Research Infrastructures:

Why do they exist and how to use them to empower your research

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Seminari per il Percorso di Eccellenza L.M. Fisica 2025/2026

26/3/2026 ,13:00-14:00

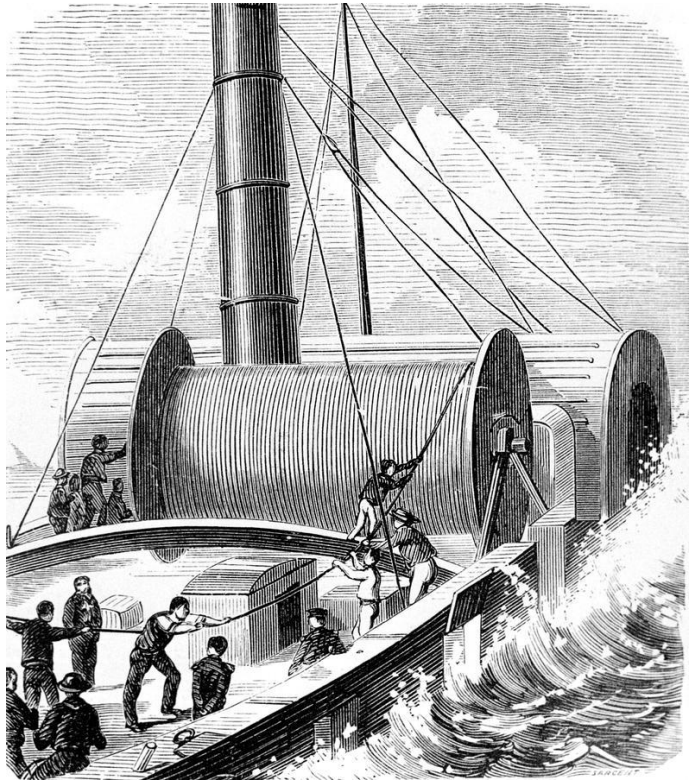
- **Outline**

  - **Historical and political background** on Research Infrastructures and Big Science
  - Principles of access and operations
  - Some examples

Infrastructure (in general): the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.

Examples of infrastructures:

- Transport infrastructures
  - Roads, Shipping routes, Rail and trains, Aviation
- Aqueducts and water supplies
- Energy grids
- Telegraph
- Internet and data sharing
- **Research Infrastructures**



The first transatlantic telegraph cables were led in the 1850s-1860s, an enterprise led by private companies yet supported by UK and US governments, also involving scientists (Kelvin, Morse, …).

An example of KT and TT?

Summary of the G20 Principles for Quality Infrastructure Investment

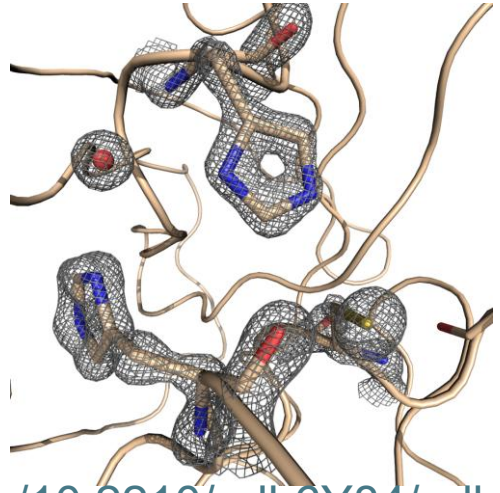
- Principle 1: Maximizing the **positive impact** of infrastructure to achieve **sustainable growth and development**
- Principle 2: Raising Economic **Efficiency** in View of **Life-Cycle Cost**
- Principle 3: Integrating **Environmental** Considerations in Infrastructure Investments
- Principle 4: Building **Resilience** against Natural Disasters and Other Risks
- Principle 5: Integrating **Social** Considerations in Infrastructure Investment
- Principle 6: Strengthening Infrastructure **Governance**

G20 2019 JAPAN

QUALITY INFRASTRUCTURE INVESTMENT PARTNERSHIP

www.worldbank.org/en/programs/quality-infrastructure-investment-partnership/qii-principles

https://oecd-development-matters.org/2022/11/07/why-do-we-need-to-invest-in-quality-infrastructure/



https://doi.org/10.2210/pdb6Y84/pdb

infrastruttura s. f. Il complesso di impianti e di installazioni a terra, necessarî per la navigazione aerea | **genrc.** Strutture che condizionano attività economiche: *le strade sono l'i. più importante per i traffici.* [da *infra-* e *struttura*].

infrasuòno s. m. Onda elastica di frequenza inferiore a

- 1961 (Oxford) no entry;
- 1971 (D.O.) Support to air traffic…
- 1985 (Larousse) foundation of streets, support to army…
- 1987 (D.O.) support to economics (routes, rails) or to cities (schools, gardens, sewers)…

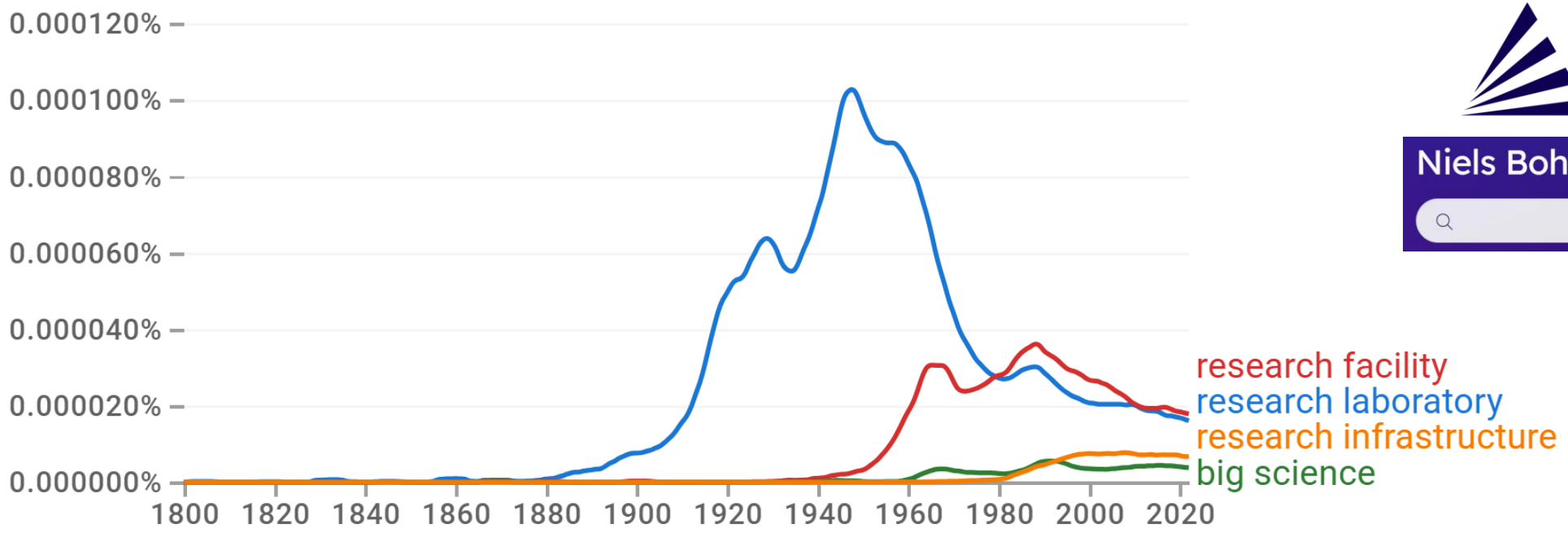
que le son, mais de fréquence trop basse pour qu'une oreille humaine puisse la percevoir.

INFRASONORE adj. Relatif aux infrasons.

INFRASTRUCTURE n. f. Couche de matériau posée entre la couche de fondation et la plate-forme d'une route. ‖ Ensemble des travaux relatifs à tout ce qui nécessite, pour un ouvrage (routes, voies ferrées, etc.), des fondations. ‖ Ensemble des installations territoriales (services, écoles, bases, etc.) indispensables à la création et à l'emploi de forces armées. ‖ Ensemble des moyens et des rapports de production qui sont à la base des formations sociales, par oppos. à SUPERSTRUCTURE. ● *Infrastructure aérienne*, ensemble des installations au sol qui sont indispensables aux avions.

della scapola)].

infrastruttura s. f. Struttura complementare rispetto a un'altra ritenuta principale; per lo più *al pl.*, per indicare le opere complementari necessarie allo svolgimento di un'attività economica o, più in generale, allo sviluppo economico di un'area (strade, ferrovie, aeroporti, ecc.) oppure indispensabili per nuovi insediamenti urbani (scuole, fognature, parchi, giardini, ecc.) ◆ *part.* Il complesso di impianti e di installazioni a terra, necessarî per la navigazione aerea. [Comp. di *infra-* e *struttura*].

