Social Impact of Synchrotrons

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23 January 2026

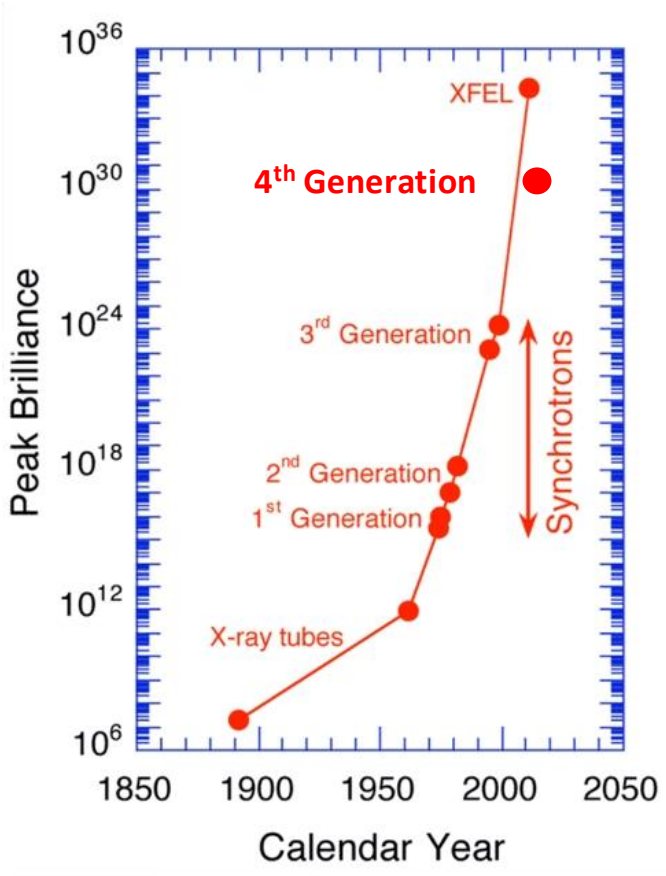
The Abdus Salam International Centre for Theoretical Physics

School on Synchrotron Light Sources and their Applications

Generalitat de Catalunya
Departament de Recerca i Universitats

Gobierno de España
Ministerio de Ciencia e Innovación

Evolution of Synchrotron Radiation Sources

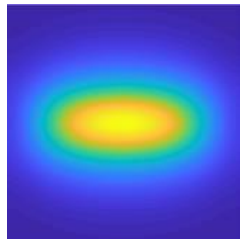


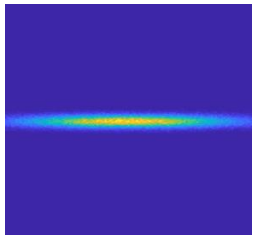
Increase in Brilliance

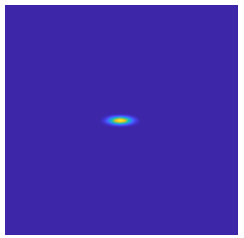
Increase in Resolution Power

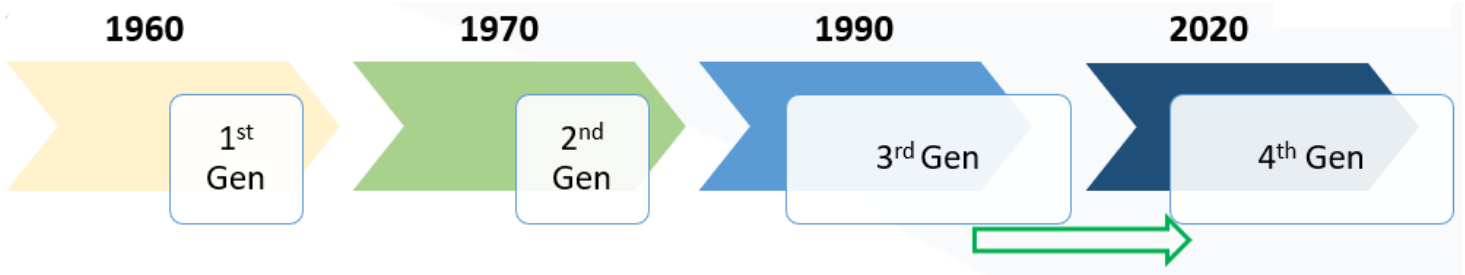
Increase in Coherence

Increase in Data Analytics capacity







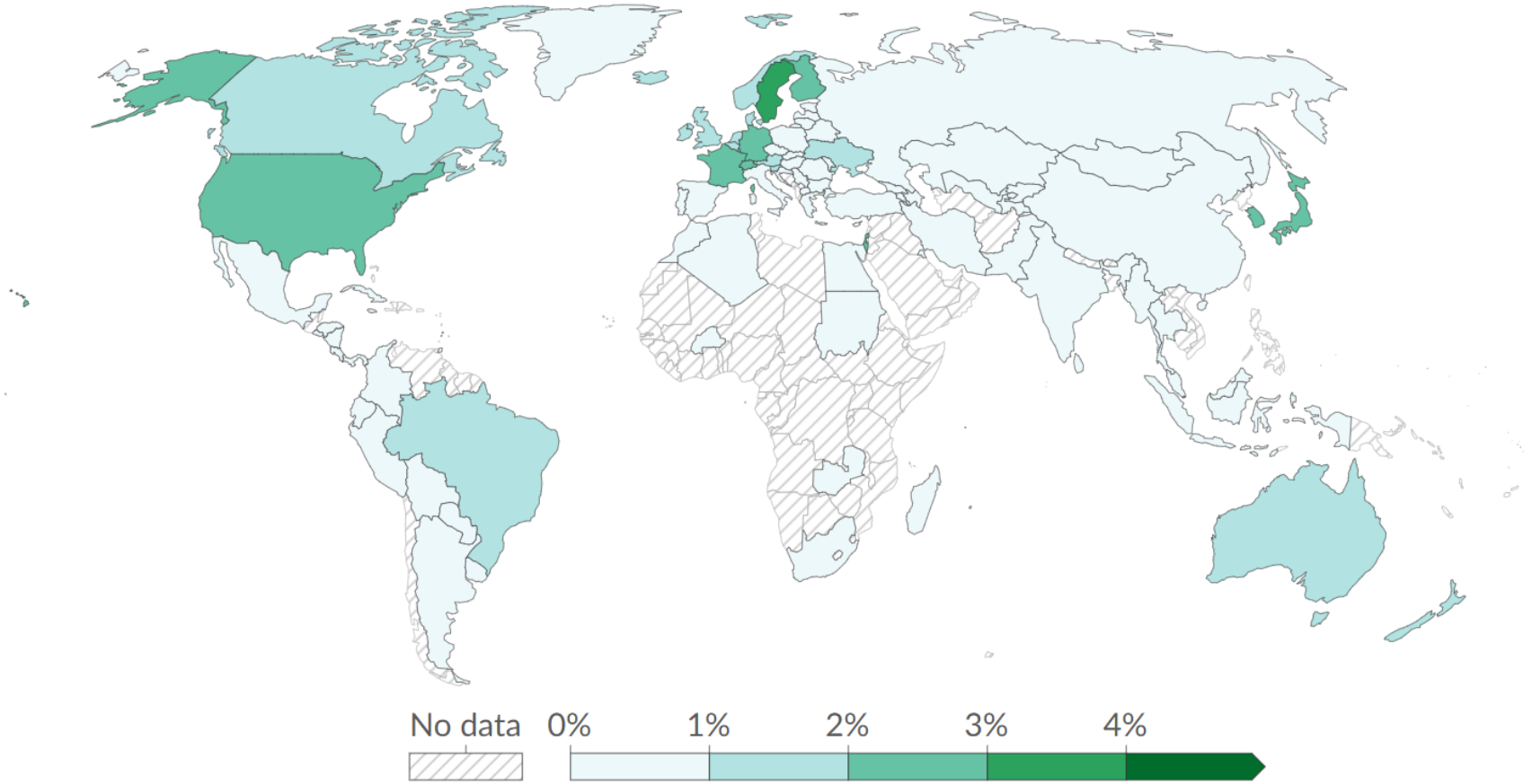


1st or 2nd generation

3rd generation

Synchrotron Radiation Facilities in 1996
Going from 2nd to 3rd generation

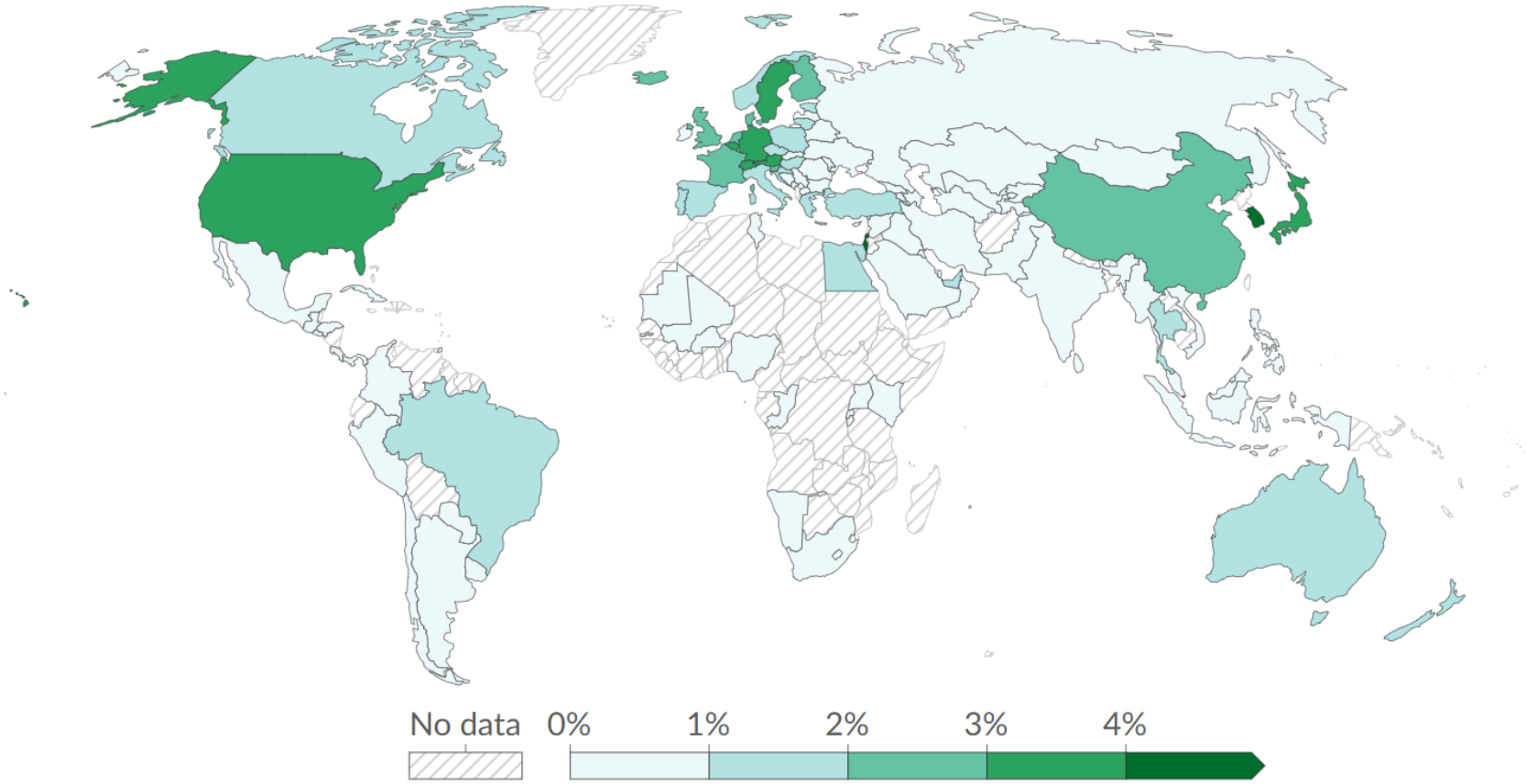
R & D spending in terms of GDP (1996 – 30 years ago)



1996 2023

1996

R & D spending in terms of GDP (2023 – 2 years ago)

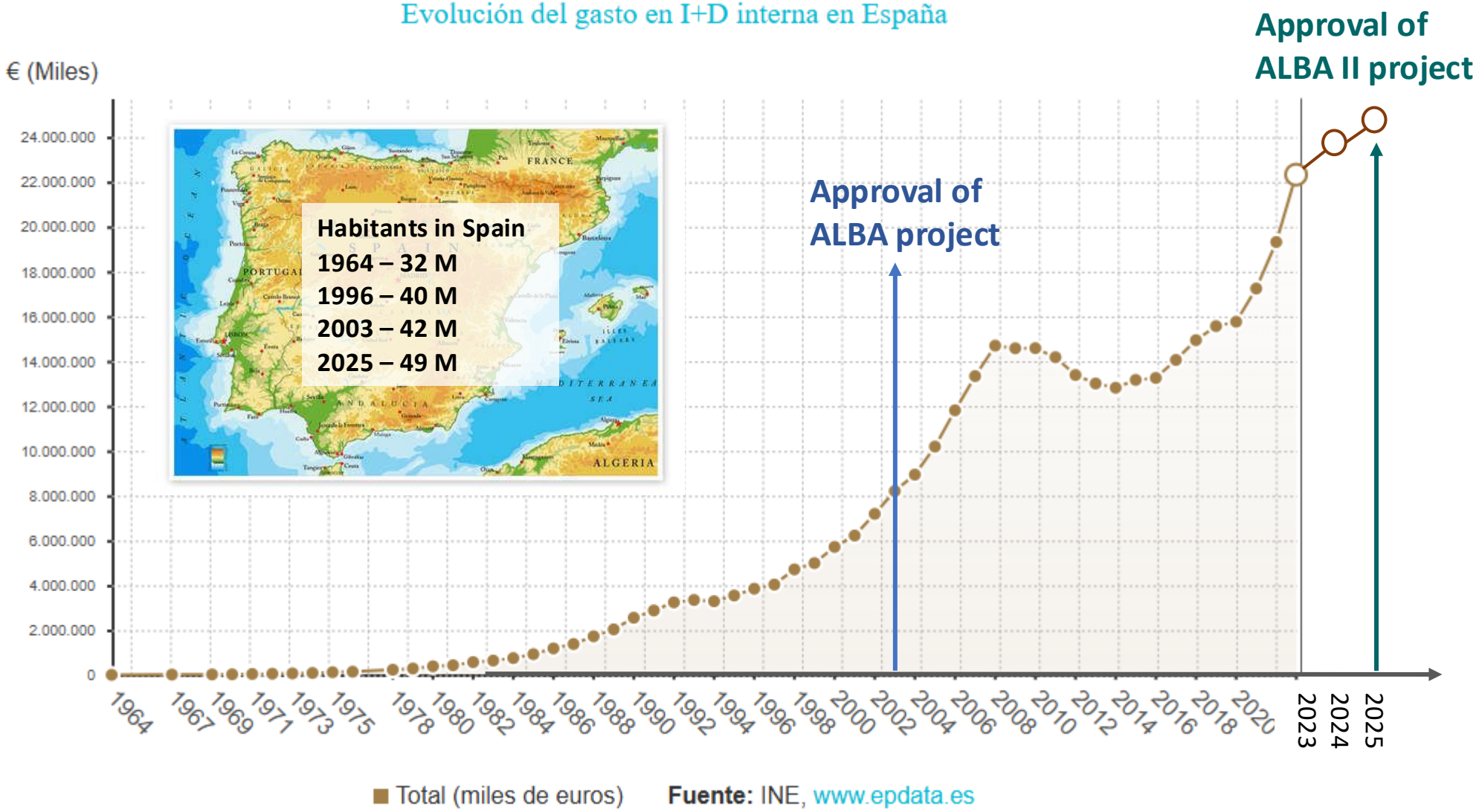


- 4th Generation IN OPERATION
- 4th Generation *in construction*
- Upgrading or planning upgrade from 3rd to 4th generation
- 3rd generation

Synchrotron Radiation Facilities in 2026
Going from 3rd to 4th generation

https://www.epdata.es/datos/gasto-investigacion-innovacion-datos-graficos/

Evolución del gasto en I+D interna en España



ALBA: past, present and future

2003 – Creation of CELLS Consortium (Spanish Government and regional Catalan Government).

1993 Initial concept

2003 ALBA Approval

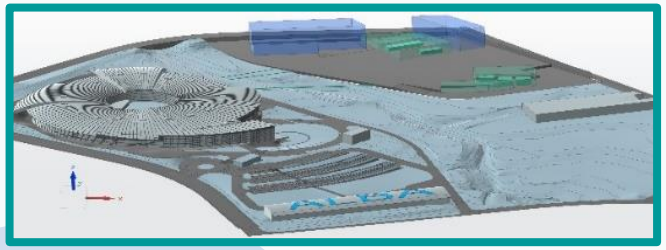
2006 Starting ALBA construction

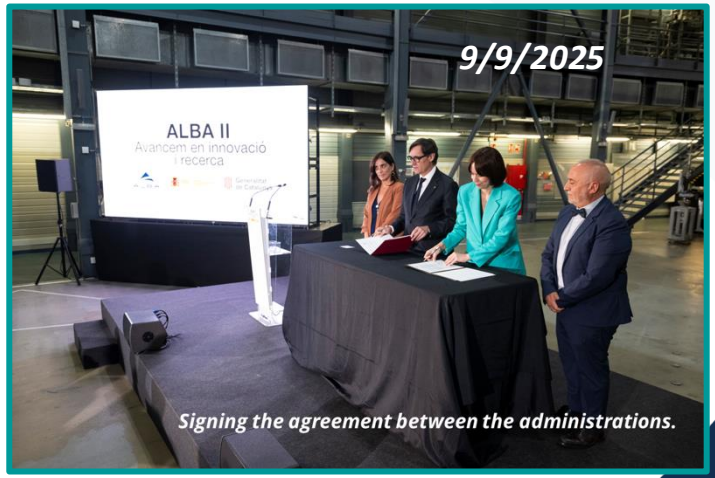
2012 Starting ALBA Operation

2020 Starting ALBA II design

2025 ALBA II and long-term (2025-38) Funding Approval

2032 ALBA II Operation





ALBA Synchrotron Radiation Facility

National *public institution with 50% Spanish + 50% Catalan* ***funding:***
Consortium owned by ***Ministerio de Ciencia, Innovación y Universidades*** *and* ***Department de Recerca i Universitats***

