



LEAPS

League of European
Accelerator-based
Photon Sources

The state of LEAPS

With ESAPS 2022 strategy into the bright future

Leonid Rivkin

PSI and EPFL

LEAPS chair

27th October 2022

<https://leaps-initiative.eu/>

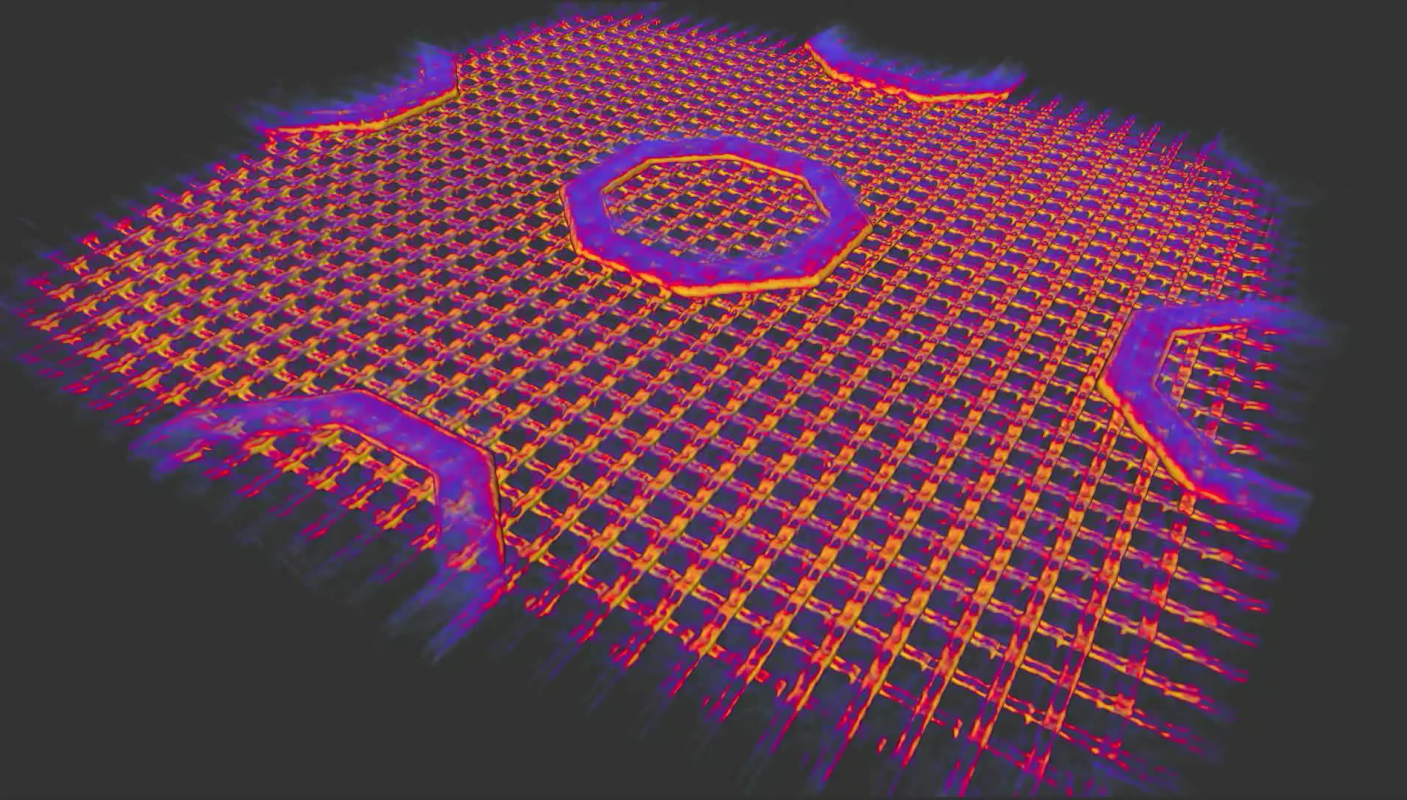
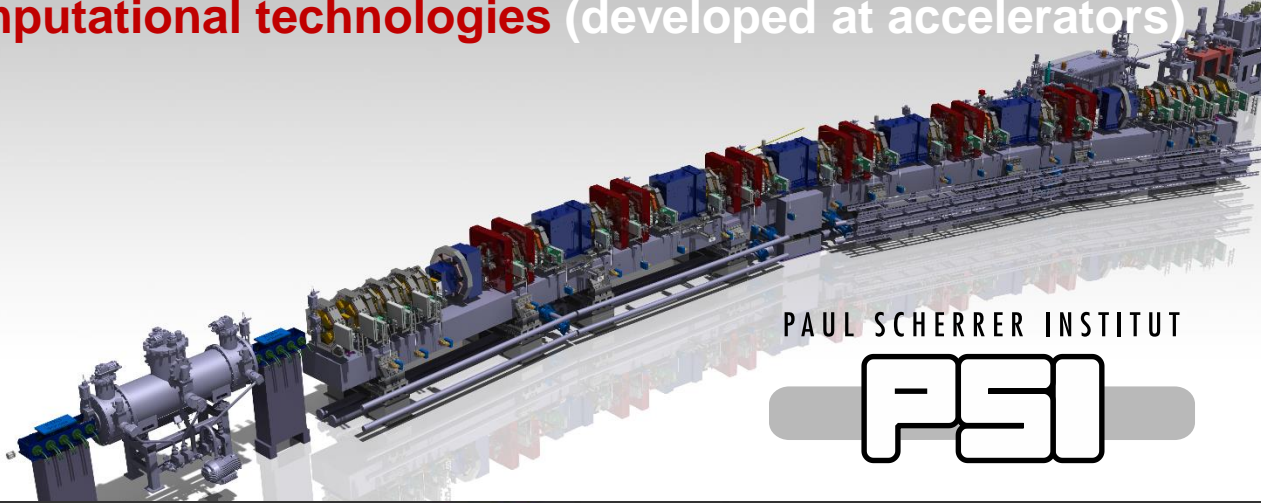
LEAPS is the largest consortium of analytical facilities world-wide and further expanding its service to an interdisciplinary European user community

- 19** facilities - **16** institutions - **10** countries
- > **300** operating End Stations
- > **1.000.000** h beamtime /year
- > **5.000** publications/year
- > **15** spin off companies
- > **35.000** users from all EU & beyond
researchers from all research area



Construction and Operation (~ 800 M€/year) through national funding

Imaging things on all length and time scales
using latest upgrades of X-Ray sources and
computational technologies (developed at accelerators)



