**Table 3.1b: Work package description**

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| **Work package number** | 4 |
| **Work package title[[1]](#footnote-1)** | Access to Infrastructure: Low Energy |

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| **Objectives**  SOME OF THIS TEXT CAN BE COPIED/MOVED TO NARRATIVE SECTION  Work Package 4 will combine Transnational Access (TA) with training, co-ordination and service improvement actions to serve a broad community of scientists working on topics of common interest to the Hadron and Nuclear Physics communities. The aim is to further our understanding of the strong interaction in a wide variety of systems covering a vast variation in scales (both spatial and temporal). Many synergies and similarities exist in the scientific topics being addressed by the Hadron and Nuclear physics communities, where a wide variety of probes and facilities are employed in parallel, to understand the phenomena in question. The progression from the fundamental interactions of quarks, gluons and hadrons up to the stability of superheavy elements and physics of neutron stars is seamless and requires understanding at all scales. Scientific topics of interest will include:  • *Nucleon-nucleon, nucleon-hyperon, nucleus-neutrino, three-body interactions*  *• Equation of State of nuclear matter*  *• Nuclear masses, charge and matter radii*  *• Nuclear clustering phenomena*  *• Nuclear shapes and deformation determined through complementary methods*  *• Precision experiments in the search for BSM physics*  *• Nuclear Astrophysics*  The work package, coordinated by GANIL, will consist of three tasks:  **Task 4.1:** Provision of Transnational Access to world-class Research Infrastructures (RIs) with focus low energy aspects of Hadron and Nuclear physics.  **Task 4.2:** GATE: Provision of training of infrastructure staff and researchers for Gamma-ray Arrays Traveling for the European community.  **Task 4.3:** RADIANT: Service development with a view to provision of future VA on Nuclear Radii  **Task 4.1** will provide TA to the following facilities:  CERN – ISOLDE and n-TOF, FAIR/GSI (ESFRI), INFN – LNL and LNS, IN2P3 – IJCLab infrastructures, GANIL-SPIRAL2 (ESFRI), ELI-NP / IFIN-HH, JYFL-ACCLAB, NLC Consortium - HIL Warsaw, IFJ/CCB Krakow Consortium Group and ECT\*.  Whilst the majority of the TA facilities are focused on experimental activities mainly using heavy-ion accelerators and associated instrumentation, these will be complemented by provision of TA to ECT\*, the European Centre for Theoretical Studies in Nuclear Physics and Related Areas. Extensive access to ECT\* for meetings and workshops will promote dialogue between both experimental and theoretical scientists and maximise the scientific impact of results obtained through provision of access to the infrastructures. The forefront research infrastructures providing TA have been carefully selected to provide as wide a range of services as possible, whilst maintaining focus on the Hadron and Nuclear Physics communities and ensuring that a variety of probes can be employed to carry out an extensive program in Hadron and Nuclear Physics. The chosen infrastructures include two ESFRI Landmark facilities GSI-FAIR and GANIL-SPIRAL2, a wide range of facilities at CERN and the emerging facility ELI-NP which is the Nuclear Physics Pillar of the pan-European Distributed Research Infrastructure ELI – Extreme Light Infrastructure. All facilities offering TA have long-term experience in provision of such services and are proven to be of significant European interest. Alongside the services allowing forefront fundamental research to be carried out, the TA facilities also offer opportunities for testing and development of instrumentation. Often smaller or shorter tests can be carried out at a different facility to help ensure the success of a longer measurement. The possibility to perform such tests at the IABA (CNA Seville/CMAM Madrid), ATOMKI Debrecen, and IST Lisbon facilities, as sub-contractors, will be also considered during the project.  **Task 4.1: Provision of TA for low-energy aspects of Hadron and Nuclear physics:**  In the following, descriptions of the individual Research Infrastructures providing TA and their services can be found, along with a common description of work outlining the modality of access and support offered by the TA facilities. All of the TA facilities provide services and perform research in a manner compliant with the European Charter for Access to Research Infrastructures.  Each of the selected facilities has a role to play in addressing the scientific topics of interest outlined above. They can be summarised as follows:  • *Nucleon-nucleon, nucleon-hyperon, nucleus-neutrino, three-body interactions*   * GSI/FAIR, ALTO, NLC   *• Equation of State of nuclear matter*   * GSI/FAIR, GANIL-SPIRAL2, ELI-NP, LNL-LNS, NLC   *• Nuclear masses, charge and matter radii*   * GSI/FAIR, GANIL-SPIRAL2, ISOLDE, ALTO, JYFL-ACCLAB   *• Nuclear clustering phenomena*   * GSI/FAIR, GANIL-SPIRAL2, ELI-NP, ISOLDE, LNL-LNS, ALTO, NLC   *• Nuclear shapes and deformation determined through complementary methods*   * GSI/FAIR, GANIL-SPIRAL2, ELI-NP, ISOLDE, LNL-LNS, ALTO, JYFL-ACCLAB, NLC   *• Precision experiments in the search for BSM physics*   * GSI/FAIR, GANIL-SPIRAL2, ISOLDE, LNL-LNS, JYFL-ACCLAB   *• Nuclear Astrophysics*   * GSI/FAIR, GANIL-SPIRAL2, ELI-NP, ISOLDE, n-TOF, LNL-LNS, ALTO, JYFL-ACCLAB   In addition, all facilities have the possibility to dedicate beam time to smaller-scale tests and preparatory work in advance of full production experiments, where it is essential to maximise the probability of success of the experiment.  **Description of the infrastructure - ALTO**  Name of the infrastructure: **ALTO – Accélérateur Linéaire et Tandem a Orsay**  Location (town, country) of the infrastructure: IJCLab, Orsay, France  Web site address: <https://www.ijclab.in2p3.fr/en/platforms/alto/>  Annual operating costs (excl. investment costs) of the infrastructure (€): 1.55M€  Description of the infrastructure:  The ALTO facility consists of two accelerators: a Tandem accelerator for stable beams and a linear electron accelerator to produce radioactive beams In addition, the LICORNE neutron converter provides intense (up to 108 neutrons/s/str), kinematically focused, quasi-mono-energetic neutron beams with energies between 0.5 and 4 MeV.  The Orsay Tandem Van de Graaff accelerator (15 MV) is usually operated up to 14.6 MV. Stable ion beams ranging from protons to gold can be delivered. “Cluster-beams” and micro-droplets can also be delivered (C60 and gold droplets), but at lower voltage (10 MV). The ion sources were recently improved to deliver 5-times higher intensity. Rare ion beams (3He, 14C, 48Ca, ...) are also available.  The ALTO electron accelerator (50 MeV, 10 μA) is used as a driver to induce fission (photofission) in a thick heated uranium carbide target (up to 1011 fissions/s). Very exotic neutron-rich nuclei are obtained and used for studies of nuclear structure, decay heat in reactors and of solid-state physics. Research and development on target and ion sources for all the future second-generation radioactive ion beam projects is at the heart of the activity at ALTO. A new area is also open to particle physics users with the use of electron beam for tests of small units of particle physics detectors (vertex detectors, several layers of calorimeters w/o absorber etc.) before going to the large facilities such as DESY and CERN.  The associated research instrumentation with ALTO: six beam lines are available for experiments for stable beams, one is devoted to industrial irradiation and two others to cluster physics. Light, non-permanent experimental devices are used in any of the three experimental areas.  There are four Radioactive Ion Beam (RIB) lines dedicated to the study of very neutron-rich nuclei from photo- fission. Fast tape transport systems are available for studying short-lived nuclei. Several target ion source ensembles are developed at the facility: surface ionisation, laser ion source, FEBIAD ion source.  Main detector setups include: BEDO (a high efficiency gamma setup for decay properties of neutron rich nuclei studies); TETRA (an 3He neutron detector used to measure neutron emission from neutron rich nuclei); LINO: for collinear laser spectroscopy and laser-induced nuclear orientation; POLAREX (an instrument based on the On- Line Nuclear Orientation method to observe the decay of a spin-oriented ensemble of nuclei); Split-Pole (magnetic spectrometer used for the study of “two-body” reactions with high resolution and for nuclear astrophysical studies); the nu-Ball gamma spectrometer, which consists of a high efficiency hybrid LaBr3/HPGe array; and SIHL (an offline separator to test and develop target ion sources). Detailed list of instrumentation: <https://alto.ijclab.in2p3.fr/en/instrumentation-en/> .  