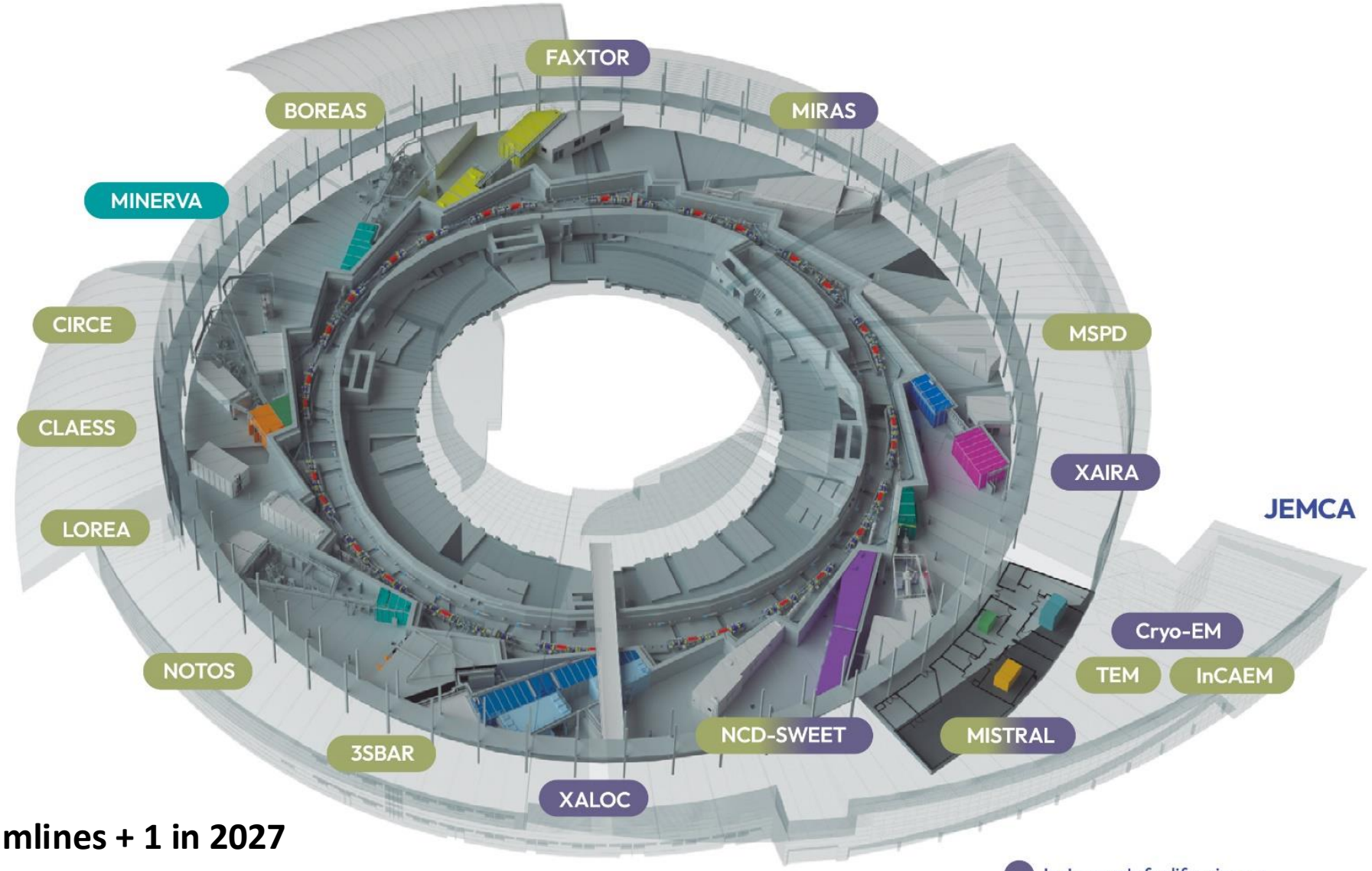
National and international (28%) staff

National and international (40%) academic users

National and international (50%) industrial users

National and international collaborations

ALBA 2026



13 operating beamlines + 1 in 2027

3 electron microscopes + SPM & AFM

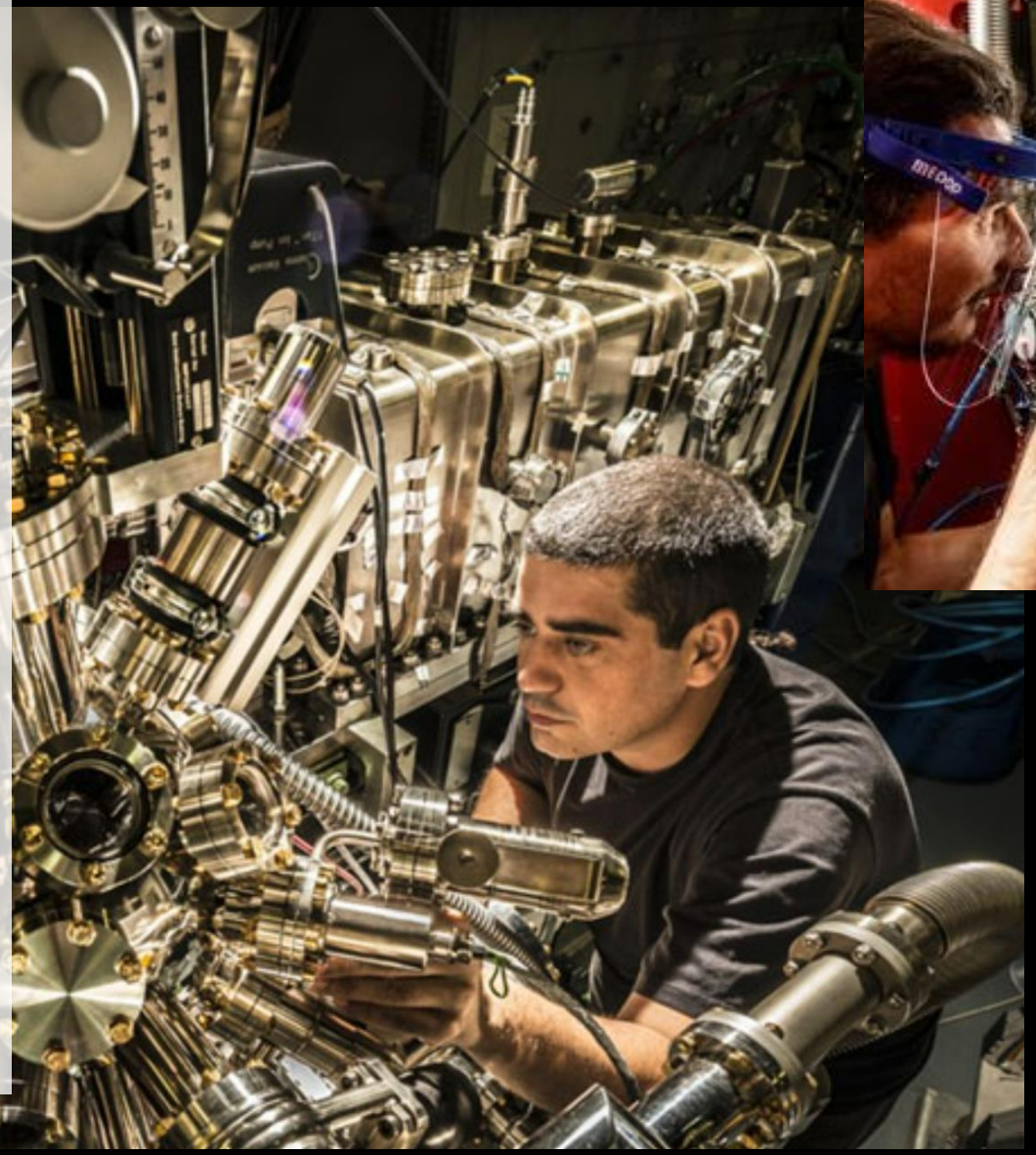
The accelerator

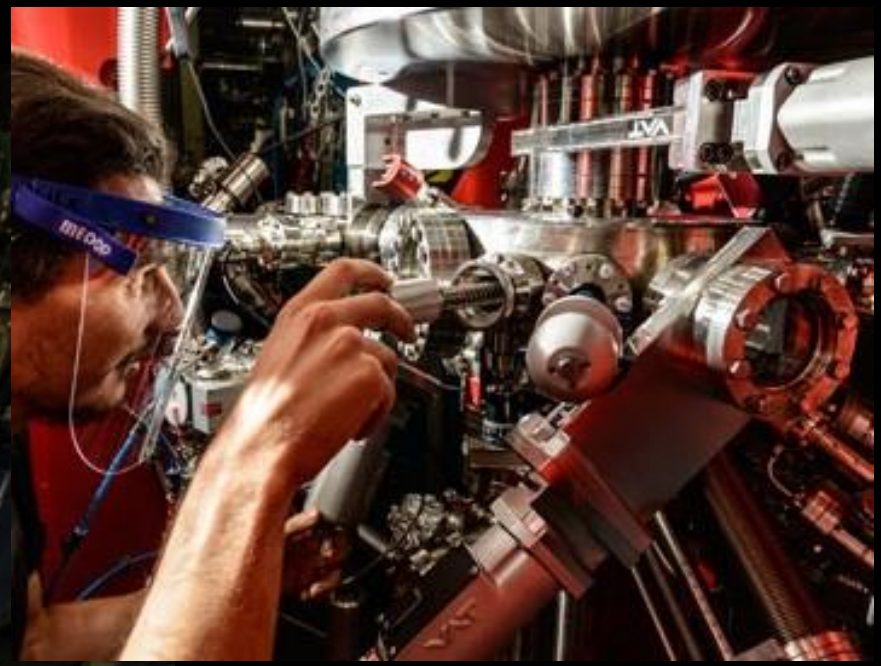
ALBA storage ring – 3rd generation light source
3 GeV electrons - 270 m circumference

Beamlines at ALBA

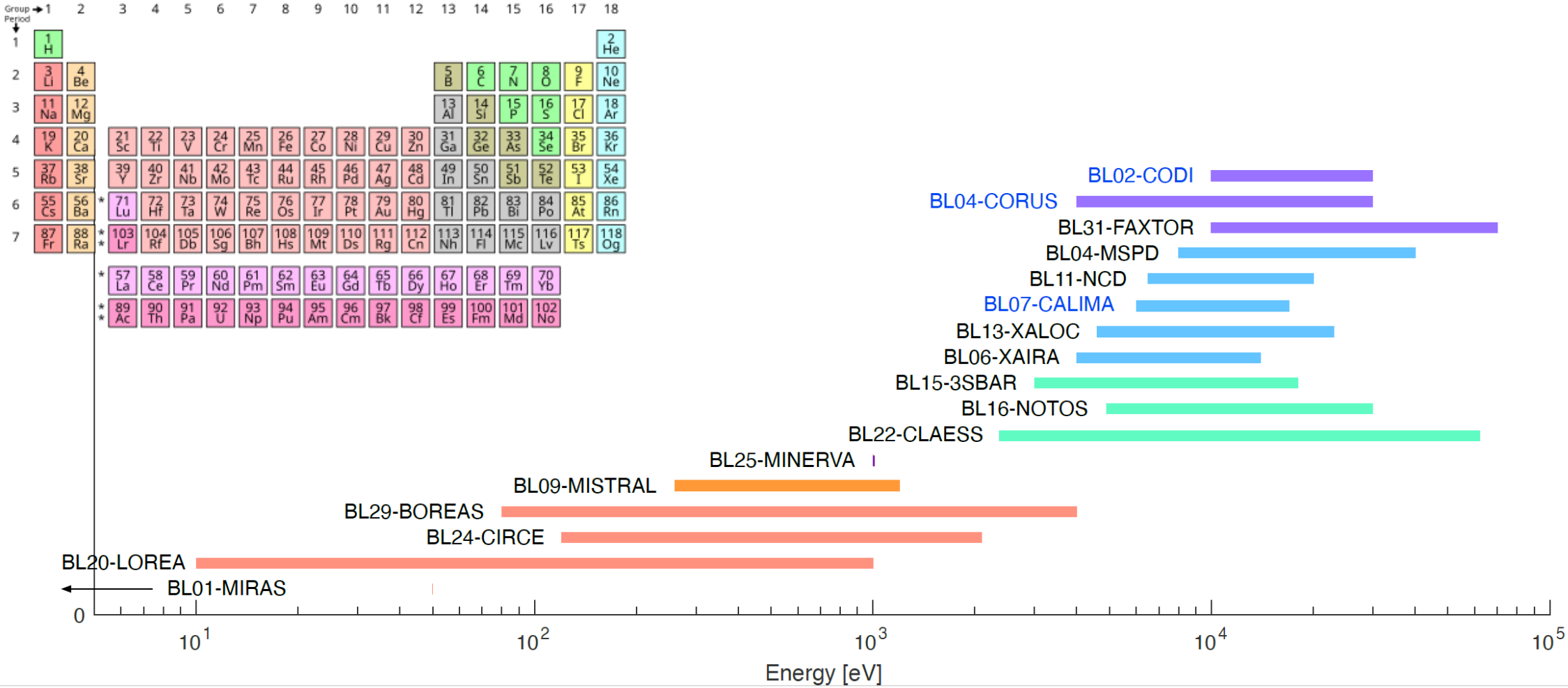
Beamline techniques

Absorption and emission spectroscopy, soft X-ray tomography, IR microscopy, Small and Wide Angle Scattering, HR and HP Powder Diffraction, Crystalline Diffraction, Photoemission, NAPP, ARPES, Resonant absorption and scattering, micro macromolecular crystalline diffraction, Metrology, hard X-ray tomography, *Surface spectroscopy and ambient pressure photoemission*





ALBA synchrotron radiation covers the interaction with most of the periodic table atoms



ALBA Photon Range

LEAPS League of European Accelerator-based Photon Sources

at a glance

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
Excellence-driven access free of charge

> 5.000 publications/year

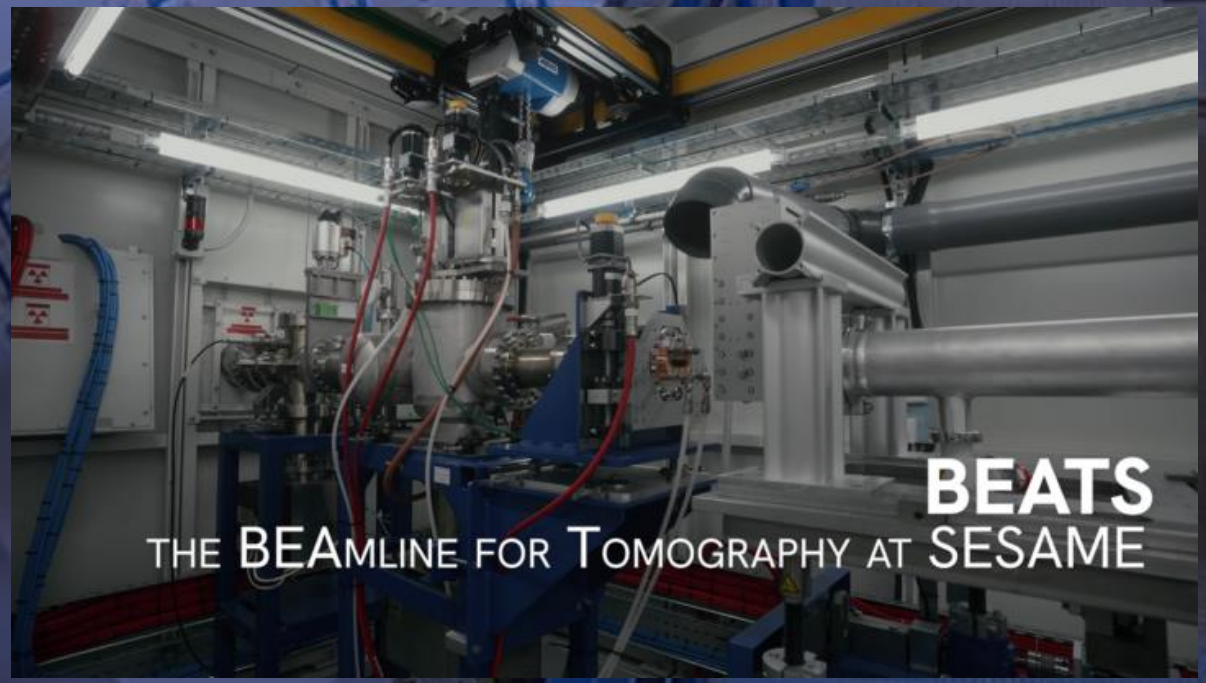
> 15 spin off companies

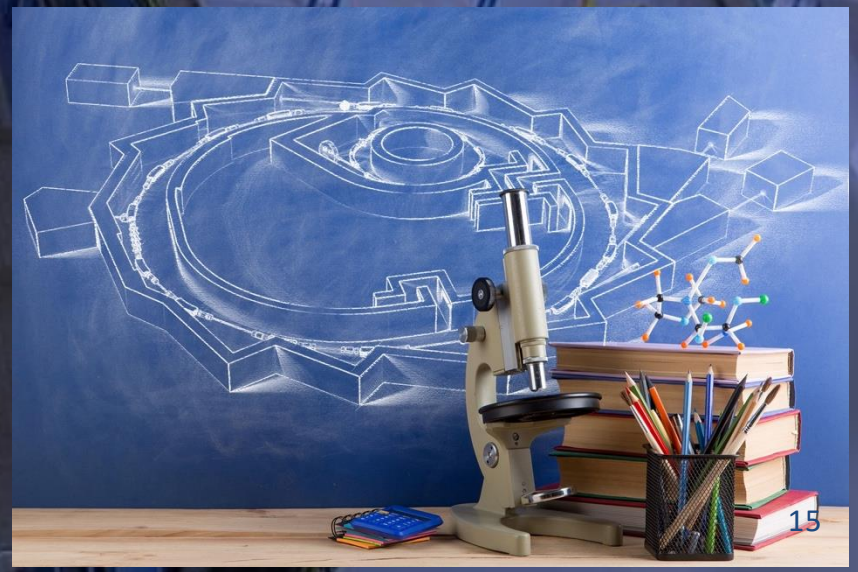
> 35.000 users from all EU & beyond
researchers from all research area

2026: LEAPS-AISBL has been constituted

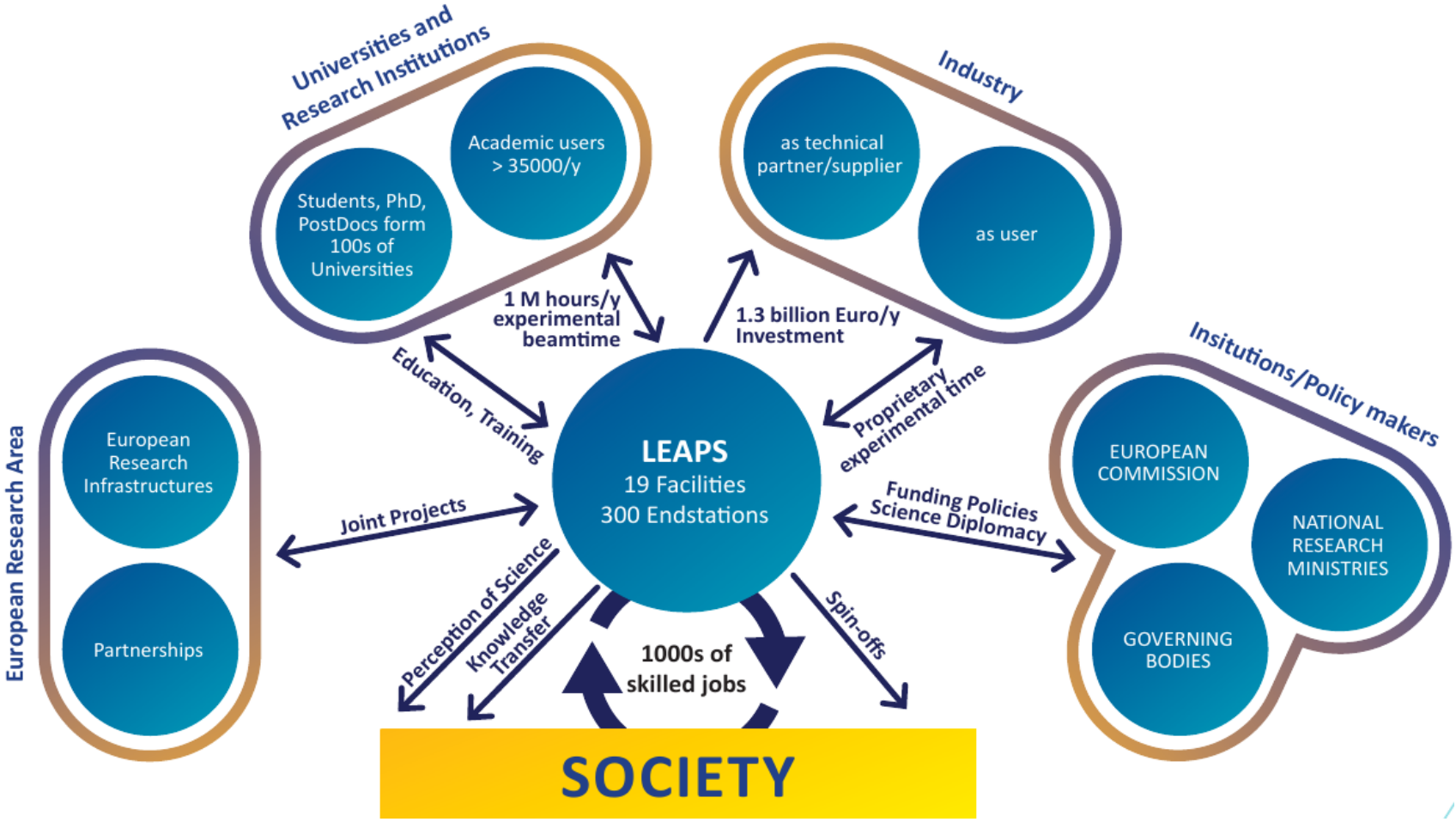
SESAME, associated to LEAPS

SESAME collaborating with LEAPS members on several projects, including instrumentation, training, competitive projects





The enormous leveraging potential of LEAPS network makes it a unique transformative opportunity



actors

LEAPS League of European Accelerator-based Photon Sources

LEAPS Strategy

“Large-scale research infrastructures are a backbone of the European Research Area and key to make Europe attractive for the best researchers across the world, contributing to knowledge sharing and innovation.” *

2017

Creation of LEAPS

- Unifying Europe’s advanced analytical capabilities.
- Unrivaled range of scientific fields and economic sectors.

2022

European Strategy ESAPS

- Roadmap for technological & scientific developments.

2025

Creation of LEAPS AISBL

- Legal entity with an even stronger voice in strategic dialogues

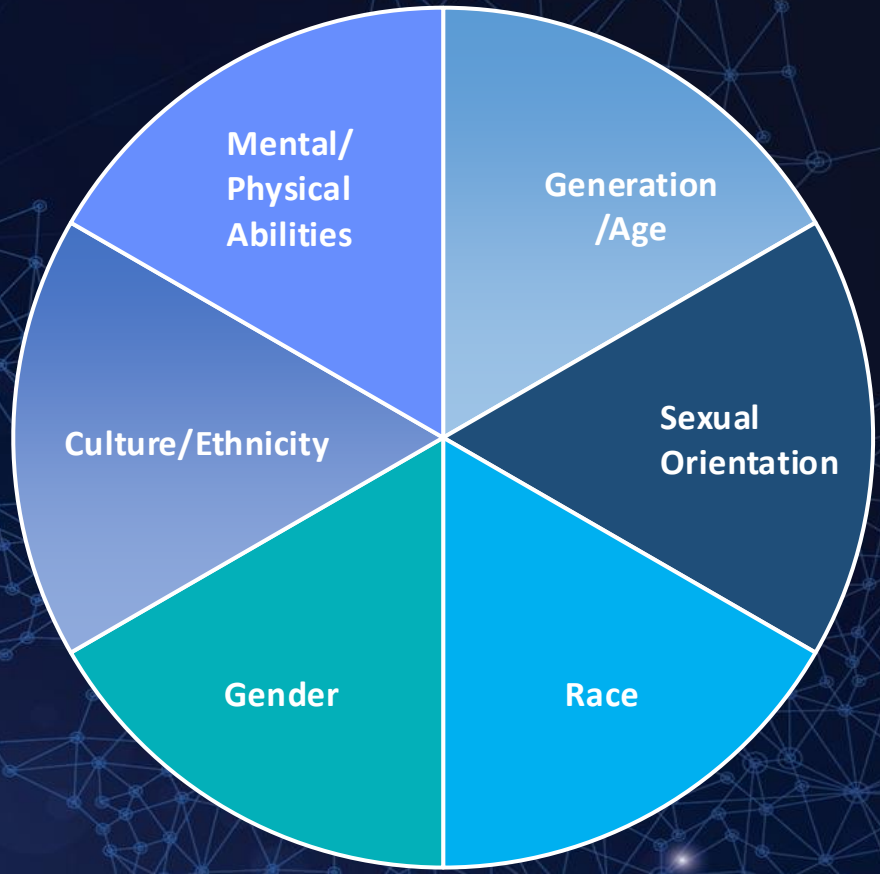
* COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS entitled “an ERA for research and innovation” 30.9.2020.

LEAPS League of European Accelerator-based Photon Sources

LEAPS IDEA

LEAPS for
Inclusion,
Diversity,
Equity, and
Anti-discrimination

Primary Dimensions of Diversity



As a European consortium focusing on scientific excellence, LEAPS is committed to strengthening diversity and is acutely aware of owing its success to the talents, ideas, cooperation, and collective and complementary collaboration of its scientists. The ingredients to this success are respect and fairness, appreciation and openness. Ensuring equity and achieving an inclusive environment, free from discrimination at all levels, is LEAPS's responsibility.

LEAPS League of European Accelerator-based Photon Sources

LEAPS in Horizon Europe

LEAPS INNOVATION

H2020 Pilot – start 2021 – 4 years
- Industry as collaborator, supplier & user

eRImote

HE Project – start 2022 – 2,5 years
- Digital & remote access

ReMade@ARI

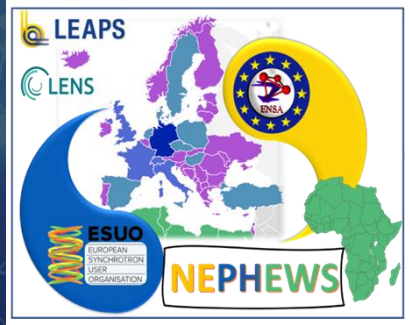
HE Project – start 2022 – 4 years
- Recyclable materials

RIANA

HE Project – start 2024 – 4 years
- Nanoscience & technology for nanomaterials

nephews

HE Project – start 2024 – 3 years
- User communities & TNA



LEAPS in HE

STUDENT Programs

Training opportunities for university and vocational training students

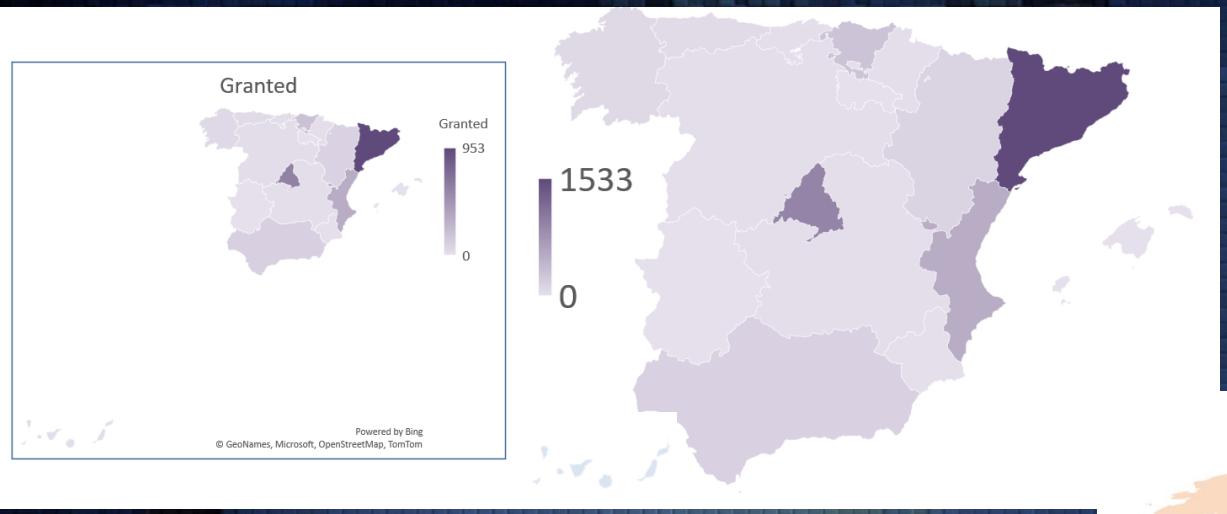
Covering from professional teaching to PhD programs
And in all activity areas
(science in BLs, engineering, IT, Accelerator physics, communication, administration,…)

