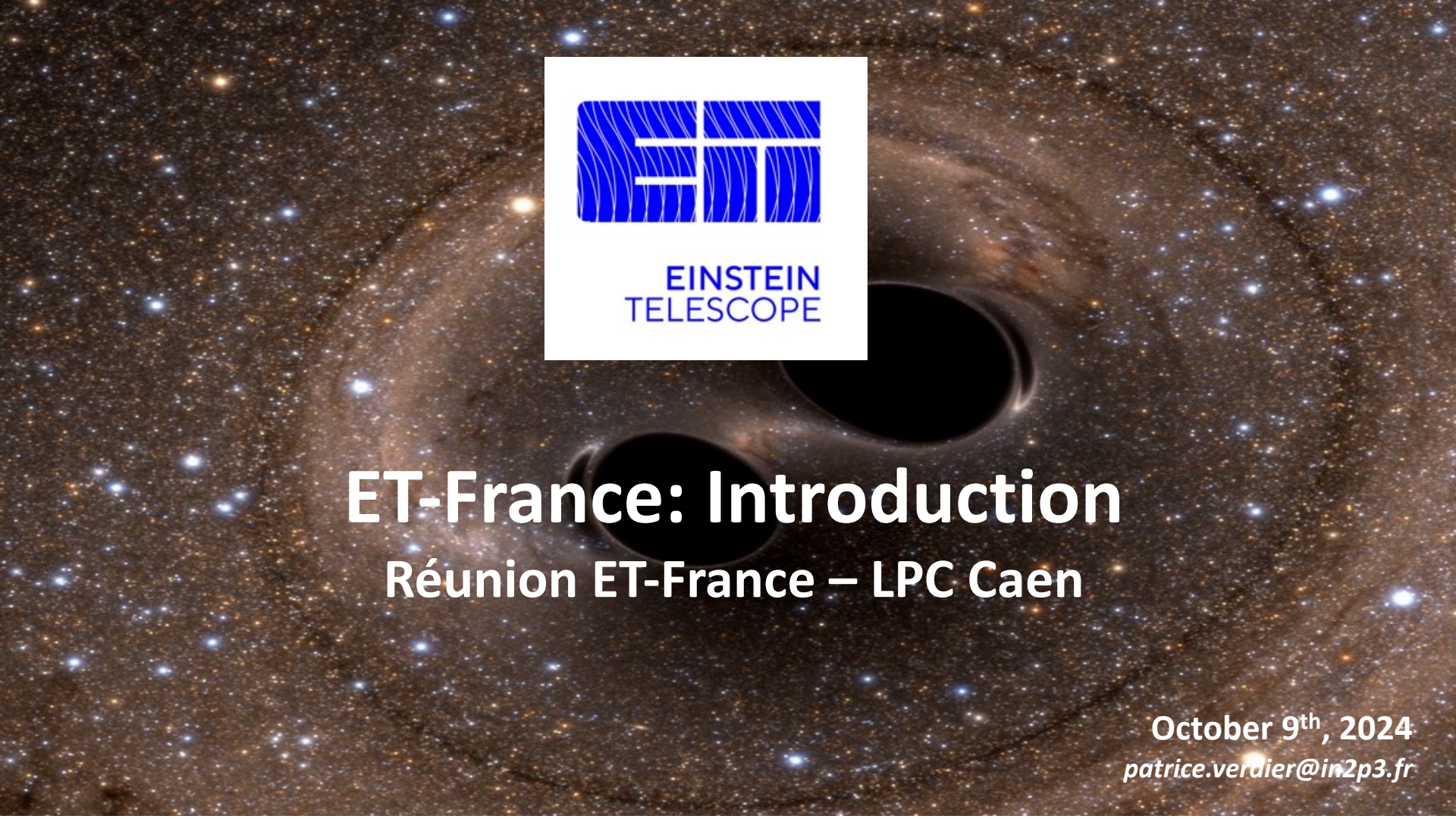


ET-France: Introduction

Réunion ET-France – LPC Caen

October 9th, 2024

patrice.verdier@in2p3.fr

ET France

Einstein Telescope France

154 French collaborators officially joined the ET Collaboration

4 CNRS Institutes: IN2P3, INP, INS2I, INSU

Mailing list ET-France:
ET-FRANCE-L@IN2P3.FR

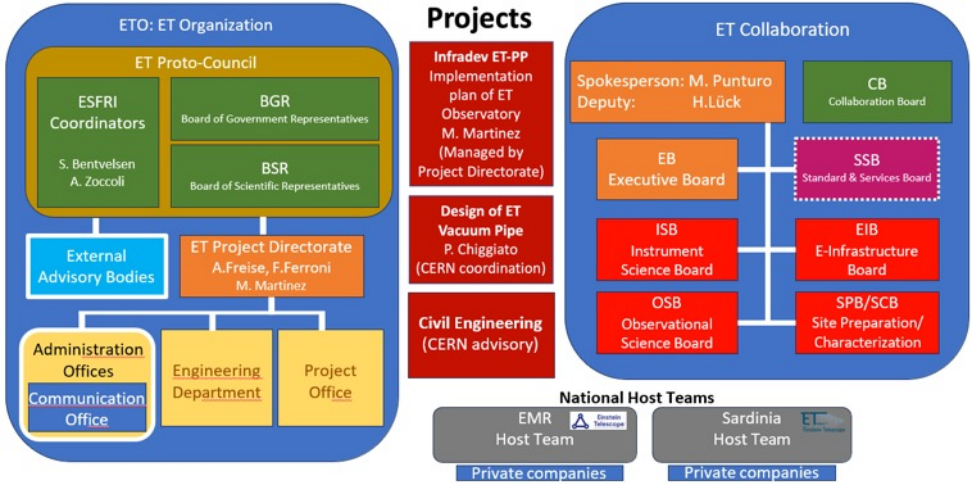
ET-France web site: https://et-france.in2p3.fr

Research Unit (RU)	Laboratories
Artemis	ARTEMIS
Astroparticule et Cosmologie (APC)	APC
	IAS
	SUBATECH
IF-ILM	IF
	ILM
	MSME
IJCLab	IJCLab
	LKB Paris
IP2I - LMA	IP2I Lyon - IN2P3
	LMA - IN2P3
IPHC-L2IT	IPHC
	L2IT
	IRAP
LAPP	LAPP
Paris - Caen	Observatoire de Paris (GEPI, LUTH, SYRTE)
	GANIL / LPC Caen
	IAP

+ CC-IN2P3

Einstein Telescope Organization & Collaboration

ETO est devenu opérationnel (Amsterdam meeting in May 2024)



La collaboration ET est en place et apprend à travailler comme une grande collaboration internationale

- ETO coordonne les activités avec le CERN (tube à vide, génie civil, …)
- Des progrès importants au niveau du BGR d'octobre 2024:
  - Vers un calendrier pour le choix des sites et de la géométrie
  - Entité légale et gouvernances
  - Interactions EGO-Virgo-ET
  - **« Update of the ET roadmap » : hiver 2024-2025**

Comité de travail en place avec un mandat pour proposer une organisation des responsabilités entre ETO et ETC
(M. Branchesi, P. Verdier, D. Trani, R. Saban)

1726 collaborators from 254 institutes in 30 countries worldwide

ETO scope, responsabilities and relations

BGR
Site selection;
Legal entity;