Services currently offered by the infrastructure:  In addition to the instrumentation described above the ALTO Target Laboratory produces thin films for targets; Experimental Hall services provide the technical assistance for new installation and maintenance. Computer centres (CC IN2P3/Lyon) and Data-Acquisition services provide help with hardware and data-acquisition software. A Laser laboratory is available to test new ionisation schemes for the production of radioactive ion beams. ALTO has a long tradition to work with different research communities: nuclear, atomic, solid-state, and acceleration physics, nanotechnology and biology. ALTO has over 250 registered international users.  **Description of the infrastructure - GANIL**  Name of the infrastructure: **GANIL - Grand Accélérateur National d’Ions Lourds**  Location (town, country) of the infrastructure: Caen, France  Web site address: <http://www.ganil-spiral2.eu/>  Annual operating costs (excl. investment costs) of the infrastructure (€): 11 M€ (GANIL without manpower), 29 M€ (including manpower)  Description of the infrastructure:  GANIL-SPIRAL2 is one of the major nuclear physics facilities in the world with SPIRAL2 an ESFRI Landmark facility. The accelerator complex delivers three different beams for users: high-intensity stable beams, from Carbon up to Uranium between ~ 1 MeV to 95 MeV/nucleon; very high-intensity light beams such as p, d, He; a wide range of high-intensity exotic beams produced either in flight with the LISE and S3 (from ~2024) fragment separators or with the ISOL method at the SPIRAL1 facility; neutron beams with Neutron For Science (NFS) since 2020 .  The infrastructure consists of the following parts:   * Two injector cyclotrons equipped with two ECR ion sources, which can be operated in parallel. * The IRRSUD beam line allowing to use low-energy beams from injectors. * CSS1: separated-sector cyclotron number 1 (delivers beams in the energy range 5-15 MeV/nucleon). * CSS2: separated-sector cyclotron number 2, fed by CSS1, to reach the maximum beam acceleration (E=30-95 MeV/nucleon). * SPIRAL 1 provides low energy radioactive beams (30 keV) at the LIRAT facility. These beams can also be accelerated by the CIME cyclotron to 2-25 MeV/nucleon. This facility is unique in Europe. * SPIRAL 2 Phase 1: Superconducting LINAC accelerates beams (with the highest worldwide intensity) from protons to heavy-ions with A/Q=3 in the energy range from 0.75 MeV/u to 20 MeV/u. The future A/Q=7 injector (~2028) will further increase the intensity of heavy ion beams.   In the GANIL experimental halls, a variety of experimental infrastructures are fully available to all users with local technical support. Among them are:  • VAMOS, a large acceptance spectrometer used essentially for direct, fusion-evaporation reactions and deep- inelastic reactions for spectroscopy studies of exotic nuclei,  • The LISE III spectrometer, which separates, focuses and unambiguously identifies projectile-like fragments using several types of detectors. LISE is also used for atomic physics experiments.  Two new experimental halls with corresponding instrumentation have been built at SPIRAL 2 Phase 1 that will open new opportunities: Neutrons For Science (NFS) facility (commissioned in 2019-2020) and Super Separator Spectrometer (S3) for nuclei far from stability (to be operational by 2026). The Decay, Excitation, and Storage of Radioactive Ions (DESIR) hall is expected to be commissioned around 2028.  Other detectors at GANIL, designed for investigations of exotic and highly excited nuclei are: EXOGAM (high efficiency array of germanium detectors); MUST2/MUGAST (set-ups consisting of Si array); ACTAR TPC (an active target and time projection chamber); INDRA and FAZIA (4π multi-detectors of charged particles), PARIS (scintillator array for γ rays), and the Neutron Wall.  In addition, three beam lines with dedicated equipment are now available for atomic and condensed matter physics, at low energy (around 1 MeV/nucleon), at medium energy (after CSS1) and at high energy (95 MeV/nucleon). Another beam line is devoted to industrial applications, and to biological research. In total, between 50 and 60% of GANIL beam time is allocated to interdisciplinary and applied research to tackle major societal challenges including cancer therapies, medical radioisotopes and energy.  Detailed list of instrumentation: <https://www.ganil-spiral2.eu/scientists/ganil-spiral-2-facilities/accelerators/> .  Services currently offered by the infrastructure:  All stable and rare isotope beams and all experimental areas at GANIL-SPIRAL2 are available to external users. Each area has both a technical and a scientific coordinator, who act as liaisons with the outside users. In 2024, GANIL provides around 9 months of beam time. The GANIL community gathers around 1000 users, among which 740 are from EU (including 370 from France). International users contribute actively to funding and construction of all major experimental devices. The average number of scientific publications related to GANIL experiments is around 120 per year. The laboratory has access to the major computer centres of the CNRS (CC IN2P3 in Lyon) and the CEA. It is located in an active academic environment, the EPOPEA science and innovation park.  **Description of the infrastructure – GSI/FAIR**  Name of the infrastructure (and its installations, if applicable):  **GSI Helmholtzzentrum für Schwerionenforschung, FAIR - Facility for Antiproton and Ion Research**  Location (town, country) of the infrastructure: GSI and FAIR are located in Darmstadt, Germany  Web site address: <https://www.gsi.de> , <https://fair-center.eu/>  Annual operating costs (excl. investment costs) of the infrastructure (€): 6230 kEuro  Description of the infrastructure:GSI operates a large accelerator complex consisting of the linear accelerator UNILAC, the heavy-ion synchrotron SIS18 and the experimental storage and cooler ring ESR, which offer both stable ion beams and relativistic radioactive ion beams. The UNILAC accelerates a wide variety of ion species, including uranium, to energies up to 11.4 MeV/u. UNILAC beams are either fed to various experimental stations or to the next accelerator stage. SIS18 accelerates all ions up to ~ 2 GeV/u for carbon, 4.2 GeV for protons, and ~ 1 GeV/u for uranium. Exotic nuclei are produced, identified, and separated in the Fragment Separator (FRS). In the ESR, equipped with powerful stochastic and electron cooling devices, stable or radioactive ion beams can be stored and cooled up to energies of ~560 MeV/u (for uranium). CRYRING@ESR offers cooled primary and secondary beams of 4 MeV/u down to 10 keV/u. It is equipped with internal ion sources for stand-alone experiments with stable beams.  The existing GSI accelerator facilities will serve as injectors for the FAIR facility. The center piece of the FAIR facility is the SIS100 synchrotron and the Super-FRS. SIS100 will provide high intensity beams of U28+ and U92+. The Super-FRS is planned to be available with SIS18 beams for first experiments end 2027. SIS100 will become operational end of 2028.  State-of-the-art equipment dedicated to nuclear, atomic, biophysics and applications at the UNILAC are: The velocity filter SHIP and the gas-filled separator TASCA for the separation and detection of super-heavy elements, the various experimental stations for materials science and a laser facility for generating hadron beams (protons and neutrons) up to 40 MeV/u.  The fragment separator FRS for production and in-flight separation of exotic nuclei serves a number of experimental sites for research on nuclei at and beyond the driplines. In particular, the storage ring ESR is a unique experimental facility at GSI/FAIR and provides Schottky mass spectrometry as well as isochronous time-of-flight mass spectrometry, an internal gas-jet target for atomic spectroscopy and nuclear reaction studies.  Dedicated experimental equipment for nuclear structure investigations at FRS@GSI and later at Super-FRS@FAIR are: The R3B nuclear reaction set-up with dipole magnet GLAD to study collective states and complete kinematics reactions is available for experiments. The Ion Catcher facility for experiments with thermalized exotic nuclei for mass measurements and isomer studies with a multiple-reflection time-of-flight mass spectrometer, for decay spectroscopy, and a suite of high-resolution Ge detectors and fast-timing arrays for atomic and nuclear spectroscopy experiments.  The Super-FRS of FAIR will allow for unprecedented experiments with exotic nuclear beams at relativistic energies; its large acceptance and higher primary intensities make experiments possible, which cannot be performed at GSI today.  Services currently offered by the infrastructure: GSI-FAIR is a user facility open to national and international user groups. The beam time application procedure is described at [www.gsi.de/en/work/organisation /scientific\_boards/user/beam\_time/applying\_for\_beamtime.htm](http://www.gsi.de/en/work/organisation%20/scientific_boards/user/beam_time/applying_for_beamtime.htm) .  On top of the wide breadth of available experimental infrastructures described above, all experimental facilities including electronics, computing, etc. are provided free of charge to research groups with approved experiments.  