinator retains sole responsibility for compliance with the obligations under the Agreement.

The beneficiaries must have **internal arrangements** regarding their operation and co-ordination, to ensure that the action is implemented properly.

If required by the granting authority (see Data Sheet, Point 1), these arrangements must be set out in a written **consortium agreement** between the beneficiaries, covering for instance:

[13] For the definition, see Article 190(2) EU Financial Regulation 2024/2509: "Where several entities satisfy the criteria for being awarded a grant and together form one entity, that entity may be treated as the **sole beneficiary**, including where it is specifically established for the purpose of implementing the action financed by the grant."

- the internal organisation of the consortium
- the management of access to the Portal
- different distribution keys for the payments and financial responsibilities in case of recoveries (if any)
- additional rules on rights and obligations related to background and results (see Article 16)
- settlement of internal disputes
- liability, indemnification and confidentiality arrangements between the beneficiaries.

The internal arrangements must not contain any provision contrary to this Agreement.

ARTICLE 8 — AFFILIATED ENTITIES

Not applicable

ARTICLE 9 — OTHER PARTICIPANTS INVOLVED IN THE ACTION

9.1 Associated partners

The following entities which cooperate with a beneficiary will participate in the action as 'associated partners':

- **UNITED KINGDOM RESEARCH AND INNOVATION (UKRI)**, PIC 906446474
- **CONSORCIO PARA EL EQUIPAMIENTO Y EXPLOTACION DEL LABORATORIO SUBTERRANEO DE CANFRANC (LSC)**, PIC 998502093
- **STELLENBOSCH UNIVERSITY (SU)**, PIC 999877359
- **South Dakota Science &Technology Authority (SURF)**, PIC 873610810
- **THE UNIVERSITY OF ADELAIDE (UoA)**, PIC 984570274
- **UNIVERSITY OF MELBOURNE (UoM)**, PIC 999658818
- **UNIVERSITY OF SOUTH AFRICA (UNISA)**, PIC 990429850
- **UNIVERSITY OF THE WESTERN CAPE (UWC)**, PIC 999883373
- **UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG (WITS)**, PIC 998014086
- **QUEEN'S UNIVERSITY AT KINGSTON (SNOLAB)**, PIC 997151562
- **UNIVERSITE LYON 1 CLAUDE BERNARD (UCB)**, PIC 999902579, associated partner of CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)
- **SORBONNE UNIVERSITE (US)**, PIC 909875521, associated partner of CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)

- **INSTITUT MINES-TELECOM (IMTA)**, PIC 999849326, associated partner of CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)

- **UNIVERSITE GRENOBLE ALPES (UGA)**, PIC 897379108, associated partner of CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)

Associated partners must implement the action tasks attributed to them in Annex 1 in accordance with Article 11. They may not charge contributions to the action (no unit contributions) and the costs for their tasks are not eligible.

The tasks must be set out in Annex 1.

The beneficiaries must ensure that their contractual obligations under Articles 11 (proper implementation), 12 (conflict of interests), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping) also apply to the associated partners.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the associated partners.

9.2 Third parties giving in-kind contributions to the action

Other third parties may give in-kind contributions to the action (i.e. personnel, equipment, other goods, works and services, etc. which are free-of-charge) if necessary for the implementation.

Third parties giving in-kind contributions do not implement any action tasks. They may not charge contributions to the action (no unit contributions) and their costs are considered entirely covered by the unit contributions paid to the beneficiaries.

The third parties and their in-kind contributions should be set out in Annex 1.

9.3 Subcontractors

Subcontractors may participate in the action, if necessary for the implementation.

Subcontractors must implement their action tasks in accordance with Article 11. The beneficiaries' costs for subcontracting are considered entirely covered by the unit contributions (irrespective of the actual subcontracting costs incurred, if any).

The beneficiaries must ensure that their contractual obligations under Articles 11 (proper implementation), 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping) also apply to the subcontractors.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the subcontractors.

9.4 Recipients of financial support to third parties

If the action includes providing financial support to third parties (e.g. grants, prizes or similar forms of support), the beneficiaries must ensure that their contractual obligations under Articles 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying

out action), 19 (information) and 20 (record-keeping)also apply to the third parties receiving the support (recipients).

The beneficiaries must also ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the recipients.

ARTICLE 10 — PARTICIPANTS WITH SPECIAL STATUS

10.1 Non-EU participants

Participants which are established in a non-EU country (if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)
- for the submission of certificates under Article 24: to use qualified external auditors which are independent and comply with comparable standards as those set out in EU Directive 2006/43/EC[14]
- for the controls under Article 25: to allow for checks, reviews, audits and investigations (including on-the-spot checks, visits and inspections) by the bodies mentioned in that Article (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.).

Special rules on dispute settlement apply (see Data Sheet, Point 5).

10.2 Participants which are international organisations

Participants which are international organisations (IOs; if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)
- for the submission of certificates under Article 24: to use either independent public officers or external auditors which comply with comparable standards as those set out in EU Directive 2006/43/EC[15]
- for the controls under Article 25: to allow for the checks, reviews, audits and investigations by the bodies mentioned in that Article, taking into account the specific agreements concluded by them and the EU (if any).

For such participants, nothing in the Agreement will be interpreted as a waiver of their privileges or immunities, as accorded by their constituent documents or international law.

[14] Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts (OJ L 157, 9.6.2006, p. 87).

[15] Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts (OJ L 157, 9.6.2006, p. 87).

Special rules on applicable law and dispute settlement apply (see Article 43 and Data Sheet, Point 5).

10.3 Pillar-assessed participants

Pillar-assessed participants (if any) may rely on their own systems, rules and procedures, in so far as they have been positively assessed and do not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries.

'Pillar-assessment' means a review by the European Commission on the systems, rules and procedures which participants use for managing EU grants (in particular internal control system, accounting system, external audits, financing of third parties, rules on recovery and exclusion, information on recipients and protection of personal data; see Article 157 EU Financial Regulation 2024/2509).

Participants with a positive pillar assessment may rely on their own systems, rules and procedures, in particular for:

- record-keeping (Article 20): may be done in accordance with internal standards, rules and procedures
- currency conversion for financial statements (Article 21): may be done in accordance with usual accounting practices
- guarantees (Article 23): for public law bodies, prefinancing guarantees are not needed
- certificates (Article 24):
    - certificates on the financial statements (CFS): may be provided by their regular internal or external auditors and in accordance with their internal financial regulations and procedures
    - certificates on usual accounting practices (CoMUC): are not needed if those practices are covered by an ex-ante assessment

and use the following specific rules, for:

- recoveries (Article 22): in case of financial support to third parties, there will be no recovery if the participant has done everything possible to retrieve the undue amounts from the third party receiving the support (including legal proceedings) and non-recovery is not due to an error or negligence on its part
- checks, reviews, audits and investigations by the EU (Article 25): will be conducted taking into account the rules and procedures specifically agreed between them and the framework agreement (if any)
- impact evaluation (Article 26): will be conducted in accordance with the participant's internal rules and procedures and the framework agreement (if any)
- grant agreement termination (Article 32): the final grant amount and final payment will be calculated taking into account also costs relating to contracts due for execution only after termination takes effect, if the contract was entered into before the pre-information letter was received and could not reasonably be terminated on legal grounds

- liability for damages (Article 33.2): the granting authority must be compensated for damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement only if the damage is due to an infringement of the participant's internal rules and procedures or due to a violation of third parties' rights by the participant or one of its employees or individual for whom the employees are responsible.

Participants whose pillar assessment covers procurement and granting procedures may also do purchases, subcontracting and financial support to third parties (Article 6.2) in accordance with their internal rules and procedures for purchases, subcontracting and financial support.

Participants whose pillar assessment covers data protection rules may rely on their internal standards, rules and procedures for data protection (Article 15).

The participants may however not rely on provisions which would breach the principle of equal treatment of applicants or beneficiaries or call into question the decision awarding the grant, such as in particular:

- eligibility (Article 6)
- consortium roles and set-up (Articles 7-9)
- security and ethics (Articles 13, 14)
- IPR (including background and results, access rights and rights of use), communication, dissemination and visibility (Articles 16 and 17)
- information obligation (Article 19)
- payment, reporting and amendments (Articles 21, 22 and 39)
- rejections, reductions, suspensions and terminations (Articles 27, 28, 29-32)

If the pillar assessment was subject to remedial measures, reliance on the internal systems, rules and procedures is subject to compliance with those remedial measures.

Participants must inform the coordinator without delay of any changes to the systems, rules and procedures that were part of the pillar assessment. The coordinator must immediately inform the granting authority.

Pillar-assessed participants that have also concluded a framework agreement with the EU, may moreover — under the same conditions as those above (i.e. not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries) — rely on the provisions set out in that framework agreement.

SECTION 2 RULES FOR CARRYING OUT THE ACTION

ARTICLE 11 — PROPER IMPLEMENTATION OF THE ACTION

11.1 Obligation to properly implement the action

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement, the call conditions and all legal obligations under applicable EU, international and national law.

11.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 12 — CONFLICT OF INTERESTS

12.1 Conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the Agreement could be compromised for reasons involving family, emotional life, political or national affinity, economic interest or any other direct or indirect interest (‘conflict of interests’).

They must formally notify the granting authority without delay of any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The granting authority may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the beneficiary may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 13 — CONFIDENTIALITY AND SECURITY

13.1 Sensitive information

The parties must keep confidential any data, documents or other material (in any form) that is identified as sensitive in writing (‘sensitive information’) — during the implementation of the action and for at least until the time-limit set out in the Data Sheet (see Point 6).

If a beneficiary requests, the granting authority may agree to keep such information confidential for a longer period.

Unless otherwise agreed between the parties, they may use sensitive information only to implement the Agreement.

The beneficiaries may disclose sensitive information to their personnel or other participants involved in the action only if they:

(a) need to know it in order to implement the Agreement and

(b) are bound by an obligation of confidentiality.

The granting authority may disclose sensitive information to its staff and to other EU institutions and bodies.

It may moreover disclose sensitive information to third parties, if:

(a) this is necessary to implement the Agreement or safeguard the EU financial interests and

(b) the recipients of the information are bound by an obligation of confidentiality.

The confidentiality obligations no longer apply if:

(a) the disclosing party agrees to release the other party

(b) the information becomes publicly available, without breaching any confidentiality obligation

(c) the disclosure of the sensitive information is required by EU, international or national law.

Specific confidentiality rules (if any) are set out in Annex 5.

13.2 Classified information

The parties must handle classified information in accordance with the applicable EU, international or national law on classified information (in particular, Decision 2015/444[16] and its implementing rules).

Deliverables which contain classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving classified information may be subcontracted only after explicit approval (in writing) from the granting authority.

Classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

Specific security rules (if any) are set out in Annex 5.

13.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 14 — ETHICS AND VALUES

14.1 Ethics

The action must be carried out in line with the highest ethical standards and the applicable EU, international and national law on ethical principles.

[16] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

Specific ethics rules (if any) are set out in Annex 5.

14.2 Values

The beneficiaries must commit to and ensure the respect of basic EU values (such as respect for human dignity, freedom, democracy, equality, the rule of law and human rights, including the rights of minorities).

Specific rules on values (if any) are set out in Annex 5.

14.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 15 — DATA PROTECTION

15.1 Data processing by the granting authority

Any personal data under the Agreement will be processed under the responsibility of the data controller of the granting authority in accordance with and for the purposes set out in the Portal Privacy Statement.

For grants where the granting authority is the European Commission, an EU regulatory or executive agency, joint undertaking or other EU body, the processing will be subject to Regulation 2018/1725[17].

15.2 Data processing by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with the applicable EU, international and national law on data protection (in particular, Regulation 2016/679[18]).

They must ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subjects
- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes
- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed
- accurate and, where necessary, kept up to date

[17] Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC (OJ L 295, 21.11.2018, p. 39).

[18] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (‘GDPR’) (OJ L 119, 4.5.2016, p. 1).

- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and

- processed in a manner that ensures appropriate security of the data.

The beneficiaries may grant their personnel access to personal data only if it is strictly necessary for implementing, managing and monitoring the Agreement. The beneficiaries must ensure that the personnel is under a confidentiality obligation.

The beneficiaries must inform the persons whose data are transferred to the granting authority and provide them with the Portal Privacy Statement.

15.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 16 — INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS —ACCESS RIGHTS AND RIGHTS OF USE

16.1 Background and access rights to background

The beneficiaries must give each other and the other participants access to the background identified as needed for implementing the action, subject to any specific rules in Annex 5.

‘Background’ means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that is:

(a) held by the beneficiaries before they acceded to the Agreement and

(b) needed to implement the action or exploit the results.

If background is subject to rights of a third party, the beneficiary concerned must ensure that it is able to comply with its obligations under the Agreement.

16.2 Ownership of results

The granting authority does not obtain ownership of the results produced under the action.

‘Results’ means any tangible or intangible effect of the action, such as data, know-how or information, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including intellectual property rights.

16.3 Rights of use of the granting authority on materials, documents and information received for policy, information, communication, dissemination and publicity purposes

The granting authority has the right to use non-sensitive information relating to the action and materials and documents received from the beneficiaries (notably summaries for publication, deliverables, as well as any other material, such as pictures or audio-visual material, in paper or

electronic form) for policy, information, communication, dissemination and publicity purposes — during the action or afterwards.

The right to use the beneficiaries' materials, documents and information is granted in the form of a royalty-free, non-exclusive and irrevocable licence, which includes the following rights:

(a) **use for its own purposes** (in particular, making them available to persons working for the granting authority or any other EU service (including institutions, bodies, offices, agencies, etc.) or EU Member State institution or body; copying or reproducing them in whole or in part, in unlimited numbers; and communication through press information services)

(b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes)

(c) **editing or redrafting** (including shortening, summarising, inserting other elements (e.g. meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation)

(d) **translation**

(e) **storage** in paper, electronic or other form

(f) **archiving**, in line with applicable document-management rules

(g) the right to authorise **third parties** to act on its behalf or sub-license to third parties the modes of use set out in Points (b), (c), (d) and (f), if needed for the information, communication and publicity activity of the granting authority

(h) **processing**, analysing, aggregating the materials, documents and information received and **producing derivative works**.

The rights of use are granted for the whole duration of the industrial or intellectual property rights concerned.

If materials or documents are subject to moral rights or third party rights (including intellectual property rights or rights of natural persons on their image and voice), the beneficiaries must ensure that they comply with their obligations under this Agreement (in particular, by obtaining the necessary licences and authorisations from the rights holders concerned).

Where applicable, the granting authority will insert the following information:

> "© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the [name of granting authority] under conditions."

16.4 Specific rules on IPR, results and background

Specific rules regarding intellectual property rights, results and background (if any) are set out in Annex 5.

16.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

ARTICLE 17 — COMMUNICATION, DISSEMINATION AND VISIBILITY

17.1 Communication — Dissemination — Promoting the action

Unless otherwise agreed with the granting authority, the beneficiaries must promote the action and its results by providing targeted information to multiple audiences (including the media and the public), in accordance with Annex 1 and in a strategic, coherent and effective manner.

Before engaging in a communication or dissemination activity expected to have a major media impact, the beneficiaries must inform the granting authority.

17.2 Visibility — European flag and funding statement

Unless otherwise agreed with the granting authority, communication activities of the beneficiaries related to the action (including media relations, conferences, seminars, information material, such as brochures, leaflets, posters, presentations, etc., in electronic form, via traditional or social media, etc.), dissemination activities and any infrastructure, equipment, vehicles, supplies or major result funded by the grant must acknowledge EU support and display the European flag (emblem) and funding statement (translated into local languages, where appropriate):

The emblem must remain distinct and separate and cannot be modified by adding other visual marks, brands or text.

Apart from the emblem, no other visual identity or logo may be used to highlight the EU support.

When displayed in association with other logos (e.g. of beneficiaries or sponsors), the emblem must be displayed at least as prominently and visibly as the other logos.

For the purposes of their obligations under this Article, the beneficiaries may use the emblem without first obtaining approval from the granting authority. This does not, however, give them the right to exclusive use. Moreover, they may not appropriate the emblem or any similar trademark or logo, either by registration or by any other means.

17.3 Quality of information — Disclaimer

Any communication or dissemination activity related to the action must use factually accurate information.

Moreover, it must indicate the following disclaimer (translated into local languages where appropriate):

> "Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or [name of the granting authority]. Neither the European Union nor the granting authority can be held responsible for them."

17.4 Specific communication, dissemination and visibility rules

Specific communication, dissemination and visibility rules (if any) are set out in Annex 5.

17.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 18 — SPECIFIC RULES FOR CARRYING OUT THE ACTION

18.1 Specific rules for carrying out the action

Specific rules for implementing the action (if any) are set out in Annex 5.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

SECTION 3 GRANT ADMINISTRATION

ARTICLE 19 — GENERAL INFORMATION OBLIGATIONS

19.1 Information requests

The beneficiaries must provide — during the action or afterwards and in accordance with Article 7

— any information requested in order to verify eligibility of the unit contributions declared, proper implementation of the action and compliance with the other obligations under the Agreement.

The information provided must be accurate, precise and complete and in the format requested, including electronic format.

19.2 Participant Register data updates

The beneficiaries must keep — at all times, during the action or afterwards — their information stored in the Portal Participant Register up to date, in particular, their name, address, legal representatives, legal form and organisation type.

19.3 Information about events and circumstances which impact the action

The beneficiaries must immediately inform the granting authority (and the other beneficiaries) of any of the following:

(a) **events** which are likely to affect or delay the implementation of the action or affect the EU's financial interests, in particular:

(i) changes in their legal, financial, technical, organisational or ownership situation (including changes linked to one of the exclusion grounds listed in the declaration of honour signed before grant signature)

(ii) linked action information: not applicable

(b) **circumstances** affecting:

(i) the decision to award the grant or

(ii) compliance with requirements under the Agreement.

19.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 20 — RECORD-KEEPING

20.1 Keeping records and supporting documents

The beneficiaries must — at least until the time-limit set out in the Data Sheet (see Point 6) — keep records and other supporting documents to prove the proper implementation of the action in line with the accepted standards in the respective field (if any).

In addition, the beneficiaries must — for the same period — keep adequate records and supporting documents to prove the number of units declared; beneficiaries do not need to keep specific records on the actual costs incurred.

The records and supporting documents must be made available upon request (see Article 19) or in the context of checks, reviews, audits or investigations (see Article 25).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Article 25), the beneficiaries must keep these records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The granting authority may accept non-original documents if they offer a comparable level of assurance.

20.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, unit contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 21 — REPORTING

21.1 Continuous reporting

The beneficiaries must report on the progress of the action (e.g. **deliverables, milestones, outputs/ outcomes, critical risks, indicators,** etc; if any), in the Portal Continuous Reporting tool and in accordance with the timing and conditions it sets out (as agreed with the granting authority).

Standardised deliverables (e.g. progress reports not linked to payments, reports on cumulative expenditure, special reports, etc; if any) must be submitted using the templates published on the Portal.

21.2 Periodic reporting: Technical reports and financial statements

In addition, the beneficiaries must provide reports to request payments, in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2):

- for additional prefinancings (if any): an **additional prefinancing report**
- for interim payments (if any) and the final payment: a **periodic report**.

The prefinancing and periodic reports include a technical and financial part.

The technical part includes an overview of the action implementation. It must be prepared using the template available in the Portal Periodic Reporting tool.

The financial part of the additional prefinancing report includes a statement on the use of the previous prefinancing payment.

The financial part of the periodic report includes:

- the financial statements (individual and consolidated; for all beneficiaries/affiliated entities)
- the explanation on the use of resources (or detailed cost reporting table, if required)

- the certificates on the financial statements (CFS): not applicable.

The **financial statements** must detail the contributions for the units implemented in the reporting period.

Unit contributions which are not declared in a financial statement will not be taken into account by the granting authority.

By signing the financial statements (directly in the Portal Periodic Reporting tool), the beneficiaries confirm that:

- the information provided is complete, reliable and true
- the unit contributions declared are eligible (see Article 6)
- the contributions can be substantiated by adequate records and supporting documents (see Article 20) that will be produced upon request (see Article 19) or in the context of checks, reviews, audits and investigations (see Article 25)

Beneficiaries will have to submit also the financial statements of their affiliated entities (if any). In case of recoveries (see Article 22), beneficiaries will be held responsible also for the financial statements of their affiliated entities.

21.3 Currency for financial statements and conversion into euros

The financial statements must be drafted in euro.

21.4 Reporting language

The reporting must be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

21.5 Consequences of non-compliance

If a report submitted does not comply with this Article, the granting authority may suspend the payment deadline (see Article 29) and apply other measures described in Chapter 5.

If the coordinator breaches its reporting obligations, the granting authority may terminate the grant or the coordinator's participation (see Article 32) or apply other measures described in Chapter 5.

ARTICLE 22 — PAYMENTS AND RECOVERIES — CALCULATION OF AMOUNTS DUE

22.1 Payments and payment arrangements

Payments will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

They will be made in euro to the bank account indicated by the coordinator (see Data Sheet, Point 4.2) and must be distributed without unjustified delay (restrictions may apply to distribution of the initial prefinancing payment; see Data Sheet, Point 4.2).

Payments to this bank account will discharge the granting authority from its payment obligation.

The cost of payment transfers will be borne as follows:

- the granting authority bears the cost of transfers charged by its bank
- the beneficiary bears the cost of transfers charged by its bank
- the party causing a repetition of a transfer bears all costs of the repeated transfer.

Payments by the granting authority will be considered to have been carried out on the date when they are debited to its account.

22.2 Recoveries

Recoveries will be made, if — at beneficiary termination, final payment or afterwards — it turns out that the granting authority has paid too much and needs to recover the amounts undue.

Each beneficiary's financial responsibility in case of recovery is in principle limited to their own debt and undue amounts of their affiliated entities.

In case of enforced recoveries (see Article 22.4), affiliated entities will be held liable for repaying debts of their beneficiaries, if required by the granting authority (see Data Sheet, Point 4.4).

22.3 Amounts due

22.3.1 Prefinancing payments

The aim of the prefinancing is to provide the beneficiaries with a float.

It remains the property of the EU until the final payment.

For **initial prefinancings** (if any), the amount due, schedule and modalities are set out in the Data Sheet (see Point 4.2).

For **additional prefinancings** (if any), the amount due, schedule and modalities are also set out in the Data Sheet (see Point 4.2). However, if the statement on the use of the previous prefinancing payment shows that less than 70% was used, the amount set out in the Data Sheet will be reduced by the difference between the 70% threshold and the amount used.

The contribution to the Mutual Insurance Mechanism will be retained from the prefinancing payments (at the rate and in accordance with the modalities set out in the Data Sheet, see Point 4.2) and transferred to the Mechanism.

Prefinancing payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.2 Amount due at beneficiary termination — Recovery

At beneficiary termination there will be no payment, but the grant must be provisionally closed for the beneficiary which leaves the consortium (and the affiliated entities which had to end their participation together with the beneficiary, if any).

Payments (if any) will be made with the next interim or final payment.

The **amount due** will be calculated in the following step:

Step 1 — Calculation of the total accepted EU contribution

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the beneficiary for all reporting periods, by calculating the unit contributions for the accepted units.

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution' for the beneficiary.

The **balance** is then calculated by deducting the payments received (if any; see report on the distribution of payments in Article 32), from the total accepted EU contribution:

{total accepted EU contribution for the beneficiary

minus

{prefinancing and interim payments received (if any)}}.

If the balance is **positive**, the amount will be included in the next interim or final payment to the consortium.

If the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount due, the amount to be recovered and the reasons why and
- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered and ask this amount to be paid to the coordinator (**confirmation letter**).

If payment is not made to the coordinator by the date specified in the confirmation letter, the granting authority may call on the Mutual Insurance Mechanism to intervene, if continuation of the action is guaranteed and the conditions set out in the rules governing the Mechanism are met.

In this case, it will send a **beneficiary recovery letter**, together with a **debit note** with the terms and date for payment.

The debit note for the beneficiary will include the amount calculated for the affiliated entities which also had to end their participation (if any).

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

The amounts will later on also be taken into account for the next interim or final payment.

22.3.3 Interim payments

Interim payments reimburse the eligible contributions claimed for the units implemented during the reporting periods (if any).

Interim payments (if any) will be made in accordance with the schedule and modalities set out the Data Sheet (see Point 4.2).

Payment is subject to the approval of the periodic report. Its approval does not imply recognition of compliance, authenticity, completeness or correctness of its content.

The **interim payment** will be calculated by the granting authority in the following steps:

Step 1 — Calculation of the total accepted EU contribution

Step 2 — Limit to the interim payment ceiling

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for the reporting period, by calculating the unit contributions for the accepted units.

After that, the granting authority will take into account grant reductions from beneficiary termination (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the interim payment ceiling

The resulting amount is then capped to ensure that the total amount of prefinancing and interim payments (if any) does not exceed the interim payment ceiling set out in the Data Sheet (see Point 4.2).

Interim payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.4 Final payment — Final grant amount — Revenues and Profit — Recovery

The final payment (payment of the balance) reimburses the eligible contributions claimed for the remaining units implemented (if any).

The final payment will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

Payment is subject to the approval of the final periodic report. Its approval does not imply recognition of compliance, authenticity, completeness or correctness of its content.

The **final grant amount for the action** will be calculated in the following steps:

Step 1 — Calculation of the total accepted EU contribution

Step 2 — Limit to the maximum grant amount

Step 3 — Reduction due to the no-profit rule

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for all reporting periods, by calculating the unit contributions for the accepted units.

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the maximum grant amount

If the resulting amount is higher than the maximum grant amount set out in Article 5.2, it will be limited to the latter.