Spatial Scales

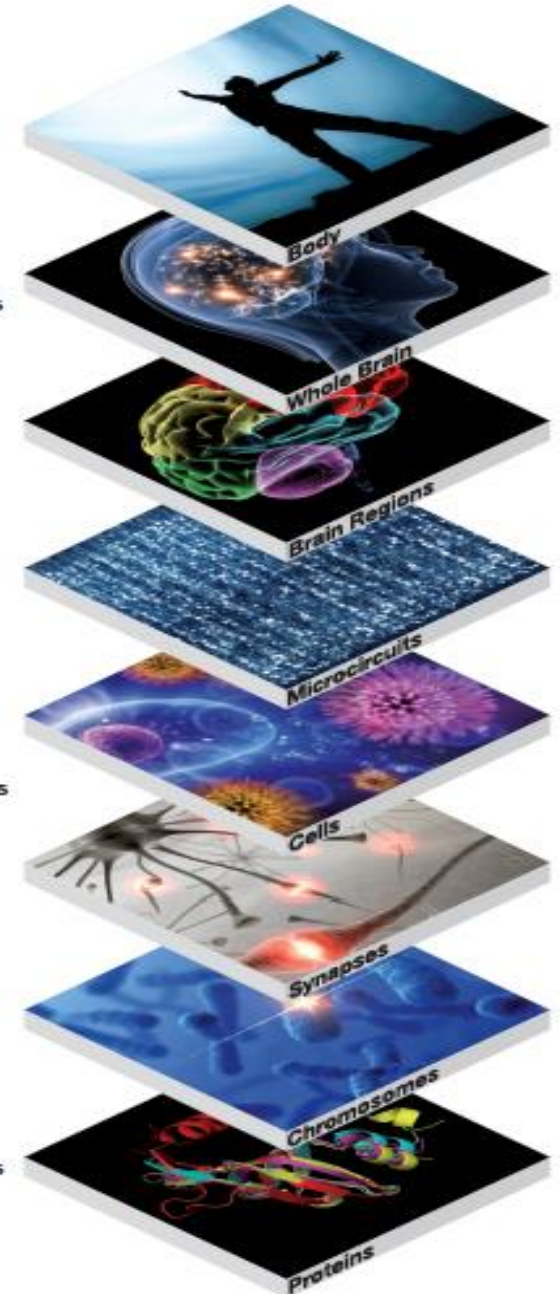
Meters
(10^0)

Centimeters
(10^{-2})

Millimeters
(10^{-3})

Micrometers
(10^{-6})

Nanometers
(10^{-9})





LEAPS

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EUROPEAN STRATEGY ACCELERATOR-BASED PHOTON SOURCES

ESAPS 2022



Strengthen Europe's
leading role in science
and innovation

ESAPS 2022

charts a transformative route into the future
that features
environmentally friendly
technologies and research strategies
to critically support solving societal challenges
while making
a core contribution to keep Europe
at the international forefront of research and development.



supporting **ERA Priority Actions**

ESAPS 2022

offers a novel pathway
for joining forces between
Europe's advanced X-ray and X-ray laser facilities
and European partnerships/initiatives
to tackle the urgent challenges of our society.

- **Climate Change**
- **Energy Materials and Materials for the Circular Economy**
- **Bio Preparedness**
- **Digital Transformation and Quantum Technology**

to achieve these goals

ESAPS 2022

has set out

A) what **LEAPS** offers with national funding

countries hosting LEAPS facilities

member countries of the European facilities ESRF and XFEL



B) where **LEAPS** requests support
by the European Commission and the European Parliament,



<https://leaps-initiative.eu/>

ESAPS 2022

has devised a **coherent strategy plan**
for the
upgrades of LEAPS facilities
in the coming decade
in close coordination with their **national funding** bodies.

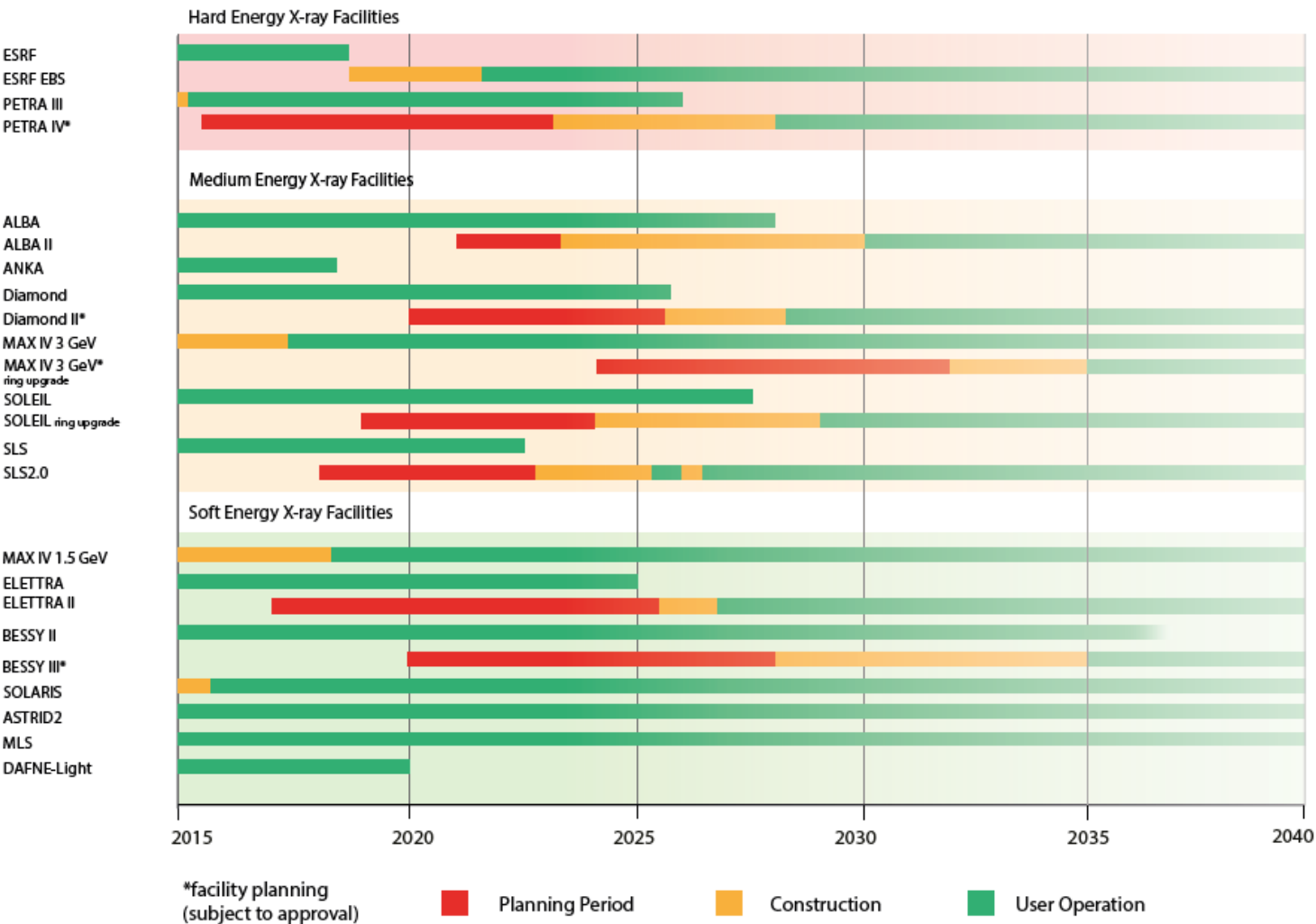
- to meet the new requirements of Europe's researchers from academia and industry
- to defend the Europe's international leading role in advanced analytical technologies
- to assure technology sovereignty of Europe in a critical field
- ERA priority action 8 

ESAPS 2022

Facility upgrade roadmap Storage rings and Free electron lasers National funding (multi-Bn € effort)

Further details in
ESAPS 2022 doc

Storage Rings



ESAPS 2022

have devised a **coherent strategy plan**
how to exploit this analytic European powerhouse
for a new handshake with European partnerships



NEW: Targeted challenge-driven
access model

→ **Longterm access to LEAPS facilities**
in cooperation with

- European partnerships/initiatives
- ARIE facilities



supporting ERA Priority Actions
3,4,8,9,10,16

ESAPS 2022

This new cooperation between RIs and partnerships/missions

requires

A) common understanding on the need
to **bridge Pillar 1** (RIs) and **Pillar 2** (Challenges & Missions)



B) European funding for targeted access
to support
tailored operando technologies at LEAPS facilities
and
specific operation costs



→ **recommendation: European funding for targeted access & technology development**

ESAPS 2022

have devised roadmaps in KEY ENABLING EUROPEAN TECHNOLOGIES for the digital transformation of ERA