Financial framework

Board of Governmental Representatives (BGR)

ETO Directorate
Strategic coordination and management

- ET Roadmap
- Technical Design Reports
- Site Evaluation Reports
- Technical Plan report
- Organisation report
- Budget report

ET coordinators
Coordinate the EU project - ESFRI

ET Coordinators

ETO
Directorate and Depts

Host Consortia

- Feasibility studies civil engineering, installations
- Feasibility studies subsurface
- Feasibility studies environment and legal

ET Collaboration

- Scientific vision
- Detector design
- Requirements,
- Common standards

ET Host Consortia (EMR and TETI)

ET Collaboration (ETC)

ETO Management team and activities

ETO Management team (still evolving)

- Fernando Ferroni & Andeas Freise (Directors), Mario Martinez (Director of ET-PP INFRADEV)
- Roberto Saban and Daniela Trani (Office of Directors)
- Alessandro Variola (Project Office)
- Fiodor Sorrentino (Technical Coordinator)
- Patrick Werneke (Engineer Department), Maria Marsella (Civil Engineer)
- Martine Oudenhoven (Communication Office)
- Lucia Lilli (Support)
- 2 more coming from KU Leuven

(Benoit Tuybens, administrative support)
(Addis Koeck Siegfried Financial)

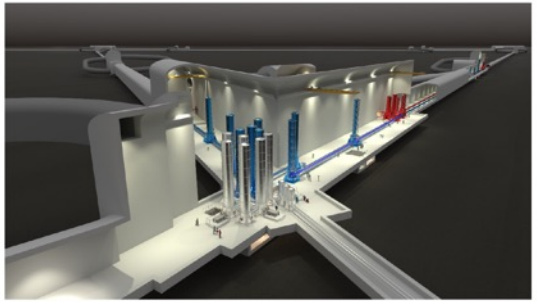
ETO – CERN Activities

IN PROGRESS:

- Civil Engineering
- Vacuum Beampipe

UNDER DISCUSSION:

- Technical Infrastructure
- Occupational Health and Safety
- Integration
- Planning
- Information management
- Costing
- Cryogenics
- Survey



19

ETO Budget request : essentially to pay CERN
(ET should be « cost neutral » for CERN)