Total number of users from the nuclear and hadron physics community: 1380, thereof 93 % external. Total number of users from the atomic physics, biophysics and materials science community: 450 users / year thereof 91 % external.  **Description of the infrastructure – IFIN/ELI-NP**  Name of the infrastructure: Tandem accelerator complex, Extreme Light Infrastructure - Nuclear Physics  Location (town, country) of the infrastructure: Magurele, Romania.  Web site address: [http://www.nipne.ro](http://www.nipne.ro/), https://www.eli-np.ro  Annual operating costs (excl. investment costs) of the infrastructure (€): 16 M€  Description of the infrastructure:  The IFIN accelerator complex, consisting of 9-MV, 3-MV and 1-MV Tandem accelerators offers access to a variety of stable ion beams.  The 9-MV Tandem accelerator of IFIN is one of the most reliable facilities in Europe providing a wide range of accelerated stable ions, with high intensity and stable operating conditions, attracting a growing international user community. The 3-MV Tandetron accelerator is mainly dedicated to applied nuclear physics: material characterization and modifications, radiobiology, archaeometry, radiation hardness, but also used for fundamental research, e.g. nuclear astrophysics studies. The 1-MV Tandetron is a state-of-the-art equipment that plays the key-role in the AMS studies. 14C dating is by far the most common application with more than 80% of the beam time allocated. Besides radiocarbon, other isotopes (10Be, 26Al, 129I and more recently actinides) were successfully measured within geological and environmental studies.  Equipment available for users include: ROSPHERE (a state-of-the-art spectrometer housing up to 25 detectors, HPGe or LaBr3(Ce), dedicated mainly to lifetime measurements); a setup dedicated to nuclear reaction and nuclear astrophysics; the neutron array of 81 BC400 plastic scintillators; a low-background measurements setup for nuclear reaction cross-sections through the activation method; a Ion Beam Analysis (IBA) setup at the 3-MV TandetronTM; an external beam setup with He-flow for in-air PIXE with applications in archaeometry and radiobiology studies.  The ELI-NP site is dedicated to nuclear photonics, i.e. nuclear physics using extreme photon beams or their secondary radiation. These beams are used for fundamental research studies as well as for developing high-impact applications. ELI–NP hosts a 2 x 10 PW laser system, the most powerful laser system worldwide, that is operational at nominal parameters since 2020. High-intensity quasi-monochromatic γ beams up to 19.5 MeV will be provided by a system based on Laser Compton Backscattering (LCB) of laser light off relativistic electrons produced by a linear accelerator. The construction of the γ-beam system is underway and completion is expected in 2026, with commissioning and first experiments starting from 2027.  Equipment available for users at ELI-NP include: ELIADE array of HPGe segmented clover detectors, ELIGANT-GN array of LaBr3(Ce)/CeBr3 and EJ301/Li glass neutron detectors, ELISSA array of DSSD Si detectors, ELITHGEM array of THick Gas Electron Multiplier detectors, experimental setups for laser-ion acceleration at 1 PW (experimental area E5) and at 10 PW (experimental area E1), and laser-electron acceleration at 1 PW (experimental area E5) and at 10 PW (experimental area E6).  The approximate number of users per year are: 200 foreign users + 150 local users.  Services currently offered by the infrastructure:   * The entire research infrastructure described above is open for external users around the world. The research activities are coordinated in collaboration with our local staff. The average beam time per year for each accelerator is around 5000 hours of beam on target while ELI-NP offers about 5000 hours of access for each laser arm. * Fully equipped electronics laboratory, state-of-the-art target laboratories, HPGe detector maintenance laboratories, laser experiment diagnostic laboratory, mechanical workshop, dosimetry laboratory are supporting the experimental activity at the Tandem accelerator complex and ELI-NP. The electronics lab offers expertise on several topics, including the development of front-end electronics for SIPM readout or digital data acquisition systems. The target labs has already produced a significant number of targets for a wide range of experiments at different facilities in Europe and around the world, and it will deliver high-quality products for the research units involved in this project. The dosimetry lab is developing dose measurement in ultra-short radiation pulses.   The Tandem accelerator complex and ELI-NP manage to attract users and obtain relevant scientific results through a combination of factors that include local expertise that is able to open niche research opportunities, beam availability that makes possible weeks long low cross-section experiments, beams with unique properties worldwide.  **Description of the infrastructure - *ISOLDE CERN***  Name of the infrastructure: ISOLDE CERN  Location (town, country) of the infrastructure: Geneva, Switzerland  Web site address: <https://isolde.cern/>  Annual operating costs (excl. investment costs) of the infrastructure (€): 4.6 M€ (10.1 M€ including manpower)  Description of the infrastructure:  ISOLDE is the radioactive ion beam (RIB) facility at CERN. The isotopes are made through a 1.4 GeV proton beam from the PS-Booster (2 μA) impinging thick targets. Over 1200 different isotopes/isomers of more than 74 chemical elements are available either at low energy (30-60 keV) or as post-accelerated radioactive beams up to 10 MeV/u. The radioactive beams are produced in two target/ion source units using 20 different targets and five types of ion sources. The RILIS lasers ion source is used for 70% of all experiments, providing element selective and efficient ionization for more than 20 elements. Isobaric on-line mass separation of isotopes is achieved with two mass separators. A gas filled Paul trap (ISCOOL) can be used to produce bunched beams with a user-defined bunch/release time. Beams are distributed to more than a dozen experimental devices (including the HIE-ISOLDE post-accelerator and its 3 experimental stations).  Research topics: about 60% nuclear structure research, explored via measurements of ground state properties (mass, radii, moments) and decay studies or Coulomb excitation and transfer reaction studies. A small fraction is devoted to nuclear astrophysics and tests of the Standard Model of particle physics (10%), while about 25% of the beam time is given to materials research and life sciences with broad societal benefits.  Research instrumentation: the ISOLDE users have access to an electronics pool, radiation detectors, multi- parameter data acquisition systems, chemistry and radioactive laboratories, liquid nitrogen and liquid He. Dedicated shielded collection points and laboratories for (off-line) materials research using long-lived radioactivity (hours to days) are available. Permanent experimental set-ups are owned, maintained and operated by “external” collaborations, both at the low- and high-energy beam lines. Small set-ups can be coupled for a single experiment to the low-energy branch or at the HIE-ISOLDE post-accelerator.  The HIE-ISOLDE post-accelerator has 3 beam lines: (1) the MINIBALL highly efficient germanium array is coupled to line 1 and is used for Coulomb excitation studies. In combination with a Si-Array T-REX also for transfer reaction studies. It can host a plunger for lifetime measurements of short-lived excited states. Since 2015, an electron conversion spectrometer, SPEDE, has been added for spectroscopy studies on actinides; (2) the ISOLDE superconducting solenoid (ISS) on line 2 provides a magnetic field up to 2 T. Its room temperature bore diameter of nearly 1 m can host two types of detectors: a Si array and an active target (SPECMAT). First successful experiments with the Si array were performed in 2018; (3) a multipurpose scattering chamber is available at line 3 for user to mount their own detection systems (inside or behind).  The low-energy part of ISOLDE hosts a suite of permanent experimental set-ups: fluorescence detected collinear laser spectroscopy set-up (COLLAPS) and collinear resonance ionization laser spectroscopy set-up (CRIS) to determine ground-state and isomeric state charge radii, spins, magnetic and quadrupole moments. CRIS can also be used for decay studies on isomerically pure samples, using dedicated alfa- and beta-decay detection set-ups; the ISOLTRAP Penning traps and an MR-TOF spectrometer for high-precision mass measurements; the ISOLDE Decay Station (IDS) includes efficient gamma detection, beta-detection and tape station, neutron array, LaBr3(Ce) for lifetime measurements; SPEDE detector for electron conversion detection; Total Absorption Spectrometer (TAS) for beta decay studies. There are also dedicated beam lines for applications in material science, biology, fundamental interactions, as well as material and biochemical studies.  