Step 3 — Reduction due to the no-profit rule

Not applicable

The **balance** (final payment) is then calculated by deducting the total amount of prefinancing and interim payments already made (if any), from the final grant amount:

{final grant amount

minus

{prefinancing and interim payments made (if any)}}.

If the balance is **positive**, it will be **paid** to the coordinator.

The amount retained for the Mutual Insurance Mechanism (see above) will be released and **paid** to the coordinator (in accordance with the rules governing the Mechanism).

The final payment (or part of it) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

If — despite the release of the Mutual Insurance Mechanism contribution — the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to recover, the final grant amount, the amount to be recovered and the reasons why
- requesting a report on the distribution of payments to the beneficiaries within 30 days of receiving notification and
- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received) and the coordinator has submitted the report on the distribution of payments, it will calculate the **share of the debt per beneficiary**, by:

(a) identifying the beneficiaries for which the amount calculated as follows is negative:

{{{total accepted EU contribution for the beneficiary

divided by

total accepted EU contribution for the action}

multiplied by

final grant amount for the action},

minus

{prefinancing and interim payments received by the beneficiary (if any)}}

and

(b) dividing the debt:

{{amount calculated according to point (a) for the beneficiary concerned

divided by

the sum of the amounts calculated according to point (a) for all the beneficiaries identified according to point (a)}

multiplied by

the amount to be recovered}.

and confirm the amount to be recovered from each beneficiary concerned (**confirmation letter**), together with **debit notes** with the terms and date for payment.

The debit notes for beneficiaries will include the amounts calculated for their affiliated entities (if any).

If the coordinator has not submitted the report on the distribution of payments, the granting authority will **recover** the full amount from the coordinator (**confirmation letter** and **debit note** with the terms and date for payment).

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.3.5 Audit implementation after final payment — Revised final grant amount — Recovery

If — after the final payment (in particular, after checks, reviews, audits or investigations; see Article 25) — the granting authority rejects unit contributions (see Article 27) or reduces the grant (see Article 28), it will calculate the **revised final grant amount** for the beneficiary concerned.

The **beneficiary revised final grant amount** will be calculated in the following step:

Step 1 — Calculation of the revised total accepted EU contribution

Step 1 — Calculation of the revised total accepted EU contribution

The granting authority will first calculate the 'revised accepted EU contribution' for the beneficiary, by calculating the 'revised accepted contributions'.

After that, it will take into account grant reductions (if any). The resulting 'revised total accepted EU contribution' is the beneficiary revised final grant amount.

If the revised final grant amount is lower than the beneficiary's final grant amount (i.e. its share in the final grant amount for the action), it will be **recovered** in accordance with the following procedure:

The **beneficiary final grant amount** (i.e. share in the final grant amount for the action) is calculated as follows:

{{total accepted EU contribution for the beneficiary

divided by

total accepted EU contribution for the action}

multiplied by

final grant amount for the action}.

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount to be recovered and the reasons why and
- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered (**confirmation letter**), together with a **debit note** with the terms and the date for payment.

Recoveries against affiliated entities (if any) will be handled through their beneficiaries.

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.4 Enforced recovery

If payment is not made by the date specified in the debit note, the amount due will be recovered:

(a) by offsetting the amount — without the coordinator or beneficiary's consent — against any amounts owed to the coordinator or beneficiary by the granting authority.

In exceptional circumstances, to safeguard the EU financial interests, the amount may be offset before the payment date specified in the debit note.

For grants where the granting authority is the European Commission or an EU executive agency, debts may also be offset against amounts owed by other Commission services or executive agencies.

(b) financial guarantee(s): not applicable

(c) joint and several liability of beneficiaries: not applicable

(d) by holding affiliated entities jointly and severally liable (if any, see Data Sheet, Point 4.4)

(e) by taking legal action (see Article 43) or, provided that the granting authority is the European Commission or an EU executive agency, by adopting an enforceable decision under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 100(2) of EU Financial Regulation 2024/2509.

If the Mutual Insurance Mechanism was called on by the granting authority to intervene, recovery will be continued in the name of the Mutual Insurance Mechanism. If two debit notes were sent, the second one (in the name of the Mutual Insurance Mechanism) will be considered to replace the first one (in the name of the granting authority). Where the MIM intervened, offsetting, enforceable decisions or any other of the above-mentioned forms of enforced recovery may be used mutatis mutandis.

The amount to be recovered will be increased by **late-payment interest** at the rate set out in Article 22.5, from the day following the payment date in the debit note, up to and including the date the full payment is received.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2015/2366[19] applies.

For grants where the granting authority is an EU executive agency, enforced recovery by offsetting or enforceable decision will be done by the services of the European Commission (see also Article 43).

22.5 Consequences of non-compliance

22.5.1 If the granting authority does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros (‘reference rate’), plus the rate specified in the Data Sheet (Point 4.2). The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only on request submitted within two months of receiving the late payment.

[19] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC (OJ L 337, 23.12.2015, p. 35).

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

If payments or the payment deadline are suspended (see Articles 29 and 30), payment will not be considered as late.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

22.5.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the coordinator may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 23 — GUARANTEES

Not applicable

ARTICLE 24 — CERTIFICATES

Not applicable

ARTICLE 25 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

25.1 Granting authority checks, reviews and audits

25.1.1 Internal checks

The granting authority may — during the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing unit contributions, deliverables and reports.

25.1.2 Project reviews

The granting authority may carry out reviews on the proper implementation of the action and compliance with the obligations under the Agreement (general project reviews or specific issues reviews).

Such project reviews may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiary concerned and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent, outside experts. If it uses outside experts, the coordinator or beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The coordinator or beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted

(including information on the use of resources). The granting authority may request beneficiaries to provide such information to it directly. Sensitive information and documents will be treated in accordance with Article 13.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with the outside experts.

For **on-the-spot visits**, the beneficiary concerned must allow access to sites and premises (including to the outside experts) and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a **project review report** will be drawn up.

The granting authority will formally notify the project review report to the coordinator or beneficiary concerned, which has 30 days from receiving notification to make observations.

Project reviews (including project review reports) will be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

25.1.3 Audits

The granting authority may carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Such audits may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the beneficiary concerned and will be considered to start on the date of the notification.

The granting authority may use its own audit service, delegate audits to a centralised service or use external audit firms. If it uses an external firm, the beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. Sensitive information and documents will be treated in accordance with Article 13.

For **on-the-spot** visits, the beneficiary concerned must allow access to sites and premises (including for the external audit firm) and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a **draft audit report** will be drawn up.

The auditors will formally notify the draft audit report to the beneficiary concerned, which has 30 days from receiving notification to make observations (contradictory audit procedure).

The **final audit report** will take into account observations by the beneficiary concerned and will be formally notified to them.

Audits (including audit reports) will be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

25.2 European Commission checks, reviews and audits in grants of other granting authorities

Where the granting authority is not the European Commission, the latter has the same rights of checks, reviews and audits as the granting authority.

25.3 Access to records for assessing simplified forms of funding

The beneficiaries must give the European Commission access to their statutory records for the periodic assessment of simplified forms of funding which are used in EU programmes.

25.4 OLAF, EPPO and ECA audits and investigations

The following bodies may also carry out checks, reviews, audits and investigations — during the action or afterwards:

- the European Anti-Fraud Office (OLAF) under Regulations No 883/2013[20] and No 2185/96[21]
- the European Public Prosecutor's Office (EPPO) under Regulation 2017/1939
- the European Court of Auditors (ECA) under Article 287 of the Treaty on the Functioning of the EU (TFEU) and Article 263 of EU Financial Regulation 2024/2509.

If requested by these bodies, the beneficiary concerned must provide full, accurate and complete information in the format requested (including complete accounts, individual salary statements or other personal data, including in electronic format) and allow access to sites and premises for on-the-spot visits or inspections — as provided for under these Regulations.

To this end, the beneficiary concerned must keep all relevant information relating to the action, at least until the time-limit set out in the Data Sheet (Point 6) and, in any case, until any ongoing checks, reviews, audits, investigations, litigation or other pursuits of claims have been concluded.

25.5 Consequences of checks, reviews, audits and investigations — Extension of results of reviews, audits or investigations

25.5.1 Consequences of checks, reviews, audits and investigations in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to rejections (see Article 27), grant reduction (see Article 28) or other measures described in Chapter 5.

Rejections or grant reductions after the final payment will lead to a revised final grant amount (see Article 22).

[20] Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18/09/2013, p. 1).

[21] Council Regulation (Euratom, EC) No 2185/96 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities' financial interests against fraud and other irregularities (OJ L 292, 15/11/1996, p. 2).

Findings in checks, reviews, audits or investigations during the action implementation may lead to a request for amendment (see Article 39), to change the description of the action set out in Annex 1.

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations in any EU grant may also lead to consequences in other EU grants awarded under similar conditions ('extension to other grants').

Moreover, findings arising from an OLAF or EPPO investigation may lead to criminal prosecution under national law.

25.5.2 Extension from other grants

Results of checks, reviews, audits or investigations in other grants may be extended to this grant, if:

(a) the beneficiary concerned is found, in other EU grants awarded under similar conditions, to have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and

(b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — within the time-limit for audits set out in the Data Sheet (see Point 6).

The granting authority will formally notify the beneficiary concerned of the intention to extend the findings and the list of grants affected.

If the extension concerns **rejections of unit contributions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings

(b) the request to submit revised financial statements for all grants affected

(c) the correction rate for extrapolation, established on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected, if the beneficiary concerned:

(i) considers that the submission of revised financial statements is not possible or practicable or

(ii) does not submit revised financial statements.

If the extension concerns **grant reductions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings and

(b) the **correction rate for extrapolation**, established on the basis of the systemic or recurrent errors and the principle of proportionality.

The beneficiary concerned has **60 days** from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method/rate**.

On the basis of this, the granting authority will analyse the impact and decide on the implementation (i.e. start rejection or grant reduction procedures, either on the basis of the revised financial statements or the announced/alternative method/rate or a mix of those; see Articles 27 and 28).

25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, unit contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 26 — IMPACT EVALUATIONS

26.1 Impact evaluation

The granting authority may carry out impact evaluations of the action, measured against the objectives and indicators of the EU programme funding the grant.

Such evaluations may be started during implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiaries and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent outside experts.

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

26.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the granting authority may apply the measures described in Chapter 5.

CHAPTER 5 CONSEQUENCES OF NON-COMPLIANCE

SECTION 1 REJECTIONS AND GRANT REDUCTION

ARTICLE 27 — REJECTION OF CONTRIBUTIONS

27.1 Conditions

The granting authority will — at beneficiary termination, interim payment, final payment or afterwards — reject any unit contributions which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 25).

The rejection may also be based on the extension of findings from other grants to this grant (see Article 25).

Ineligible unit contributions will be rejected.

27.2 Procedure

If the rejection does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the rejection, the amounts and the reasons why. The coordinator or

beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the rejection (payment review procedure).

If the rejection leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

27.3 Effects

If the granting authority rejects unit contributions, it will deduct them from the contributions declared and then calculate the amount due (and, if needed, make a recovery; see Article 22).

ARTICLE 28 — GRANT REDUCTION

28.1 Conditions

The granting authority may — at beneficiary termination, final payment or afterwards — reduce the grant for a beneficiary, if:

(a) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), failure to cooperate with checks, reviews, audits and investigations, etc.), or

(b) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (see Article 25).

The amount of the reduction will be calculated for each beneficiary concerned and proportionate to the seriousness and the duration of the errors, irregularities or fraud or breach of obligations, by applying an individual reduction rate to their accepted EU contribution.

28.2 Procedure

If the grant reduction does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the reduction, the amount to be reduced and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the reduction (payment review procedure).

If the grant reduction leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

28.3 Effects

If the granting authority reduces the grant, it will deduct the reduction and then calculate the amount due (and, if needed, make a recovery; see Article 22).

SECTION 2 SUSPENSION AND TERMINATION

ARTICLE 29 — PAYMENT DEADLINE SUSPENSION

29.1 Conditions

The granting authority may — at any moment — suspend the payment deadline if a payment cannot be processed because:

(a) the required report (see Article 21) has not been submitted or is not complete or additional information is needed

(b) there are doubts about the amount to be paid (e.g. ongoing audit extension procedure, queries about eligibility, need for a grant reduction, etc.) and additional checks, reviews, audits or investigations are necessary, or

(c) there are other issues affecting the EU financial interests.

29.2 Procedure

The granting authority will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day the notification is sent.

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining time to pay (see Data Sheet, Point 4.2) will resume.

If the suspension exceeds two months, the coordinator may request the granting authority to confirm if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the report and the revised report is not submitted (or was submitted but is also rejected), the granting authority may also terminate the grant or the participation of the coordinator (see Article 32).

ARTICLE 30 — PAYMENT SUSPENSION

30.1 Conditions

The granting authority may — at any moment — suspend payments, in whole or in part for one or more beneficiaries, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under this Agreement or during its award (including

improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), failure to cooperate with checks, reviews, audits and investigations, etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant.

If payments are suspended for one or more beneficiaries, the granting authority will make partial payment(s) for the part(s) not suspended. If suspension concerns the final payment, the payment (or recovery) of the remaining amount after suspension is lifted will be considered to be the payment that closes the action.

30.2 Procedure

Before suspending payments, the granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to suspend payments and the reasons why and
- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

At the end of the suspension procedure, the granting authority will also inform the coordinator.

The suspension will **take effect** the day after the confirmation notification is sent.

If the conditions for resuming payments are met, the suspension will be **lifted**. The granting authority will formally notify the beneficiary concerned (and the coordinator) and set the suspension end date.

During the suspension, no prefinancing will be paid to the beneficiaries concerned. For interim payments, the periodic reports for all reporting periods except the last one (see Article 21) must not contain any financial statements from the beneficiary concerned (or its affiliated entities). The coordinator must include them in the next periodic report after the suspension is lifted or — if suspension is not lifted before the end of the action — in the last periodic report.

ARTICLE 31 — GRANT AGREEMENT SUSPENSION

31.1 Consortium-requested GA suspension

31.1.1 Conditions and procedure

The beneficiaries may request the suspension of the grant or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 35) — make implementation impossible or excessively difficult.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why
- the date the suspension takes effect; this date may be before the date of the submission of the amendment request and
- the expected date of resumption.

The suspension will **take effect** on the day specified in the amendment.

Once circumstances allow for implementation to resume, the coordinator must immediately request another **amendment** of the Agreement to set the suspension end date, the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the amendment. This date may be before the date of the submission of the amendment request.

During the suspension, no prefinancing will be paid. Moreover, no units may be implemented. Ongoing units must be interrupted and no new units may be started. Unit contributions for activities implemented during grant suspension are not eligible (see Article 6.3).

31.2 EU-initiated GA suspension

31.2.1 Conditions

The granting authority may suspend the grant or any part of it, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), failure to cooperate with checks, reviews, audits and investigations, etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant

(c) other:

  (i) linked action issues: not applicable

  (ii) the action has lost its scientific or technological relevance

31.2.2 Procedure

Before suspending the grant, the granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to suspend the grant and the reasons why and
- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

The suspension will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification).

Once the conditions for resuming implementation of the action are met, the granting authority will formally notify the coordinator a **lifting of suspension letter**, in which it will set the suspension end date and invite the coordinator to request an amendment of the Agreement to set the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the lifting of suspension letter. This date may be before the date on which the letter is sent.

During the suspension, no prefinancing will be paid. Moreover, no units may be implemented Ongoing units must be interrupted and no new units may be started. Unit contributions for activities implemented during suspension are not eligible (see Article 6.3).

The beneficiaries may not claim damages due to suspension by the granting authority (see Article 33).

Grant suspension does not affect the granting authority's right to terminate the grant or a beneficiary (see Article 32) or reduce the grant (see Article 28).

ARTICLE 32 — GRANT AGREEMENT OR BENEFICIARY TERMINATION

32.1 Consortium-requested GA termination

32.1.1 Conditions and procedure

The beneficiaries may request the termination of the grant.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why
- the date the consortium ends work on the action ('end of work date') and
- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

The termination will **take effect** on the termination date specified in the amendment.

If no reasons are given or if the granting authority considers the reasons do not justify termination, it may consider the grant terminated improperly.

32.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted and taking into account the unit contributions for activities implemented before the end of work date (see Article 22).

If the granting authority does not receive the report within the deadline, only unit contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

Improper termination may lead to a grant reduction (see Article 28).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.2 Consortium-requested beneficiary termination

32.2.1 Conditions and procedure

The coordinator may request the termination of the participation of one or more beneficiaries, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing)
- the date the beneficiary ends work on the action ('end of work date')
- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

If the termination concerns the coordinator and is done without its agreement, the amendment request must be submitted by another beneficiary (acting on behalf of the consortium).

The termination will **take effect** on the termination date specified in the amendment.

If no information is given or if the granting authority considers that the reasons do not justify termination, it may consider the beneficiary to have been terminated improperly.

32.2.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a **report on the distribution of payments** to the beneficiary concerned

(ii) a **termination report** from the beneficiary concerned, for the open reporting period until

termination, containing an overview of the progress of the work, the financial statement and the explanation on the use of resources

(iii) a second **request for amendment** (see Article 39) with other amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the report submitted and taking into account the unit contributions for activities implemented before the end of work date (see Article 22).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 21).

If the granting authority does not receive the termination report within the deadline, only unit contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

If the granting authority does not receive the report on the distribution of payments within the deadline, it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

If the second request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the second request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

Improper termination may lead to a reduction of the grant (see Article 31) or grant termination (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.3 EU-initiated GA or beneficiary termination

32.3.1 Conditions

The granting authority may terminate the grant or the participation of one or more beneficiaries, if:

(a) one or more beneficiaries do not accede to the Agreement (see Article 40)

(b) a change to the action or the legal, financial, technical, organisational or ownership situation of a beneficiary is likely to substantially affect the implementation of the action or calls into question the decision to award the grant (including changes linked to one of the exclusion grounds listed in the declaration of honour)

(c) following termination of one or more beneficiaries, the necessary changes to the Agreement (and their impact on the action) would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(d) implementation of the action has become impossible or the changes necessary for its continuation would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(e) a beneficiary (or person with unlimited liability for its debts) is subject to bankruptcy proceedings or similar (including insolvency, winding-up, administration by a liquidator or court, arrangement with creditors, suspension of business activities, etc.)

(f) a beneficiary (or person with unlimited liability for its debts) is in breach of social security or tax obligations

(g) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has been found guilty of grave professional misconduct

(h) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed fraud, corruption, or is involved in a criminal organisation, money laundering, terrorism-related crimes (including terrorism financing), child labour or human trafficking

(i) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) was created under a different jurisdiction with the intent to circumvent fiscal, social or other legal obligations in the country of origin (or created another entity with this purpose)

(j) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), failure to cooperate with checks, reviews, audits and investigations, etc.)

(k) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (extension of findings from other grants to this grant; see Article 25)

(l) despite a specific request by the granting authority, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its affiliated entities or associated partners that is in one of the situations under points (d), (f), (e), (g), (h), (i) or (j) and to reallocate its tasks, or

(m) other:

(i) linked action issues: not applicable

(ii) the action has lost its scientific or technological relevance

32.3.2 Procedure

Before terminating the grant or participation of one or more beneficiaries, the granting authority will send **a pre-information letter** to the coordinator or beneficiary concerned:

- formally notifying the intention to terminate and the reasons why and
- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the termination and the date it will take effect (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

For beneficiary terminations, the granting authority will — at the end of the procedure — also inform the coordinator.

The termination will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification; 'termination date').

32.3.3 Effects

(a) for **GA termination**:

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the last open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted (see Article 22). Only units implemented until termination will be accepted.

If the grant is terminated for breach of the obligation to submit reports, the coordinator may not submit any report after termination.

If the granting authority does not receive the report within the deadline, only unit contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

Termination does not affect the granting authority's right to reduce the grant (see Article 28) or to impose administrative sanctions (see Article 34).

The beneficiaries may not claim damages due to termination by the granting authority (see Article 33).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

(b) for **beneficiary termination**:

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a **report on the distribution of payments** to the beneficiary concerned

(ii) a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, the financial statement, and the explanation on the use of resources

(iii) a **request for amendment** (see Article 39) with any amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the report submitted (see Article 22). Only units implemented until termination will be accepted.

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 21).

If the granting authority does not receive the termination report within the deadline, only unit contributions included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

If the granting authority does not receive the report on the distribution of payments within the deadline, it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

If the request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

SECTION 3 OTHER CONSEQUENCES: DAMAGES AND ADMINISTRATIVE SANCTIONS

ARTICLE 33 — DAMAGES

33.1 Liability of the granting authority

The granting authority cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of the implementation of the Agreement, including for gross negligence.

The granting authority cannot be held liable for any damage caused by any of the beneficiaries or other participants involved in the action, as a consequence of the implementation of the Agreement.

33.2 Liability of the beneficiaries

The beneficiaries must compensate the granting authority for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement, provided that it was caused by gross negligence or wilful act.

The liability does not extend to indirect or consequential losses or similar damage (such as loss of profit, loss of revenue or loss of contracts), provided such damage was not caused by wilful act or by a breach of confidentiality.

ARTICLE 34 — ADMINISTRATIVE SANCTIONS AND OTHER MEASURES

Nothing in this Agreement may be construed as preventing the adoption of administrative sanctions (i.e. exclusion from EU award procedures and/or financial penalties) or other public law measures, in addition or as an alternative to the contractual measures provided under this Agreement (see, for instance, Articles 137 to 148 EU Financial Regulation 2024/2509 and Articles 4 and 7 of Regulation 2988/95[22]).

SECTION 4 FORCE MAJEURE

ARTICLE 35 — FORCE MAJEURE

A party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

‘Force majeure’ means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement
- was unforeseeable, exceptional situation and beyond the parties’ control
- was not due to error or negligence on their part (or on the part of other participants involved in the action) and
- proves to be inevitable in spite of exercising all due diligence.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

[22] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

CHAPTER 6 FINAL PROVISIONS

ARTICLE 36 — COMMUNICATION BETWEEN THE PARTIES

36.1 Forms and means of communication — Electronic management

EU grants are managed fully electronically through the EU Funding & Tenders Portal ('Portal').

All communications must be made electronically through the Portal, in accordance with the Portal Terms and Conditions and using the forms and templates provided there (except if explicitly instructed otherwise by the granting authority).

Communications must be made in writing and clearly identify the grant agreement (project number and acronym).

Communications must be made by persons authorised according to the Portal Terms and Conditions. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a 'legal entity appointed representative (LEAR)'. The role and tasks of the LEAR are stipulated in their appointment letter (see Portal Terms and Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Portal.

36.2 Date of communication

The sending date for communications made through the Portal will be the date and time of sending, as indicated by the time logs.

The receiving date for communications made through the Portal will be the date and time the communication is accessed, as indicated by the time logs. Formal notifications that have not been accessed within 10 days after sending, will be considered to have been accessed (see Portal Terms and Conditions).

If a communication is exceptionally made on paper (by e-mail or postal service), general principles apply (i.e. date of sending/receipt). Formal notifications by registered post with proof of delivery will be considered to have been received either on the delivery date registered by the postal service or the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

36.3 Addresses for communication

The Portal can be accessed via the Europa website.

The address for paper communications to the granting authority (if exceptionally allowed) is the official mailing address indicated on its website.

For beneficiaries, it is the legal address specified in the Portal Participant Register.

ARTICLE 37 — INTERPRETATION OF THE AGREEMENT

The provisions in the Data Sheet take precedence over the rest of the Terms and Conditions of the Agreement.

Annex 5 takes precedence over the Terms and Conditions; the Terms and Conditions take precedence over the Annexes other than Annex 5.

Annex 2 takes precedence over Annex 1.

ARTICLE 38 — CALCULATION OF PERIODS AND DEADLINES

In accordance with Regulation No 1182/71[23], periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

'Days' means calendar days, not working days.

ARTICLE 39 — AMENDMENTS

39.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

39.2 Procedure

The party requesting an amendment must submit a request for amendment signed directly in the Portal Amendment tool.

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3). If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why
- the appropriate supporting documents and
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The granting authority may request additional information.

If the party receiving the request agrees, it must sign the amendment in the tool within 45 days of receiving notification (or any additional information the granting authority has requested). If it does

[23] Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8/6/1971, p. 1).

not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected.

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date of entry into force or other date specified in the amendment.

ARTICLE 40 — ACCESSION AND ADDITION OF NEW BENEFICIARIES

40.1 Accession of the beneficiaries mentioned in the Preamble

The beneficiaries which are not coordinator must accede to the grant by signing the accession form (see Annex 3) directly in the Portal Grant Preparation tool, within 30 days after the entry into force of the Agreement (see Article 44).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 44).

If a beneficiary does not accede to the grant within the above deadline, the coordinator must — within 30 days — request an amendment (see Article 39) to terminate the beneficiary and make any changes necessary to ensure proper implementation of the action. This does not affect the granting authority's right to terminate the grant (see Article 32).

40.2 Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 39. It must include an accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool.

New beneficiaries will assume the rights and obligations under the Agreement with effect from the date of their accession specified in the accession form (see Annex 3).

Additions are also possible in mono-beneficiary grants.

ARTICLE 41 — TRANSFER OF THE AGREEMENT

In justified cases, the beneficiary of a mono-beneficiary grant may request the transfer of the grant to a new beneficiary, provided that this would not call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiary must submit a request for **amendment** (see Article 39), with

- the reasons why
- the accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool and
- additional supporting documents (if required by the granting authority).

The new beneficiary will assume the rights and obligations under the Agreement with effect from the date of accession specified in the accession form (see Annex 3).