		In-kind	CERN Fellows Junior			CERN Fellows Senior			Materials	Studies	Studies	Contributions	Software
		FTE for 3 years	Number	Person-Years	Budget [MCHF]	Number	Person-Years	Budget [MCHF]	[MCHF]	[MCHF]	[M€]	[MCHF]	[M€]
Directorate		8.6											
Project Office		2.0				5.00	10.00	1.12					0.45
Engineering Department		10.0	5.00	15.00	1.40	12.00	26.00	2.91	0.66	1.50	1.00	1.40	0.09
	Totals	**61.8**			**1.40**			**4.03**	**0.66**	**1.50**	**1.00**	**1.40**	**0.53**
	Total [MCHF]	**8.99**	**9.35 in €**										
	Total [M€]	**1.53**			exchange rate 1 CHF =			1.04 €					
	Total in M€		**10.88**										
	+ 10% contingency		**11.97**										

Goals of CERN Contracts in short

- Civil Engineering : Consultancy and Review of the documents. Validation of the final choices. Guidance in preliminary TDR formulation [where most of the cost of the project is]
- Vacuum Pipe : Choice of pipes technology, TDR for the system [120 km of 1m diameter vacuum system [second item for cost]
- Costing : First release of the cost book
- Engineering Department : Definition of the technical infrastructure equipping the tunnel. [see next slide]

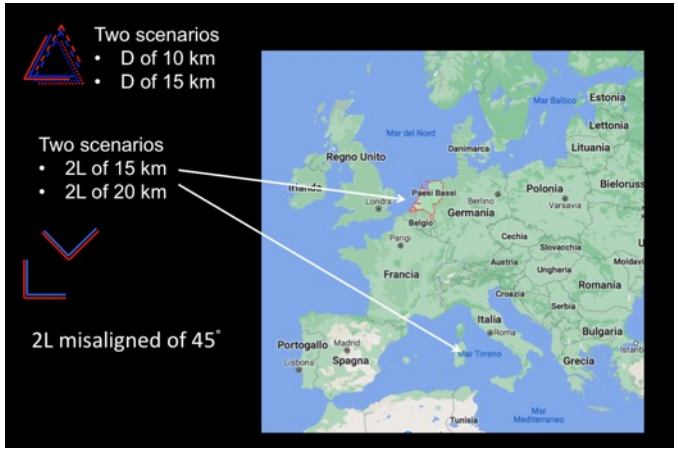
ET Geometry

Highlights 2023-2024

"COBA" (Cost-Benefit Analysis):

- Impact of the geometry on the physics potential
- Essential inputs from ISB
- ETRAC risk analysis

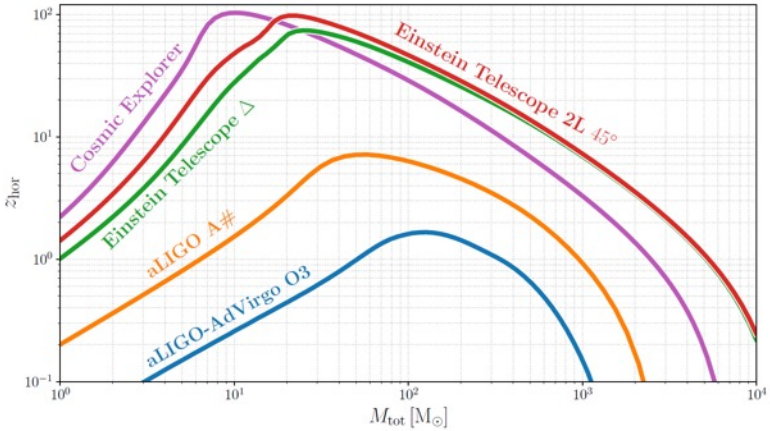
The result of these analyses put strong emphasis on the comparison between the configurations: “1Δ 10km” and “2L 15km”



arXiv:2303.15923 - *JCAP* 07 (2023) 068

Science with the Einstein Telescope: a comparison of different designs

Marica Branchesi, Michele Maggiore, David Alonso, Charles Badger, Biswajit Banerjee, Freija Beirnaert, Swetha Bhagwat, Guillaume Boileau, Ssohrab Borhanian, Daniel David Brown, Man Leong Chan, Giulia Cusin, Stefan L. Danilishin, Jerome Degallaix, Valerio De Luca, Arnab Dhani, Tim Dietrich, Ulyana Dupletsa, Stefano Foffa, Gabriele Franciolini, Andreas Freise, Gianluca Gemme, Boris Goncharov, Archisman Ghosh, Francesca Gulminelli, Ish Gupta, Pawan Kumar Gupta, Jan Harms, Nandini Hazra, Stefan Hild, Tanja Hinderer, Ik Siong Heng, Francesco Iacovelli, Justin Janquart, Kamiel Janssens, Alexander C. Jenkins, Chinmay Kalaghatgi, Xhesika Koroveshi, Tjonnie G. F. Li, Yufeng Li, Eleonora Loffredo, Elisa Maggio, Michele Mancarella, Michela Mapelli, Katarina Martinovic, Andrea Maselli, Patrick Meyers, Andrew L. Miller, Chiranjib Mondal, Niccolò Muttoni, Harsh Narola, Micaela Oertel, Gor Oganesyan, Costantino Pacilio, Cristiano Palomba, Paolo Pani, Antonio Pasqualetti, Albino Perego, Carole Périgois, Mauro Pieroni, Ornella Juliana Piccinni, Anna Puecher, Paola Puppo, Angelo Ricciardone, Antonio Riotto, Samuele Ronchini, Mairi Sakellariadou, Anuradha Samajdar, Filippo Santoliquido, B.S. Sathyaprakash, Jessica Steinlechner, Sebastian Steinlechner, Andrei Utina, Chris Van Den Broeck, and Teng Zhang