- **PhD Students**
- **University (degree/master)**
- **FP program**

Cross country Users

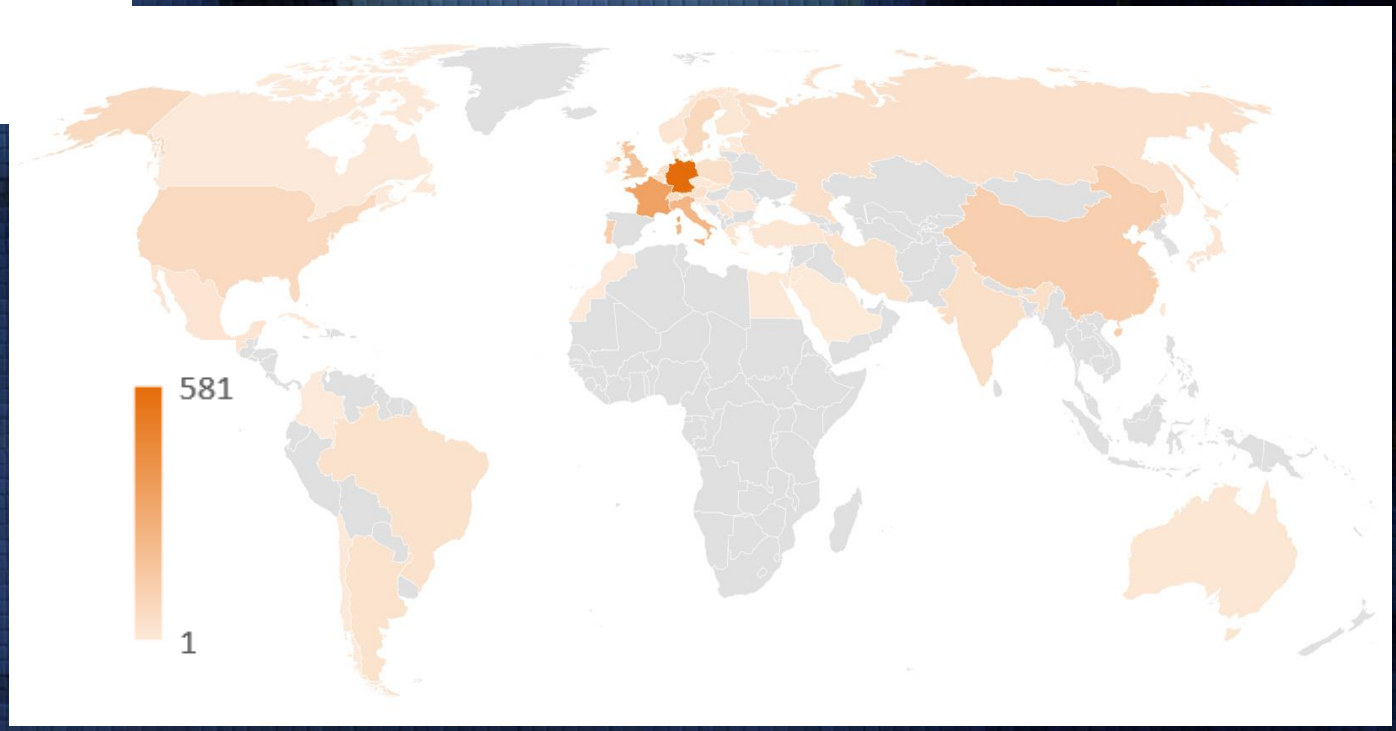
Example at ALBA

National (60%)



Circulation of ideas, collaboration build-up, opening new horizons

International (40%)



Period 2012-2026-I

	Submitted	Granted	OF
National	3861	2234	1.7
International	2666	1267	2.1
TOTAL	6527	3501	1.9

Sustainable world

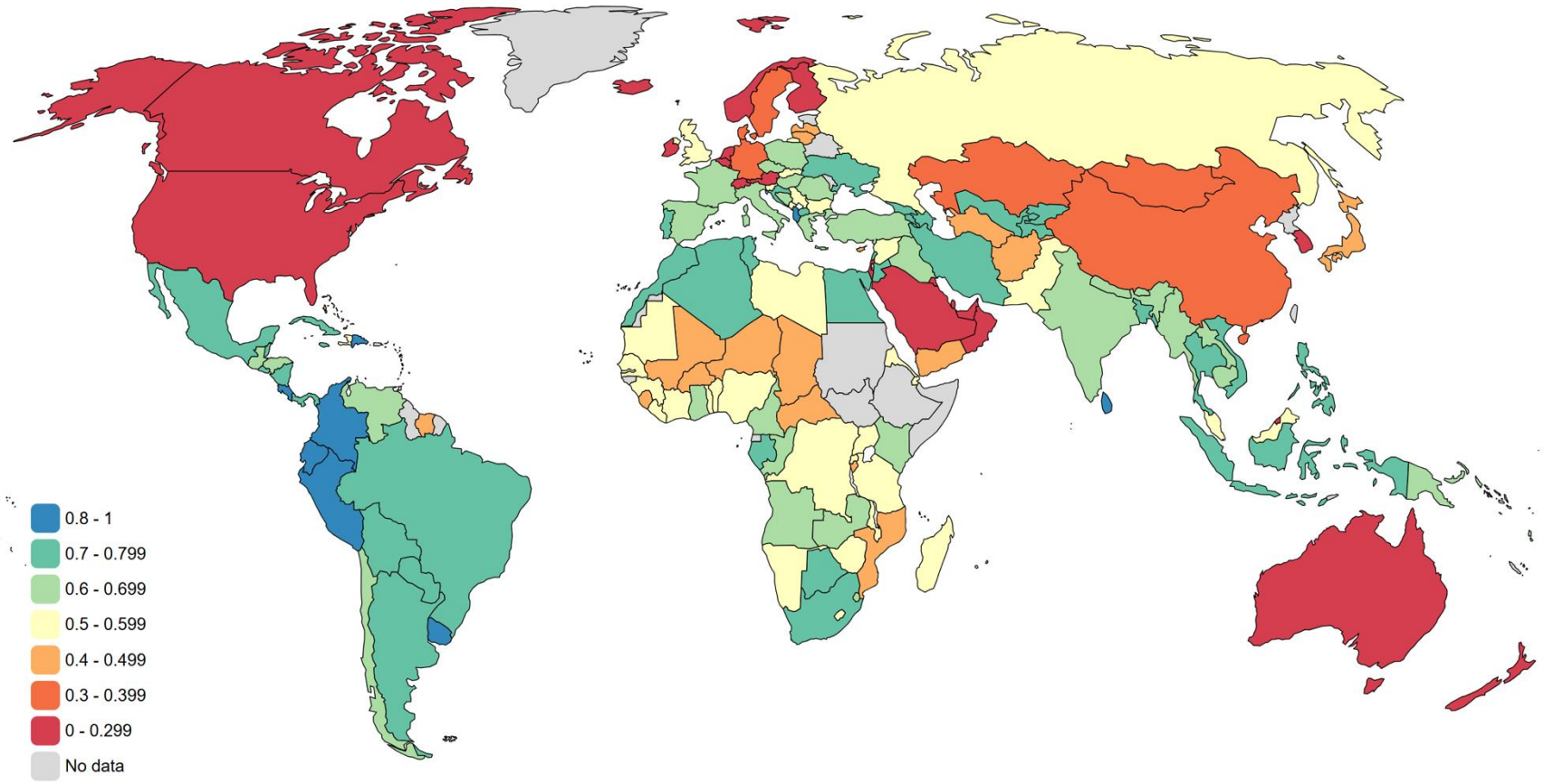
From a model of exploiting earth resources as if they were unlimited to the awareness of their finitude and of the need to change explotation habits
What can and must scientists do?
Synchrotrons in the world, aligning their capacities to be part of the solution

https://data.worldbank.org/

Sustainable Development Index

https://www.sustainabledevelopmentindex.org/

The Sustainable Development Index (SDI) **measures the ecological efficiency of human development, recognizing that development must be achieved within planetary boundaries**. It was created to update the Human Development Index (HDI) for the ecological realities of the Anthropocene.

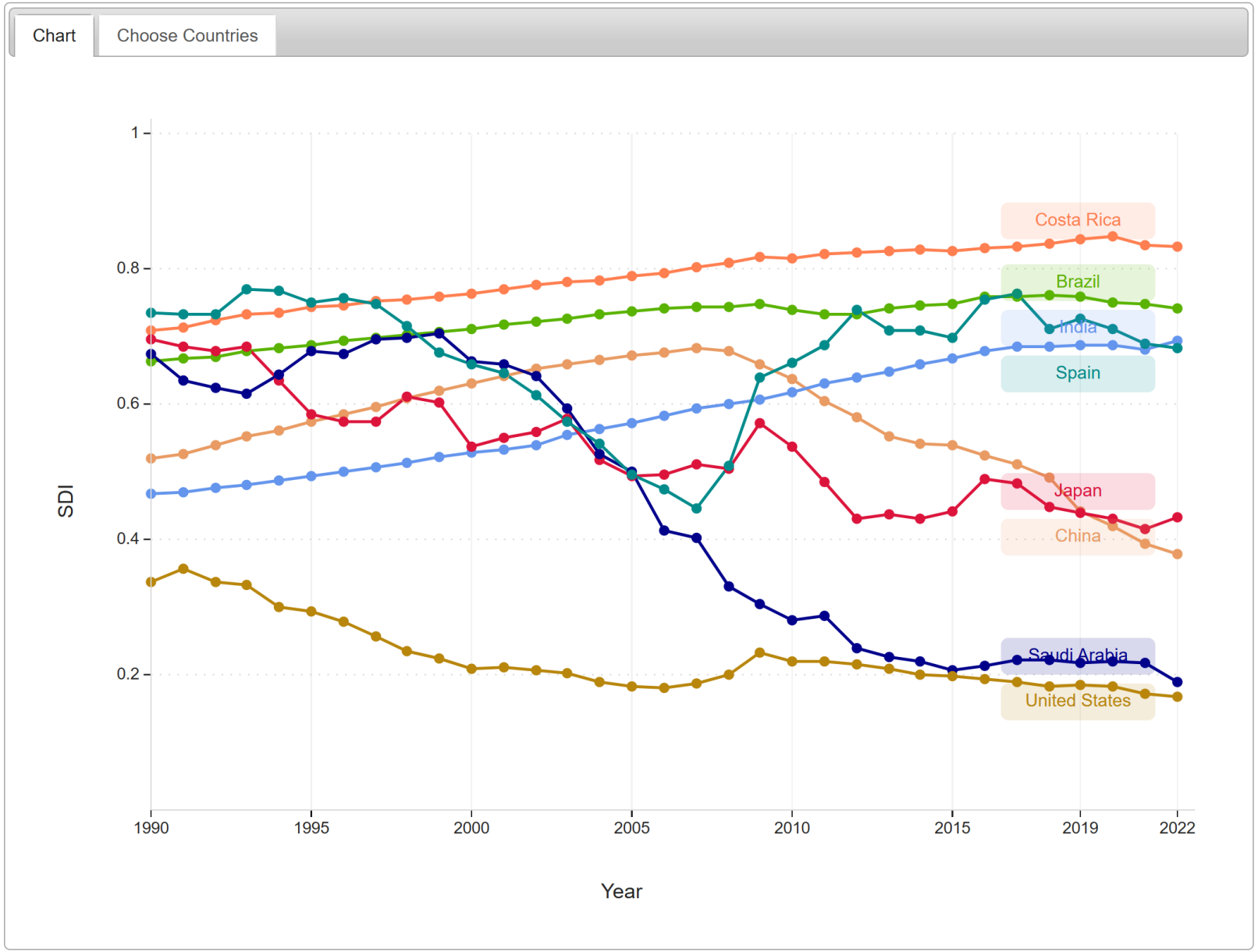


SDI gets higher if

Increase: life expectancy, education and income

Decrease: consumption-based CO2 emissions and material footprint

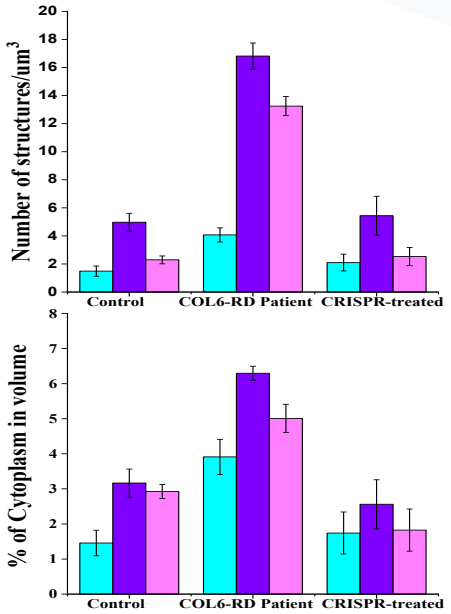
https://www.sustainabledevelopmentindex.org/time-series

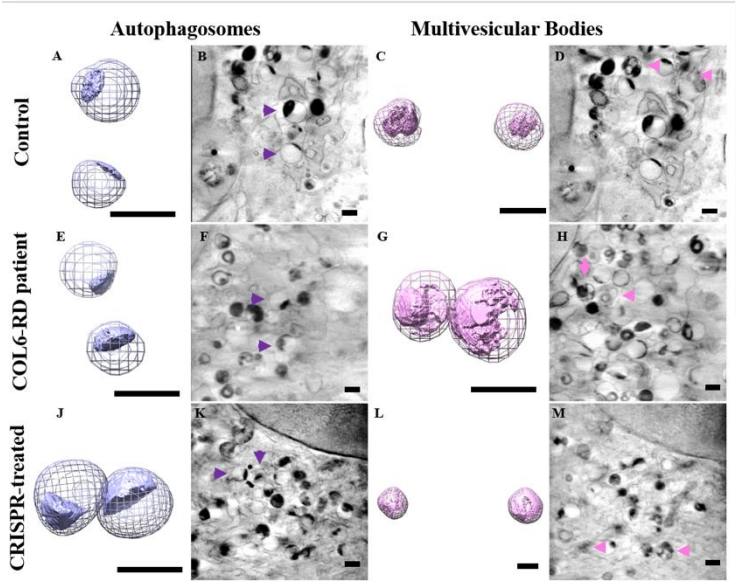


A549 cell (adenocarcinomic human alveolar basal epithelial cells) infected with SARS-CoV-2

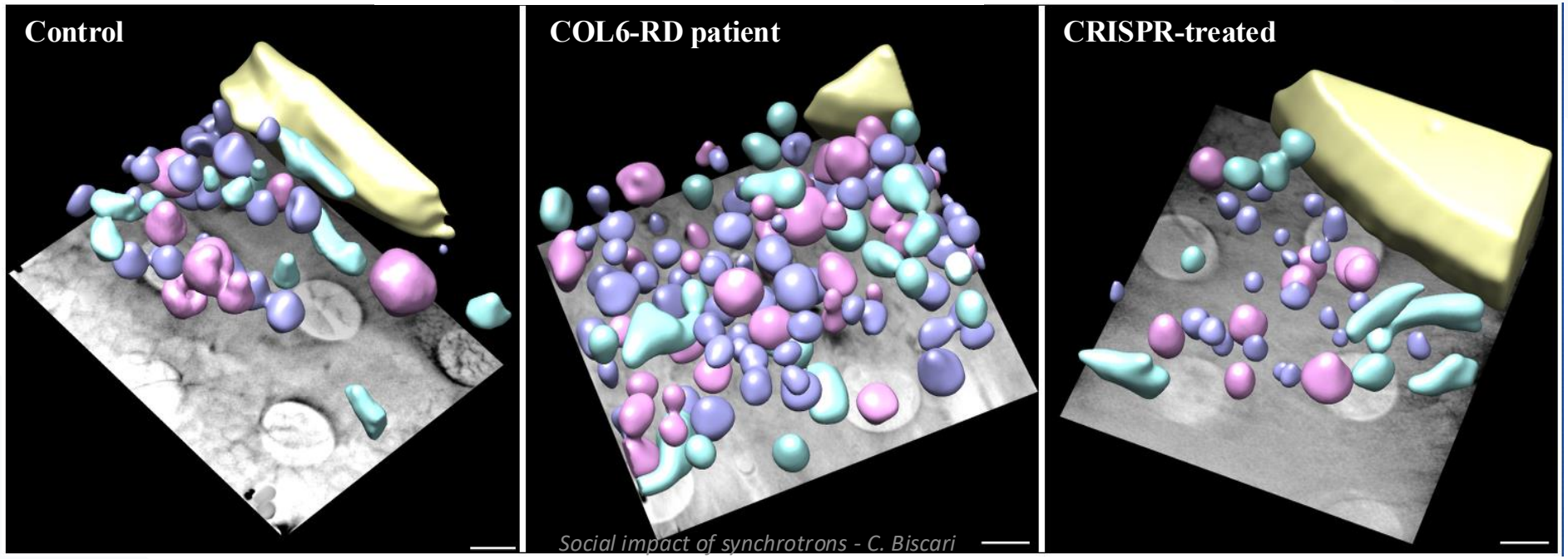
COVID research at BL09-MISTRAL

A New Tool to Proof Effectiveness of CRISPR/Cas9 Therapies: X-ray Tomography





Contribution of the X-Ray tomography in the cellular pathologies field: possibility to develop the proof of concept of ***the success of gene therapy application*** *in the disease reversion of the cellular and biochemical phenotype of cells harbouring the cellular mutation triggering the disease by application of CRISPR/Cas9.*



One example of industrial use

ARTAX (company from Massachusetts with representation at PCB), is developing a **new generation of oral compounds against autoimmune diseases. Artax compounds prevent T lymphocytes from responding against antigens but preserves their protective role against infection by pathogens**. Such modulatory control of T cells allows the **development of new treatments for a wide range of inflammatory and autoimmune diseases.** (Protein production by CRG Biomolecular Screening & Protein Technologies Unit" and Crystalization plus structure solving by XALOC)

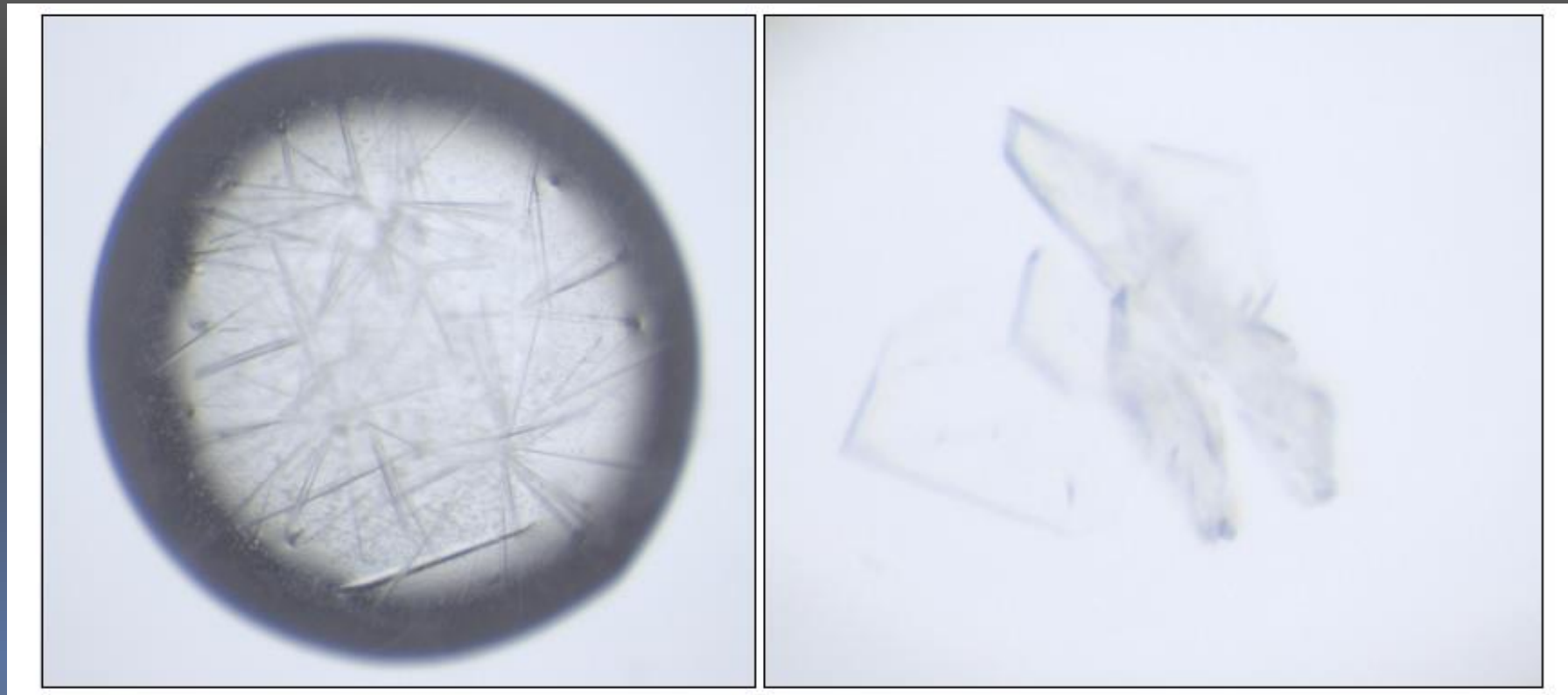
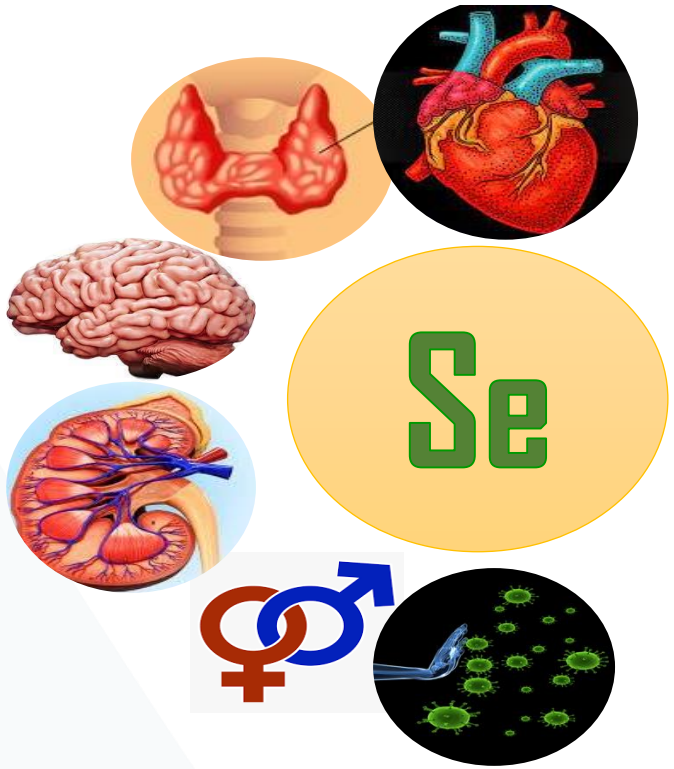
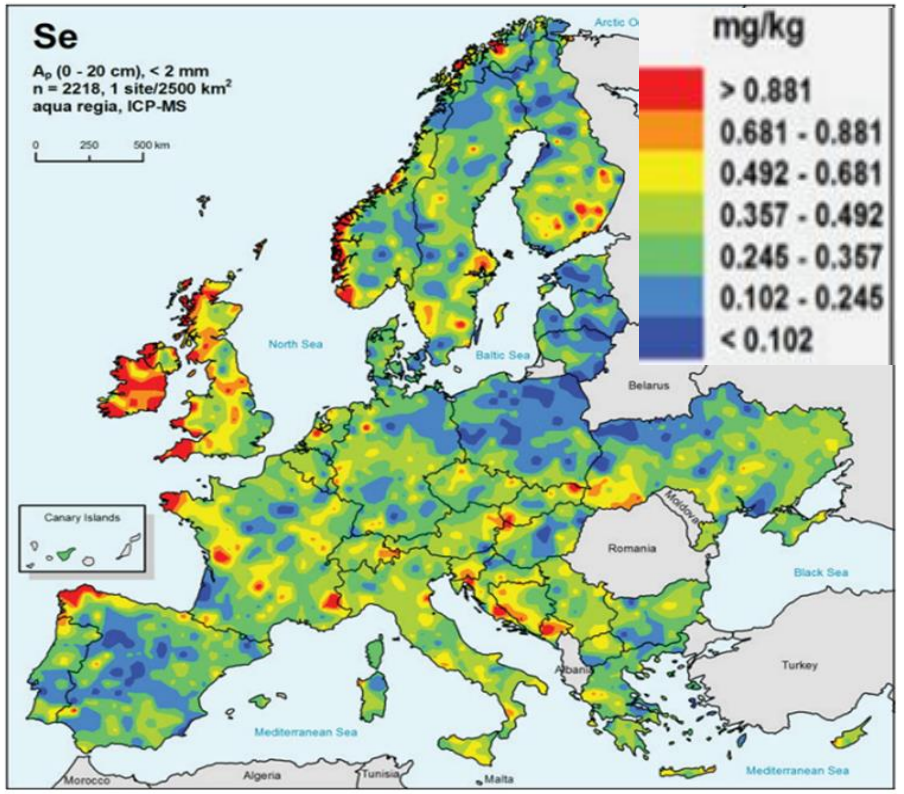


Fig. Crystals obtain **Artax to resolve the first ever structure of its target protein** © Artax Biopharma