Detailed list of instrumentation - <https://isolde.cern/experimental-setups> .  Services currently offered by the infrastructure:  Radioactive beams are provided up to the switchyards towards the experimental beam line. ISOLDE presently provides about 4500 hours of beam time per year for about 50 experiments with the leading and participation of more than 600 external users per year. The scientific output from ISOLDE can be found on the web (isolde.cern/publications) and includes an average of 80 publications per year, many in high-impact journals (PRL, PRX, PBL, Nature, Nature Physics, Nature Communications, ...). A new class C laboratory is available for the users, which hosts an extended laboratory for condensed matter and bio-physics with a separate chemistry laboratory, as well as two large laser laboratories, a mechanical workshop, and a detector laboratory.  All ISOLDE users have access to the standard CERN services, including computing, library 24h, a small store, electronics pool, restaurants, housing service, hourly bus transfer to/from airport etc. The top floor of the new users building is accessible for visits and includes data acquisition rooms for the different collaborations, a visitors’ area, the ISOLDE control room, and a kitchen and meeting area.  **Description of the infrastructure – JYFL-ACCLAB**  Name of the infrastructure: **Accelerator Laboratory**, Department of Physics, University of Jyväskylä  Location (town, country) of the infrastructure: Jyväskylä, Finland  Web site address: <https://www.jyu.fi/accelerator/>  Annual operating costs (excl. investment costs) of the infrastructure (€): 6.55 M€ (Real Estate + Operating Costs typically 2.55 M€, Salaries 3.7 M€)  Description of the infrastructure:  The facility can provide stable ion beams with two accelerator facilities: a K=130 heavy ion cyclotron with three ECR ion sources and a multi-cusp ion source delivering a large variety of stable-ion beams (from p to Au) suitable for modern nuclear physics research and applications. In the past decade, the third 18 GHz ECR Ion Source HIISI has allowed the intensity and energy range of the beams delivered by the K130 cyclotron to be increased (up to energies of 16 MeV/u for Xe and 22 MeV/u for Kr) and an 800 m2 extension of the JYFL target hall was equipped with an additional K=30 light-ion cyclotron. The cyclotrons also drive the IGISOL ion-guide facility, delivering various species of cooled and bunched radioactive ion beams at low energies. The annual operating time of these facilities has been about 7000 hours during the last years.  Associated research instrumentation:  Instrumentation for in-beam and decay spectroscopic studies of exotic nuclei at the proton drip line and of super- heavy elements such as the RITU gas-filled recoil separator and new vacuum-mode recoil-mass spectrometer MARA. Coupled with detector arrays at the target area (JUROGAM III Ge detector array) and at their respective focal planes, they form some of the most flexible and efficient systems in the world for such studies. Optionally, the SAGE spectrometer composed of the JUROGAM III array of Ge clover detectors and a novel in-beam electron spectrometer are also available.  The IGISOL facility provides beam lines equipped with ion traps (e.g. JYFLTRAP) for accurate nuclear mass measurements, detector systems for exotic decay modes and laser spectroscopy systems for hyperfine structure studies and resonance ionisation. Two beam lines are available for nuclear reaction studies and test experiments. One of them is equipped with a scattering chamber of 1.5 meters in diameter.  The JYFL Accelerator Laboratory has close contacts with the experts of experimental and theoretical high-energy and materials physics at the Department of Physics and at the adjacent Nanoscience Centre (http://www.jyu.fi/nsc/en/).  Services currently offered by the infrastructure:  All the accelerators and associated instrumentation are available for the users. In addition, JYFL has well-equipped mechanical and electronics workshops ready for rapid delivery of purpose-built equipment and to carry out repairs. The requested beams are delivered by the JYFL staff. Each experiment proposed by the users has a local liaison and is typically carried out in collaboration with one of the in-house research teams. The total staff is currently around 80 persons. The international exchange programmes have led to a significant transfer of foreign users (around 300 foreign visitors and over 2000 visitor-days annually) and equipment (value of 10 M€) to JYFL.  As a university laboratory, JYFL provides a unique environment for graduate students and young scientists for active participation in experiments as well as in the design and construction of instrumentation.  There is a strong national support for the research activities at JYFL: the Academy of Finland awarded the status of a **Finnish Centre of Excellence (CoE)** in Nuclear and Accelerator Based Physics up until 2017. It also has a special task given by the Ministry of Education as a centre of expertise in radiation- and ion beam applications and is one of 21 large-scale infrastructures awarded a position on Finland’s “Roadmap of National Research Infrastructures 2025-2028.  **Description of the infrastructure – LNL/LNS**  Name of the infrastructure: **Laboratori Nazionali di Legnaro** and **Laboratori Nazionali del Sud**  Location (town, country) of the infrastructure: Legnaro, Padua (LNL) and Catania (LNS) - Italy  Web site address: [www.lnl.infn.it](http://www.lnl.infn.it/), [www.lns.infn.it](http://www.lns.infn.it/)  Annual operating costs (excl. investment costs) of the infrastructure (€): 10 M€  Description of the infrastructure:  LNL and LNS are property of the Istituto Nazionale di Fisica Nucleare (INFN) and are devoted to Fundamental and Applied Nuclear Physics Research. Their activities are complementary and strictly coordinated.  *Accelerator Facilities*: The LNL-LNS laboratories offer an access to stable-ion beams, radioactive ion beams and also to neutron beams, delivered by the BELINA facility at LNL. The LNL and LNS laboratories have different accelerator complexes providing light and heavy ion beams up to 80 MeV/u. In particular, the accelerators in use are:   * the PIAVE RFQ injector + ALPI linear accelerator at LNL, which delivers ion beams with A>90 and energies up to 15 MeV/u; * the 16 MV Tandem XTU + ALPI linear accelerator complex at LNL, which delivers ion beams with A<90 and energies up to 10 MeV/u * the Superconducting Cyclotron at LNS providing a wide variety of heavy-ion beams with energies up to 80 MeV/u. * the 15 MV SMP Tandem accelerator at LNS providing heavy-ion beams with energies of a few Mev/u.   The LNS Superconducting Cyclotron will be equipped with a second beam extraction system to improve the intensity of stable beams. This will allow the use of the new FRAgment Ion Separator (FRAISE) for exotic beams production via projectile fragmentation.  At LNL the SPES facility will come into operation during the period of the offered access. SPES is an ISOL type facility for radioactive beam production based on the fission of a UCx target induced by a primary proton beam delivered by the high intensity cyclotron B70.  Applied, interdisciplinary and biomedical physics activities are based on:   * The Van de Graaff accelerators 2.5 MV AN2000 and 7 MV CN at LNL delivering light-ion beams. * The CATANA facility at LNS where, besides the proton-therapy, biomedical physics experiments using proton and carbon beams from the cyclotron are performed. * The B70 Cyclotron at LNL for research activities in the field of radioisotopes for medicine and neutrons for applied physics.   *Research instrumentation:*  Among the several state-of-the-art detection systems we can mention: GALILEO at LNL, a high-resolution Ge array implemented with various complementary detectors for nuclear structure studies; The heavy-ion magnetic spectrometers PRISMA at LNL and MAGNEX at LNS for the study of quasi-elastic processes and single and double charge exchange reactions; The charged particle array detectors GARFIELD+RCo at LNL and CHIMERA at LNS for the study of the dynamics and thermodynamics of nuclear reactions; The PISOLO set-up at LNL, based on a electrostatic deflector followed by a time-of-flight spectrometer, for the study of sub-barrier fusion reactions; The BELINA facility installed at the CN accelerator of LNL, which is devoted to the production of neutron beams through the 7Li (p,n) reaction for both astrophysics and applied research studies; The STARTRACK detector for micro dosimetry studies and the micro-beam line at the AN2000 accelerator for elemental analysis at LNL; the LANDIS laboratory at LNS for non-destructive in situ analysis of archaeological samples; A beta-decay station and an electron spectrometer for nuclear structure studies using non-reaccelerated SPES beams are in the installation phase at LNL. The European gamma spectrometer AGATA is currently hosted at LNL.  