

INSTITUT DE CIÈNCIA DE MATERIALS DE  
BARCELONA

# Materials science and nanotechnology in Catalonia

## Funding opportunities for collaboration

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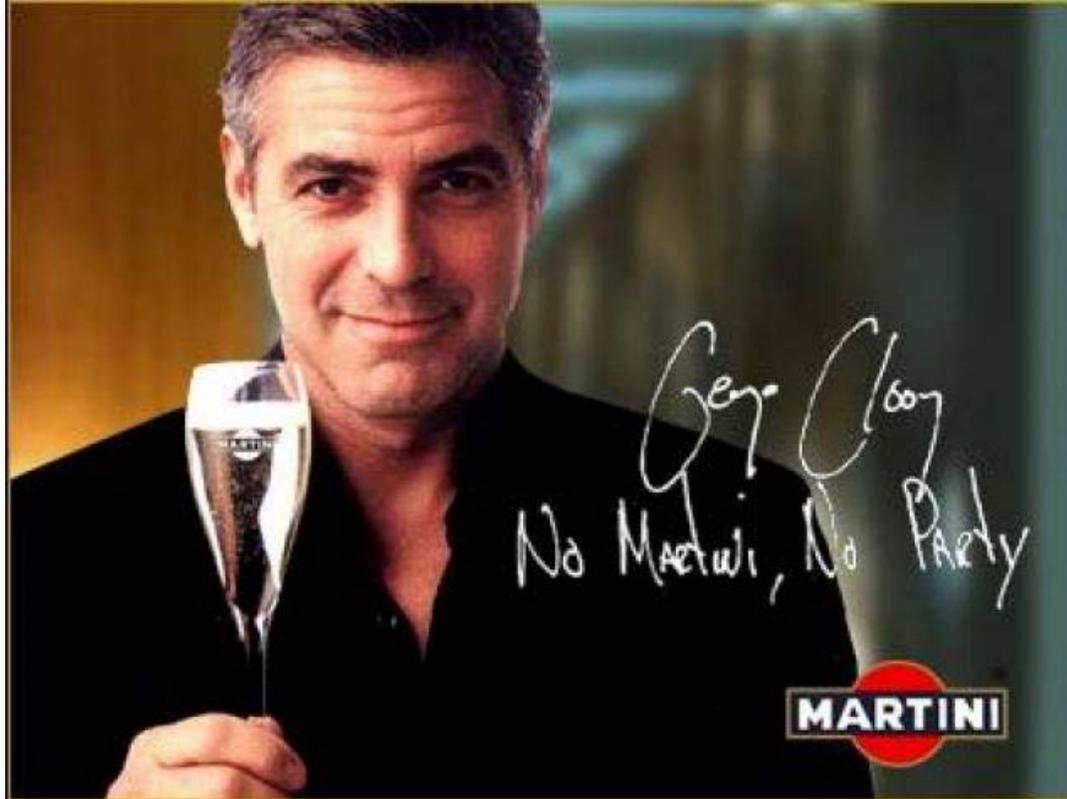
Director: Xavier Obradors



Clustering and Global Challenges  
Grenoble – Barcelona - Tsukuba twin conference  
7<sup>th</sup> – 9<sup>th</sup> April 2021



# Materials are an enabling technology!



**Many scientific and social grand challenges rely on achieving advanced materials and integrating them in competitive devices**