Food science for a proper alimentation in all world regions

Se recommended: 50-70 µg/day
Se tolerable upper limit: 400 µg/day

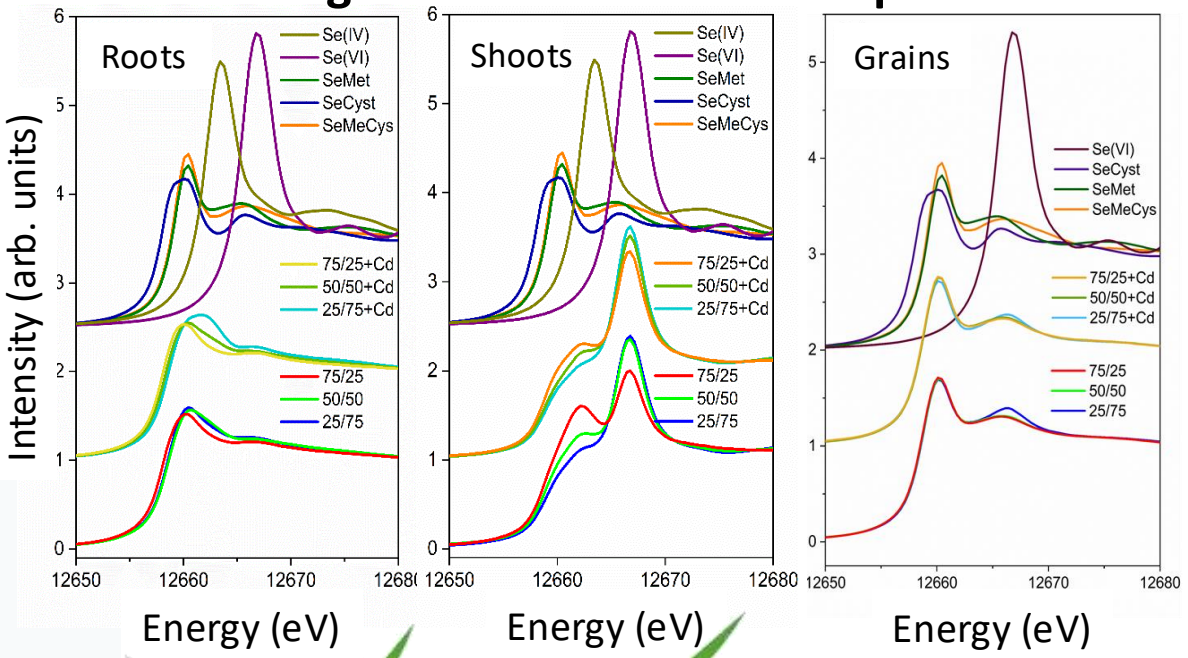




2018-2021 ALBA PhD thesis – DOCFAM project "*Study of Se-biofortified functional food: Interactions and competing mechanisms among different elements using synchrotron analytical techniques*"
2020-2024 Se4All MSCA RISE EU project "*Se-bioFORtified ALfaLfa for Se-enriched Dairy products*"

Selenium biofortification in plants

Se K-edge XAS to access the Se speciation



Application methods

Hydroponics (HP)

Controlled parameters ☺

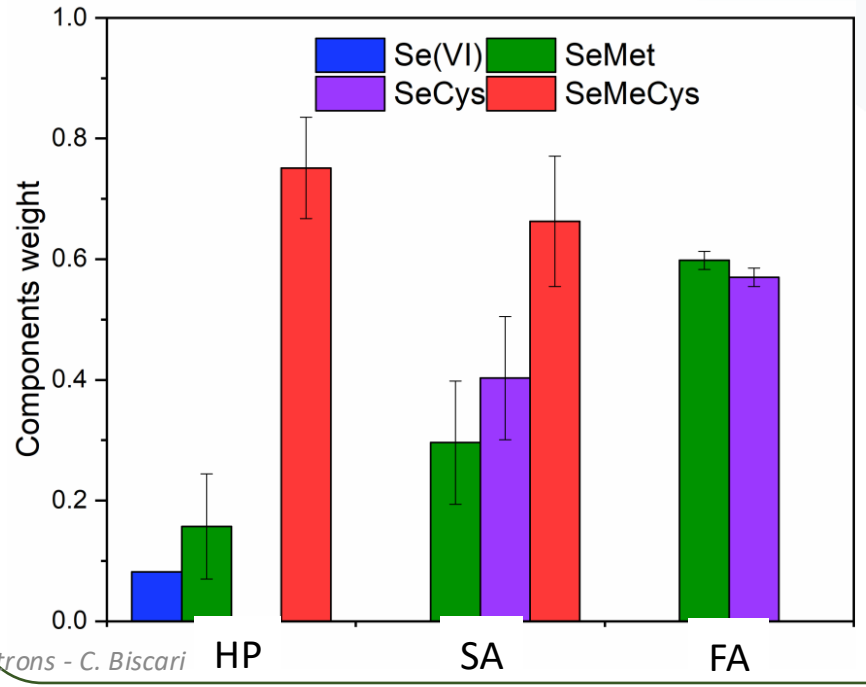
Soil (SA)

Soil interaction ☹
Large scale application ☺

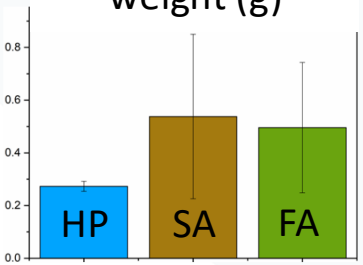
Foliar (FA)

Applicable in both hydroponic and soil culture ☺
No soil interaction ☺
Large scale application ☺

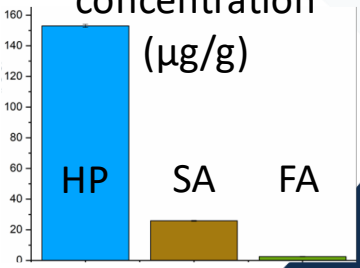
Bioavailable to humans



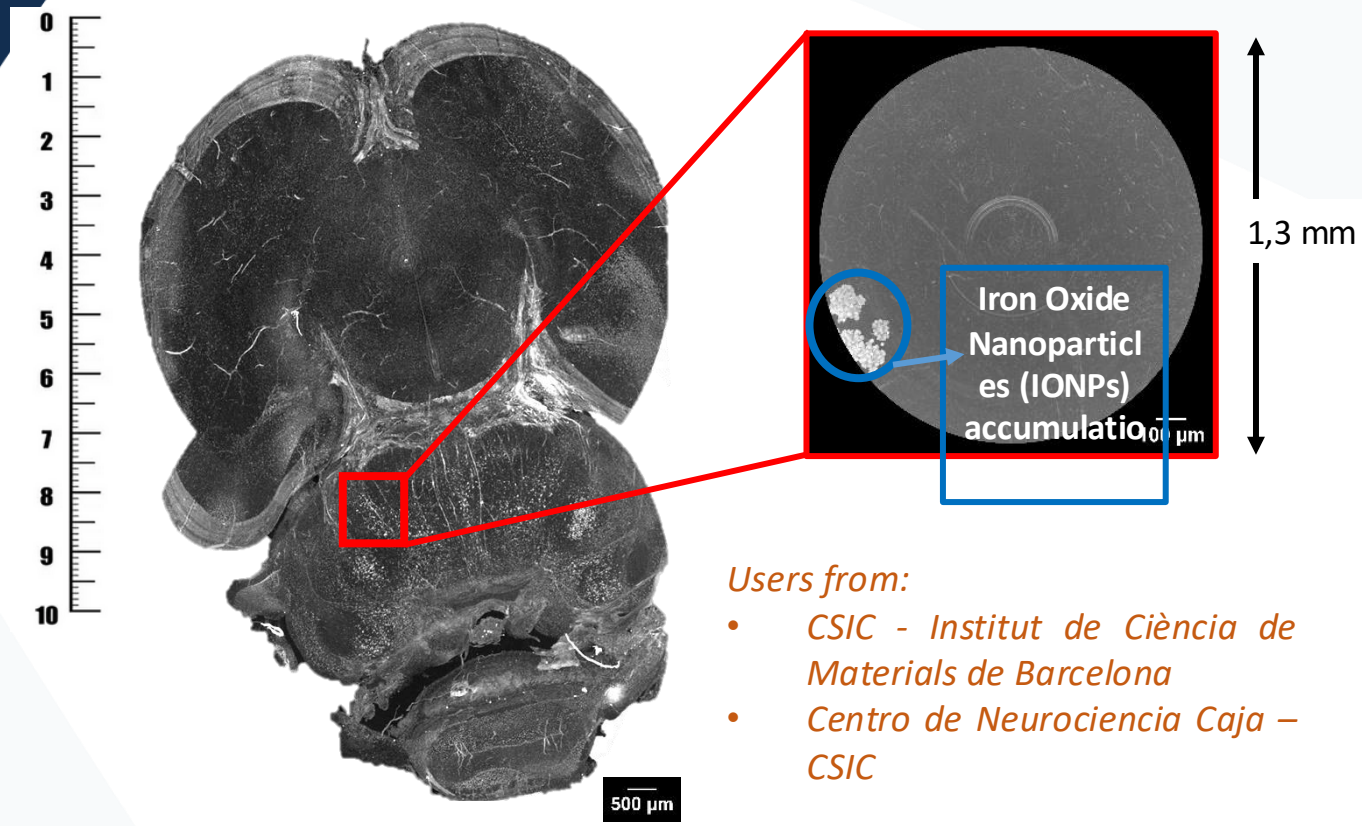
Average grain weight (g)



Grains Se concentration (µg/g)



Examples at FaXToR: Imaging the procoagulant state of Alzheimer´s disease and neuronal circuits

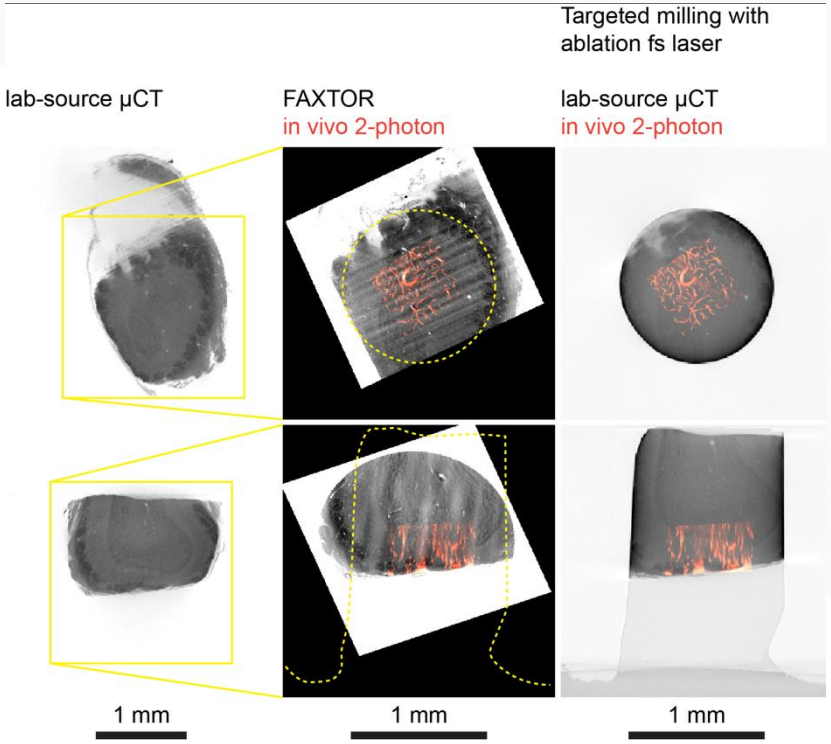


Users from:

- *CSIC - Institut de Ciència de Materials de Barcelona*
- *Centro de Neurociencia Caja – CSIC*

Scientists have detected IONPs accumulation in the brain of AD mice by PET imaging but they cannot capture exact location where the IONPs are being accumulated (intra vs. extra-vascularly). To this end, they have anlysed the ex-vivo brains of AD and WT mice pre-injected with the IONP tracer using synchroton-based phase-contrast tomographic microscopy at FaXToR, allowing us to visualize and/or quantify the presence of iron to evaluate their specific accumulation in brain micro-thrombi.

Advancing in connectomics

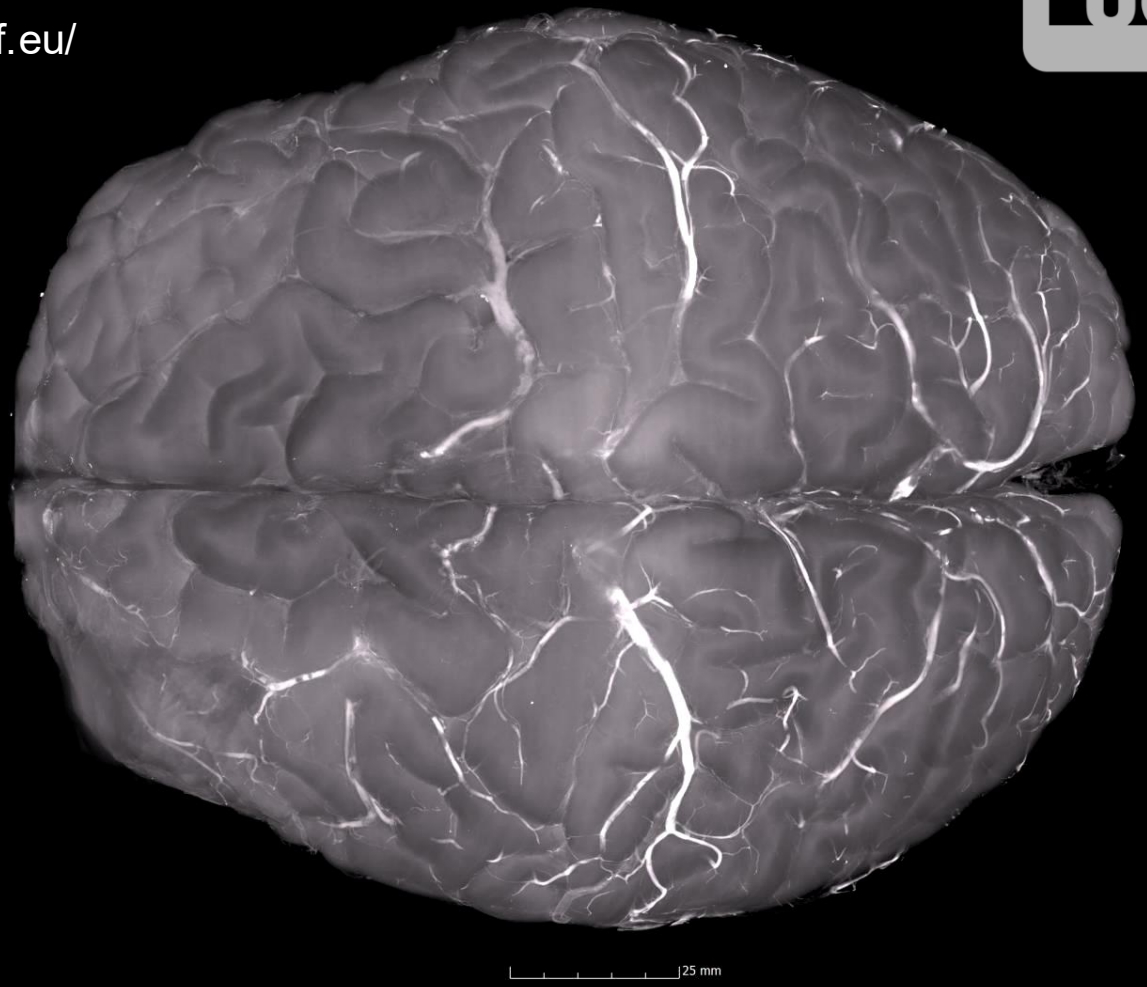


Yikai Yang, Yuxin Zhang, Carles Bosch, Alexandra Pacureanu, Andreas Schaefer et al., The Francis Crick Institute

Opening the data to the world to advance together

Human Organ Atlas

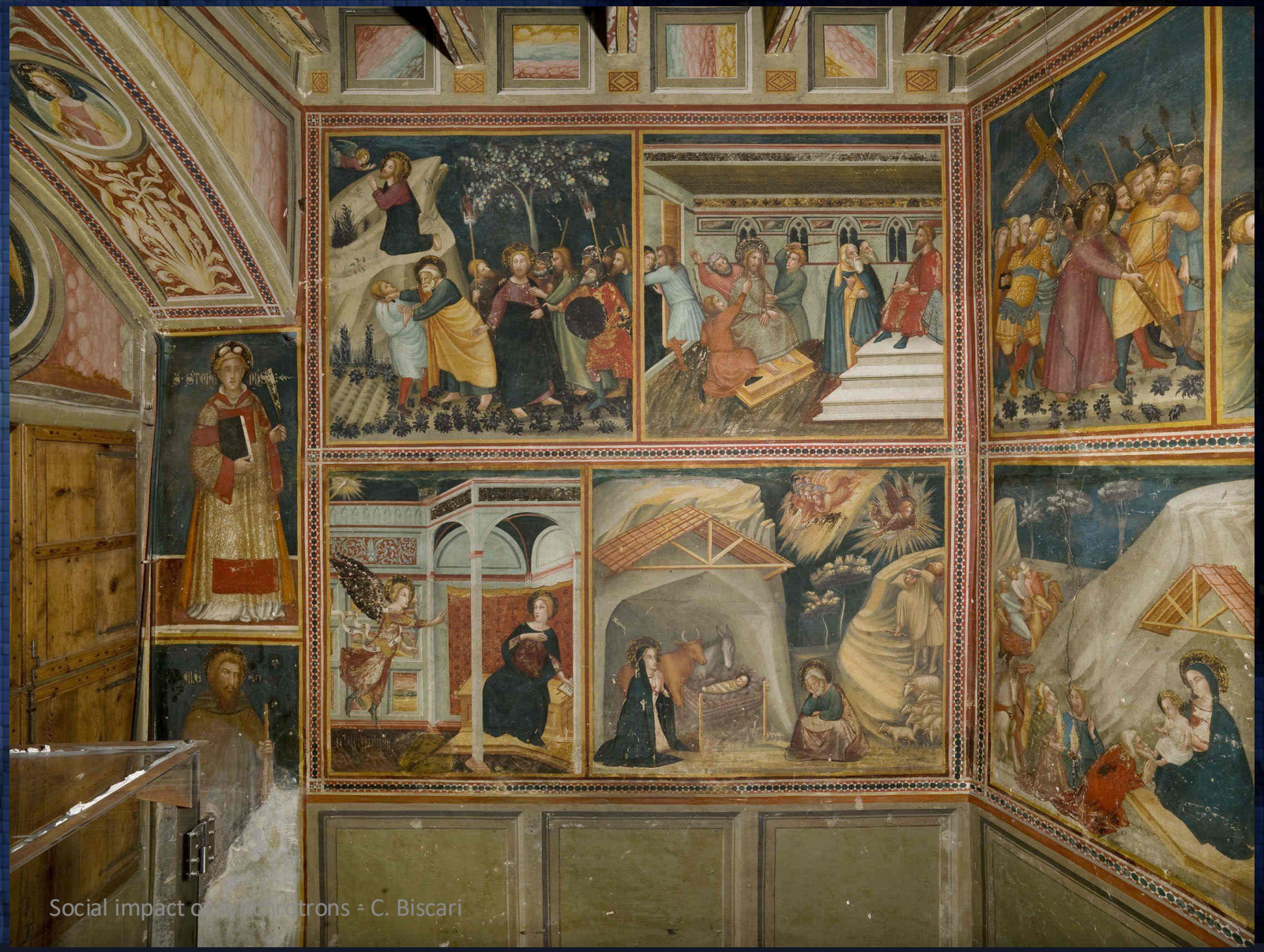
https://human-organ-atlas.esrf.eu/



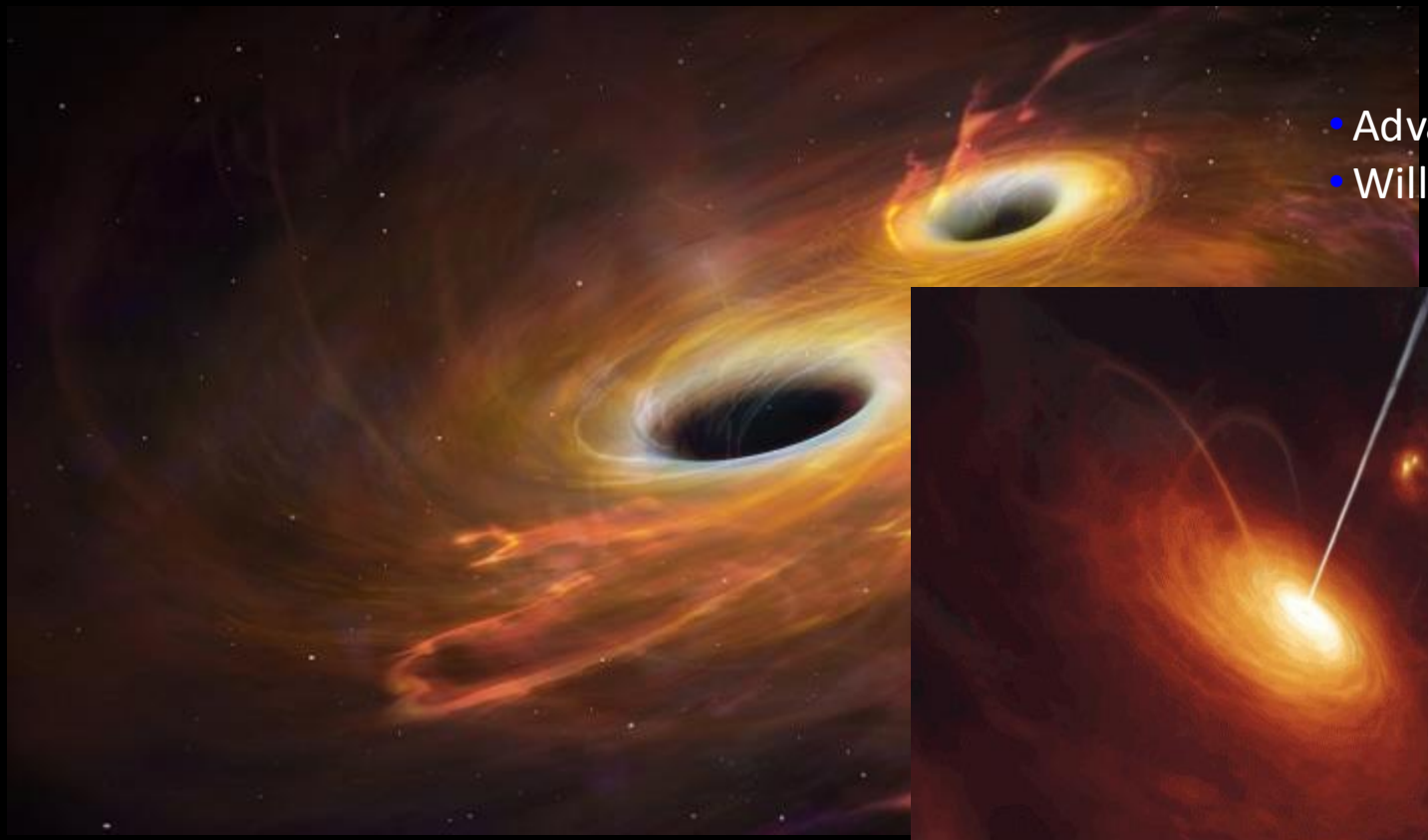
Discovering our cultural heritage

...and learning how to preserve it

Researchers from the Universitat Politecnica de Catalunya have analized in teh ALBA Synchrotron the materials and their properties for contributing in the reparation of the frescos in la Capilla de San Miguel del Real Monasterio de Pedralbes and of the glasses of Catedral of Toledo.