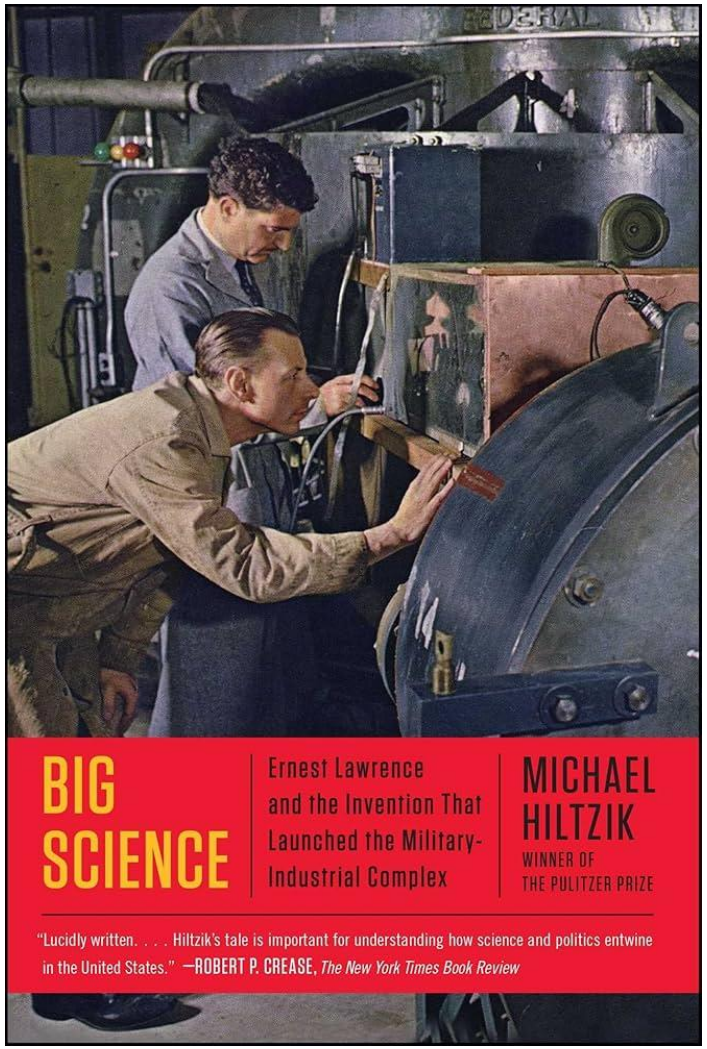


AIP

Niels Bohr Library & Archives

Search

- “Big Science” and “Research Infrastructures” are partly-overlapping and **broad** terms
- A narrow interpretation of **B**ig **S**cience (capitalized) corresponds to “science made big in three dimensions: **big organizations, big machines, and big politics**”
- A narrow interpretation of “**R**esearch **I**nfrastructures” (capitalized) refers more to the European research landscape, regulation, and policymaking.



Big Science in the Cold War

- Accelerators, reactors and space programmes on both sides of the **Iron Curtain** to demonstrate technological and military superiority (**dual research**)
- In Europe, need for **cooperation and peace** (CERN, ESO, ILL, ESRF)
- Science required larger scale infrastructures, from Rutherford to Lawrence

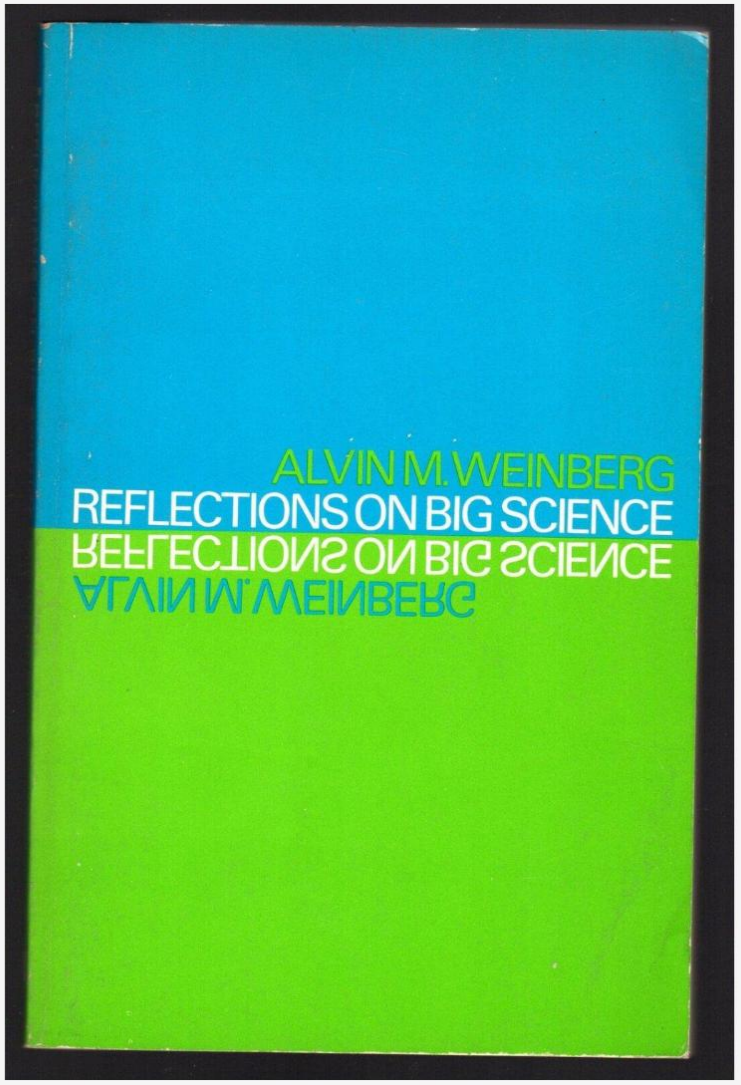
"The Organization shall have **no concern with work for military** requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available."

New Service to Analysts

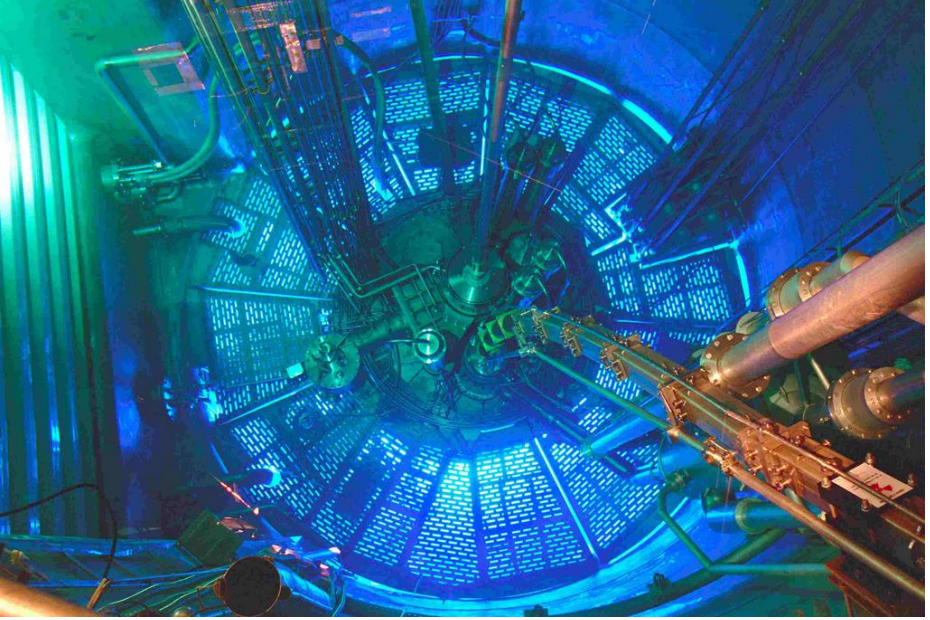
Chemical and Engineering News in its issue of August 11 publishes the information that Carbide and Carbon Chemicals Corp., operator of the Oak Ridge National Laboratory for the Atomic Energy Commission, is offering another service comparable to its radioisotope distribution program. Industrial, scientific, and medical groups can have samples analyzed for impurities, using a highly accurate method devised at ORNL.

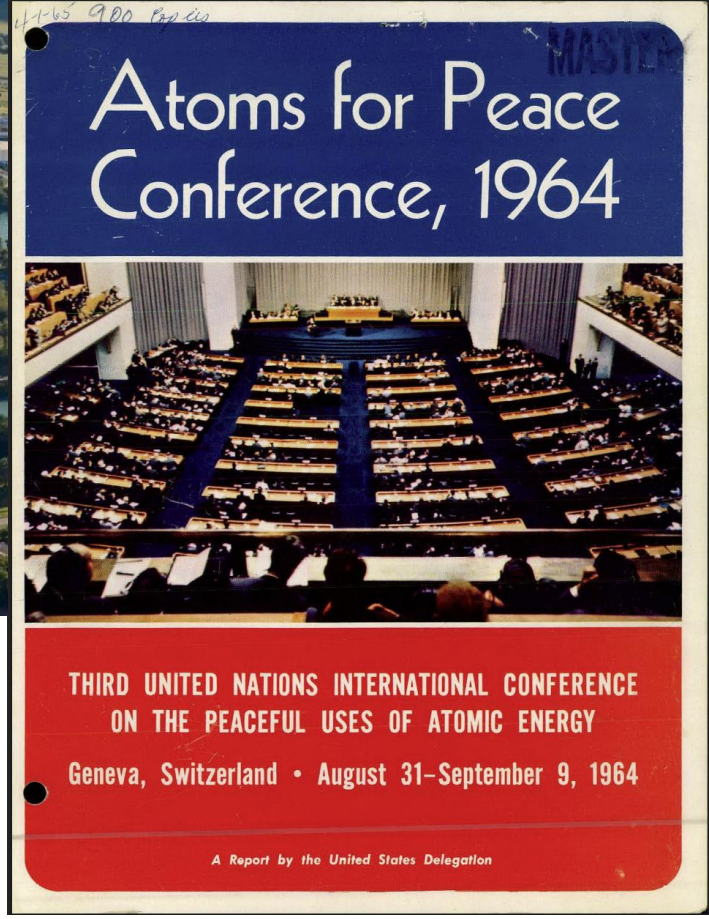
The technique followed involves placing the test sample in the Oak Ridge graphite-uranium reactor, and exposing it to neutron bombardment, causing traces of impurities in the material to become artificially radioactive.