# Functional Materials: from the hardware to the devices

EU: 80 % of new products in the market rely on new materials

## Clusters - HE

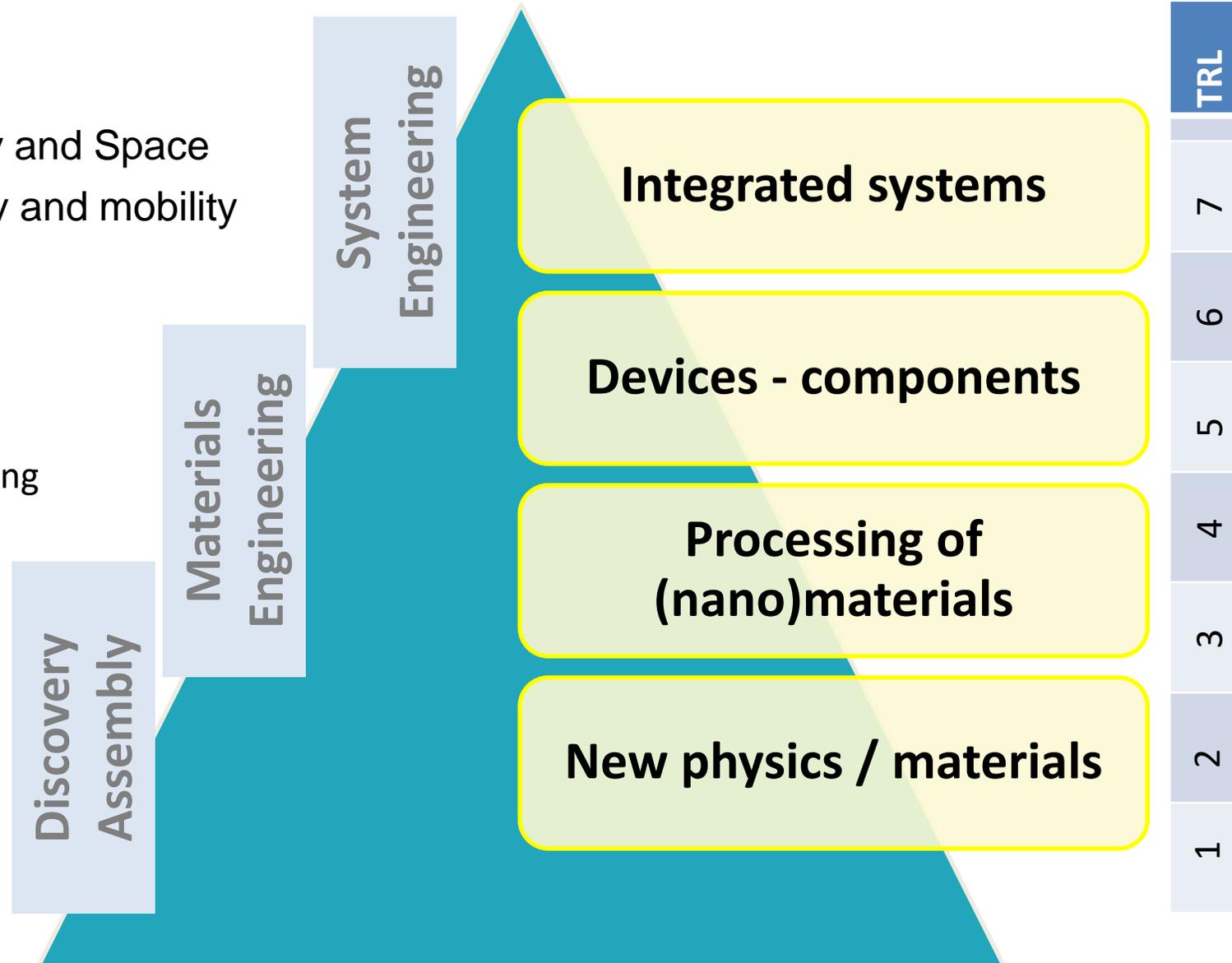
Cl. #1: Health

Cl. #4: Digital, Industry and Space

Cl. #5: Climate, Energy and mobility

## KET (Key Emerging Technologies) – H2020

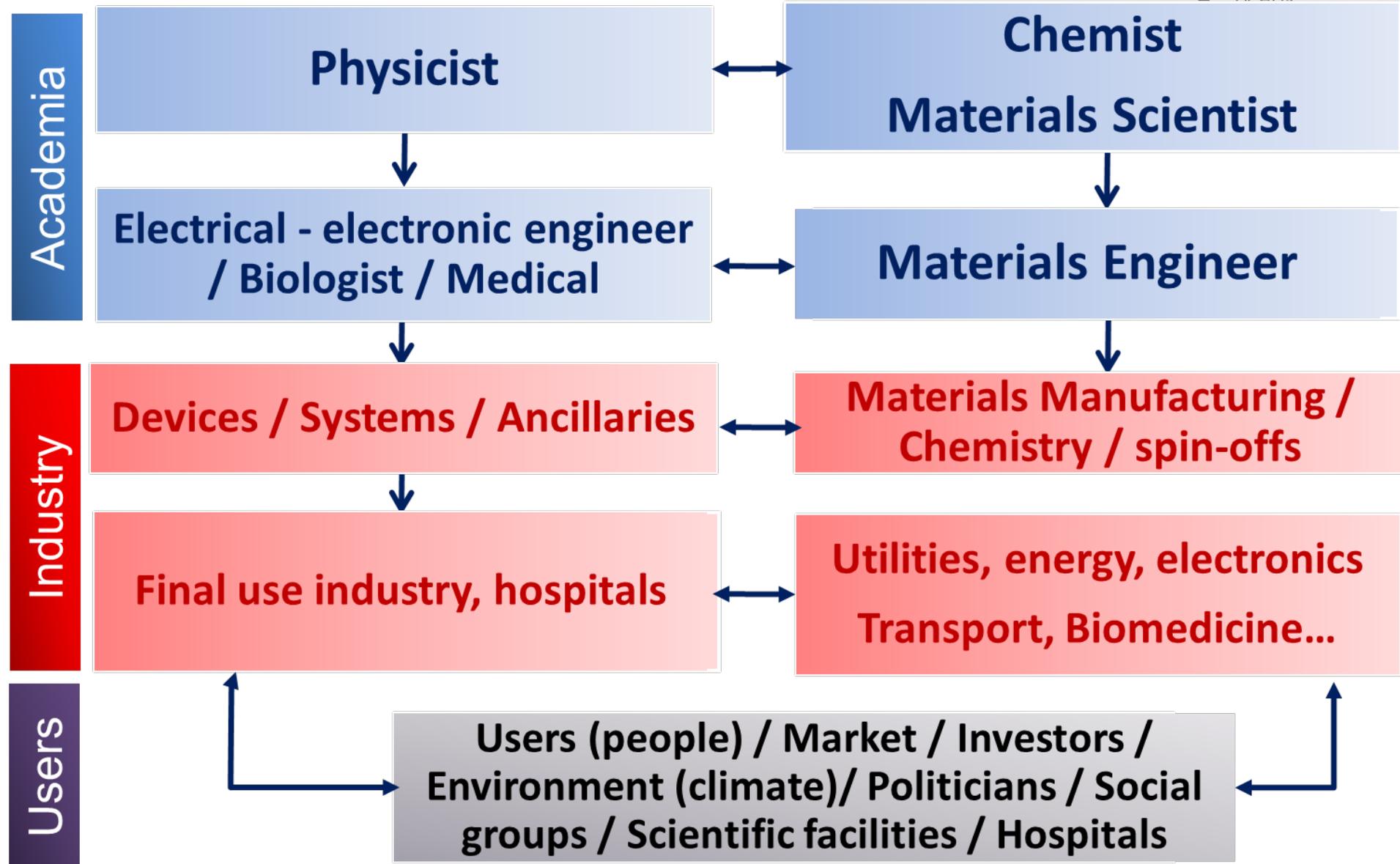
- Advanced Materials
- Nanotechnology
- Advanced manufacturing



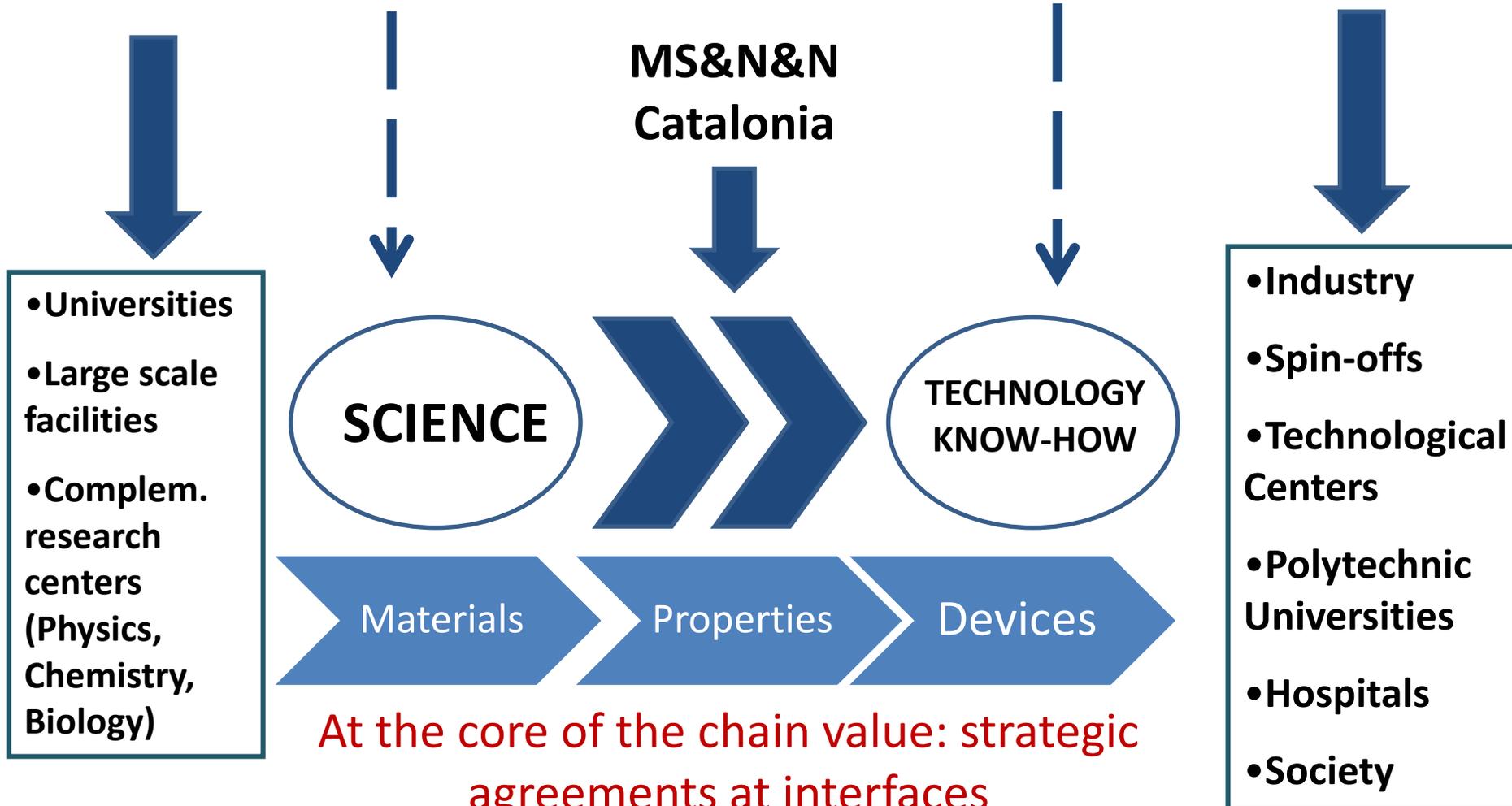
Horizon Europe  
THE NEXT EU RESEARCH & INNOVATION  
PROGRAMME (2021 – 2027)



