ALBA Synchrotron & LEAPS

Caterina Biscari

ALBA Director, LEAPS Chair

20-11-2020

ALBA is the Spanish Synchrotron

National public institution with 50% national + 50% regional funding (Ministerio de Ciencia e Innovacion and Departament de Empresa I Coneixement)

National and international (25%) staff

National and international (+35%) users

National and international collaborations

Participation to projects plus services providing extra 7-8% of income and 10% of staff

ALBA Preparatory work

✓1990: Proposal, lead by Juan Antonio Rubio, of building a tau-charm factory in Spain with participation from CERN and other countries, retired in 1991 after detailed cost estimation and related difficulties in aggregating partnerships

✓**1992: Proposal of building a synchrotron light facility in Catalunya**, and preparation of a report 'The Synchrotron Laboratory of Catalonia', by a team headed by Joan Bordas, Salvador Ferrer and Ramon Pascual

✓1993: Catalonia government approves the start of a feasibility study under Bordas's guidance. A Steering Committee and a SAC were nominated. J. Bordas was selected as Director. **Powerful training program is established:PHD and Post docs in SL facilities.**

✓1995: Agreement between national and reginal governments to make a detailed study with the creation of the Division LLS (Laboratorio de Luz de Sincrotron) within the IFAE (Instituto de Fisica de Altas Energias, UAB) – Meeting with industries for construction and exploitation

✓1996: Survey of interested groups (up to 80) and range of photons needed

✓1996: Organization of EPAC Conference in Sitges, nearby Barcelona, gathering all the accelerator international community (800 participants) and presenting the project

✓1997: Scientists (beamline and accelerator experts) trained at international synchrotron light source facilities

✓**1997: Decision of building CRG (BM25) at ESRF**

✓1998: 'LLS Detailed Design Report' (2.5 GeV – C=250 m) 8 years construction period – LLS independent from IFAE

✓1999: Creation of the LLS Consortium, promoted by Catalonia Government ,

✓**2000: New CRG (BM16) at ESRF administrated by LLS**.

✓2001: Informe Abela – 50 pages with the evaluation of the necessity, of the opportunities and of the socio-economic impact

✓2002: Agreement between central and regional governments engaging to signing an agreement for co-funding the project.

✓2003: Professor Jose Garcia Montalvo, of the University Pompeu y Fabra, Barcelona requested to carry out an economic analysis of the construction of a Synchrotron Light Source in Catalonia