Weinberg, director of Oak Ridge National Laboratory, was probably the first to use the term "Big Science" (1961), **not with a positive connotation**, while the neutron reactor was starting operation as a Research Infrastructure.



*"... an increasing subordination of individual scientists under **large and bureaucratic projects**, with a consequential damage to academic freedom and individual creativity"*





Systematic access of external users to neutron reactors started in the UK in the 1950s, allocating beamtime to academic users.

In 1964 at the UN conference, it was agreed that France and Germany would start a project of a **shared neutron user facility**, funded and dedicated entirely for **fundamental research through user access**.

Example of Scientific Diplomacy to foster **peace and collaboration**.

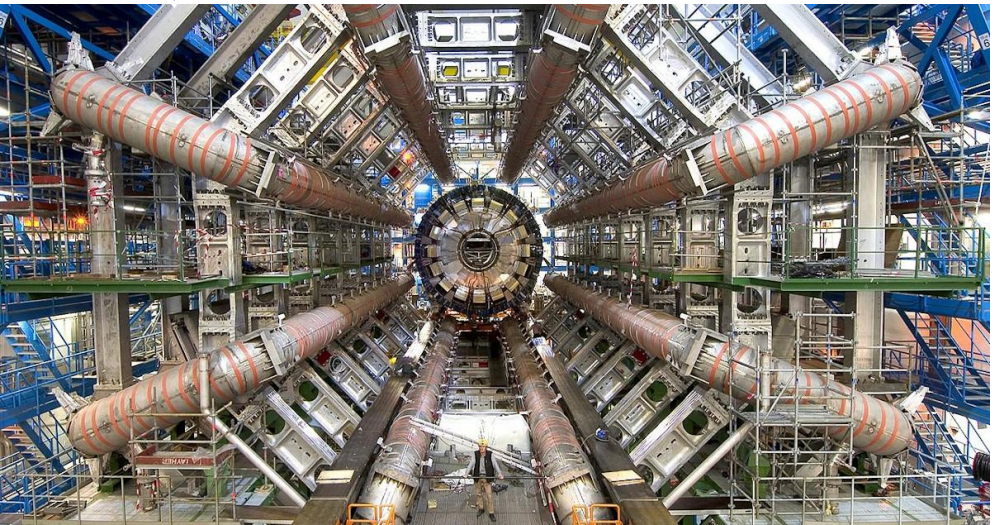
NEUTRONS FOR SCIENCE®

Big Science

A possible evolution of the terms, and strategies they represent.

Transformational Big Science

Small Science @ Big Machines



Research Infrastructures

Europe *à la carte* or *variable geometry*

- CERN (1957) – 20 states
- European Southern Observatory (1962) – 6 states
- European Space Vehicle Launcher Development ELDO (1964) – 6 states and European Space Research Organization (1964) – 10 states, later ESA
- Institute Laue Langevin (1967) – 2 states
- European Molecular Biology Laboratory (1973) – 10 states
- European Synchrotron Radiation Facility (1988) – 11 states

https://cds.cern.ch/record/764877

More recent strategies on RIs

- European Research Area – ERA (2000)
- European Intergovernmental Research Organisation forum, EIROForum (2002)
- **European Strategy Forum on Research Infrastructures – ESFRI (2002)**
- ERIC as a new European **legal organizational form** (2009)
- European X-ray Free-Electron Laser (2009) - 12 states
- European Spallation Source ERIC (2009) – 13 states

The primary goal of ESFRI is to prepare and publish a RI roadmap to plan the EU investments in Research and Innovation.

It works as an interface between the research community and policymakers.

The roadmap includes RIs based on scientific peer-review & strategic and political importance.

Roadmap 2006

Roadmap 2008

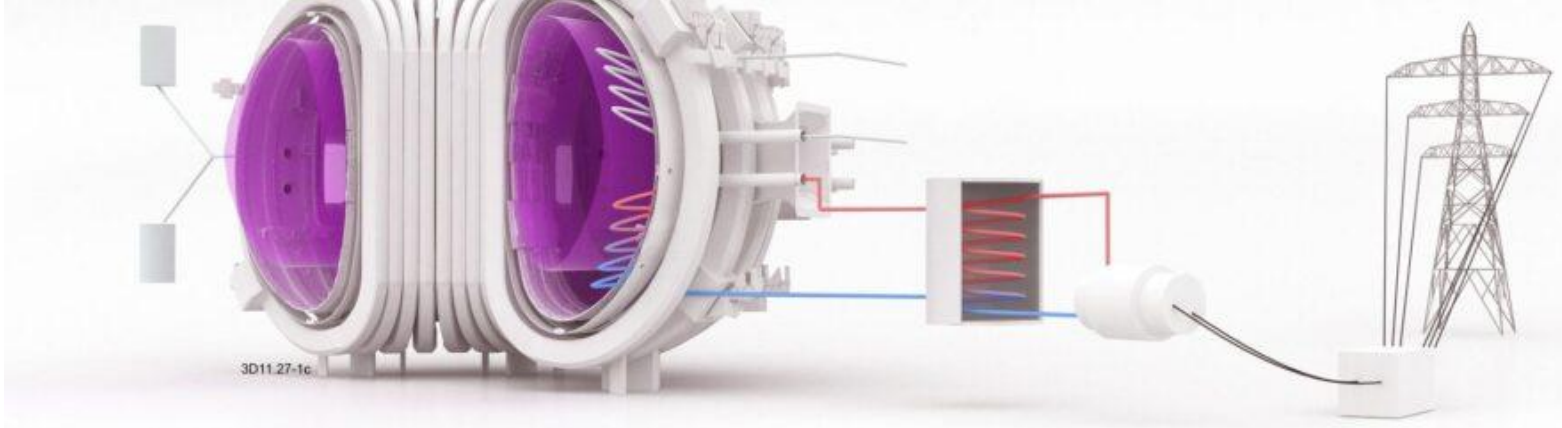

Roadmap 2010

Roadmap 2016


Roadmap 2018


Roadmap 2021

ESFRI **Roadmap archive**



Research infrastructures are facilities that provide resources and services for the research communities to conduct **research** and foster **innovation** in their fields.

(EU Definition, one could think something is missing…)

These include

- major equipment or sets of instruments
- knowledge-related facilities such as collections,
- archives or scientific data infrastructures
- computing systems
- communication networks

SECTION 1

ESFRI LANDSCAPE ANALYSIS 2024

THEMATIC AREAS

CONTENTS

Capacity *vs* Capability

CONTENTS

The EU budget for Research

The total Gross National Income of the EU:
18.000.000.000.000 € (T€)

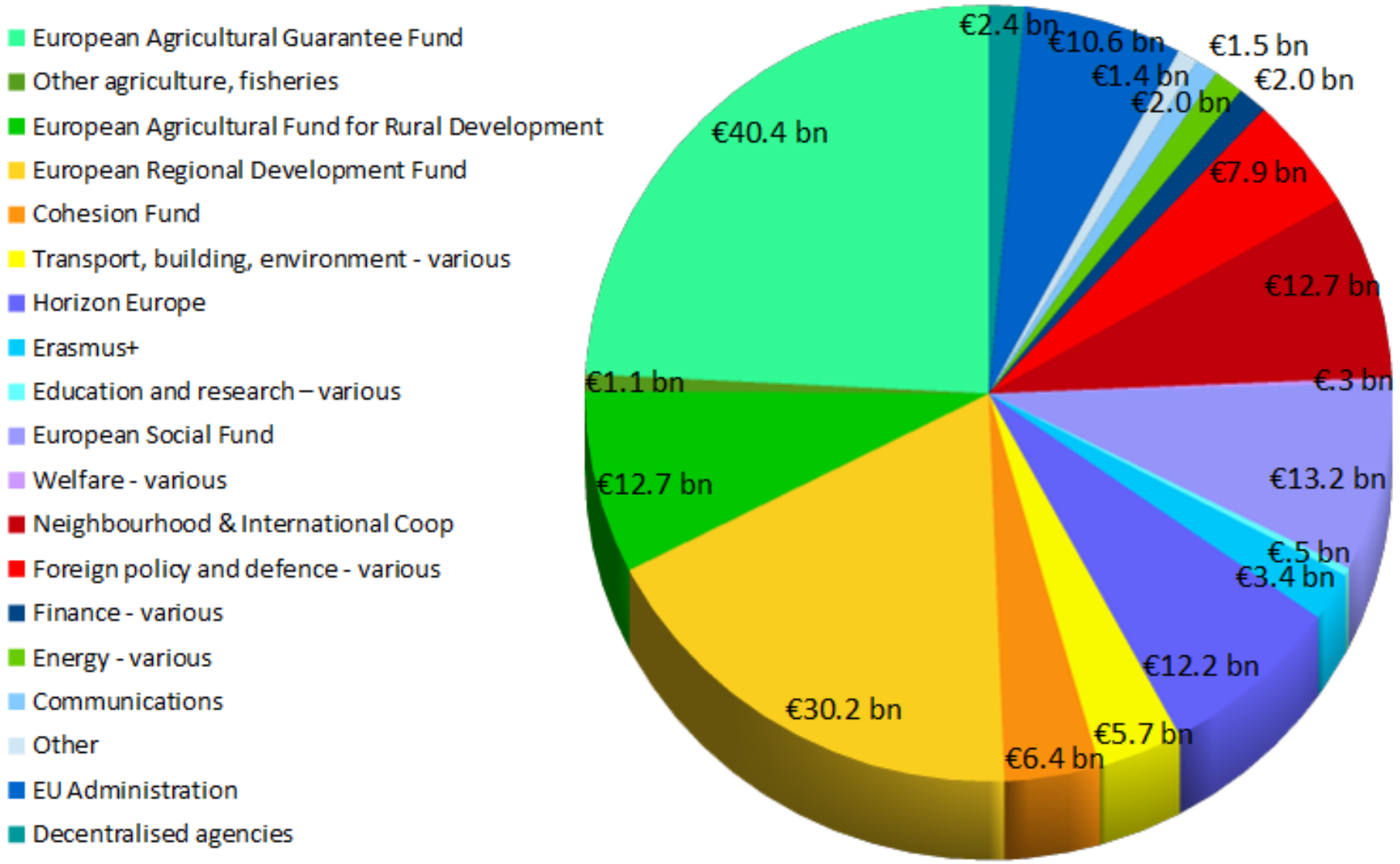
The yearly budget of EU:
about 180 G€

The Multiannual Financial Framework programme, also including Next Generation EU:
about 1.8 T€