- New **remote operation modalities** for all European Researchers and for European industry
(contributing to technology resilience, reduction of CO₂ footprint)
- **AI-assisted** autonomous HTP **operation** (robotics, ...)
- **Testbeds** for novel quantum technologies (q-sensing, QC,)
- Partnering with **EOSC**
- **Transformative technologies** in X-ray optics, sample delivery, accelerators, by early collaboration with industry



supporting ERA Priority Actions
1,2,3,8,9,11,12,16

→ **Recommendation: European call for the development of key enabling technologies through innovation/with early collaboration with industry**

Remote Access

- MX Beamlines in Europe were already using remote access
- MX BLs were among the most requested by pharma industry
- Remote control well developed – ‘light’ assistance at the facility
- Remote access has grown in all facilities where it has been offered
- Other BLs are joining this modality, as well as Cryo-EM (for example SOLARIS, ESRF, DIAMOND)

Mail-in sample

- Administrative procedures for mailing-in in place thanks to remote access
- BL scientists doing the experiments, with zoom-linked users
- Work load for BL scientists not sustainable on the long term

MIXED Solutions

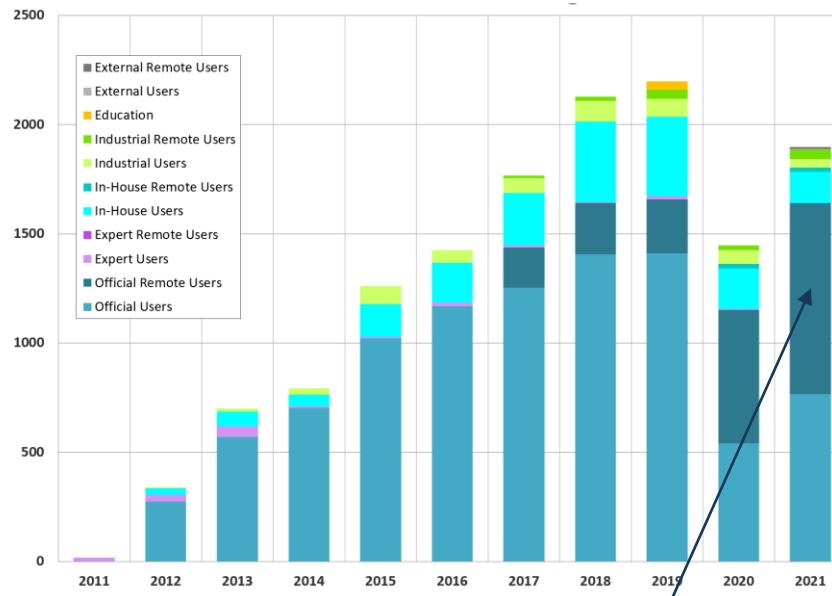
Evolution of ‘zoom-linked’ users towards ‘remotely-active’ users, thanks to ad-hoc solutions for specific Beamlines, or open source software like Guacamole, used at ESRF



BL scientist executing user proposals: fast experiments, even combining samples of different proposals with similar configurations to optimize the time

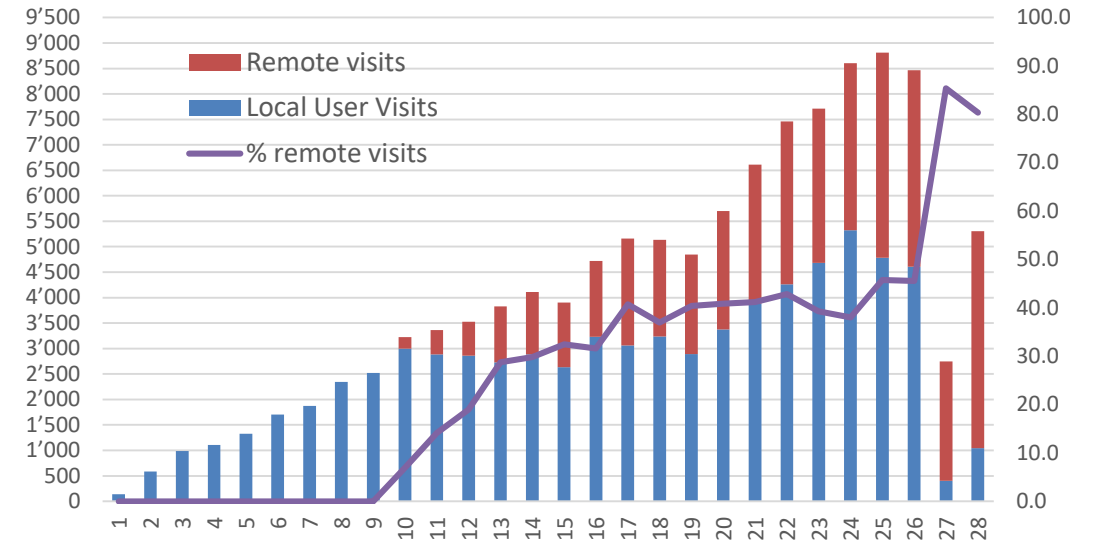
At ALBA experiments were done in shorter beamtimes. Would be sustainable only with increased staff

Increase of remote access (ALBA, DIAMOND and ESRF as examples)

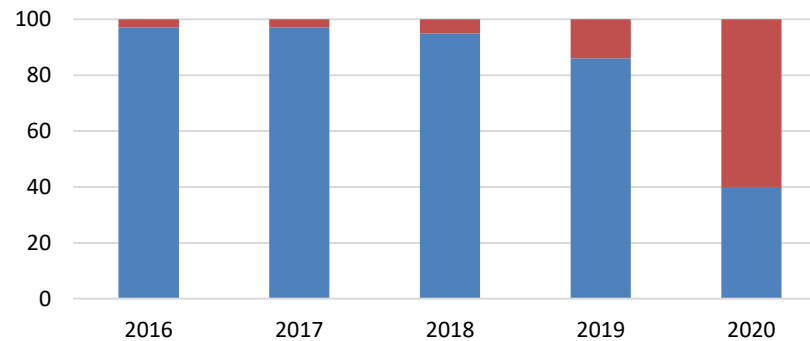


ALBA users

REMOTE



DIAMOND users through Allocation Periods



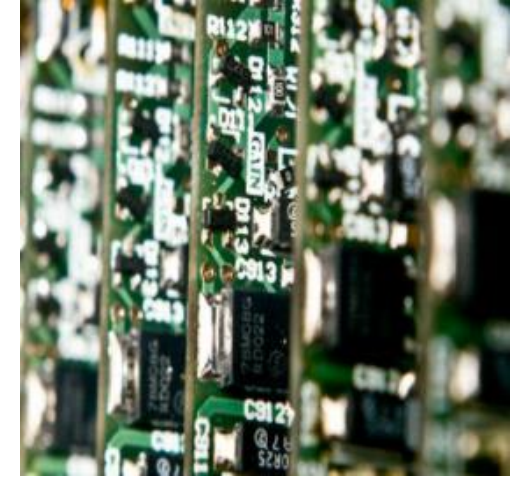
■ % on-site ■ % remote access

ESRF users

In all facilities the total number of users has decreased, the remote users have increased (for example at Soleil by a factor of 3)

IT services: essential for remote use of facilities

- Fast and safe connection
- Remote control system for the experiments (e.g. NoMachine)
- Video conferencing tool
- Remote desktop services, VNC
- Services for real time data transfer, SFTP/Globus
- Git repository for software

