



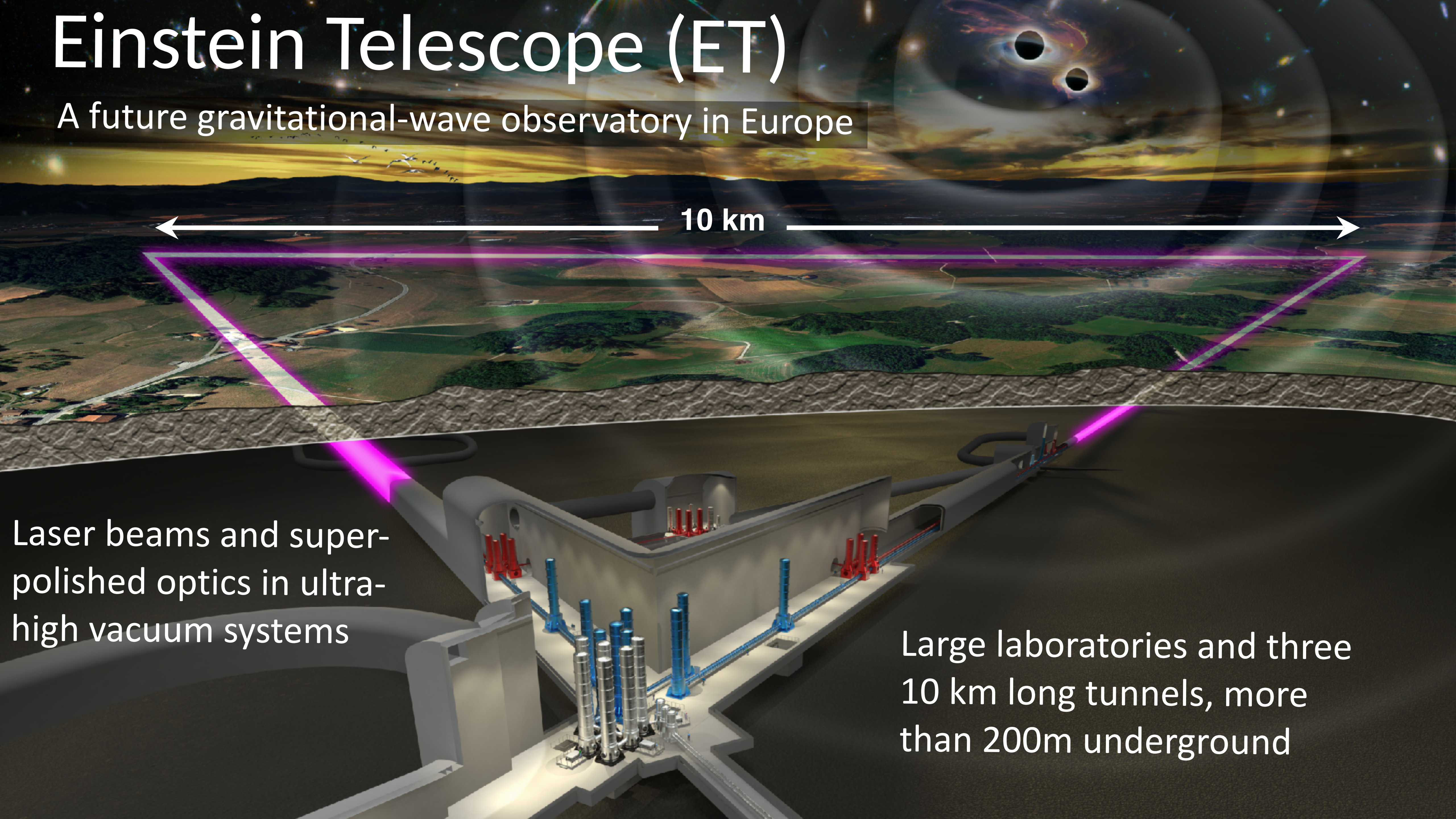
Einstein Telescope, an international project

Andreas Freise

Nikhef VISTA meeting, 07.09.2022

Einstein Telescope (ET)

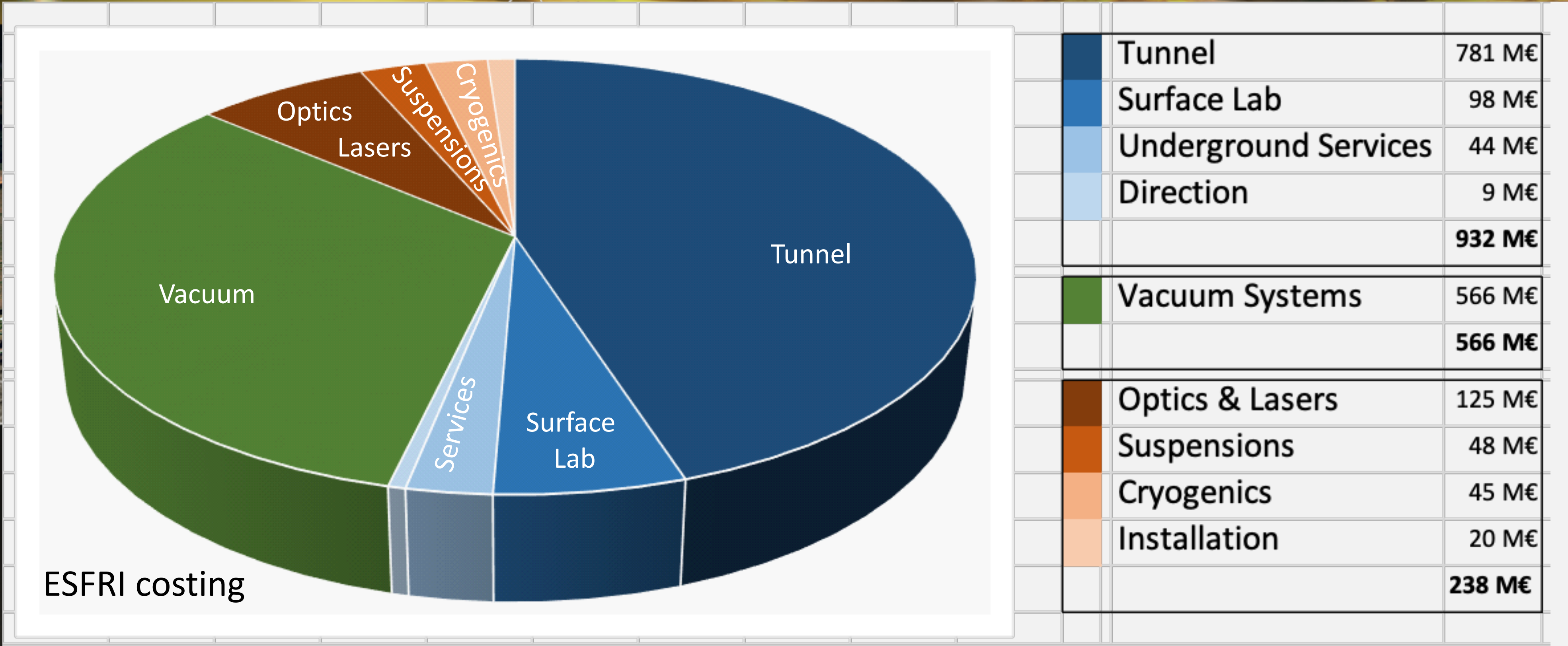
A future gravitational-wave observatory in Europe