The overall budget 2021-2027 for Horizon Europe (Research and Innovation):
about 95 G€

EU budget, by category, 2022

Source: Official Journal, Definitive Adoption 2022/182 (24.2.2022) L 45/18-29



HORIZON EUROPE BUDGET

Horizon Europe programme structure

		Total in € million
EXCELLENT SCIENCE *of which*		**25 011**
The European Research Council (ERC)	16 004	
Marie Skłodowska-Curie Actions (MSCA)	6 602	
Research infrastructures	2 406	
GLOBAL CHALLENGES AND EUROPEAN INDUSTRIAL COMPETITIVENESS *of which*		**53 516**
Health	8 246	
Culture, creativity and inclusive society	2 280	
Civil Security for Society	1 596	
Digital, Industry and Space	15 349	
Climate, Energy and Mobility	15 123	
Food, Bioeconomy, Natural Resources, Agriculture and Environment	8 952	
Non-nuclear direct actions of the Joint Research Centre (JRC)	1 970	
INNOVATIVE EUROPE *of which*		**13 597**
European Innovation Council (EIC)	10 105	
European innovation ecosystems	527	
European Institute of Innovation and Technology (EIT)	2 965	
WIDENING PARTICIPATION & STRENGTHENING THE EUROPEAN RESEARCH AREA *of which*		**3 393**
Widening participation and spreading excellence	2 955	
Reforming and enhancing the European R&I System	438	
TOTAL HORIZON EUROPE		**95 517**

The EU budget for Ris, mostly through grants and open calls for proposals, selected according to excellence, impact and the quality and efficiency of implementation

European Commission

EN

Horizon Europe

Work Programme 2023-2024

3. Research Infrastructures

(European Commission Decision C(2023) 2178 of 31 March 2023)

Transnational access to European Research Infrastructures

RIs should find a balance between member and non-member access as well as priority, excellence-based, and fee-based access.

Transnational Access (TNA) allows for funds to access and travel to a RI in another country.

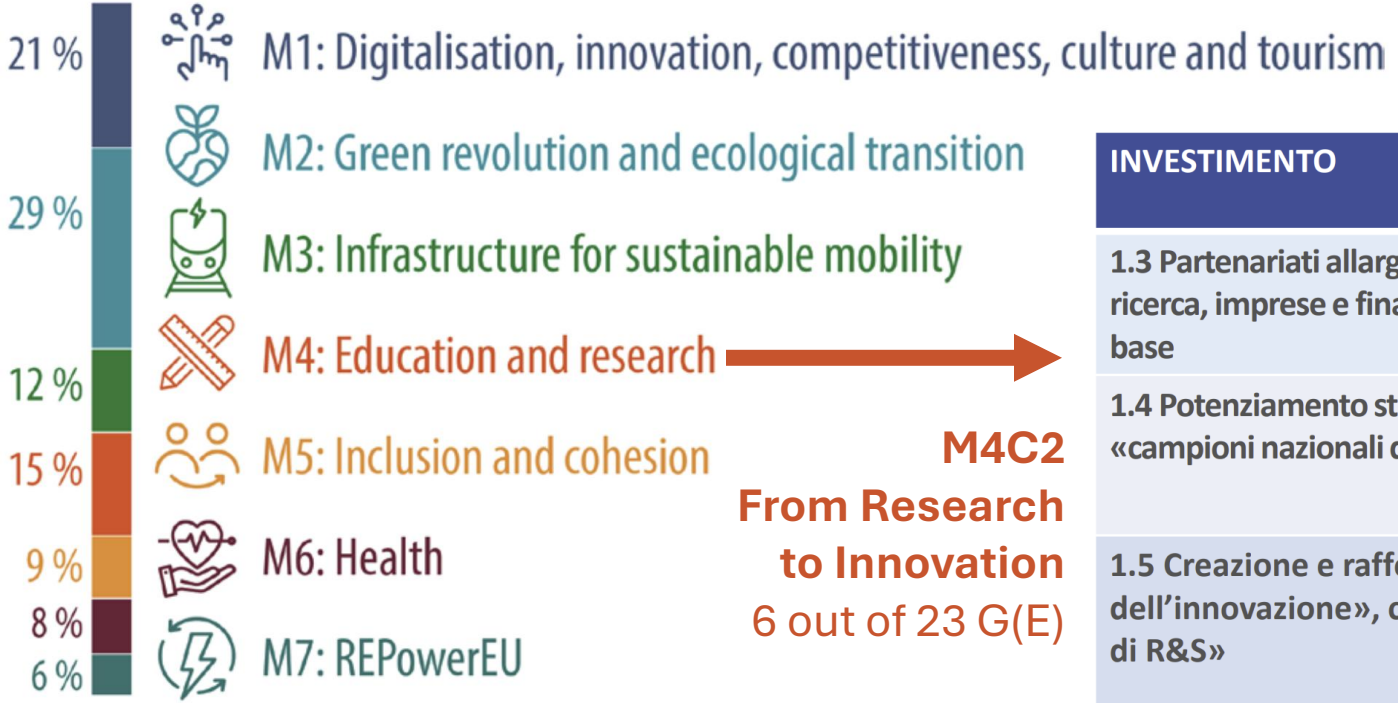
The EC and MS/AC are invited to make RI **access costs eligible** for an expanded set of funding sources, including national funds, European structural and investment funds, and appropriate EC framework funds (e.g. all Pillar 1 and Pillar 2 instruments in Horizon Europe).

In Italy

The National Research Programme (PNR) outlines system priorities, major **research and innovation** areas, respective areas of intervention, and two National Plans.

The **National Plan on Research Infrastructures** (PNIR) recommends the strengthening of access to RIs, their integration within European partnerships, their role for training and higher education.

https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698847/EPRS_BRI(2021)698847_EN.pdf



M4C2
From Research to Innovation
6 out of 23 G(E)

INVESTIMENTO	DURATA	RISORSE IN MILIONI DI €
1.3 Partenariati allargati estesi a Università, centri di ricerca, imprese e finanziamento progetti di ricerca di base	2022-2026	**1610**
1.4 Potenziamento strutture di ricerca e creazione di «campioni nazionali di R&S» su alcune KET	2022-2026	**1600**
1.5 Creazione e rafforzamento di «ecosistemi dell'innovazione», costruzione di «leader territoriali di R&S»	2022-2026	**1300**
3.1 Fondo per la costruzione di un sistema integrato di infrastrutture di ricerca e di innovazione	2022-2026	**1580**

INFRASTRUTTURE DI RICERCA

- Sono impianti, risorse e i relativi servizi. Comprendono laboratori o grandi strumenti o complessi di strumenti per la ricerca; collezioni, banche dati, archivi o informazioni scientifiche strutturate; infrastrutture basate sulle tecnologie abilitanti dell'informazione e della comunicazione
- Sono create per essere **fruite da un'utenza ampia**, nazionale, europea o globale, attraverso **accesso aperto su base competitiva**

Principles of access and operations

Provided by the Directorate-General for Research and Innovation

‘Users’ of RIs can be **individuals**, teams and institutions from **academia**, **business**, **industry** and **public services**.

RIs can provide access to machine time; computing; software; data; sample preparation; archives; collections; the set-up, execution and dismantling of experiments; education and training; expert support; and analytical services.

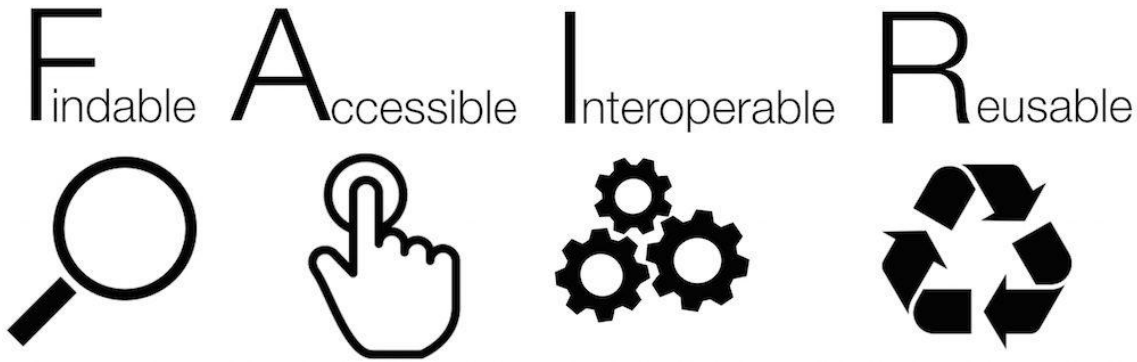
RIs define **Access Unit** as measure specifying the Access offered to the Users (hours, days, CPUs, etc…)