ARTICLE 42 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE GRANTING AUTHORITY

The beneficiaries may not assign any of their claims for payment against the granting authority to any third party, except if expressly approved in writing by the granting authority on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the granting authority has not accepted the assignment or if the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the granting authority.

ARTICLE 43 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

43.1 Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

Special rules may apply for beneficiaries which are international organisations (if any; see Data Sheet, Point 5).

43.2 Dispute settlement

If a dispute concerns the interpretation, application or validity of the Agreement, the parties must bring action before the EU General Court — or, on appeal, the EU Court of Justice — under Article 272 of the Treaty on the Functioning of the EU (TFEU).

For non-EU beneficiaries (if any), such disputes must be brought before the courts of Brussels, Belgium — unless an international agreement provides for the enforceability of EU court judgements.

For beneficiaries with arbitration as special dispute settlement forum (if any; see Data Sheet, Point 5), the dispute will — in the absence of an amicable settlement — be settled in accordance with the Rules for Arbitration published on the Portal.

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 22 and 34), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice — under Article 263 TFEU.

For grants where the granting authority is an EU executive agency (see Preamble), actions against offsetting and enforceable decisions must be brought against the European Commission (not against the granting authority; see also Article 22).

ARTICLE 44 — ENTRY INTO FORCE

The Agreement will enter into force on the day of signature by the granting authority or the coordinator, depending on which is later.

SIGNATURES

For the coordinator

Christophe MULLER with ECAS id n00gw5c8 signed in the Participant Portal on 02/09/2025 at 14:16:06 (transaction id SigId-20021-UdYvnOel5DznhbqGAVU36J6xJBDtxoA4BkDnlzHwYGpT7tpyHYzgVl56gmzcy3YUolbh02WKP3b4eJUr8f0J12a-R2zIpfT8xjMrnAtWWU1sFa-RIPX0yeHizi6ZGYp2JMcnGXM2hs22WHBPewfKuEwqxzIlrOztj8dGdjuMHhCVLHdfkvBSkAHYk8b78dwuqWBzgq). Timestamp by third party at 2025.09.02 14:16:10 CEST

For the granting authority

Signed by Monika HOLIK with ECAS id holikma as an authorised representative on 02-09-2025 17:39:48 (transaction id SigId-22776-3ZzzOs94dh8DPbwugnoWzbaVzrzfCMgVSVhSx80rNY5Q0ZlzLP8Ci3IBzMwcS59LYTCD5CzwStSaMG0mZ7MZcldl-R2zIpfT8xjMrnAtWWU1sFa-J4mV1K8zeq4UzTturq9afFrnbGyHVV5LT7zQG5zaKzsc5zuS14cqhnuxfU1i9AvFhRtdsS7wQbnZYzfPct6wzqEg) 2025.09.02 17:39:55 CEST

ANNEX 1

Horizon Europe (HORIZON)

Description of the action (DoA)

Part A

Part B

DESCRIPTION OF THE ACTION (PART A)

COVER PAGE

Part A of the Description of the Action (DoA) must be completed directly on the Portal Grant Preparation screens.

PROJECT *Grant Preparation (General Information screen) — Enter the info.*	
Project number:	101236929
Project name:	North-south EXchange for Underground Science
Project acronym:	NEXUS
Call:	HORIZON-MSCA-2024-SE-01
Topic:	HORIZON-MSCA-2024-SE-01-01
Type of action:	HORIZON-TMA-MSCA-SE
Service:	REA/A/03
Project starting date:	fixed date: 1 January 2026
Project duration:	48 months

TABLE OF CONTENTS

PROJECT SUMMARY

Project summary

Grant Preparation (General Information screen) — Provide an overall description of your project (including context and overall objectives, planned activities and main achievements, and expected results and impacts (on target groups, change procedures, capacities, innovation etc)). This summary should give readers a clear idea of what your project is about.

Use the project summary from your proposal.

The nature of invisible dark matter (DM), which constitutes ~26% of the mass-energy balance of the Universe, remains a major puzzle in physics. Despite extensive searches, DM constituents remain undetected, though experiments have significantly constrained the allowed parameter space. The NEXUS project aims to advance this research by enhancing detector performance, refining instrumentation, and expanding theoretical insights through a sustainable expert network. Partnering with world-class laboratories in Europe, the USA, Canada, Australia, and South Africa, NEXUS will tackle extraordinary experimental and theoretical challenges. This research relies on Underground Laboratories (ULs), where cosmic rays are suppressed by ~1000 meters of rock, minimizing the cosmogenic backgrounds. The proposed NEXUS initiative aims to establish a global network of ULs dedicated to ground-breaking advancements in the field. The collaborative approach undertaken in NEXUS is designed to provide a dynamic environment for advances in ultra-sensitive detectors and ultra-low radiation techniques, ready to lead innovation in both the global search for rare events and cutting-edge technological development ultimately benefiting society and industry. ULs' support for research will provide: (i) effective radiation shielding; (ii) above-ground and underground support facilities, such as clean (radon-free) rooms, radio-purity assay equipment, and cryogenic equipment; (iii) material production and purification facilities; (iv) tools and methods to characterize underground facilities and related instrumentation; and (v) a unique environment for multidisciplinary research. In addition, efforts are being made to further increase instrument sensitivity to meet new challenges in rare-event research. NEXUS will pave the way for ground-breaking discoveries, fostering a deeper understanding of the universe while driving technological advancements with broad societal and industrial benefits.

LIST OF PARTICIPANTS

PARTICIPANTS

Grant Preparation (Beneficiaries screen) — Enter the info.

Number	Role	Short name	Legal name	Country	PIC
1	COO	CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	999997930
2	BEN	INFN	ISTITUTO NAZIONALE DI FISICA NUCLEARE	IT	999992789
3	BEN	SKAO	THE SQUARE KILOMETRE ARRAY OBSERVATORY	UK	890491041
4	AP	UKRI	UNITED KINGDOM RESEARCH AND INNOVATION	UK	906446474
5	AP	LSC	CONSORCIO PARA EL EQUIPAMIENTO Y EXPLOTACION DEL LABORATORIO SUBTERRANEO DE CANFRANC	ES	998502093
6	AP	SU	STELLENBOSCH UNIVERSITY	ZA	999877359
7	AP	SURF	South Dakota Science &Technology Authority	US	873610810
8	AP	UoA	THE UNIVERSITY OF ADELAIDE	AU	984570274
9	AP	UoM	UNIVERSITY OF MELBOURNE	AU	999658818
10	AP	UNISA	UNIVERSITY OF SOUTH AFRICA	ZA	990429850

PARTICIPANTS

Grant Preparation (Beneficiaries screen) — Enter the info.

Number	Role	Short name	Legal name	Country	PIC
11	AP	UWC	UNIVERSITY OF THE WESTERN CAPE	ZA	999883373
12	AP	WITS	UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG	ZA	998014086
13	AP	SNOLAB	QUEEN'S UNIVERSITY AT KINGSTON	CA	997151562
14	AP	UCB	UNIVERSITE LYON 1 CLAUDE BERNARD	FR	999902579
15	AP	US	SORBONNE UNIVERSITE	FR	909875521
16	AP	IMTA	INSTITUT MINES-TELECOM	FR	999849326
17	AP	UGA	UNIVERSITE GRENOBLE ALPES	FR	897379108

LIST OF WORK PACKAGES

Work packages

Grant Preparation (Work Packages screen) — Enter the info.

Work Package No	Work Package name	Lead Beneficiary	Effort (Person-Months)	Start Month	End Month	Deliverables
WP1	Low background technologies	1 - CNRS	44.00	1	48	D1.1 – Dissemination and publication of test results on Rn absorption D1.2 – Progress report on low background suppression technologies of interest
WP2	Muography and radiation measurements	2 - INFN	48.00	1	48	D2.1 – Characterization of the ULs background environment D2.2 – Best practices for the concept and design of ULs
WP3	Modelling, Simulation and Machine learning	10 - UNISA	12.00	1	48	D3.1 – Results of denoising of muon data and monitoring of sensor equipment using machine learning
WP4	Quantum science and technology	13 - SNOLAB	24.00	1	48	D4.1 – Prototype quantum detector for low-mass Dark Matter and performance assessment D4.2 – Report on noise mitigation framework for Quantum Technologies
WP5	Education and Training Activities	2 - INFN	26.00	1	48	D5.1 – Report on project workshops D5.2 – Report on training activities
WP6	Management and Coordination	1 - CNRS	0.00	1	48	D6.1 – Progress report D6.2 – Mid-term meeting D6.3 – Data Management Plan D6.4 – Website D6.5 – Communication, Dissemination and Exploitation plan

Work package WP1 – Low background technologies

Work Package Number	WP1	Lead Beneficiary	1 - CNRS
Work Package Name	Low background technologies		
Start Month	1	End Month	48

Objectives

The DULs have provided material characterisation measurements to a substantial number of experiments over a number of years whilst R&D and knowledge exchange has helped to increase sensitivity and uniformity in this time. As we move toward the next generation of low-background particle physics projects, such as large-scale dark matter or neutrinoless double beta decay experiments, the throughput and sensitivity needed will increase further. The expertise acquired by scientists of the underground laboratories allows them to develop in the DULs radiopure materials when a commercial alternative is not available: this is the case for interposers for electronic circuits. The standard printed circuit boards (PCB) are based on relatively radiopure epoxies reinforced with fiber fabrics (glass, kevlar, carbon, liquid crystal elastomers). These fabrics, even when based on clean materials, are strongly contaminated by radiogenic elements, given their high exposed surface. Most experiments use polyimide derived substrates (CIRLEX): while the substrate is radiopure, the PCB is typically contaminated with lead during the production. Furthermore, polyimide has very bad adhesion and no rigidity, both causing problems in the use. Interposer techniques based on metal film deposition on radiopure substrates (like fused silica) are more promising for the electronic circuits of future low background experiments. Furthermore, it will be possible to produce non-planar radiopure circuits by integrating the most modern additive manufacturing techniques for alumina/zirconia and the film deposition facilities that are being planned at INFN (LNGS).

O1.1: DUL background reduction and mitigation strategy
O1.2 Reinforce and innovate the development of assay techniques
O1.3 Exploiting pulse shape discrimination to improve gamma spectrometry sensitivities
O1.4 Define protocols for building radiopure electronic circuits

Description

Task 1.1 Innovative technology in radio-purity assay. Institutions involved: UKRI, CNRS, INFN, LSC, SNOLAB, UWC, SURF
This task aims to (i) reinforce and innovate the development of assay techniques to reach the sensitivities and throughput required for next generation low-background rare events experiments; (ii) establish better protocols for surface background mitigation; (iii) to foster the relationships between the assay facilities in Europe to offer a comprehensive, coordinated, and communal material characterisation for customers worldwide; to develop robust relationships between collaborators. There is great interest in low-background material radio-assay in the fields of particle physics, astroparticle physics, biophysics, environmental science and, increasingly, in the industry particularly focussing on single-event damage. This action can foster synergy between scientists working in this field and optimise workload sharing, increase sensitivity and ensure compatibility of results at different sites.

Task 1.2 New technology for radon-free environments. Institutions involved: UKRI, CNRS, INFN, LSC, SNOLAB, UWC, SURF
For rare event searches, Rn (222Rn) is a crucial source of background. In particular, exposing detector components to Rn will produce a plate out of 210Pb. This radioactive isotope has a half-life of 22 years and decays into 210Bi(β) → 210Po(α). The alpha in the decay of 210Po can mimic a nuclear recoil event and produce neutrons in the alpha-n reactions. Therefore, reducing lead plate out is a crucial background mitigation strategy. The goals of this task are complex research and innovation in the broad area of the Rn program. Activities will support cooperation between Proposers and cooperation with technological companies. The main results planned are new technologies and innovative devices. Rn mitigation is a critical issue in low background experiments during construction and running phases. This work will focus on Rn reduction and monitoring in air and studies on Rn transport and emanation in different pure gasses and material typically used in low background experiments. This task will also study how to innovate Rn abatement systems in collaboration with industrial partners to improve power efficiency and to provide the requested Rn-free air flow rate needed for innovative research programs for next-generation experiments. For this purpose, systematic studies of the pressure/temperature operation points and of innovative adsorption materials in high flow rate conditions will be performed. This task requires collaboration with Task1.1 for selection of materials. The task has per objective to co-ordinate the design efforts on an innovative Rn detector with a sensitivity of order mBq/m3; and to co-ordinate the design efforts and report on an innovative Rn abatement system.

Task 1.3 New protocols for production of radiopure materials to be used in detectors searching for rare processes. Institutions involved: UKRI, CNRS, INFN, LSC, SNOLAB
This task aims at improving the collaboration between scientists of underground facilities in order to identify improved protocols for the development of radiopure materials at the DULs. A large expertise has been acquired by scientists of low background experiments not only on low background materials but on lithography techniques: such expertise can be harnessed for the development of improved interposers for electronic circuits for future dark matter and neutrinoless double beta decay experiments.
Interposers are the evolution of standard printed circuit boards in which the traces are deposited on crystal surfaces (fused silica, alumina, sapphire) that can be produced planar or, by means of advanced additive manufacturing, with custom 3D shapes. Fused silica wafers are synthesis products that can be delivered with high levels of (radio)purity, while there are studies about clean alumina. For the deposited electrical traces, high purity metal pellets can be obtained from electroforming. Laser trimming will allow encapsulation of resistors in the circuit without additional components.
The task will initially focus on the preliminary research on the protocol to produce such interposer; after the lithography and additive manufacturing equipment will be available in one or more DULs it will be important to support the exchange of scientists between the different institutions in order to accelerate the finalization of the process and overall, the dissemination of the know-how.

Work package WP2 – Muography and radiation measurements

Work Package Number	WP2	**Lead Beneficiary**	2 - INFN
Work Package Name	Muography and radiation measurements		
Start Month	1	**End Month**	48

Objectives

A key aspect of this WP will involve characterizing underground laboratories (ULs), using muography techniques. This is steadily becoming a monitoring tool for underground environments due to its leap in robustness, reliability, imaging performance and cost-efficiency. To characterize ULs, it is also of great importance to monitor the environmental radioactivity (gamma rays' emission) and radon exhalation and concentration inside underground tunnels. The other aspect is the neutrons which are another critical source of background that requires careful control and understanding.

O2.1: Underground Muons Measurements with electronic detectors and nuclear emulsion
O2.2: Underground Neutrons Measurements with electronic detectors and nuclear emulsion
O2.3: Underground Radon measurements and Gamma Rays measurements
O2.4: Technological transfer and characterisation of the PAUL facility.

Description

Task 2.1 (O2.1) Measurement of angular muons spectrum. Institution : INFN, UWC, SU - (M8-M40)
Measurement of a precise angular muon's spectrum. Simultaneous measurements by several emulsion detectors located in different positions are possible in the tunnel where the future South African laboratory (PAUL) will be located. Combined measurement of emulsion and electronic detectors can be performed.
We propose to perform similar measurements in other ULs (UKRI, SURF, LSC).

Task 2.2 (O2.1) Geophysical measurements. Institutions: CNRS, UWC, SU - (M12-M36)
Installation of a permanent muon monitoring station to perform geophysical measurements (joint gravimetry inversion + hydrological studies) to characterize the Huguenot Tunnel at maximum overburden for the future PAUL facility design and study.

Task 2.3 (O2.1): Installation of muons detector. Institutions : UWC, SU, CNRS, INFN, LSC, UKRI - (M12-M48)
Development of a local muon detector system in South Africa. As part of this objective, SU also recognizes this as an opportunity to train students and ensure knowledge and skills transfer (WP5). The network of existing UL expertise, in especially European institutions, offers an ideal channel for staff exchange wherein staff and students can be trained in the best measurement techniques, tomography, technical know-how of muon detectors and detector development.

Task 2.4 (O2.2): Characterization and measurement of neutrons spectral and flux. Institutions: CNRS, INFN, SU, SURF, SNOLAB

The neutron spectral and flux characterization in an underground laboratory is one of the most important measurements to be performed to understand the background of any rare event detector installed in UL. The LPSC (CNRS-IN2P3) has developed a directional neutron spectrometer, a neutron flux monitor detector, and other complementary detectors able to perform a fast and thermal neutron characterization of UL, such a Spherical Proportional Counter (SPC) and He-3 counters. The LNGS has developed a new method for precise measurement of directional and energetic spectrum of neutrons in sub-MeV using nuclear emulsion detector (NIT: nano imaging tracker). We will perform neutron characterization in South-Africa (Huguenot-Tunnel and the future PAUL), at SURF and at SNOLAB using all these new technologies. SU in collaboration with CNRS-LPSC-LSM is already planning to construct and install an SPC-neutron detector to measure the neutron flux in South Africa in the Huguenot tunnel. To ensure the long-term sustainability and autonomy of the South African team, we aim also to train students (WP5). A PhD student from SU has already started to work on the subject and had the opportunity to be trained on the instrumentation and the simulation at LSM in 2024.

Task 2.5 (O2.3) Measurement of radon level. Institutions : UWC, SU, CNRS, INFN, LSC, UKRI
The important issue of radon exhalation from materials used in the detection systems of low activity experiments is addressed in WP1. However, the radon gas concentration in the laboratory from exhalation from the walls of an underground laboratory (UL) is also of great importance. For the new PAUL laboratory in South Africa, the radon level in the present road tunnel has been measured and found to be relatively low, but the closed environment of the laboratory could be more challenging. Secondments are necessary to consider the best practice in the ULs in Europe and to support measurements in South Africa.

Task 2.6 (O2.3) Measurement of gamma background. Institution involved: UWC, SU, CNRS, INFN
Gamma rays from environmental radioactivity (40K plus the 238U and 232Th series) is an important source of background in underground laboratories. These gamma rays are of relatively low energy (up to 3.5 MeV) compared to the cosmic muon energies, but the underground experiments still need to be shielded from these rays. We propose to measure the gamma radiation from the rock faces in different places in the Huguenot Tunnel to test what shielding is required for the future PAUL facility. Since the Paarl Mountain contains granite rocks, this needs to be done carefully.

Task 2.7 (O2.4) Design and study of the future UL in South Africa. Institutions: SKAO, SU, UWC, INFN, CNRS, LSC
The geotechnical layout of the tunnel in which the future PAUL facility is proposed to be constructed is unique in layers presented and widths. However other UL would have faced similar challenges when preparing construction methodologies, tie-ins to operational tunnels and how the co-operation between the different service providers are managed. Staff exchange visits are required to consider the best practice in the UL in Europe to understand the different construction approaches undertaken and best options for South Africa. The design and engineering consultants have provided some recommendations but there is a need for knowledge exchange on construction methodology and tunnel management and other information relevant for the future facility.

Work package WP3 – Modelling, Simulation and Machine learning

Work Package Number	WP3	**Lead Beneficiary**	10 - UNISA
Work Package Name	Modelling, Simulation and Machine learning		
Start Month	1	**End Month**	48

Objectives

This Work Package will focus on two aspects: the study of Dark Matter models and the usage of the MC simulation to study the muon flux that underground facilities need to get rid of to be able to measure rare events.

Dark Matter theories: a strong cosmic DM simulation program is key to translating cosmological observations to robust constraints on DM fundamental physics and provides a connection to laboratory-based probes of DM physics. Also, to facilitate the effective use of data generated from various experiments, we will establish a centralized data-sharing platform that enables real-time access to experimental results and analysis tools. The originality of this approach stems from its emphasis on collaborative data utilization.

Monte Carlo simulation to characterize the muon flux: A Monte Carlo-based methodology in conjunction with the physical measurements of the muon flux in underground facilities can be used to characterize the cosmic ray muon flux, including muon angular and energy differential distributions at depths representative of geological structures. Also, the use of machine learning based algorithms are useful to automate and speed up the data analysis procedure. Muography measures (WP2) usually involve low statistics measurement, which requires that the background noise and environmental

factors need to be closely monitored. Convolutional neural networks (CNN) will be trained to identify the systematic noise using real data in combination with augmented data which is generated by Monte Carlo based software.

O3.1: Use Monte Carlo based software such as GEANT4 to simulate the muon flux for the underground laboratory.
O3.2: Use Machine Learning algorithms such as convolution of neutral networks to be trained using existing data sets which are relevant.
O3.3: Develop Dark Matter models that can be indirectly tested using the simulations and machine learning algorithms of O1.1 and O1.2.

Description
Task 3.1 – (O3.1). Institutions: SU, WITS, CNRS, INFN, UKRI Obtain the physical measurements of the muon flux in underground facilities and simulate it to characterize the cosmic ray muon flux. Task 3.2 – (O3.2). Institutions: SU, CNRS, INFN, WITS, UKRI Use machine learning as an application to denoise muon data and monitor and evaluate the onboard temperature, humidity and other sensors. Task 3.3 – (O3.3). Institutions: UNISA, CNRS, WITS, UKRI Develop a collaboration with theoreticians all over the word on Dark Matter model and work closely to the scientists at underground laboratories within this project to validate them with the data obtained at the different experiments running in each facility.

Work package WP4 – Quantum science and technology

Work Package Number	WP4	**Lead Beneficiary**	13 - SNOLAB
Work Package Name	Quantum science and technology		
Start Month	1	**End Month**	48

Objectives

O4.1: Advance understanding of quantum foundations through R&I
Conduct cutting-edge research to explore fundamental issues in quantum mechanics, including wave function collapse, quantum gravity interplay, and the measurement problem, utilizing experimental data from quantum sensors in deep underground laboratories.

O4.2: Develop and test quantum sensors for dark matter detection
Drive innovation by designing and deploying quantum superconducting circuits and low-background detectors to search for low-mass dark matter and evaluate their performance. These technologies will also serve as a platform for training early-career researchers (WP5).

O4.3: Mitigate environmental noise in quantum technologies
Through collaborative R&I, identify and mitigate environmental noise sources that impact both quantum sensors and superconducting qubits, contributing to advancements in detector performance and quantum computing.

O4.4: Promote training and knowledge transfer through secondments and reintegration
Facilitate secondments across partner institutions, offering interdisciplinary training opportunities in quantum science, experimental techniques, and data analysis. Reintegration plans will ensure knowledge transfer and application across all partners, including academic and non-academic sectors (WP5).

Description
Task 4.1 Theoretical and experimental investigation of quantum foundations. Institutions: SNOLAB, UOA, INFN, CNRS This task is led by INFN-LNF and Adelaide includes the design and implementation of experimental setups to test quantum collapse theories, wave function collapse models, and quantum gravity effects using data from quantum sensors. These secondments will provide hands-on training to researchers on advanced quantum detection techniques

and theoretical modelling. The researchers will conduct collaborative analysis of experimental data after the secondment to ensure knowledge dissemination among all partners.

Task 4.2 Development and testing of quantum detectors. Institutions: SNOLAB, UOA, INFN
This task is led by INFN-LNGS and involves the evaluation and underground running of advanced sensor technologies based on quantum circuits and novel materials to test theories of low mass dark matter. Secondments will include detector testing and evaluation. Promising prototype detectors will be deployed in deep underground infrastructure at SNOLAB and/or LNGS and SUPL (laboratory of which the University of Adelaide is a member) for low background evaluation and dark matter searches. The groups will evaluate the data after secondments to utilize underground data to improve the dark matter sensitivity and improve future detector design.

Task 4.3 Noise characterization and mitigation in Quantum Technologies. Institutions: SNOLAB, INFN
This task is led by SNOLAB and involves the development and underground running of advanced qubit technologies based on superconducting quantum circuits. Secondments will include qubit deployment, test, and evaluation, which will transfer quantum processor operational experience across the consortium. Quantum processors will be deployed in deep underground infrastructure at SNOLAB for low background evaluation and to study the impact of correlated errors from ionizing radiation. The groups will evaluate the data after secondments to utilize underground data to improve the understanding of this critical source of qubit errors and incorporate this knowledge into future quantum computer concepts.

Task 4.4 Collaboration, dissemination and reintegration activities. Institutions: SNOLAB, UOA, INFN, CNRS.
This task will be collaborative between the four institutions involved in this work package. SNOLAB, INFN and the University of Adelaide will organize interdisciplinary training workshops during secondments to facilitate knowledge exchange on quantum foundations, dark matter, quantum sensors, and quantum processors. Knowledge will be shared with participating institutions and major results will be published in academic literature and conferences to inform the broader research and device development communities. Outreach and public engagement activities will be utilized to amplify the societal impact more broadly. The organization of a workshop on quantum foundations and quantum technologies in underground laboratories is planned during the first half of the project.

Work package WP5 – Education and Training Activities

Work Package Number	WP5	**Lead Beneficiary**	2 - INFN
Work Package Name	Education and Training Activities		
Start Month	1	**End Month**	48

Objectives
This work package focuses on developing and implementing educational and training programs across participating institutions. It aims to equip researchers and students with essential skills and knowledge to excel in underground research environments. Additionally, it supports dissemination, communication, outreach, and exploitation activities O5.1 – Implement a training network focused on instrumental, experimental data usage and theory and computation aspects, related to WP1, WP2 and WP3 activities.

Description
Task 5.1: Summer School for PhD physics and ESRs Two summer schools will be organized (one in Northern Hemisphere and the other one in Southern Hemisphere) to provide specialized training on underground lab research. Each school will last two weeks, accommodating 20 students and featuring lectures from world-class scientists. The Northern Hemisphere school will be organized within SURF, as NEXUS-SURF++, augmenting the regularly running Neutrino School of training young post-docs and graduate students. Task 5.2: Training and ESR development This task focuses on a hybrid training model, combining online and on-site training at host laboratories. Researchers will receive mentoring, access webinars and guidelines, and participate in NEXUS training programs designed to enhance experimental and computational skills, including best practices for Machine Learning (ML) methodologies (WP3). Task 5.3: Project Workshop every 2 years

A project-wide workshop will be organized every two years (total of two workshops), one in Italy (by INFN) and another one outside EU to facilitate discussion on research advancements, collaborations, and technological developments.