Participating in exploring the universe: ALBA - European Space Agency collaboration



New-ATHENA Mission (2037)

- Advanced Telescope for High-ENergy Astrophysics
- Will study the high energy universe, including black holes

MINERVA, BL to align hundreds of mirrors to be mounted in ATHENA satellite

Sustainable Development Index

https://www.sustainabledevelopmentindex.org/

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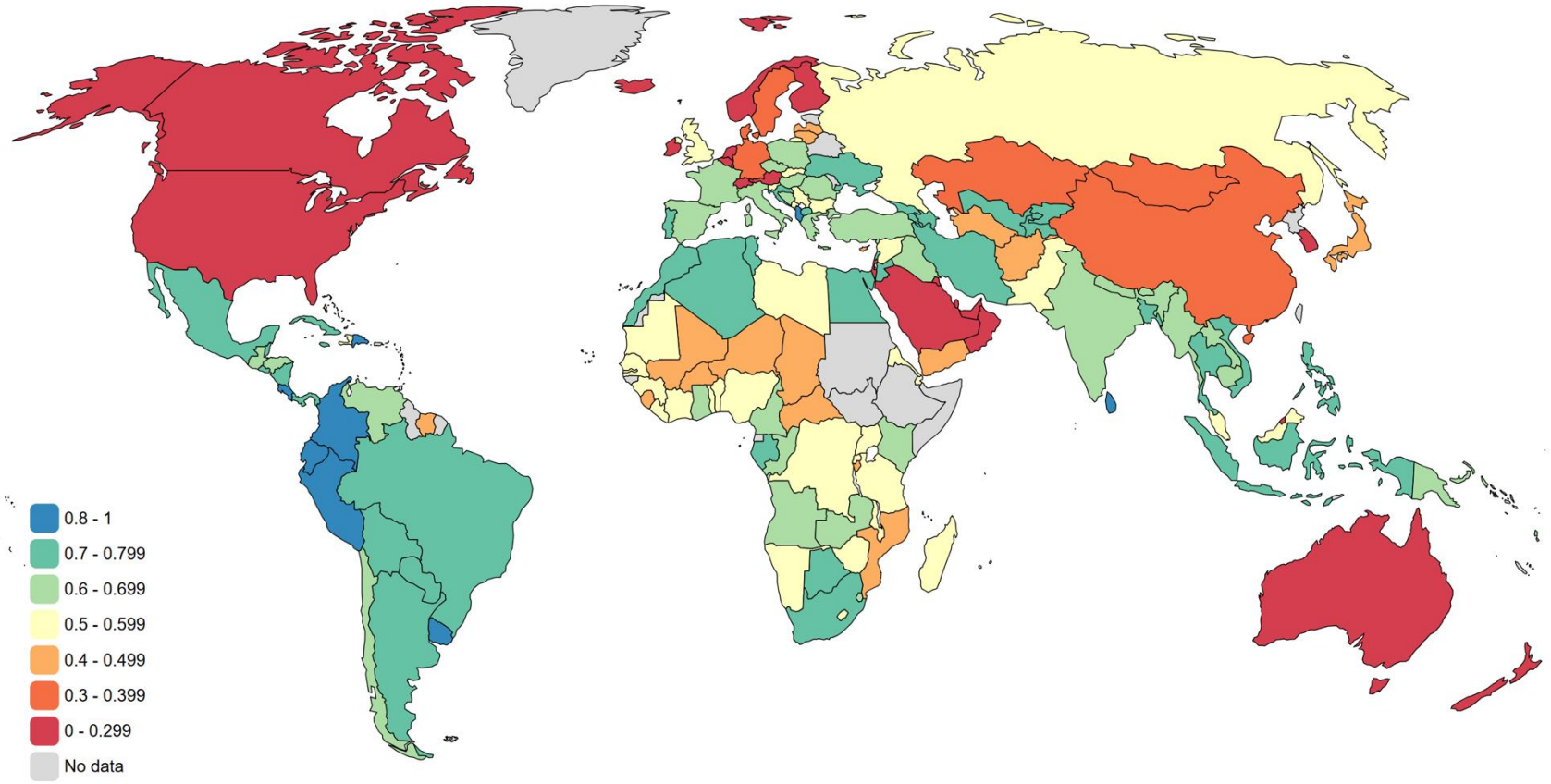


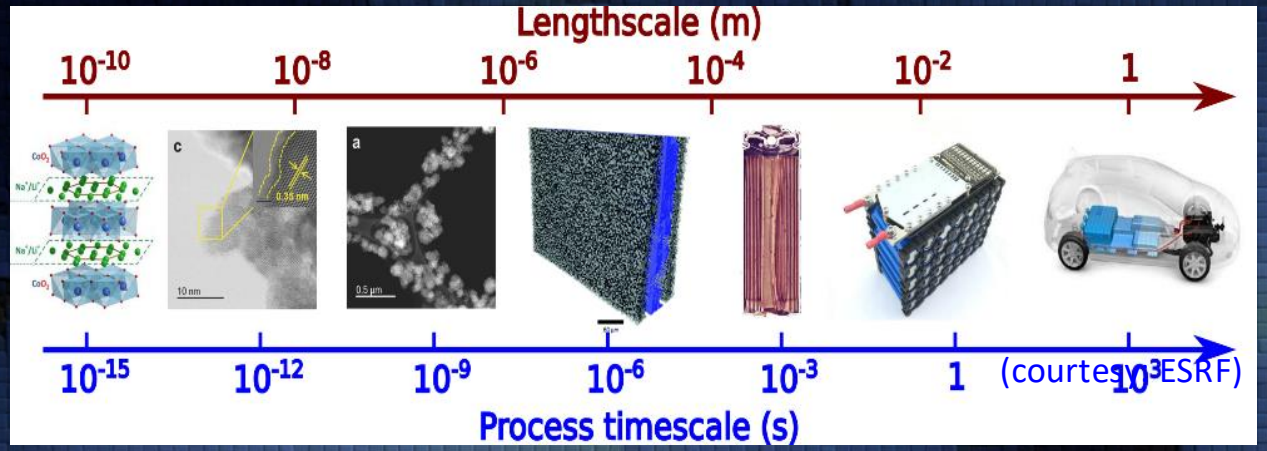
SDI gets higher if

Increase: life expectancy, education and income

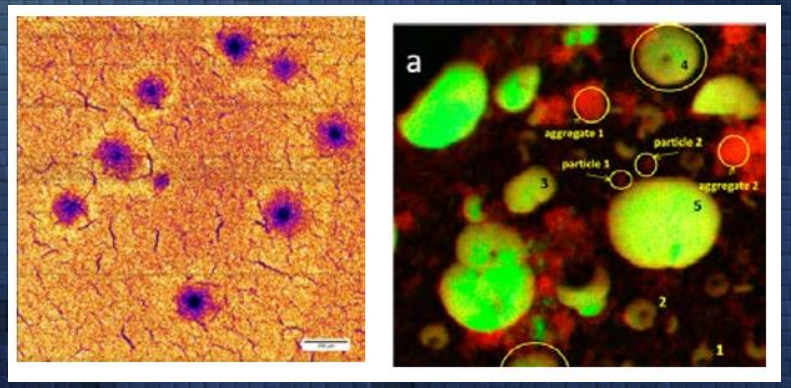
Decrease: consumption-based CO2 emissions and material footprint

We develop new materials for efficient generation-, storage-, conversion-, and ultimately transport of energy

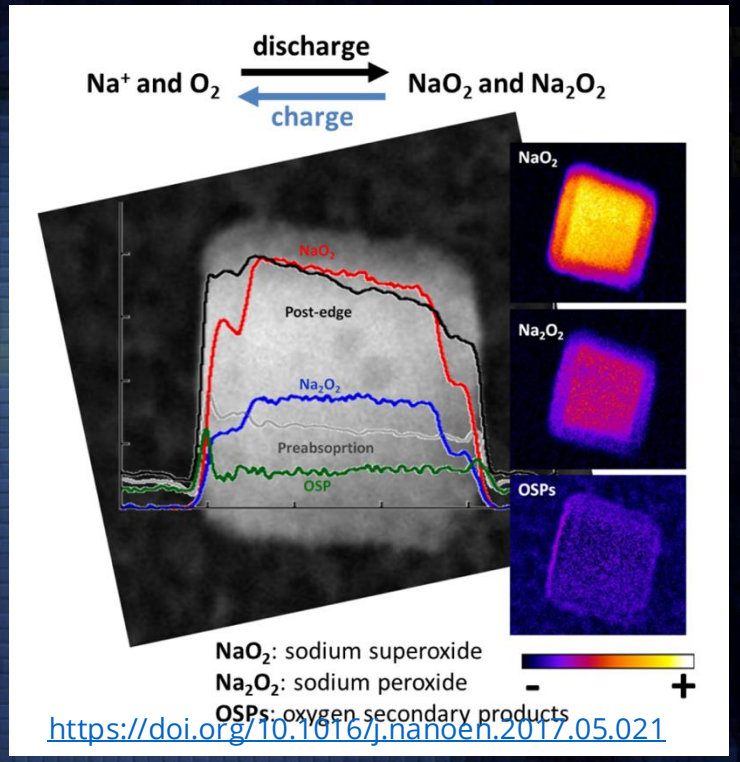
ENERGY Materials



Length scale challenge in battery research
Bridging spatial, temporal and chemical information



Synchrotron X-ray studies of Li battery materials (courtesy: ALBA)

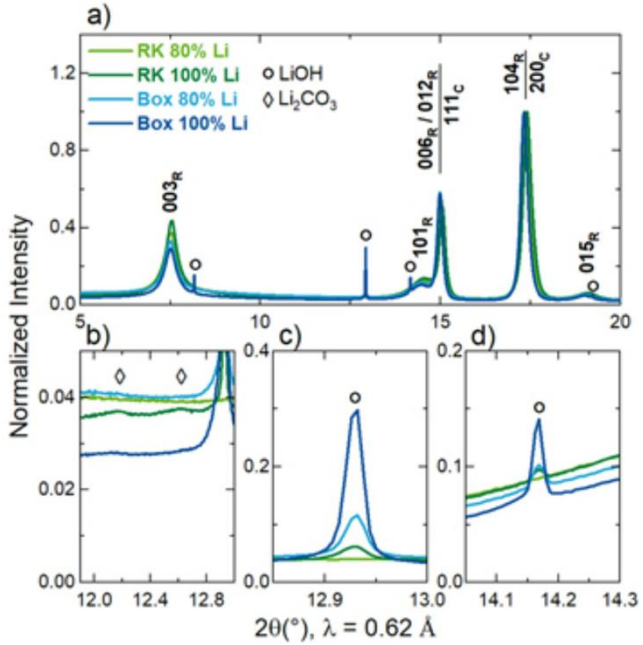


https://doi.org/10.1016/j.nanoen.2017.05.021

Li is expensive and scarce. Research on batteries based on alternative electrodes are investigated in LEAPS facilities
Example: Na based batteries (Na, V, P, O and F) at ALBA

BASF COLLABORATES WITH THE ALBA SYNCHROTRON IN IMPROVING THE PRODUCTION OF BATTERIES FOR ELECTRIC VEHICLES

A research lead by the company BASF has characterized a new methodology to produce nickel-rich cathode materials used in lithium-ion batteries that optimizes the conventional production process. The proposed model leads to an increase in throughput by a factor of three, representing a considerable increase in the efficiency of future cathode active materials production for battery electric vehicles. The contributions of the MSPD beamline at ALBA have been key in these findings.



Synchrotron powder X-ray diffraction (PXRD) patterns of the samples after a partial-lithiation step at 500 °C and a dwell time of one hour using either the rotary kiln setup (RK) or the box furnace (Box)

Philipp Kurzhals, Felix Riewald, Matteo Bianchini, Shamail Ahmed, Andreas Michael Kern, Felix Walther, Heino Sommer, Kerstin Volz, and Jürgen Janek. **Deeper Understanding of the Lithiation Reaction during the Synthesis of $LiNiO_2$ Towards an Increased Production Throughput**. *J. Electrochem. Soc* (2022). DOI: 10.1149/1945-7111/ac6c0b

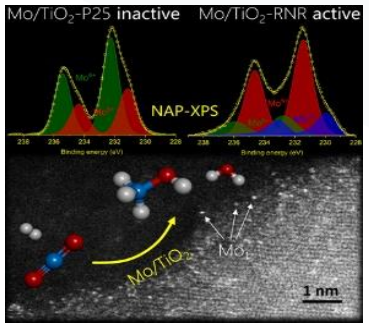
The Challenge of Catalyst Development

- higher selectivity,
- better energy efficiency
- smaller raw material consumption
- Reduction of required H2 pressure

At ALBA

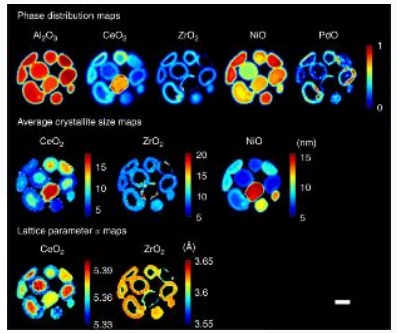
- Rational design of novel catalyst classes
- Optimizing existing catalyst classes using combinatorial approaches
- Understanding degradation effects
- Search for replacement of critical materials (especially for the H2 production)

Soft X-ray spectroscopy



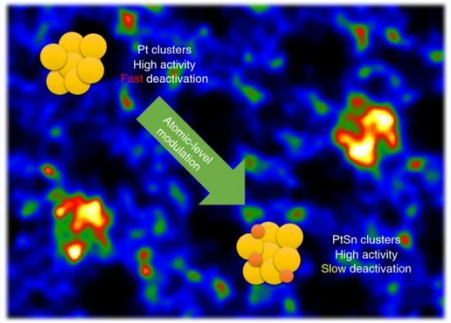
DOI: 10.1039/d1gc01761f

X-ray microscopy



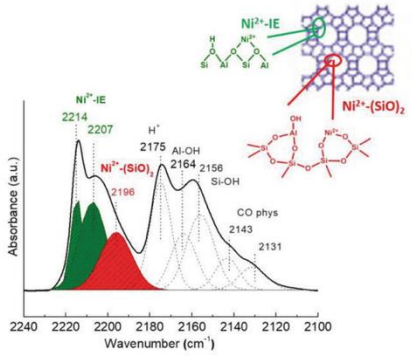
doi.org/10.1038/s41467-018-07046-8

Hard X-ray spectroscopy



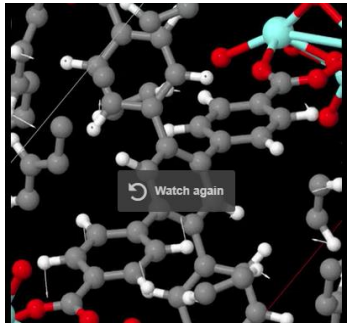
DOI: 10.1038/s41929-020-0472-7

Far IR spectroscopy



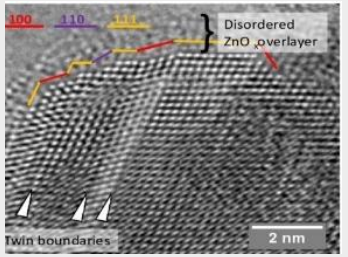
DOI: 10.5772/intechopen.80524

Powder diffraction (operando and high resolution)



https://dx.doi.org/10.1021/jacs.0c01459

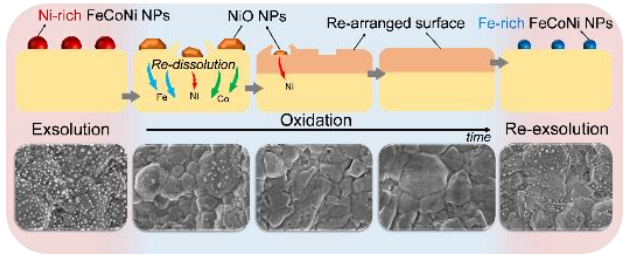
And high resolution TEM



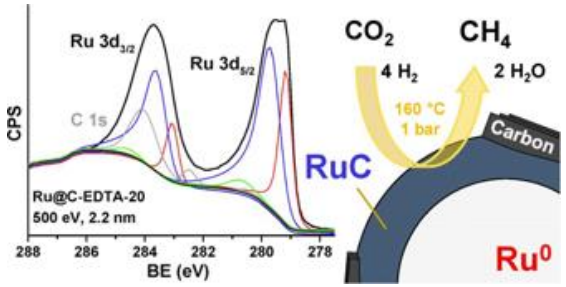
DOI 10.1515/recat-2015-0009

ALBA on developments on clean energy Interconnecting academy and companies

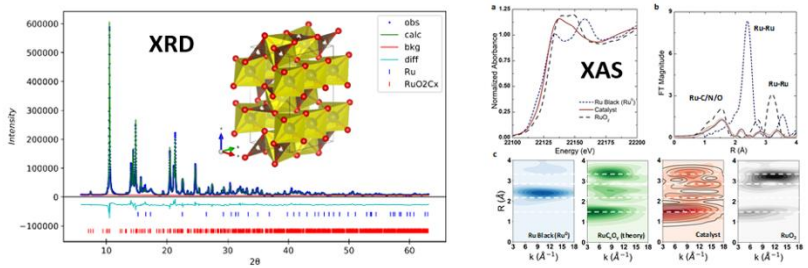
Nanocatalysts in double perovskite oxides – ITQ-UPV-ALBA
https://doi.org/10.1039/D4TA03146F



Characterization of catalysts and their hosting environment – ITQ-Taiwan Un- ALBA
DOI: 10.1021/jacs.9b07088



Hydrogenation of waste carbon dioxide into methanol – ITQ-SOLEIL-UN Cadiz- ALBA



AI supported catalysis development and process optimization

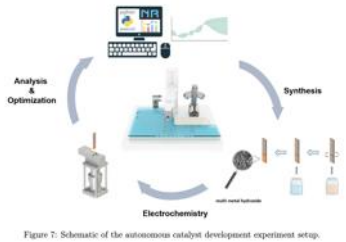


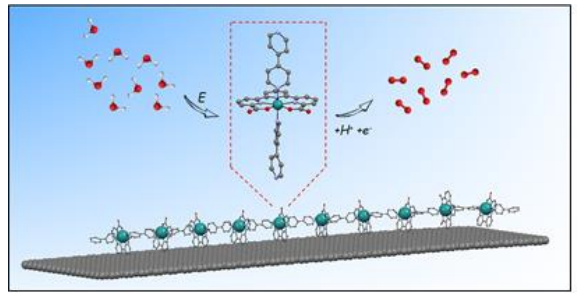
Figure 7: Schematic of the autonomous catalyst development experiment setup.

https://chemrxiv.org/engage/chemrxiv/article-details/6862ec211a8f9bdab5d6be25

Additional Potential

High throughput capabilities for QA and degradation
Biochemical optimization.

Water oxidation electrocatalysis - ICIQ



Nature Chemistry **volume 12**, 2020

A CATALYST TO REMOVE EMISSIONS OF METHANE, A POWERFUL GREENHOUSE GAS

Researchers from the UPC, the University of Udine (Italy) and the ALBA Synchrotron have discovered a palladium and platinum catalyst, the first to eliminate methane emissions from transport and other human activities to reduce global warming.

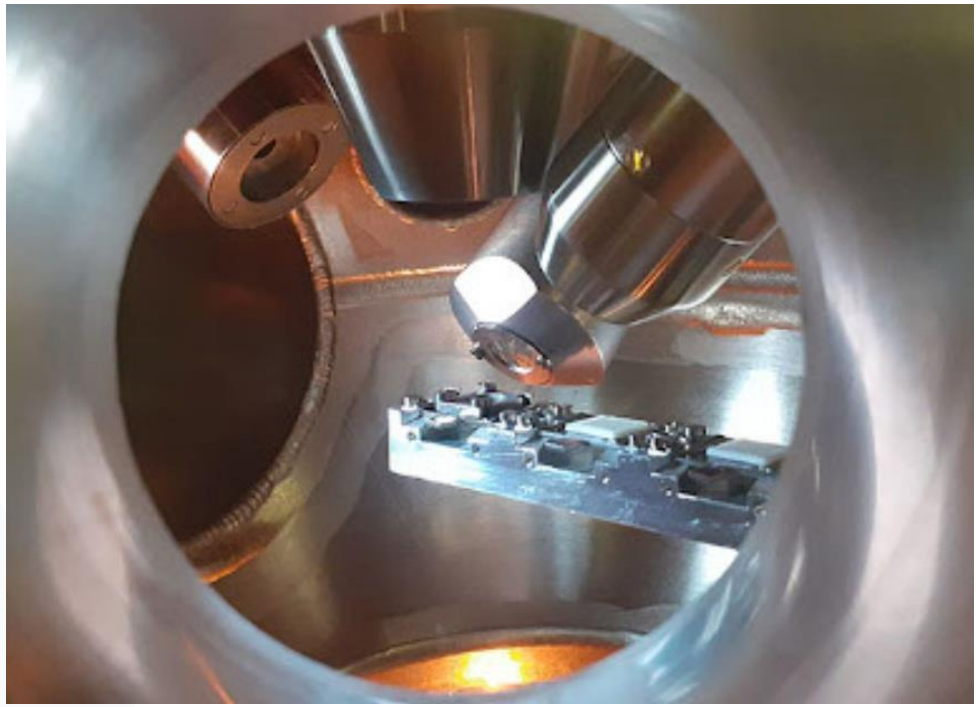
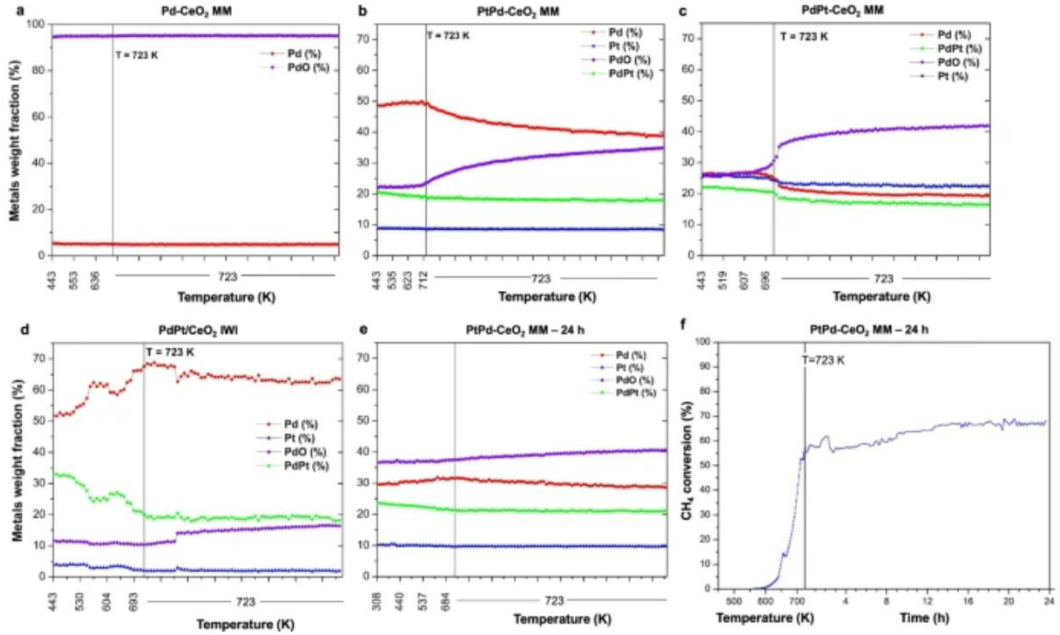


Fig. 2: Evolution of the normalized weight fraction of the phases obtained from the Rietveld refinement under wet lean methane oxidation conditions at different temperatures.

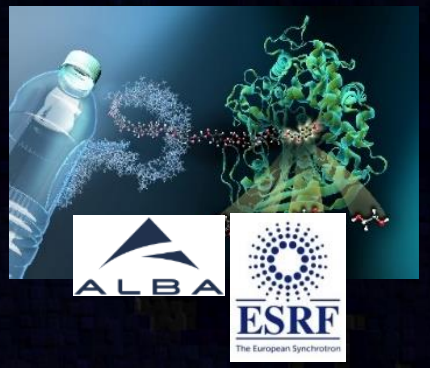


a–**e** For the indicated catalysts. **f** Methane conversion of PtPd-CeO_2 MM under time-on-stream at 723 K for 24 h under wet lean methane conditions (0.5% CH_4, 2% O_2, 10% H_2O, balance He). MM mechanical milling, IWI incipient wetness impregnation.