# The long and winding road of functional materials: from academia to industry and final users



# The long chain of added value

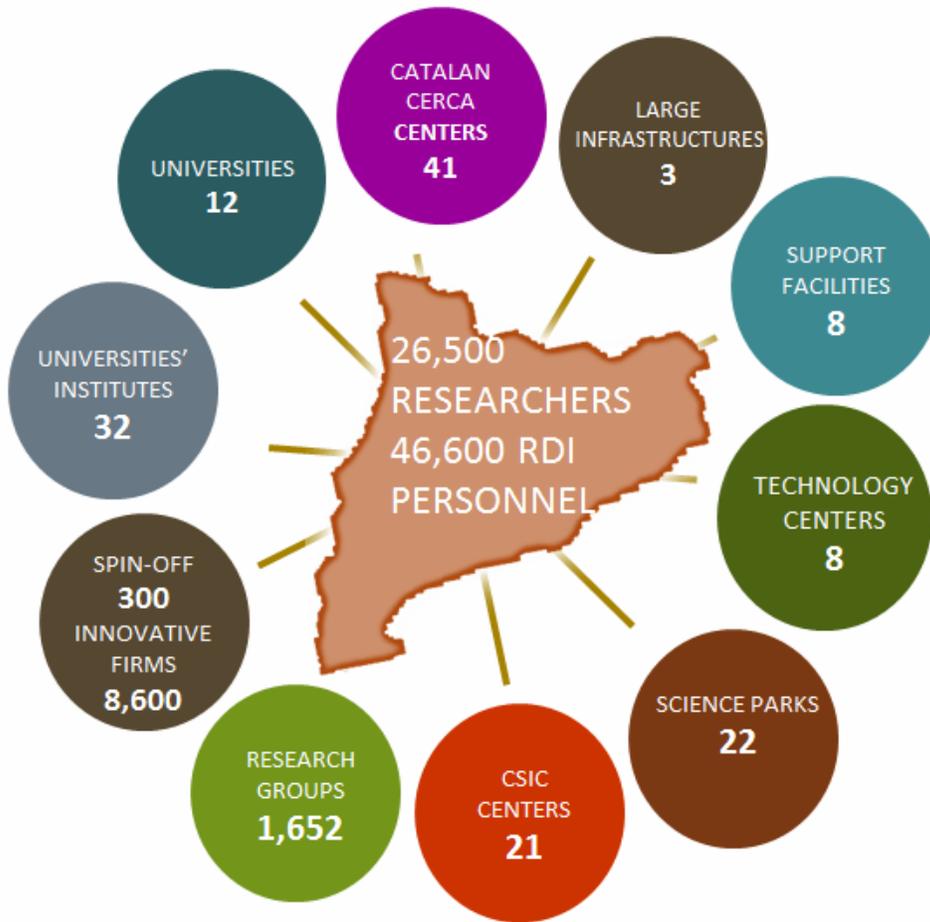


At the core of the chain value: strategic agreements at interfaces  
Impact on social grand challenges

# Catalonia's RTD system and policies



Generalitat de Catalunya  
 Departament d'Empresa i Coneixement  
**Secretaria d'Universitats i Recerca**



Catalonia is a cutting-edge cluster and strategic hub of Southern Europe, thanks to a highly competitive economy and a privileged geographic location that opens it up to the world.

Its business activity benefits from an excellent university and research system.



UNIVERSITAT DE BARCELONA

**UAB**  
 Universitat Autònoma de Barcelona

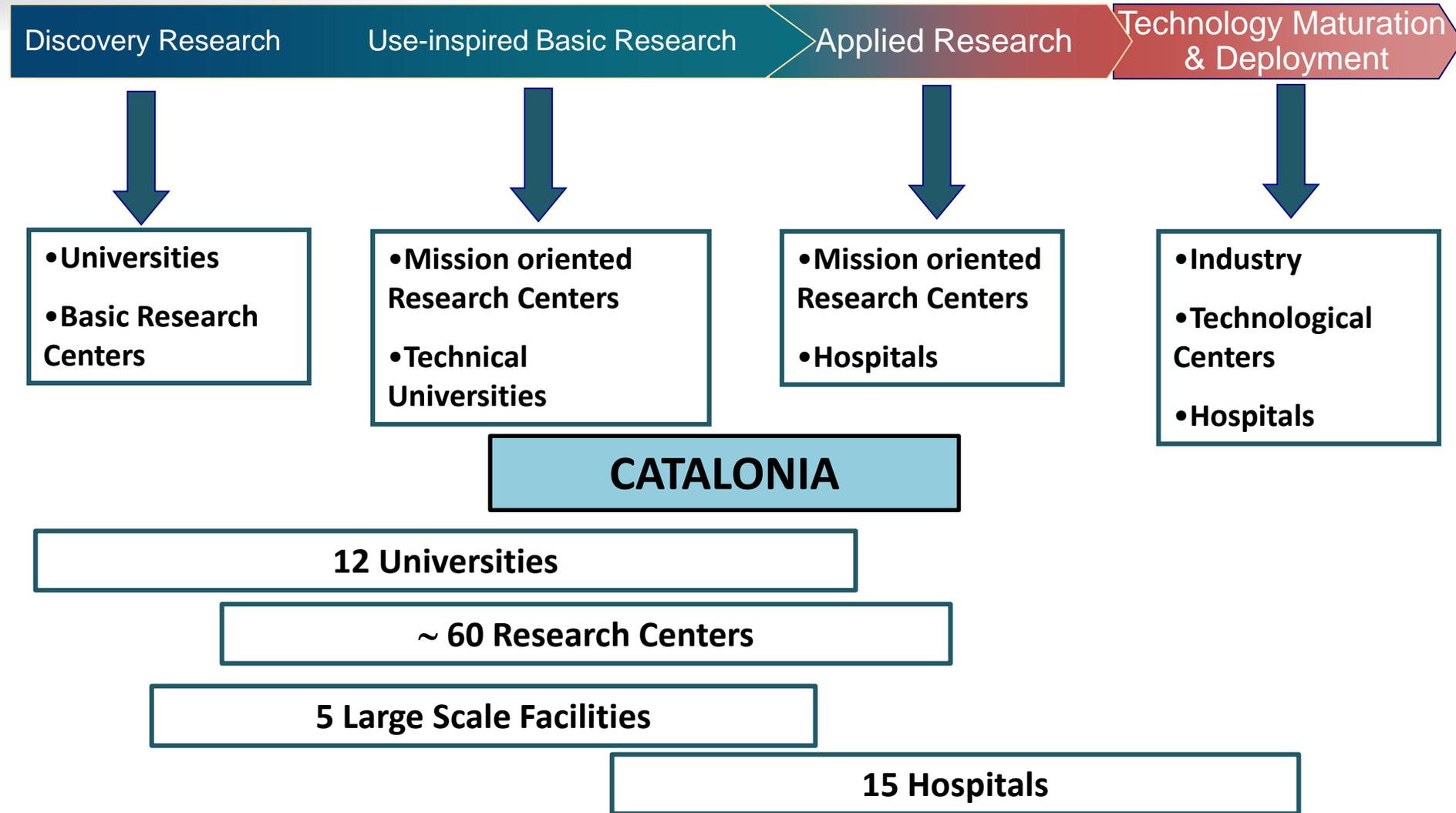


UNIVERSITAT POLITÈCNICA DE CATALUNYA  
 BARCELONATECH

- 3,7 % EU pub (1,2 % popul.)
- 2,2 % 7 PM / 3,3 % ERC
- 55 % ERC Spain
- 3.100 PhD/yr
- 3 pat/ Mhab (÷ 10-50 top)
- R&D&i private still low

~ 31.000 publications / year  
 226,000 students / 9,500 faculty

# R&D&i VALUE CHAIN: WHO IS WHO?



The whole chain value is attended: interdisciplinary and multi-institucional cooperation is a must!