Provided by the Directorate-General for Research and Innovation

Access policy to regulate, grant and support Access to Users

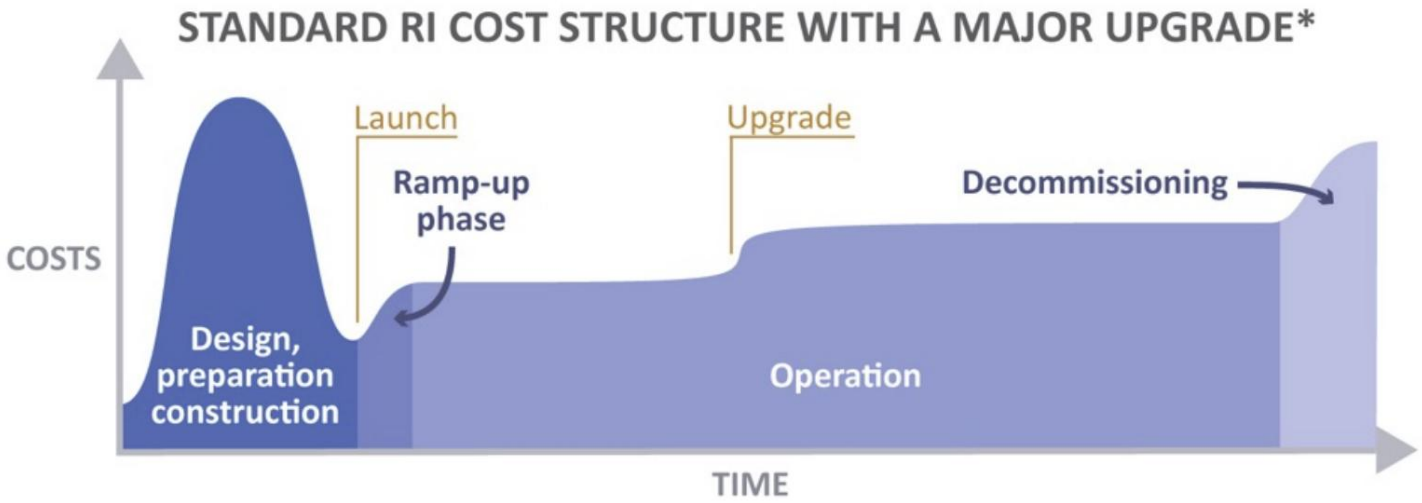
RIs can apply fees for Access to contribute to their **financial sustainability**.

RIs should **manage data** so that are appropriately **maintained, archived** for a reasonable period, and **available for review** and **(re-)use**. If appropriate, they are also encouraged to consider providing open access to research data.



Research Infrastructure Costs

- Design and preparation
- Construction and start-up, including:
  - Physical (e.g., land acquisition, installations, constructions) and non-physical (e.g., IPRs, cloud, other information technologies) assets, usually the major component of initial investment costs;
  - Personnel;
  - Start-up costs (e.g. training, licences, etc.);
- Replacement costs;
- Major upgrades;
- Decommissioning and end-of-life costs.



Provided by the Directorate-General for Research and Innovation

Access modes

- **Excellence-driven Access, free of charge**
  - Requires a project proposal
  - Peer-reviewed
  - Usually free of charge
- **Market-driven Access, at a cost**
- Wide Access

As well as

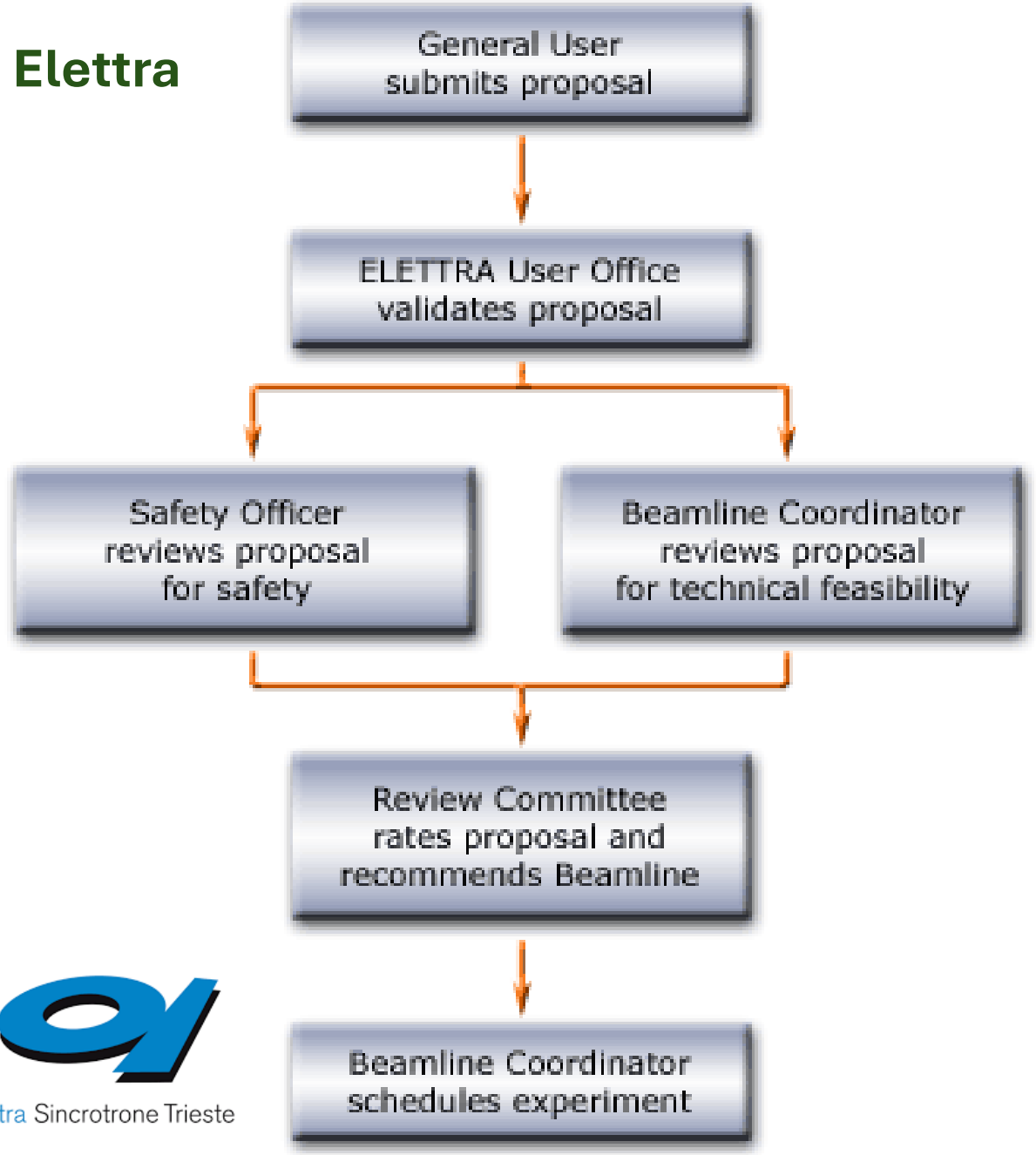
- Physical
- Remote
- Virtual

Depending on the access route, data could be public or proprietary, and with an **embargo period**.

Example of Access Proposal Life Cycle at Elettra

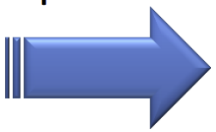
Excellence-driven access is obtained through the submission of an experiment proposal, which is reviewed on technical, health-and-safety grounds by the facility, then scientifically evaluated by a panel of independent **peers.**

If successful, access is granted and the experiment is scheduled and performed.



Elettra Sincrotrone Trieste

ISIS Proposal Routes – how to get beamtime

Name	What's it for?	How does it work?	When am I likely to get the beamtime?	Comments
Direct Access 	All types of ISIS experiments	Submit a proposal - deadlines are the third Wednesday of April and October every year.	Normally 3-8 months after proposal submission	Discussion with ISIS scientist strongly advised before proposal submission.
Rapid Access 	When beamtime is required more rapidly than is possible with Direct Access.	Submit a proposal any time	Normally 2 weeks – 2 months after proposal submission	Discussion with ISIS scientist is essential before proposal submission.
Xpress Access 	A small amount of beamtime (not a full experiment). Must be a very simple measurement.	Submit a very short proposal any time	Data likely to be available from 1 week to a few weeks after submission.	Discussion with ISIS scientist is essential before proposal submission.
Industrial Access: Access mechanisms, in particular the ISIS Collaborative R&D scheme, are available for companies wishing to use neutrons at ISIS. Please contact the ISIS industry liaison, Dr Chris Frost (Christopher.frost@stfc.ac.uk) for details				

Science and Technology Facilities Council

ISIS Neutron and Muon Source

Example of Access Routes at ISIS

Access to RIs is offered and requested through **calls for proposals**. These can be few times per year, when the largest number of scientific proposals is submitted.