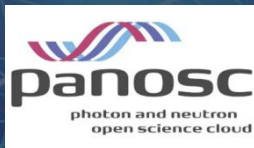


Existing collaborations now focusing on the new way of communicating

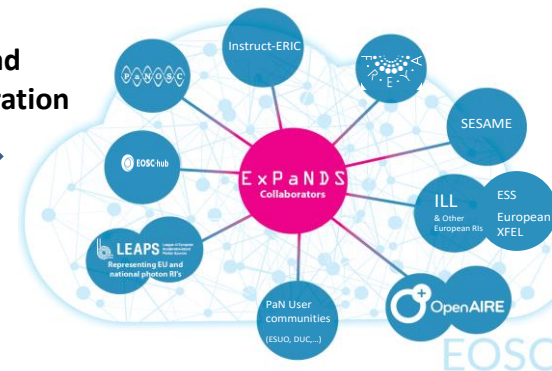
Example: PaNdata => PaNOSC and ExPaNDS projects



Zoom (and other platforms) have made the difference



broad
collaboration



Aiming at Delivering services to every Photon and Neutron RI in a coherent and integrated way

pandata



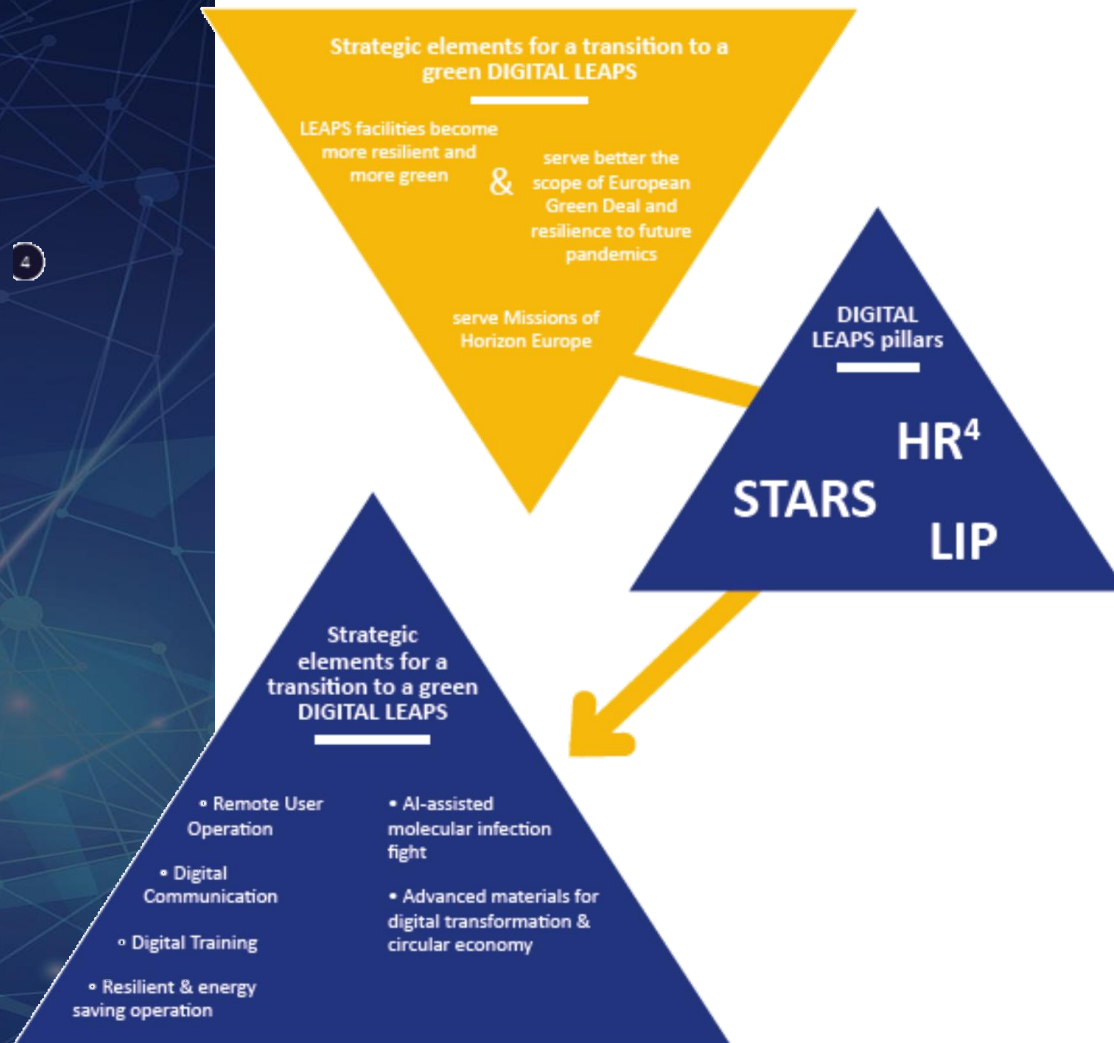
Learning from the challenges, developing new tools for the future

- **Remote access** will continue
- It will decrease the traveling needs
- Its extension to non-MX areas will greatly depend on reinforcing human resources to implement new IT tools and automated setups
- **Agile sample shipment and new procedures** are being developed complying with safety protocols for labelling and package of the samples and also to deal with customs clearance
- Remote access is strongly technique-dependent and is not foreseen to be applicable to all fields and instruments
- Increase of user communities thanks to easiest access

REMOTE ACCESS CANNOT BE THE ONLY SOLUTION

- It is important to keep a strong link between staff and users, critical for developing new ideas and experiments. Discussions at the beamline remain essential
- "Hybrid" experiments where part of the experimental team will be on-site and part of it in their lab could be an efficient way of working in the future.

Learning from the pandemic, new collaborative project



GOALS:

to transform **LEAPS** research infrastructures into **more resilient** ones towards pandemic crisis situations to **support the European society** in infection fight and in developing a circular economy within the scope of the **European Green Deal** and **Missions of Horizon Europe**

Green “DIGITAL LEAPS” project

STandardisation for **R**emote Sample handling (**STARS**)

LEAPS Integrated **P**latform (**LIP**)