ALBA history

UAB

4 Centres of Excellence “Severo Ochoa” and the 2 Units of Excellence “María de Maeztu” are located in the UAB campus

BARCELONA NANOTECHNOLOGY CLUSTER-BELLATERRA

UAB

ICN2

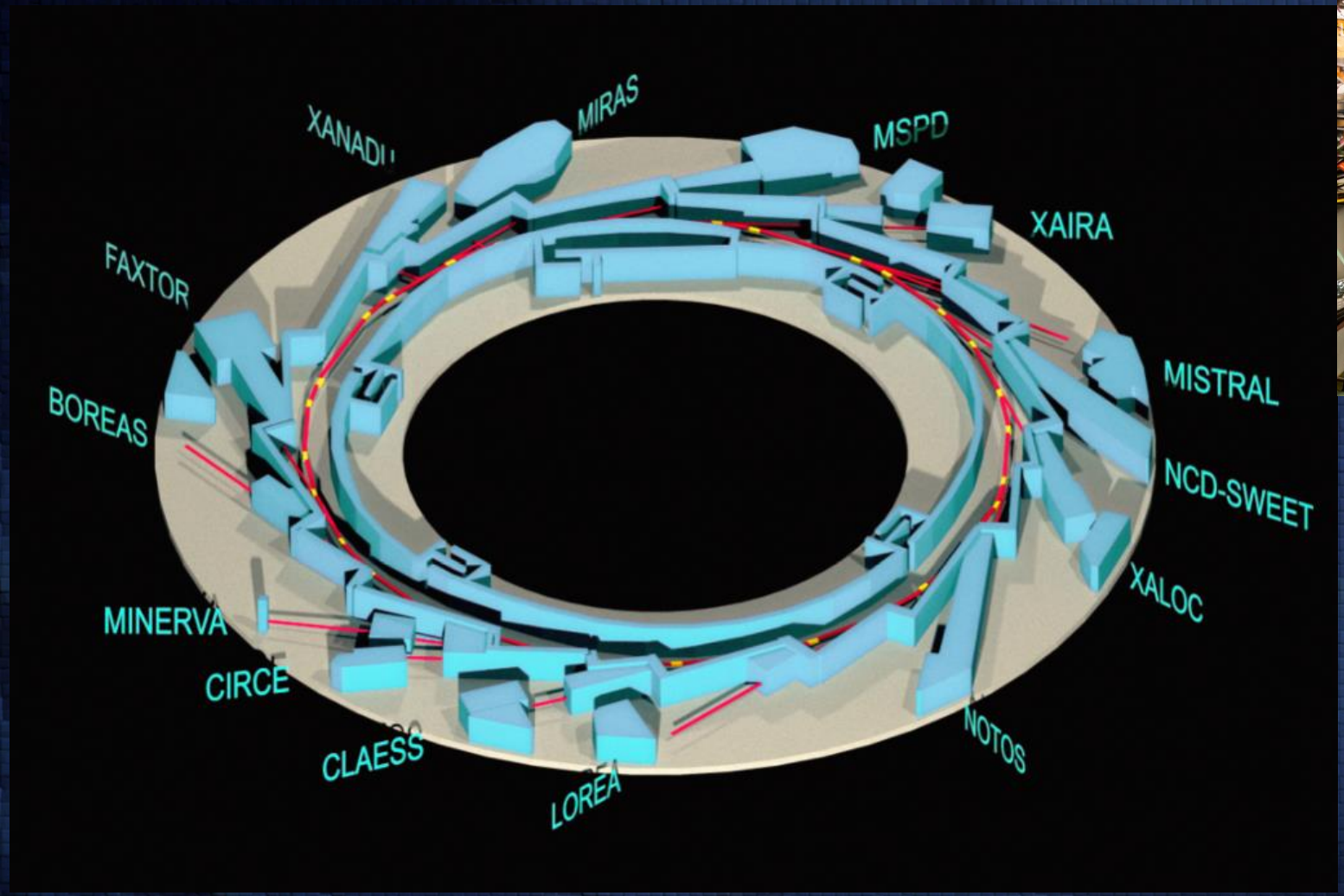
ALBA

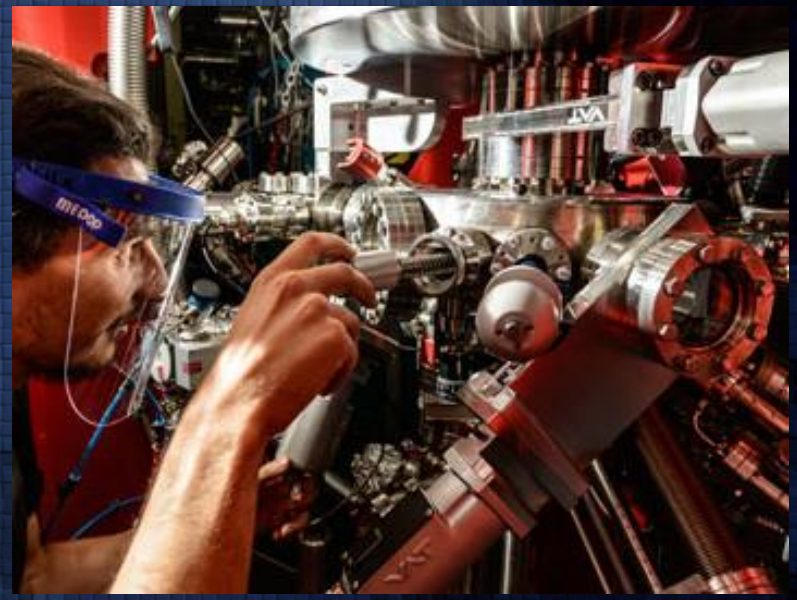
MATGAS

Materials Science Institute

National Center Microelectronics

Today: 8 BI in operation, + 2 BL in 2021 + 3 BL in construction

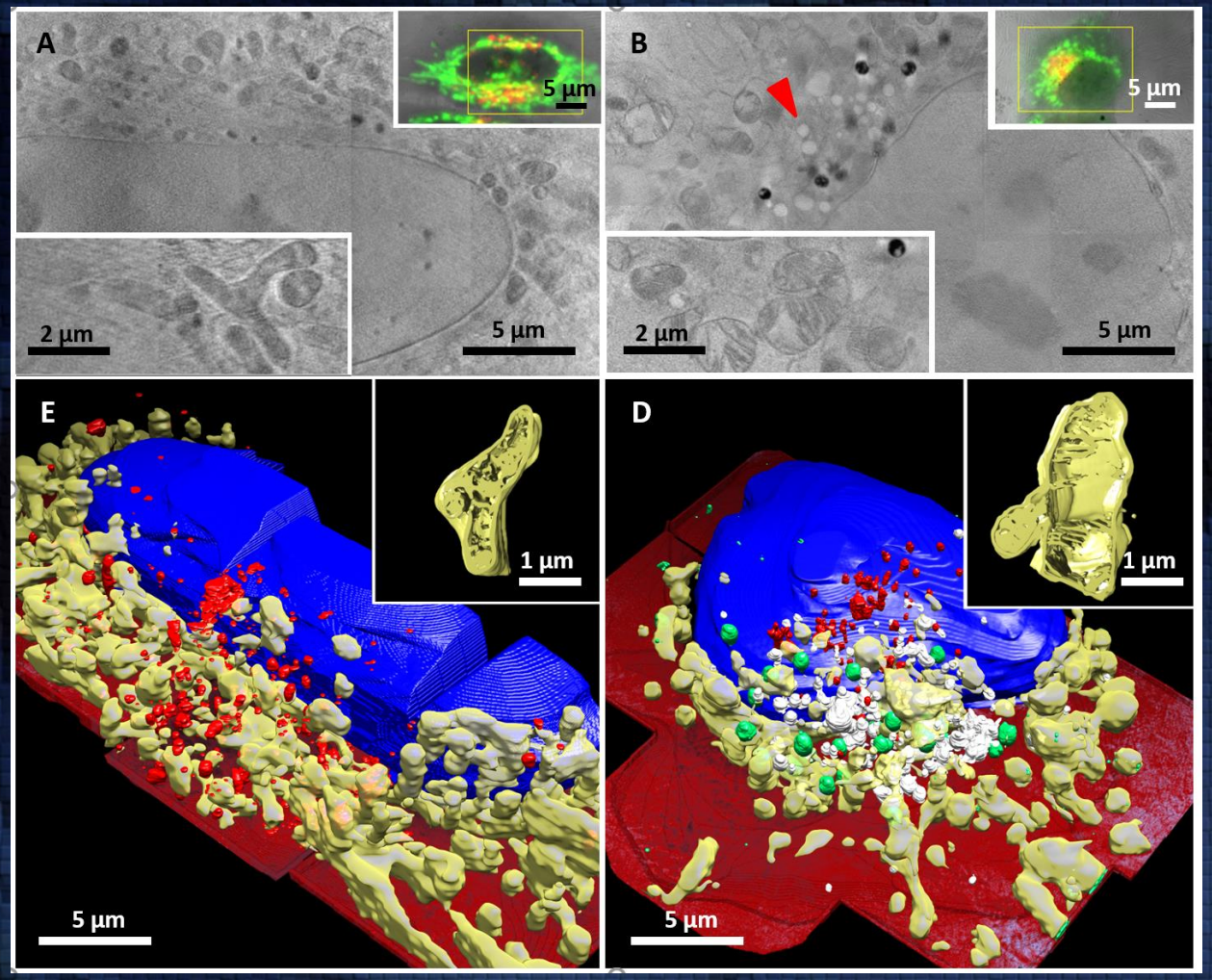




ALBA
10 YEARS | ILLUMINATING THE UNKNOWN

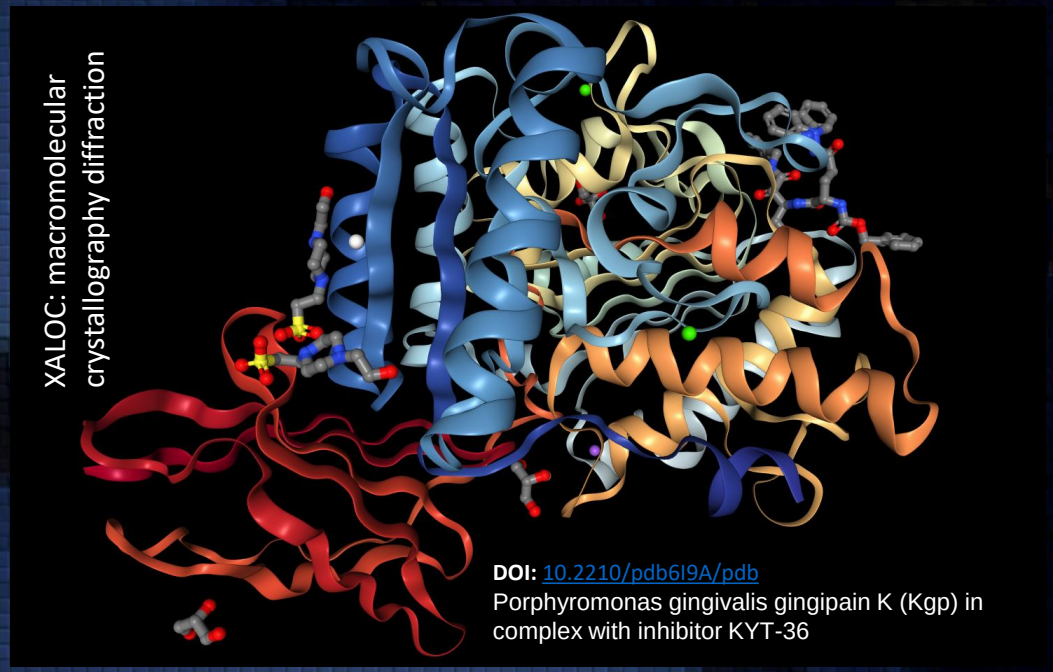
HEALTH

We look at cell's inner details



A combination of X ray tomography (MISTRAL BL ALBA) and fluorescence imaging (ESRF)

We resolve protein structures down to atomic resolution



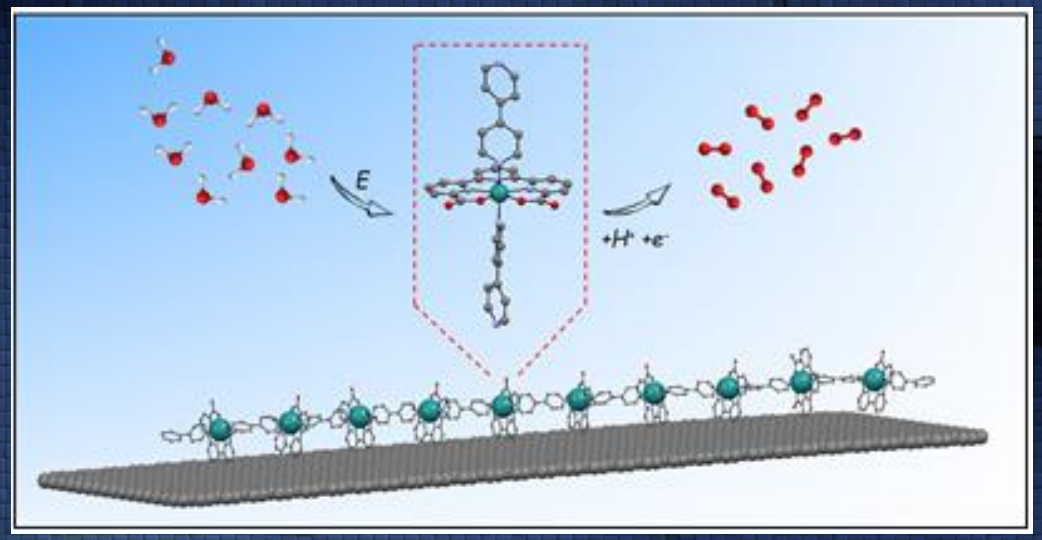
to understand diseases,
to design new treatments, drugs
and vaccines