# Catalonia: research centers distribution

| Institutions          | Number            | Number researchers | % Catalonia |
|-----------------------|-------------------|--------------------|-------------|
| Universities          | 12                | 16.000             | 62          |
| CERCA*                | 41                | 5.000              | 20          |
| CSIC*                 | 21                | 1.500              | 6           |
| Hospitals             | 15                | 5.000              | 20          |
| Large Infrastructures | 5                 | ~300 -400          | ~1-2        |
| ICREA                 |                   | 235                | ~1          |
| Research groups       | 1297 (530 Sc&Eng) | ~18 inv / GR       |             |
| Total researchers     |                   | ~25.000            | ~ 100       |

\* 5 centers are shared by CERCA and CSIC

Participation CGC2021 meeting: ICN2, IREC, ICFO, IFAE, IBEC, IMB, ICMAB, UAB, UPC

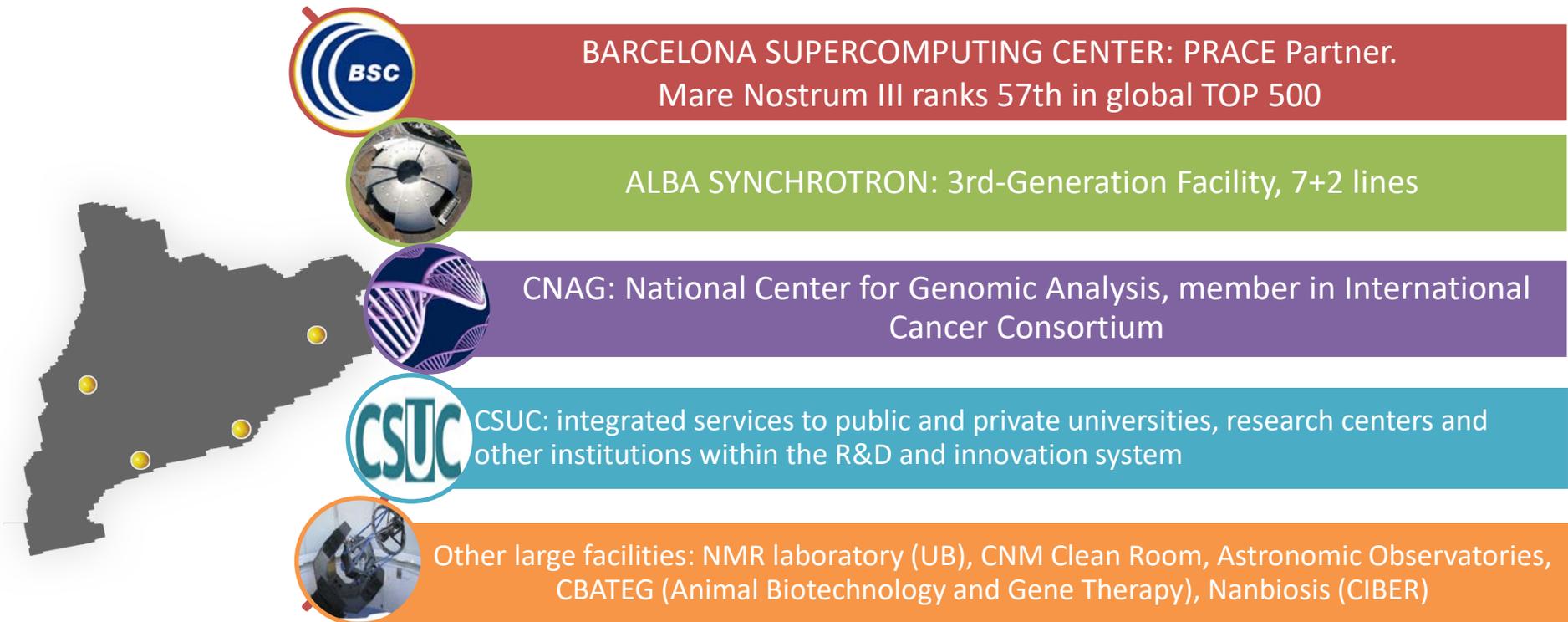
# Research institutions (Physical Sciences and Engineering)

|             | CERCA                                     | CSIC                         | UNIV             |
|-------------|---|------------------------------|------------------|
| Physics     | IFAE, ICFO, ICN2,<br>IREC, IEEEC          | ICN2, ICMAB,<br>IMB-CNM, ICE | UB, UAB          |
| Chemistry   | ICIQ, IREC, ICN2,<br>ICRA,                | IQAC, ICMAB,<br>ICN2, IDAE   | UB, UAB, URV, UG |
| Engineering | CIMNE,<br>CVC, IBEC, IREC,<br>CTTC, I2CAT | IRI, IMB-CNM,<br>ICMAB, IIIA | UPC, UB, UAB     |

Strong institutional complementarity: many opportunities  
for international cooperation! (30-50 % PhDs/postdocs)

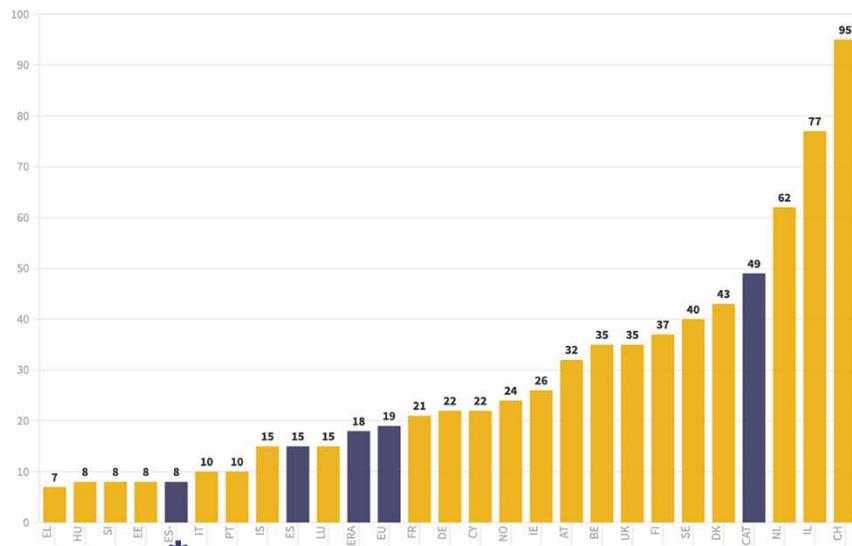
# Catalonia's RTD large scale facilities

Catalonia is home of world-class large research facilities. Catalonia hosts large infrastructures that participate in the main international projects and networks.



# ERC Grants

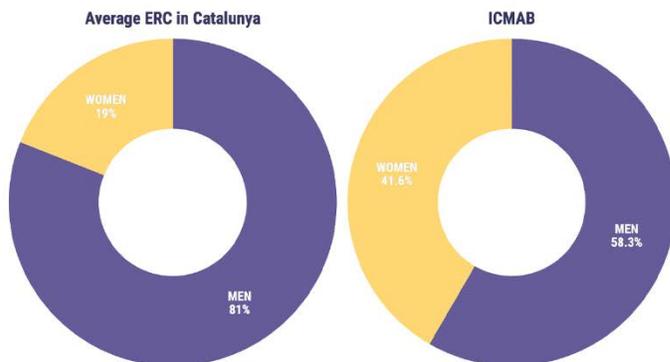
Catalunya is the 4th region in ERC per million habitants with **53% of all Spanish ERC**



\* Spain with Catalunya excluded

# ERC grants in Catalonia

## ERC Grants



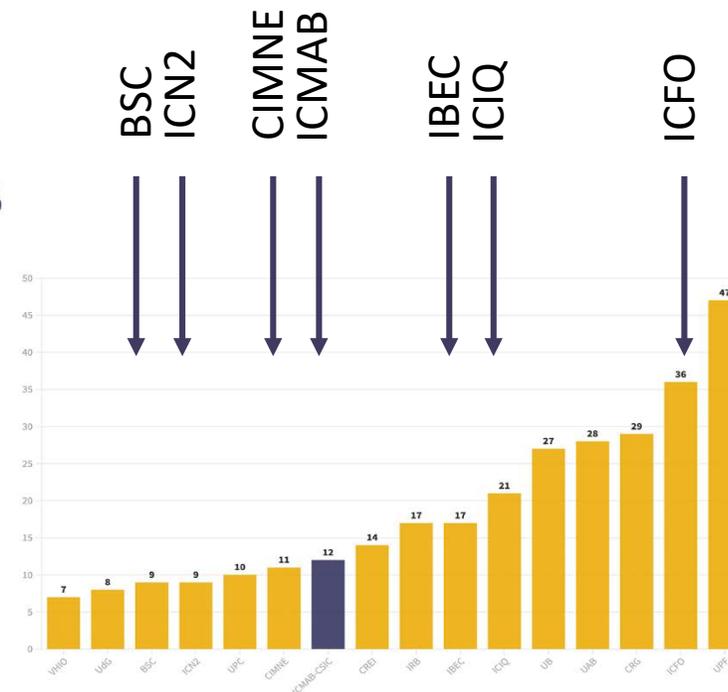
**22.6% over the ERC Average in Catalunya**

From a total of 12 ERC grants, 7 have been given to men and 5 to women.