Laser beams and super-polished optics in ultra-high vacuum systems

Large laboratories and three 10 km long tunnels, more than 200m underground

Einstein Telescope: construction costs

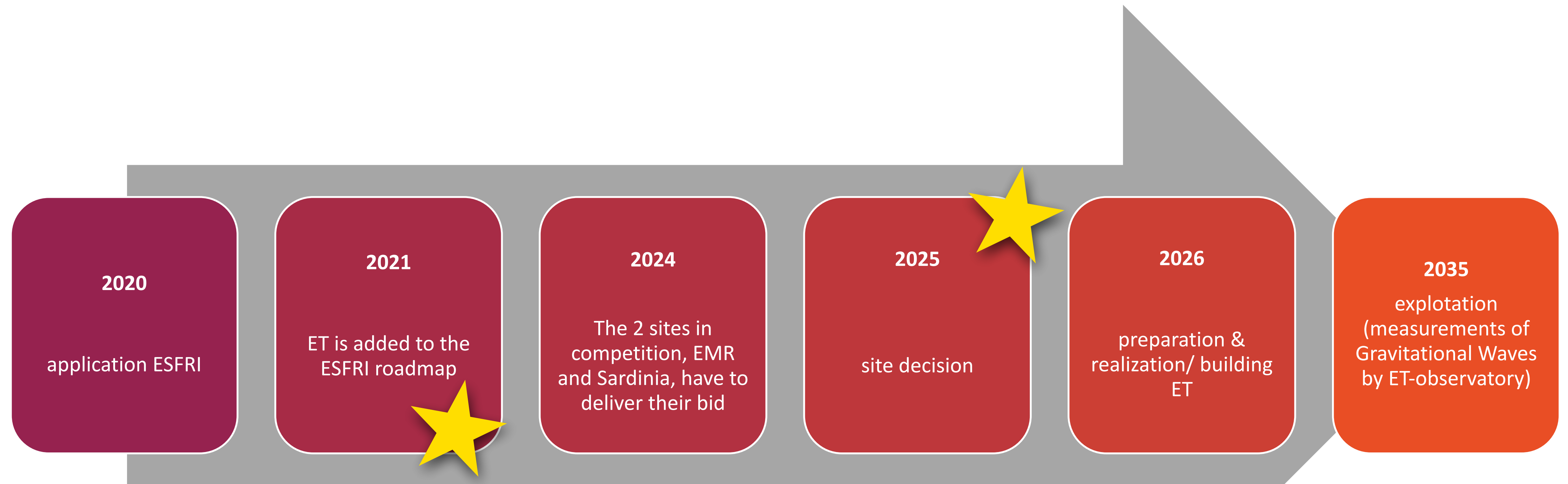


Underground infrastructure for
more than 50 years of operation

Plus design and development cost: ~200 M€
Total cost (excluding personnel): ~1.900 M€



The Einstein Telescope, the EU project timeline



The Einstein Telescope is a project that will be carried out within the framework of the European Strategy Forum for Research Infrastructures (ESFRI).

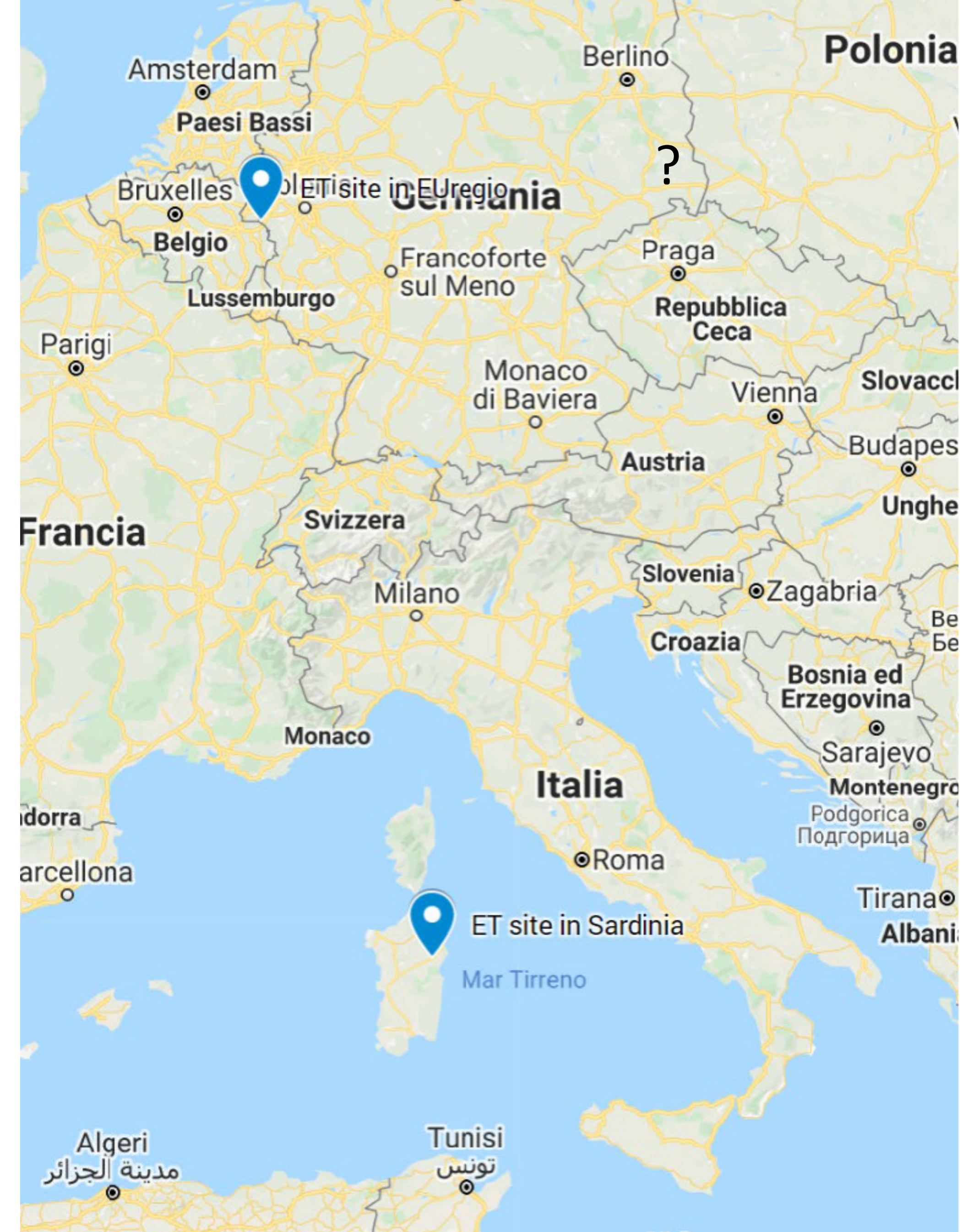
ET Governance: INFN and Nikhef leading a consortium of 41 European institutions.

By 2025 governments must decide on whether to host ET in their country.



Possible ET site(s)

- Currently there are two sites, in Europe, candidate to host ET:
 - The Sardinia site, close to the Sos Enattos mine
 - The Meuse-Rhine Euroregion site, close to the NL-B-D border
- A third option in Saxony (Germany) is under discussion, but still too preliminary to be a candidate.
- Site decision foreseen for 2025



Proto-Council

ESFRI Coordinators

Stan Bentvelsen, Antonio Zoccoli

BGR (Board Governm. Represent.)

BSR (Board Scient. Represent.)

Advisory Bodies

- **STAC:** Scientific and Technical Advisory Committee
- **Program Advisory Board**

Policy & monitoring

Project Directorate

Andreas Freise, F. Ferroni

Deliverables:
Beam pipe vacuum
Site Preparation
Civil Infrastructure

INFRA-DEV

M. Martinez

- WP1 Coordination and Management
- WP2 Organization, Governance, Legal
- WP3 Financial Architecture
- WP4 Site Preparation
- WP5 Project Office/Engineering Dept.
- WP6 Technical Design
- WP7 Transfer of Technology
- WP8 Computing and Data Access
- WP9 Sustainable Development Strategy
- WP10 Education, Outreach, Citizen Engagement

monitoring

delivering

CERN

MOA

CERN-INFN-Nikhef

P. Chiggiato

TDR ET Vacuum Pipe

Requirements & competences

Setting up

Communication Office

Project Office

Engineering Department

ET Observatory

ET Collaboration

M. Punturo, H. Lück

EB
Executive Board

CB
Collaboration Board

managing reporting

SF
Science Forum

participating supervising

ISB
Instrument Science Board

EIB
Electronics/
Computational
Infrastructure
Board

OSB
Observational
Science Board

SCB
Site
Characterisation
Board

Specific Boards

Snapshot of a system in flux, during the creation of the ET organisation

Dual structure: formal organisation (towards legal entity) and scientific collaboration

ET Observatory

Board of governmental representatives

Coordinators

Board of Scientific
representatives

ET Directorate

INFRA-DEV

EU project coordination
WP1:
WP2:
WP3:
...

Project office

Engineering
department

...

ET Collaboration

Collaboration board

Executive board

Specific boards

ISB

OSB

EIB

SCB

SSB

...