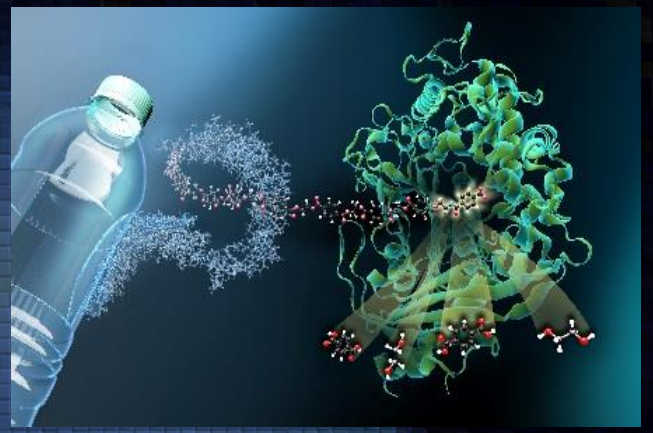
We care for environment

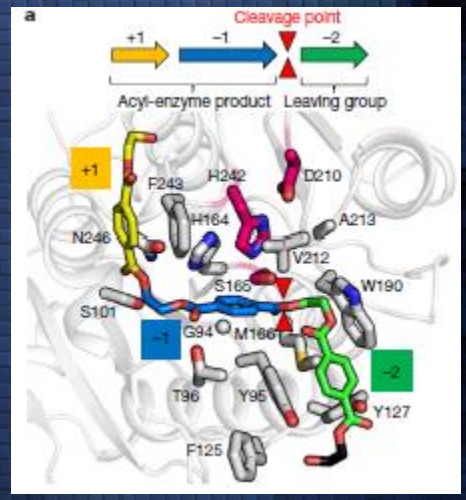
developing new catalysts for green fuels … or PET digesting bacteria

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.







Experiment at 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

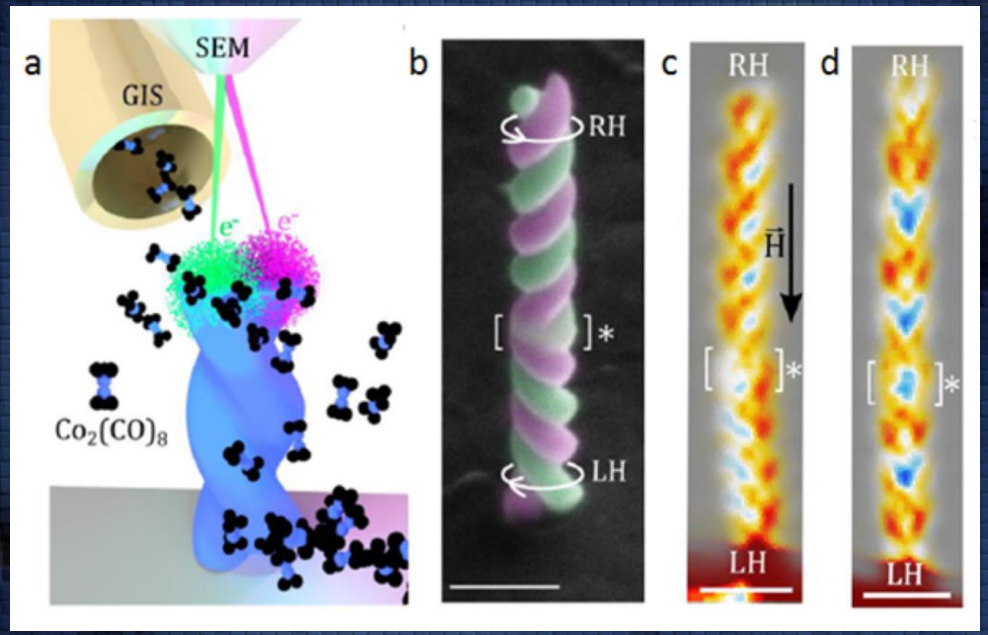
Water oxidation electrocatalysis using ruthenium coordination oligomers adsorbed on multiwalled carbon nanotubes Hoque, A et al A. *Nat. Chem*. **2020** (DOI: 10.1038/s41557-020-0548-7).

Tournier, V et al. *Nature* (2020), doi.org/10.1038/s41586-020-2149-4

We advance in complex materials and technologies developments

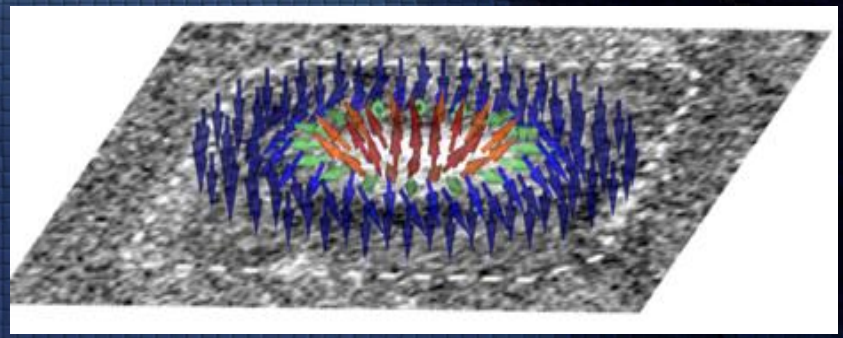
Tools for the ERA of Complexity

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



S. Ruiz-Gomez et al. **Helical Surface magnetization in nanowires: the role of chirality**. *Nanoscale*, 2020. DOI: 10.1039/D0NR05424K.

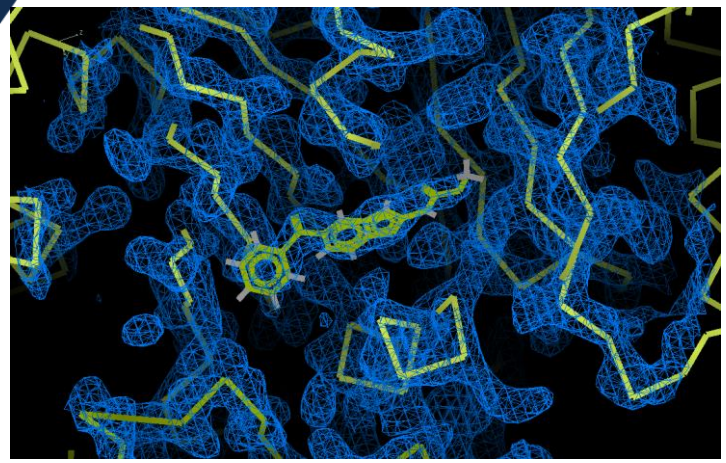
Skyrmion schematic



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

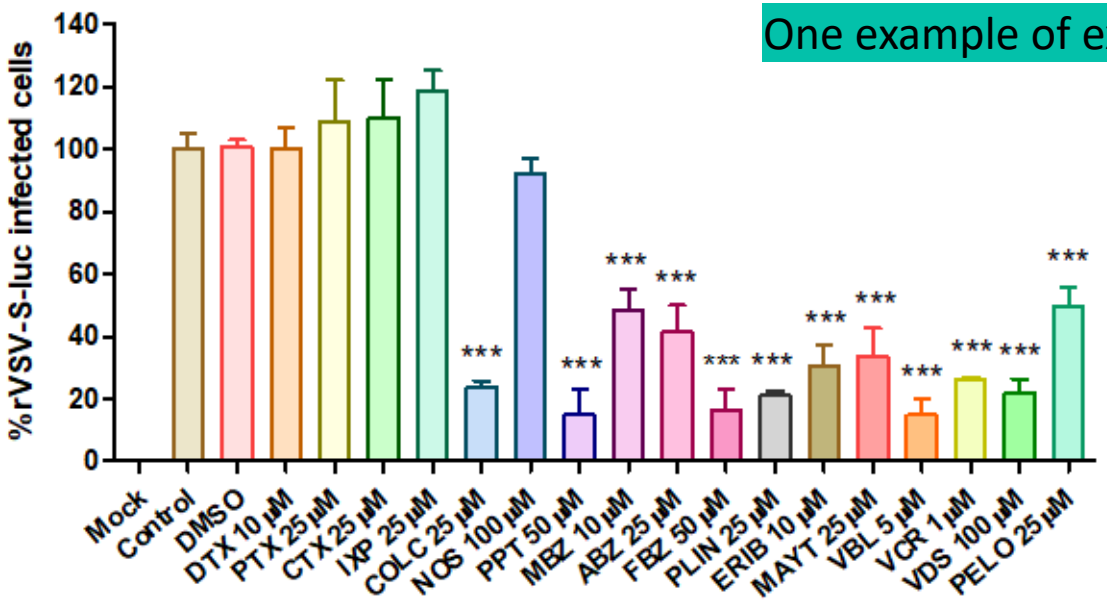
Inhibition of COVID-19 viral replication using microtubule modulators.