Task 5.4: PhD thesis co-supervision
This initiative provides three-month or longer secondments for PhD students at beneficiary institutions. A co-tutorship model will be implemented, ensuring students develop their research programs through extended stays at partner organizations. Host institutions will provide accommodation support and cultural integration assistance. Secondments are requested within each research WP.

Work package WP6 – Management and Coordination

Work Package Number	WP6	**Lead Beneficiary**	1 - CNRS
Work Package Name	Management and Coordination		
Start Month	1	**End Month**	48

Objectives

WP6 aims to set and implement the management processes. The Management Board (MB), where all project partners are represented, will be created, representing the decision-making body for all questions related to the project's strategy and operation.

The main objectives are:
O6.1 - Open science, IPR, DCOP, EMP, DMP: Ensure compliance with open science principles, manage intellectual property rights (IPR), and develop effective data and exploitation management plans.
O6.2 - Manage secondments and their accounting.
O6.3 - Ensure that all knowledge is created and managed in a coordinated and coherent manner and that all activities, financial and legal aspects and other issues are managed to a high standard.
O6.4 - All aspects of the EC requirements for reporting are met including controlling the achievement of project deliverables.
O6.5 - Overall management/coordination of project activities (WP1-5), including risk management and definition of contingency planning.
O6.6 – Disseminate and promote project results: actively engage stakeholders by sharing scientific findings, fostering knowledge exchange, and increasing project visibility.
O6.7 – Coordinate the related various general public communication events activities, organized by the participating organization.

Description

Task 6.1: Data Management Plan, Open Science, Intellectual Property Management and Exploitation
This task ensures adherence to Open Science (OS) principles, providing clear guidelines for acknowledging project funding and managing results. It also develops Intellectual Property Rights (IPR) strategies and oversees the Exploitation and Data Management Plan (DMP).

Task 6.2: Project mobilisation
Implement management and coordination system, creating all necessary documents. The project will produce a Project Handbook (PH) covering all necessary practical information related to secondments (e.g., travel and visa information, payment schedules) and event organisation (e.g., guidelines for yearly conference and fellowships). In addition to the MB, an advisory board (AB) of experts for scientific and ethical issues will be nominated. A kick-off meeting will be organised to allow all partners to become acquainted with the project management and coordination.

Task 6.3: Project management and coordination
This task will oversee the overall management for the project, ensuring it is properly implemented and successfully reaches its objectives on time and within budget and will ensure that the project's activities and results are delivered in a transparent, effective and efficient manner, by all partners, according to the highest quality standards, and within an appropriate decision-making process. It will also perform all coordinating and reporting activities.

Task 6.4: Risk management, contingency planning
If deviations from the project plan occur, the coordinator will report and discuss it with the MB. When appropriate,

recommendations will be made for implementing the contingency plan(s) associated with the WP in question. Where alternative contingency plans are needed, the coordinator, together with other relevant persons (e.g., the WP Leader in question) will draft them. In the event of more serious problems, the coordinator will report the problem to the EC Project Officer and seek the Commission's approval for the proposed solution.

Task 6.5: Dissemination, Communication and Outreach Plan
A comprehensive Dissemination, Communication, and Outreach Plan (DCOP) will be formulated within the first six months and updated regularly. It will define target audiences, key messaging, and publication guidelines while ensuring compliance with authorship rules. A dedicated project website will be created, a Communication Toolkit developed, and guidelines for social media engagement established.

STAFF EFFORT

Staff effort per participant

Grant Preparation (Work packages - Effort screen) — Enter the info.

Participant	WP1	WP2	WP3	WP4	WP5	WP6	Total Person-Months
1 - CNRS	16.00	17.00		3.00	6.00		42.00
2 - INFN	24.00	9.00	3.00	21.00	13.00		70.00
3 - SKAO		2.00					2.00
6 - SU		15.00	5.00		2.00		22.00
10 - UNISA			3.00		2.00		5.00
11 - UWC	4.00	5.00			2.00		11.00
12 - WITS			1.00		1.00		2.00
Total Person-Months	44.00	48.00	12.00	24.00	26.00	0.00	154.00

LIST OF DELIVERABLES

Deliverables

Grant Preparation (Deliverables screen) — Enter the info.

The labels used mean:

Public — fully open (⚠ automatically posted online)
Sensitive — limited under the conditions of the Grant Agreement
EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D1.1	Dissemination and publication of test results on Rn absorption	WP1	1 - CNRS	R — Document, report	PU - Public	30
D1.2	Progress report on low background suppression technologies of interest	WP1	1 - CNRS	R — Document, report	SEN - Sensitive	36
D2.1	Characterization of the ULs background environment	WP2	2 - INFN	R — Document, report	PU - Public	36
D2.2	Best practices for the concept and design of ULs	WP2	2 - INFN	R — Document, report	PU - Public	44
D3.1	Results of denoising of muon data and monitoring of sensor equipment using machine learning	WP3	10 - UNISA	R — Document, report	PU - Public	48
D4.1	Prototype quantum detector for low-mass Dark Matter and performance assessment	WP4	13 - SNOLAB	R — Document, report	PU - Public	24
D4.2	Report on noise mitigation framework for Quantum Technologies	WP4	13 - SNOLAB	R — Document, report	PU - Public	42
D5.1	Report on project workshops	WP5	2 - INFN	R — Document, report	PU - Public	45
D5.2	Report on training activities	WP5	2 - INFN	R — Document, report	PU - Public	42
D6.1	Progress report	WP6	1 - CNRS	R — Document, report	SEN - Sensitive	13

Deliverables

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Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D6.2	Mid-term meeting	WP6	1 - CNRS	OTHER	SEN - Sensitive	18
D6.3	Data Management Plan	WP6	1 - CNRS	DMP — Data Management Plan	PU - Public	6
D6.4	Website	WP6	1 - CNRS	DEC —Websites, patent filings, videos, etc	PU - Public	6
D6.5	Communication, Dissemination and Exploitation plan	WP6	2 - INFN	OTHER	SEN - Sensitive	6

Deliverable D1.1 – Dissemination and publication of test results on Rn absorption

Deliverable Number	D1.1	**Lead Beneficiary**	1 - CNRS
Deliverable Name	Dissemination and publication of test results on Rn absorption		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	30	**Work Package No**	WP1

Description
Dissemination and publication of test results on Rn absorption, emanation, transport, and reduction in view of a next generation Rn abatement system

Deliverable D1.2 – Progress report on low background suppression technologies of interest

Deliverable Number	D1.2	**Lead Beneficiary**	1 - CNRS
Deliverable Name	Progress report on low background suppression technologies of interest		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	36	**Work Package No**	WP1

Description
Progress report on low background suppression technologies of interest for the participating ULs

Deliverable D2.1 – Characterization of the ULs background environment

Deliverable Number	D2.1	**Lead Beneficiary**	2 - INFN
Deliverable Name	Characterization of the ULs background environment		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	36	**Work Package No**	WP2

Description
Characterization of the ULs background environment

Deliverable D2.2 – Best practices for the concept and design of ULs

Deliverable Number	D2.2	**Lead Beneficiary**	2 - INFN
Deliverable Name	Best practices for the concept and design of ULs		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	44	**Work Package No**	WP2

Description
Best practices for the concept and design of ULs

Deliverable D3.1 – Results of denoising of muon data and monitoring of sensor equipment using machine learning

Deliverable Number	D3.1	**Lead Beneficiary**	10 - UNISA
Deliverable Name	Results of denoising of muon data and monitoring of sensor equipment using machine learning		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	48	**Work Package No**	WP3

Description
Use machine learning as an application to denoise muon data and monitor and evaluate the onboard temperature, humidity and other sensors.

Deliverable D4.1 – Prototype quantum detector for low-mass Dark Matter and performance assessment

Deliverable Number	D4.1	**Lead Beneficiary**	13 - SNOLAB
Deliverable Name	Prototype quantum detector for low-mass Dark Matter and performance assessment		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	24	**Work Package No**	WP4

Description
Reports on modern prototype quantum sensors evaluated during secondments, with documented performance and sensitivity metrics. Training documentation and guidelines for future detector development and deployment.

Deliverable D4.2 – Report on noise mitigation framework for Quantum Technologies

Deliverable Number	D4.2	**Lead Beneficiary**	13 - SNOLAB
Deliverable Name	Report on noise mitigation framework for Quantum Technologies		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	42	**Work Package No**	WP4

Description
A technical report and toolkit developed collaboratively during secondments, outlining methods for identifying and mitigating noise sources in quantum detectors and qubits.

Deliverable D5.1 – Report on project workshops

Deliverable Number	D5.1	**Lead Beneficiary**	2 - INFN
Deliverable Name	Report on project workshops		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	45	**Work Package No**	WP5

Description
Organize workshop every second year.

Deliverable D5.2 – Report on training activities

Deliverable Number	D5.2	**Lead Beneficiary**	2 - INFN
Deliverable Name	Report on training activities		
Type	R — Document, report	**Dissemination Level**	PU - Public
Due Date (month)	42	**Work Package No**	WP5

Description
Report on training activities highlighting knowledge transfer and integration of skills and technologies.

Deliverable D6.1 – Progress report

Deliverable Number	D6.1	**Lead Beneficiary**	1 - CNRS
Deliverable Name	Progress report		
Type	R — Document, report	**Dissemination Level**	SEN - Sensitive
Due Date (month)	13	**Work Package No**	WP6

Description
Report on management and coordination of WPs.

Deliverable D6.2 – Mid-term meeting

Deliverable Number	D6.2	**Lead Beneficiary**	1 - CNRS
Deliverable Name	Mid-term meeting		
Type	OTHER	**Dissemination Level**	SEN - Sensitive
Due Date (month)	18	**Work Package No**	WP6

Description
Mid-term meeting between M14 and M18.

Deliverable D6.3 – Data Management Plan

Deliverable Number	D6.3	**Lead Beneficiary**	1 - CNRS
Deliverable Name	Data Management Plan		
Type	DMP — Data Management Plan	**Dissemination Level**	PU - Public
Due Date (month)	6	**Work Package No**	WP6

Description
Data Management Plan (DMP), updated yearly, and development of guidelines and strategies for Open Science, IPR.

Deliverable D6.4 – Website

Deliverable Number	D6.4	**Lead Beneficiary**	1 - CNRS
Deliverable Name	Website		
Type	DEC —Websites, patent filings, videos, etc	**Dissemination Level**	PU - Public
Due Date (month)	6	**Work Package No**	WP6

Description
Launch of the website and links to social media

Deliverable D6.5 – Communication, Dissemination and Exploitation plan

Deliverable Number	D6.5	**Lead Beneficiary**	2 - INFN
Deliverable Name	Communication, Dissemination and Exploitation plan		
Type	OTHER	**Dissemination Level**	SEN - Sensitive
Due Date (month)	6	**Work Package No**	WP6

Description
Dissemination, Communication, Exploitation and Outreach Plan (DCOP), a structured approach to engaging stakeholders and promoting project results.

LIST OF MILESTONES

Milestones

Grant Preparation (Milestones screen) — Enter the info.

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Means of Verification	Due Date (month)
1	Kick-off meeting	WP6	1 - CNRS		1
2	Definition of interposer technologies of interest	WP1	1 - CNRS		12
3	Neutrons measurements	WP2	2 - INFN		12
4	Emulsion measurements	WP2	2 - INFN		18
5	Definition of the protocols for the accepted technologies	WP1	1 - CNRS		24
6	Radon levels measurement, recommendation on the ventilation and other methods, Gamma background measurement	WP2	2 - INFN		24
7	Identification of suitable radio pure materials to add to the sharing material and screening assay results	WP1	1 - CNRS		30
8	New protocols for sample treatment and automation prior to ICP-MS measurement	WP1	1 - CNRS		30
9	Geophysical measurements in the Huguenot Tunnel for the future PAUL facility	WP2	2 - INFN		36
10	Muon flux measurements and simulation	WP3	10 - UNISA		36
11	Comprehensive cross-calibration for low background material assay of HPGe detectors	WP1	1 - CNRS		40
12	Realisation of density distribution map and the joined inversion with gravimetry	WP2	2 - INFN		48

LIST OF CRITICAL RISKS

Critical risks & risk management strategy

Grant Preparation (Critical Risks screen) — Enter the info.

Risk number	Description	Work Package No(s)	Proposed Mitigation Measures
1	Potential problems in the execution of research plan.	WP4, WP2, WP1, WP3	The WP leaders will lead risk resolution attempts and will be responsible for consulting the coordinator who will report to the EU Project Officer, if any significant changes to the project are likely.
2	Delay in planned secondments (e.g., due to start-up of project, travel restrictions, pandemic, ...)	WP4, WP2, WP5, WP1, WP3, WP6	1.1 Secondments' implementation will be monitored by a designated person at the level of each participant. At project level, the Coordinator will organise meetings every 2-3 months to discuss the monitoring of secondments and collect any information about possible identified delays at participants' level, both at sending and hosting institutions. On the other hand, each Participant takes responsibility that the secondments take place as planned and reports immediately or maximum 2 months prior to the scheduled secondment any possible deviation to the Coordinator. 1.2. Once a potential delay is identified, action plans will be agreed at Consortium level. The Coordinator will inform REA about the solution found. 1.3. For secondments to third countries, the beneficiary will identify in time the human resources to be seconded and the necessity of visa. In order to avoid visa issues, administrative support and follow-up needs to be put in place several months prior to the scheduled secondment, so that the visa is obtained on time.
3	Key staff leaving	WP4, WP2, WP5, WP1, WP3, WP6	All participants will identify additional personnel with the necessary experience, not intended initially to be seconded in the project work, so that the risk is minimized.
4	Difficulties in hiring suitable postdocs and doctoral students	WP4, WP2, WP1, WP3	Positions will be advertised through suitable channels
5	Withdrawal of participants	WP6	If possible, another participant from the consortium will carry out the tasks/WP of the withdrawing one. If not, a new entity with the same specific expertise could be included in the project upon agreement of REA.
6	Shortage of funding for third country partners	WP6	(Third country) associated partners not eligible for EU funding would ensure their own funding (e.g., national funds) and complete the transfer of knowledge for the activities they engaged in the project. An Agreement will be signed.

MSCA SE PARTNER EXCHANGES AND OVERALL FUNDED EXCHANGES

Partner exchanges

Summary of secondment months per sending partner (beneficiaries and associated partners)

Partner No	Partner Name	Country	Country Group	Academic Sector	Number of Secondment Months Period 1	Number of Secondment Months Period 2	Total Number of Secondment Months
1	CNRS	FR	EU/AC	Y	22	20	42
2	INFN	IT	EU/AC	Y	35	35	70
3	SKAO	UK	EU/AC	Y	2	0	2
6	SU	ZA	TC	Y	14	8	22
10	UNISA	ZA	TC	Y	3	2	5
11	UWC	ZA	TC	Y	7	4	11
12	WITS	ZA	TC	Y	2	0	2
				Total	85	69	154

Overall funded exchanges

Summary of secondment months funded by the EU per beneficiary (as sending partner + seconded to partner)

Partner No	Partner Name	Country	Number of Secondment Months Period 1	Number of Secondment Months Period 2	Total Number of Secondment Months
1	CNRS	FR	35	31	66
2	INFN	IT	48	38	86
3	SKAO	UK	2	0	2

Overall funded exchanges

Summary of secondment months funded by the EU per beneficiary (as sending partner + seconded to partner)

Partner No	Partner Name	Country	Number of Secondment Months Period 1	Number of Secondment Months Period 2	Total Number of Secondment Months
		Total	85	69	154

ANNEX 1

Horizon Europe (HORIZON)

Description of the action (DoA)

DESCRIPTION OF THE ACTION (PART B)

TABLE OF CONTENTS

History of Changes

Version	Date	Change	Page
1	May 2025	Initial version	-
2	August 2025	Review of the list of deliverables, milestones and risks	Part A
		Addition of table 2 – Secondments allocated to associated partners linked to a beneficiary	
		Addition and completion of the Ethics section	

1. Excellence

1.1 Quality and pertinence of the project's research and innovation objectives

1.1.1 Introduction, objectives and overview of the research and innovation programme

Introduction

The nature of invisible dark matter (**DM**) that constitutes some 26% of the mass-energy balance of the Universe remains one of the most intriguing puzzles in today's physics. To date, experiments have been unable to detect the DM constituents, but have drastically reduced the allowed parameters space. To advance research in this field, the NEXUS project will enhance detectors performance, refine instrumentation and expand theory insights by establishing a sustainable network of experts. Collaboration among European scientists and world-class laboratories in USA, Canada, Australia and South-Africa will be addressing extraordinary experimental and theoretical challenges.

The research necessitates the use of Underground Laboratories (**UL**), where experiments are **shielded from cosmic rays background** by at least ~1000 meters of rock. ULs provide the essential low-background radioactive environment necessary for astroparticle and fundamental physics to research and **explore extremely rare phenomena**. Their geological settings naturally suppress muons and cosmic-ray particles, significantly reducing the production of cosmogenic by-products.

The NEXUS consortium consists of top-level researchers in the fields of nuclear and particle physics, astro-particles and cosmology, theoretical physics, low background measurements, earth and atmospheric background measurements, quantum physics and sensing etc. ensuring a diverse range of knowledge and skills necessary to accomplish the project objectives.

Objectives, Overview of the research and innovation programme

Currently, there are twelve operational underground laboratories in the northern hemisphere, each hosting a rich, diverse and interdisciplinary research agenda. Five of them are participating to this project (UKRI, LNGS, LSC, LSM, SURF, and SNOLAB). The recent establishment of the first laboratory in the southern hemisphere, SUPL in Australia, in 2022, alongside the proposed PAUL facility in South Africa, signifies a major expansion of global research capabilities, particularly by incorporating the African continent into this crucial scientific endeavour. This collaboration is essential to address the **complex challenges posed by low-background experiments**, which are crucial for **probing rare phenomena** and enhancing our understanding of the universe. The reduced underground radiation background opens new possibilities to **search for rare events**, such as low energy (MeV scale) neutrino interactions, hypothetical dark matter particles interactions, and evidence of neutrinoless double beta decay. Besides astroparticles, other fields of research can benefit from the rock overburden that underground laboratories provide as developed in the proposal. Earth and environmental science, biology and planetary exploration, geophysics, and gravitational waves observation can be studied in these infrastructures. ULs can be a good environment for the studies of **quantum foundations and computing**. In the last decade these deep ULs have been expanding research to neighbouring sectors turning into **multidisciplinary research** infrastructures although the main focus remains the rare events research.

The search for rare events is like looking for a needle in a haystack. Therefore, the objective of the NEXUS project is to provide the tools and methods to enhance detection techniques by mitigating atmospheric and inherent background noise. The collaborative approach is aimed at providing a dynamic environment for advances in **ultra-sensitive detectors and ultra-low radiation techniques** ready to lead innovation in both the global search for rare events and cutting-edge technological development to benefit society and industry.

These new challenges demand much stronger international cooperation in sharing existing infrastructure and know-how, as well as for new bold, **cross-disciplinary initiatives**. Importantly, these growing demands can to a large extent be met by making a more efficient use of existing resources. Forming a network of deep ULs in Europe need to be re-invigorated and opened to cooperation with facilities on other continents. This is the aim of NEXUS project.

1.1.2 Pertinence and innovative aspects of the research program

The most compelling solution to the DM enigma is provided by postulating new elementary particle that must be outside of the spectrum of the Standard Model (SM) – which, in fact, provides one of the strongest arguments in support of "new physics" beyond the SM (BSM). For decades, DM models

focused on the Weakly Interacting Massive Particle (WIMP) paradigm. These models can be confirmed/constrained through a range of experimental techniques including collider, direct detection, and indirect detection experiments[1]. Likewise, so far only gravitational effects of DM have been observed. Nevertheless, there are good reasons to expect that a particle DM relic may also exhibits much less feeble interactions, up to the (electro)weak ones of the SM, as is the case of WIMPs in a large variety of BSM models, or intermediate ones, in the case of Axions and, more generally, pseudoscalar Axion-Like Particles (ALP).

The state-of-the art (SOA) and the challenges

To date, experiments have been unable to detect the DM constituent, but have drastically reduced the allowed parameter space of WIMPs. In light of this, there is a major effort **to move beyond the WIMP paradigm,** which is driving research at the intersection of astrophysics, cosmology, and particle physics. Moving beyond the WIMP paradigm leads to some proposed particle physics models that can only be tested by astrophysical and cosmological probes rather than terrestrial experiments[2].

Intense increasingly global worldwide experimental searches is conducted following three main strategies: direct detection (DD) of the scattering of a DM particle off a target in deep ULs, indirect detection (ID) of exotic products of DM pair annihilation (or possibly decay) in the Galactic halo and beyond, and their production in colliders or accelerators with fixed-target experiments. The underlying principle to search for **axions and ALPs** in haloscopes (DM axions), helioscopes (solar axions) and laboratory experiments is to primarily make use of axion-photon conversion in the presence of a strong magnetic field, but also other complementary couplings to electrons or nuclei are used.

The prime scientific objectives of DD (in underground laboratories), in both WIMP and axion/ALP searches, are: **(i)** to detect a direct interaction of a DM particle with a detector, and **(ii)** to determine its mass and interaction cross section, or else **(iii)** to experimentally exclude the broadest accessible ranges of both quantities. **A detection of a DM particle will clearly constitute a historical landmark in the exploration of the (invisible) Universe**. It will confirm its particle nature and will open a new window on the present, and also very early, Universe. At the same time, it must be emphasised that this will only mark the first step in a long quest to unravel the true nature of the particle constituting DM that will require employing a multichannel, multi-messenger approach combining information also from ID, collider searches, astrophysics, cosmology and astronomy. Figure 1 shows the current landscape for DM searches[3]. The figure is scoping the WIMP model and parameters are constrained by the measured relic abundance of dark matter today. When looking for very low cross-sections, those detectors will soon start detecting Neutrinos (from our Sun, from the atmosphere, from supernovae, etc.). This so-called Neutrino fog, acting as background, will make the DM search more challenging, but it will also open new doors to Neutrino physics studies. As can be seen from the figure, two regions of the parameter space remain to be explored, which require different and complementary experimental efforts.

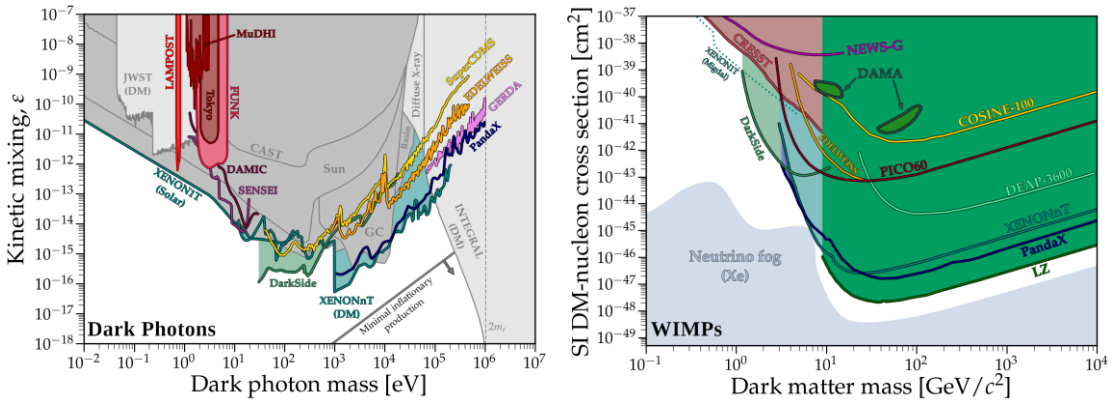

Figure 1: Current status of the search for Dark Photons (left) and the Spin-Independent WIMP-nucleon interaction (right), as an example of the most common models used to look for Dark Matter

[1] A. Boveia and C. Doglioni, Dark Matter Searches at Colliders, Ann. Rev. NP in Science 68 (2018) 429; M. Schumann, Nucl. Phys. 46 (2019) 103003 [1903.03026]; T.R. Slatyer, Les Houches Lectures on Indirect Detection of Dark Matter (2021), arXiv:2109.02696

[2] M.R. Buckley and A.H.G. Peter, Phys. Rep. 761 (2018) 1.

[3] C. O'Hare, https://github.com/cajohare/DirectDetectionPlots

Beyond SOA- How to tackle the problem

At high DM masses (above ~ 5 GeV): only detectors using noble liquids (Xenon and Argon) can reach the required sensitivity. Besides the continuous reductions of the radiogenic background, the next generation experiments **challenge the building of the ultimate dark matter detector, using a multi-ton target of liquid noble gas for the direct detection of particle dark matter in a sensitive time projection chamber**. The timescale of next generation DM experiments foresees data taking in 2030 (XLZD, seen as the natural step after the currently running experiments XENONnT and LZ) and beyond (Argo, which is the next step of DarkSide-20k[4], still under construction). **At small DM masses (below ~ 5 GeV)**[5]: mass below the proton (sub-GeV) typically lies in a dark sector, which does not interact directly with any of the Standard Model forces. Instead, new particles (such as dark photons, scalars, or pseudo-scalars) can mediate interactions between the dark matter and the ordinary matter. DM particles can scatter off electrons, nuclei (via the Migdal effect), or collective modes in a detector target, leaving small signals consisting of ionization or phonons. There is nowadays a plethora of experimental techniques that are trying to gain sensitivity to such small signals. In this case, **the challenge is to develop detectors with very low energy thresholds and excellent control over detector backgrounds**, rather than to build large detectors that are highly demanding in terms of occupied volumes in an underground laboratory.