Physics potential with "2L 15 km" is generally better (45° orientation) and less risky: Detailed analysis of the costs to be carried out

ET roadmap

WP6 - Deliverables

- D6.1 Refined Science Case (M18) – Feb24
- D6.2 Vacuum pipe Design (M24) – Sept 24
  → CERN (no news over the summer break)
- ~~D6.3 Preliminary RI TDR (M24) – Sept24~~; → ETO
- D6.4 Preliminary DET TDR (M24) – Sept24;
- ~~D6.5 RI TDR (M40) – Feb26~~; → ETO
- D6.6 DMP and Data Access Policy (M46) – Jul26.

D6.1 Refined Science Case

- **Science with the Einstein Telescope: a comparison of different designs** (Published)
  Can be submitted as an intermediate step.

- Blue Book: Slight delays expected w.r.t. plans reported in June 2024
  - The current plan: have a draft with all chapters at the beginning of October, i.e. in ca. 2 weeks time.
  - Final version beginning of 2025.
  - Plan to submit Feb. 2025 still holds

ETO Deliverables in Phase 1

- Definition and organisation of ETO during Phase 1
- Preliminary Technical Design Reports (TDRs) of all parts of the research infrastructure
- Project Management Plan, including project structure, validation and risk analysis managment plans
- Organisational Chart, including financial framework, proposed governance structure etc
- Preliminary Safety Agreement, including a shared and validated understanding of the aspects of safety and applicable laws
- Cost Book
- Project Impact Assessment
- Sites Characterisation
- Configuration analysis
- Risk Report

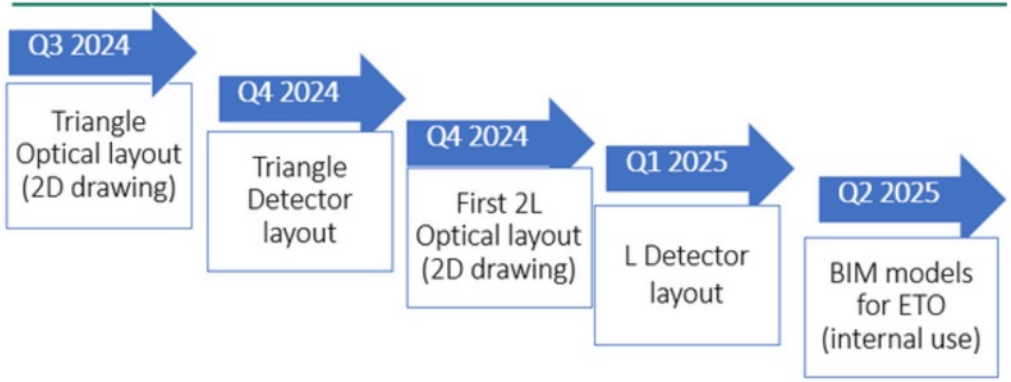
The blue bullets are closely interlinked. One coherent, well managed activities is required to deliver a feasible design and its associated schedule and cost.

Milestones

We have identified critical milestones, many which are out of our (ETO) control, but are essential for advancing along the defined roadmap (timings are estimated):

1) Hierarchical lines, and operative rules between the stakeholders establishment and validation, Q1 2025
2) Approval of ETO organisational and legal definition, Q1 2025
3) ETO resources available, Q1 – Q4 2025 (money – in-kind personnel)
4) Project Baseline definition and release 1.0. (limited to detector and preliminary civil engineering), Q4 2025
5) Project structure finalised, Q3 2025
6) ET-PP project outcome, Q3 2026
7) Recognition of the ET project in CERN's strategy, Q1 2026
8) New ESFRI roadmap release, 2026
9) The bid process definition, TBD
10) The bid-books release. This will trigger the selection process, TBD

Design of the underground civil infrastructure



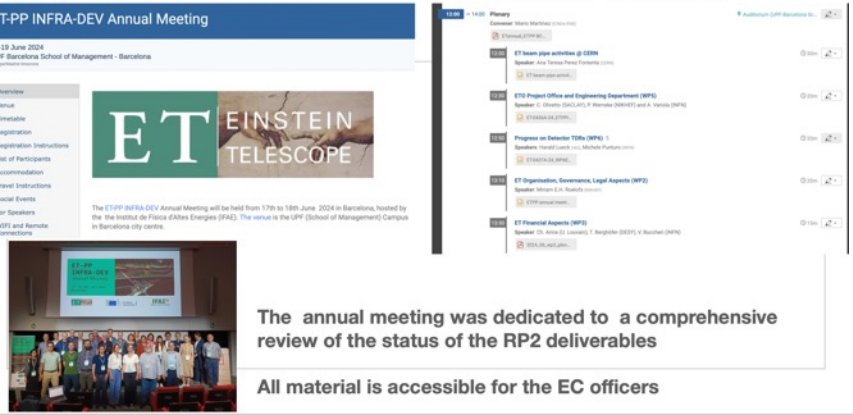
- *ETO will complete the layout of the detector to be adopted as a baseline for the design of the civil infrastructure*
- *Local Teams should optimise construction solutions for site feasibility studies starting from a common design*