Divins, N.J., Braga, A., Vendrell, X. *et al.* Investigation of the evolution of Pd-Pt supported on ceria for dry and wet methane oxidation. *Nat Commun* **13**, 5080 (2022). https://doi.org/10.1038/s41467-022-32765-4

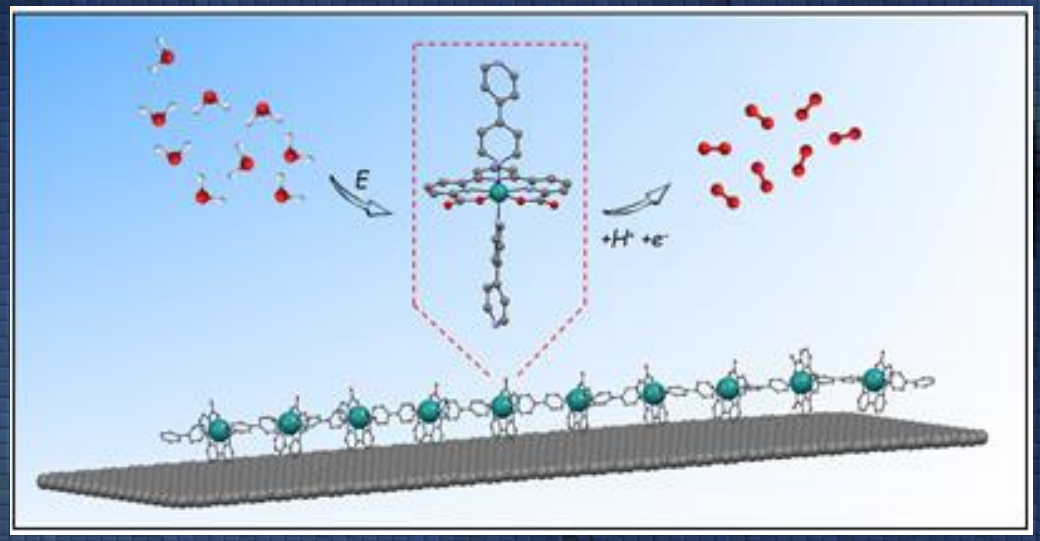
We care for environment

developing new catalysts for green fuels, cybor plants … or PET digesting bacteria



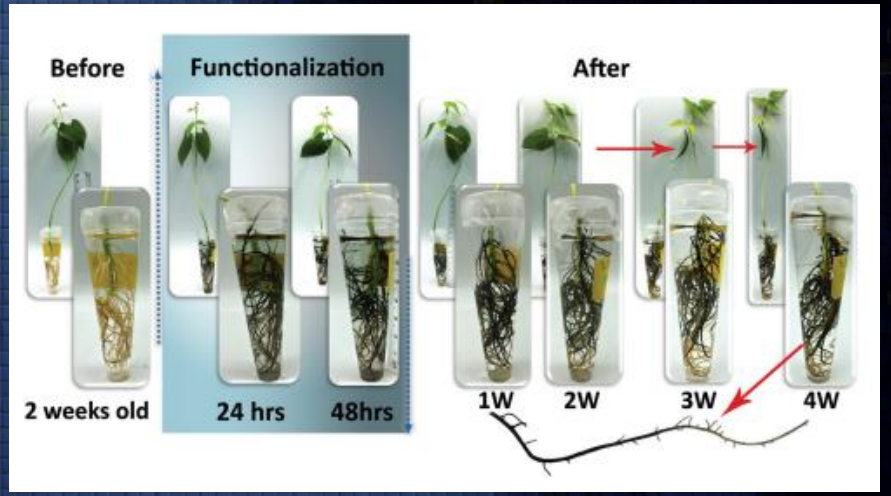
ENVIRONMENT

Photocatalytic water splitting is being investigated to produce **hydrogen**, a clean-burning fuel. Photocatalytic water splitting has the simplicity of using a catalyst and sunlight to produce hydrogen out of water.

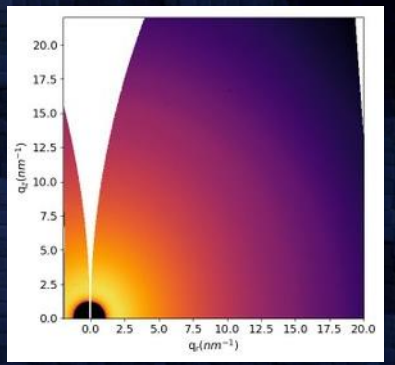


NCD-SWEET: putting the basis for designing robust and efficient hybrid molecular electro-anode materials for the **oxidation of water-based on Ru complexes**, that can be extended to other transition metals and other catalytic reactions. The team is already working on implementing the hybrid material on photoelectrochemical cells to test its applications in a water-splitting device

Water oxidation electrocatalysis using ruthenium coordination oligomers adsorbed on multiwalled carbon nanotubes Hoque, A et al A. *Nat. Chem.* **2020** (DOI: 10.1038/s41557-020-0548-7).



CYBORG PLANTS: ROOTS CAN STORAGE ENERGY

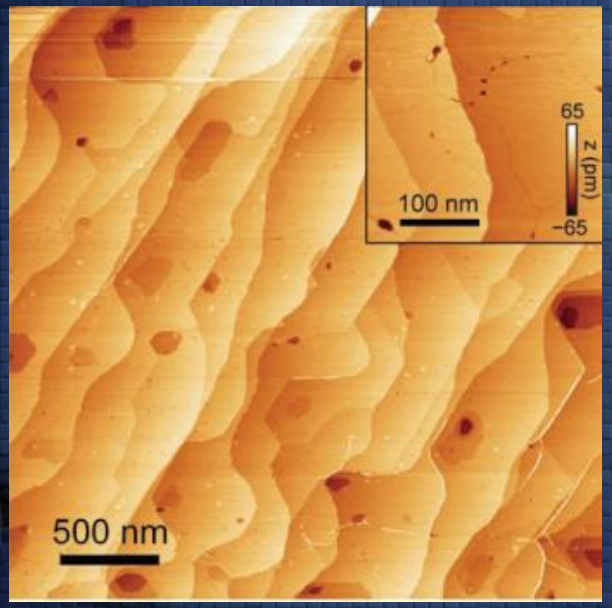


Materials Horizons (2021). DOI: 10.1039/d1mh01423d

We advance in complex materials and technologies developments

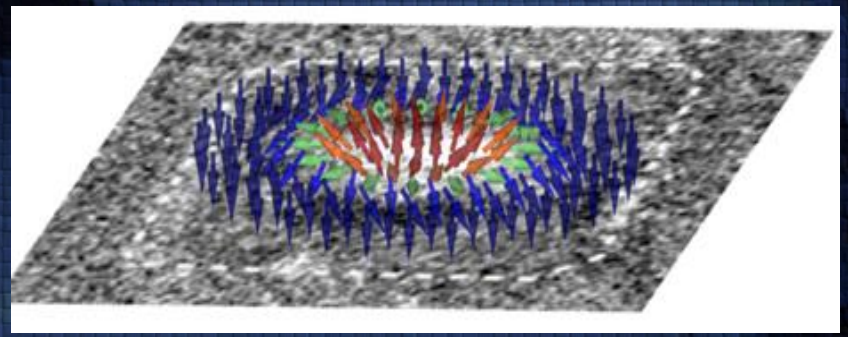
Tools for the ERA of Complexity

Optimizing complex materials needs experimental tools including extreme conditions (T, P, magnetic fields) and real-time control (in-situ and operando) of relevant parameters and their functionality: quantum materials, superconductors, nanomagnetism are bricks of complex technologies



DISCOVERY OF NOVEL CLASS OF 2D MAGNETS: 2D-XY FERROMAGNETISM IN MONOLAYER CrCl3 **Science (2021)**. DOI: 10.1126/science.abd5146

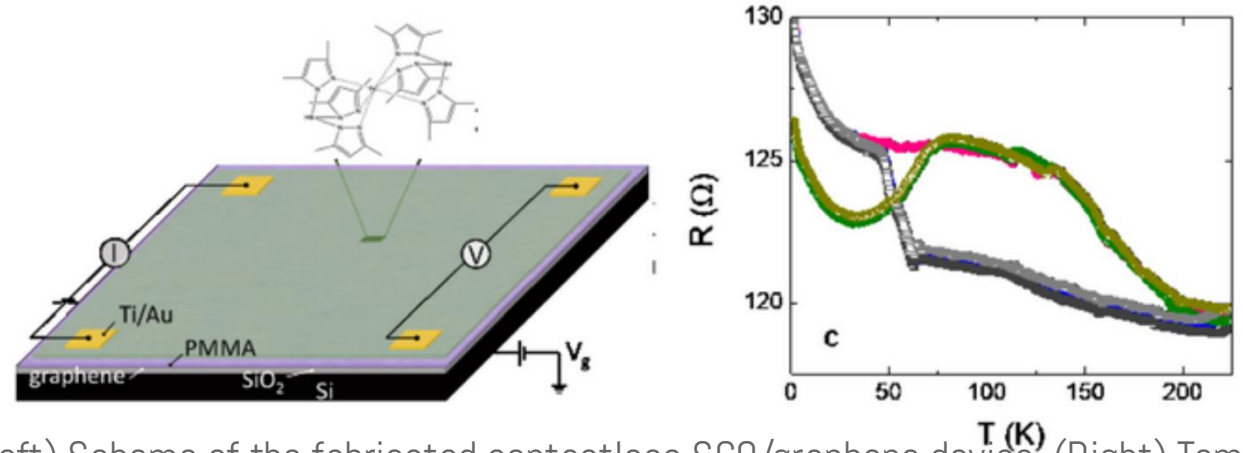
Skyrmion schematic



Nature Nanotechnology (2016) O. Bulle ….L. Aballe, M. Foester, …G. Gaudin , ALBA

DESIGN OF A LIGHT-INDUCED SPIN SWITCHING DEVICE WITH PROMISING APPLICATIONS IN SPINTRONICS

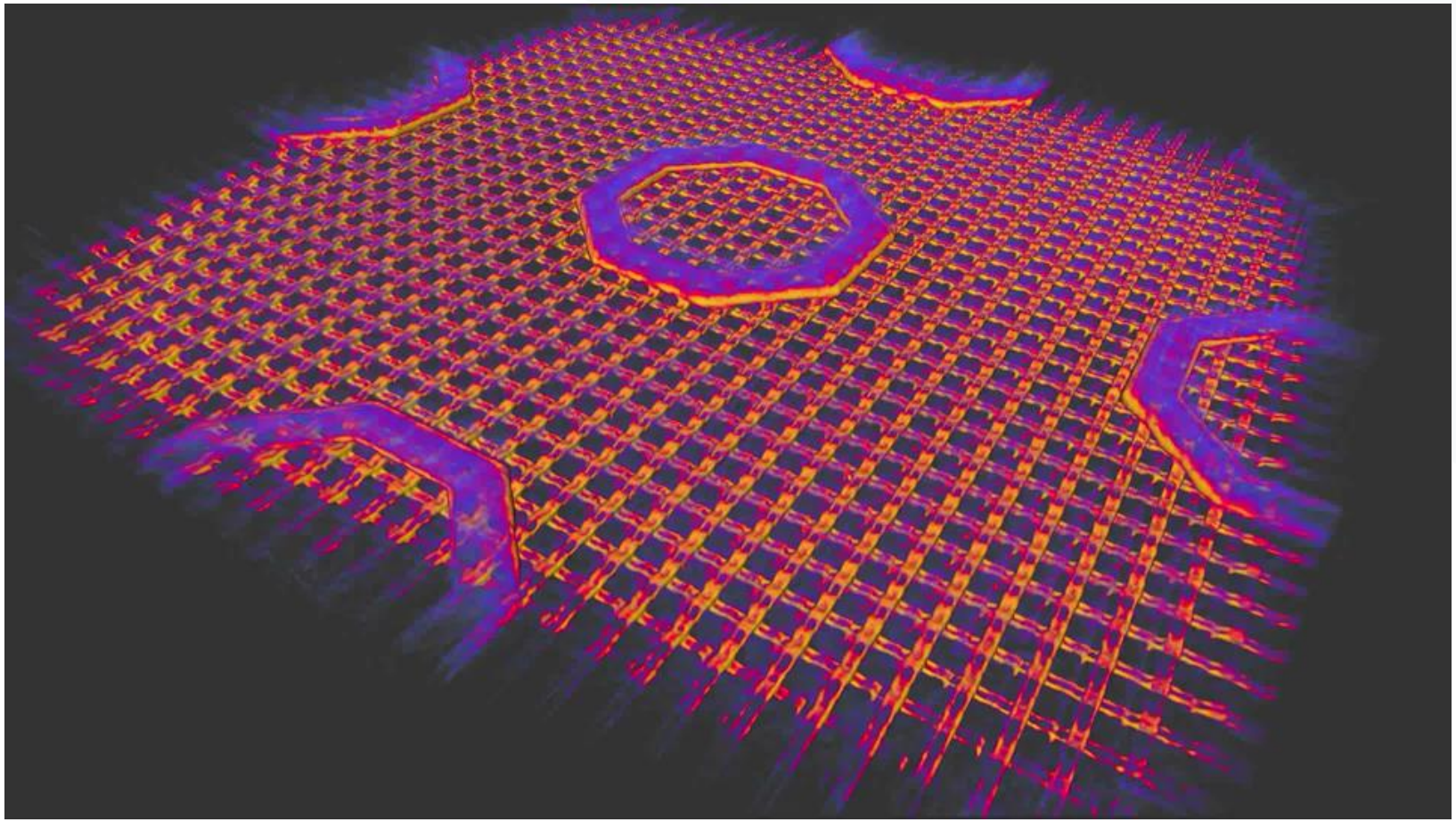
A research work led by the University of Valencia (Spain) has reported the fabrication of a novel device that allows the robust electrical detection of a fast and effective light-induced and thermally induced spin transition with an outstanding performance. It represents a tool with promising potential for generating new systems with applications in spintronics and straintronics. Experiments carried out at the BOREAS beamline have been crucial in this study



(Left) Scheme of the fabricated contactless SCO/graphene device. (Right) Temperature-dependent electrical measurements showing cycles without light irradiation (black, grey and blue lines: cooling process and pink line: heating process) and after light irradiation (two green lines: heating process by irradiating at 2 K with a laser for 5 minutes). Cooling cycles reveal an abrupt thermally induced spin transition at 60 K. Heating cycles without irradiation are indicative of a more progressive reversibility in the transition finishing at 180 K.

Electrical Sensing of the Thermal and Light-Induced Spin Transition in Robust Contactless Spin-Crossover/Graphene Hybrid Devices. *Advanced Materials* (2022). DOI: https://doi.org/10.1002/adma.202202551

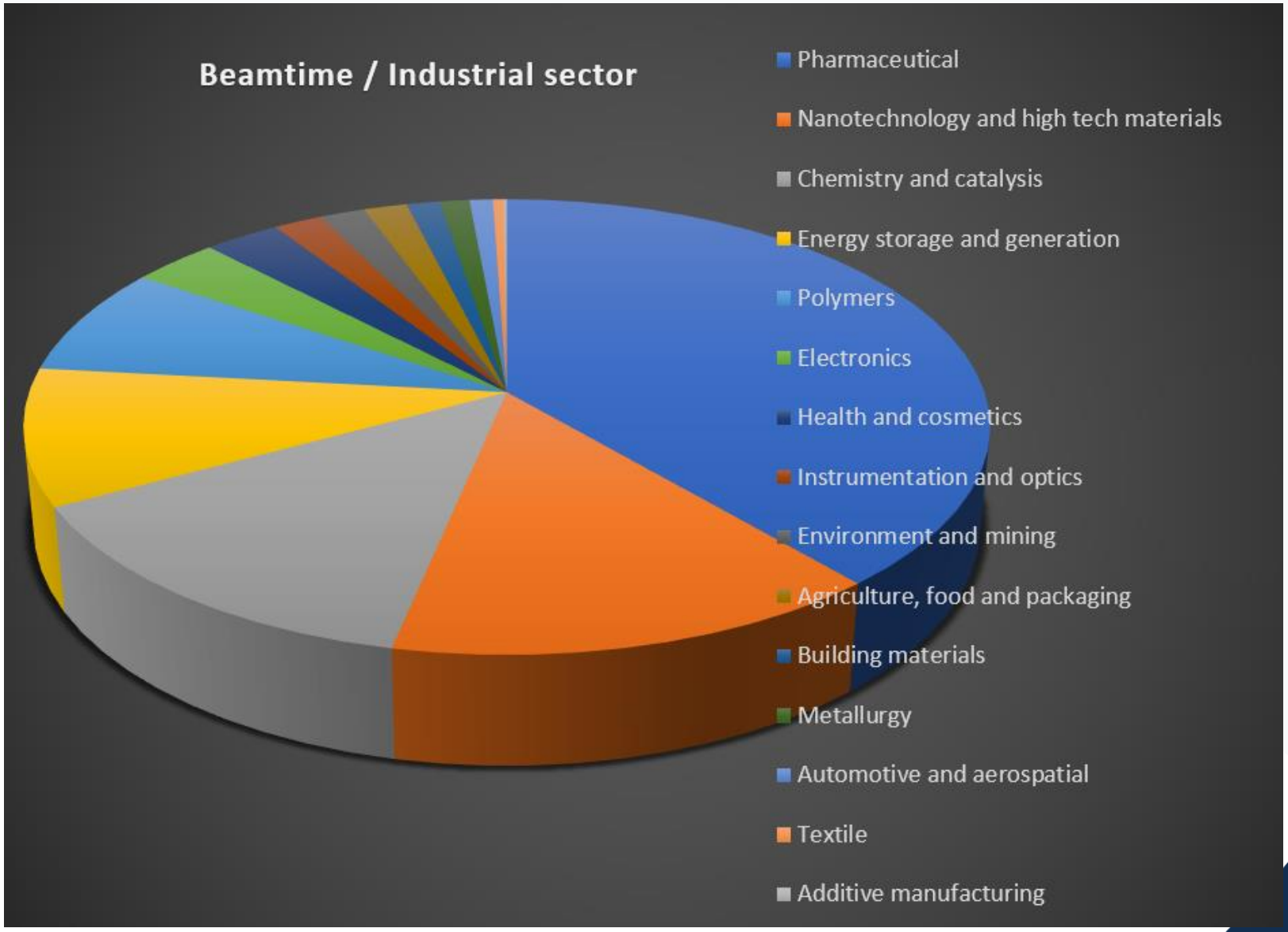
Instruments for developing the future microchips



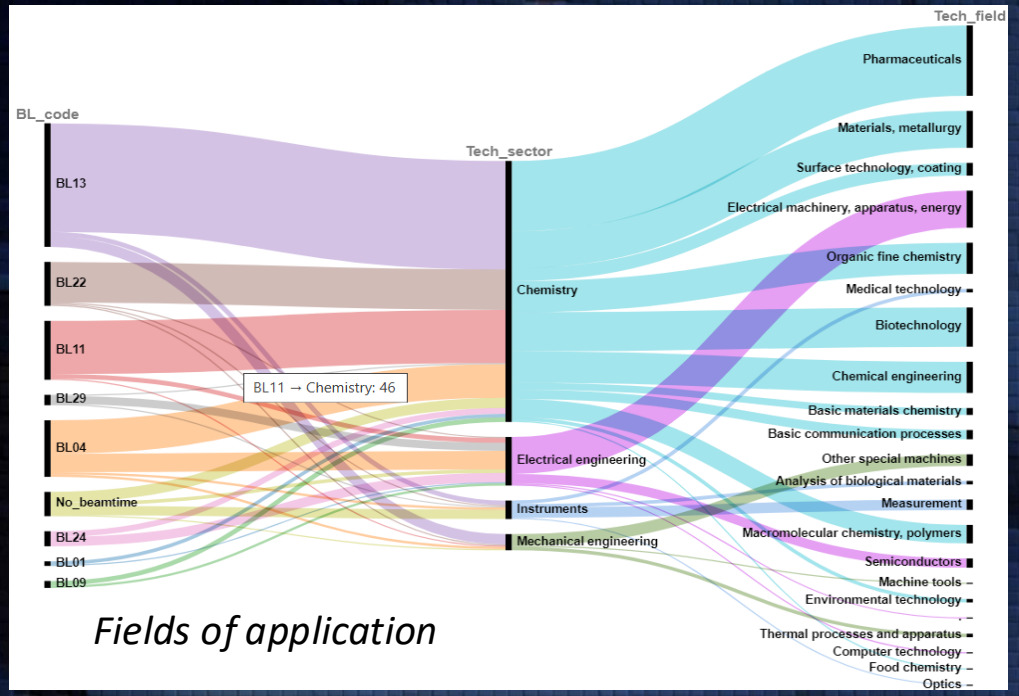
Microchip Structure - PSI

ALBA as industrial instrument

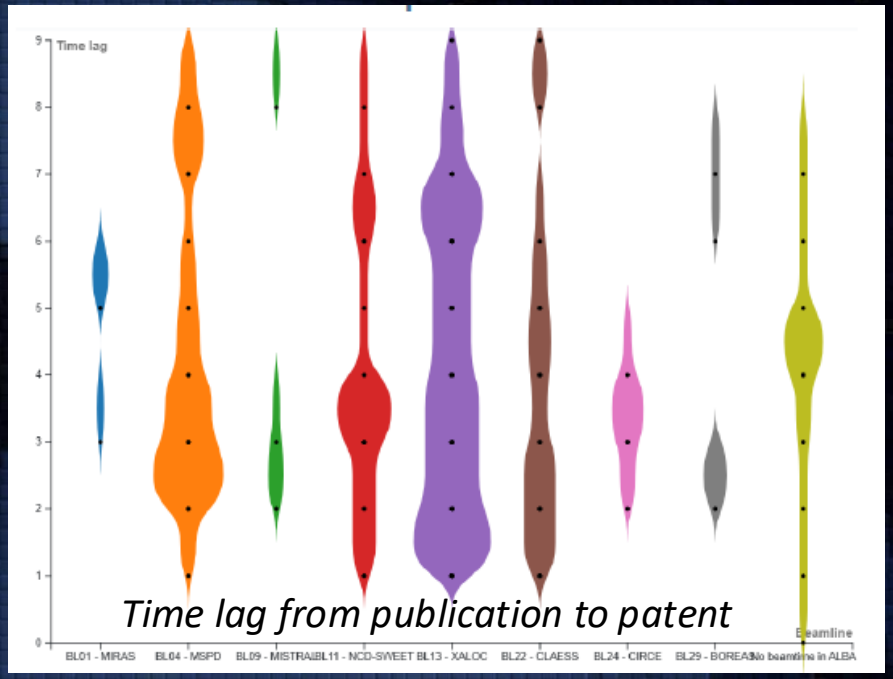
- Direct access to all instruments
- One single entry point: the industrial office
- Full confidentiality and IP protection
- Development of other services as methodologies and data analysis
- Connection to European Partners for participation to European Programs and complementing instrumentation
- Teaming up with academy for low TRL developments
- Organization of focused industrial events



Impact of public competitive research on Innovation: Patents citing ALBA publications



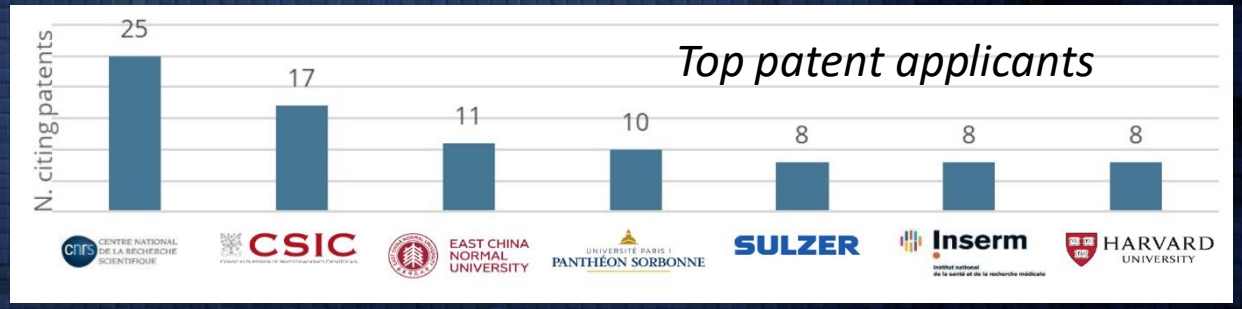
Fields of application



Time lag from publication to patent

142 ALBA publications out of 2,901 were cited in **290** **patent documents** (P_0)

2579 were cited by a total of **51,628 scholar works** (P_1). 2214 of the 51,628 citing scholar works were in turn cited by **4283** **patent documents** (Pat_1)



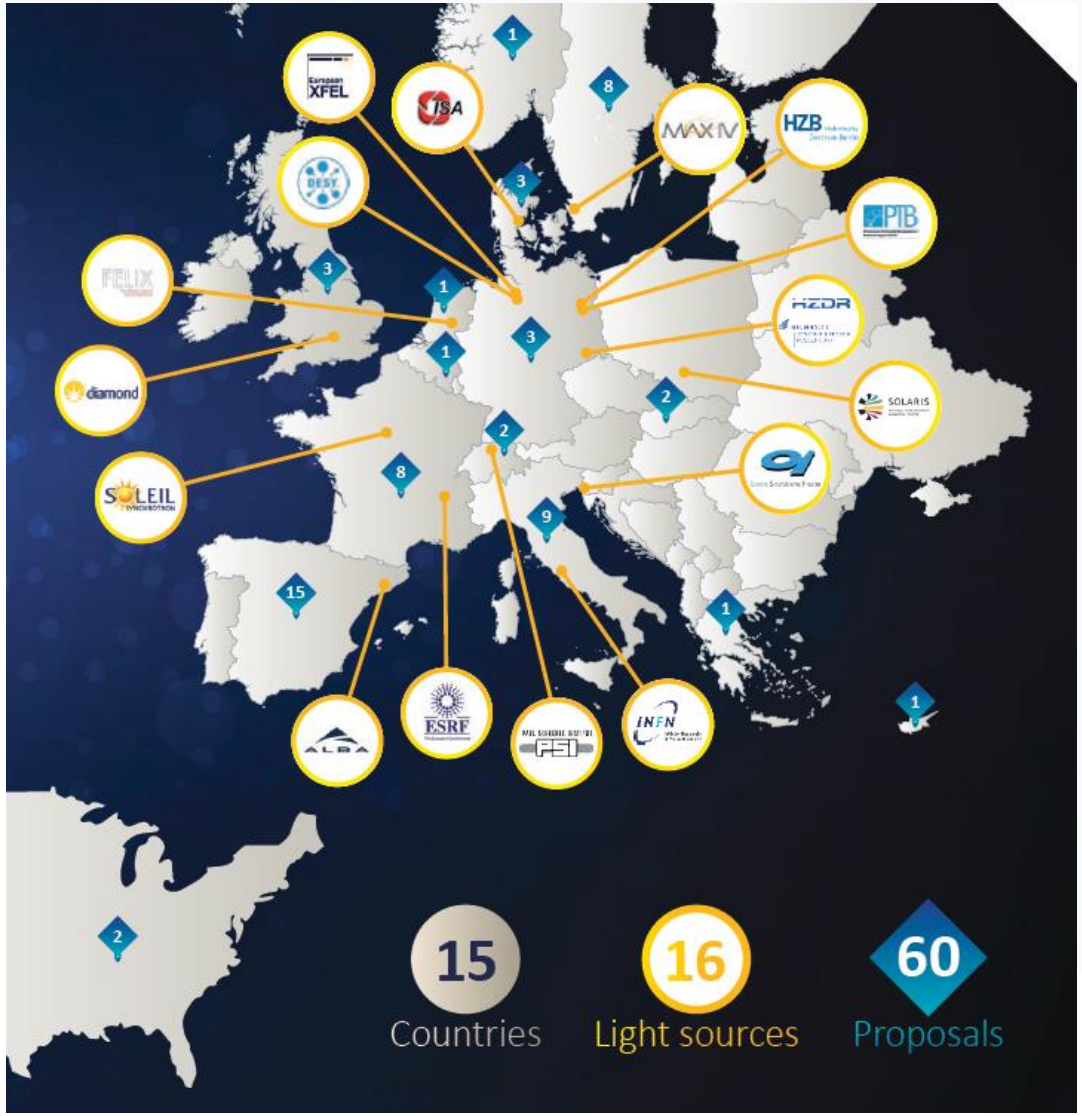
Top patent applicants

Tamata projects

a programme that helps small- to medium-sized companies perform experiments at world-class synchrotrons and other light sources in Europe and in the Middle East, to make the companies more innovative and competitive.