CIB Margarita Salas, INIA, ALBA.

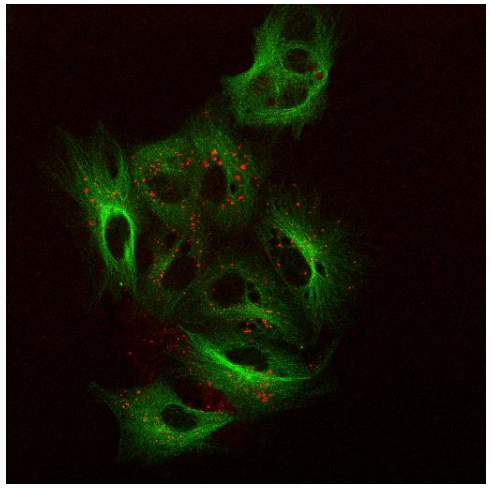


Mebendazole (a in clinical use antiparasite) blocks the activation conformational switch of tubulin precluding the use of microtubules for viral infection (Data adquired at XALOC)

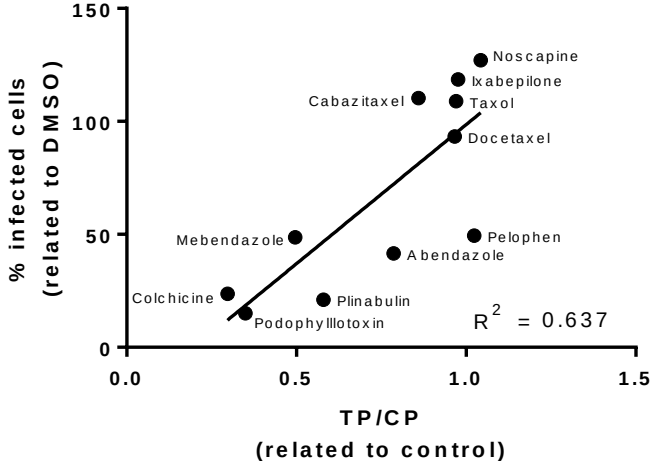
One example of experiment



This blockage of the activation is reflected in an effective inhibition of viral replication by compounds using this mechanism of action (Data obtained at INIA)



The inhibition of the viral replication is caused by the blockage of the movement of viral particles over the infected cell microtubules. Microtubules labelled in green, viral particles over dynein in red (Data obtained at CIB).

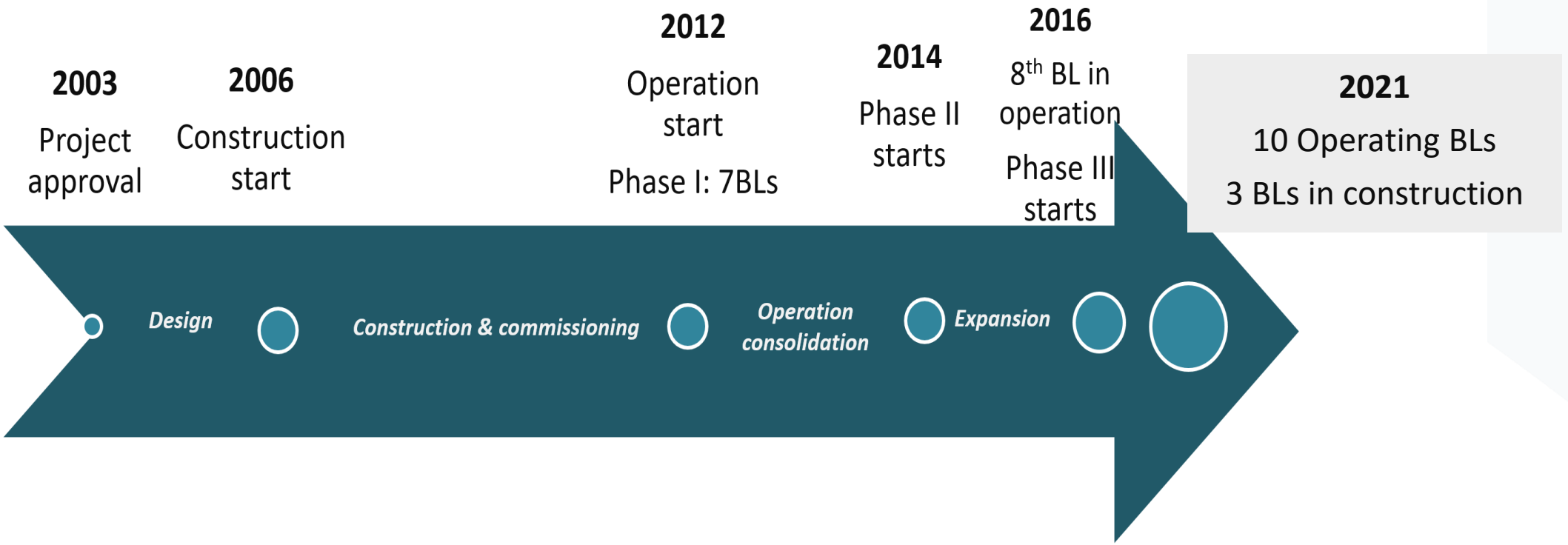


Viral replication inhibition correlates with the inhibition of movement over microtubules (Data obtained at CIB)

ALBA History: Past and Present

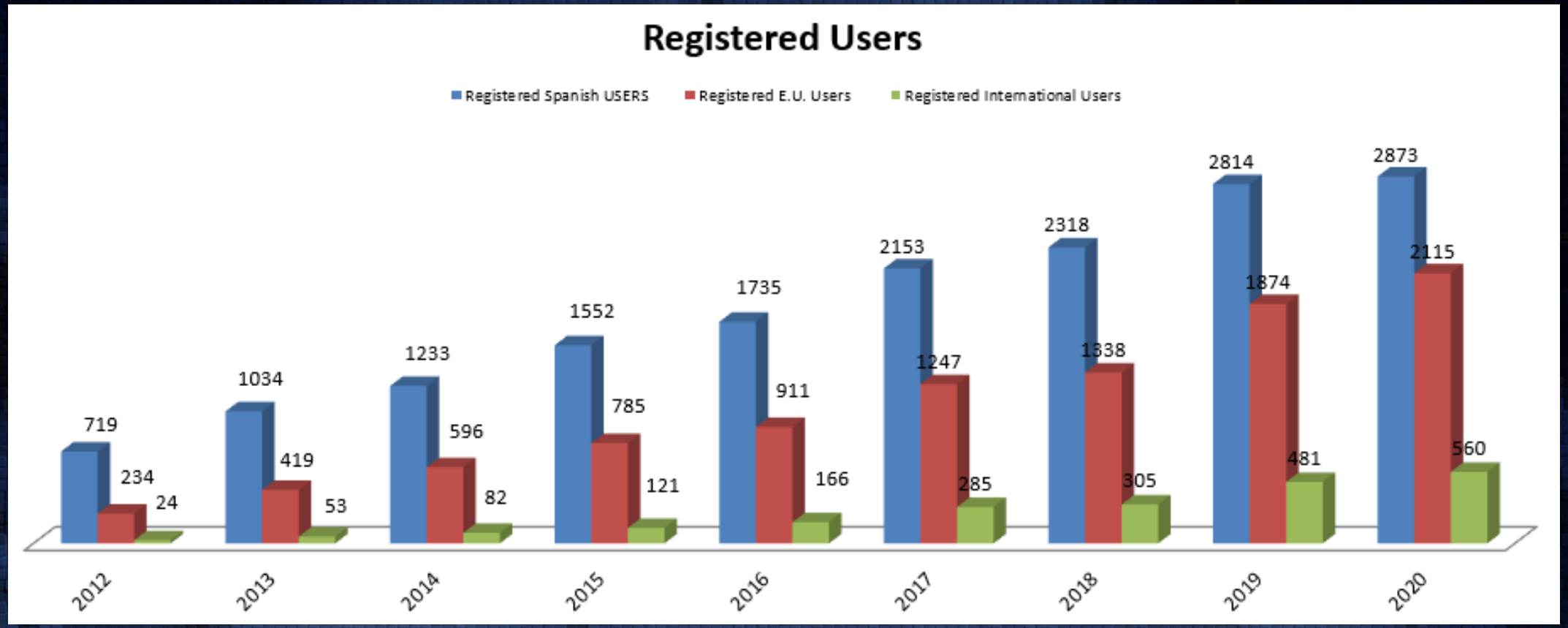
First proposal for building a synchrotron in Spain: in the '90s