- The collaboration updated the 2020 TDR optical 10 km-triangle layout, currently under review to be approved soon.
- Layout shared with EMR and TETI to identify relevant impacts on civil infrastructure, to associated boundary values, tolerances and possible alternatives

Status of ET-PP

ET-PP annual meeting (17th -18th June)

https://indico.ifae.es/event/1930/timetable/?view=standard



The annual meeting was dedicated to a comprehensive review of the status of the RP2 deliverables

All material is accessible for the EC officers

INFRADEV ET-PP status

ET-PP project reached the equator of its execution (2 more years to go)

- ET-PP passed the first formal review; next one expected by Spring 2025

ETO Directorate meeting with EC official on July 2024 @ Brussels

- Good understanding of the status of the project and its complexity
  - Origin of delays w.r.t original ESFRI planning were identified
    - including ET geometry discussions
  - Discussion on new timelines for different deliverables with emphasis on:
    - Site characterization (WP4) —> needs a new timeline
    - Sustainability (WP9) —> studies not at the required level —> hiring expert services
    - Research Infrastructures (WP6 & ETO) and relation with CERN
  - Good Progress reported in many fronts

At CNRS:

- we are on time for our WP5 and WP8 deliverables
- Issues with WP9 to be solved (next slide)

EC Officer review: October 25th, 2024 - Preparation meeting: October 10th, 2024

@ Art Institute Of Chicago

EU analysis on RI sustainability

https://www.esfri.eu/sites/default/files/ESFRI_SCRIPTA_SINGLE_PAGE_19102017_0.pdf

Sustainability studies are supported by EU calls

https://data.europa.eu/doi/10.2777/76269

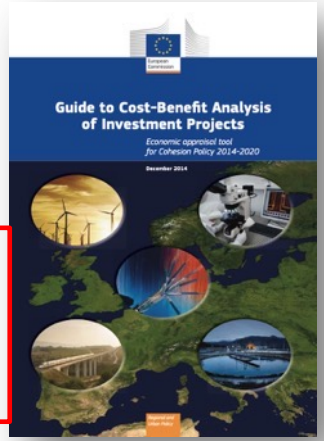
Cost-Benefit analysis:

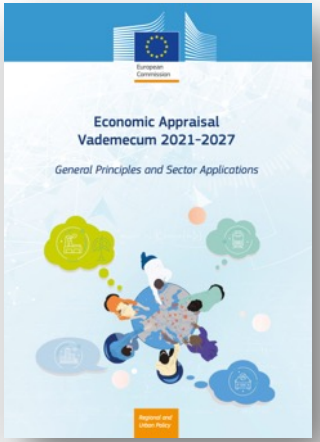
Research Infrastructure guides foresee this approach

Required by ESFRI

WP9 is in difficulty to achieve its works: new personpower required (=> external company), reorganization mandatory

Anyone interested in your lab ?

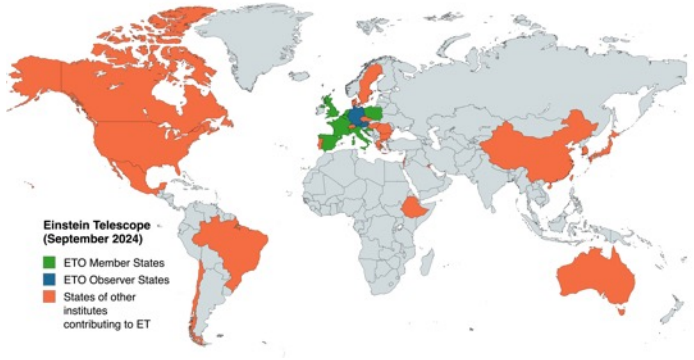




ET BGR Meeting @ EGO : October 3-4, 2024

ET Board of Government Representatives:

- **Members:** Belgium, Croatia, France, Italy, Netherlands, Poland, Spain, United Kingdom
- **Observers:** Austria, Germany
- **Chairs:** Aldo Covello (Italy) & Lodewijk Smoor (NL)
- **Secretaries:** Roberto Cimino (Italy) & Jérôme Pourbaix (Belgium)



Significant progress on many aspects:

- ✓ The role of EGO-Virgo in the preparatory phase of ET
- ✓ Preparation of the update of the ET roadmap
- ✓ Preliminary discussion on the ET geometry
- ✓ Discussion on the ET legal entity: ERIC, IGO, Hybrid (ESRF model)
- ✓ Establish a BGR WG to define the criteria and the decision process for the site selection
- ✓ Clarification needed on the role of CERN (ESPPU impact)

Minutes in preparation…

Muon tomography: pilot run

One of the few French contribution to ET site characterization: J. Marteau *et al*

Muon detectors installed in the Sos Enattos cavern (point Incroce 1) in June 2024 :

- scintillator tracker from the Lyon (France)
- multiwire gaseous tracker from the Wigner (Budapest) team

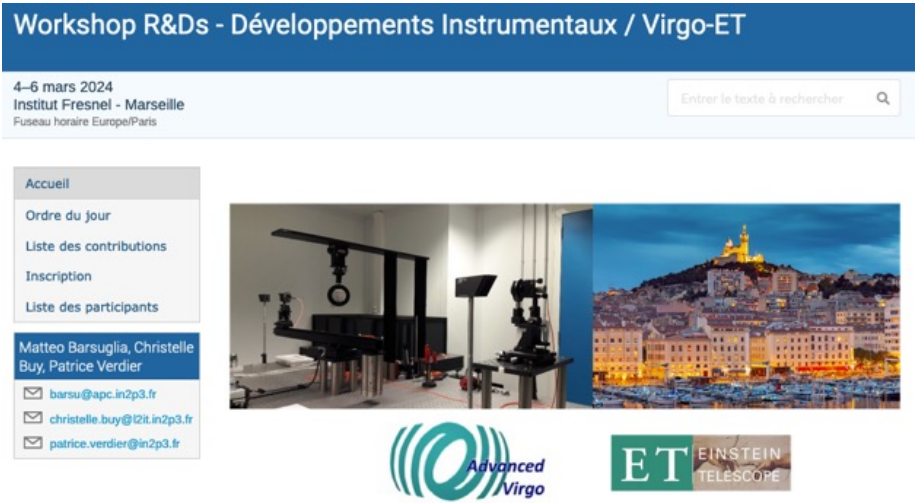
The pilot run will last 2 months and the detector will be moved to a new measurement point (Incroce 2) to perform the characterization of the overburden."

R&D funding & roadmap

Funding:

EU Infratech proposal **M2TECH** : 2nd submission, excellent evaluation, but negative result

Roadmap:



See Christelle Buy's presentation at Virgo France 2024 annual meeting :

https://indico.in2p3.fr/event/33581

Christelle has produced a detailed and exhaustive document about French lab interests in Technology developments for Virgo+ET

Executive summary and R&D roadmap (2-3 pages !!)

- to be prepared during Fall 2024
- to be sent to MESR/DGRI

Industrial partnerships

First meeting organized in March 2023 with MESR to present ET to the French industries interested by this project

=> About 30 companies were present and have shown interest to works with us, either through dedicated/joint R&D program, either as manufacturer of components

https://indico.in2p3.fr/event/28704

Follow-up in Sept. 2023 with a network of French companies (PIGES) involved in Big Sciences

https://www.piges.eu

ET-France has an "Innovative Liaison Officer" (same function as for other RIs like CERN, XFEL, ESRF …) reporting to MESR-DGRI => Guillaume Olry

We are following and contributing to ET-PP WP7 dedicated to industrial partnerships => Big Science Business Forum at Trieste in Oct. 2024:

ET was very well represented (but no French ET participant…)

https://www.bsbf2024.org

Discussion en cours pour la mise en place éventuelle d'une organisation type **Maison SKA-France**: à suivre https://ska-france.oca.eu/fr/accueil-ska

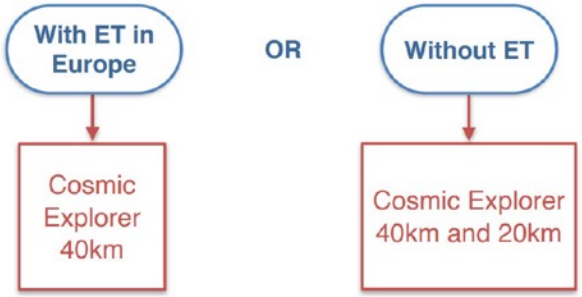
Contacts:

guillaume.olry@ijclab.in2p3.fr and patrice.verdier@in2p3.fr

Next-generation GW Observatory in the U.S.

In 2023, NSF convened a review panel to study the landscape of next-generation GW observatories in the U.S. In March 2024 the panel (or MPS AC sub-committee) recommended potential candidates for such observatories as MREFC projects.

Recommendations:



MPS and Physics Division have provided $14.2M in 2023/24 for CE design work. While these commitments are expected to be carried out in the next years, everything depends on the NSF budget appropriations.