HR⁴ – remote training and collaborative tools

To be prepared for future urgent challenges ESAPS 2022



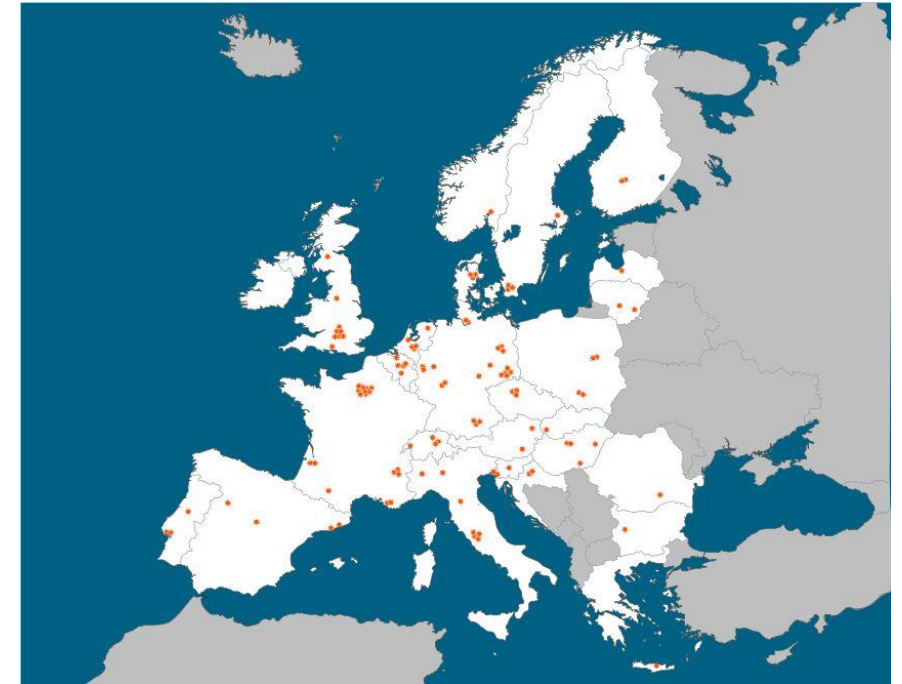
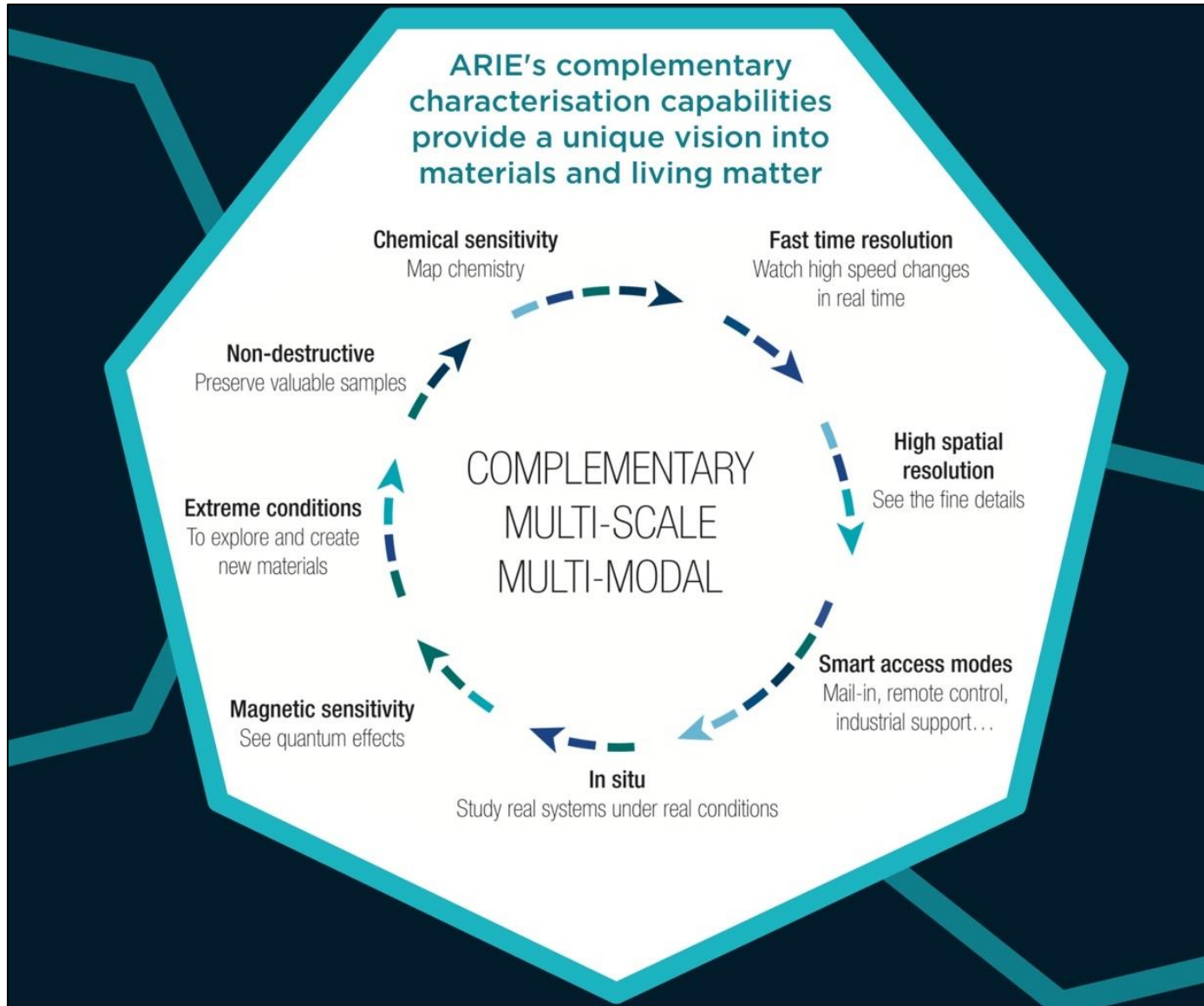
Enhancing collaboration among facilities and countries as a European asset

Aiming at European funding for **targeted challenge-driven access**

to support **taylored operando technologies** at LEAPS facilities and specific operation costs

- supports **high quality research** in Europe,
- contributes to develop the skills of the **next generation of scientists and engineers** in Europe,
- subscribes to **diversity, gender balance, anti-discrimination** (“LEAPS-IDEA”),
- devises particle accelerators and associated **technologies of tomorrow** for a wide range of use in manufacturing and service industries in health, materials design, energy and security,
- supports European industry in **new product development** and market and by accelerating product design and development,
- devises **deeptech roadmaps** in close cooperation with European industries
- contributes to European **technology sovereignty**
- supports ERA Priority Actions.

ARIE IS AN EUROPEAN ASSET



About 120 research infrastructures
Unique photon, X-ray, electron,
neutron, ion and proton beam and
high magnetic field facilities
available to researchers.

ARIE: HUB OF SEVEN NETWORKS



e-DREAM was formed to promote cooperation between European-level advanced electron microscopy infrastructure providers, collaborative research and transnational user programmes.



The EMFL develops and operates world class high magnetic field facilities for excellent research by in-house and external users.



Led by the University of Manchester, Inspire is a European Research Project that aims to provide a world-leading integrating activity for European research in Proton Beam Therapy (PBT).



Laserlab-Europe understands itself as the central place in Europe where new developments in laser research take place in a flexible and coordinated fashion.



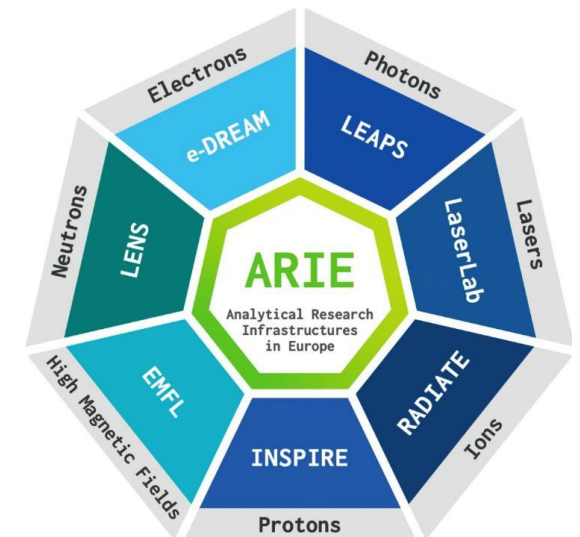
LEAPS is a strategic consortium working to ensure and promote the quality and impact of the fundamental, applied and industrial research carried out at Synchrotron Radiation and Free Electron Laser user facilities in Europe.



LENS is a not-for-profit consortium working to promote cooperation between European-level neutron infrastructure providers offering transnational user programs to external researchers.



The RADIATE project is working to structure the European Research Area of ion technology application by strengthening the cooperation between European ion beam infrastructures.