## ERC Grants

**82% ERC** in Catalunya come from **16 Institutions** (5 Universities)

ICMAB is the 10th institution with more ERC Grants in Catalonia (7<sup>th</sup> Institute)



# PUBLICATIONS CATALONIA - GRENOBLE

Physics – Materials – Chemistry: priority topics in our collaboration

## Catalonia vs France and Grenoble publications (2020)

Catalonia: ~ 31.000 art /yr

Catalonia: ~ 5.000 art/yr in Materials, Condensed Matter Physics, Applied Physics, Nanoscience, Electrical Engineering, Chemistry, Optics (~ 16 %)

France-Catalonia co-authorship (all topics): ~4.200 art/yr (~ 14 % Catalonia)

Grenoble-Catalonia co-authorship (all topics): ~ 400 art/yr (~ 10 % France)

Grenoble-Catalonia co-authorship (Mater&Phys&Chem&Eng): ~ 100 art/yr (~ 25 %)

## Catalonia: “Nano” search

2020: ~ 1.200 art (X 10 in 20 years)

Total: ~ 14.500 art

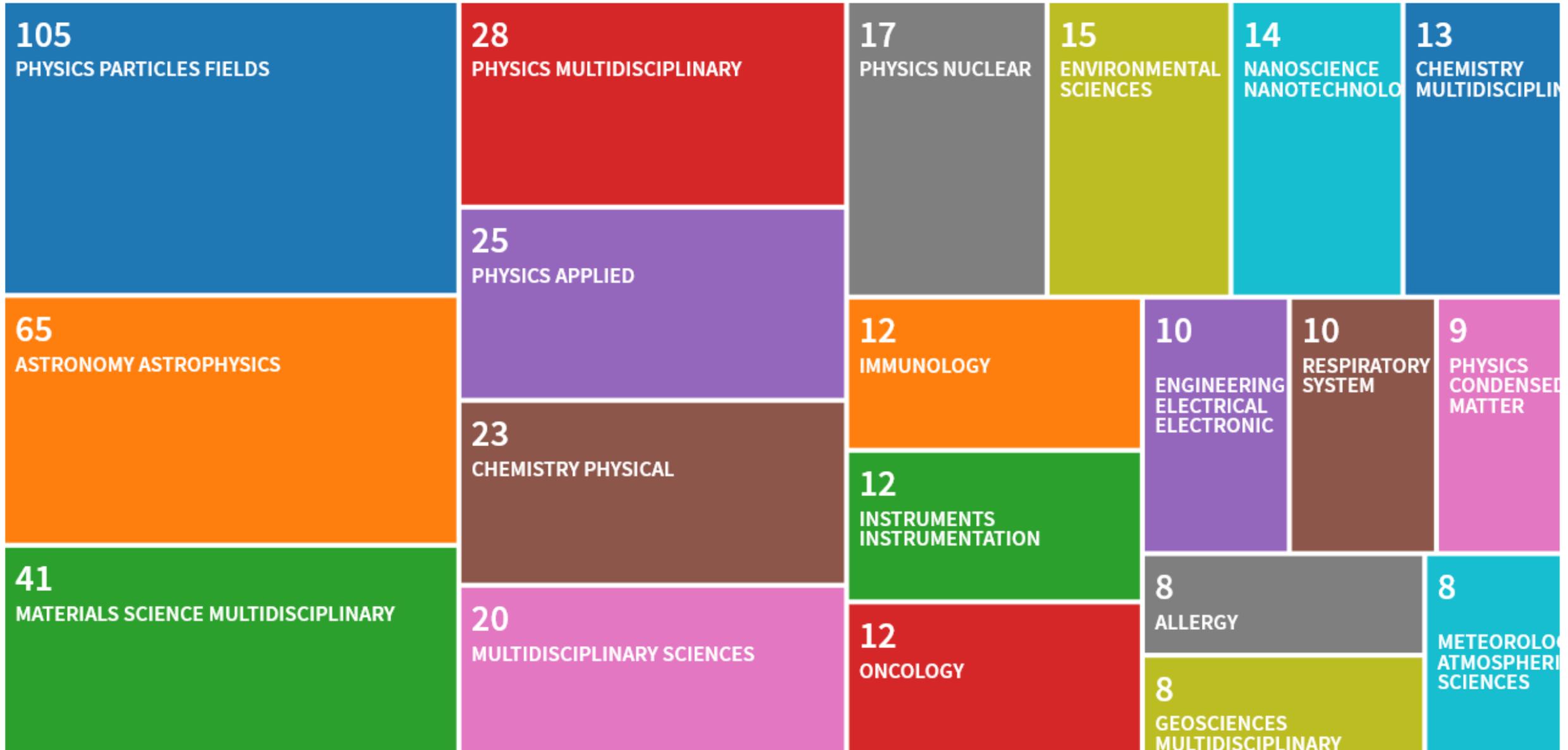
France co-authorship: ~1.500 art (~ 10 %)

France co-authorship (2020): ~150 art

Grenoble co-authorship (2020): ~20 art

# PUBLICATIONS CATALONIA - GRENOBLE

Physics – Materials – Chemistry: priority topics in our collaboration



# Research structure Mat&N&N: push of emerging technologies and social challenges driven pull

Long term knowledge leadership combined with thematic focus

Oriented research

Blue-Sky Research

In-situ, in-operando, nanoscale and hyperspectral characterization

Sustainable multifunctional materials:  
From synthesis to advanced manufacturing

Targeted design, theory and simulation

Nanomaterials for clean  
Energy and environment

Next generation  
electronics and photonics

Biomaterials for Nanomedicine

# Barcelona Nanotechnology Cluster at Bellaterra



The largest R+D Mat&N&N concentration in Spain

~ 40-50 % Catalonia scientific production Mat&N&N

- 5 S.O. centers
- 2 M.M. centers
- 2 Large scale facilities
- Multidisciplinary Campus

# Cutting-edge Research for Global Challenges

SOMMa is the alliance of Severo Ochoa Centres and María de Maeztu Units to promote Spanish Excellence in research and to enhance its social impact at national and international levels



## Key facts and figures

SOMM alliance brings together the top-performing and most competitive Spanish research centres and units in all disciplines



49

CENTRES AND  
UNITS

That hold the Severo Ochoa  
and María de Maeztu  
Excellence Awards

8,515

RESEARCHERS

Work in the SOMMa member  
institutions (data at end 2018,  
obtained from 43 members)

159

ERC GRANTS

Total number including  
Starting, Consolidator,  
Advanced and Synergy grants  
(data at end 2018, obtained  
from 46 members)

40.8%

D1  
PUBLICATIONS

Out of 7,775 publications, this  
fraction was published in the  
top-10% ranked journals (data  
from 2018, obtained from 44  
members)