The collaboration





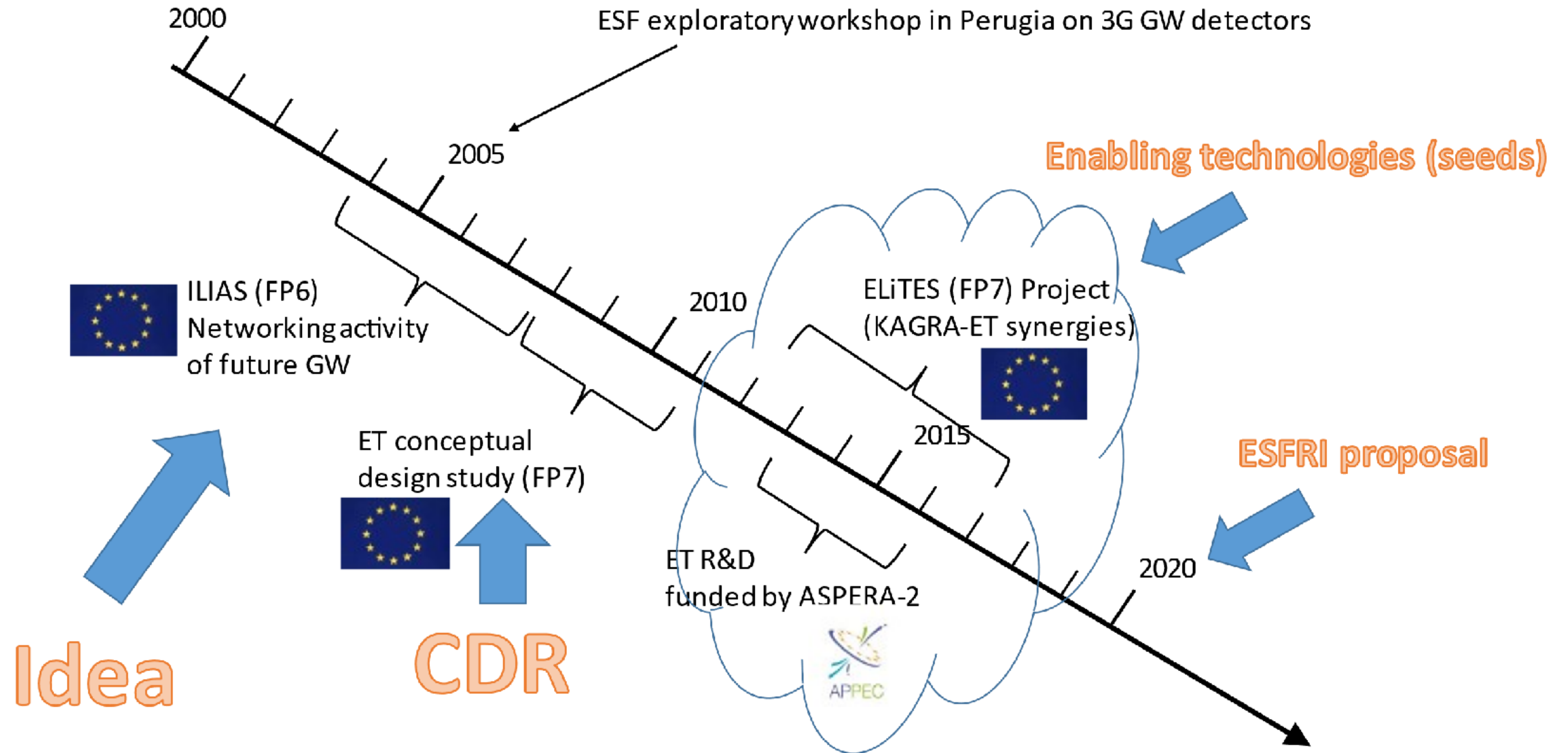
Harald Lück
deputy spokesperson

Michele Punturo
spokesperson

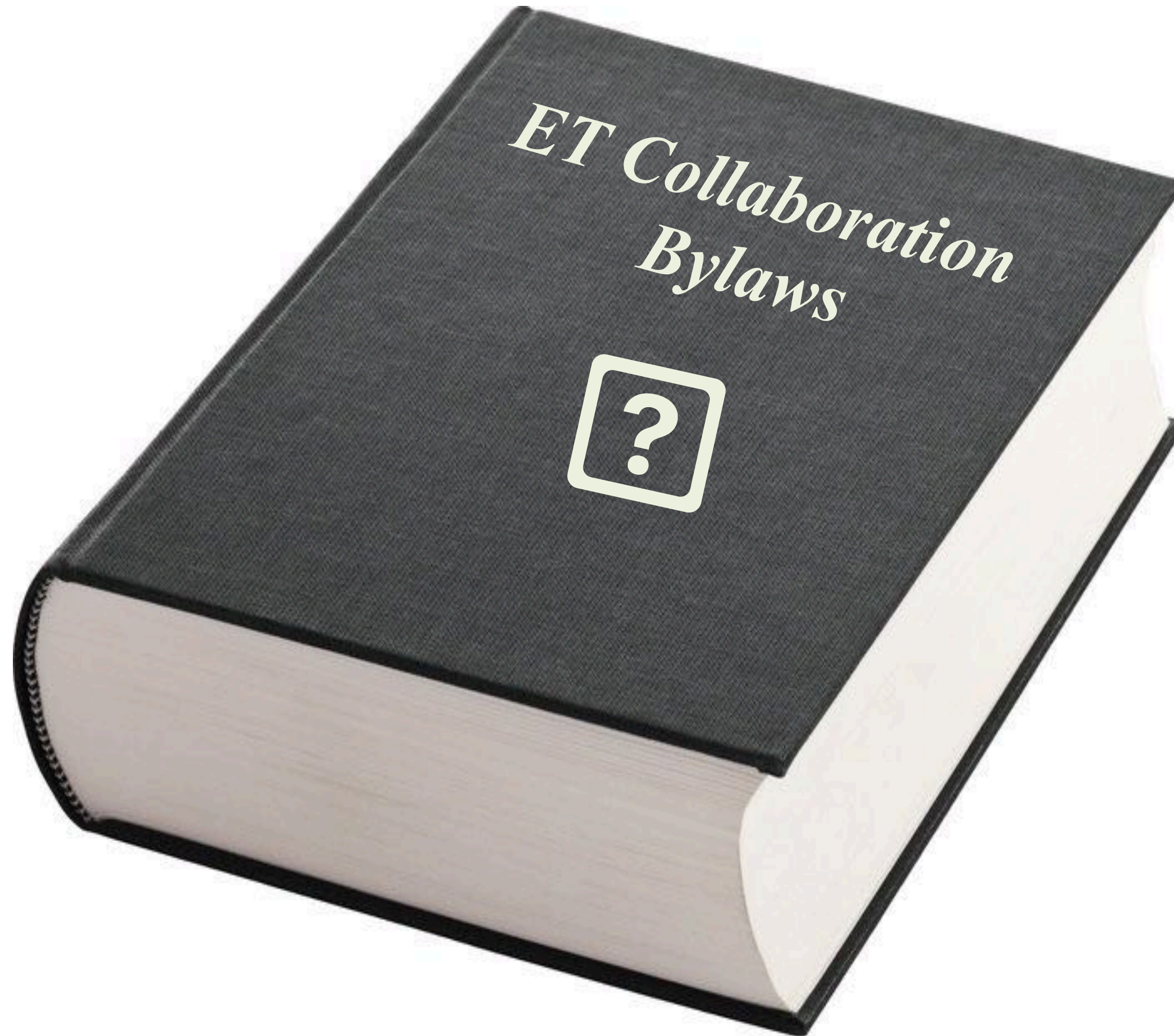
Official Birth of the ET Collaboration
XII ET Symposium, Budapest on June 7th - 8th 2022
More than 400 scientists, out of >1200 members of the
Collaboration, attended the meeting in person or remotely.