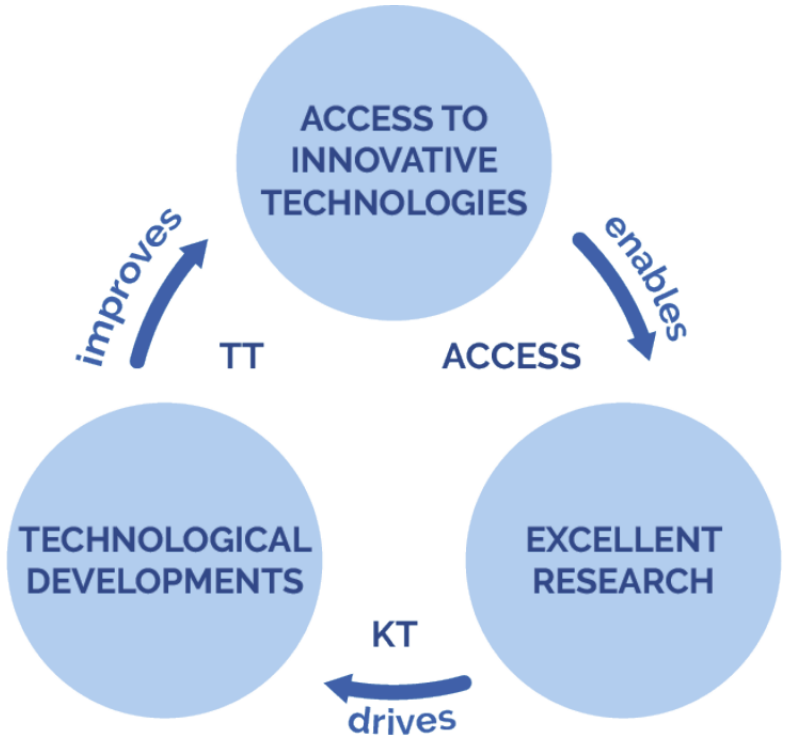
Often, some rapid access routes are available to access the RI outside an ordinary call for proposals.
(e.g., during global crisis, or to complete PhD theses…)

Excellence-driven access is exclusively dependent on the **scientific excellence, originality, quality** evaluated through peer review, after having assessed technical and ethical feasibility of an application.

Example of peer-review criteria at ISIS

Grade	Expected Review Outcome	Definition – For guidance
10	Beam time allocation is essential	Outstanding, world class
9		
8	Beam time allocation is recommended	Excellent
7		
6	Beam time allocation is possible	Good
5		
4	Beam time allocation should not be made	Fair
3		
2		Uncompetitive
1		Unsatisfactory
R	Panel would like to see a resubmission with panel comments addressed. Rapid or Xpress routes could be recommended. Proposals requiring ISIS Deuteration Lab effort must be resubmitted via the Direct Access route only	Resubmit
X	Panel do not want to see a resubmission	Reject

- Industrial R&D exploits the rich knowledge environment of Research Infrastructures;
- the scientific results of RIs percolate into innovation value;
- the industry benefits from access to RIs and to scientific data



- Industry as a supplier
- Industry as a user

Market-driven access generally involves **a fee for the access**. Examples are **proprietary research** at full cost or other specific contractual conditions – e.g. for the development of highly advanced technologies. The results are – partially – not published.

Some examples,

to show the

variety of RIs as

well as different

access plans

- ISIS Neutron and Muon Source
- www.isis.stfc.ac.uk
- www.isismachitalia.eu
  - Access: in person
  - Access mode: scientific excellence, commercial
  - Cost: free or commercial fee
  - PNIR, bilateral agreement

Materials characterization, Cultural Heritage, Electronic radiation hardening, physics, chemistry, geology, engineering, and biology…

ISIS@MACH ITALIA

1200 experiments by 3000 users from 30 countries generating 600 publications

- **High Performance Computing (HPC)**
- https://userdb.hpc.cineca.it/
- www.hpc.cineca.it/hpc-access/access-cineca-resources/iscra-projects/
- Access: virtual
- Access mode: scientific excellence
- Cost: free
- Council Regulation 2021 and 2024

Proposals need to include a scientific description of the problem to investigate and technical description on how to tackle it.

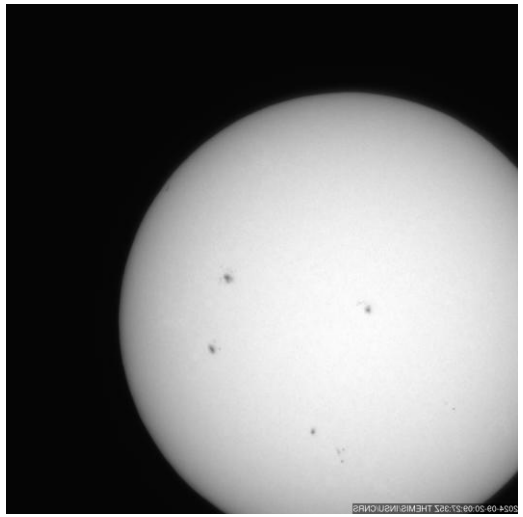
- European level by HPC Joint Undertaking
- National level by CINECA ISCRA calls

- THEMIS
- https://www.themis.iac.es

  - Access: in person
  - Access mode: scientific excellence
  - Cost: free
  - National RI open to others

Solar magnetism and the dynamical processes within the Sun’s atmosphere, or near-Sun objects such as Mercury and comets.

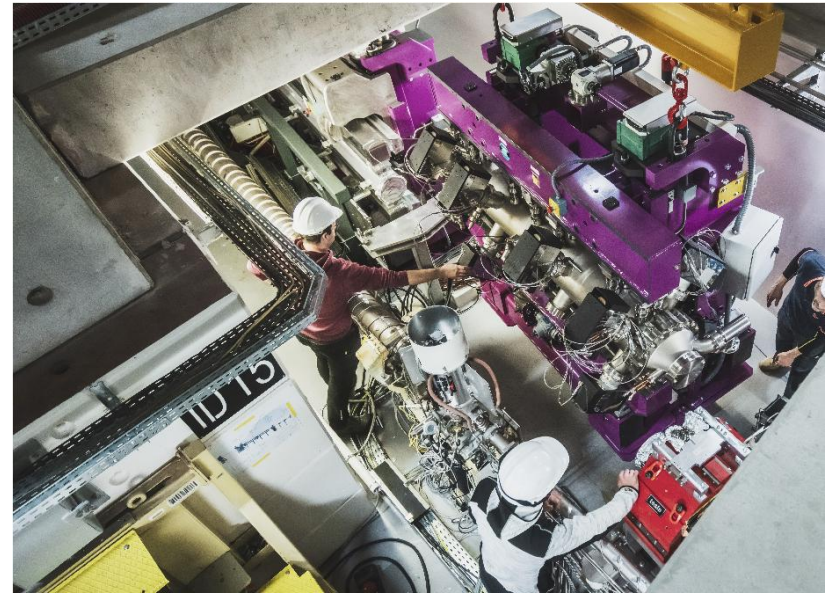
The telescope is an Italian-French-Spanish facility that also awards observing time through its International Time Program (ITP) for 5% of the total observing time.

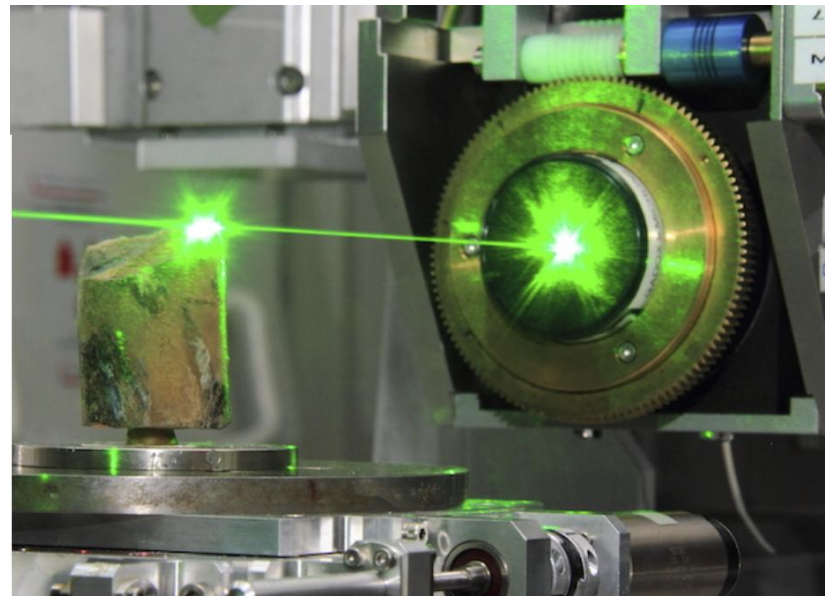


- European Synchrotron Radiation Facility
- https://esrf.fr/

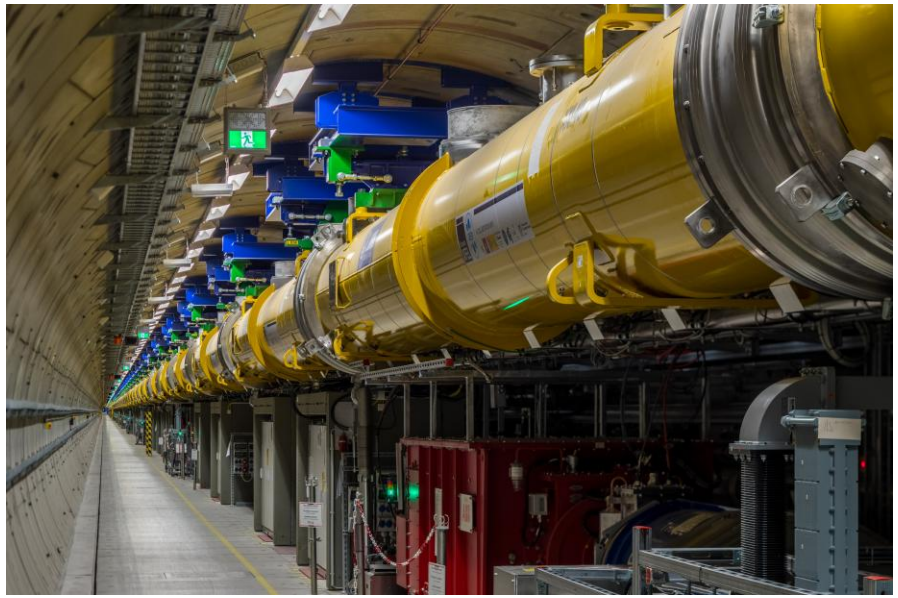
  - Access: in person
  - Access mode: scientific excellence, commercial
  - Cost: free + travel funds
  - ESFRI Landmark