10 Years for the approval - 10 Years for the operation



Evolution of user community

In 2003, when ALBA was approved, 200 users in Spain

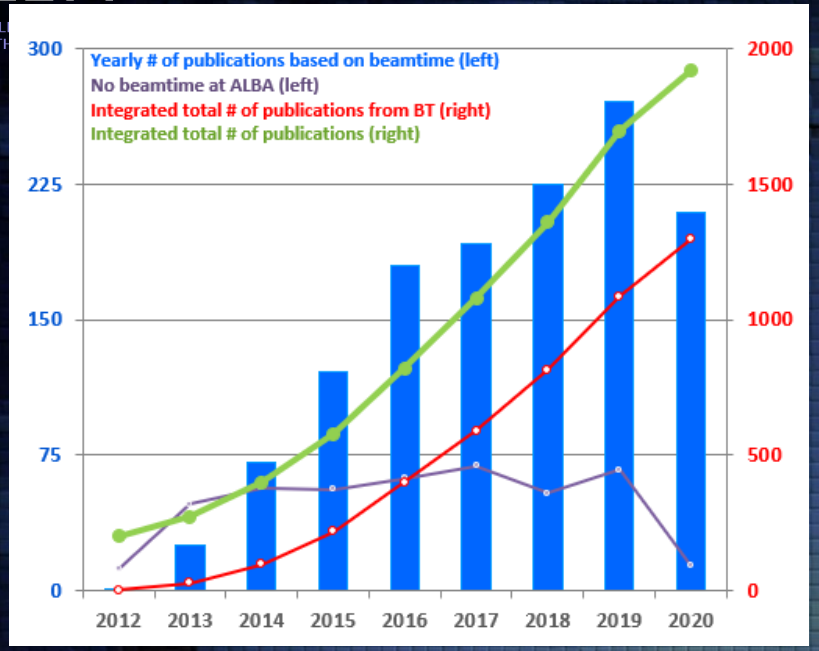


2012 over 2003
X 3.5 National

2020 over 2003
X 14 National

2020 over 2012
X 4 National
X 10 International

Today

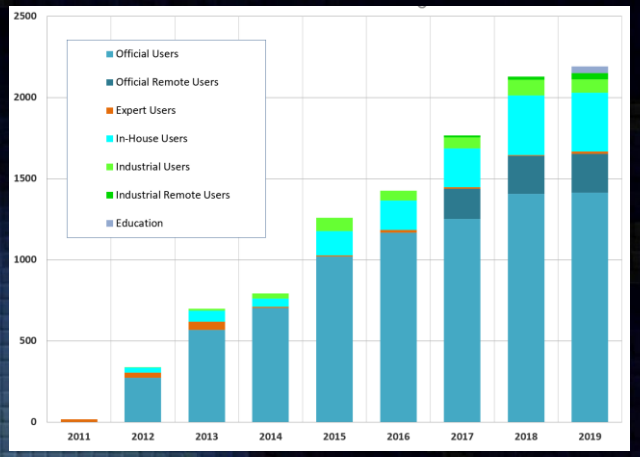


+1900 publications

+300 yearly experiments

ALBA science

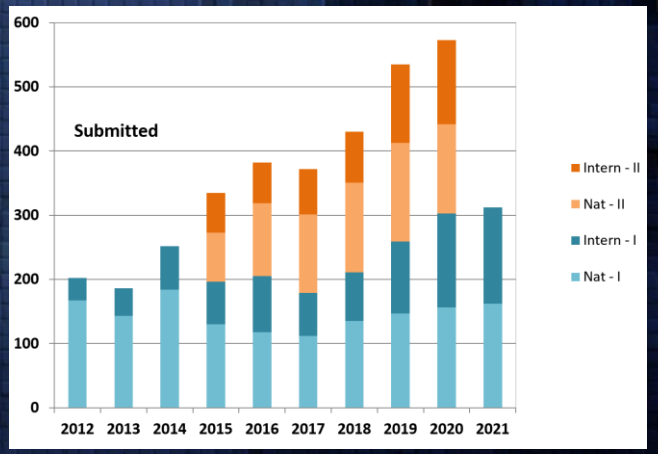
+ 2200 user visits/y



2/3 from Spain

User database:
2873 national
2675 international users

Continuous increase of proposals #

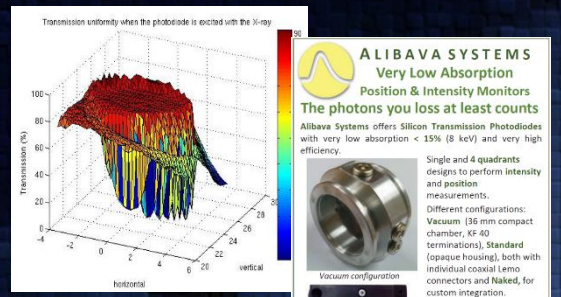


8 operating beamlines
+ 2 beamlines in operation @2021
+ 3 beamlines in construction

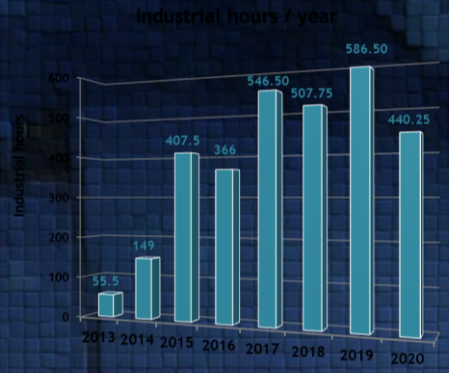
3 GeV e- synchrotron
270 m circumference
250 mA operating current
> 98% availability

ALBA Today
10 YEARS | ILLUMINATING THE UNKNOWN

Technological transfer



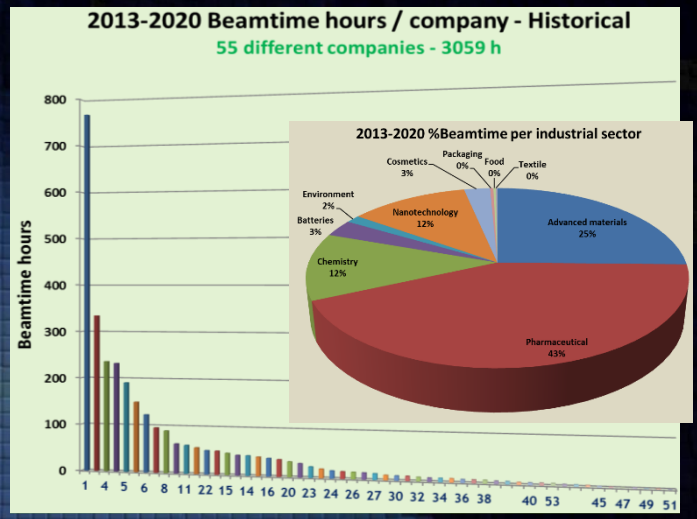
Photodiode detector: Col
industries to commerciali
developments: license contract with ALIBAVA
an spin-off company of the CSIC.