<https://indico.ego-gw.it/event/411/>

Historic timeline of the Einstein Telescope



Collaboration bylaws approved

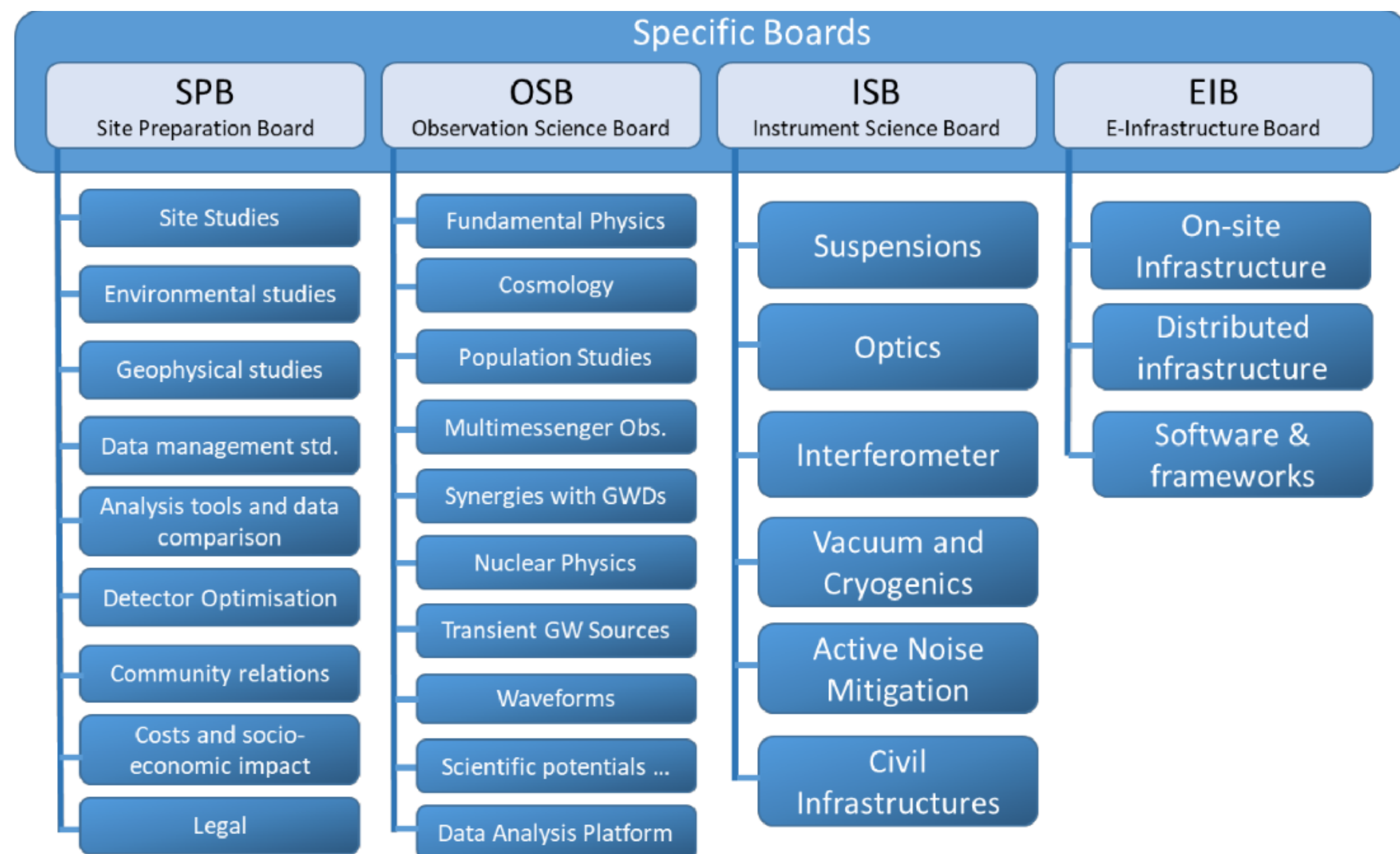


- 1) Preamble
- 2) Scope of the Collaboration
- 3) Collaboration Structure
 - Collaboration Membership
 - Membership Categories
 - Qualification for Membership;
 - Duties of Collaboration Members
 - Member Rights
 - Becoming a Member
 - Legacy Members
 - Membership Termination
 - Role Incompatibilities
 - The Collaboration Board (CB)
 - Collaboration board activities
 - Collaboration Board Composition
 - Motions and Voting
 - ET Science Forum
 - Forum of National Representatives
 - Collaboration Spokesperson and Deputy Spokesperson
 - Executive Board
 - Specific Collaboration Boards
 - Instrument Science Board (ISB)
 - Observational Science Board (OSB)
 - Site Characterization Board (SCB)
 - Collaboration Services and Standards Board
 - Basic Structure
 - ET Core Program Committee (CPC)
 - ET Early Career Scientists Support Committee (ECSS)
 - Diversity, Equity, Inclusion, Access and Ethics Committee (DEIAEC)
 - Speakers and Awards Committee (SAC)
 - Editorial Committee (EC)
 - Collaboration Agreement Document Committee (CADC)
 - Standards and Conduct Committee (SACC)
 - Elections, Voting and Membership Committee (EVMC)
 - Meetings and Symposia Committee (MSC)
- 4) Collaboration
- 5) Common funds



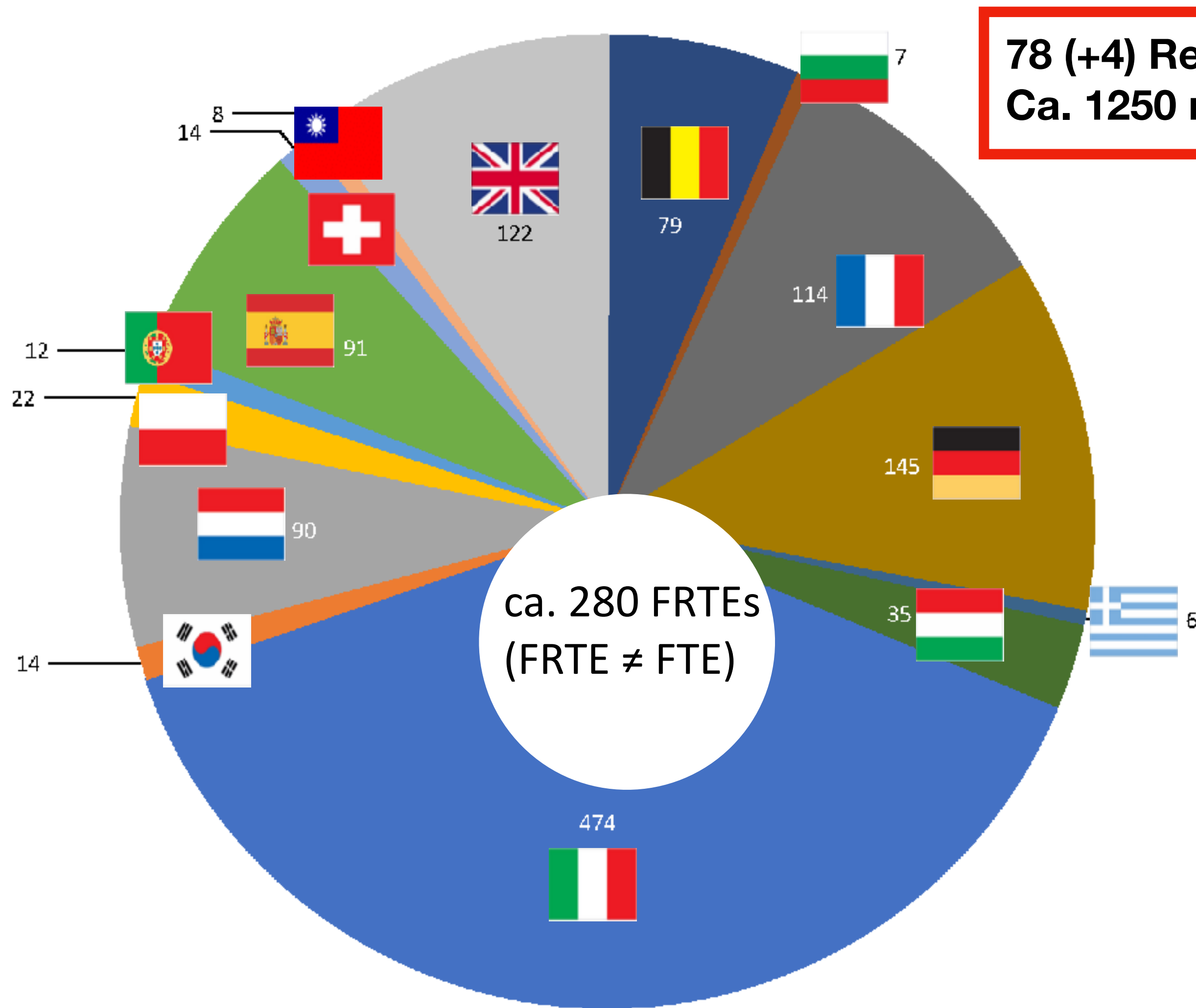
International scientific collaboration

The international ET collaboration has established an organization with boards and working groups on instrumentation science (ISB), observation science (OSB), site studies (SPB) and computing infrastructures (EIB)