One of the most interesting facts about having the possibility to perform an experiment on direct DM detection in an underground laboratory located in the **Southern Hemisphere** is to compare the eventual systematic errors or **modulation with respect to the same detector in the northern hemisphere**. Any systematic error or annual modulation correlated to a seasonal variation will have an opposed phase, giving the opportunity to discriminate these effects from a genuine DM signal. **It also opens different regions of parameter space when searching for daily modulations**[6]. The other advantage is to **combine the direct detection with indirect dark matter detection from radio astronomy surveys** that South Africa and Australia are leading. The world-astronomy collaboration SKA mid-frequency arrays[7] has 64-dishes precursor "MeerKAT" telescopes. Also, the annihilation and decay of WIMP during dark ages can leave imprints in the cosmic microwave background (CMB) radiation and alter the cosmic re-ionization process, which can be measured by high-sensitivity Hydrogen-Epoch Re-ionization Array (HERA) and CMB Stage-4 survey[8]. Both experiments have South Africa's deep participation and involvement. Therefore, the strong synergy between the astrophysical (**indirect detection**) and the future PAUL facility **(direct detection**) can jointly measure and constrain dark matter effect, which may shed lights on new physics.

How to proceed

Structured knowledge-sharing initiatives among different experiments and research teams will foster real synergies in key technologies and research methodologies. To achieve the main goal of this project, research and training activities will be developed along interconnected and complementary research work-packages (WPs) within NEXUS. The achievement of each specific aim will rely on contributions from all the participants and adopting an interdisciplinary approach based on complementary expertise. For this, the research efforts are structured into four dedicated work packages (WPs):

WP1 - Low background technologies

This WP will explore advanced low radioactivity techniques and their applications in various fields in order to provide support to next generation experiments. Radio-purity is a key ingredient for the success of next generation rare processes experiments.

WP2 - Muography and radiation measurements

This WP will involve characterizing underground laboratories. It will prospect the potential use of the cosmic ray muons properties to sense ans quantify the atmosphere parameters and to perform deep earth tomography. Their study is also fundamental to better understand the sources of background for

[4]XLZD:https://xlzd.org/; XENONnT: https://xenonexperiment.org/; LZ: https://lz.lbl.gov/; DarkSide-20k: https://cerncourier.com/a/the-darkside-of-gran-sasso/.
[5]M. Battaglieri et al. [arXiv :1707.04591 [hep-ph]] ; R. Essiget al. [arXiv:2203.08297 [hep-ph]].
[6] C. Kouvaris and I. M. Shoemaker, Phys. Rev. D 90, 095011 (2014); N. Avalos et al., Journal of Physics: Conference Series 2156, 012074 (2021); N. Avalos et al. J. Phys. Conf. Ser. 2156, 012074 (2021).
[7] SKA observatory web site: https://en.wikipedia.org/wiki/Square_Kilometre_Array
[8] HERA facility web site: http://reionization.org; CMB-S4: https://cmb-s4.org.

extremely sensitive measurements such as Dark Mater search. Fast neutrons are another critical source of background that requires careful control and understanding. The important issue of radon exhalation from materials used in the detection systems of low activity experiments is another issue, partly addressed in WP1.

WP3- Modelling, Simulation, Computing

This WP will focus on a close collaboration between theory, and simulation to study Dark Matter models and characterization of muon flux for underground facilities. We use Monte Carlo (MC) for simulation.

WP4 - Quantum science and technology

This WP will prospect the development and deployment of new quantum technologies and studies to generate new knowledge about the physical nature of the Universe. Two areas of research are facilitated within international collaboration between deep underground laboratories: foundations of quantum mechanics and searches for low mass dark matter with quantum technologies.

The research objectives are perfectly aligned with the research fields of the participants and the output of the project is verifiable and can be measured by the following, among others, key performance indicators: **(1)** low background techniques and their performances for rare events measurements; **(2)** cosmic-rays, neutrons measurements and the related techniques to characterize the performances of a facility and its instrumentation to detect rare events **(3)** guidelines, methods, algorithms and protocols for understanding and using the data and modelling; **(4)** publicly available code repositories, FAIR data platforms to ensure the work is being consolidated and skills and knowledge are shared; **(5)** communication, dissemination and outreach. The NEXUS consortium partners bring a unique expertise that is essential for the successful realisation of the project.

1.2 Soundness of the proposed methodology

1.2.1 Overall methodology

The NEXUS project combines institutions working in data analyses, simulation, software-oriented-activities, R&Ds and tools developments to uncover novel insights into the search of DM and other rare processes. The establishment of a cohesive network among these organizations, universities, research laboratories and facilities will enable them to operate as a unified entity, facilitating the sharing of data, resources, and best practices. This collaborative environment will not only enhance the efficiency of existing projects but also **foster the development of innovative research initiatives.** It is essential to address the **complex challenges** posed by **low-background experiments in Underground Laboratories**, which are crucial for **probing rare phenomena**. This collaborative approach is original in its scale and scope, allowing for a comprehensive exploration of parameter spaces that individual laboratories are able to achieve independently. **The approach** undertaken in NEXUS is aimed at providing a dynamic environment for advances in ultra-sensitive detectors (**WP2, WP4**), ultra-low radiation techniques (**WP1**), characterization of the instruments, the facilities, modelling (**WP2, WP3**), all ready to lead innovation in both the global search for rare events and cutting-edge technological development to also benefit society and industry. A significant focus of our methodological approach will be to prioritize research into novel materials that will enhance the sensitivity of detectors, as well as advanced shielding techniques to minimize background noise. Our approach will involve collaboration with materials scientists and engineers to create prototypes that can be tested in real experimental conditions. The originality of this activity lies in the **cross-disciplinary** collaboration that **combines fundamental physics with engineering** and material science. We **demonstrate this cross-disciplinary approach** by combining underground capabilities and knowledge (WP1, WP2, WP3) with new detectors and analyses (**WP4**) **resulting in new sensitivity to fundamental questions about physics and quantum technology**. The collaboration will engage in **extensive R&D** activities aimed at developing an extraordinary next-generation detectors and instrumentation. National Institutions or facilities like CNRS (including LSM), INFN (including LNGS), LSC, SNOLAB and research labs from Australia or South-Africa will **leverage for the first time their collective expertise** to innovate technologies that enhance detection capabilities and **improve experimental outcomes**. The South-African consortium related to the PAUL project[9] provides a great opportunity for best practice and

[9] PAUL project: arXiv:2306.12083

process benchmarking towards data standardization and interchangeability among different solutions, especially within WP2 framework. **To achieve these objectives**, regular meetings, symposia, open training schools, conferences and outreach activities will be organised to facilitate continuous knowledge exchange (**WP5**). The project will prioritise the support and development of young researchers, ensuring adherence to the highest standards of quality, ethics, and gender balance. **Training** will be a crucial component of each secondment, especially for early-stage researchers (ESRs). The objective is to provide high-level research, soft skills, and complementary skills training, along with adequate mentoring. Beneficiaries will have access to an environment conducive to acquiring cutting-edge skills in physics and technology, instrumentation, detectors and computing. **The expertise** of the partners involved in this project will not only contribute to achieving the research objectives but also provide invaluable training experiences for the young researchers (ESRs and PhDs). Graduate students, as well as staff from universities and research centres, will benefit from exposure to new techniques and technologies, enhancing their research and academic skills, as well as their non-academic abilities. **ESRs** will receive support in working in an international setting with foreign collaborators and advisors, enabling them to function and communicate in multicultural atmospheres of scientific excellence. **Senior researchers** will also develop skill sets required for research in international contexts through cross-collaboration with international partners and co-advising junior researchers from foreign countries. This will provide them with novel expertise to pursue their careers as independent scientists. The different work-packages (WP), state-of-the art, challenges and methodology are described below:

WP1 - The ultimate source of background in many cases in the search for rare events is the natural radioactivity present in the detector materials. The selection of radiopure materials and detectors for low-level radioactivity measurements has been a key point over the past 20 years. ULs are currently collaborating to improve the selection of materials, both in the assays of ultra-low contamination and in the production in situ of radiopure components (such as the electro-formed copper at LSC and SURF). The next generation experiments aiming at detecting rare processes such as direct dark matter (DDM) interactions and neutrinoless double β-decay (0νDBD), require unique levels of radiopurity in detector target and shielding materials. Most of these experiments are located at underground laboratories to reduce external backgrounds induced by cosmic rays. Indeed, the depth of the laboratory provides a first protection from radioactive background: neutron and muon fluxes from cosmic rays are reduced by several orders of magnitude by the rock overburden which filters them out (see WP2). Furthermore, experiments use active and passive shielding schemes to moderate the environmental natural radioactivity. Usually, the flux of gamma-rays is attenuated by a lead or water shielding, whereas the radiogenic neutrons coming from the rock and materials close to the detectors are moderated by a polyethylene or water shielding material. In addition, active muon veto surrounding the experimental set-up will help tagging the residual muons that can interact in the lead shielding and then producing neutrons. New detector technologies along with smart analysis techniques of background discrimination are being developed in order to disentangle different event populations occurring in the detectors. Some of them make use of an active veto detector around the sensitive part to mitigate the background from cosmic muons and radioactivity sources in the veto itself and to reduce the background from the residual radioactive decays in the innermost detector, decays that could limit the sensitivity. Nowadays, DDM search experiments strive to reach lower interaction cross section sensitivities, whereas 0νDBD experiments aim at longer half-life sensitivities. A typical next generation experiment may have several thousand components, most of which need measurement to the O (1), 10^{-12}g/g level of ^{238}U, ^{232}Th, 10^{-10} g/g level, and beyond, of ^{40}K. Therefore, **radio-purity techniques** are key ingredients for the success of next generation rare processes experiments. It is expected that next generation experiments will face an order of 1000 samples to be assayed with sensitivity of order of 1 μBq/kg – 10 μBq/kg depending on isotopes. **The aim of the WP1 is to reinforce and innovate the development of low-background techniques to reach the sensitivities and throughput required for next generation underground particle physics experiments**. **This is achieved following two avenues**: **(i)** improving the capabilities of radio-assays of the ULs and **(ii)** enabling the production of radiopure components. Both can be achieved by fostering the relationships between the facilities and the expertise of the ULs to offer a comprehensive, coordinated, effort for customers worldwide; to develop relationships with partners in other areas of science and industry to provide assay facilities to those yet to realise the potential sensitivity gains of underground facilities. There is a great interest in low-background materials in the fields of particle physics, astroparticle physics, quantum computing, biophysics, environmental science

and, increasingly, **in industry particularly focussing on single-event damage**. Therefore, the exchange program can make an important contribution not only to the fundamental research of DDM, 0vDBD, and the development of quantum computing, but also to other areas.

WP2 - Atmospheric **muons** represent the largest proportion of charged particles reaching the surface of the Earth. They are secondary products of cosmic-ray interactions with the atmosphere. They easily penetrate the atmosphere and can reach the Earth's surface. The flux of muons decreases as muons travel through an increasing amount of matter, which results in a natural tool to probe density structures in large opaque bodies such as archeological sites, caves or volcanoes in an equivalent way to the density imaging done with X-rays in medicine. Thus, muon imaging has emerged as a powerful method to complement standard tools in Earth Sciences and the collaboration with the Astroparticle community has enabled huge progress in the application of muon tomography to interesting applications. Atmospheric muons can also be used to monitor the atmospheric temperature. One aspect of this WP is to focus on the use of atmospheric muons with the extended muography domain. It will prospect the potential use of the cosmic ray muons properties to better understanding the sources of background for extremely sensitive measurements such as Dark Mater search. Measurements require the use of muon detectors behind, below (or on both parts of) the area to be mapped, measuring the characteristics of particles that have passed through the interested area and reconstructing images via dedicated algorithms. Depending on the measurements to be taken the muography is used either in "transmission" and "absorption" mode (for stopping-muons, like X-ray imaging) or in "scattering" mode (for through-going muons). Currently, several technologies coexist with their respective advantages depending on the targeted application. The other aspect is the **neutrons** which are another critical source of background that requires careful control and understanding. Fast neutrons produce the same nuclear recoil signals searched for direct detection of dark matter in ULs. Thermal neutrons by radiative capture produce gamma-rays giving electrons in all the materials used to build the detectors searching for rare events. The main source of neutrons in UL is the (α,n) nuclear reactions produced in the rock of the walls of the laboratory. The alpha particles are produced mainly by the uranium decay chains, also producing the Rn-222 chain. The neutron spectral and flux characterization in an underground laboratory is one of the most important measurements to be performed to understand the background of any rare event detector installed in UL. The task proposed is to perform a neutron characterization of one UL per year, four in total, in collaboration with all the participants. Installing an SPC-neutron spectrometer to measure the neutron flux in the Huguenot tunnel where the future South-African underground laboratory will be constructed is planned. A key aspect of this WP will involve **characterizing underground laboratories**, using not only muography techniques but also monitoring the environmental **radioactivity** (gamma rays' emission) and **radon exhalation** and concentration inside underground tunnels. Another important key aspect is the possibility to consolidate a framework of groups involved in muography by offering common reference tools (like common data formats, benchmark datasets, common methodologies, etc…). Common targets for muography measurements in the domain of geosciences (volcanoes, hydrogeology etc), archaeology, civil engineering and industrial controls are not the objectives of this WP but can be a spin-off. Collaborators within WP2 are particularly interested in performing muons and neutrons measurement in the Huguenot tunnel where the future PAUL facility will be built, using both electronic detectors and nuclear emulsion. The participants have the experience and know-how for wide range spectrum of measurements including sub-MeV and thermic neutrons, particularly critical for the dark matter search.

WP3 - This Work Package will focus on two aspects: the study of **Dark Matter models** and the usage of the **MC simulation** to study the muon flux that underground facilities need to get rid of to be able to measure rare events.

Dark Matter theory: Recent advances of modern telescopes like NASA's Hubble Space Telescope, Euclid space telescope, and Square Kilometer Array have enabled mankind to do various astronomical measurements, from a wide range of cosmological epochs and length-scales. This has also facilitated independent research groups across the globe to confirm the existence of Dark Matter (DM) in our universe. These measurements include galaxy rotation curves, the Cosmic Microwave Background, and weak and strong gravitational lensing. However, very little is currently known about the microphysical nature of DM, but its mere presence is an existence proof of physics beyond the Standard Model of particle physics. For decades, DM model building on the particle physics side focused on the Weakly

Interacting Massive Particle (WIMP) paradigm. These models can be detected/constrained through a range of experimental techniques including collider, direct detection, and indirect detection experiments. To date, these experiments have been unable to detect the DM constituent, but have drastically reduced the allowed parameter space of WIMPs. In light of this, there is a major effort to move beyond the WIMP paradigm, driving research at the intersection of astrophysics, cosmology, and particle physics. Moving beyond the WIMP paradigm leads to some proposed particle physics models that can only be tested by astrophysical and cosmological probes rather than terrestrial experiments[10]. They include the physics of DM or a dark sector that only communicates with the visible sector through gravitational effects; for instance, a warm DM candidate with non-negligible free streaming scale, fuzzy DM models, DM interactions with a dark thermal bath, and DM self-interactions.

Our research initiative shall identify the key elements that our research programs shall focus its effects on. These key elements are:

- Close collaboration between simulators and particle theorists to both identify key models and areas of parameter space and to successfully implement these models. This includes starting from appropriate initial conditions to providing simulation outputs in a manner that is meaningful to particle theorists, simulators and observers alike.
- Algorithm development and code comparison tests ensuring that simulations meet the required precision targets set by the sensitivity of the new facilities. For hydrodynamic modeling, this includes evaluation and comparison of different subgrid physics parameterizations.
- Analysis of outputs in the realm of observations including mass functions, luminosity functions, galaxy morphology, kinematics, intracluster light all measured in an apples-to-apples manner with observations from current and upcoming facilities.

Thus, we identified these elements to foster areas of growth on both the particle theory side as well as the simulation algorithm and implementation side, so that we can robustly simulate the cosmic evolution of DM for well-motivated models. We recommend that simulations include a fully calibrated and well-tested treatment of baryonic physics, and that outputs should connect with observations in the space of observables. We identify the tools and methods currently available to make predictions and the path forward for building more of these tools. A strong cosmic DM simulation program is key to translating cosmological observations to robust constraints on DM fundamental physics, and provides a connection to lab-based probes of DM physics.

Monte Carlo simulation to characterize the muon flux: Compared to aboveground facilities, subsurface geological repositories cannot be directly monitored. A Monte Carlo-based methodology in conjunction with the physical measurements of the muon flux in underground facilities can be used to characterize the cosmic ray muon flux, including muon angular and energy differential distributions at depths representative of geological structures. Simulating the muon flux in underground research facilities provides researcher tools to design and plan the facility, as well as study the geology of the overburden above the research facility. This is actually an important task to pursue in view of the design and construction of the new facilities such PAUL in South-Africa. Monte Carlo based transport software for the simulation of particle tracks in detectors is an integral component in the development of new radiation sensors and detectors. A dedicated simulation workgroup within the underground physics collaboration will support the design and development of new detectors and sensor equipment which will be used in underground experiments and technologies (see WP2). Also, the use of machine learning based algorithms are useful to automate and speed up the data analysis procedure. Muography measures (WP2) usually involve low statistics measurement, which requires that the background noise and environmental factors need to be closely monitored. Convolutional neural networks (CNN) will be trained to identify the systematic noise using real data in combination with augmented data which is generated by Monte Carlo based software. These algorithms can be used to denoise muography images. Muographic data from different points of view will be simulated to train a denoising neural network. These new machine learning methods can significantly improve the muography images. Muon detectors which are used for muography measurements are often exposed to an open environment where factors such as temperature, and humidity need to be monitored. In addition to the denoising of the muography

[10] M.R. Buckley and A.H.G. Peter, Phys. Rep. 761 (2018) 1

data, the data collected from temperature and humidity sensors could be used to train a CNN to identify patterns in the data which could improve the performance and precision of the detector and enhance the quality of the data.

WP4 - Quantum science and technology are rapidly advancing on an international scale, driving the development of innovative technologies with the potential to enhance societal capabilities. International strategies for fundamental science emphasize the significance of quantum science and technology in unlocking new pathways for understanding the Universe and enabling extraordinary societal applications that are already emerging. In this work package, we aim to develop and deploy novel theoretical models and associated technologies grounded in quantum foundations. Through this effort, we seek to generate new knowledge about the physical nature of the Universe. We have identified two primary research areas poised for transformation through international collaboration between deep underground laboratories: the foundations of quantum mechanics and the search for low-mass dark matter, in connection to quantum technologies. The foundations of quantum mechanics remain an open field, presenting intriguing challenges such as the "measurement problem" and the interplay between quantum physics and gravity. Recent theories and models, including quantum collapse theories, suggest that underground experiments could make significant contributions to testing these theories and advancing our understanding of quantum foundations. Conversely, the search for low-mass dark matter relies on low-background detectors located deep underground, equipped with state-of-the-art low-energy sensitivity. Quantum sensors, capable of detecting lower energy events than traditional detectors, have opened new avenues for investigating novel types of dark matter particles. Recent experiments have demonstrated the nature of one major problem with qubits when they collide with high-energy particles like cosmic rays or radiation. These energy particles can cause correlated "error hotspots" in the qubits, similar to how a small disruption of a smooth surface like water can create ripples that spread interference. When a particle hits a qubits processor, all the qubits can be disturbed, leading to a chip-wide failure. This interference can limit how long a quantum computer can effectively perform calculations before all the information is lost to high energy particles. The CUTE facility at SNOLAB originally built for the Super Cryogenic Dark Matter Search experiment (SuperCDMS), became a user facility at **SNOLAB** in 2021 and is now available for scientific and technological projects that benefit from its unique conditions. The ICRQ project, led by the Spain at **LSC**, will lay the first stones on the road to the development of quantum detectors using the technology of quantum superconducting circuits. These circuits behave like artificial atoms with tunable properties and exhibit very high sensitivity to environmental perturbations. Thus, quantum information processing units in quantum computers are sensitive, low-energy particle detectors, and new insights into nature could be discovered by utilizing this new technology. Our work involves collaborating with leading detector developers worldwide to explore quantum foundations by utilizing these extremely low-background detectors and prototype quantum sensors. We will evaluate their sensitivity to low-mass dark matter, study noise sources that limit their performance, and contribute to improving these technologies. Notably, the noise sources in these detectors are also sources of errors in superconducting qubits, linking quantum foundations and dark matter searches to the broader objective of understanding and mitigating environmental sources of qubit errors. Quantum sensors not only enable innovative methods for dark matter detection but also enhance our understanding of the foundations of quantum mechanics. This work package encompasses analysing quantum sensor data for evidence of dark matter and examining quantum sensor and low-background detection data (from WP1) for potential evidence supporting new theories related to wave function collapse and quantum gravity.

1.2.2 Integration of methods and disciplines to pursue the objectives

Advancing instrumentation and modelling in the search for DM imply interactions with various disciplines, including material science, chemistry and computer science. Direct collaboration with scientist and technology experts from these disciplines will be essential to achieve our goal. Advanced techniques and original solutions in mechanical and electronic engineering requires a strict **interplay** with **solid state** physicists, **mechanics** and **electronics** engineers, to develop new production techniques and shapes which may reduce unwanted degradation effects on the devices. Physics data analysis and their interpretation include **simulation** as well as **theoretical** concepts and models. The development of efficient **algorithms** which implement **computational science** expertise will exploit **machine learning techniques** (**WP3**). The whole computing activity implements several information technology advanced

techniques for farming, networking, data and code management. ULs are a good environment to understand the effects of cosmic rays, geological and instrumental neutrons and gamma rays (**WP2**) and reduce the background to be able to detect rare events with an unknown nature (**WP1**) or correlated errors in quantum computing processors caused by interaction with high-energy particles (**WP4**). Data acquisition and remote controls of the detector's parameters imply collaboration with electronics engineering to develop challenging real time applications and efficient slow control protocols, which often can be considered also for applications in smart devices for health or environment monitoring.
Precise measurements performed in some European underground laboratories (LNGS, LSC, LSM, Boulby) and in Canada at SNOLAB require advanced competences in **nuclear chemistry** to check **t**he purity and reduce contamination of the compound (**WP1**). On the other hand, the study of organic photo-sensors involves chemists, physicists and engineers: solid state physicists design and simulate the conductivity and **light sensing** properties of different **polymers, chemists** synthesize and deliver the selected polymers with the proper purity, physicists and engineers build the final device and characterize it for photon-detection, noise properties and conductivity (**WP1**). **Inter-sectoral aspects** come naturally from the above listed connections, which in some cases are already involving collaboration with technology producers.

1.2.3 Gender dimension and other diversity aspects

With a focus on particle physics and research to enhance the understanding of our universe, the research activities carried out in this project are not gender related. Nevertheless, gender will be considered in this project by committing to promote gender balance and equal opportunity in its research and training activities. While men and women are unequally represented in scientific research, especially in physics, the consortium aims to involve at least 50% of female participants. The diversity is shown in the coordination of the tasks, out of 6 WPs three of them are coordinated by women. We will ensure that all gender-related data collected avoids biases, and our public engagement activities will take into account the socio-cultural aspects of gender.

1.2.4 Open science practices

The values of open science have always been at the heart of High-Energy community back to the creation of CERN (European Organization for Particle Physics). This research community has been at the forefront of global open science throughout the Organization's seventy-year history, engaging in "open science" well before the term was even created and setting an example for other scientific domains. Science, by nature, requires open communication and collaboration in order to progress. The partners are dedicated to favouring open access to particle physics research, as it is shown by their involvement in initiatives such as the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3). In order to foster collaboration and greater impact, results and knowledge will be shared as widely as possible. The partners will notably publish their results in open access journals (e.g., arXiv, Inspire or HAL)[11] and make research data available on the trusted repository Zenodo ensuring findability, access and reusability of data. Sharing of data and results will follow the principle of 'as open as possible, as closed as necessary'. A Data Management Plan (**DMP**)[12] specifying how the data will be collected, generated and processed will be elaborated within the first six months (**WP6**) and updated in line with the progress of the project.

1.2.5 Research data management and management of other research outputs

In recent years, digital object management practices to support findability, accessibility, interoperability, and reusability (FAIR) have begun to be adopted across a number of data-intensive scientific disciplines. The FAIR4HEP collaboration[13] explored the interpretation of FAIR principles in the context of data and AI models for experimental high energy physics (HEP) research. A FAIR Analysis research data preservation repository platform is a repository service which allows collaborations to deposit and share the **structured information** about analyses as well as to capture the individual data assets associated to the analysis. It is a typical data ingestion pipelines, through which an individual physicist can preserve and share their final meta- and digested data, in our case **n-tuples (reconstructed and calibrated data), ROOT macros, Jupyter notebooks**, or even **full analysis work-flow code** and any intermediate

[11] Arxiv: https://arxiv.org/; Inspire-hep: https://inspirehep.net/; HAL: https://in2p3.hal.science/.
[12] DMP at CNRS/IN2P3: https://dmp.in2p3.fr/
[13] FAIR Principles for data and AI models in high energy physics research and education, DOI: 10.48550/arXiv.2211.15021

datasets of interest for preservation within the restricted context of experimental collaboration. The importance of annotating the deposited content with high-level structured information about physics concepts in order to promote information discovery and knowledge sharing inside the collaboration is an asset. To maximize the scientific output of the project and we will facilitate the re-usability of preserved data assets by capturing and re-executing reproducible recipes and computational work-flows using for example the REANA (Reusable Analysis) platform[14]. We will ensure that data collected from various ULs, including radio-assay data for calibration, are accessible to all collaborators, even those outside this project. There are many possibilities offered within the consortium, like the platform RDA/RDMO[15] which is recommended to CNRS/IN2P3 research institutions.This will facilitate joint analyses, enhance statistical power, and enable the identification of potential signals of DM or other rare events across different experiments.