X-ray absorption spectroscopy and serial crystallography on proteins, Electronic structure, magnetism and dynamics, Complex systems and biomedical sciences, Structural biology, Structure of materials, Matter at extremes





- European X-ray Free Electron Laser
- https://www.xfel.eu/

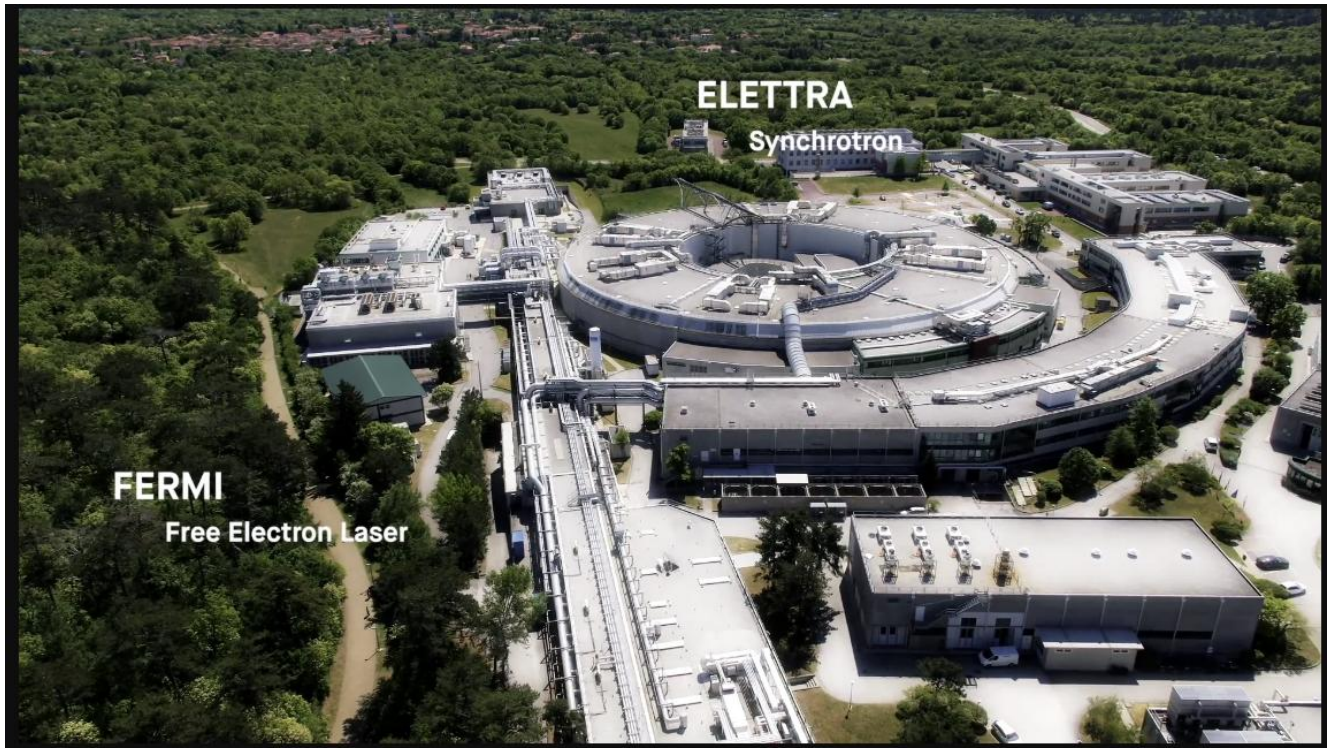


- Access: in person
- Access mode: scientific excellence, commercial
- Cost: free of charge, providing partial funds for travel
- ESFRI Landmark

- Time-resolved femtosecond serial crystallography on proteins, coherent imaging on fibrils, proteins, and cells. physics, chemistry, materials science, biology and nanotechnology

- Elettra Sincrotrone Trieste
- https://www.elettra.eu/
- https://www.ceric-eric.eu/

- Access: in person
- Access mode: scientific excellence, commercial
- Cost: free of charge, providing partial funds for travel
- EFRI, PNIR, CERIC-ERIC



CERIC
Central European Research Infrastructure Consortium

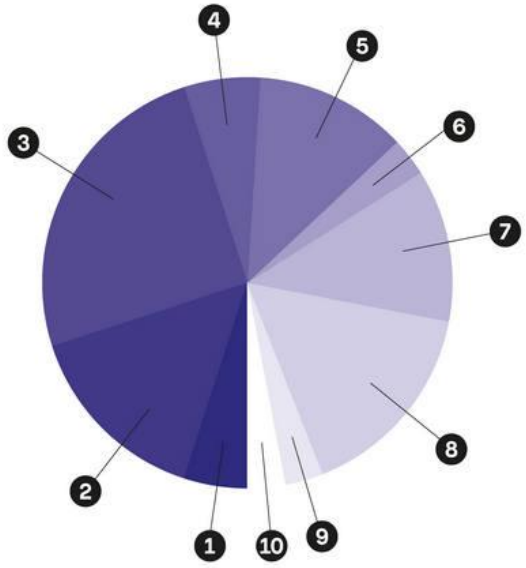
Elettra Sincrotrone Trieste

II semester 2021 - I semester 2022

Proposals submitted: 898 (+ 181 through CERIC-ERIC)
Proposals allocated: 463 (+ 114 through CERIC-ERIC)

Elettra proposals on site by research area:

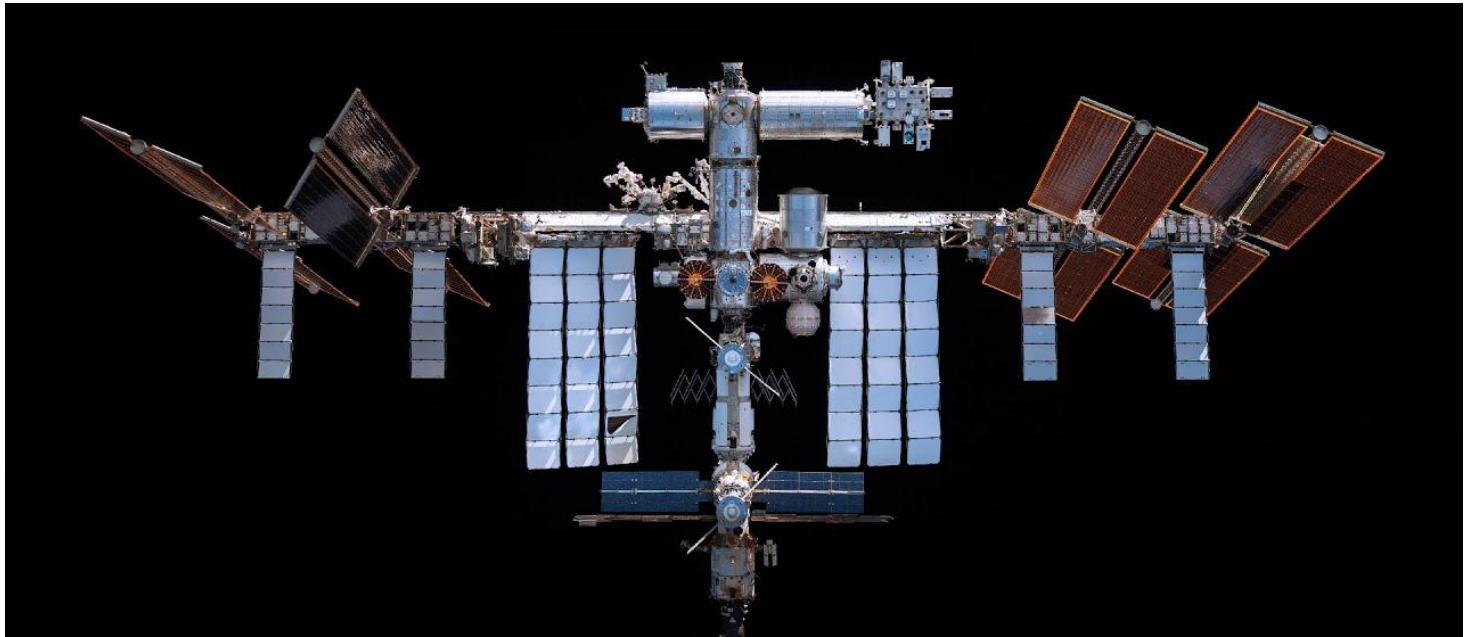
1. Atoms Molecules and Plasmas (5%)
2. Catalytic Materials/Surface Science (15%)
3. Condensed matter - Electronic and Magnetic Structure (25%)
4. Environmental and Earth Science (6%)
5. Hard condensed matter - Structures (12%)
6. Instrumentation and Technological materials (3%)
7. Life and Medical Sciences (excluding Crystallography) (12%)
8. Macromolecular, Protein and Polymer Crystallography (16%)
9. Polymers and Soft Matter (3%)
10. Scattering (3%)



- International Space Station

- www.asi.it/bandi_e_concorsi/bando-di-ricerca-di-progetti-di-ricerca-fondamentale-ricerca-industriale-sviluppo-sperimentale-per-la-valorizzazione-delle-risorse-italiane-di-accesso-alla-stazione-spaziale-internazionale-iss-per/

- Access: remote
- Access mode: scientific excellence
- Cost: depends on the call
- Is it a RI?