Dedicated staff

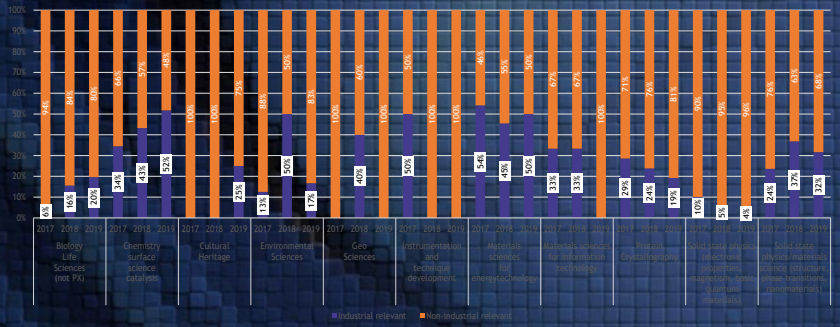
ALBA innovation

Industrial beamtime in all BLs



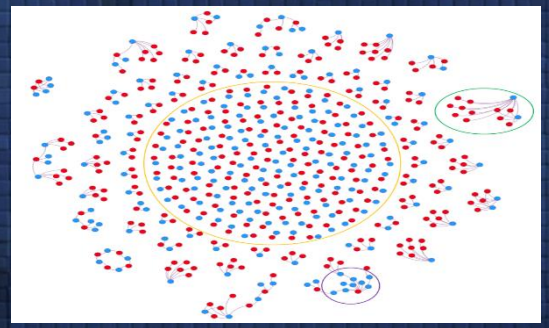
+ EU projects granting free access for SME

Industrial relevance of academic experiments

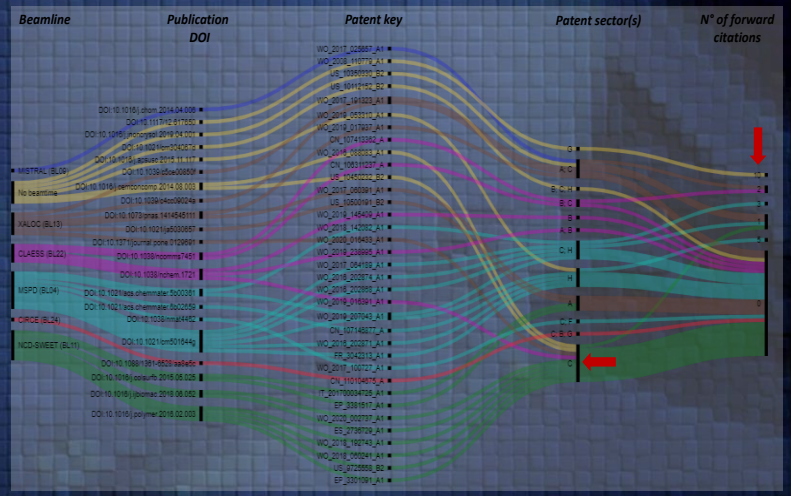


Industrial participation in BL funding (Henkel @ FaxTor)

Patents citing publications



243 ALBA P1 publications (blue dots)
out of a total of 9974 are directly cited
by 337 patents (red dots)



15 patents + 337 citing ALBA

Training center

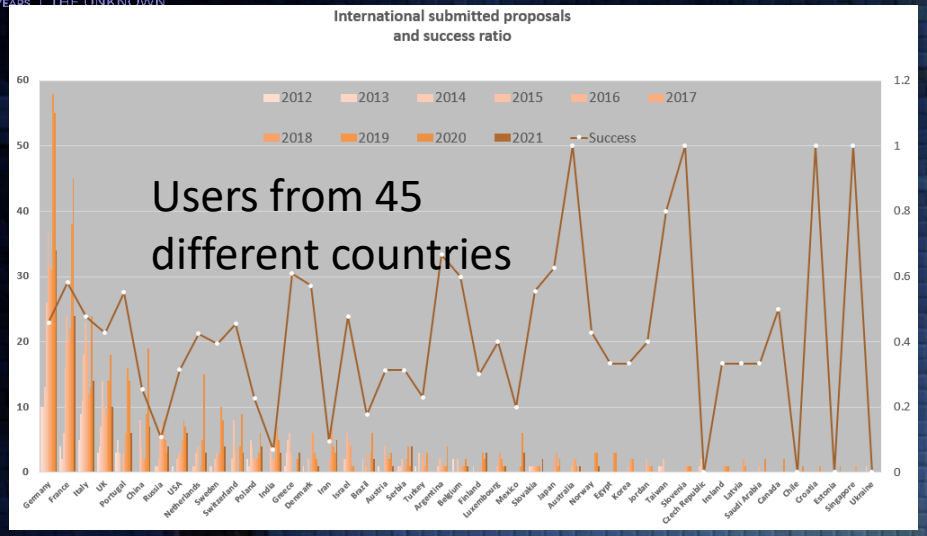
In normal and also in exceptional circumstances

- Training new generations of scientists, engineers, technicians, administrative officers, communication experts at different stages of
- PhD programs + PhD participation to user programs

Outreaching to society

Today

ALBA 10 YEARS | ILLUMINATING THE UNKNOWN



ALBA collaborations

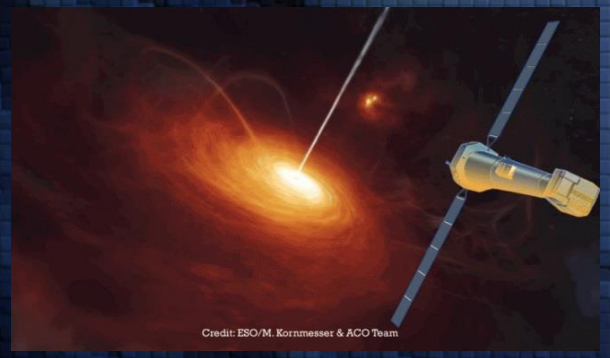
LEAPS League of European Accelerator-based Photon Sources

Chairing LEAPS on 2020 and 2021

19 facilities - 16 institutions - 10 countries

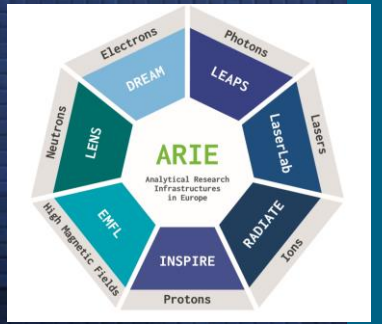
ARIE spokesperson for start-up the collaboration

Minerva: BL in collaboration with ESA



European Commission

Agreement with Portugal



+170 students trained

+7500 outreach visits per year

220 staff

Outreach projects for children

ALBA & society

High-qualified job offers

Positive Economic return of investments

Involvement in educational programs from schools to universities

Organization of scientific and industrial workshops for pharma, chemistry,…

Academic and Industrial PhDs

Contributing to health, clean energy, advanced technologies, climate change, environment, food, agriculture, transport & mobility, security, cultural heritage,…

ALBA Future

2021

10 Operating BLs

3 BLs in construction

Next decade fully exploiting the initial infrastructure by increasing number of BLs and add additional platforms (as Advanced Microscope Center)