Services currently offered by the infrastructure:  The main services offered to users are the following:   * A Detector Laboratory at LNL, one the most advanced laboratories in Europe for testing and repairing High- Purity Germanium detectors. * Target laboratories at LNL and LNS for the production of targets and thin films depositions for nuclear physics experiments and interdisciplinary projects, respectively. * Technical assistance for the installation of new set-ups, the maintenance of vacuum instrumentation, pumping systems, electrical components and mechanical parts of the existing apparatuses. * Computer centres and Data Acquisition Services. * Cellular and molecular biology laboratories at LNS. * A surface technology and superconductivity laboratory at LNL.   The international relevance and quality of the research performed at LNL and LNS, are testified by about 350 scientific papers per year published in Scientific Journals with high impact factor and the number of users from foreign institutions (about 500 researchers per year).  **Description of the infrastructure - *NLC (SLCJ Warsaw & CCB Krakow) – National Laboratory of Cyclotrons***  Name of the infrastructure: **NLC (SLCJ Warsaw & CCB Krakow) – National Laboratory of Cyclotrons**  Location (town, country) of the infrastructure: Warsaw, Poland (SLCJ) - Kraków, Poland (CCB)  Web site address: [www.slcj.uw.edu.pl](http://www.slcj.uw.edu.pl), <https://experimentsccb.ifj.edu.pl>  Annual operating costs (excl. investment costs) of the infrastructure (€): SLCJ: ca. 1.7 M€ (excluding isotope research and production centre), CCB (incl. medical part): ca. 2.0 M€  Description of the infrastructure:  NLC is a consortium of the two institutions – Heavy Ion Laboratory of the University of Warsaw (SLCJ) and Cyclotron Center Bronowice (CCB) at Institute of Nuclear Physics Polish Academy of Sciences in Kraków. It offers access to a wide range of stable ion beams to conduct complementary (by using high energy protons in CCB Krakow and low energy heavy ions in SLCJ Warsaw) research activities, encompassing the fields of nuclear structure, nuclear reactions dynamics, radiochemistry, radiobiology, nano-dosimetry, material sciences, industrial application, medical research and proton therapy.  *Accelerator Complex:* SLCJ: Isochronous heavy-ion cyclotron (K=160) with two ECR sources, proton/deuteron GE PETtrace cyclotron (K=16.5); CCB: Medical proton cyclotron PROTEUS-230.  *Available Beams:* SLCJ: from He up to Ar up to 10 MeV/A, protons/deuterons 16 MeV/A; CCB: protons 70-230 MeV .  *Main detectors/spectrometers:*  *SLCJ Warsaw*: EAGLE (4π gamma-ray array) and associated ancillary detectors with possible integration with the PARIS gamma-ray calorimeter and the NEDA neutron detector; scattering chambers ICARE (obtained from Strasbourg) and CUDAC for charged particle spectroscopy; array JANOSIK for nuclear giant resonance studies; irradiation station for radiobiology (with a cells’ laboratory infrastructure) and material interdisciplinary studies; irradiation station with target water cooling; low background lead shielded HPGe counters.  Detailed list of instrumentation: <http://slcj.uw.edu.pl/en/experiments-and-research-facilities-at-hil/>  *CCB Krakow*: BINA (Big Instrument for Nuclear Data Analysis for in-beam experimental investigations of the dynamics of few-nucleon systems; high-energy gamma-ray detection array HECTOR, which can be complemented with the PARIS array; KRATTA (Kraków Triple Telescope Array- 35 multi-module telescopes for charged-particle detection); large reaction chamber**;** large volume LaBr3 detectors**;** DSSS detectors. Detailed list of instrumentation: https://experimentsccb.ifj.edu.pl/?static=3.  It shall be mentioned that some of the offered instrumentation (HECTOR, PARIS, KRATTA, DSSS, NEDA, Ge- detectors), as well as the associated electronics, can be moved between the 2 infrastructures.  Services currently offered by the infrastructure:  SLCJ has at its disposal: mechanical and electronics workshops, target laboratory, detector laboratory, library, two conference rooms, 15 scientists and 38 technicians ready to help an external user.  CCB Krakow offers library and a conference room. CCB has at its disposal mechanical and electronics workshops. In addition, 7 scientists and 6 technicians can help the external users.  The user’s community gathers: at NLC\_SLCJ – 110 (70 foreign), at NLC\_CCB – 130 (foreign 75) users.  **Description of the infrastructure – n\_TOF CERN**  Name of the infrastructure: The CERN neutron time-of-flight facility  Location (town, country) of the infrastructure: Geneva, Switzerland  Web site address: [www.cern.ch/n\_TOF](http://www.cern.ch/n_TOF)  Annual operating costs (excl. investment costs) of the infrastructure (€): 14.7 M€ (for 6-month full-time operation)  Description of the infrastructure:  Accelerators involved: LINAC injector, CERN Booster, CERN Proton Synchrotron, offering access to the neutron beams. The n\_TOF facility is based on the 20 GeV/c proton beam from the CERN Proton-Synchrotron accelerator, transported to a target/moderator assembly that feeds two beam lines of length respectively of 185m (horizontal) and 18.2m (vertical) with respect to the incident proton beam direction. At the end of each beam line there are two fully equipped areas, EAR1 and EAR2, where the experimental activities are taking place. A third area, located at 2-3 meters from the spallation module has been recently constructed (the n\_TOF NEAR Station) which can provide higher neutron flux for irradiation activities and activation measurements.  The n\_TOF facility is a world-wide unique installation which offers a pulsed neutron beam with an extremely wide energy spectrum covering the thermal region (sub-meV) up to the fast region with neutrons up to GeV energies. Very high resolution in low-background conditions in both experimental areas are characteristics of the facility, which coupled to the low duty-cycle/high-intensity characteristics of the driver accelerator makes n\_TOF a unique neutron source for nuclear physics experiments.  Specific instrumentation, presently available in the experimental areas for neutron induced reactions studies includes beam monitoring, fission reaction detectors, Si-based detectors for neutron-induced light-charged-particle reactions, multi-detection spectrometer, a total-absorption calorimeter. Additional detection systems for capture gamma-ray spectroscopy (iTED, sTED), for neutron detection (TarT) are available for innovative experimental activities from 2022.  Services currently offered by the infrastructure:  The n\_TOF facility is embedded in the research infrastructure provided by CERN, which enables thousands of users worldwide to perform experiments for basic science. The n\_TOF users are organized in a Collaboration which includes over 130 researchers from Europe. The n\_TOF Collaboration, established in 2000, has so far performed 120 experiments, resulting in over 200 publications. The scientific activities have covered research domains in nuclear astrophysics (big-bang nucleosynthesis, nuclear cosmochronometry, stellar evolution models), in advanced nuclear technologies (accelerator driven systems, basic data for improved safety of nuclear installations) and basic science (medical applications, neutron radiography).  The beam for n\_TOF is measured in terms of number of protons delivered to the target station. This amounts to (2.1–2.5)x1019 in a year-run (the equivalent of about 6-7 months). The proton pulses are spaced by an average of 6s (with a minimum of 1.2s) and intensities of 7x1012 protons/pulse. Experiments at n\_TOF are characterized by large variation of the number of protons requested to achieve the required statistical accuracy. Some of the measurements performed so far have requested 6x1017 protons (less than a week), while others needed 10 times as much. At n\_TOF, some experiments can run in parallel in the same experimental area. In addition, EAR1 and EAR2 receives neutrons at the same time, doubling the capabilities of measurements. Even more, the new NEAR Station will receive a neutron beam in parallel with EAR1 and EAR2, expanding further the accessibilities to neutron beams for experimental activities.  **Description of work – TA facilities for experiment**  Modality and Review Procedure for access under this proposal:  All of the TA facilities offering access for experiments will have unified models and procedures for granting access to the facility, based on vast experience from previous IA and INFRA-SERV projects. In terms of project selection, there will be small, facility-specific differences, but in general the project selection will be performed by the existing Program Advisory Committees (PAC) of the individual facilities. Each PAC consists of international independent experts external to the facility. Due to the very high demand for the facilities, along with the differences in local operating procedures and available beam time, it is extremely impractical, if not impossible for a single advisory committee to carry out this part of the selection process. Each facility will have dedicated calls for proposals, often several times per year, but sometimes less frequently. These calls will be broadly advertised as has been done in the past. All facilities will grant access based on a unit of access “beam time hours” and access costs will be declared on the basis of a unit cost. Typical experiment durations can be from several days up to several weeks.  