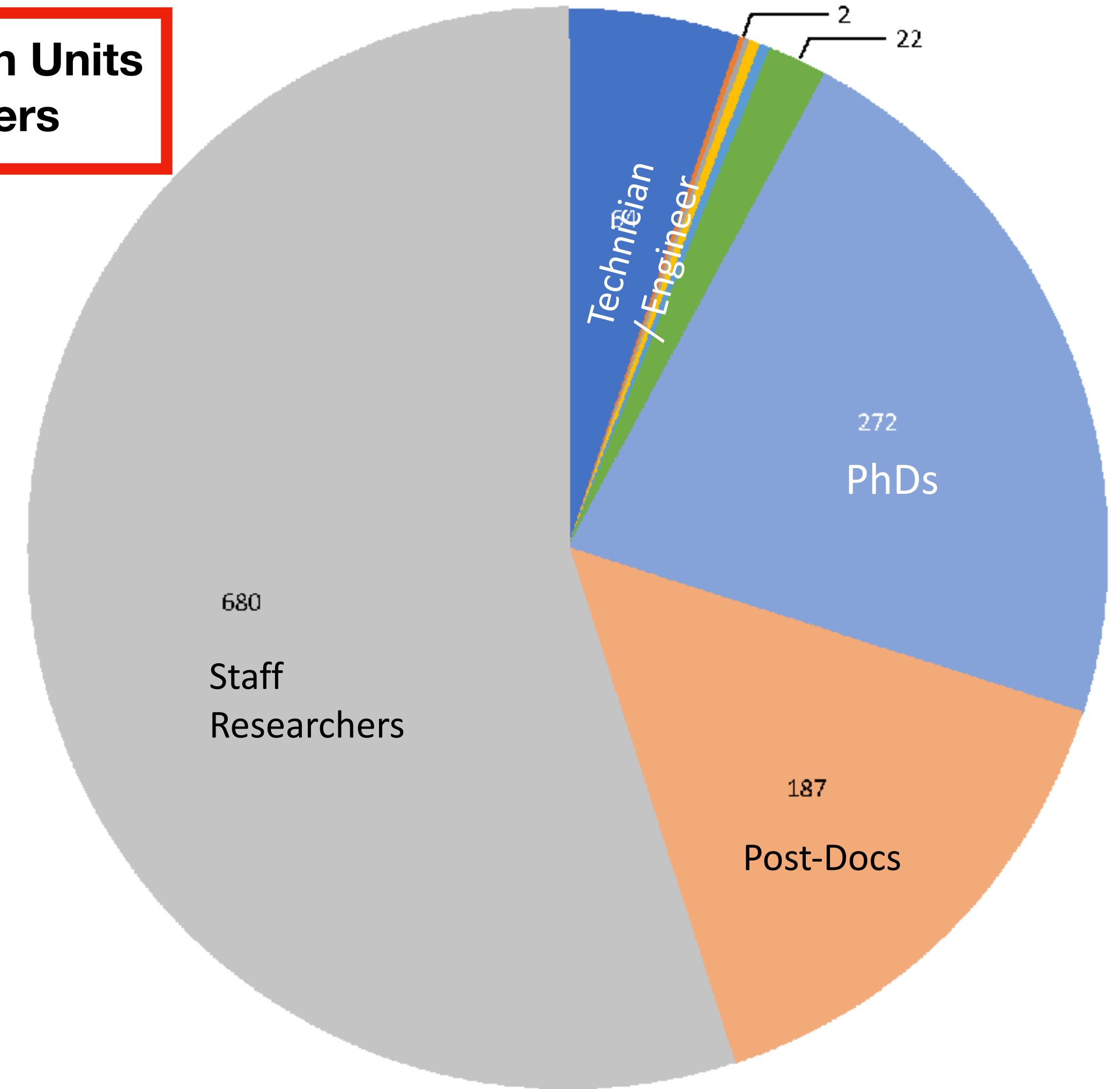
ET Collaboration Members per Country

- | | | | | |
|----------|----------|--------------|-------------|----------------|
| Belgium | Bulgaria | France | Germany | Greece |
| Hungary | Italy | Korea, South | Netherlands | Poland |
| Portugal | Spain | Switzerland | Taiwan | United Kingdom |



Collaboration Composition

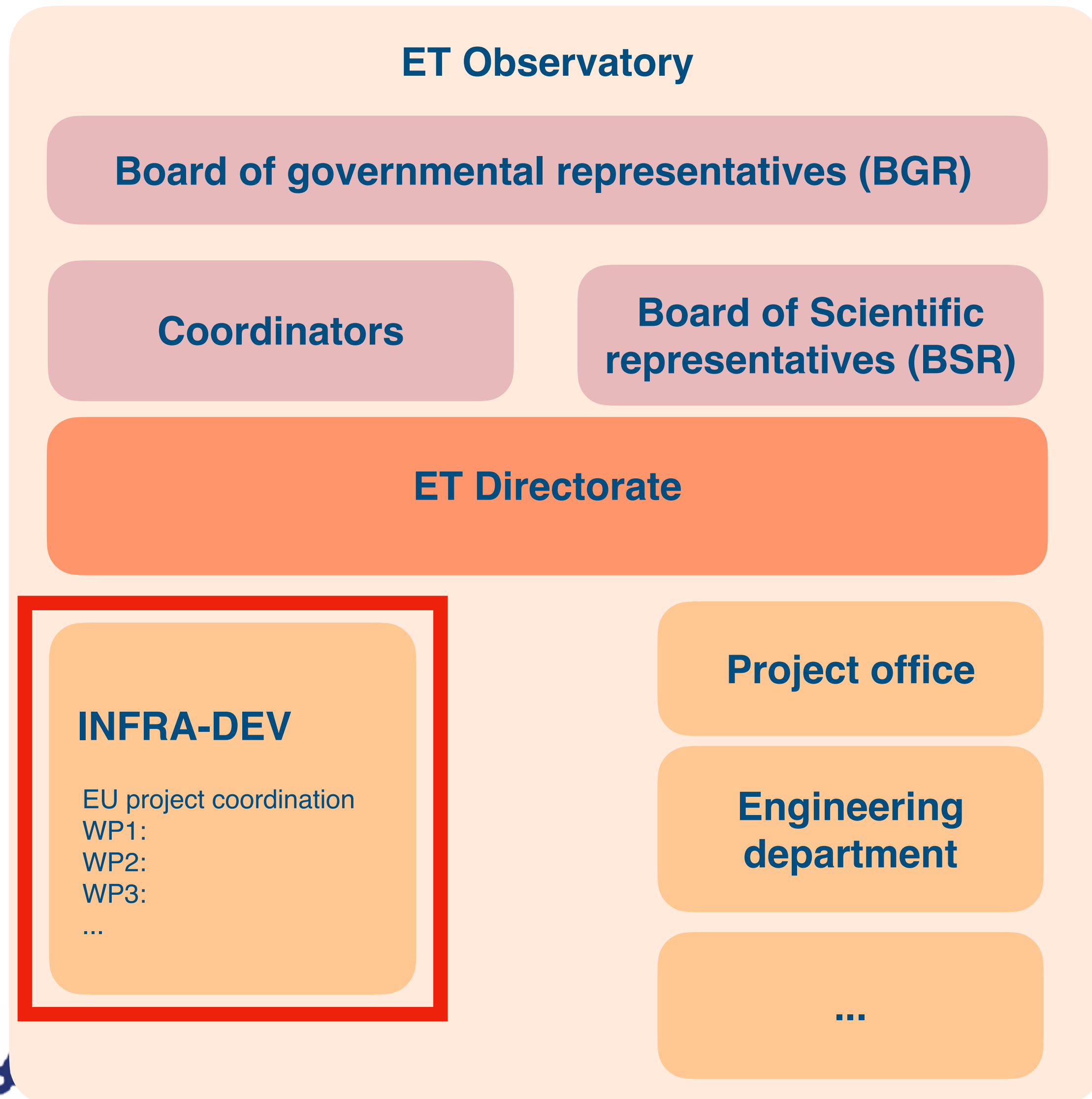
- | | | | | |
|------------|---------------------|----------|------------------|--------------|
| Technician | Assistant Professor | director | Full Professor | group-leader |
| Other | PhD | Post-doc | Staff researcher | |



The 'observatory'



Nikhef and INFN co-lead setting up the observatory



- BGR chair: **Jeanette de Ridder**, Aldo Cavallo
Job de Kleuver (secretariat)
- Coordinators: **Stan Bentvelsen**, Antonio Zoccoli
- BSR, chaired by coordinators, NL member **Stefan Hild**
- ET Directorate: **Andreas Freise**, Fernando Ferroni
- INFRA-DEV: Mario Martinez
- Project office: Alessandro Variola
- Engineering department: **Patrick Werneke**

European 'Preparation Phase' (INFRA-DEV)

INFRA-DEV

EU project coordination
WP1:
WP2:
WP3:
...