Informations projet

SURE

N° de convention de subvention: 26069

Projet clôturé

Date de début
1 Janvier 2006

Date de fin
31 Decembre 2012

Financé au titre de
Research infrastructures: Specific programme for research, technological development and demonstration: "Structuring the European Research Area" under the Sixth Framework Programme 2002-2006

Coût total
€ 2 018 000,00

Contribution de l'UE
€ 2 018 000,00

Coordonné par
EUROPEAN SPACE AGENCY (EUROPEAN SPACE RESEARCH AND TECHNOLOGY CENTRE)
France

EST	European Solar Telescope	SINGLE-SITED
KM3NeT 2.0	KM3 Neutrino Telescope 2.0	DISTRIBUTED
CTAO	Cherenkov Telescope Array Observatory	SINGLE-SITED
ELT	Extremely Large Telescope	SINGLE-SITED
ELI ERIC	The Extreme Light Infrastructure European Research Infrastructure Consortium	SINGLE-SITED
EMFL	European Magnetic Field Laboratory	DISTRIBUTED
ESRF EBS	European Synchrotron Radiation Facility Extremely Brilliant Source	SINGLE-SITED
ESS	European Spallation Source ERIC	SINGLE-SITED
European XFEL	European X-Ray Free-Electron Laser Facility	SINGLE-SITED
FAIR	Facility for Antiproton and Ion Research	SINGLE-SITED
HL-LHC	High-Luminosity Large Hadron Collider	SINGLE-SITED
ILL	Institut Max von Laue - Paul Langevin	SINGLE-SITED
SKAO	Square Kilometre Array Observatory	SINGLE-SITED
SPIRAL2	Système de Production d'Ions Radioactifs en Ligne de 2e génération	SINGLE-SITED
ET	Einstein Telescope	SINGLE-SITED
EuPRAXIA	European Plasma Research Accelerator with Excellence in Applications	DISTRIBUTED

https://ri-portfolio.esfri.eu/ri-portfolio/table/

PHYSICAL SCIENCES & ENGINEERING

During his last lecture, Edoardo Amaldi, who strongly contributed in paving the way for the Italian scientific research after WWII, interrogated the young students on what should be the most precious quality in a physicist:

Perseverance.

Amaldi's legacy spread in different directions, amongst which the research in gravitational waves with his student, Guido Pizzella, pioneer of this field in Italy – and professor at our University – but also with Francesco Paolo Ricci, neutron physicist who strongly supported the use of international neutron sources by the Italian community, such as the ISIS Neutron and Muon Source – another 40-year collaboration anniversary celebrated recently.

Scientists lobbying politicians

Venus transits are rare events that helped astronomers estimating the dimension and distance of the sun in the solar system.

Halley suggested in 1716 to exploit a predicted Venus transit in 1761, which sprang an international collaboration of 176 astronomers in 117 observing stations. Scientists' travel around the globe was possible thanks to scientific institutions lobbying their governments (often at war).

Que ces pays de l'Europe occidentale, en s'associant pour la construction et le fonctionnement d'un observatoire commun situé en Afrique du Sud, ouvriraient aux astronomes européens un champ de recherches peu exploré et d'une grande richesse,

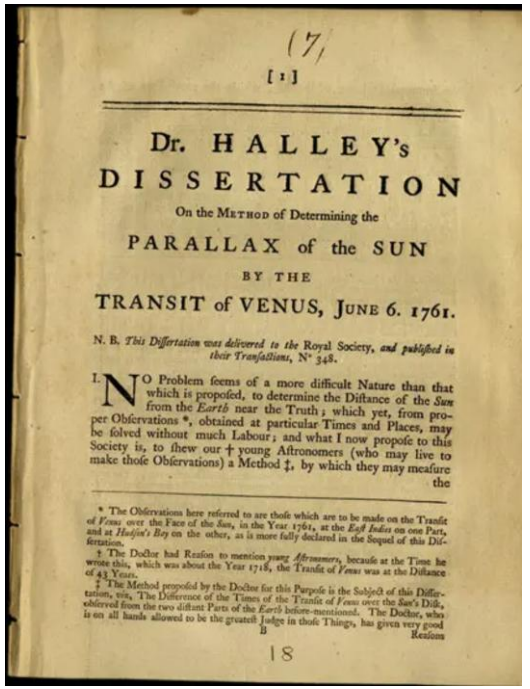
Que la participation à cette entreprise des six pays susmentionnés parait indispensable pour en assurer le succès,

Émettent le voeu

January 1954

Que les organisations scientifiques représentatives de ces six pays recommandent aux autorités qualifiées la construction en Afrique du Sud d'un observatoire commun, doté, notamment, d'un télescope de 3 m d'ouverture et d'une chambre de Schmidt de 1,20 m.

June 1761



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Dr. HALLEY's

DISSERTATION

On the METHOD of Determining the

PARALLAX of the SUN

BY THE

TRANSIT of VENUS, JUNE 6. 1761.

N. B. *This Dissertation was delivered to the* Royal Society, *and published in their Transactions*, N° 348.

I. NO Problem seems of a more difficult Nature than that which is proposed, to determine the Distance of the *Sun* from the *Earth* near the Truth; which yet, from proper Observations *, obtained at particular Times and Places, may be solved without much Labour; and what I now propose to this Society is, to shew our † young Astronomers (who may live to make those Observations) a Method ‡, by which they may measure the

* The Observations here referred to are those which are to be made on the Transit of *Venus* over the Face of the *Sun*, in the Year 1761, at the *East Indies* on one Part, and at *Hudson's Bay* on the other, as is more fully declared in the Sequel of this Dissertation.

† The Doctor had Reason to mention young *Astronomers*, because at the Time he wrote this, which was about the Year 1718, the Transit of *Venus* was at the Distance of 43 Years.

‡ The Method proposed by the Doctor for this Purpose is the Subject of this Dissertation, viz. The Difference of the Times of the Transit of *Venus* over the *Sun's* Disk, observed from the two distant Parts of the *Earth* before-mentioned. The Doctor, who is on all hands allowed to be the greatest Judge in those Things, has given very good Reasons

B

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Scientists lobbying politicians

EDITORIAL

Dark skies and bright satellites

Most ground-based observatories require a dark night sky to uncover answers to some of the most fundamental questions about the nature of our Universe. However, a number of companies and governments are in various stages of planning or deploying bright satellites in low-Earth orbit (or LEOsats) in greater numbers than ever before. These "megaconstellations" will fundamentally change astronomical observing at visible wavelengths. Nighttime images will be contaminated by streaks caused by the passage of Sun-illuminated satellites. If proposals calling for 100,000 or more LEOsats are realized, no combination of mitigations will be able to fully avoid the negative impact on astronomy.

This threat comes at a time when new technology of-

faint objects change over time. It is precisely this kind of astronomy that is most at risk from image artifacts arising from LEOsat megaconstellations. These satellites scatter sunlight for several hours after sunset or before sunrise, are relatively close and bright, and thus can affect ground-based telescopes observing at visible wavelengths. Constellations in orbits well above 600 km will be illuminated by the Sun all night long.

Astronomers worldwide are seeking ways to diminish the satellites' most damaging effects—the focus of a recent virtual workshop* sponsored by the U.S. National Science Foundation—and are collaborating with SpaceX (in particular, the Rubin Observatory), the first operator to launch a substantial constellation of LEOsats. SpaceX has shown that satellite operators can reduce reflected

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Earth orbit is a natural resource without environmental protections, and we are now witnessing its industrialization. Currently there are about a thousand bright LEOsats, but that may be just the beginning. Proposals to expand telecommunications and data relay to serve new technologies like self-driving cars could lead to a 100-fold increase in the number of LEOsats in the next decade. The American Astronomical Society is working with astronomy stakeholders, commercial satellite operators, and international organizations to begin to forge policy on light pollution from space. It is unclear how long this will take and how effective it can be. What is clear is that without productive industry-observatory collaboration, voluntary operator compliance with best practices for mitigation, and subsequent regulatory action, we are slated to lose a clear view of the Universe and its secrets.

–Anthony Tyson and Joel Parriott

Press Release

New ESO analysis confirms severe damage from industrial complex planned near Paranal

17 March 2025

Press Release

AES Andes announces cancellation of INNA, the industrial complex planned near Paranal

2 February 2026

International Conference on Research Infrastructures – ICRI 2026

Expected outcome:

The project is expected to contribute to all the following outcomes:

- Contribution to address research infrastructure challenges with a global dimension;
- Increased capacity of the EU to respond, in cooperation with international players, to challenges at global level;
- Development of further cooperation with key international partners on research infrastructures;
- Enhanced role of the Union in international organisations and multilateral fora;
- Progress towards the development of global research infrastructures.

Project description

DE EN ES FR IT PL

Role of research infrastructure in driving innovation and growth

The International Conference on Research Infrastructures (ICRI) brings together policy experts, facility managers, researchers, and stakeholders to discuss global challenges and trends in research infrastructures (RIs). The EU-funded ICRI 2026 project is the organiser of the ICRI 2026 conference in Rome, Italy, in December 2026. Led by the Consiglio Nazionale delle Ricerche (CNR), the largest public research institution in Italy, the event will collaborate with Italy's Ministry of University and Research and the European Commission. The conference will explore the dual role of RIs in driving socio-economic impact and promoting science diplomacy. It will develop frameworks to assess RI contribution to research, innovation, public services, and international collaboration.

Project Information

ICRI 2026

Grant agreement ID: 101261024

DOI

10.3030/101261024

EC signature date

10 September 2025

Start date

1 October 2025

End date

31 March 2027

Funded under

Research infrastructures

Total cost

€ 300 000,00

EU contribution

€ 300 000,00

Investment in EU policy priorities

Digital agenda	○	Clean air	○
Artificial Intelligence	○	Climate action	○
Biodiversity	○		

Coordinated by

CONSIGLIO NAZIONALE DELLE RICERCHE

Italy


Thank
you