1.3 Quality of the proposed interaction between the participating organisations in light of the research and innovation objectives

1.3.1 Contribution of each participating organisation in the activities planned

Each single partner in the consortium is contributing with special competences and, by converse, will profit of the project activities in term of increasing scientific expertise, personnel skills and number of collaborating groups. Here is a non-exhaustive summary of the contributed expertise. Additional description of each partner is given in section 3.2 and in the tables of part-B2 of the project call.

CNRS institution and the national institute **IN2P3**, gathers 25 joint universities and CNRS research laboratories and platforms, six of them are involved in this project through: IJCLab Orsay, IP2I Lyon, LP2I Bordeaux, LPNHE Paris, LPSC Grenoble and SUBATECH Nantes. In addition, the **LSM** underground facility located in Modane is the technological platform of the LPSC. Many actual and future experiments as well as low radioactivity (germanium, biophysics, etc...) measurements related to this project will be performed at LSM. Participants from CNRS have a wide range of expertise, just to cite their know-how in ultra-low background measurements, neutrons and muons measurement and rare events search. Spin-off of their research at LSM has an important impact in radiobiology and the environmental aspects. Participating scientists will be involved in all research WPs as well as to outreach and dissemination. Two of the WPs are coordinated by CNRS: WP1 and WP6 (management of the project).

INFN is a public research institution funded by the Italian ministry of research. **LNGS**, the Gran Sasso National Laboratory in Italy, is the largest deep underground scientific laboratory in Europe. Experiments on dark matter, neutrinoless double beta decay, nuclear astrophysics, search for rare processes beyond the Standard Model (e.g., VIP), geophysics, and biology are in operation. Participants from INFN, including LNF and LNGS have a wide range of expertise. Just to cite a few in relation with the project: muography, radiopurity assay, radiobiology, low energy neutrinos and direct dark matter research, quantum sensing and computing. Participating scientists will be involved in four research WPs. Also, they will coordinate WP2 and WP5.

LSC in Spain is the second largest deep underground scientific laboratory in Europe. Participants from LSC have a wide range of expertise and are renowned for their involvement in low background techniques especially towards radiobiology and quantum sensing. They will participate to the tasks of WP1, WP2 and WP4 as well as to WP5.

UKRI, United Kingdom Research and Innovation, is the largest underground low radon environment located in the Boulby mine. It has a very diversified scientific program from astroparticle physics to planetary exploration. Plans are being developed for an important enlargement of the underground laboratory starting in 2030. Science ranges from particle physics and ultra-low background science, earth and environmental science, biology / astrobiology, planetary exploration technology development. Given their large expertise in this typical environment, they will contribute mainly to WP1 as hosts to participants.

[14]CERN Analysis Preservation and Reuse Framework, EPJ Web of Conferences 245, 06011 (2020) ; REANA: https://reanahub.io/.
[15] RDMO: https://rdmorganiser.github.io/en/

SNOLAB is an international facility for underground science; The primary focus of the science program includes solar neutrinos, supernova neutrinos, neutrino-less double beta decay and dark matter searches. SNOLAB is expert in dark matter detectors, underground operations, and clean rooms, quantum computing, data analysis techniques and researcher mentoring. Although only hosts to EU participants, they will involve in WP1 and WP4. They will coordinate WP4.

SURF Sanford Underground Research Facility in South Dakota, USA, hosts world leading experiments on dark matter and neutrino physics and on biology and geophysics underground. It is strongly engaged in advance training, education, and outreach. It hosts the Institute for Underground Science. Participating scientists will be involved in WP1 and WP5.

University of Melbourne (UoM) constructs and operates state-of-the-art experiments to directly detect dark matter in Australia. They also administrate "the ARC Centre for excellence for Dark matter particle physics". As hosts to the EU partners, they will involve mainly in WP1.

The University of Adelaide (UoA) The University of Adelaide is a key node of the "ARC Centre of Excellence for Dark Matter Particle Physics", actively contributing to the development of dark matter experiments at the Stawell Underground Physics Laboratory (SUPL). The University of Adelaide is also home to the ARC Special Research Centre for the Subatomic Structure of Matter, a hub of excellence driving cutting-edge discoveries in fundamental physics. Given their expertise they will involve mainly in WP4 as hosts to EU partners.

South-Africa research teams and SKAO PAUL (Paarl Africa Underground Laboratory) is the unique African future UL, the second in the southern hemisphere after SUPL (in Australia). It has been founded and supported by a consortium of South-African universities and organizations, among them the participants to this project are: **SU**, **UWC**, **WITS**, **UNISA**, **SKAO**. Participants from the different universities forming PAUL consortium have expertise in experimental nuclear and particle physics and its instrumentation and detector development etc. Also, given their expertise in theoretical and computational nuclear and particle physics and Monte Carlo simulations, they will be involved in WP1, WP2 and WP3. UNISA will coordinate WP3.

1.3.2 Justification of the main networking activities

The NEXUS project has been conceived as a broad-spectrum initiative designed to encourage and facilitate collaboration between scientists doing research in Underground Laboratories. By fostering interactions among scientists working on different experiments and facilities, we aim **(i)** to develop common solutions to shared technological challenges, **(ii)** facilitate the exchange of knowledge and expertise and **(iii)** maximize the effectiveness of research efforts. The networking activities will be conducted within the framework of WP5 (knowledge transfer and training) and the four research WPs. While researchers will acquire skills and knowledge during their secondments, they will also participate in various networking activities and transfer knowledge on their return. The partners will especially organise two summer schools to deepen the knowledge and expertise in matter of low background measurements techniques, quantum sensing and dark matter theory. Seconded staff will further enhance their knowledge at seminars held during their visits. Training sessions will focus on DM searches and related techniques (low background measurements, radiopurity techniques, myography and neutron measurements), quantum sensing, simulation and computing as well as soft skills training. These networking activities will be closely integrated with those of related initiatives, including the French-South Africa international research networking PAULINE[16], the Australian ARC excellence centre for dark matter research[17], etc. In addition, the project will leverage the wealth of online training resources already produced by collaborators, to cite the few, ARC (Australia)[18].

The project partners will participate in top-ranked international conferences and meetings to disseminate project results and establish new contacts for future collaborations. Throughout the project, particular attention will be given to conferences such as TAUP, IWIDM, LRT[19] etc. Emphasis will also be placed on encouraging early-stage researchers (ESRs) to participate in these events, promoting their research

[16] PAULINE: https://pauline.in2p3.fr/
[17] ARC: https://www.centredarkmatter.org/
[18] Education and training at ARC(Australia): https://www.centredarkmatter.org/all/teachers-receive-cosmic-education
[19] TAUP 2023: https://www.taup-conference.to.infn.it/taup2023.html; IDM2024: https://www.idm2024.eu/ ; LRT2024: https://indico.fais.uj.edu.pl/event/1/ .

and networking skills. In addition, 2 general workshops will be organised in relation with each of the research WPs (description in WP5), providing further opportunities for ESRs to present their results and discoveries to other network members, invited guests, and researchers from various disciplines. These meetings serve as an ideal mechanism for the transfer of scientific knowledge within and outside the consortium, fostering interdisciplinary collaborations. Furthermore, these gatherings offer valuable social networking opportunities, enabling ESRs, partners, and industrialists to establish connections that can support ESRs in their careers beyond the project duration.

2. Impact

2.1 Developing new and lasting research collaborations achieving transfer of knowledge between participating organisations and contribution to improving research and innovation potential at the European and global level

2.1.1 Describe the development and sustainability of new and lasting research collaborations

NEXUS aims to enhance and **unite the collaborative framework** among researchers from European institutions, Canada and the southern hemisphere engaged in global underground laboratory projects. Our initiative will actively promote opportunities for increased involvement and strengthen our roles within these collaborations, paving the way for **new and sustainable research partnerships**. In the context of underground physics, European institutions play a crucial role in several significant collaborations. The establishment of a cohesive network among these laboratories will enable them to operate as a unified entity, facilitating the sharing of data, resources, and best practices. This collaborative environment will not only enhance the efficiency of existing projects but also foster the development of innovative research initiatives. The current network is built upon existing collaborations, for e.g., PAULINE (Ref. 16) which is an International Research Network between CNRS, LSC, INFN and the consortium of universities representing the future underground facility, PAUL (see also examples n section 3.2). This shows that the network is reliable and long lasting. To achieve the unification, we will focus on creating a framework for regular communication, joint project management, and shared scientific objectives among participating laboratories. Moreover, our initiative will engage in the planning and execution of cutting-edge experiments that leverage the unique capabilities of underground laboratories. By fostering international partnerships, we aim to contribute to ground breaking discoveries in particle physics, astrophysics, and related fields. The collaborative efforts will also extend to the development of advanced technologies that can be utilized across different research facilities, ensuring that all partners benefit from shared advancements. These partnerships are designed to endure beyond the duration of the initiative, establishing a robust network among European institutions and their international counterparts. By the conclusion of the NEXUS project, the collaborations between European institutions and underground laboratories worldwide will be well-established, facilitating ongoing research and funding opportunities. Our initiative will also encourage the formation of **new collaborations** among researchers working on similar experimental challenges, promoting a unified approach to **instrumentation, data analysis and theoretical approaches**.

2.1.2 Describe how the project will generate knowledge transfer

Training, skill transfer, supervision: The initiative will involve extensive secondments across Europe, Canada and the southern hemisphere. Participants will engage in the commissioning and operation of advanced detectors and infrastructures developed at their home institutions or at ULs. This process will require comprehensive training from the personnel at host laboratories on utilizing local facilities, equipment, and computing resources, as well as mandatory safety training covering relevant hazards associated with underground research. Researchers will benefit from daily interactions with colleagues from various institutions who are actively engaged in similar or complementary projects, facilitating a continuous exchange of knowledge and expertise. This close collaboration will enhance the transfer of skills and insights from host institutions back to Europe and vice-versa, creating a rich learning environment. This collaborative environment will significantly enhance knowledge transfer among the researchers, fostering new partnerships and joint efforts. Early-stage researchers (ESRs) will typically engage in longer secondments (e.g., 6PM per year or longer), allowing them to delve deeper into their research topics for their PhD theses, often with co-supervision from experts at host laboratories. This arrangement will not only benefit their academic development but also facilitate further knowledge

transfer. Knowledge transfer will also happen during the workshops, project conference and the in-situ training organised during the secondments (see WP5 and WP2/tasks 2.3 and 2.4).

Advancement of knowledge: The action involves a highly multidisciplinary collaboration that spans fields from nuclear physics and particle physics to astrophysics, material science, chemistry and computing**.** By bringing together experts from diverse backgrounds, the action promotes knowledge exchange, cross-pollination of ideas, and the generation of new insights. The proposed initiative will facilitate extensive secondments at prominent underground laboratories and research laboratories located in both hemispheres. Participants will be actively involved in the set-up and operation of sophisticated detectors and systems that have been designed and developed at their respective home institution.

Cutting-edge research infrastructures and centres of excellence: The action includes research groups that possess state-of-the-art infrastructure and facilities for the hunt of cosmological dark matter and rare-events searches. By leveraging such infrastructures, the action enhances the research capabilities of the participating laboratories and contributes to the overall research and innovation potential. Researchers will have the opportunity to engage in daily interactions with peers from various institutions, fostering a dynamic exchange of knowledge and expertise. This collaborative atmosphere will significantly enhance the transfer of skills and insights back home, creating a vibrant learning ecosystem.

2.1.3 Research and innovation potential within Europe and/or worldwide

The proposed action makes significant contributions to enhancing research and innovation potential both within Europe and on a global scale. **Greater mobility of researchers in Europe and Worldwide**: This project not only involves renowned scientific research centres in Europe, which are global references for ULs and DM research, but also includes world-class partners from Canada and Australia and an emerging country, South-Africa, a leading country in Africa for nuclear and particles, astroparticles and cosmology research. **International collaboration**: The action goes beyond European borders by involving partners from Canada, Australia and South-Africa, see section 3.2. This international collaboration facilitates the exchange of knowledge, methodologies, and perspectives, enriching the research landscape and expanding the global research network. It enhances Europe's standing as a hub for scientific collaboration and positions European institutions as attractive destinations for researchers worldwide. **Talent attraction and retention**. There is a concerning trend of declining interest in scientific studies among young individuals, resulting in a loss of enthusiasm for careers in research. The project will attract and inspire young students, especially women, to pursue careers in science within the laboratories and facilities involved in this project. The action focuses on creating an international and dynamic work environment that appeals to young researchers. By providing mobility opportunities and fostering a collaborative atmosphere, the action aims to attract and retain talented individuals, encouraging them to pursue careers in science. This contributes to the long-term growth of research and innovation potential by nurturing the next generation of scientists and innovators.

2.2 Credibility of the measures to enhance the career perspectives of staff members and contribution to their skills development

2.2.1 Describe how the action contributes to realising the potential of individuals and provides new skills, enhances their knowledge and career perspectives.

The proposed initiative aims to cultivate the capabilities of a new generation of scientists through a comprehensive global approach that emphasizes exposure to diverse research and industrial environments across northern and southern hemisphere. By facilitating secondments in leading research laboratories and facilities in Europe, Canada, Australia and Africa, as well as **interdisciplinary and cross-disciplinary exchanges**, participants will gain invaluable experience working alongside top-tier academic. These secondments are designed to foster future employment opportunities, including fellowships and contracts, as evidenced by successful placements at the participating laboratories. Our initiative is at the cutting edge of technology across various domains, including advanced particle radiation detection, radiation-resistant and magnetic-tolerant electronics, sensitive instrumentation for high-energy physics and medical and environment applications, quantum computing, and cutting-edge

high-energy physics technologies. This unique opportunity will not only broaden their expertise but also significantly enhance their career prospects in both academia and industry.

Participants will engage in the entire experimental process, from initial design and hardware commissioning through to the operation, calibration of experiments, optimization of data reconstruction and analysis tools, and completion of data evaluations. This initiative presents an exceptional opportunity for early-stage researchers (ESRs) to pursue PhDs in astroparticle physics and technologies, with the added benefit of presenting their findings at workshops and international conferences.

The diverse skill sets acquired by early-career researchers (ESRs) will significantly enhance their competitiveness in the academic job market—opening doors to post-doctoral research positions and faculty roles—as well as in the private R&D sector, setting them apart from their peers without similar opportunities. We will implement a comprehensive training program designed to equip early-career researchers with the skills necessary for interdisciplinary research (**WP5**). This program will include hands-on workshops, mentorship opportunities, and collaborative projects that encourage knowledge exchange among participants. By fostering a culture of collaboration and innovation, we aim to create a new generation of scientists who are well-versed in multiple disciplines and capable of addressing complex scientific challenges. Moreover, extended secondments will enable senior staff members to assume leadership roles in managing international collaborations that necessitate ongoing presence at laboratories in Canada, Australia and South Africa. The project will facilitate the integration of the future PAUL laboratory with leading global laboratories and experiments, enhancing the academic landscape in Africa and fostering the development of new human resources and innovative research technologies. **By integrating African research efforts** into the global framework, we will enhance opportunities for specialized training in advanced instrumentation, computational techniques, and machine learning. These competencies are increasingly sought after in both academia and industry, ensuring that early-career researchers are well-prepared to meet the demands of a rapidly evolving scientific landscape. **It is also for Europe be an opportunity to establish contacts and prepare collaborations for future experiments in the future facility in South Africa.**

2.3 Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and exploitation plan, including communication activities

2.3.1 Plan for the dissemination and exploitation activities, including communication activities

In the initial phase, i.e., first 1.5 years, our focus will be on raising awareness of the unique capabilities and discoveries of underground laboratories through science perception studies. These studies will help us understand how the public perceives underground science, enabling us to communicate more effectively and foster trust and social dialogue.

To measure the efficiency of this initial phase, the following indicators will be used: two questionnaires to assess the public awareness and level of knowledge on NEXUS topics; at least 50 scientific publications and at least 10 dissemination articles; at least 10,000 visitors on the NEXUS website and at least 1,000 followers on social networks; 3 newsletters (2/year) will be published; at least 20 conferences/events organized or participated in; at least 5,000 participating in science day or other events related to NEXUS.

The initial phase will be followed by a consolidation phase aiming to build on the awareness and engagement generated during the initial phase and transition towards deeper involvement and sustained impact. It will focus on strengthening collaborations with key stakeholders, expanding outreach efforts, and ensuring the long-term visibility of underground science. Additionally, this phase will emphasize capacity-building activities, fostering a community of informed advocates, and integrating underground science more firmly into public discourse and educational frameworks. The overall numbers of indicators from the initial phase will increase by at least a factor of 3. This means achieving at least 150 scientific publications and 30 dissemination articles; a minimum of 30,000 visitors on the NEXUS website and 3,000 followers on social networks; at least 9 newsletters (2/year) published; a minimum of 60 conferences/events organized or participated in; and at least 15,000 participants in science day or other events related to NEXUS. Final questionnaire to assess the public awareness and knowledge of NEXUS topics.

We will draw inspiration from leading institutions like CERN, CNRS, ARC, LSC, and LNGS[20], which have established successful outreach strategies, including websites, brochures, and multimedia content. To enhance our communication, we plan to publish outcomes in peer-reviewed journals, ensuring open access, and encourage joint publications within the consortium. We will also be present at international conferences and host master-classes for undergraduate students to engage the scientific community. Additionally, we will organize workshops for stakeholders and a biennial conference to showcase project progress, featuring presentations from early-stage researchers (ESRs). Our project website will outline the mission, vision, research, and training details, providing comprehensive information and enhancing visibility with webinars and an infographic. A periodic newsletter will communicate updates to stakeholders, while social media platforms will share real-time project news, linking to the website for more information.

Furthermore, we will collaborate with local partners to host science days and STEM initiatives, such as public open days, workshops, and events like the International Underground Science Festival and International Dark Matter Day[21], aimed at engaging local communities, high school students, and the general public. Our communication team will actively engage with local schools to develop tailored programs that inspire students to pursue careers in STEM fields, as well as create online activities like virtual lab tours to expand our reach beyond geographical boundaries. By integrating these strategies with our public perception studies, we aim to effectively communicate our research, engage diverse audiences, and inspire the next generation of scientists.

2.3.2 Strategy for the management of intellectual property, foreseen protection measures

The project aims to generate concrete impact by generating new knowledge and developing innovative applications. **Open science** is a fundamental principle of the project, and it considers the exploitation of project-related results and assets, both within and beyond the consortium, for academic and commercial purposes, as a measure of impact. Proper acknowledgement of project funding and results usage, in a machine-readable format, is promoted to track impact and demonstrate return-on-investment to funders, such as the EU and national/international entities.

IPR management follows international good practices, prioritising the interests of inventors. All parties involved respect the confidentiality of each other's technical and commercial information. The leading scientists of all participants have extensive international connections and expertise to effectively disseminate and exploit the results in both industry and research communities. They will identify patentable results and protect them as necessary. Guidelines will be developed in **WP6** in order to set common practices in regard with funding acknowledgement, results usage, IPR and Open Science. Details on exploitation strategy, ownership and protection of results as well as transfer and licensing will be discussed among the parties and agreed upon in the Consortium Agreement in line with the provisions of the Grant Agreement.

2.4 The magnitude and importance of the project's contribution to the expected scientific, societal and economic impacts

2.4.1 Expected scientific impact(s)

Scientific and technological aspects: quantum computing

Quantum technologies are the future in many fields of research and industry, including communications, computing, simulation and sensing. Deep underground laboratories can be a good environment for the studies of quantum computing. The aim is to understand the effects of cosmic rays and reduce errors in quantum information bits (qubits, analogous to the bits in today's computers) caused by interaction with high-energy particles (**WP4**). The development of quantum detectors using the technology of quantum superconducting circuits represents a unique combination of equipment experienced in cubits and in low-background sensing necessary for the development of high-quality quantum sensors.

[20] DM@CERN: https://home.cern/science/physics/dark-matter, ILE : http://ile.in2p3.fr, ARC: https 2024 Open days@LSC: https://lsc-canfranc.es/en/open-day-2024/, LNGS outreach activities: https://www.lngs.infn.it/en/outreach-activities.
[21] IDMD: https://www.interactions.org/dark-matter-day

Societal and economical aspects: radiobiology and environment

Radiobiology and environmental radioactivity which are related to low background measurements of this project (**WP1)** is a crucial tool for a**bsolute dating of sediment and ice cores**. In addition, radioactivity measurements contribute to the **understanding of the mechanisms of the on-going climate warming**, which is one of the major scientific issues for the 21st century. The underground laboratory can also provide new insight on environmental topics. In glaciology, the study of ice samples from the Arctic, Antarctic etc. allows mapping of the evolution of climatic parameters and contamination both in space and over time for the last centuries. The measurement of ^{137}Cs and ^{241}Am is the only way to get a precise dating of ice samples and has to be done in underground laboratories[22]. The high accuracy in the radioactivity measurements gives the opportunity to study human impact on the environment with temporal resolutions from seasons to one year. The lack of data on environmental monitoring with high temporal resolution over the last several hundred years, makes these **studies of paramount importance**.

3. Quality and Efficiency of the Implementation

3.1 Quality and effectiveness of the work plan, assessment of risks and appropriateness of the effort assigned to work packages

3.1.1 Consistency and adequacy of the work plan and the activities

The NEXUS project is organised in **6 work-packages** which complement each other's and are designed to reach the various project objectives. The first 4 WPs (1.1.2) are built upon the core activities of the underground laboratories: fighting the source of background, establishing radiopure materials and designing detectors for low-level radioactivity measurements (WP1), characterizing the environment of the lab or the experiment or the instrumentation (WP2), performing simulations to study the muon background to cite a few, establishing theoretical models for DM search (WP3), using quantum sensing to reach better sensitivity for DM search(WP4). Such activities need to be developed in parallel and involve all partners. These four WPs build up synergies and exchange specific knowledge.
Knowledge transfer, training, outreach and dissemination activities of the project are considered part of the research process and are actually developed in close connection with each WP. Management activity is included in WP6. Each work package has a very clear work plan, depending on the agreed schedules and reasonable expectations in each of the quickly evolving fields.

3.1.2 Credibility and feasibility of the secondments proposed

The credibility of the project research activities is first ensured by the fact that they are all part of well-defined research programs, and they are carried on by experienced and reputed research groups. Moreover, well renown and experienced researchers are in charge to coordinate the WPs and for the accomplishment of each task, as described in the various WP summary tables. Finally, none of the project objectives and deliverable is manifestly not reachable on the basis of the present activity status, nor it is missing the essential infrastructure and instrumentation. Few risks connected to external factors are described in part A and mitigation measures are discussed.

Feasibility of the networking and transfer of knowledge activities is ensured first of all by the previous experiences of the consortium members, used to collaborate already inside their experimental collaborations, and trained also to cross collaborate and fertilize each other's. The proponents have a strong track-record in successfully managing and achieving the milestones in similar projects.

The network includes six major world-class underground research facilities, LNGS, LSC, LSM, SNOLAB, SURF and UKRI/Boulby, a number of National Institutes of Research in Europe (INFN, CNRS), several world class universities (UoM and UoA in Australia and SU, UWC, Wits and UNISA in South Africa) and an international organization, SKA. The available expertise abundantly covers all the involved areas of nuclear, particle, astoparticles, cosmology and their involved technologies. The project will involve about sixty researchers and technical staff from the European Institutions and the associated partners that will execute secondments and hosting at the facilities and research laboratories in Australia, Canada, Europe, South-Africa and USA.

[22] Chuxian Li et al., Journal of Environmental Radioactivity Volumes 175–176, September 2017, Pages 164-169

Consortium structure

The NEXUS project will be managed according to robust principles with a Management Board **(MB)** at the heart of a small set of teams, including the WP coordinators that are dedicated to successful management of key areas such as research, training and quality control. The MB will hold executive power to make all decisions relating to the successful completion of the project. It will clearly define the goals at the outset, interface with an Executive Board **(EB)**, which is able to make simpler day-to-day decisions, and use a Scientific and Ethics Advisory Board **(SEAB)** and Project Support Team. Project Coordinator, advised by the EB and SEAB, will coordinate the project and (i) be responsible for the legal, contractual, ethical, financial and administrative management; (ii) act as intermediary between the Consortium and the Commission; (iii) receive all payments made by the Commission and ensure that appropriate payments are made to partners; (iv) keep accounts and inform the Commission as requested.