LEAPS meets conference series

LEAPS meets *Emerging Challenges in Life Sciences*



Chair:

C. Biscari, ALBA, LEAPS

Scientific Chair:

G. Schertler, ETH Zürich and PSI

Scientific Vice-Chair:

K. Djinić-Carugo, EMBL-Grenoble

Organising Committee:

Søren Pape Møller, ISA, LEAPS

Massimo Ferrario, INFN, LEAPS

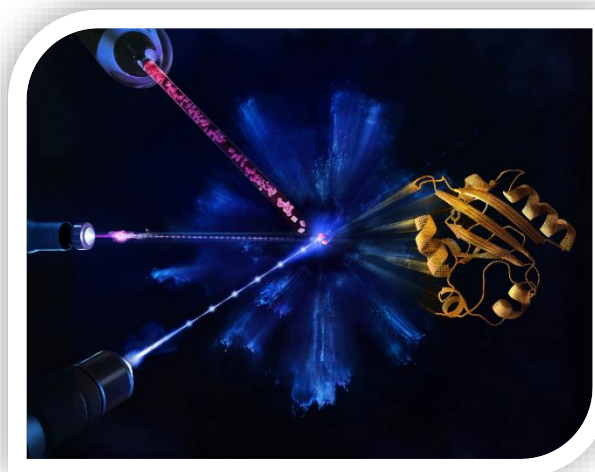
Rafael Abela, PSI, LEAPS



DATE: 14-19th of May 2023



VENUE: La Biodola, Elba, Italy



TECH-focus keynote and tutorials:

Protein Crystallography

Bioimaging

Correlative Microscopy

X-FEL methodologies

Cryo-Electron Microscopy

Computational Biology

TOPICAL subjects:

Viral and Microbial infections

Antibiotics resistance

Cancer research

Neurodegenerative diseases

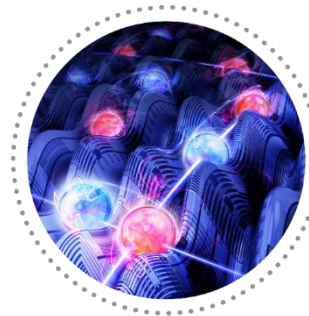
and much more...

Previous Edition:



LEAPS meets *Quantum Technology*

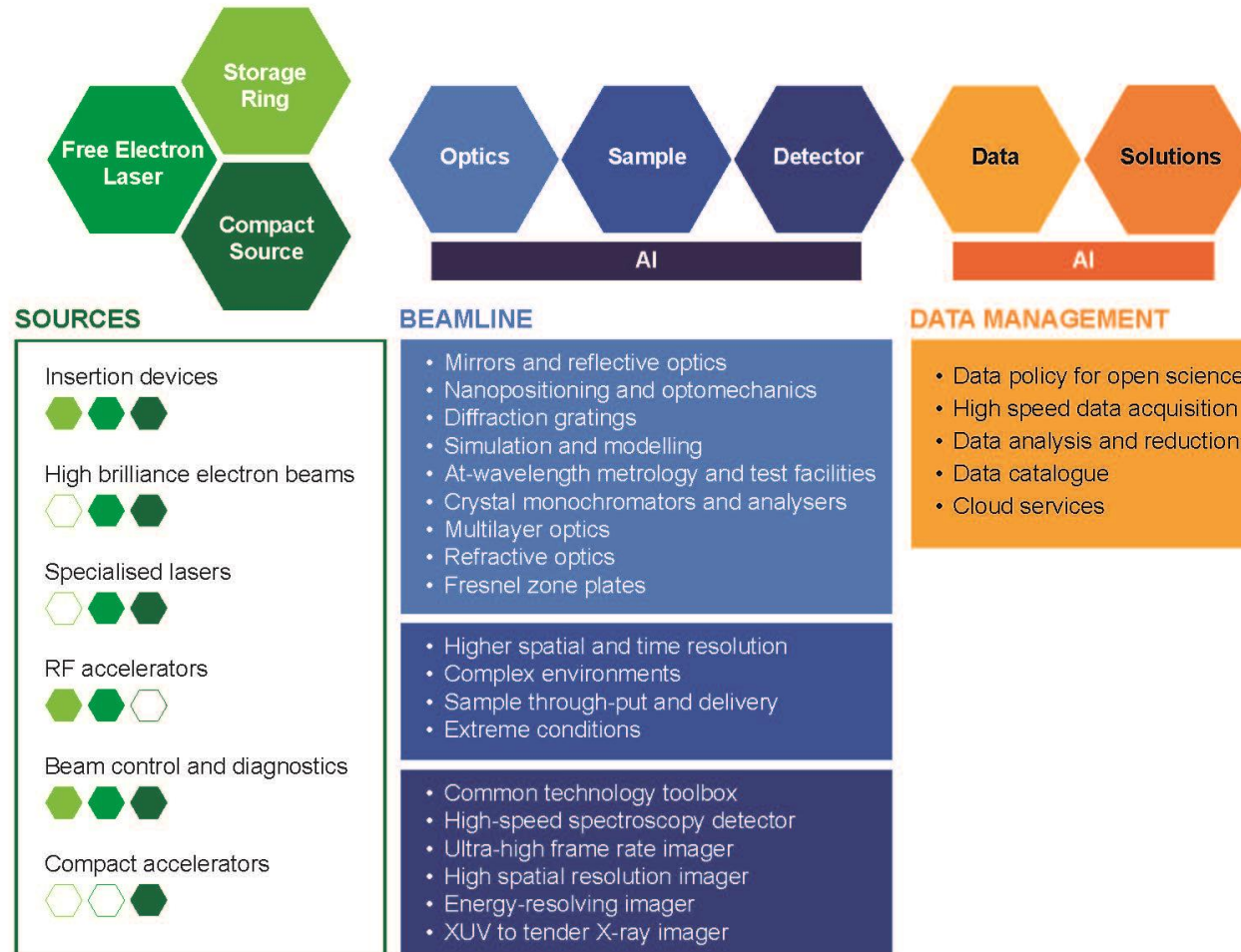
Elba, 15-19 May 2022



LEAPS League of European
Accelerator-based
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Pilot actions towards the implementation of the LEAPS Technology Roadmap and explore open innovation strategies for partnership with industry

Work packages based on LEAPS technology roadmap



- **Jointly develop** urgent key technologies for LEAPS facilities
 - **Speed up** the innovation process for LEAPS facilities and industry
 - **Create** viable markets through joint developments and standardisation
 - **Exchange** of facility experts with industry throughout the development process
 - **Transfer** technology and knowledge within LEAPS and to interested companies at an early stage
 - **Develop** models for production plans and technology transfer
- ➔ **Shorten development times**
- ➔ **Reduce costs**
- ➔ **Enhance commercial exploitation through open innovation**



Open innovation for accelerator-based light sources in Europe

Visit <https://www.leaps-innov.eu/>

Work Packages

- Project Management and Dissemination
- **XAFS-DET:** High throughput Germanium X-ray spectroscopy detector
- **SuperFlat:** PCP for high-performance X-ray mirrors
- **NeXtgrating:** e-beam lithography for soft X-ray gratings
- **POSIT:** New positioning and scanning systems for speed and accuracy
- **LIDs:** Novel insertion devices
- **DATA:** Data reduction and compression
- **INDUSTRY:** Industrial Innovation through Light Sources
- **CO-CREATION:** Innovation by Co-creation towards Global Challenges

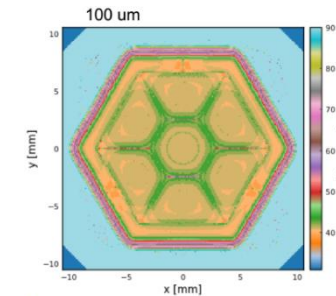
Coordinator: DESY, 2021-2025, budget: 10 M€

Elke Ploenjes-Palm

Consortium:

all 16 LEAPS members
3 SMEs
3 technology partners
(ENEA, KIT, STFC)

> 50 European
industrial partners
(> 77% are SMEs)