49  
institutions

20

María de Maeztu Units

29

Severo Ochoa Centers



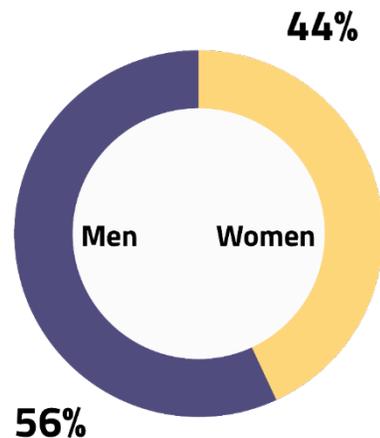
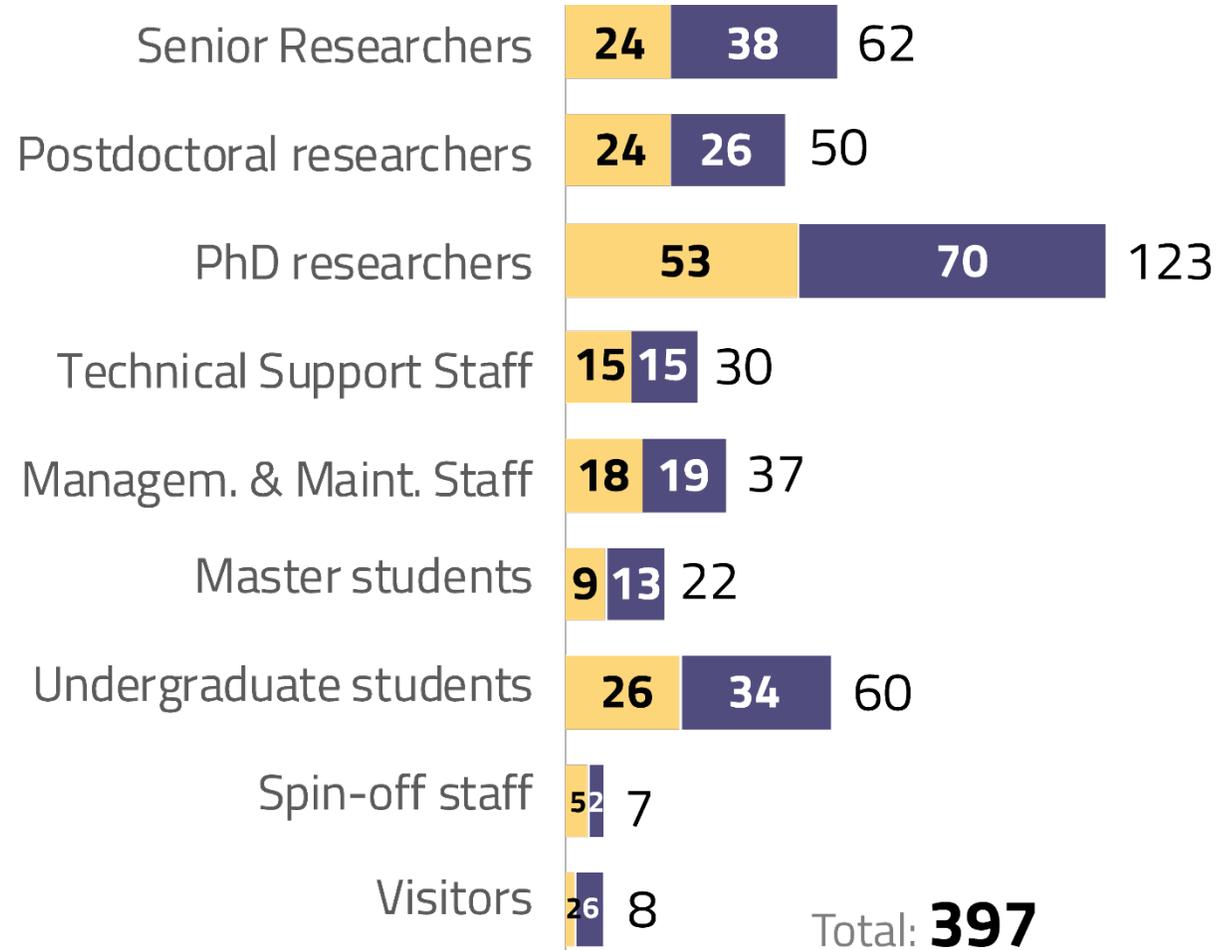
~ 50 % of SOMMA centers of excellence located in Catalonia

CGC2021

- ICFO
- IFAE
- ICN2
- IBEC
- ICMAB

# ICMAB: a research Institute on advanced functional (nano)materials

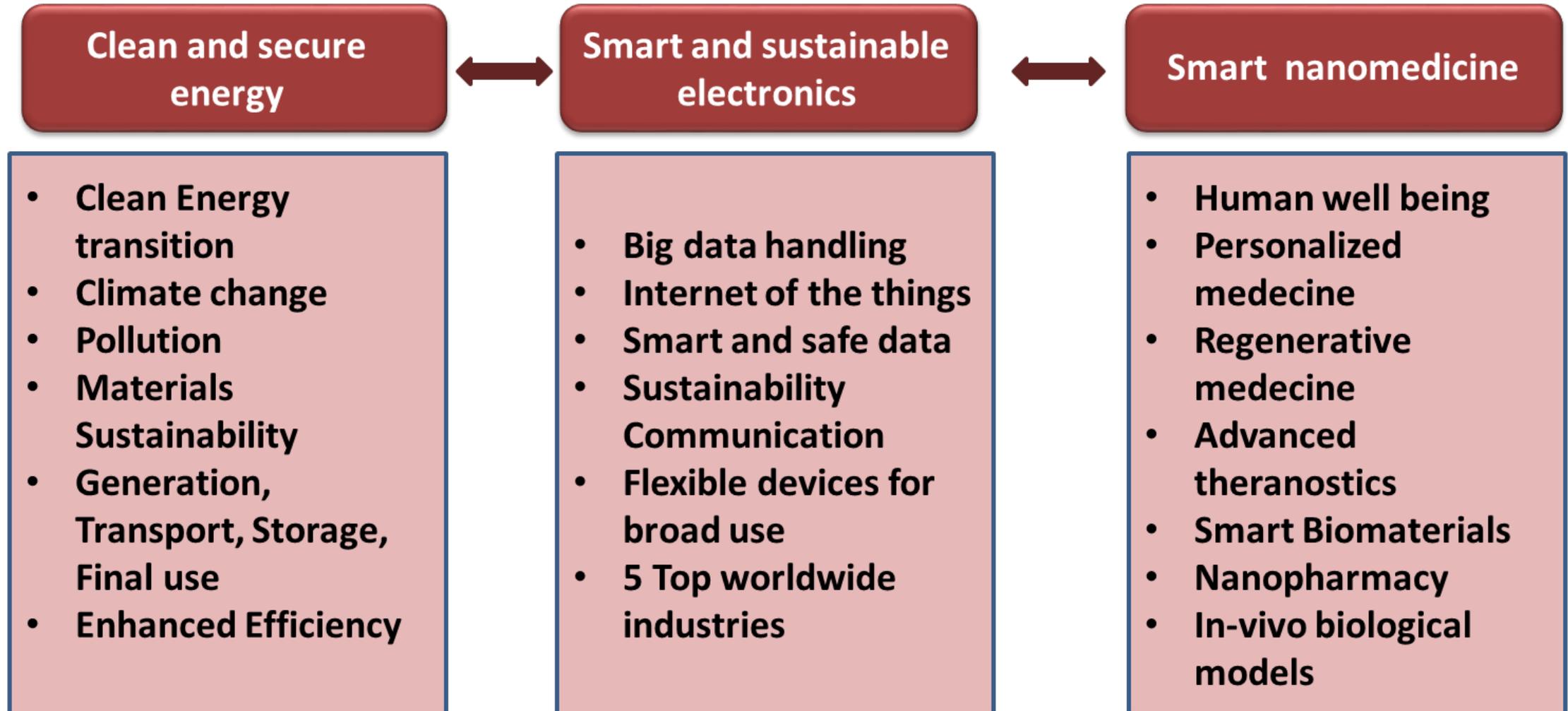
## ICMAB Personnel 2020



Women Men



## “Smart FUNctional materials for a better FUTURE” (FUNFUTURE)



# Research Lines



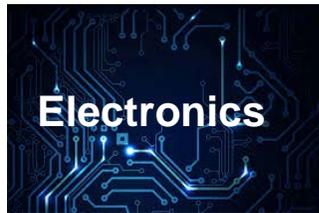
Cl. #1: Health  
 Cl. #4: Digital, Industry and Space  
 Cl. #5: Climate, Energy and mobility



ICMAB : 13 ERCs (1<sup>st</sup> CSIC)