From the selected projects which are eligible for support under the terms of the Grant Agreement, a second, unified User Selection Panel will act to make a final selection of projects best suited to the scientific goals of the project and to finally allocate support to individual users, favouring new and younger users as per the goals of the TA programmes.  Support offered under this proposal:  All of the TA facilities offer similar user support, again with small differences but in general the level of support and type of support available is consistent. Firstly, all facilities designate a local contact person to liaise with the external and to provide practical assistance prior to, during and after the experiment in order to help ensure success. Local staff provide all required technical support, including for example, access to mechanical and electronic workshops, target laboratories, and assistance with vacuum components, electronics and data acquisition, etc. Local training in safety and other technical aspects is also provided. All facilities offer assistance with user liaison (registration, radiation safety, accommodation, etc) and in some cases offer digital or online solutions for many user liaison/access procedures.  **Task 4.2: GATE -** Provision of training of infrastructure staff and researchers for **Gamma-ray Arrays Traveling for the European community**  Building upon experience and delivered successes in previous IA and INFRA-SERV activities such as EURO-LABS, training of both infrastructure staff and researchers from the community will be provided. GATE tackles the challenge of providing expertise for an optimal utilisation of instrumentation for the Nuclear Physics community in order to address some of the scientific topics covered by the RIs providing TA in this WP. Large research collaborations invest significant effort and resources in developing new instrumentation (such as [AGATA](https://doi.org/10.1140/epja/s10050-020-00132-w) ( <https://www.agata.org>) ), experimental methods and techniques for semiconductor and scintillator detectors, for front-line research on the fundamental properties, and for correlations and interactions of strongly-interacting matter. Several of these techniques are of common interest and the effective sharing of information through training and/or exchange of technical experts, in addition to the pooling and maintaining of resources, will be of great benefit to the whole research community working at all facilities. The coordinated effort of different collaborations centred around detectors and experimental resources that can travel and be shared among the infrastructures of various European laboratories for an optimal time period will largely enhance the quality and the scientific output of the experimental programs and globally improve our knowledge of nuclear structure in a coordinated way. Moreover, the optimal services for the travelling detectors, including crucial training of new experts on the state-of-art detector technology, digital electronics, FPGA pre-processing, data analysis and Machine Learning, will be provided.  This will guarantee long-term availability of the existing resources and the future development of the field.  This task is split into three sub-tasks to maximize effectiveness at multiple levels**:**  **Subtask 4.2.1:** Efficient use of flagship European spectroscopy resources   * The use of flagship instrumentation at the RIs will be optimised (service improvement). Focus will be given to maximizing their effectiveness, coordination of the experimental campaigns, and exchange of information on their potential opportunities. For this task, we propose to organize remote annual meetings between the management of the nuclear spectroscopy collaborations and the directorate of the hosting infrastructures to ensure the best exploitation and dissemination to the user communities of the opportunities provided by the different infrastructures; to coordinate timelines and optimise the distribution of the resources for physics campaigns. We also offer our services for the organization of a workshop to discuss physics opportunities and perspectives for the future of the field.   **Subtask 4.2.2:** Training in nuclear spectroscopy techniques   * Organization of training courses for new and more experienced users. The courses will cover the most important and useful subjects and techniques for nuclear spectroscopy, from hardware aspects to software tools, data access and management as well as data-analysis techniques of relevance to the investigation of the physics topics of interest. * Organization of hands-on workshops for experienced scientific and technical staff. These workshops allow the experts in detector technologies to share their knowledge and expertise, reducing the risk of exposure by the retiring experts. Such a dissemination of information will benefit the physics campaigns of the community of ~500 spectroscopists.   **Subtask 4.2.3:** Knowledge transfer   * Sharing of technological expertise and transfer of knowledge through the exchange of technical experts between infrastructures and research institutions, with special emphasis on High Purity Ge detector maintenance and repair.   **Task 4.3.:** **RADIANT – development to provide Nuclear Radii Data services**  Nuclear charge radii play an important role in many aspects of fundamental physics. They are a prerequisite for precision tests of the Standard Model with nuclear, hadronic, and electroweak probes, precision atomic physics, nuclear astrophysics, and in direct and indirect searches for dark matter. They are also used to benchmark *ab initio* nuclear theory that describes and predicts properties of nuclear structure and nuclear matter. RADIANT will provide an appropriate framework for a fruitful interaction between experimentalists and theorists across various fields with the scope of realizing a modern interactive web-based table of nuclear radii, which will benefit many fields of fundamental and applied physics.  Nuclear radii can be accessed with different experimental techniques such as muonic x-ray measurements, laser spectroscopy of ordinary atoms, and electron scattering. In many cases, they should be known at the level of 0.1-0.01% which requires a delicate merger of techniques and a close cooperation between theory and experiment. The most recent table of recommended nuclear charge radii was published by Angeli and Marinova in 2013, in ADNDT 99 (2013) 69-95. It is hosted by the International Atomic Energy Agency (IAEA) and accessible at the Nuclear Data Services webpage: <https://nds.iaea.org/radii/> . The need for an update that would include all recent developments in the experimental techniques and theoretical tools was discussed at a recent meeting held at the IAEA Headquarters in January 2025. The meeting summary is available online at: <https://www-nds.iaea.org/publications/indc/indc-nds-0918.pdf> .  The group of researchers who participate in this WP will share their vision on accurate and reliable nuclear radii in a white paper, which will then be used as a basis for a broad physics community discussion and involvement. This involvement will be ensured by a dedicated workshop aimed at gathering all experts and interested parties. As a result of the workshop, we envision a set of recommendations on the evaluation of radii obtained from various data. Following this work, an updated radii data base will be created and described in detail in a review paper. As a final step, a modern, interactive website will be created, running and available for users to test. Upon completing the testing phase, the final, fully functional interactive website with clearly defined rules for updating, uploading new data and theory tools, will become available to the broad physics community, on the IAEA or other open access server. A similar highly visible initiative is that of the nuclear moments: <https://www-nds.iaea.org/nuclearmoments/> .  From this description, it is clear that the technical aspects of the work can be subdivided into two tasks: (i) the physics of measurements and analysis of pertinent experiments and evaluation of nuclear radii, including the state-of-the-art theory tools; and (ii) the compilation of the tables, the implementation, maintenance and updates of the website. Technion and JGU will lead the task (i), where funds for a dedicated postdoc position at Technion with a JGU co-supervision and for related travel are requested. The task (ii) will be led by Clemson U. with the support of IAEA.  **TA for Theory**  **Access to ECT\* in WP(2?) will also cover theory activities related to Low-Energy Nuclear Physics which are not repeated here.** |