- EU proposal 'Infra-dev', duration 4 years, starting now!
- Total budget 13.3 M€ (Nikhef participates with 3 M€) for the European 'Preparation Phase' of ET, towards a legal entity with functional management structure
- Key deliverables include:
 - financial structure, **organisation and governance**
 - creation of international project office and engineering department
 - scan of legal procedures, permitting and land acquisitions
 - updated cost and schedule estimates of the excavations
 - ...



Local ET efforts in other countries (two examples)



ETIC – Einstein Telescope Infrastructure Consortium



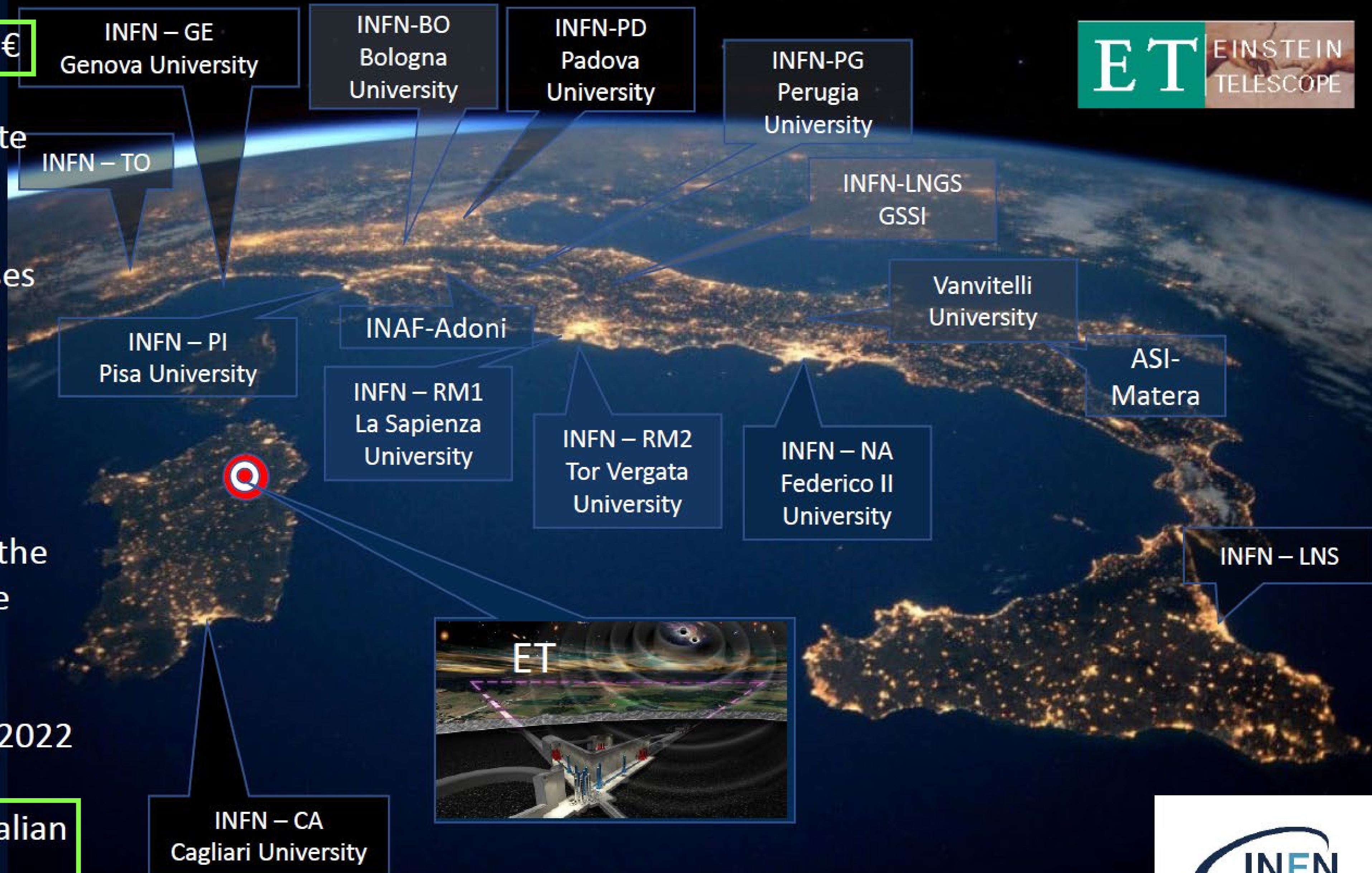
Next Generation EU
Investment proposed **100M€**
focused on ET enabling
technology and Sardinian site
candidature support

- 8% Human Resources
- 30% Scientific apparatuses
- 12% Distributed Infrastructures
- **28% ET design**
- 12% Training

Additional 5M€ funding on the
same framework for the site
characterization

Feedback expected in June 2022

**Discussion ongoing on an Italian
share toward ET realization**



<https://www.deutscheszentrumastrophysik.de>



Vision

Zentrum

Wettbewerb

Partner

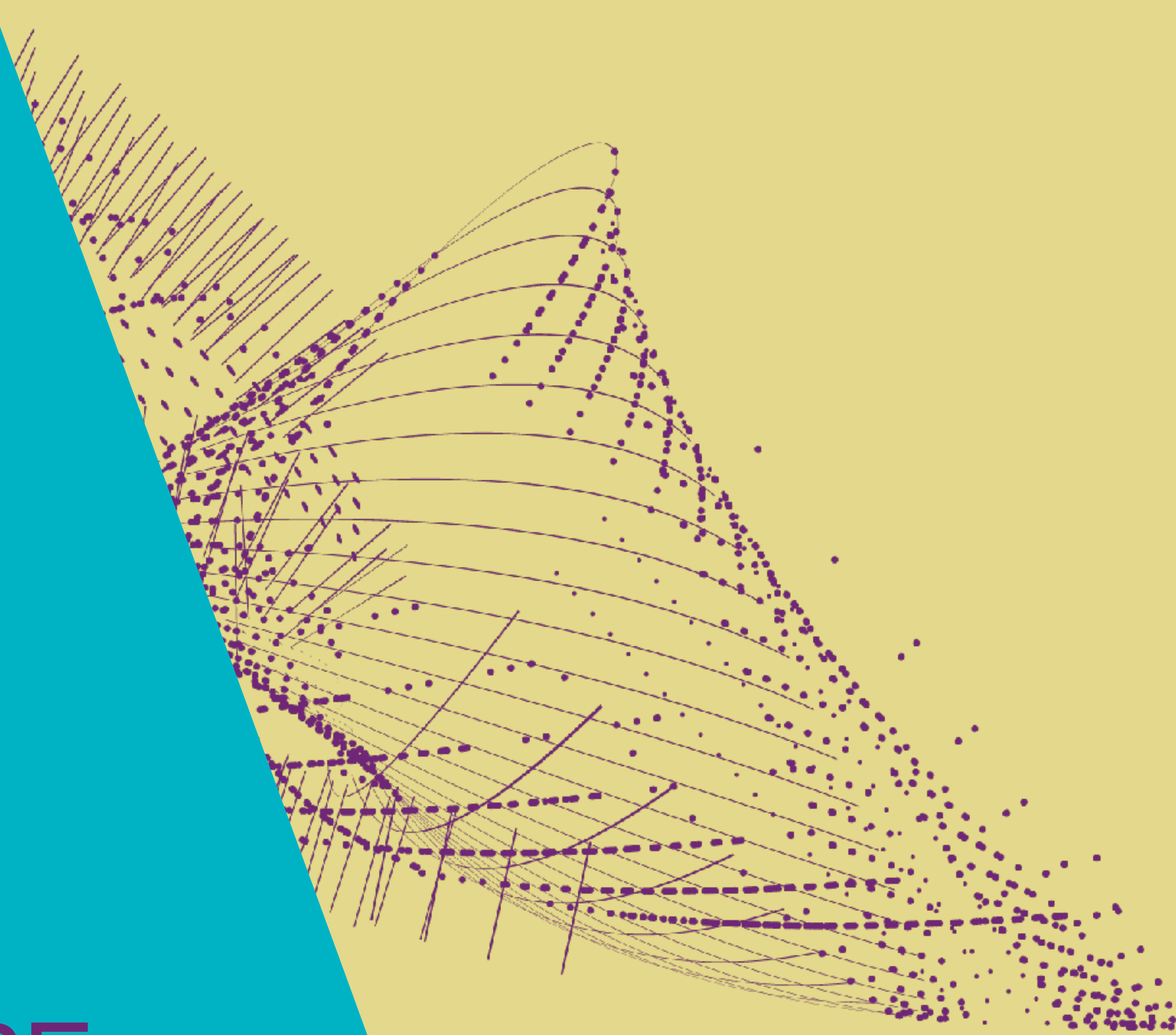
- Deutsches Zentrum für Astrophysik (German centre for astrophysics): proposal for a large new institute in east Germany.
- Pre-proposal was successful, main proposal submitted summer 2022. Proposal highlights SKA and ET as key topics for the institute, including the possibility to host ET.