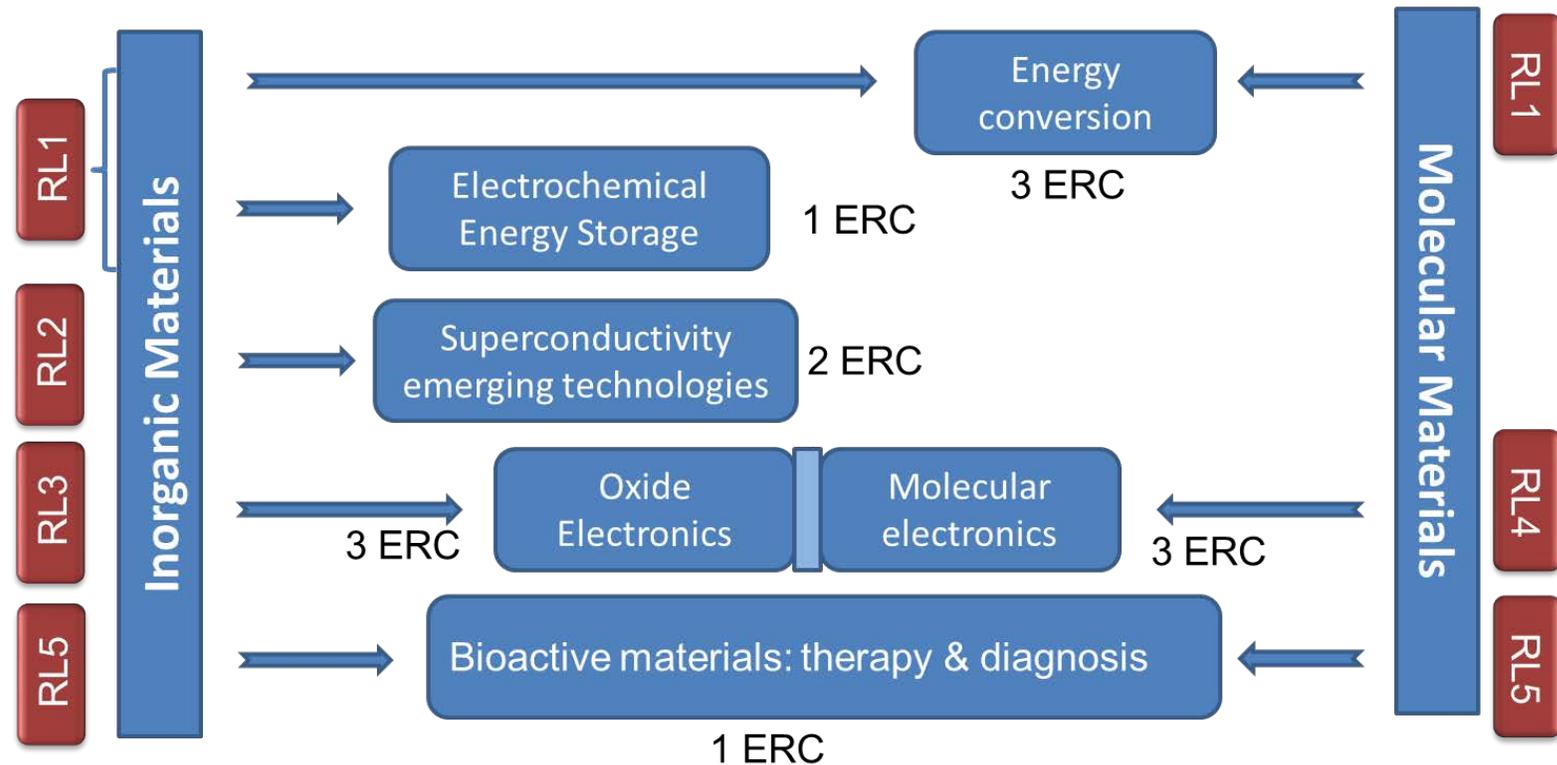
Energy



Electronics



Health



# History of publications and citations 1986-2020\*



## ICMAB

~ 14,000 CITATIONS/YEAR

~ 220 ARTICLES/YEAR

h = 152 (2020)

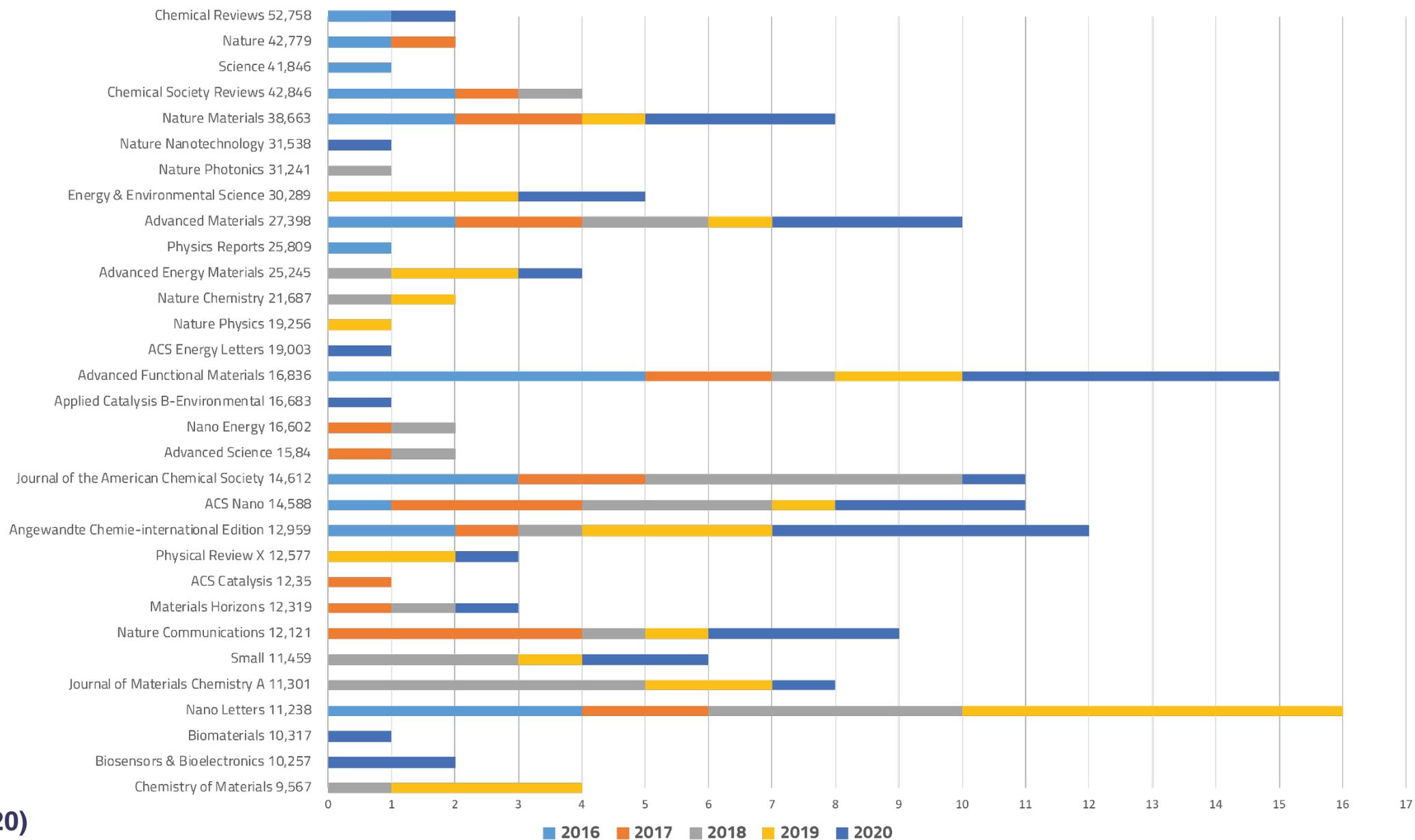
IF = 7.42 (2020)