- CalipsoPlus: 36 proposals for SME
- TAMATA-INNOV: 32 proposals for SME
- ReMade-SME: 32 for SME
- ReMade-IND: 12 projects (5 SMEs + 7 not SMEs)

Example:
ALTINCO, ES
Agrochemicals, developing a copper-complex solution that can trigger the autumn leaf-fall of fruit trees in a short time, allowing farmers to plan the subsequent pruning process more efficiently



Example of public-private European collaboration:
REcyclable MAterials DEvelopment at Analytical Research Infrastructures

*Current global economy is **wasting 92% of materials after single use** (Circularity Gap Report 2024)*

***Circular economy** is helping to delay Earth Overshooting Day and reduce humanity's ecological footprint.*

***Circular economy adoption** in materials like plastics, electronics, textiles, and construction could **cut global ecological overshoot by 30–40% or more** (according to Global Footprint Network).*

'Tailor-made Access Routes for Advancing Materials Development for a Circular Economy'

WP: ReMade - IND

TARGET GROUP:

Companies in partnership with a knowledge provider (academic partners, RTOs, CROs, specialized service companies, etc.) working on circular economy projects at Advanced Research Infrastructures.

BENEFITS:

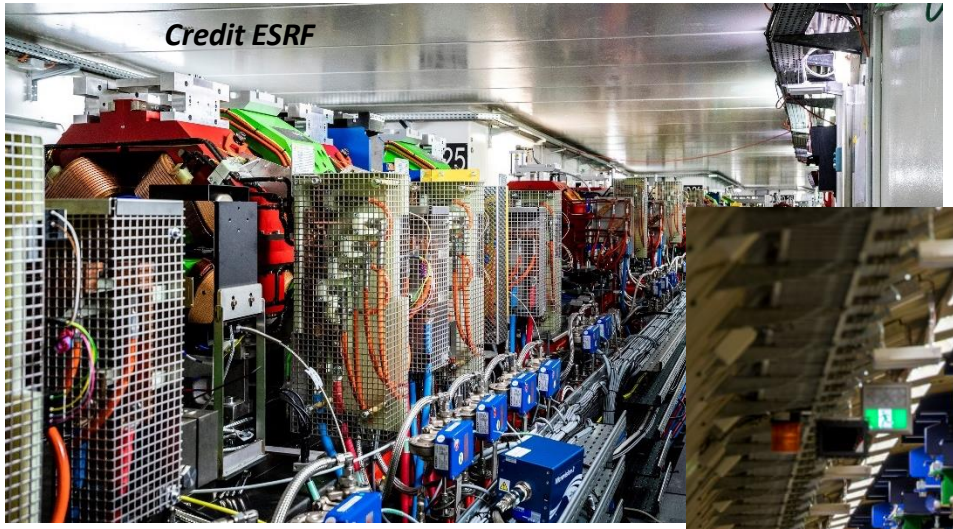
- **30,000€** grant for customization of access, e.g.:
  - Expert services by the knowledge provider
  - Consumables, sample environment
- Proprietary access against payment and no publication of results

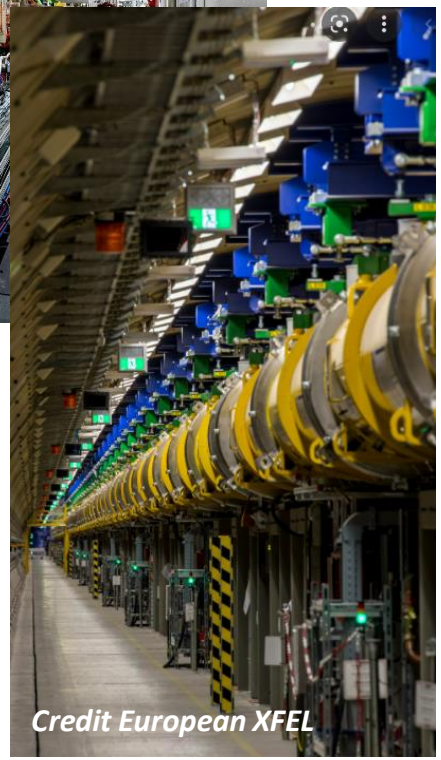
Presented by Dr. Lakshmi Bhaskaran, ReMade@ARI Project Manager, email: l.bhaskaran@hzdr.de

Technological Transfer

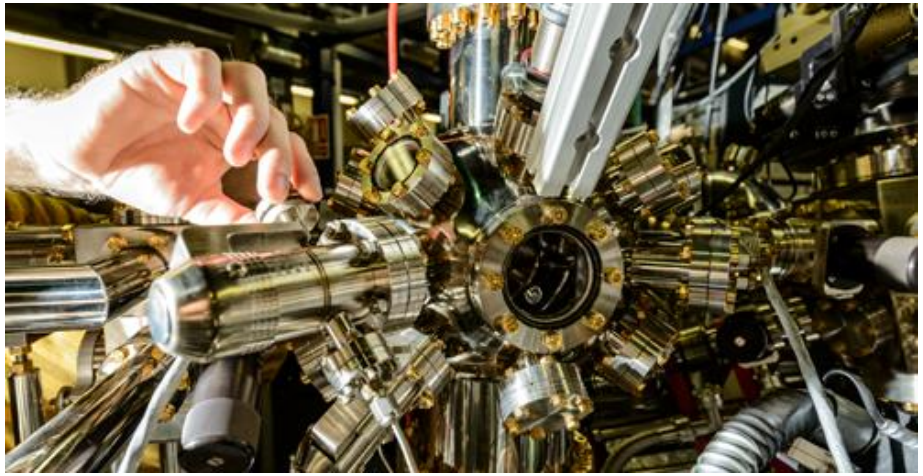
LEAPS and Industry

Leading evolution from 3rd to 4th generation synchrotrons and FEL technologies





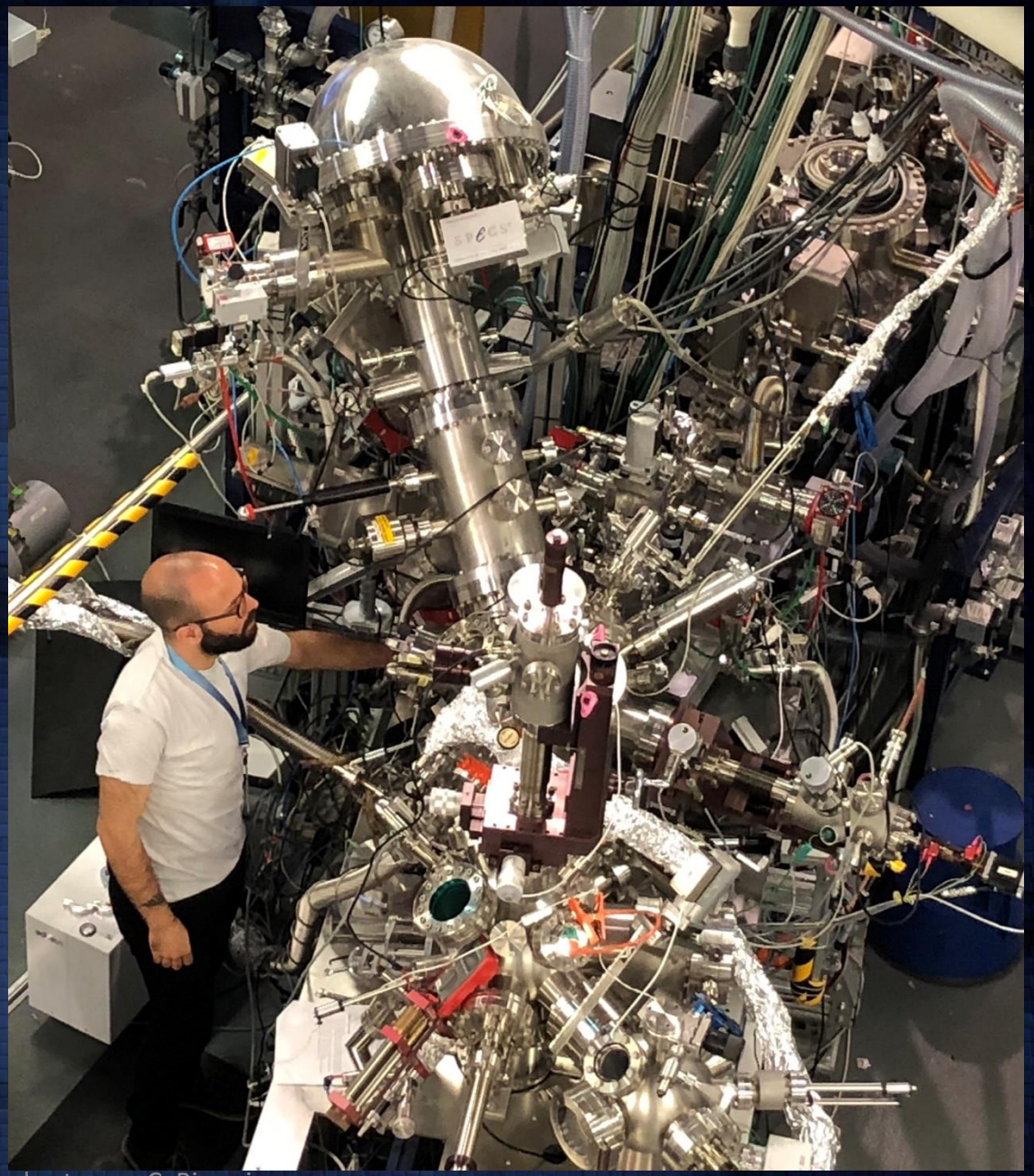
Innovation hubs
Industry as provider and Industry as a research collaborator



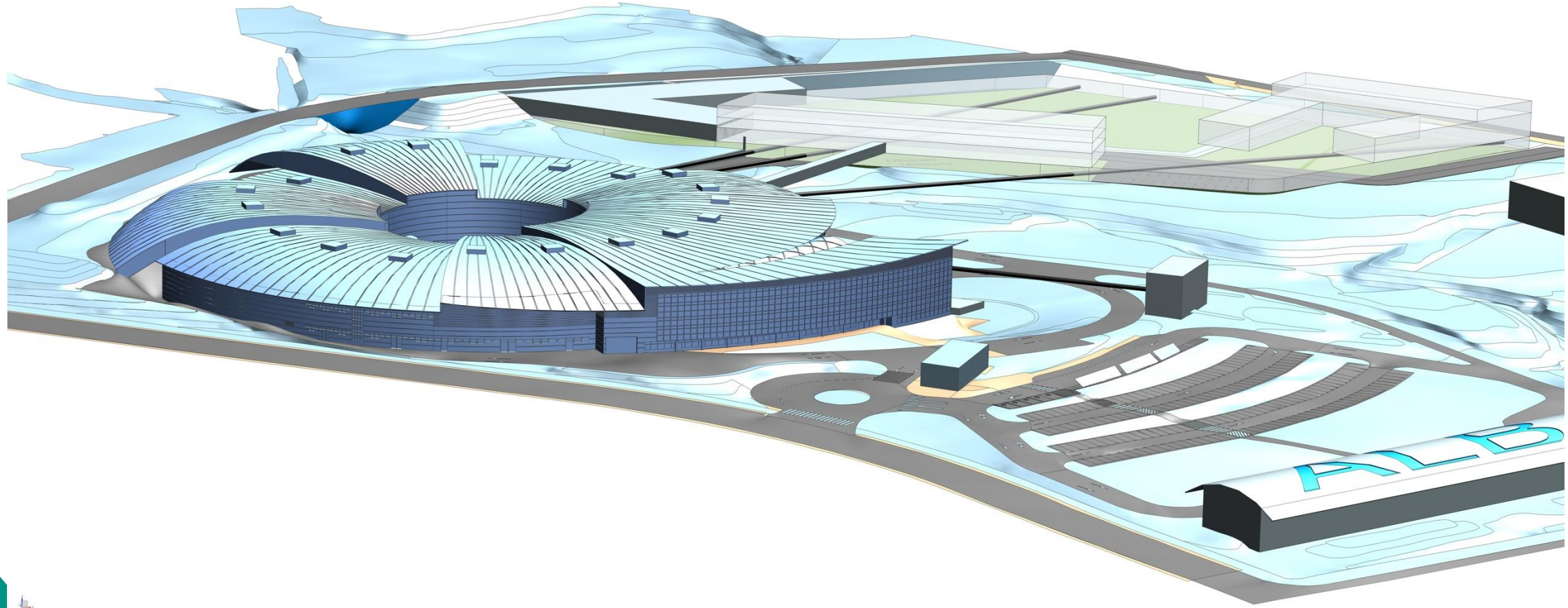
LEAPS League of European Accelerator-based Photon Sources

… and for producing technologies related to

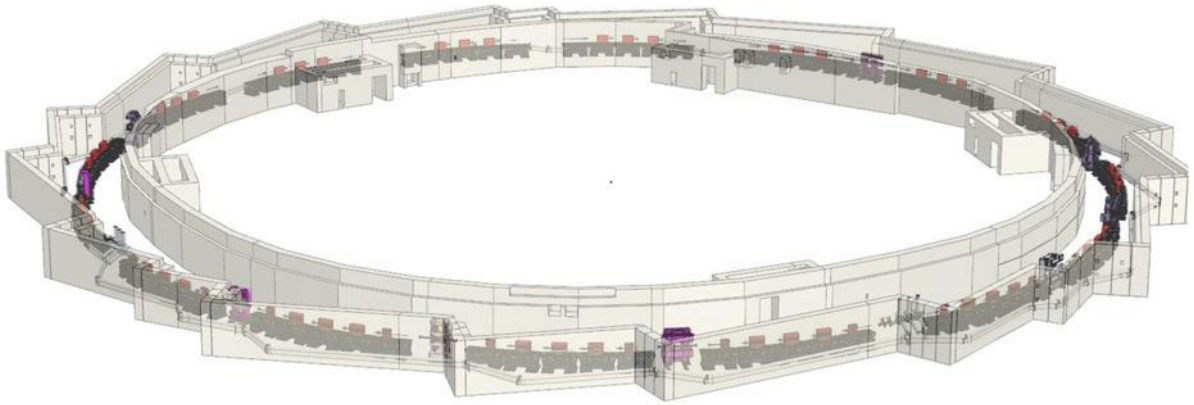
- Accelerators
- Photon beam optics
- Sample environment
- Detectors
- Data analytics

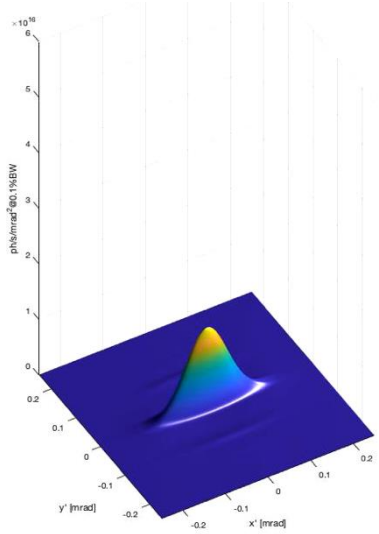


ALBA II – Increased photon beam resolution power and coherence, boosted by the future Long Beamlines

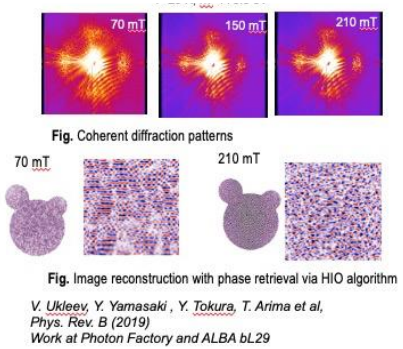


ALBA to ALBA II:
Brightness is Key to Develop Probes on Relevant Scales

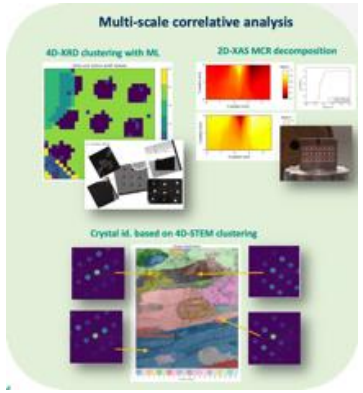




Imaging



Throughput, Data analytics, and Multimodal

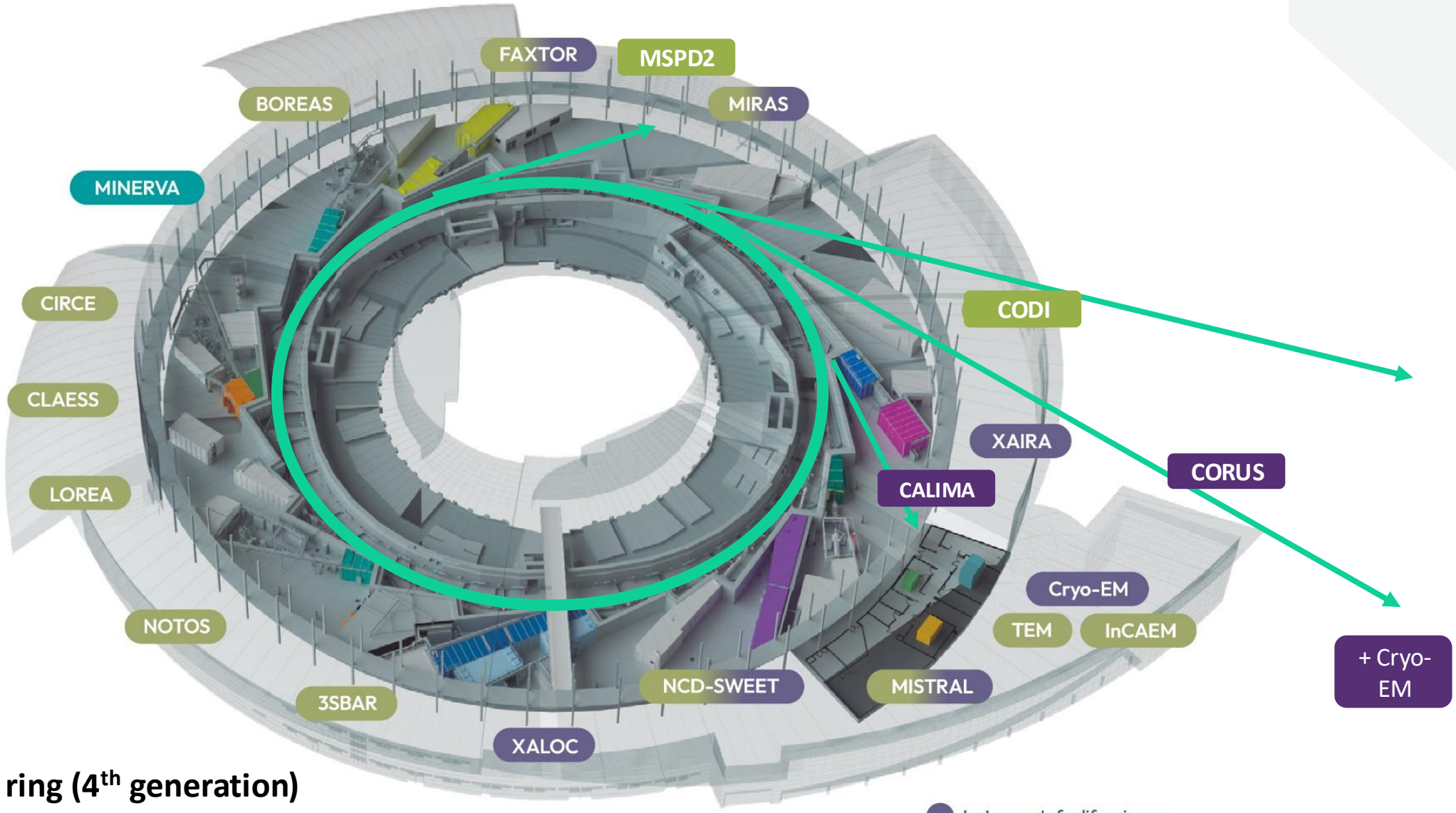


Operando and in-situ

Upgrade gives the tools for bridging basic and applied sciences:

- Accelerator upgrade
- Existing beamline upgrade
- 3 new beamline fully benefitting from ring upgrade
- Conventional facility upgrade
- Strategy and user mode upgrades
- Non X-ray based probes to complete portfolio suite

ALBA II in 2032

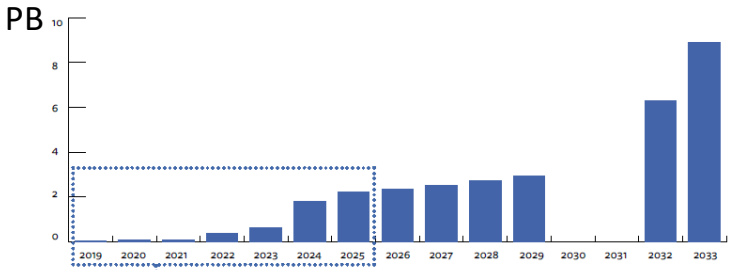


New storage ring (4th generation)
17 operating beamlines
4 electron microscopes + SPM & AFM

DATA and Scientific Computing

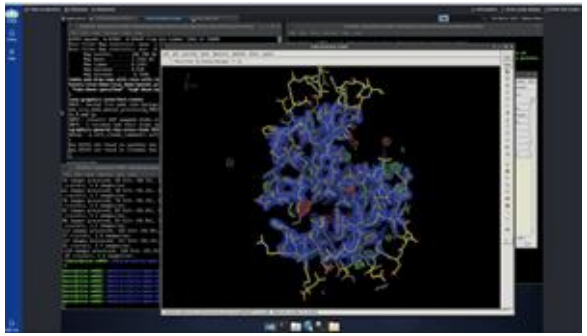
Data Deluge at ALBA II

- Specialized data processing and analysis will require High Performance Computing optimization.