**Table 3.1c: List of Deliverables[[2]](#footnote-2)**

Only include deliverables that you consider essential for effective project monitoring.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number** | **Deliverable name** | **Short description** | **Work package number** | **Short name of lead participant** | **Type** | **Dissemination level** | **Delivery date**  **(in months)** |
| D4.1 | Report on Access to Low-Energy Facilities | Report will summarise the provided access offered to users by Low-Energy Facilities of WP4 | 4.1 | GANIL | R | PU | M46 |
| D4.2 | Final report on training courses | Report will summarise training courses for new and more experienced users of techniques for nuclear spectroscopy | 4.2 | CNRS-IJCLab | R | PU | M46 |
| D4.3 | Interactive, publicly accessible website on nuclear radii | The work of this WP is directed towards an update of the table of nuclear radii and making it a virtual access: publicly open, interactive website | 4.3 | Clemson U. | DEC | PU | M48 |
|  |  |  |  |  |  |  |  |

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| **KEY**  Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number>.<number of deliverable within that WP>.  For example, deliverable 4.2 would be the second deliverable from work package 4.  **Type:**  Use one of the following codes:  R: Document, report (excluding the periodic and final reports)  DEM: Demonstrator, pilot, prototype, plan designs  DEC: Websites, patents filing, press & media actions, videos, etc.  DATA: Data sets, microdata, etc.  DMP: Data management plan  ETHICS: Deliverables related to ethics issues.  SECURITY: Deliverables related to security issues  OTHER: Software, technical diagram, algorithms, models, etc.  **Dissemination level:**  Use one of the following codes:  PU – Public, fully open, e.g. web (Deliverables flagged as public will be automatically published in CORDIS project’s page)  SEN – Sensitive, limited under the conditions of the Grant Agreement  Classified R-UE/EU-R – EU RESTRICTED under the Commission Decision No2015/444  Classified C-UE/EU-C – EU CONFIDENTIAL under the Commission Decision No2015/444  Classified S-UE/EU-S – EU SECRET under the Commission Decision No2015/444  **Delivery date**  Measured in months from the project start date (month 1) |

**Table 3.1d: List of milestones**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Milestone number** | **Milestone name** | **Related work package(s)** | **Due date (in month)** | **Means of verification** |
| MS4.1 | Call for submission of projects to access ready | 4.1 | M10 | Publication of calls on the Web sites of the low-energy facilities |
| MS4.3 | White Paper | 4.3 | M12 | Preprint deposited on arXiv |
| MS4.4 | Radii database | 4.3 | M30 | Database validated by the task coordinator |

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| **KEY**  **Due date**  Measured in months from the project start date (month 1)  **Means of verification**  Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype that is ‘up and running’; software released and validated by a user group; field survey complete and data quality validated. |

**Table 3.1e: Critical risks for implementation** #@RSK-MGT-RM@#

|  |  |  |
| --- | --- | --- |
| **Description of risk (indicate level of (i) likelihood, and (ii) severity: Low/Medium/High)** | **Work package(s) involved** | **Proposed risk-mitigation measures** |
| Breakdown of specific components of accelerators (very low likelihood, impact could be medium/high) | 4.1 | The planned activities (and the related allocated budget) could be shifted to other facilities in the consortium. |
| Reduced availability of RIs due to longer shutdowns or unforeseen technical stops (Medium/Medium) | 4.1 | Reschedule TAs for later times if possible, otherwise rearrange tests to accommodate more in parallel. If not possible to resolve within the RI, shift access units to other RIs starting from within the same Task, then same WP, and eventually in other WPs. |
| Failure to attract the foreseen number of users to the TA facilities (Low/High) | 4.1 | Regular monitoring of TA allocation within WP/Task. Effort for better publicity of the access opportunities offered by the RIs, promote success stories among target user community for the RI. Use dynamic allocation of access units (i.e. shift of EC funds to other RIs) within the WP/Task. |
| Reduced mobility of scientific & technical participants due to extreme weather events, pandemic or another unforeseeable event (Low) | 4.2 | Remote participation and recorded demonstrations |

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| --- |
| **Definition critical risk:**  A critical risk is a plausible event or issue that could have a high adverse impact on the ability of the project to achieve its objectives.  **Level of likelihood to occur: Low/medium/high**  The likelihood is the estimated probability that the risk will materialise even after taking account of the mitigating measures put in place.  **Level of severity: Low/medium/high**  The relative seriousness of the risk and the significance of its effect. |

#§RSK-MGT-RM§#

**Table 3.1f: Summary of staff effort**

*Please indicate the number of person/months over the whole duration of the planned work, for each work package, for each participant. Identify the work-package leader for each WP by showing the relevant person-month figure in bold.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **WP4** | **WPn+1** | **WPn+2** | **Total Person-**  **Months per Participant** |
| **Participant Number/Short Name** | Technion IIT |  |  |  |
| **Participant Number/**  **Short Name** |  |  |  |  |
| **Participant Number/**  **Short Name** |  |  |  |  |
| **Total Person Months** | 24 |  |  |  |

**Table 3.1g: ‘Subcontracting costs’ items**

For each participant describe and justify the tasks to be subcontracted (please note that core tasks of the project should not be sub-contracted).