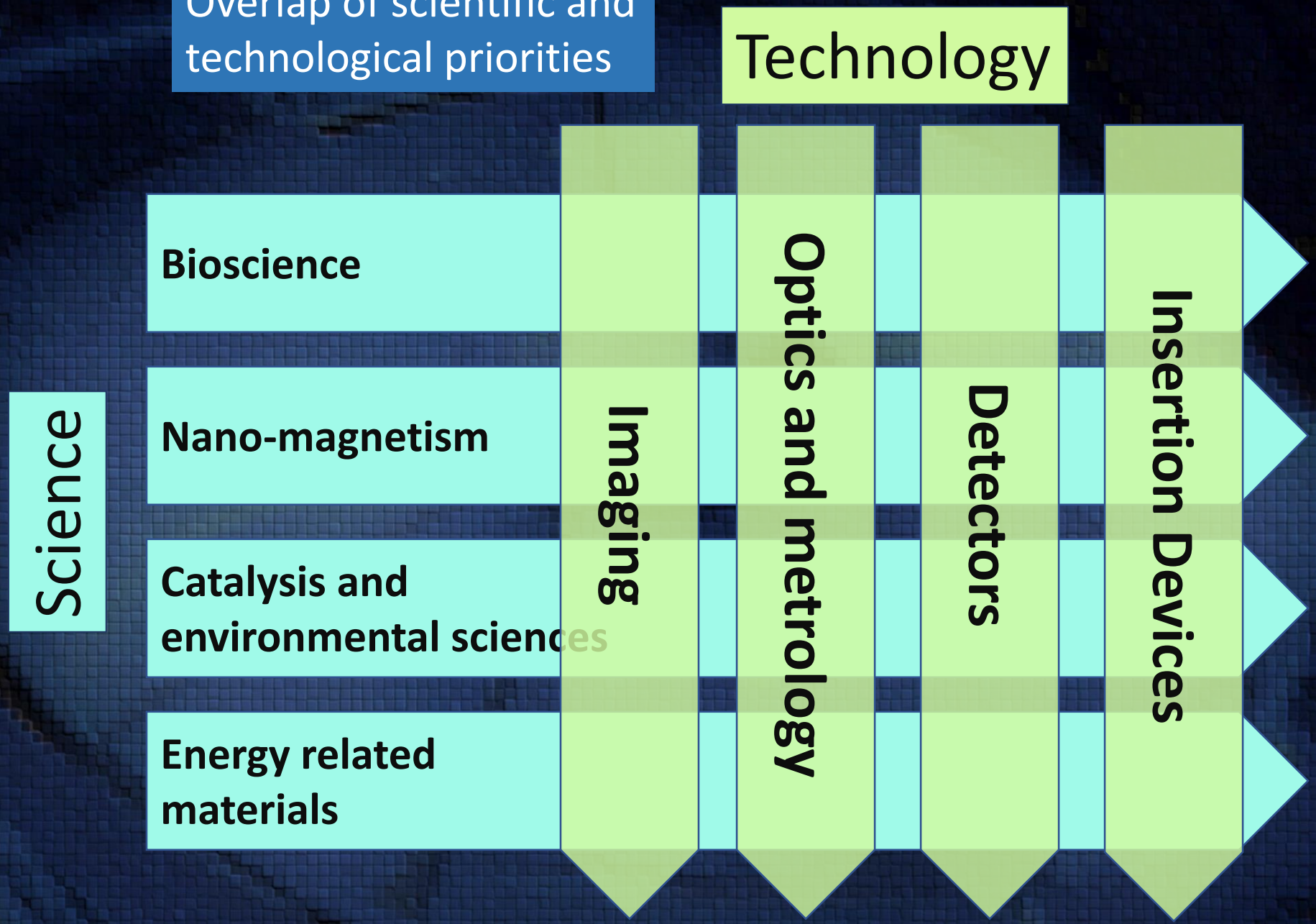
2030

ALBA II

2017-2020 Strategy Plan
In progress

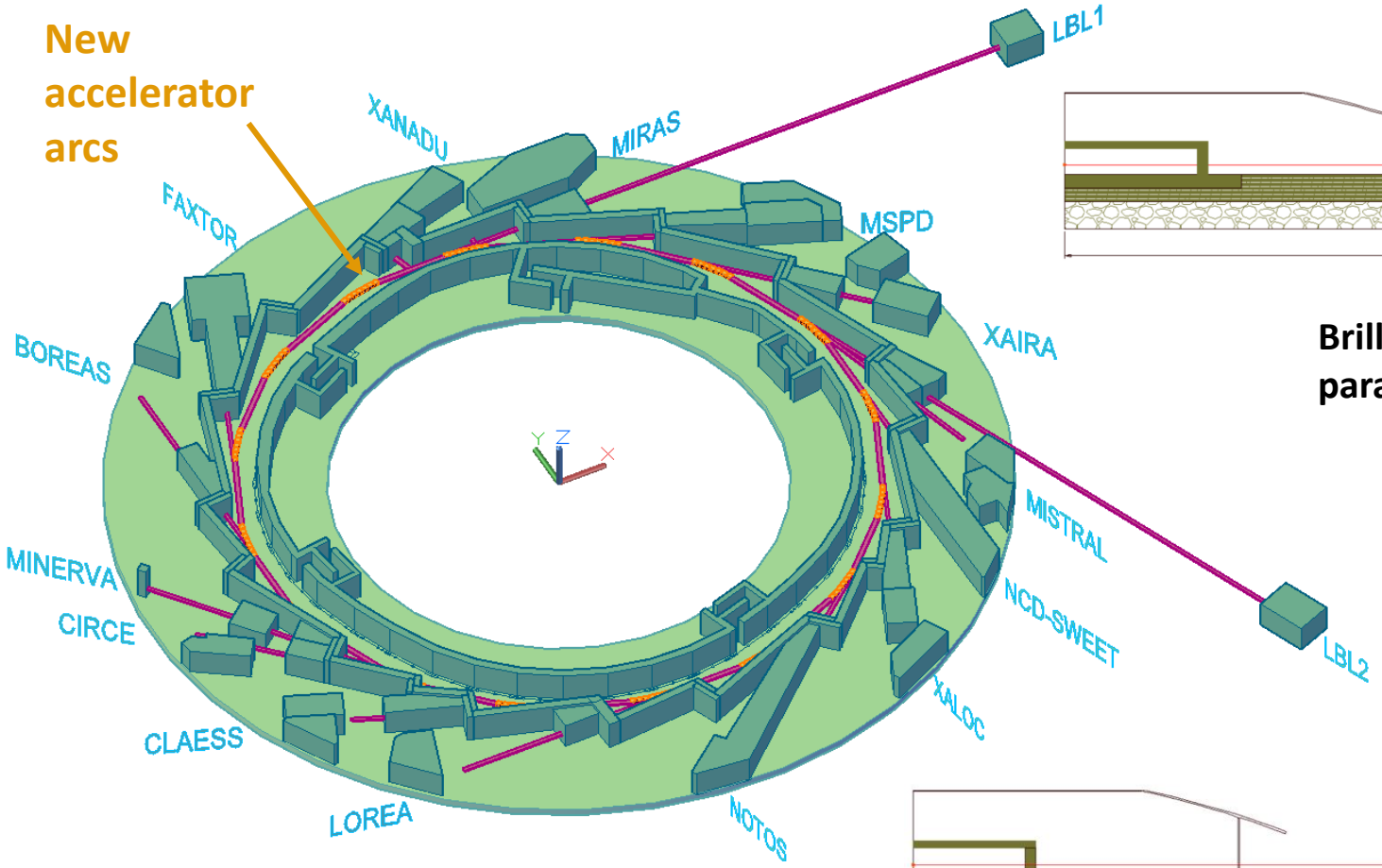
Upgrade to more brilliant source

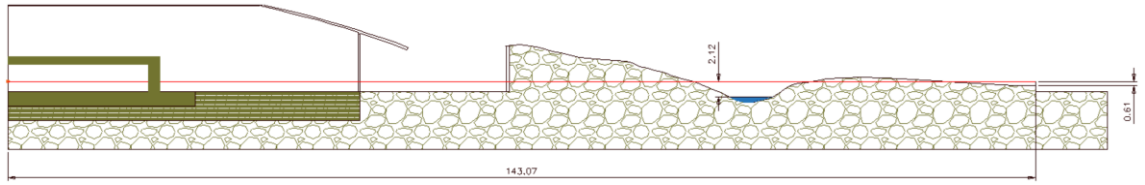
Overlap of scientific and technological priorities



ALBA II: Building on existing infrastructures

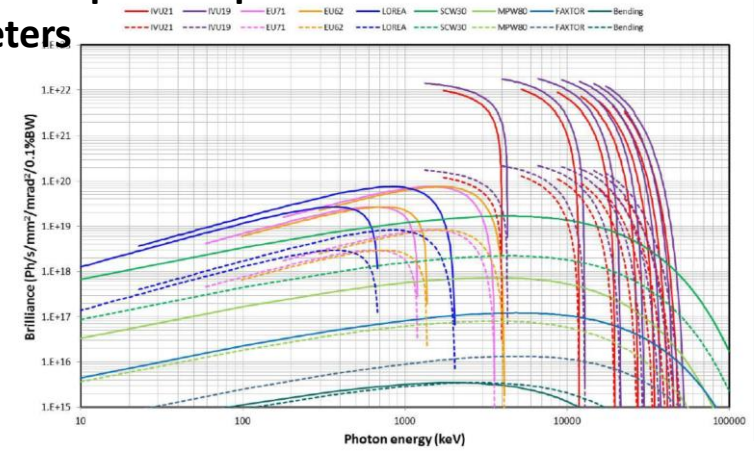
and using adjacent land plots for long beamlines

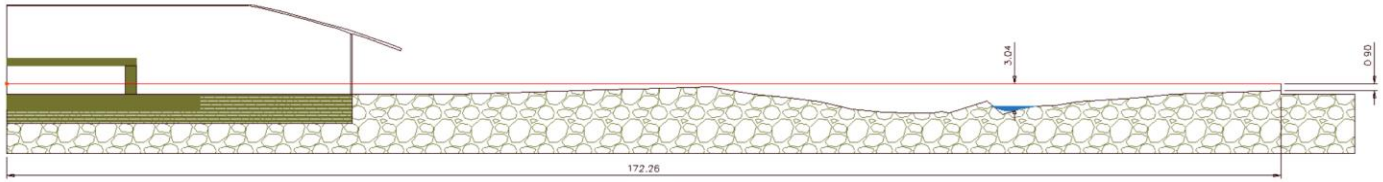




143 m

Brilliance of present photon sources with ALBA II parameters





172 m

ASTIP (Alba Science Technology and Innovation Park)

Preliminary proposal being prepared

Still at very initial stage; already an opportunity for involving the user community in ALBA II design

Proposal of creating a new center near ALBA in collaboration with other scientific, academic and technological institutions (Eurecat, IBMB, ICN2, ICMAB, IFAE, Parc de l'Alba, UAB).