Summary

- ET can look back on **more than 10 years of stable corporation between many European research groups** (majority of GW community).
- The **ESFRI approval in 2021 kick-started** a process to formalise the collaboration and to start the **path towards a legal entity for the observatory**.
- **Nikhef has been - and is - in the driving seat** for this process, provides essential leadership and expertise which **complements** the scientific collaboration.
- ESFRI and Nationaal Groiefonds success provides enormous momentum for ET, we must use **this opportunity** to establish international partnership for funding and organisation.
- Next years are critical for gathering local and international support on all levels. **Without a strong international scientific community there will be no Einstein Telescope.**



EINSTEIN TELESCOPE IN THE *EMR*



ET IN EUREGIO MEUSE-RHINE (EMR)

Dutch National Growth Fund for ET

- 42 ME (conditionally) awarded *now*
 - 19 ME: connections to industry for research and innovation: 'the aim of this programme is to optimally position [...] in particular Dutch industry, for R&D and orders related to Einstein Telescope'
 - 23 ME: 'for the preparation toward the realisation of the underground infrastructure [...]', project organisation and management
- 870 ME have been reserved for the construction of the ET infrastructure
 - If the EMR site is selected as the location for ET



NATIONAL GROWTH FUND

Fantastic opportunity for a giant scientific infrastructure

- Strong support from the NGF committee - based on economic benefits
- NGF funding is additional - does not interfere with 'usual' science budget
 - The Nikhef science program will **not** benefit from NGF funds

Strong and dedicated support for ET by our ministries

- Einstein Telescope is well known in the Hague, as well as Limburg

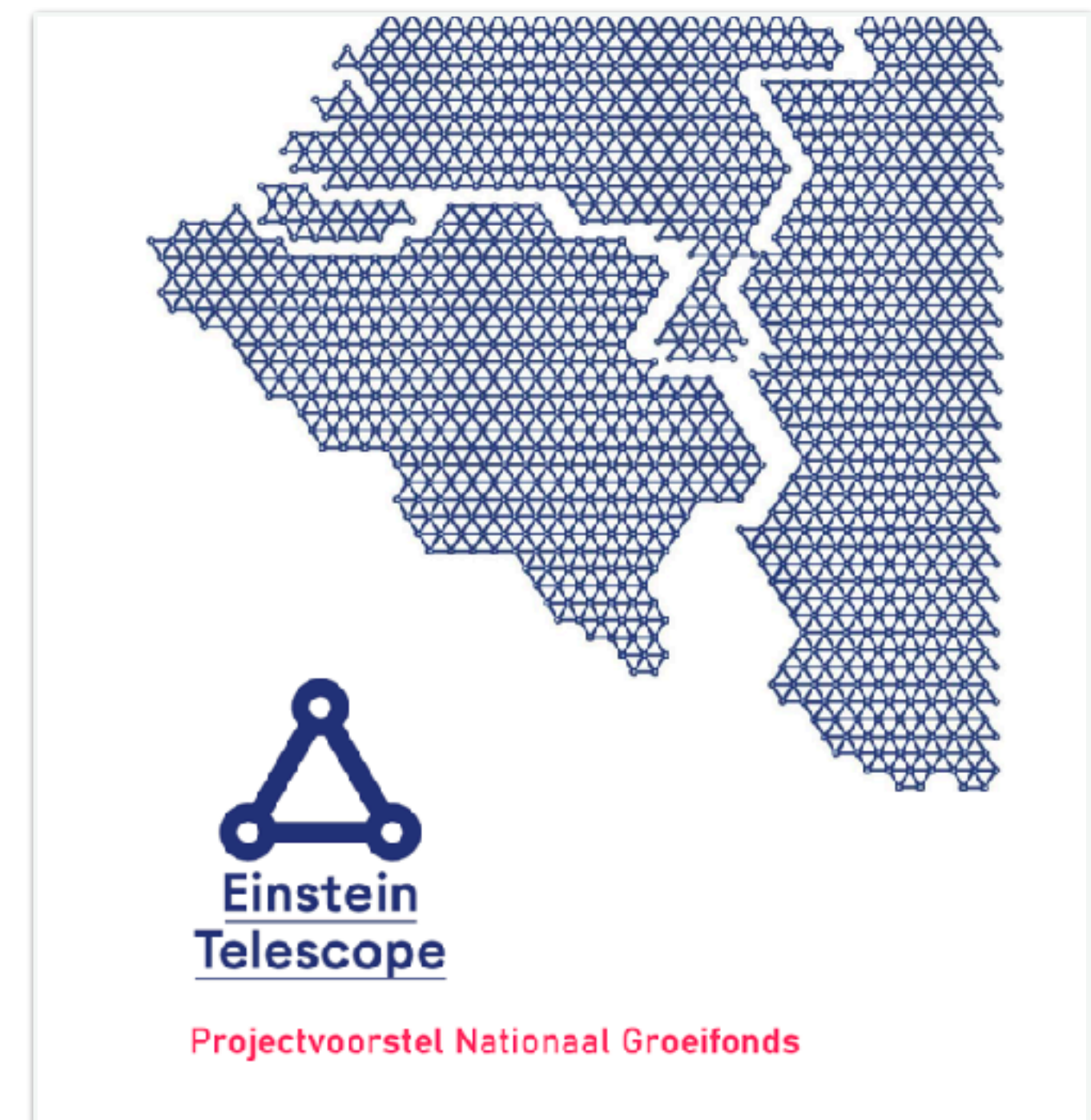
This achievement thanks to excellent preparations of the ET-NL board

- Frank Linde, Job de Kleuver, Martijn Rumpen, Jos Rokx, Jo van den Brand, Rob van der Meer, Martine Oudenhoven, Hans Chang, Arjen van Rijn, ...

NATIONAL GROWTH FUND - ORGANISATION

Dedicated team with five partners -

- Ministry OCW
 - Oscar Delnooz (Director of Research and Science Policy)
& Peter van Asperen
- Ministry EZK
 - Jetske Verkerk (MT Innovation & Knowledge)
& Patrick Schelvis
- LIOF - regional development agency for Limburg
 - Tys van Elk & Bert de Wit
- Province of Limburg
 - Guido Derks & Martijn Rumpen
- Nikhef
 - SB & Arjen van Rijn