Conclusion & Perspectives

Technologies needed for ET are not yet available. An ambitious R&D program is needed at European level to develop them during the next 10-15 years:

- In synergy with EGO-Virgo which will continue to lead the field in Europe for the next 15 years: the technologies developed for Virgo and its upgrades (Virgo_nEXT) are the ones which will be used for ET-HF (risk reduction for ET)
- Funding dedicated R&Ds for ET-LF is mandatory : ET-LF is the main reason to go underground and to significantly increase the cost of the civil infrastructure, while 6 orders of magnitude (!) in sensitivity must be gained compared to the current state-of-the-art (!)

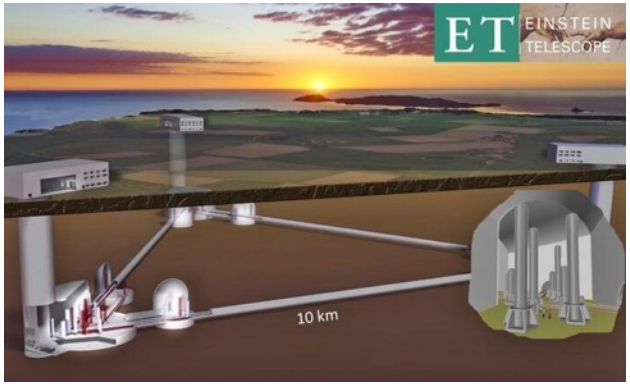
French position:

- Supporting EGO-Virgo remains the top priority for the next years: it is only once Virgo has reached its nominal sensitivity that we will be able to convince decision makers to support and fund ET
- The preparation of ET must be organized as a global European project with tight links with other international projects (Virgo, KAGRA LIGO, Cosmic Explorer)
- French scientists support the idea that ET should favor the configuration with the longest possible arms in order to face the competition with the US project Cosmic Explorer

BACKUP

Site candidates

Sardinia – Italy



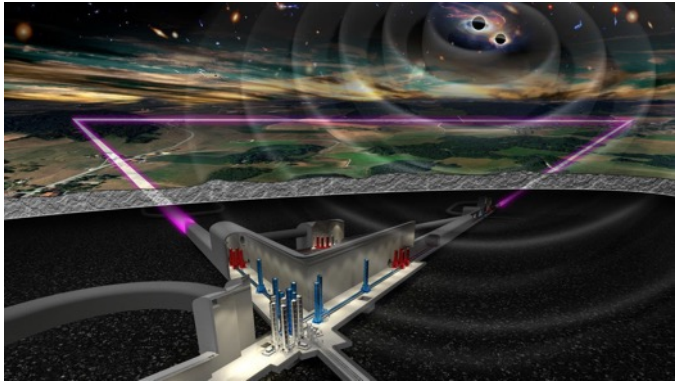
€50 million for R&D and preparatory work

ETIC in Italy

Einstein Telescope Infrastructure Consortium

"Multi-100 M€" financing to support ET's site in Sardinia

Euregio Meuse-Rhin Netherland



€42 million for R&D and preparatory work

ET-Pathfinder in Maastricht

"Multi-100 M€" financing if the ET site is in Euregio Meuse-Rhine

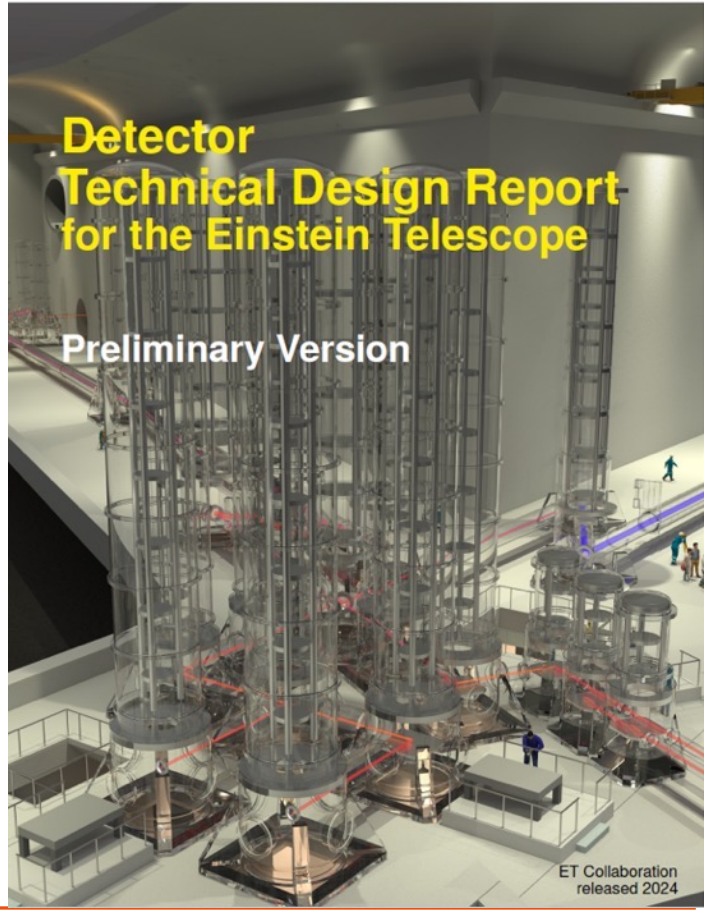
Saxe – Germany

New DZA laboratory (2022)