Plan supported by Ayuntamiento de Cerdanyola del Valles in view of development of territory

Based on three pillars, optimized for ALBA II exploitation:

- AMBIC = Advanced Multiscale BioImaging Center
- COMTEC = COmplex Materials and TEchnology Center
- SYNDUSTRY = Synchrotron light based R&D towards new industrial applications (Eurecat)

ALBA II Long beamlines in partnership with AMBIC and COMTEC

We are European photon sources

LEAPS League of European Accelerator-based Photon Sources

+35000 users from all EU & beyond

+300 operating End Stations

+25000 publications In last 5 years

offering +800000 h/year

19 facilities - 16 institutions - 10 countries

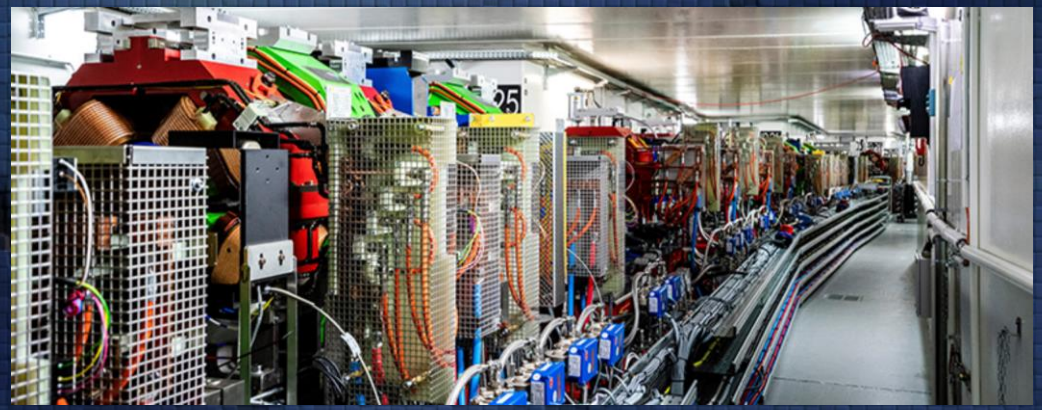
Associate: SESAME (Jordan)
Partners: LENS, CLS

Leading world leap from 3rd to 4th generation synchrotrons

World leadership in technologies

MaX IV, the first 4th gen Synchrotron

ESRF-EBS, the first upgraded from 3rd to 4th

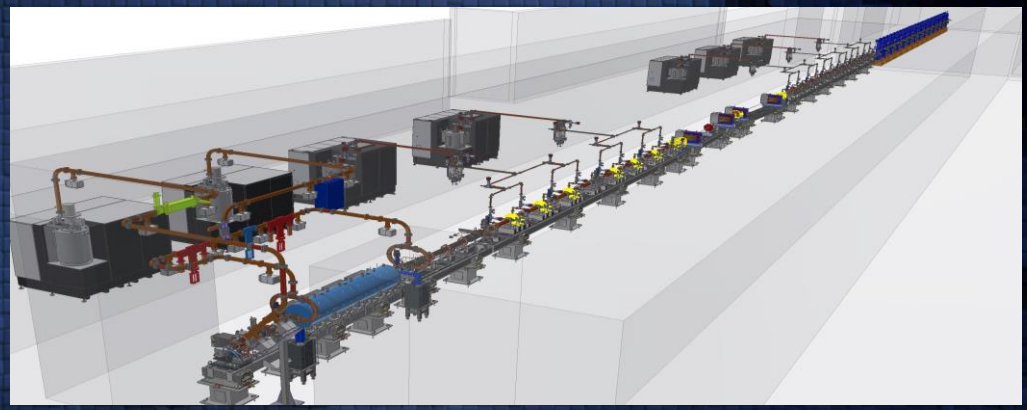


Its example followed all over the world. @ LEAPS: Alba, Diamond, Elettra, Petra III, Soleil, SLS

…and FEL technologies

EuXFEL the highest energy FEL

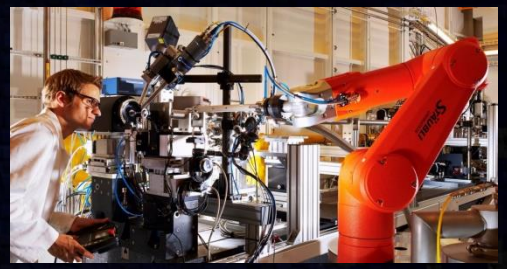
EuPRAXIA - in construction, LNF



the 1st plasma acceleration based FEL facility, based on H2020 EU design study

Digital LEAPS

Learning from present challenges
Looking towards the future



- **AI-assisted resilient and energy-saving operation of LEAPS Ris**
- Autonomous operation of complex accelerators - Remote operation
- **Digital user operation modes**

Remote user experiments - Real-time analysis of data and real-time (exascale) simulations

- **Advanced digital communication**

Lessons Learnt: new digital forms of communication between labs and between labs and users

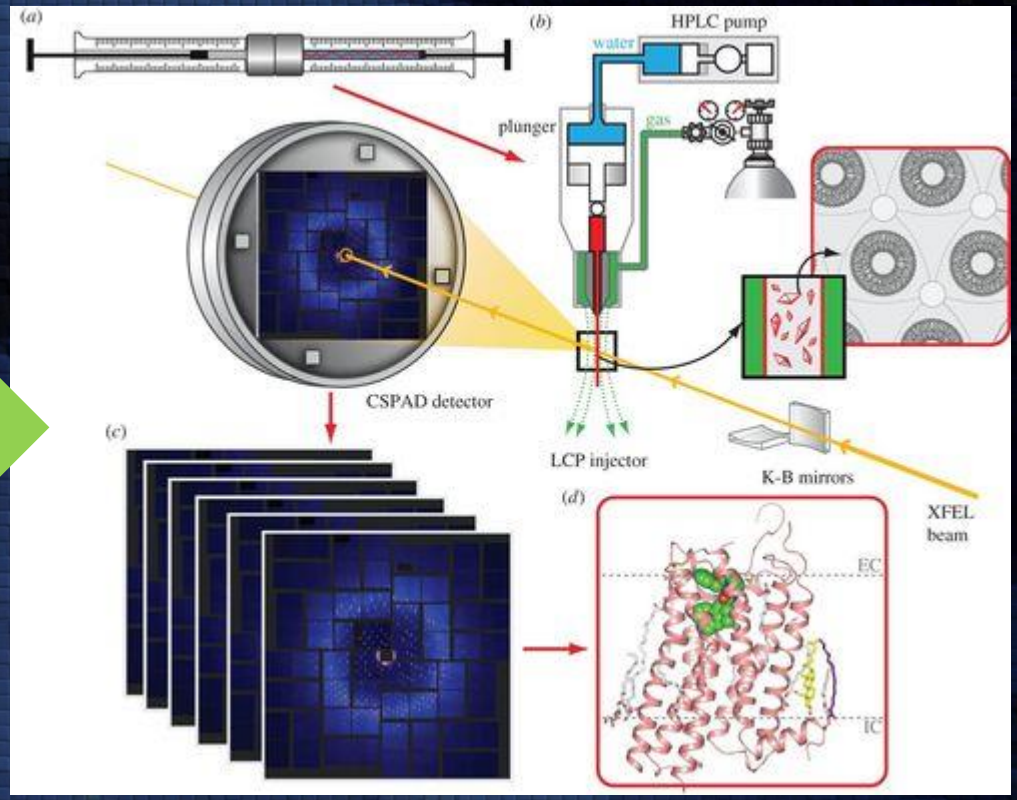
- **Digital training concepts**

New forms of training exploiting Virtual Reality

- **AI-assisted molecular infection fight**

LEAPS facilities prepare for future infection fight *(virus, bacteria, parasites)*

- **Advanced materials for the digital transformation and circular economy**



LEAPS members working together for

- Common technological developments
- Better user services
- Common answer to societal challenges (see Horizon Europe Missions)
- Collaboration with other analytical facilities (see ARIE initiative)
- Motor of innovation for enabling technologies and industry as user
- Training centers for young generations

Open to collaboration with AfLS

… the best of ALBA: its people

Thanks for your attention