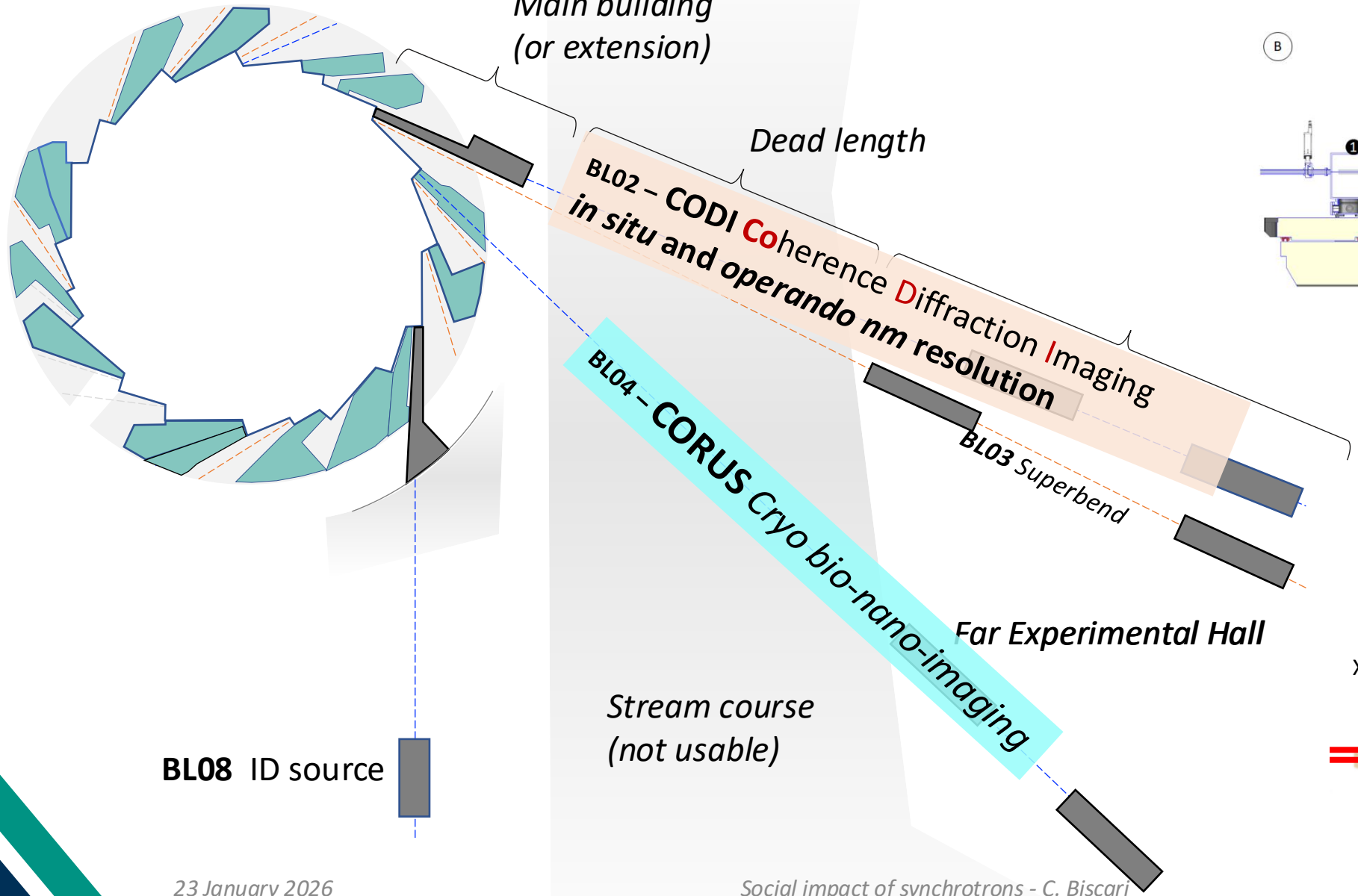
Actions in progress

- Ambitious IT investment program
- Develop methods and software tailored for specific scientific cases (two groups already working operatively at ALBA).
- Crafting versatile data tools

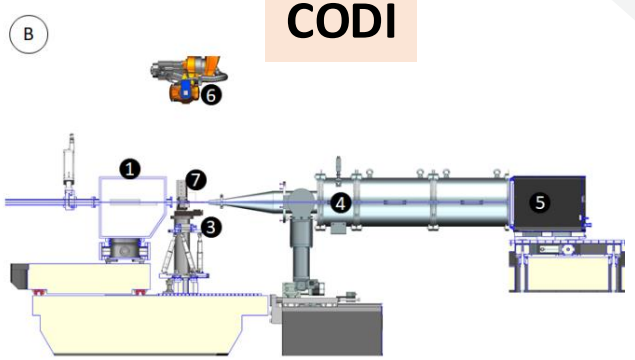


- Users will benefit of additional Computing Services, further ensuring their ability to navigate and harness the scientific potential of ALBA II's data-rich environment.

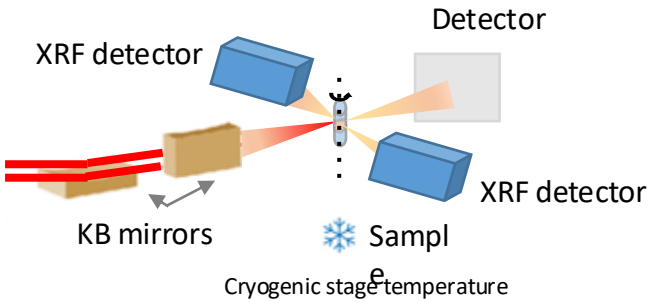
First 2 long Beamlines



CODI



CORUS



Expanding ALBA II reach and connection to new institutes

- New space nearby the main infrastructure
- Experimental stations of long beamlines
- Space for offices and labs
- Space for new science and innovation institutions

Advancing in the cooperation with partners for definition of new institutes

Resilience to Global Health challenges through the One Health approach – BSL3 connected to CORUS BL

UAB Universitat Autònoma de Barcelona · ALBA · CNB Centro Nacional de Biotecnología · IRTA Institut de Recerca i Tecnologia Agroalimentàries · ibmb Institut de Biologia Molecular de Barcelona CSIC · IRB Barcelona · Barcelona & Partners by Barcelona Global

Reach One Health

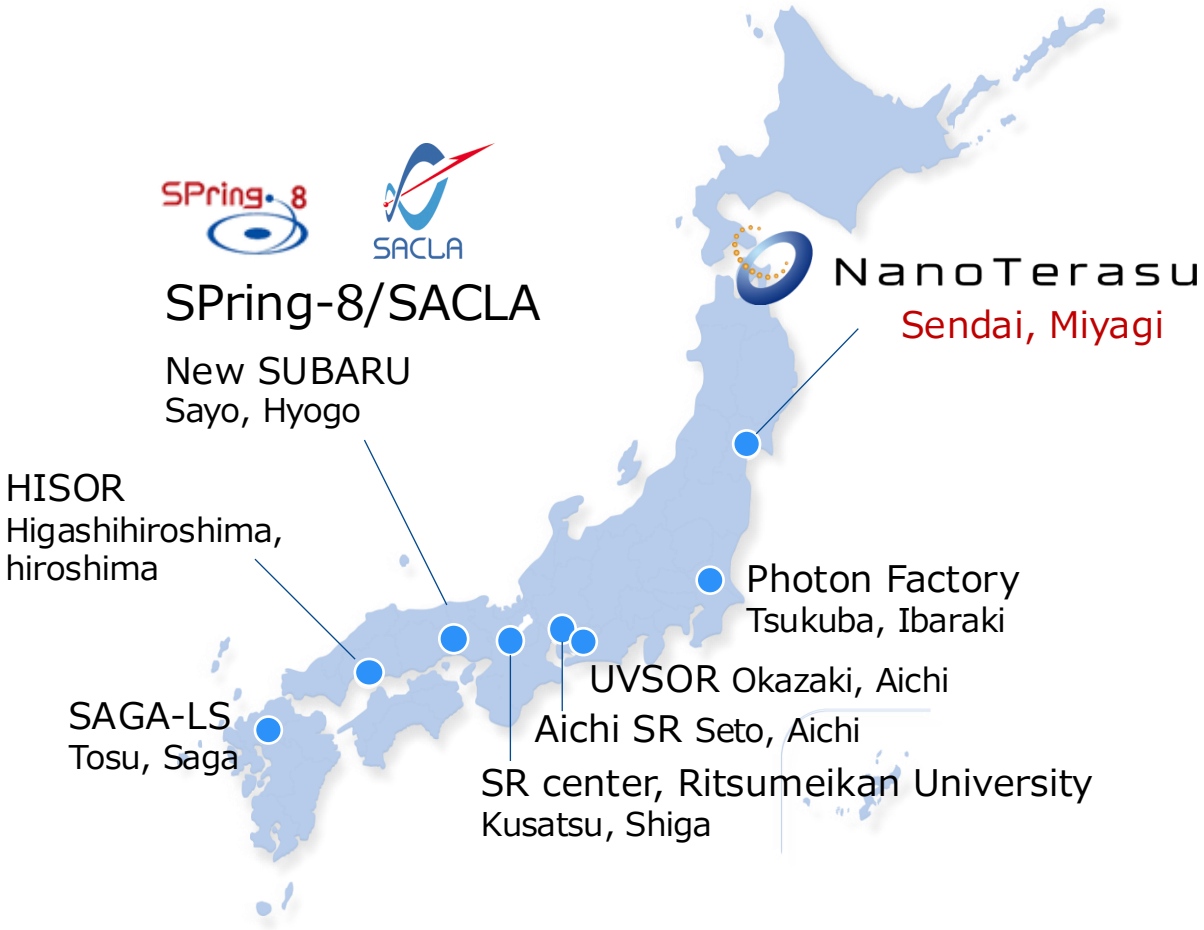
CORUS

INNOFAB

Lab to Fab clean room for microelectronics for development of semiconductors technologies

Generalitat de Catalunya · ICN2 · ALBA · CNM · ICFO · INBRAIN Neuroelectronics · UAB Universitat Autònoma de Barcelona · Barcelona & Partners

Synchrotron Radiation Facilities in Japan



- **Synchrotron is now used not only for fundamental science but also for various industries including materials, electronics, nanotechnology, pharmaceuticals, cosmetics, food industry and so on.**
- **NanoTerasu has started its operation since April 2024 as the 10th synchrotron radiation facility in Japan.**

Eco-friendry Tires

Shampoo

Chewing Gum in Dental Caries

Building materials

Influenza Antiviral Drugs

Electric Vehicles

Carbon fiber

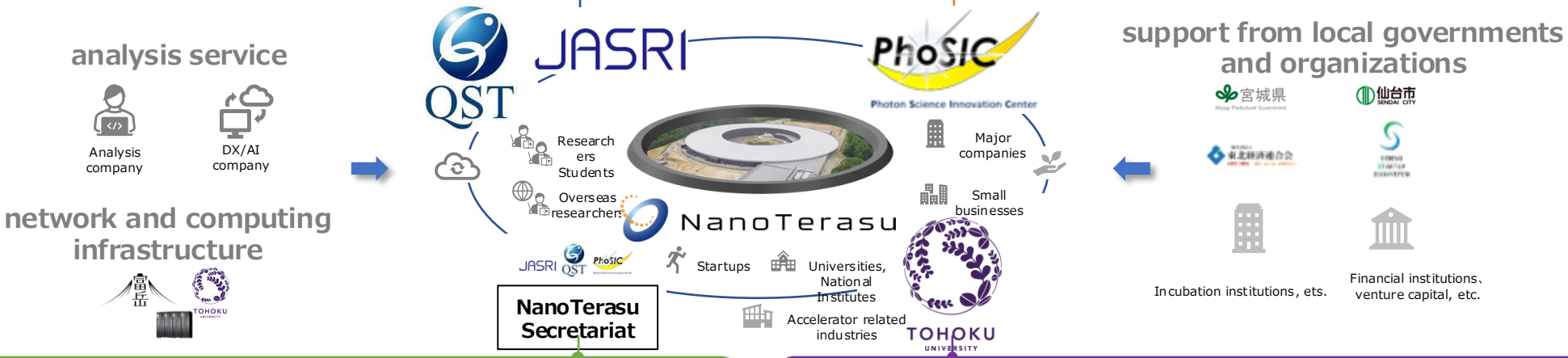
Ecosystem around NanoTerasu

Public beamlines

- Open to any academic and industrial users
- Free beamtime in exchange for publication of results
- Finding innovation seeds

Coalition beamlines

- Proprietary use by coalition members
- No requirement of proposal writing nor publication of results
- Growing innovation seeds to mature technology



NanoTerasu Secretariat

- An integrated administrative office is responsible for coordination of common issues including safety, advertisement and computer network.

Research complex

- Opportunity for collaboration among industry, academia, and national institutes
- Easy access to fundamental research resources, such as super computers and liquid helium
- Education and training of future human resources involved in synchrotron science

The Innovation Pioneered by NanoTerasu

NanoTerasu

Visualizing the functions of important elements and molecules in academia and industry.

- **High-resolution image data**
- **High temporal resolution data**

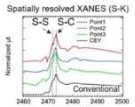
Energy

Boosting renewable energy use with smaller, more powerful, and longer-lasting batteries.

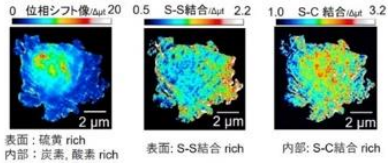
- ✓ Real-time visualization of chemical reactions and degradation in fuel cells, lithium-ion, and lithium-sulfur batteries.
- ✓ Accelerating R&D to improve wind power and EV performance.

before

Lithium-sulfur battery



now

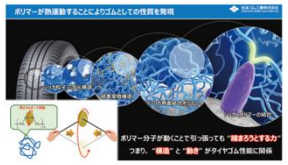


By Tohoku Univ.

Material

Building a circular economy through polymer recycling, biomaterial expansion, and longer-lasting fuel-efficient tires.

- ✓ Visualizing polymer synthesis, decomposition, and recycling to accelerate the development of recyclable plastics, high-performance biomaterials, and eco-friendly tires.



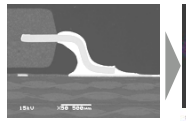
By Sumitomo Rubber

Device

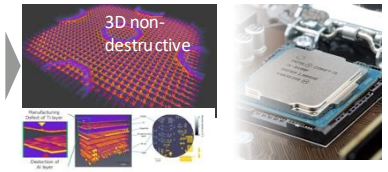
Next-generation electronics and spintronics

- ✓ Visualizing nanoscale circuits and semiconductor defects to advance miniaturization, 3D integration, AI, and yield improvement.

before **now**



Imaging a single cross-section

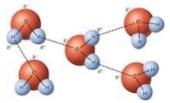


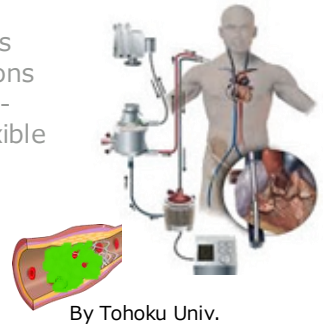
By SLS

Wellbeing

Creating new technologies to support health and medical care

- ✓ Visualizing drug behavior in cells and biomaterial-water interactions to develop targeted drugs, long-lasting artificial organs, and flexible medical wearables.





By Tohoku Univ.

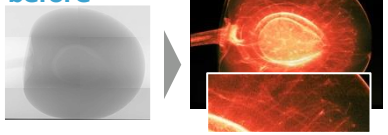
Food

Branding and adding value to Japanese food, and standardizing food regulations globally

- ✓ Visualizing plant nutrients, food processing, and transport to produce safe, high-quality food efficiently and boost exports.

before **now**

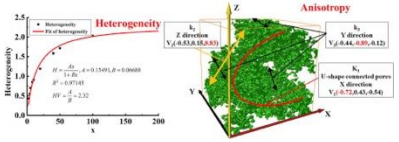
By Tohoku Univ.

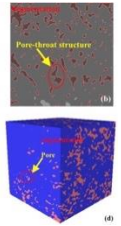


Mineral resources

Evaluation of mineral resources

Quantifying nanopore variations and anisotropy in gas shale for precise reservoir evaluation and optimal well layout.





Microporous and Mesoporous Materials
Volume 258, 1 March 2018, Pages 8-16

Economists study us to measure the socio-economic impact: From DIAMOND socio-economic impact study

www.diamond.ac.uk/Home/News/LatestNews/2022/19-10-22.html

"Diamond should be hugely proud of the leading research work they are doing with the scientific community, delivering real-world innovations from plastic degrading enzymes to synthetic vaccines against the Foot-and-Mouth disease virus.

The fact this work is ***also contributing an economic boost of over two-and-a-half billion pounds to the UK*** *illustrates just how important the science and research sector is to our country's growth and prosperity, and the benefits we continue to see from persevering with our ambitions to remain a science superpower."*

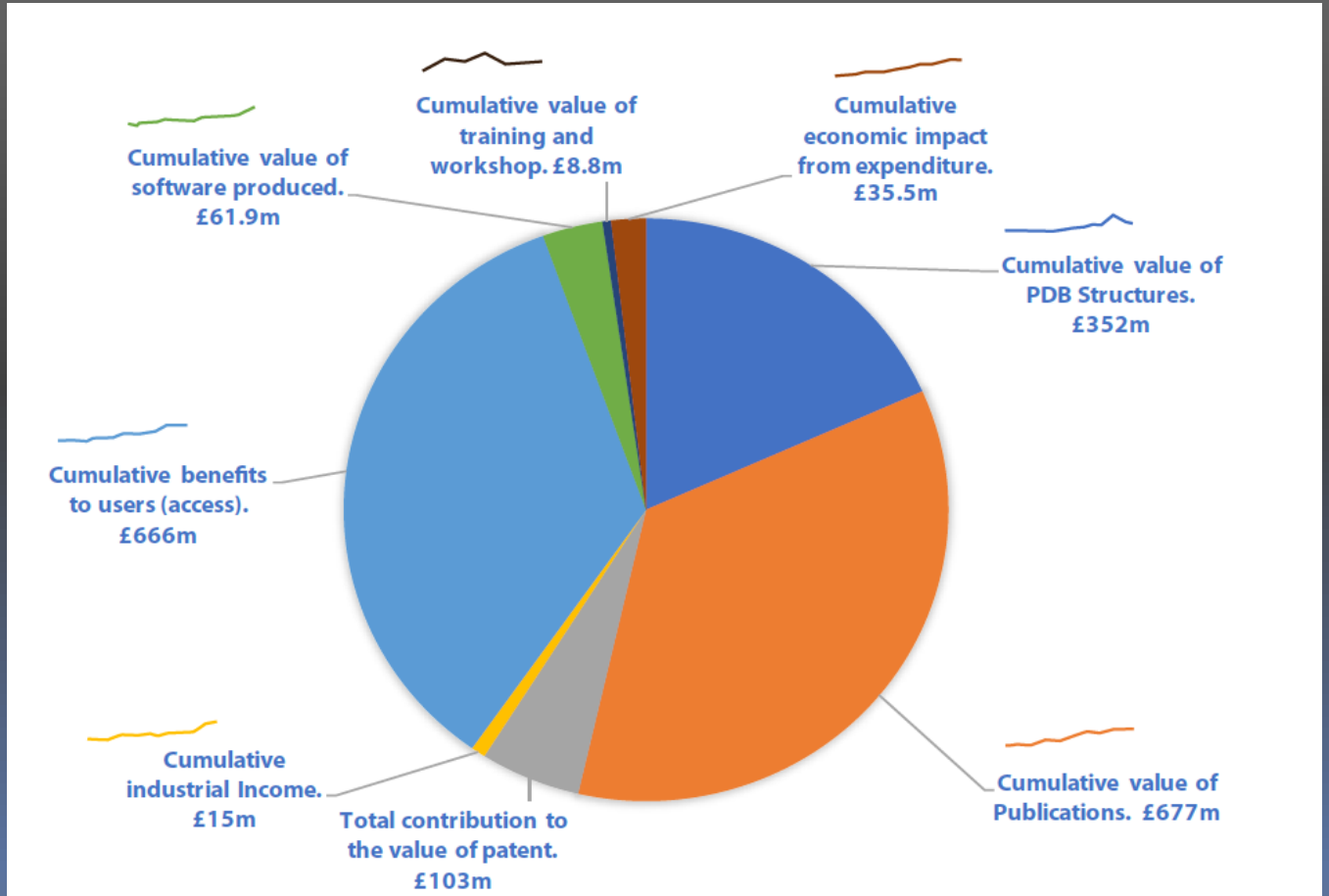


Figure 21: Break down of impact areas mapped as part of this report with trend data (where available) showing the steady growth over time.

Socio-economic Impact Assessment of ALBA

2004 – ALBA ex ante

ANÁLISIS COSTE BENEFICIO Y ESTUDIO DE IMPACTO ECONÓMICO DE UNA FUENTE DE LUZ DE SINCROTRÓN EN EL VALLÈS OCCIDENTAL

Equipo de investigación
Director: José García Montalvo (Universitat Pompeu Fabra)
Colaboradores: Josep Maria Raya (Universitat Pompeu Fabra)
Ferran Sancho (Universitat Autònoma de Barcelona)
Júlia Bosch (Institut d'Estudis Territorials)

Barcelona, Enero 2004

Cuadro 2.2. El impacto económico del sincrotrón. España.
Millones de euros de 2003.

	Inversión (2003-2008)	Funcionamiento (2009-2033)	Total (2003-2033)
Producción bruta	266	735	1.001
Valor añadido	140	417	557
Empleo	463	257	720

2010 – ALBA after construction

Noviembre 2010

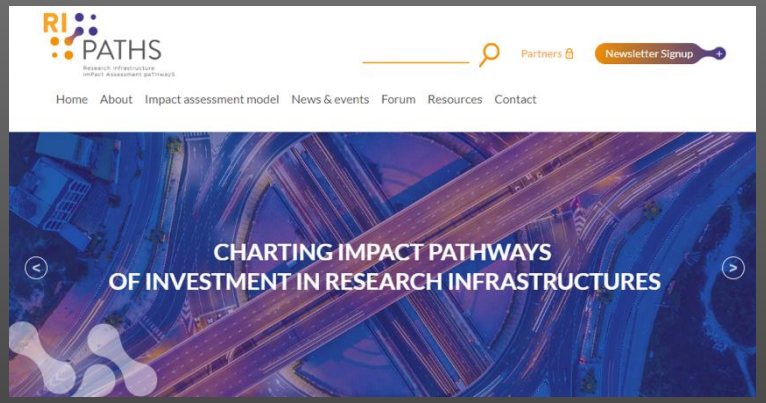
LA FUENTE DE LUZ DE SINCROTRÓN ALBA: ANALISIS COSTE BENEFICIO Y ESTUDIO DE IMPACTO ECONÓMICO

Autores: José García Montalvo y Josep Raya

Quadre 4. Impacte econòmic del sincrotró. Espanya (milions d'euros de 2010)

	Inversió (2003-2010)	Funcionament (2011-2035)	Total (2003-2035)
Producció bruta	301	898	1.199
Valor afegit	140	414	554
Llocs de treball	447	269	716

H2020 project - RI Paths



2025 – ALBA II

…"As a whole, economic analysis in the basic scenario provides a net updated value of 460 million euros and an internal rate of profitability of 20.3%. That is, every euro of investment has a social return of 1.2 euros per year"

ALBA
key numbers

+400 yearly experiments

+ 3800 yearly user visits

~ 5000 national and
~ 5000 international users

+4000 experiments
- **60% national**
- **40% international**

+7500 yearly public visits

~ 4000 publications

+350 trained students

+280 staff

Member of LEAPS

The Abdus Salam International Centre for Theoretical Physics

IAEA

unesco

Thank you for your attention

School on Synchrotron Light Sources and their Applications