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Description of tasks and justification** |
| **Subcontracting** |  |  |

**Table 3.1h: ‘Purchase costs’ items (travel and subsistence, equipment and other goods, works and services)**

Please complete the table below for each participant if the purchase costs (i.e. the sum of the costs for ’travel and subsistence’, ‘equipment’, and ‘other goods, works and services’) exceeds 15% of the personnel costs for that participant (according to the budget table in proposal part A). The record must list cost items in order of costs and starting with the largest cost item, up to the level that the remaining costs are below 15% of personnel costs.

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** |  |  |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** |  |  |

**Table 3.1i: ‘Other costs categories’ items (e.g. internally invoiced goods and services)**

Please complete the table below for each participant that would like to declare costs under other costs categories (e. g. internally invoiced goods and services), irrespective of the percentage of personnel costs.

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Justification** |
| **Internally invoiced goods and services** |  |  |
| **…** |  |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name INFN/LNL-LNS** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 64000 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 64000 |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name GANIL** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 64000 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 64000 |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name CNRS/IJCLab** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 12800 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 12800 |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name JYU** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 60000 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 60000 |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name UNIWARSAW/NLC-SLCJ** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 13168 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 13168 |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name IFJ PAN/CCB** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 14400 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 14400 |  |

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name ELI-NP/IFIN-HH** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** | 64000 | WP4-[user support for TA] |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** | 64000 |  |

**Table 3.1j: ‘In-kind contributions’ provided by third parties**

Please complete the table below for each participant that will make use of in-kind contributions (non-financial resources made available free of charge by third parties). In kind contributions provided by third parties free of charge are declared by the participants as eligible direct costs in the corresponding cost category (e.g. personnel costs or purchase costs for equipment).

If the contributions are research infrastructure services, please specify the estimated number of units of access to be provided under the project (even if this can vary depending from the users’ requests), whether the cost of the services will be calculated on the basis of a unit cost, as actual costs or as a combination of the two, and the related total costs that will be charged by the participants which use them to provide access

|  |  |  |  |
| --- | --- | --- | --- |
| **Participant Number/Short Name** | | | |
| **Third party name** | **Category** | **Cost (€)** | **Justification** |
|  | **Select between**  Seconded personnel  Travel and subsistence  Equipment  Other goods, works and services  Internally invoiced goods and services |  |  |
|  |  |  |  |

**Table 3.1k: Summary of trans-national/virtual access provision**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Access provider short name[[3]](#footnote-3)*** | ***Short name of infrastructure*** | ***Installation*** | | ***Installation Country code[[4]](#footnote-4)*** | ***Type of access[[5]](#footnote-5)*** | ***Unit of access*** | ***Estimated quantity of access to be provided*** | ***Unit cost (UC) (€)[[6]](#footnote-6)*** | ***Access costs[[7]](#footnote-7)*** | | ***Estimated number of users*** | ***Estimated number of applications\**** |
| ***Nr8*** | ***Short name*** | ***On the basis of UC*** | ***As actual costs*** |
| **INFN** | **LNL- LNS** |  | **LNL-LNS** | **IT** | **TA-uc** | **Beam hour** | **500** | **90** | **45000** |  | **80** | **25** |
| **GANIL** | **GANIL-SPIRAL2** |  | **GANIL-SPIRAL2** | **FR** | **TA-uc** | **Beam hour** | **500** | **90** | **45000** |  | **80** | **18** |
| **CNRS** | **IJCLAB** | **-** | **IJCLAB** | **FR** | **TA-uc** | **Beam hour** | **190** | **70** | **13300** |  | **16** | **3** |
| **JYU** | **JYFL** |  | **JYFL** | **FI** | **TA-uc** | **Beam hour** | **1000** | **50** | **50000** |  | **60** | **10** |
| **UNIWARSAW** | **NLC\_SLCJ** |  | **NLC-SLCJ** | **PL** | **TA-uc** | **Beam hour** | **192** | **70** | **13440** |  | **16** | **4** |
| **IFJ PAN** | **NLC\_CCB** |  | **NLC\_CCB** | **PL** | **TA-uc** | **Beam hour** | **170** | **70** | **11900** |  | **18** | **3** |
| **IFIN-HH** | **ELI-NP/TANDEM** |  | **ELI-NP/TANDEM** | **RO** | **TA-uc** | **Beam hour** | **500** | **90** | **45000** |  | **80** | **20** |

#§QUA-LIT-QL§# #§WRK-PLA-WP§#

1. The title of work packages focusing on access provision must be preceded by the indication of the type of access activity (TA for transnational access, VA for virtual access, TA/VA for both) and the number of work package for that activity; TA1, TA2, …., VA1, VA2,. [↑](#footnote-ref-1)
2. You must include a data management plan (DMP) and a ‘plan for dissemination and exploitation including communication activities as distinct deliverables within the first 6 months of the project. The DMP will evolve during the lifetime of the project in order to present the status of the project's reflections on data management. A template for such a plan is available in the [Online Manual](https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/om_en.pdf) on the Funding & Tenders Portal. [↑](#footnote-ref-2)
3. Short name of the beneficiary, affiliated entity or associated partner. It can be the infrastructure owner or, if the owner of the infrastructure is another third party contributing resources, the beneficiary/affiliated entity to whom the infrastructure owner provide resources in Annex I and who coordinates access to the service of this research infrastructure. [↑](#footnote-ref-3)
4. Give the ISO two-letter code of the country where the installation is located, or ‘IO’ if the access provider (the beneficiary or linked third party) is an international organization, an ERIC, or a similar legal entity. When the installation is mobile (e.g. a research vessel) give the country of its usual location (e.g. the home port). [↑](#footnote-ref-4)
5. “TA-uc” for trans-national access with access costs declared on the basis of unit costs, TA-ac for trans-national access with access costs declared as actual costs, or “TA-cb” for trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit costs. “VA-uc” for virtual access with access costs declared on the basis of unit costs, VA-ac for virtual access with access costs declared as actual costs, or “VA-cb” for virtual access with access costs declared as a combination of actual costs and costs on the basis of unit costs. Associate partners, as they cannot charge costs, must indicate actual cost (TA-ac or VA-ac) and put 0 in the actual cost column. [↑](#footnote-ref-5)
6. To be filled in only for installations providing trans-national access or virtual access declaring access costs either on the basis of unit costs (TA-uc or VA-uc) or as a combination of actual costs and costs on the basis of unit costs (TA-cb or VA-uc). The unit cost must be calculated through the specific excel table provided in the submission system. Leave blank in case of or trans-national access with access costs declared as actual costs (TA-ac), or virtual access with access costs declared as actual costs (VA-ac). [↑](#footnote-ref-6)
7. Cost of the access provided under the project. For trans-national access and virtual access fill in one of the two columns or both according to the way access costs are declared. The trans-national and virtual access cost on the basis of unit costs must be computed by multiplying the unit cost by the quantity of access to be provided. [↑](#footnote-ref-7)