170 M€/year over 10 years

3 pillars: astrophysics, data science, technology

Preparing the ET TDR



Deadline: July 2025

Preparing the Blue Book

Contents

+Summary and Appendix

- New updated Science Case Paper for ET
- Detailed comparison among different configurations and designs through simple metrics and specific science cases

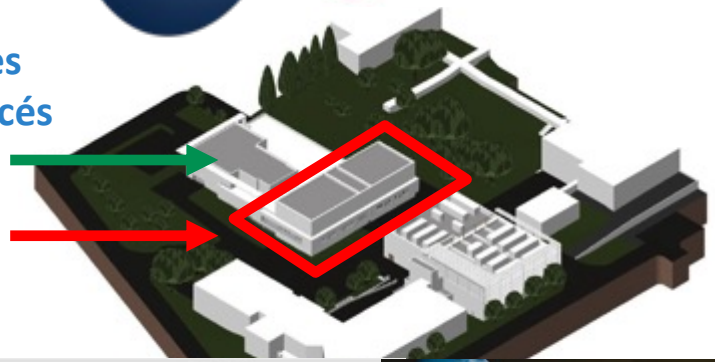
Deadline: February 2025

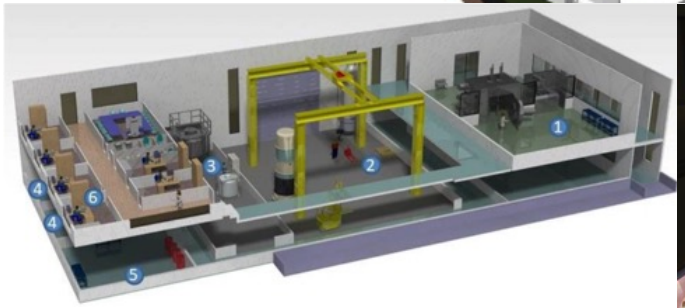
Extension of the LMA in Lyon

Laboratoire des Matériaux Avancés

Current

Extension





Contrat de Plan Etat-Région 2021-2027

An investment for:

- the extension of the LMA building
- the construction of a new coater allowing the deposition of thin films on very large substrates: Ø 1.6 m, 600 kg
- associated optical and metrology tools

LMA is a research infrastructure unique in the world

Developing technologies for future experiments (e.g. Einstein Telescope)

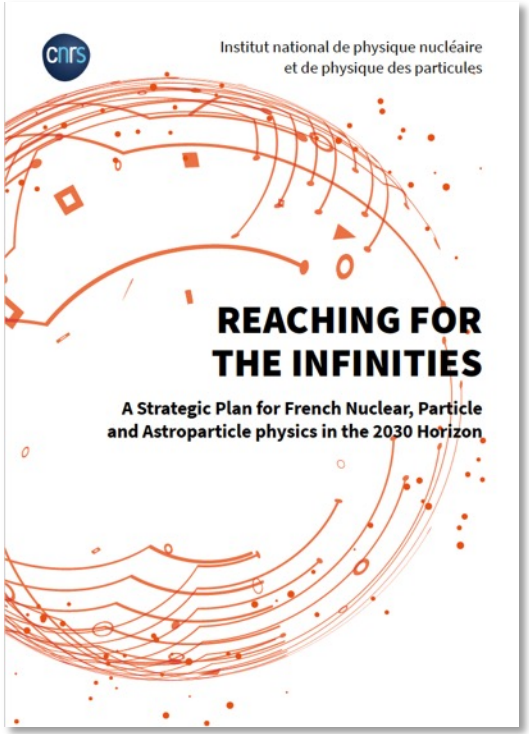
Conclusion & Perspectives

In France, preparing 3G experiments for ground-based GW detection has been identified as a priority in the [Strategic Plan for French Nuclear, Particle and Astroparticle physics in the 2030 Horizon]

Compte rendu

Conseil scientifique de l'IN2P3
3-4 juillet 2023

Concernant le lien avec ET, le Conseil s'inquiète du fait que, à l'opposé du mouvement observé aujourd'hui dans la communauté internationale, l'IN2P3 ne s'engage pas dès aujourd'hui plus fortement sur ET. Le Conseil recommande en conséquence de contribuer à Virgo_nEXT prioritairement sur les sujets qui permettront aux équipes de se préparer et de se positionner au mieux dans ET, c'est-à-dire en particulier, sur les enjeux communs aux deux projets que sont la stabilisation des cavités, les développements des revêtements pour des masses d'une centaine de kg pour Virgo_nEXT, qui permettront d'avancer vers les 200 kg prévus pour la détection d'ondes gravitationnelles de haute fréquence avec ET, et la réduction de 10 dB du bruit quantique grâce aux états comprimés visée par Virgo_nEXT, qui est identique aux spécifications d'ET aux hautes fréquences.



EINSTEIN TELESCOPE