Bringing together technology
innovation and people

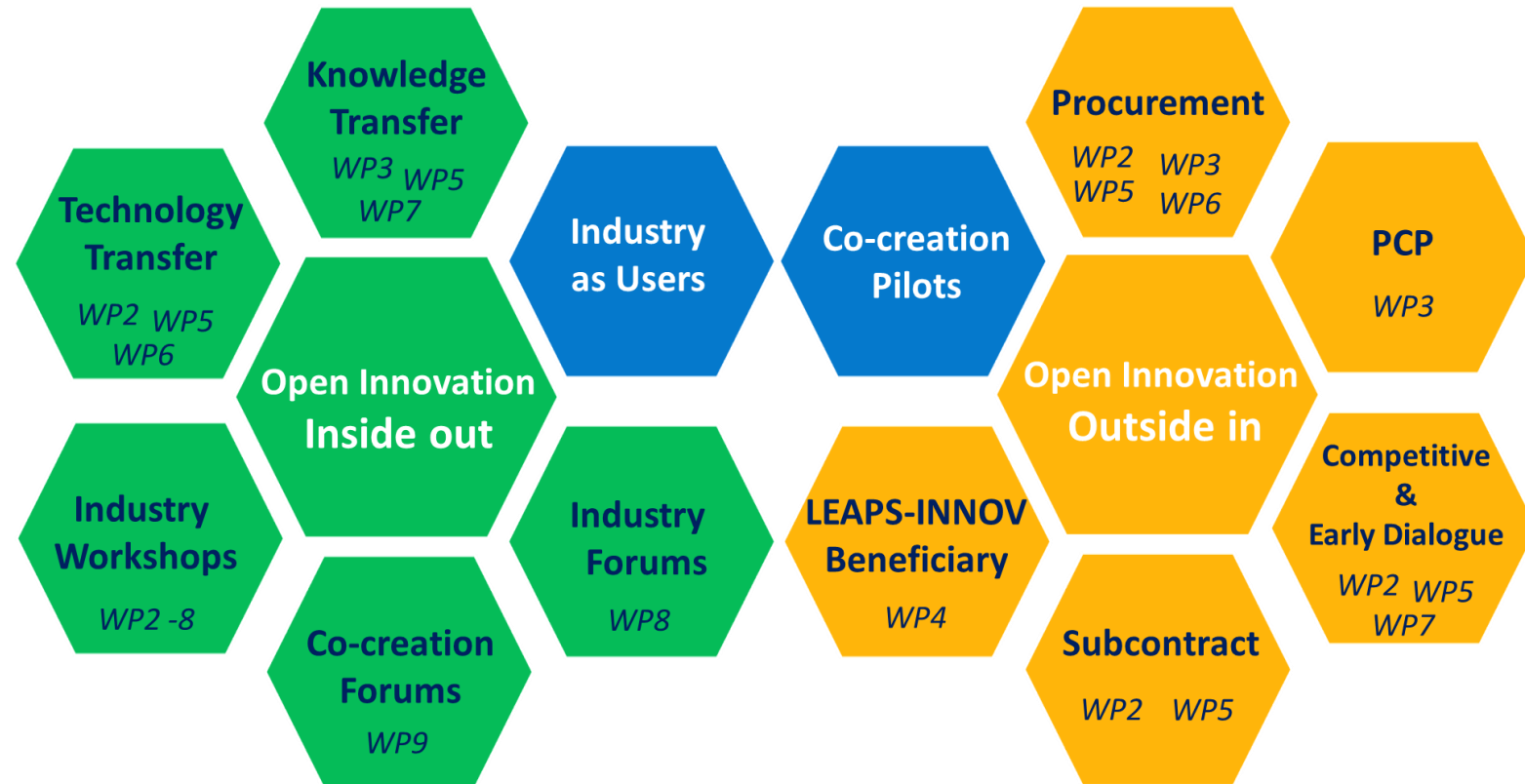


LEAPS-INNOV tools to foster technological development with early industry involvement

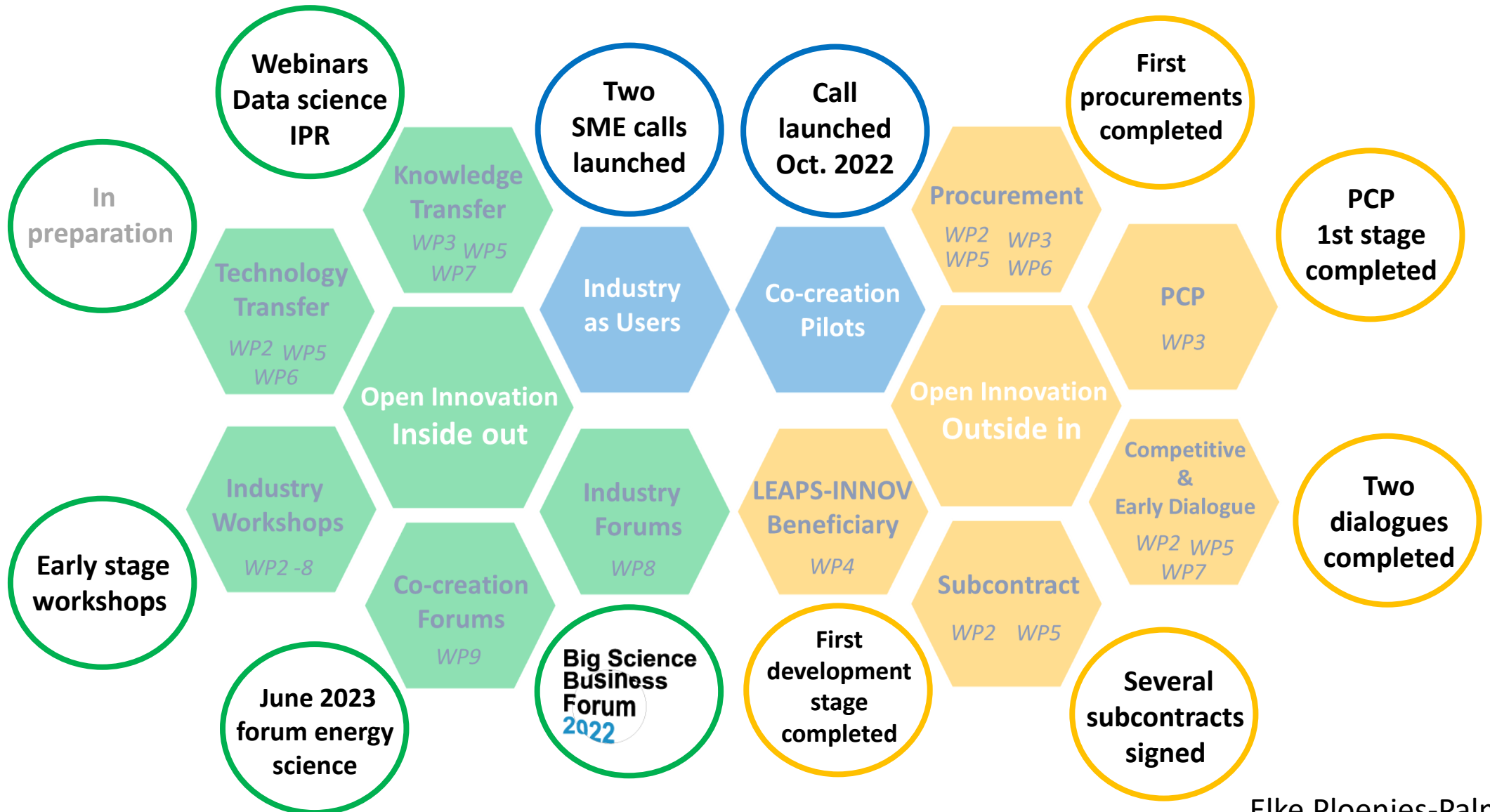
Open Innovation

Involve **industry** in innovation for SR & FELs in Europe as

- suppliers
- users
- trigger of science



LEAPS-INNOV tools to foster technological development with early industry involvement