The scientific coordination

The NEXUS project is led by experienced scientists:

- Dr. Fairouz Malek, is the project manager (PM), also coordinating WP6. She is a CNRS Research Director and has long term research experience in international collaborations (LEAR and SPS experiments, AMS experiment in space, ATLAS experiment at CERN/LHC and South-Africa PAUL project co-founder). She has been team leader of the Grenoble group on ATLAS experiment and led the construction of the pre-sampler of the electromagnetic calorimeter. She has served as Scientific leader of the National infrastructure LCG (LHC computing GRID) for ten years. She is fellow of the African Academy of Sciences and served at the IUPAP and the European Physical Society committees, physics for development groups.
- Dr Silvia Scorza is a CNRS Research Director and the scientific director of the LSM. She is an expert in ultra-low background measurements and she will coordinate the WP1. Her interest in using novel, cross-discipline techniques to better understand the most puzzling questions in astrophysics and particle physics has led her to conduct research in the field of dark matter and neutrino within the EDELWEISS, the CDMS, the SuperCDMS Soudan/SNOLAB, the Ricochet and the TESSERACT experiments.
- Dr Nicola D'Ambrosio is Technology Director and responsible of the electronic workshop at LNGS. He has a long research experience in international collaboration (OPERA, CHORUS and SND at CERN, Collaboration with University of Nagoya, ...) as well as in technology transfer project like Muography of volcanos and underground cavity. He will coordinate the WP2.
- Prof. Mantile Leslie Lekala is a theoretical physicist. His expertise includes application of few-body physics methods to many-body systems such as Bose-Einstein condensates, and to nuclear and particle physics systems to investigate aspects of Standard Model and beyond, including Dark Matter. He is a member of International Advisory Committees of scientific conferences such the European Conferences on Few-Body Problems in Physics, and IUPAP International Conferences on Few-Body Problems in Physics, among others. He is currently the Director of School of Science at UNISA. He will coordinate WP3.
- Dr Jeter Hall is the Director of Research at SNOLAB in Canada and the coordinator of WP4. He leads a research group that coordinates with international users on many projects including dark matter searches, neutrino studies, and quantum sensors and computing. He has spent over 15 years in deep underground research and is leading the emerging effort to test and evaluate quantum sensors and computers in underground environments to understand the impact of ionizing radiation on these new devices. He has authored over 40 articles and given over 50 presentations on dark matter searches and underground scientific endeavours.
- Dr Catalina Curceanu is a Research Director at the National Laboratories of Frascati (INFN), Italy. She leads a team conducting advanced research in nuclear and quantum physics and is the spokesperson for the SIDDHARTA-2 and VIP-2 collaborations. An expert in nuclear and particle physics and quantum foundations, she has authored over 500 scientific articles, given over 50 invited talks, and actively promotes scientific outreach. She coordinates multiple European and

international projects and has received prestigious awards, including the 2017 Emmy Noether Prize and the 2019 Fundamental Physics Innovation Award. In 2018, she was honoured with the Order of Cultural Merit by the President of Romania. She conducts the WP5.

The secondments

The secondments have been allocated by matching research expertise and interests. Some secondments will focus on setting up the large simulations, addressing problems such as the coding of the physics, convergence testing, scalability and generation of initial conditions. The remaining secondments focus on tackling the problem of low radioactivity background, fast neutrons, radon-free lab objective etc. The person months are counted in terms of the institution of origin of the seconded researcher, as required. Note that associated partners as well as EU partners are hosting secondments and will also contribute to the WPs through mentor and supervisor time (in-kind); this contribution is not explicitly listed in the WP descriptions but is recorded by the PM. The proposed secondments are necessary, their duration is appropriate to the needs and the staff profiles are suitable to implement the activities described.

3.2 Quality, capacity and role of each participant, including hosting arrangements and extent to which the consortium as a whole brings together the necessary expertise

ULs have many common features and at the same time they also have different specific characteristics (e.g., varying depths, geological compositions, laboratory sizes, access capabilities and support services provided) that make them more or less suitable for specific activities. For example, Boulby in the UK has surrounding geology that results in a particularly low ambient radon level underground; Canfranc in Spain has access to sites at different depths allowing studies with a different muons background level; SNOLAB in Canada is very deep with a significant reduction of the locally muon-induced background. The muon flux changes depending on the surface landscape, thus under a mountain the flux can have a strong dependence on zenith and azimuth angles.

ULs support research can provide: **(i)** effective radiation shielding; **(ii)** above ground and underground support facilities, such as clean rooms and radon-free clean rooms, radio-purity assay equipment (a key technology for rare events research[23]), cryogenic equipment; **(iii)** material production and purification facilities [24; **(iv)** very high specialized equipment of high-purity germanium detectors (HPGe) for gamma spectroscopy which provide a unique material screening capability for the present and next-generation experiments [and **(v)** a unique environment for multi-disciplinary research. **All these supportive efforts, technological tools and services** are being made to push further the sensitivity of instruments to face new challenges for DM and neutrinoless double β decay research.

European beneficiaries within the consortium have a noteworthy track record of successfully delivering significant projects. They have also managed nationally and internationally funded initiatives, providing services, techniques, building advanced instrumentation. One of the anticipated impacts of the project is to expand the network to include for the first time an African country in this type of calls and extend the existing underground laboratories networking beyond Europe. The consortium plans to utilise existing dissemination channels to ensure that project outputs, especially the software, the techniques, the tools and the output of the R&D and innovation are adopted by all stakeholders, including those not directly involved in the project. This will involve establishing a presence in meetings, internal webinars, and workshops organised by the connected initiatives. It is important to note that there are no companies involved as beneficiaries in the consortium. However, specific activities in WP1, WP2 as well as WP4 will engage with industry and SMEs.

For the European, the host Institutions in Australia, Canada, South Africa and USA will provide onsite housing for rent to visitors and users, with family friendly conditions, which will be useful for the long-term secondments. For the associated partners eligible for secondments (e.g., South-Africa), they will be hosted at the European research laboratories and facilities which will provide world-class tools, experiment and facilities and equipment and computing facilities to pursue their work and get skills and

[23] M. Laubenstein and I. Lawson, Front. Phys. 8, 577734 (2020), doi :10.3389/fphy.2020.577734.
[24] A. Ianni, Int. J. Mod. Phys. A 32,1743001 (2017), doi:10.1142/S0217751X17430011.

experience to build their astropartcile community and helping them to build the future underground facility in Africa.

3.2.1 Appropriateness of the research infrastructure and capacity of each participating organisation

All the members of the consortium are well-known and reputed research institutions in nuclear, particle and astroparticle physics. They all hold several high-level technological infrastructures and top-level competences in detector technology and data analysis, as described for each of them in the relevant capacity table in Part-B2. There are no doubts that such a consortium holds the appropriate environment to accomplish the activities proposed. We will briefly summarize few key points:

CNRS The six CNRS institutions involved in this project are high-standard research laboratories performing large experiments all over the world in many domains and more specifically in astroparticles and cosmology. In addition, the national platform **LSM** is home of dark matter and neutrinoless double β-decay experiments since more than 15 years (SUPER Nemo, EDLWEISS) and is preparing the infrastructure to host next generation experiments such as TESSERACT and DAMIC-M as well as low radioactivity measurements related to this project. With 14 HPGe detectors, LSM has the largest deep underground facility for low-background gamma-ray spectrometry in the world. This expertise turns out to be extremely useful for environmental studies for example.

INFN is a public research institution. It gave important contribution to all the major particle and nuclear physics measurements and discoveries. **LNGS**, the Gran Sasso National Laboratory in Italy, is the largest deep underground scientific laboratory in Europe. Experiments on dark matter, neutrinoless double β-decay, nuclear astrophysics, geophysics, and biology are in operation. The facility includes a large radio-purity assay infrastructure underground, an ICP-MS laboratory on surface, an advance machining infrastructure, a 400 m^2 ISO-6 clean room for SiPM based photodetectors assembly.

LSC in Spain is the second largest deep underground scientific laboratory in Europe. It is running many facilities and infrastructures such and ESA equipment to explore life in microgravity underground, a clean room underground, the most sensitive mass spectrometer in Uranium(2ppq) and a high-performance computing and storage system that has the ability to process data and perform complex calculations more than a million times faster than local systems.

UKRI, United Kingdom Research and Innovation, is the largest underground low radon environment located in the boulby mine, with a cleanliness level in class ISO7 and ISO6 (in a sector). Boulby has a very diversified scientific program from astroparticle physics to planetary exploration. Plans are being developed for an important enlargement of the underground laboratory starting in 2030.

SNOLAB is an international facility for underground science; The primary focus of the science program includes solar neutrinos, supernova neutrinos, neutrino-less double beta decay and dark matter searches. SNOLAB supports multiple projects covering these research fields, including various aspects of the dark matter interaction parameter space, and both neutrino source and intrinsic physics studies. Participants are expert in low background techniques and rare event searches. They are also expert in dark matter detectors, underground operations, and clean rooms, quantum sensing.

University of Melbourne (UoM) administrates the "ARC Centre for excellence for Dark matter particle physics". The Centre constructs and operates state-of-the-art experiments to directly detect dark matter in Australia. These experiments play an important role in international collaborations and will be conducted at the Stawell Underground Physics Laboratory (SUPL) and at the University of Western Australia (UWA). The director of the centre of excellence is also the Spokesperson of SABRE South Collaboration a flagship experiment in the Southern Hemisphere.

The University of Adelaide (UoA) The University of Adelaide is a key node of the ARC Centre of Excellence for Dark Matter Particle Physics, actively contributing to the development of dark matter experiments at the Stawell Underground Physics Laboratory (SUPL). Adelaide is home to the ARC Special Research Centre for the Subatomic Structure of Matter (CSSM), where cutting-edge studies on rare events and quantum foundations are conducted, further enhancing the University's contributions to fundamental physics.

South-Africa research teams, PAUL and SKAO PAUL (Paarl Africa Underground Laboratory) is the unique African future UL, the second in the southern hemisphere after SUPL (in Australia). It has been founded and supported by a consortium of South-African universities and organizations, among them the participants to this project are: **SU**, **UWC**, **WITS**, **UNISA**, **SKA**O. The project will offer the unique possibility to integrate PAUL with the other worldwide top-level facilities, laboratories and experiments and increase the potential of the African region by increasing its research activities. It is also for Europe an opportunity to establish contacts and prepare collaborations for future experiments in South Africa. Participants from the different universities forming PAUL consortium have expertise in civil engineering, experimental nuclear and particle physics and its instrumentation, applied nuclear radiation detection, especially involving novel techniques of radon measurements.

The consortium

All partners have excellent outreach and communication expertise, and they organize many initiatives and events, both toward the general public and toward the scientific community. Moreover, they have professional and experienced administrative support for European research projects participation and management.

The anticipated success of this collaborative effort is grounded in the historical achievements of numerous international partnerships that have successfully executed experiments at prestigious facilities such as BOULBY(UKRI), LNGS, LSC, LSM and SNOLAB. Not to forget to mention ARC excellence centre for DM research in Australia ([17]) and the PAUL project in South-Africa. For example, one of the senior research participants from CNRS, Sara Diglio, contributed to the creation of an International Emerging Actions (**IEA**) project between the **CNRS and Melbourne University** focused on neutrino and dark matter physics. This IEA has been extended into an International Research Project (**IRP**) between **CNRS and Australia** for which she is the French PI and Elisabetta Barberio, the principal partner from UoM, is the Australian [one25]. This collaboration now includes CNRS SUBATECH and LPNHE laboratories, Melbourne University, and Sydney University, they count **four PhD students jointly supervised** by the French and Australian members participating to the project. The main aim of this project is the preparation of the playground for the next generation XLZD experiment via data analysis of the current running XENONnT experiment and R&D activities. Also, **CNRS** has now established an International Research Network **(IRN)** with **six South African universities** and institutions participating to the **PAUL** project, IRN **PAULINE**[16]) and the PI of this project, Fairouz Malek, is the director of that IRN. It counts already **one PhD student co-supervised** by **SU** and **LPSC** at LSM on the neutrons measurements (WP2).

3.2.2 Consortium composition and exploitation of participating organisations' complementarities

Participants have designed breakthrough physics experiments, are world leaders in detector development and operation and have sophisticated skills in many aspects of the research, computing and data analysis, theory, engineering etc. We will exploit the available competences and resources to ensure the scientific achievements of the network are enhanced with respect to the sum of the individual institutions. Synergy between the EU Institutions, USA, Canada, Australia and South-Africa (see section 3.2.1) is already well established. The laboratories provide the infrastructures and the long-standing experience in managing large experimental projects involving many detector subsystems assembled into one single experiment, the local technical support of infrastructure/instrumentation/R&D, technical and computing divisions, which are fundamental in commissioning and operating the experiments. The European Institutions have provided leading contribution to the design and construction of the experiments and will take leading roles in detector operation, data taking and analysis. The European Institutions also have strong theoretical physics groups that will greatly contribute to data analysis and interpretation also in tight collaboration with the theoretical divisions at the laboratories in South-Africa.

Table 1 – Data for non-academic beneficiaries

Not applicable, the project does not involve non-academic beneficiaries.

[25] https://melbourne.office.cnrs.fr/wp-content/uploads/2024/09/cnrs_booklet_oceanie_2024.pdf (page 26)

Table 2 - Secondments allocated to Associated Partners linked to a beneficiary

WP	Task name	Staff member profile (ER/ESR/MNG/ ADM/TECH)	Beneficiary /Partner organisation short name	Associated partner linked to a beneficiary short name	Country of the Associated partner linked to a beneficiary	Person-months allocated
WP1	T1.1	ER	CNRS	IMTA	France	1
WP1	T1.1	TECH	CNRS	IMTA	France	0.5
WP1	T1.1	ESR	CNRS	IMTA	France	0.5
WP1	T1.1	ER	CNRS	US	France	2
WP2	T2.2	ER	CNRS	UCB	France	2.5
WP2	T2.3	ER	CNRS	UCB	France	0.5
WP2	T2.4-2.6	ESR	CNRS	UGA	France	1
WP5	All tasks	ER	CNRS	US	France	0.5
WP5	All tasks	ER	CNRS	IMTA	France	1.25
WP5	All tasks	ESR	CNRS	IMTA	France	0.5
WP5	All tasks	TECH	CNRS	IMTA	France	0.5

4. Ethics Issues

The NEXUS project involves non-EU countries, namely Australia, Canada, South Africa, and the United States. Staff from EU laboratories will be seconded to these countries and vice versa to implement the project. Engaging laboratories at the international level is essential for advancing research in particle physics, as each partner contributes unique facilities and expertise.

European laboratories will benefit from NEXUS activities as follows:

- from Canada: Expertise in quantum sensing to enhance detection capabilities.
- from South Africa: Advancements in theory, simulation, and machine learning to refine analytical models.
- from Australia & North America: Access to underground laboratories with distinct geological conditions, advantageous for low-background experiments.

As this project focuses on fundamental physics, no industrial or economic risks have been identified. Additionally, the planned actions will benefit South African partners, who are actively involved in developing a new underground facility. Through secondments, training, and shared instrumentation, staff—particularly early-career researchers—will strengthen their expertise and expand their technical skills. Best practices established in Europe and Australia will serve as a reference for the design and operation of this new facility. In return, this underground laboratory will provide EU researchers with the opportunity to conduct experiments under diverse environmental conditions, that may not be available in existing European underground sites, further advancing scientific progress, putting Europe in forefront of scientific research worldwide.

The NEXUS collaboration presents a valuable opportunity to leverage complementary expertise and infrastructures, fostering progress in fundamental physics research while also driving technological innovations with potential applications in industry and for society, such as advancements in radiation detection, data processing, and quantum sensing.
By combining expertise, sharing infrastructures, and fostering long-term collaborations, the NEXUS project will drive advancements in fundamental physics while strengthening global scientific ties. Additionally, the project's innovations in ultra-sensitive detection, low-radiation technologies, and

machine learning will have broader applications in medical imaging, environmental monitoring, and high-tech industries, ensuring that its impact extends beyond academia.

Project NEXUS will be managed in compliance with ethical principles and applicable international, EU and national law in the implementation of research and innovation activities. Any ethical concerns raised by those activities will be handled following rigorously the recommendations provided in the European Commission Ethics Self-Assessment Guidelines.

ANNEX 2

ESTIMATED BUDGET FOR THE ACTION

Forms of funding	Estimated EU contribution					
	Estimated eligible unit contributions (per budget category)				Total	Maximum grant amount[1]
	A. Contributions for seconded staff members		B. Institutional contributions			
	A.1 Top - up allowance	A.5 Special needs allowance	B.1 Research, training and networking contribution	B.2 Management and indirect contribution		
	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	Unit contribution[2]	h = a + e + f + g	i
	a	e	f	g		
1 - CNRS	178 860.00	0.00	85 800.00	66 000.00	330 660.00	330 660.00
2 - INFN	233 060.00	0.00	111 800.00	86 000.00	430 860.00	430 860.00
3 - SKAO	5 420.00	0.00	2 600.00	2 000.00	10 020.00	10 020.00
4 - UKRI						
5 - LSC						
6 - SU						
7 - SURF						
8 - UoA						
9 - UoM						
10 - UNISA						
11 - UWC						
12 - WITS						
13 - SNOLAB						
14 - UCB						
15 - US						
16 - IMTA						
17 - UGA						
Σ consortium	417 340.00	0.00	200 200.00	154 000.00	771 540.00	771 540.00

[1] The 'maximum grant amount' is the maximum grant amount fixed in the grant agreement (on the basis of the sum of the beneficiaries' estimated units).
[2] See Annex 2a 'Additional information on the estimated budget' for the details (units, amount per unit).

ANNEX 2a

ADDITIONAL INFORMATION ON UNIT COSTS AND CONTRIBUTIONS

HE MSCA Doctoral Networks/Post-doctoral Fellowships and HE ERA fellowships

See Additional information on unit costs and contributions (Annex 2a and 2b)

HE MSCA Staff Exchanges

See Additional information on unit costs and contributions (Annex 2a and 2b)

HE MSCA COFUND

See Additional information on unit costs and contributions (Annex 2a and 2b)

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ISTITUTO NAZIONALE DI FISICA NUCLEARE (INFN), PIC 999992789, established in Via Enrico Fermi 54, FRASCATI 00044, Italy,

hereby agrees

to become beneficiary

in Agreement No 101236929 — NEXUS ('the Agreement')

between CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS) **and** the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Ezio PREVITALI with ECAS id npreviez signed in the Participant Portal on 18/09/2025 at 12:29:57 (transaction id SigId-13957-bukAYVzwahkshopf0tD5sMyFBXxm7e2QXcylUGjtfzhzvUpZZu0zKFuO8tIuEbarzxEQoly5tNMALqObsdo3w2b-rS0vSrmBGYCYd4RFSyCJhe-2MRUvkE5VyuthzlNrD3lBIos7M0eYV4LnstORKQ7AuAGtM7oyzWqDaZVbKgBntAwaAUcWGSXUGpOwT41aJknHC). Timestamp by third party at 2025.09.18 12:30:02 CEST

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

THE SQUARE KILOMETRE ARRAY OBSERVATORY (SKAO), PIC 890491041, established in JODRELL BANK, MACCLESFIELD SK11 9FT, United Kingdom,

hereby agrees

to become beneficiary

in Agreement No 101236929 — NEXUS ('the Agreement')

between CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS) **and** the **European Research Executive Agency (REA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

Colin GREENWOOD with ECAS id n007h8d4 signed in the Participant Portal on 04/09/2025 at 23:45:07 (transaction id SigId-594-0gykiczjE CkV9lC9zOiYUiA9O3ZBd9J3cRP1LefzQCG1I1L2bYlpTzuUzYpOInPiHl 8uIzWWKvjkRNgPxzb6StiG-R2zIpfT8xjM4irqDme64tu-aMAMRBqDo 05sPmFVx0g8KH7nBPXgJP2XFZazyEXsivOlhzyTYXrf2PZZ5CebhPATO xcx239mnEIrrPatrjjiRo). Timestamp by third party at 2025.09.04 23:45:12 CEST

ANNEX 4 HORIZON EUROPE MSCA UNIT MGA — MULTI + MONO

FINANCIAL STATEMENT FOR [PARTICIPANT NAME] FOR REPORTING PERIOD [NUMBER]

	EU contribution								
	Eligible unit contributions (per budget category)								**Requested EU contribution**
	[OPTION for all MSCA ToA except COFUND: **A. . Contributions for** *[* **recruited researchers***]* *[* **seconded staff members***]][OPTION for COFUND:* **A. COFUND contributions***]*					*[OPTION for all MSCA ToA except COFUND:* **B. Institutional contributions***]*		**Total**	
	[OPTION for DN and PF : A.1 Living allowance*]* *[OPTION for SE:* A.1 Top - up allowance*]* *[OPTION for COFUND:* A.1 COFUND allowance*]*	*[OPTION for DN and PF:* A.2 Mobility allowance*]*	*[OPTION for DN and PF:* A.3 Family allowance*]*	*[OPTION for all MSCA ToA except SE:* A.4 Long-term leave allowance*]*	A.5 Special needs allowance	*[* B.1 Research, training and networking contribution*]*	*[* B.2 Management and indirect contribution*]*		
Forms of funding	Unit contribution[1]	*[* Unit contribution[1] *]*	*[* Unit contribution[1] *]*	*[* Unit contribution[1] *]*	Unit contribution[1]	*[* Unit contribution[1] *]*	*[* Unit contribution[1] *]*	h = a *[* + b *][* + c*]* *[* + d*]* + e *[* + f*]* *[* + g*]*	i
	a	*[* b*]*	*[* c*]*	*[* d*]*	e	*[* f*]*	*[* g*]*		
XX – [short name beneficiary/affiliated entity]									

The beneficiary/affiliated entity hereby confirms that:

The information provided is complete, reliable and true.

The unit contributions declared are eligible (see Article 6).

The contributions can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 19, 20 and 25).

[1] See Annex 2a 'Additional information on the estimated budget' for the details (units, amount per unit).

ANNEX 5

SPECIFIC RULES

CONFIDENTIALITY AND SECURITY (— ARTICLE 13)

Sensitive information with security recommendation

Sensitive information with a security recommendation must comply with the additional requirements imposed by the granting authority.

Before starting the action tasks concerned, the beneficiaries must have obtained all approvals or other mandatory documents needed for implementing the task. The documents must be kept on file and be submitted upon request by the coordinator to the granting authority. If they are not in English, they must be submitted together with an English summary.

For requirements restricting disclosure or dissemination, the information must be handled in accordance with the recommendation and may be disclosed or disseminated only after written approval from the granting authority.

EU classified information

If EU classified information is used or generated by the action, it must be treated in accordance with the security classification guide (SCG) and security aspect letter (SAL) set out in Annex 1 and Decision 2015/444[1] and its implementing rules — until it is declassified.

Deliverables which contain EU classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving EU classified information may be subcontracted only with prior explicit written approval from the granting authority and only to entities established in an EU Member State or in a non-EU country with a security of information agreement with the EU (or an administrative arrangement with the Commission).

EU classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

ETHICS (— ARTICLE 14)

Ethics and research integrity

The beneficiaries must carry out the action in compliance with:

- ethical principles (including the highest standards of research integrity)

[1] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

and

- applicable EU, international and national law, including the EU Charter of Fundamental Rights and the European Convention for the Protection of Human Rights and Fundamental Freedoms and its Supplementary Protocols.

No funding can be granted, within or outside the EU, for activities that are prohibited in all Member States. No funding can be granted in a Member State for an activity which is forbidden in that Member State.

The beneficiaries must pay particular attention to the principle of proportionality, the right to privacy, the right to the protection of personal data, the right to the physical and mental integrity of persons, the right to non-discrimination, the need to ensure protection of the environment and high levels of human health protection.

The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiaries must ensure that the activities under the action do not:

- aim at human cloning for reproductive purposes
- intend to modify the genetic heritage of human beings which could make such modifications heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed)
- intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer, or
- lead to the destruction of human embryos (for example, for obtaining stem cells).

Activities involving research on human embryos or human embryonic stem cells may be carried out only if:

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the granting authority.

In addition, the beneficiaries must respect the fundamental principle of research integrity — as set out in the European Code of Conduct for Research Integrity[2].

This implies compliance with the following principles:

- reliability in ensuring the quality of research reflected in the design, the methodology, the analysis and the use of resources
- honesty in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair and unbiased way

[2] European Code of Conduct for Research Integrity of ALLEA (All European Academies).

- respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment

- accountability for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts

and means that beneficiaries must ensure that persons carrying out research tasks follow the good research practices including ensuring, where possible, openness, reproducibility and traceability and refrain from the research integrity violations described in the Code.

Activities raising ethical issues must comply with the additional requirements formulated by the ethics panels (including after checks, reviews or audits; see Article 25).

Before starting an action task raising ethical issues, the beneficiaries must have obtained all approvals or other mandatory documents needed for implementing the task, notably from any (national or local) ethics committee or other bodies such as data protection authorities.

The documents must be kept on file and be submitted upon request by the coordinator to the granting authority. If they are not in English, they must be submitted together with an English summary, which shows that the documents cover the action tasks in question and includes the conclusions of the committee or authority concerned (if any).

VALUES (— ARTICLE 14)

Gender mainstreaming

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action and, where applicable, in line with the gender equality plan. They must aim, to the extent possible, for a gender balance at all levels of personnel assigned to the action, including at supervisory and managerial level.

INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS — ACCESS RIGHTS AND RIGHTS OF USE (— ARTICLE 16)

Definitions

Access rights — Rights to use results or background.

Dissemination — The public disclosure of the results by appropriate means, other than resulting from protecting or exploiting the results, including by scientific publications in any medium.

Exploit(ation) — The use of results in further research and innovation activities other than those covered by the action concerned, including among other things, commercial exploitation such as developing, creating, manufacturing and marketing a product or process, creating and providing a service, or in standardisation activities.

Fair and reasonable conditions — Appropriate conditions, including possible financial terms or royalty-free conditions, taking into account the specific circumstances of the request for access, for example the actual or potential value of the results or background to which access is requested and/or the scope, duration or other characteristics of the exploitation envisaged.

FAIR principles — ‘findability’, ‘accessibility’, ‘interoperability’ and ‘reusability’.

Open access — Online access to research outputs provided free of charge to the end-user.

Open science — An approach to the scientific process based on open cooperative work, tools and diffusing knowledge.

Research data management — The process within the research lifecycle that includes the organisation, storage, preservation, security, quality assurance, allocation of persistent identifiers (PIDs) and rules and procedures for sharing of data including licensing.

Research outputs — Results to which access can be given in the form of scientific publications, data or other engineered results and processes such as software, algorithms, protocols, models, workflows and electronic notebooks.

Scope of the obligations

For this section, references to ‘beneficiary’ or ‘beneficiaries’ do not include affiliated entities (if any).