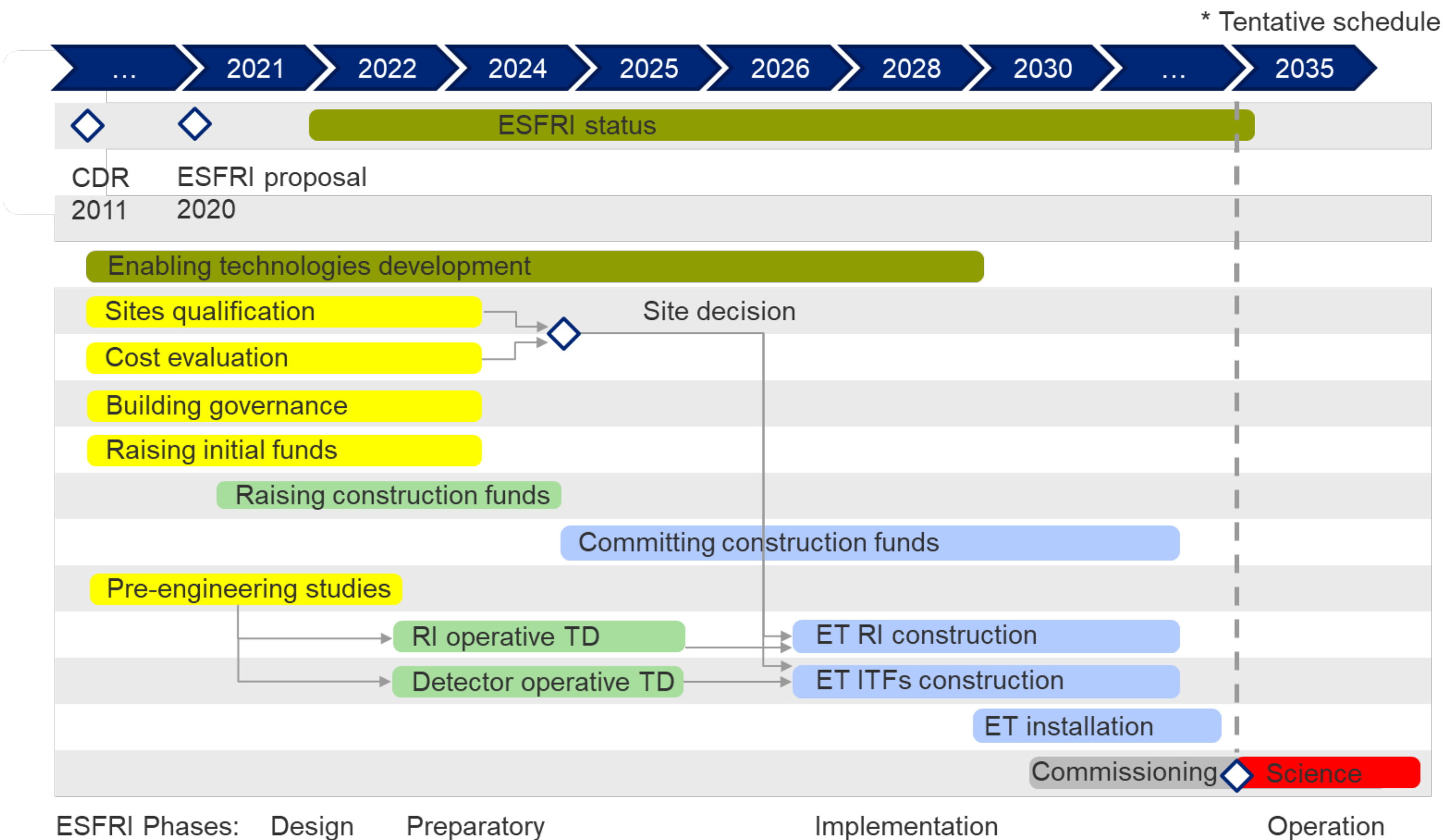
TIMELINE

1. Bidbook (2024/2025)

- 42 ME reserved for the optimization of the Bidbook

Project timeline

Approved by ESFRI for the 2021 Roadmap



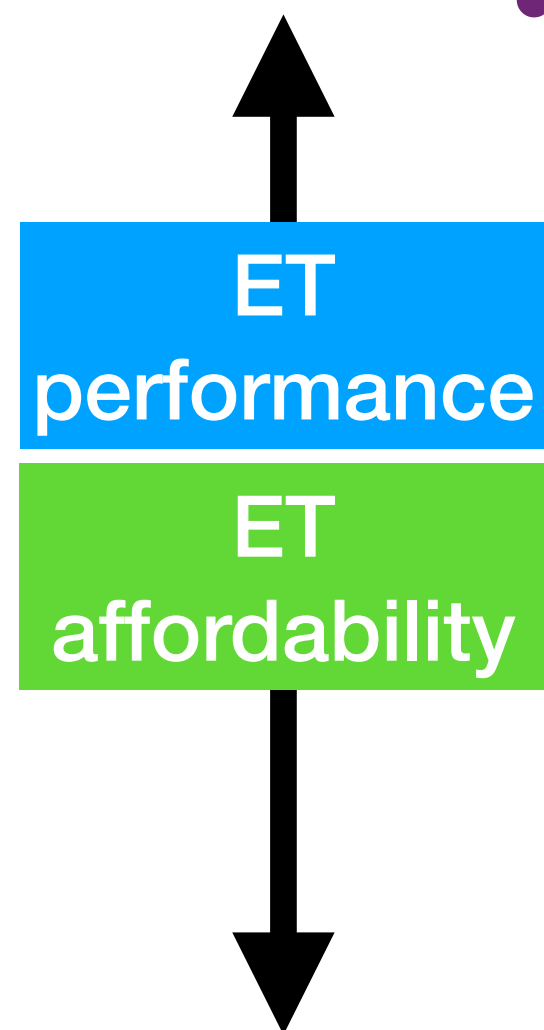
SUBSURFACE - LOCATION OF ET

Wim Walk (Nikhef)

- program manager subsurface Einstein Telescope
 - before: *General manager subsurface imaging Shell*

Challenge: cost and location

- huge involvement Frank Linde & team
 - Issues:
 - noise environment,
 - water,
 - rock quality,
 - legal issues,
 - local population,
 - local environment,
 - etc. etc.



SUBSURFACE

De-risking of the (geological) feasibility

- 'Fail-fast' in approach subsurface studies
 - Triangle corners of greatest concern
 - Search area largely in Belgium

The right parties at the table

- Contacts with TUs, TNO, KNMI, BRO, RWTH, Liege, etc.
 - Currently: charging planning with commitments
- Independent critical opinion about manufacturability

Soon there will be many visible activities in the area

- At some point invite Wim for a colloquium / status



LEGAL ISSUES - SURROUNDING MANAGEMENT

Province Limburg

- Guido Derks (director environmental management ET)

Proactive conservation of the quality of the site

- Stop the installation of (new) windturbines in search area, heavy industry
 - Recent letter from Dijkgraaf to ministries in Belgium and Germany to act similarly

Expertise on traject development in the region

- Legal permits, population support, environment, etc etc
 - Traject A2 highway Maastricht as an example

1. BIDBOOK ET-EMR SITE ~2025

Crucial ingredients for the EMR bid

- **Geology: demonstrably suitable location with minimum construction risks**
 - Coordination by Wim Walk with many partners to imagine subsurface over large area
- Spatial planning and communication
 - Guido Derks and his team from Province Limburg: detailed legal issues
 - **Martine Oudenhoven and her team for communication**
- Financial commitment partner countries
 - “Arrange the other billion” by ministry OCW
- **Science, technology and civil engineering in order**
 - Implementation of international ET Technical Design Reports - Project Office
 - Valorization by ministry EZK and LIOF

ETpathfinder: proof-of-principle technology & engineering

- ETpathfinder will have to be a success!

INTERNATIONAL ACTIVITIES - ET-PP (SEE ANDREAS)

Dutch participation in ET_PP (Preparatory Phase) - coming three years

- WP2: ET organization, Governance and Legal aspects
 - Miriam Roelofs (NWO-i), Job de Kleuver (NWO-i) and Hans Chang
- WP4: Site preparation
 - Frank Linde
- WP5: Project Office and Engineering Department
 - Andreas Freise, Patrick Werneke + *2 new engineers (system-, vacuum-)*
 - *CERN vacuum contract*
- WP6: Technical Design
 - Stefan Hild, Andreas Freise, Conor Mow-Lowry, Alessandro Bertolini
- WP7: Innovation and industrial Engagement
 - Rob van der Meer
- WP10: Education, Outreach and Citizen Engagement
 - Martine Oudenhoven, Gideon Koekoek

1. BIDBOOK - NATIONAL PROJECT OFFICE

UM (DUB30) as nerve centre for ET-EMR - prelude to the headquarter

- Putting the Project Office (further) in order
 - Equip Communication Department
 - Equip department space/planning
- Equipping department technique & internationalisation
 - Technology development via international cooperation, ET_PP
 - Resources via NGF and Nikhef

Scientific directorate ET-EMR

- I am asked to take-up this position (as director of Nikhef)
- We need similar positions in Belgium and Germany

SCENARIOS FOR NIKHEF

Procedure for selecting the site is not clear yet

- Large role for the BGR - Board of Governmental Representatives
- Around that time the international organisation should have taken shape
 - Inspired by CERN council & directorate

If ET-EMR wins the bid and ET will arrive in the Limburg area

- Headquarters of ET (most probably) arrives to Netherlands
 - Home of the legal entity 'Einstein Telescope'
- Participation of the Netherlands as one of the (international) members
 - Unclear if this is (part of) Nikhef or a new institute will be formed
 - The science community is larger than Nikhef alone!

... end