<https://indico.esrf.fr/event/2/>

Facility	Energy [GWh/year]	Operating time reduction
CERN LHC	1300 (2200 with FCC)	- 20% in 2022, 2023 (C-free energy)
DESY	153	
PSI	125	- 20%
~ all RIs	~ 5000?	
Bitcoin mining		200'000 GWh/a



Total: 510'000
SNCF: 7'000



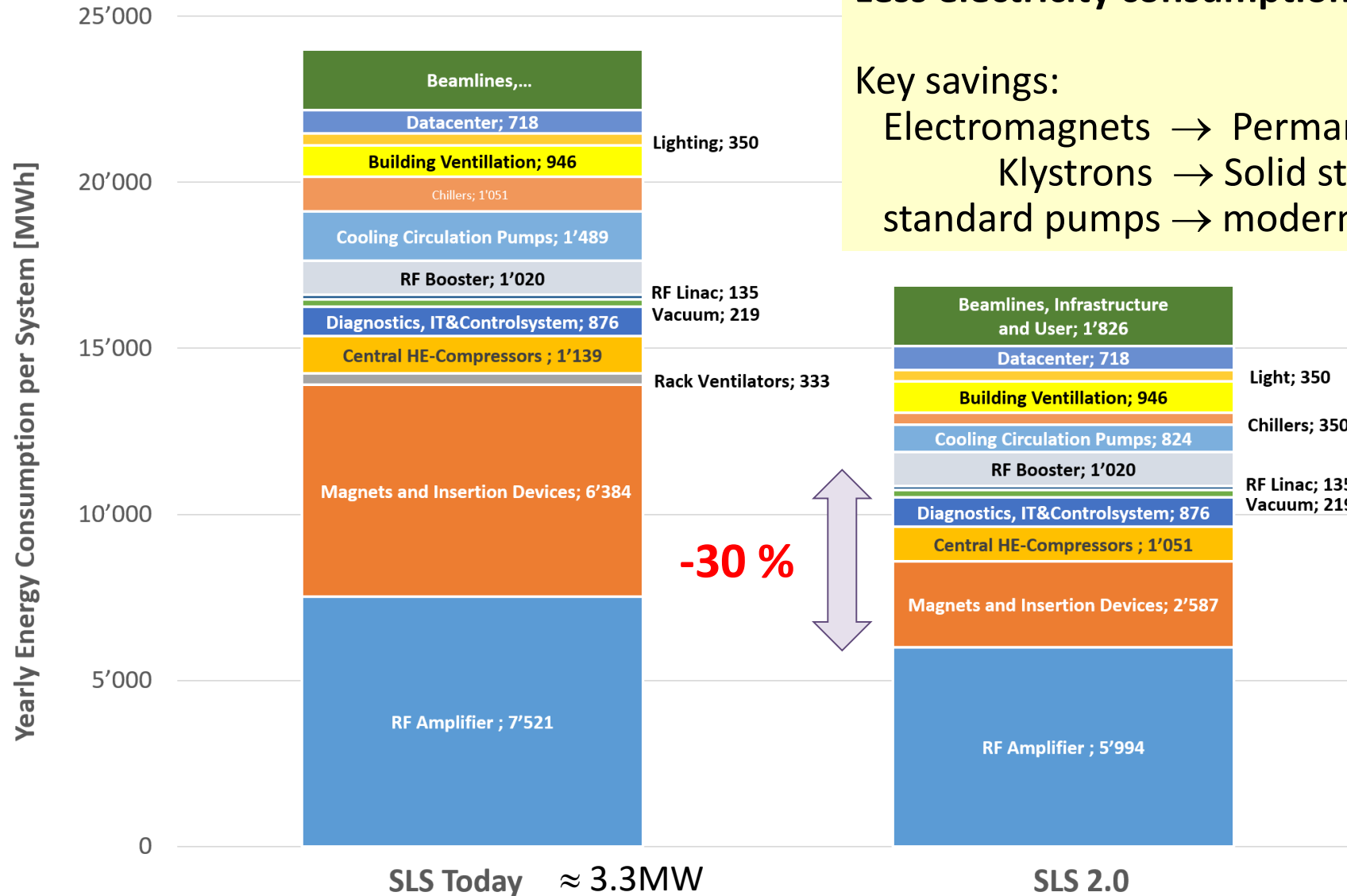
Total: 277'000
RENFE: 2'600



Total: 58'000
SBB: 3'000



LEAPS Facilities upgrades: example of Swiss Light Source SLS2



More X-rays for users
Less electricity consumption

Key savings:

Electromagnets \rightarrow Permanent magnets
Klystrons \rightarrow Solid state amplifiers (63%)
standard pumps \rightarrow modern pumps for cooling

Example: LEAPS Facilities Investment Plans 2022-2026

- Given the initial investment, cutting operation time we give up on our primary task of being the engine of innovation and progress
- Do we re-balance the weight of science and what it contributes to society?
RIs are integral part of the solution for the challenges ahead

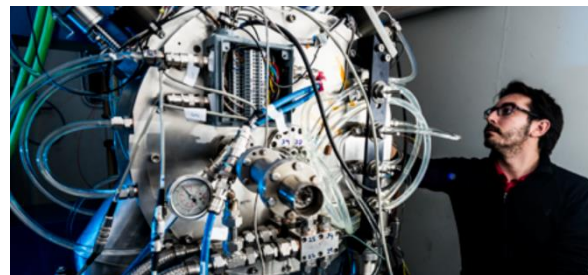
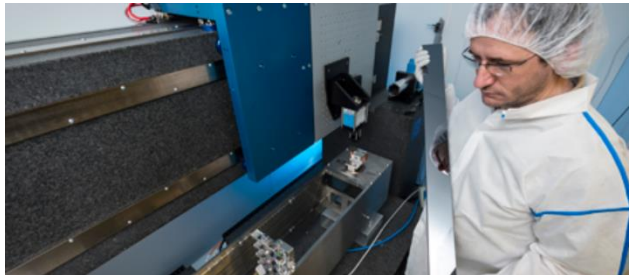
Activity (2022-2026)	Approximate numbers
No. of new beamlines being constructed or refurbished	70
Yearly/Total operational budget	800/4000 M€
Budget for investments	450 M€
Budget for the upgrade programs (partly already funded)	550 M€

Larger investments
foreseen for the
period 2027-2030

Our instruments are oversubscribed: delays and cost increases due to supply chain problems, inflation etc. will result in cancellation of projects, harming careers of PhDs and early career researchers

WHAT SHOULD BE DONE?

- **Stabilize the energy supply: RIs need long-term planning**
 - ✓ Sustainable, affordable, predictable
 - ✓ **Regulated tariff mechanism?**
 - ✓ Fluctuations in energy cost makes the planning unrealistic and hampers the scientific progress on challenges the society is facing, including energy production



Instruments development: 400 years of discoveries with “telescopes” and “microscopes”



Galileo Galilei



« Le seul véritable voyage ... ce ne serait pas d'aller vers de nouveaux paysages, mais d'avoir d'autres yeux, de voir l'univers avec les yeux d'un autre, de cent autres, de voir les cent univers que chacun d'eux voit, que chacun d'eux est. » Marcel Proust

“The real voyage of discovery consists not in seeking new landscapes but in having new eyes”
Marcel Proust

Zacharias Janssen



The First Compound Microscope (circa 1595)



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Tool for
European
inclusiveness



“The strength of LEAPS lies in its staff and users, hailing from all European countries, beyond those which host the facilities.”



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@LEAPSinitiative

<https://leaps-initiative.eu>