Agreement on background — Background free from restrictions

The beneficiaries must identify in a written agreement the background as needed for implementing the action or for exploiting its results.

Where the call conditions restrict control due to strategic interests reasons, background that is subject to control or other restrictions by a country (or entity from a country) which is not one of the eligible countries or target countries set out in the call conditions and that impact the exploitation of the results (i.e. would make the exploitation of the results subject to control or restrictions) must not be used and must be explicitly excluded in the agreement on background — unless otherwise agreed with the granting authority.

Results free from restrictions

Where the call conditions restrict control due to strategic interests reasons, the beneficiaries must ensure that the results of the action are not subject to control or other restrictions by a country (or entity from a country) which is not one of the eligible countries or target countries set out in the call conditions — unless otherwise agreed with the granting authority.

Ownership of results

Results are owned by the beneficiaries that generate them.

However, two or more beneficiaries own results jointly if:

- they have jointly generated them and
- it is not possible to:
    - establish the respective contribution of each beneficiary, or
    - separate them for the purpose of applying for, obtaining or maintaining their protection.

The joint owners must agree — in writing — on the allocation and terms of exercise of their joint ownership ('joint ownership agreement'), to ensure compliance with their obligations under this Agreement.

Unless otherwise agreed in the joint ownership agreement or consortium agreement, each joint owner may grant non-exclusive licences to third parties to exploit the jointly-owned results (without any right to sub-license), if the other joint owners are given:

- at least 45 days advance notice and
- fair and reasonable compensation.

The joint owners may agree — in writing — to apply another regime than joint ownership.

If third parties (including employees and other personnel) may claim rights to the results, the beneficiary concerned must ensure that those rights can be exercised in a manner compatible with its obligations under the Agreement.

The beneficiaries must indicate the owner(s) of the results (results ownership list) in the final periodic report.

Protection of results

Beneficiaries which have received funding under the grant must adequately protect their results — for an appropriate period and with appropriate territorial coverage — if protection is possible and justified, taking into account all relevant considerations, including the prospects for commercial exploitation, the legitimate interests of the other beneficiaries and any other legitimate interests.

Exploitation of results

Beneficiaries which have received funding under the grant must — up to four years after the end of the action (see Data Sheet, Point 1) — use their best efforts to exploit their results directly or to have them exploited indirectly by another entity, in particular through transfer or licensing.

If, despite a beneficiary's best efforts, the results are not exploited within one year after the end of the action, the beneficiaries must (unless otherwise agreed in writing with the granting authority) use the Horizon Results Platform to find interested parties to exploit the results.

If results are incorporated in a standard, the beneficiaries must (unless otherwise agreed with the granting authority or unless it is impossible) ask the standardisation body to include the funding statement (see Article 17) in (information related to) the standard.

Additional exploitation obligations

Where the call conditions impose additional exploitation obligations (including obligations linked to the restriction of participation or control due to strategic assets, interests, autonomy or security reasons), the beneficiaries must comply with them — up to four years after the end of the action (see Data Sheet, Point 1).

Where the call conditions impose additional exploitation obligations in case of a public emergency, the beneficiaries must (if requested by the granting authority) grant for a limited period of time specified in the request, non-exclusive licences — under fair and reasonable

conditions — to their results to legal entities that need the results to address the public emergency and commit to rapidly and broadly exploit the resulting products and services at fair and reasonable conditions. This provision applies up to four years after the end of the action (see Data Sheet, Point 1).

Additional information obligation relating to standards

Where the call conditions impose additional information obligations relating to possible standardisation, the beneficiaries must — up to four years after the end of the action (see Data Sheet, Point 1) — inform the granting authority, if the results could reasonably be expected to contribute to European or international standards.

Transfer and licensing of results

Transfer of ownership

The beneficiaries may transfer ownership of their results, provided this does not affect compliance with their obligations under the Agreement.

The beneficiaries must ensure that their obligations under the Agreement regarding their results are passed on to the new owner and that this new owner has the obligation to pass them on in any subsequent transfer.

Moreover, they must inform the other beneficiaries with access rights of the transfer at least 45 days in advance (or less if agreed in writing), unless agreed otherwise in writing for specifically identified third parties including affiliated entities or unless impossible under the applicable law. This notification must include sufficient information on the new owner to enable the beneficiaries concerned to assess the effects on their access rights. The beneficiaries may object within 30 days of receiving notification (or less if agreed in writing), if they can show that the transfer would adversely affect their access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

Granting licences

The beneficiaries may grant licences to their results (or otherwise give the right to exploit them), including on an exclusive basis, provided this does not affect compliance with their obligations.

Exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights.

Granting authority right to object to transfers or licensing — Horizon Europe actions

Where the call conditions in Horizon Europe actions provide for the right to object to transfers or licensing, the granting authority may — up to four years after the end of the action (see Data Sheet, Point 1) — object to a transfer of ownership or the exclusive licensing of results, if:

- the beneficiaries which generated the results have received funding under the grant
- it is to a legal entity established in a non-EU country not associated with Horizon Europe, and

- the granting authority considers that the transfer or licence is not in line with EU interests.

Beneficiaries that intend to transfer ownership or grant an exclusive licence must formally notify the granting authority before the intended transfer or licensing takes place and:

- identify the specific results concerned
- describe in detail the new owner or licensee and the planned or potential exploitation of the results, and
- include a reasoned assessment of the likely impact of the transfer or licence on EU interests, in particular regarding competitiveness as well as consistency with ethical principles and security considerations.

The granting authority may request additional information.

If the granting authority decides to object to a transfer or exclusive licence, it must formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information it has requested).

No transfer or licensing may take place in the following cases:

- pending the granting authority decision, within the period set out above
- if the granting authority objects
- until the conditions are complied with, if the granting authority objection comes with conditions.

A beneficiary may formally notify a request to waive the right to object regarding intended transfers or grants to a specifically identified third party, if measures safeguarding EU interests are in place. If the granting authority agrees, it will formally notify the beneficiary concerned within 60 days of receiving notification (or any additional information requested).

Limitations to transfers and licensing due to strategic assets, interests, autonomy or security reasons of the EU and its Member States

Where the call conditions restrict participation or control due to strategic assets, interests, autonomy or security reasons, the beneficiaries may not transfer ownership of their results or grant licences to third parties which are established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) — unless they have requested and received prior approval by the granting authority.

The request must:

- identify the specific results concerned
- describe in detail the new owner or licensee and the planned or potential exploitation of the results, and
- include a reasoned assessment of the likely impact of the transfer or license on the strategic assets, interests, autonomy or security of the EU and its Member States.

The granting authority may request additional information.

Access rights to results and background

Exercise of access rights — Waiving of access rights — No sub-licensing

Requests to exercise access rights and the waiver of access rights must be in writing.

Unless agreed otherwise in writing with the beneficiary granting access, access rights do not include the right to sub-license.

If a beneficiary is no longer involved in the action, this does not affect its obligations to grant access.

If a beneficiary defaults on its obligations, the beneficiaries may agree that that beneficiary no longer has access rights.

Access rights for implementing the action

The beneficiaries must grant each other access — on a royalty-free basis — to background needed to implement their own tasks under the action, unless the beneficiary that holds the background has — before acceding to the Agreement —:

- informed the other beneficiaries that access to its background is subject to restrictions, or

- agreed with the other beneficiaries that access would not be on a royalty-free basis.

The beneficiaries must grant each other access — on a royalty-free basis — to results needed for implementing their own tasks under the action.

Access rights for exploiting the results

The beneficiaries must grant each other access — under fair and reasonable conditions — to results needed for exploiting their results.

The beneficiaries must grant each other access — under fair and reasonable conditions — to background needed for exploiting their results, unless the beneficiary that holds the background has — before acceding to the Agreement — informed the other beneficiaries that access to its background is subject to restrictions.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action (see Data Sheet, Point 1).

Access rights for entities under the same control

Unless agreed otherwise in writing by the beneficiaries, access to results and, subject to the restrictions referred to above (if any), background must also be granted — under fair and reasonable conditions — to entities that:

- are established in an EU Member State or Horizon Europe associated country

- are under the direct or indirect control of another beneficiary, or under the same direct or indirect control as that beneficiary, or directly or indirectly controlling that beneficiary and

- need the access to exploit the results of that beneficiary.

Unless agreed otherwise in writing, such requests for access must be made by the entity directly to the beneficiary concerned.

Requests for access must be made — unless agreed otherwise in writing — up to one year after the end of the action (see Data Sheet, Point 1).

Access rights for the granting authority, EU institutions, bodies, offices or agencies and national authorities to results for policy purposes — Horizon Europe actions

In Horizon Europe actions, the beneficiaries which have received funding under the grant must grant access to their results — on a royalty-free basis — to the granting authority, EU institutions, bodies, offices or agencies for developing, implementing and monitoring EU policies or programmes. Such access rights do not extend to beneficiaries' background.

Such access rights are limited to non-commercial and non-competitive use.

For actions under the cluster 'Civil Security for Society', such access rights also extend to national authorities of EU Member States for developing, implementing and monitoring their policies or programmes in this area. In this case, access is subject to a bilateral agreement to define specific conditions ensuring that:

- the access rights will be used only for the intended purpose and

- appropriate confidentiality obligations are in place.

Moreover, the requesting national authority or EU institution, body, office or agency (including the granting authority) must inform all other national authorities of such a request.

Additional access rights

Where the call conditions impose additional access rights, the beneficiaries must comply with them.

COMMUNICATION, DISSEMINATION, OPEN SCIENCE AND VISIBILITY (— ARTICLE 17)

Dissemination

Dissemination of results

The beneficiaries must disseminate their results as soon as feasible, in a publicly available format, subject to any restrictions due to the protection of intellectual property, security rules or legitimate interests.

A beneficiary that intends to disseminate its results must give at least 15 days advance notice to the other beneficiaries (unless agreed otherwise), together with sufficient information on the results it will disseminate.

Any other beneficiary may object within (unless agreed otherwise) 15 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the results may not be disseminated unless appropriate steps are taken to safeguard those interests.

Additional dissemination obligations

Where the call conditions impose additional dissemination obligations, the beneficiaries must also comply with those.

Open Science

Open science: open access to scientific publications

The beneficiaries must ensure open access to peer-reviewed scientific publications relating to their results. In particular, they must ensure that:

- at the latest at the time of publication, a machine-readable electronic copy of the published version or the final peer-reviewed manuscript accepted for publication, is deposited in a trusted repository for scientific publications

- immediate open access is provided to the deposited publication via the repository, under the latest available version of the Creative Commons Attribution International Public Licence (CC BY) or a licence with equivalent rights; for monographs and other long-text formats, the licence may exclude commercial uses and derivative works (e.g. CC BY-NC, CC BY-ND) and

- information is given via the repository about any research output or any other tools and instruments needed to validate the conclusions of the scientific publication.

Beneficiaries (or authors) must retain sufficient intellectual property rights to comply with the open access requirements.

Metadata of deposited publications must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent, in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: publication (author(s), title, date of publication, publication venue); Horizon Europe or Euratom funding; grant project name, acronym and number; licensing terms; persistent identifiers for the publication, the authors involved in the action and, if possible, for their organisations and the grant. Where applicable, the metadata must include persistent identifiers for any research output or any other tools and instruments needed to validate the conclusions of the publication.

Open science: research data management

The beneficiaries must manage the digital research data generated in the action (‘data’) responsibly, in line with the FAIR principles and by taking all of the following actions:

- establish a data management plan (‘DMP’) (and regularly update it)

- as soon as possible and within the deadlines set out in the DMP, deposit the data in a trusted repository; if required in the call conditions, this repository must be federated in the EOSC in compliance with EOSC requirements

- as soon as possible and within the deadlines set out in the DMP, ensure open access — via the repository — to the deposited data, under the latest available version of the Creative Commons Attribution International Public License (CC BY) or Creative Commons Public Domain Dedication (CC 0) or a licence/dedication with equivalent rights, following the principle ‘as open as possible as closed as necessary’, unless providing open access would in particular:

- be against the beneficiary's legitimate interests, including regarding commercial exploitation, or
- be contrary to any other constraints, in particular the EU competitive interests or the beneficiary's obligations under this Agreement; if open access is not provided (to some or all data), this must be justified in the DMP

- provide information via the repository about any research output or any other tools and instruments needed to re-use or validate the data.

Metadata of deposited data must be open under a Creative Common Public Domain Dedication (CC 0) or equivalent (to the extent legitimate interests or constraints are safeguarded), in line with the FAIR principles (in particular machine-actionable) and provide information at least about the following: datasets (description, date of deposit, author(s) and embargo); Horizon Europe or Euratom funding; grant project name, acronym and number; licensing terms; persistent identifiers for the dataset, the authors involved in the action, and, if possible, for their organisations and the grant. Where applicable, the metadata must include persistent identifiers for related publications and other research outputs.

Open science: additional practices

Where the call conditions impose additional obligations regarding open science practices, the beneficiaries must also comply with those.

Where the call conditions impose additional obligations regarding the validation of scientific publications, the beneficiaries must provide (digital or physical) access to data or other results needed for validation of the conclusions of scientific publications, to the extent that their legitimate interests or constraints are safeguarded (and unless they already provided (open) access at publication).

Where the call conditions impose additional open science obligations in case of a public emergency, the beneficiaries must (if requested by the granting authority) immediately deposit any research output in a trusted repository and provide open access to it under a CC BY licence, a Public Domain Dedication (CC 0) or equivalent. As an exception, if the access would be against the beneficiaries' legitimate interests, the beneficiaries must grant non-exclusive licenses — under fair and reasonable conditions — to legal entities that need the research output to address the public emergency and commit to rapidly and broadly exploit the resulting products and services at fair and reasonable conditions. This provision applies up to four years after the end of the action (see Data Sheet, Point 1).

Plan for the exploitation and dissemination of results including communication activities

Unless excluded by the call conditions, the beneficiaries must provide and regularly update a plan for the exploitation and dissemination of results including communication activities.

SPECIFIC RULES FOR CARRYING OUT THE ACTION (— ARTICLE 18)

Implementation in case of restrictions due to strategic assets, interests, autonomy or security of the EU and its Member States

Where the call conditions restrict participation or control due to strategic assets, interests, autonomy or security, the beneficiaries must ensure that none of the entities that participate as affiliated entities, associated partners, third parties giving in-kind contributions, subcontractors or recipients of financial support to third parties are established in countries

which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) — unless otherwise agreed with the granting authority.

The beneficiaries must moreover ensure that any cooperation with entities established in countries which are not eligible countries or target countries set out in the call conditions (or, if applicable, are controlled by such countries or entities from such countries) does not affect the strategic assets, interests, autonomy or security of the EU and its Member States.

Specific rules for MSCA actions

When implementing MSCA Doctoral Networks (DN), Postdoctoral Fellowships (PF) and COFUND actions, the beneficiaries must respect the following conditions:

- take all measures to implement the principles set out in Annex II to the Council Recommendation on a European framework to attract and retain research, innovation and entrepreneurial talents in Europe[3] ('the European Charter for Researchers') and ensure that the researchers and all participants involved in the action are aware of them

- ensure that the researchers enjoy at the place of the implementation at least the same standards and working conditions as those applicable to local researchers holding a similar position

- ensure that the employment contract, other direct contract or fixed-amount-fellowship agreement (see Article 6) specifies:

    - the name of the supervisor(s) for the research training activities

    - the starting date and duration of the research training activities

    - the monthly support for the researcher under this Agreement (in euro and, if relevant, in the currency in which the remuneration is paid)

    - the obligation of the researcher to work exclusively for the action, unless part-time for professional reasons is allowed and has been approved (and for MSCA-DN and MSCA-PF: not to receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiary or other entities mentioned in Annex 1)

    - the working pattern of the researcher

    - the arrangements related to the intellectual property rights (during implementation of the action and afterwards), in particular full access — on a royalty-free basis — for the researcher to background and results needed for their activities under the action

[3] Council Recommendation C/2023/1640 of 18 December 2023 on a European framework to attract and retain research, innovation and entrepreneurial talents in Europe, Annex II (OJ C, C/2023/1640, 29.12.2023).

    - the obligation of the researcher to inform as soon as possible about events or circumstances likely to affect the implementation of the action or the compliance with requirements under the Agreement (see Article 19)
    - the obligation of the researcher to maintain confidentiality (see Article 13)
    - the obligation of the researcher to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Articles 17)
    - where set out in the call conditions, the obligation of the researcher to carry out a mandatory return period of 12 months
- assist the researchers in the administrative procedures related to the recruitment
- inform the researchers about:
    - the description, conditions, location and timetable for the implementation of the research training activities
    - the rights and obligations toward the researchers under this Agreement
    - the obligation of the researchers to complete and submit — at the end of the research training activities — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the granting authority
- ensure full access — on a royalty-free basis — for the researchers to background and results needed for their activities under the action
- ensure that the researchers do not have to bear any costs for the implementation of the action as described in Annex 1
- provide training and the necessary means for implementing the action (or ensure that such training and means are provided by other participants in the action)
- ensure that the researchers are adequately supervised and receive appropriate career guidance
- ensure that personalised career development plans are established, support their implementation and update in view of the needs of the researchers
- ensure an appropriate exposure to the non-academic sector (if applicable)
- respect the maximum limit for secondments set out in the call conditions
- respect the conditions for the outgoing and return phases set out in the call conditions (if any)
- ensure that the researchers are informed that they are ‘Marie Skłodowska-Curie fellows’
- for MSCA-DN and MSCA-COFUND:

- advertise and publish vacancies internationally, including on the web-sites requested by the granting authority, indicating the gross salary (not including employer's social contributions) to be offered to the researcher
- recruit the researchers, following an open, transparent, merit-based, impartial and equitable recruitment procedure (for postdoctoral programmes in MSCA-COFUND: with regular selection rounds and international peer review), on the basis of:
  - their scientific skills and the relevance of their research experience
  - the impact of the proposed training on the researcher's career
  - a fair gender representation (by promoting genuine equal access opportunities throughout the recruitment process)

  The selection committees must bring together diverse expertise, have an adequate gender balance and include members from different countries and with relevant experience to assess the candidates.
- ensure that no conflict of interest exists in or arises from the recruitment

- for MSCA-DN and MSCA-PF:
  - ensure that the researchers do not receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiaries (or other entities mentioned in Annex 1)
  - host the researchers at their premises (or at the premises of other participants in the action)
- for MSCA-COFUND where doctoral or post-doctoral programmes are implemented as financial support to third parties through implementing partners:
  - ensure that the implementing partners comply with the same standards and procedures for implementing the research training activities, including the recruitment and working conditions for researchers, the specific rules for MSCA-COFUND actions and the specific rules on ethics and research integrity set out in Annex 5
  - implement effective monitoring and oversight arrangements towards the implementing partners, covering all aspects relating to the action
  - ensure effective and reliable reporting by the implementing partners, covering the activities implemented, information on indicators, as well as the legality and regularity of the expenditure claimed
  - ensure that the implementing partners provide that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the final recipients.

When implementing Horizon Europe MSCA Staff Exchanges (MSCA-SE), the beneficiaries must respect the following conditions:

- take all measures to implement the principles set out in Annex II to the Council Recommendation on a European framework to attract and retain research, innovation and entrepreneurial talents in Europe[4] ('the European Charter for Researchers') and ensure that the seconded staff and all participants involved in the action are aware of them

- ensure that the seconded staff enjoys at the place of the implementation at least the same standards and working conditions as those applicable to local staff holding a similar position

- assist the seconded staff with the administrative procedures related to their secondment

- inform the seconded staff about:

  - the description, conditions, location and timetable for the implementation of the secondment

  - the rights and obligations of the beneficiary toward the seconded staff under this Agreement

  - the obligation of the seconded staff to complete and submit — at the end of the secondment — the evaluation questionnaire and — two years later — the follow-up questionnaire provided by the granting authority

  - the arrangements related to the intellectual property rights between the beneficiary and the seconded staff (during the secondment and afterwards), in particular full access — on a royalty-free basis — for the staff to background and results needed for their activities under the action

  - the obligation of the seconded staff to maintain confidentiality (see Article 13)

  - the obligation of the seconded staff to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Article 17)

- ensure that the seconded staff do not have to bear any costs for the implementation of the action as described in Annex 1

- provide training and the necessary means for implementing the action (or ensure that such training and means are provided by other participants in the action)

- ensure that the seconded staff are adequately mentored

- ensure that the rights and obligations of the seconded staff remain unchanged during the secondment

- ensure full access — on a royalty-free basis — for the staff to background and results needed for their activities under the action

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[4] Council Recommendation C/2023/1640 of 18 December 2023 on a European framework to attract and retain research, innovation and entrepreneurial talents in Europe, Annex II (OJ C, C/2023/1640, 29.12.2023).

- if appropriate, ensure that seconded staff are reintegrated after the secondment
- ensure that the seconded staff are covered by an adequate medical insurance scheme
- ensure that the seconded staff have the relevant expertise for the action
- use the top-up allowance (see Article 6) to contribute to the subsistence, accommodation and travel of the seconded staff.

Specific rules for ERA Fellowship actions

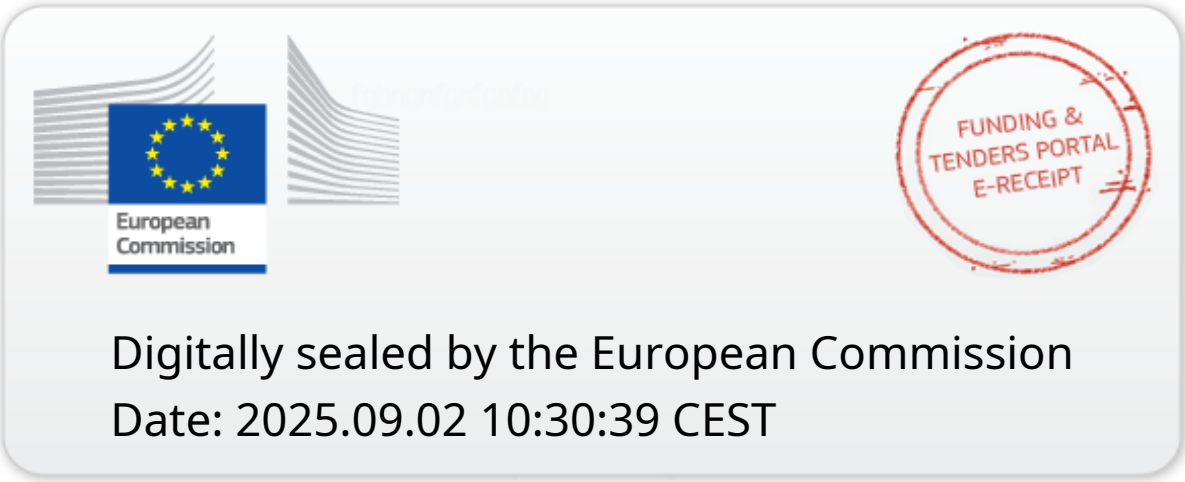
When implementing ERA Fellowships, the beneficiaries must respect the following conditions:

- take all measures to implement the principles set out in Annex II to the Council Recommendation on a European framework to attract and retain research, innovation and entrepreneurial talents in Europe[5] ('the European Charter for Researchers') and ensure that the researchers and all participants involved in the action are aware of them
- ensure that the researchers enjoy at the place of the implementation at least the same standards and working conditions as those applicable to local researchers holding a similar position
- ensure that the employment contract, other direct contract or fixed-amount-fellowship agreement (see Article 6) specifies:
    - the name of the supervisor(s) for the research training activities
    - the starting date and duration of the research training activities
    - the monthly support for the researcher under this Agreement (in euro and, if relevant, in the currency in which the remuneration is paid)
    - the obligation of the researcher to work exclusively for the action, unless part-time for professional reasons is allowed and has been approved (and not to receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiary or other entities mentioned in Annex 1)
    - the working pattern of the researcher
    - the arrangements related to the intellectual property rights (during implementation of the action and afterwards), in particular full access — on a royalty-free basis — for the researcher to background and results needed for their activities under the action

[5] Council Recommendation C/2023/1640 of 18 December 2023 on a European framework to attract and retain research, innovation and entrepreneurial talents in Europe, Annex II (OJ C, C/2023/1640, 29.12.2023).

    - the obligation of the researcher to inform as soon as possible about events or circumstances likely to affect the implementation of the action or the compliance with requirements under the Agreement (see Article 19)
    - the obligation of the researcher to maintain confidentiality (see Article 13)
    - the obligation of the researcher to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Articles 17)
    - where set out in the call conditions, the obligation of the researcher to carry out a mandatory return period of 12 months
- assist the researchers in the administrative procedures related to the recruitment
- inform the researchers about:
    - the description, conditions, location and timetable for the implementation of the research training activities
    - the rights and obligations toward the researchers under this Agreement
    - the obligation of the researchers to complete and submit — at the end of the research training activities — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the granting authority
- ensure full access — on a royalty-free basis — for the researchers to background and results needed for their activities under the action
- ensure that the researchers do not have to bear any costs for the implementation of the action as described in Annex 1
- provide training and the necessary means for implementing the action (or ensure that such training and means are provided by other participants in the action)
- ensure that the researchers are adequately supervised and receive appropriate career guidance
- ensure that personalised career development plans are established, support their implementation and update in view of the needs of the researchers
- ensure an appropriate exposure to the non-academic sector (if applicable)
- respect the maximum limit for secondments set out in the call conditions
- respect the conditions for the outgoing and return phases set out in the call conditions (if any)
- ensure that the researchers are informed that they are ‘ERA fellows’
- ensure that the researchers do not receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiaries (or other entities mentioned in Annex 1)

- host the researchers at their premises (or at the premises of other participants in the action)



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