**CATALONIA x 6-10 (Mater&N&N)**

## MAIN COLLABORATIONS (articles)

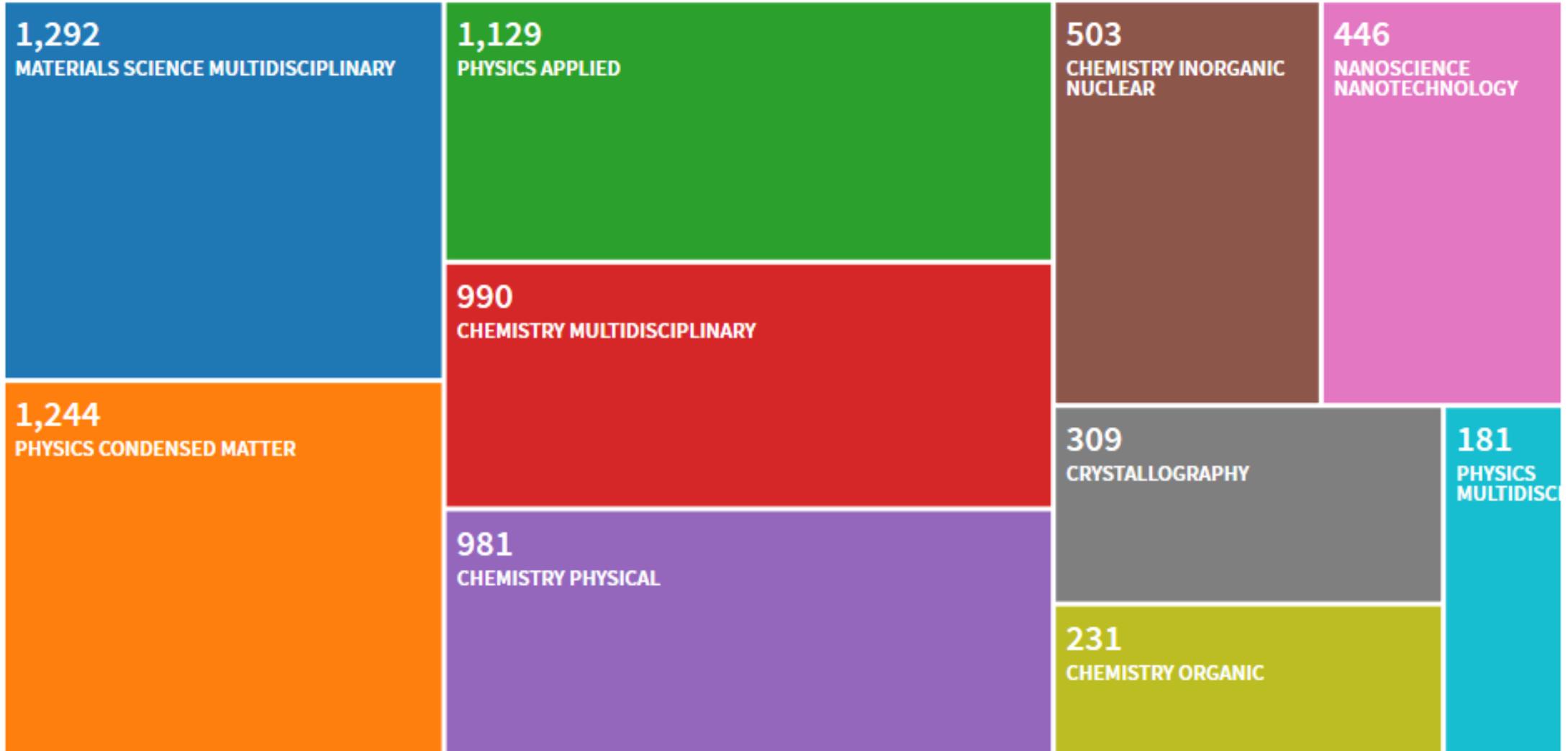
- UAB: 790
- UB: 770
- ICN2: 260
- UPC: 175
- IMB-CNM: 155
- ALBA: 125
- IREC: 75

# High impact: Journals with IF>10 2016-2020\*



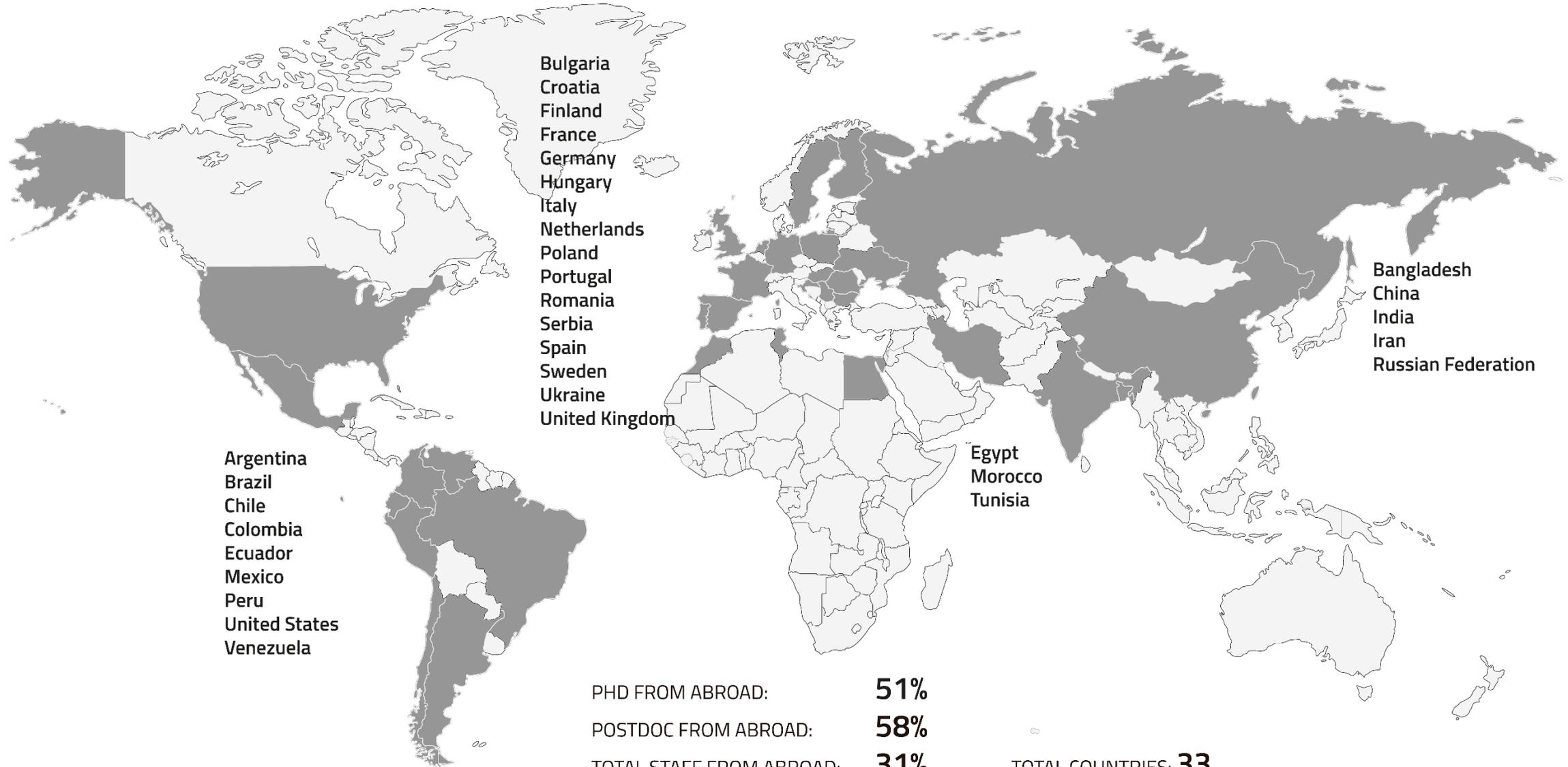
\*(10 Nov 2020)

# Interdisciplinary profile



**~ 5.700 articles: diversified areas**

# Internationality of our personnel 2020

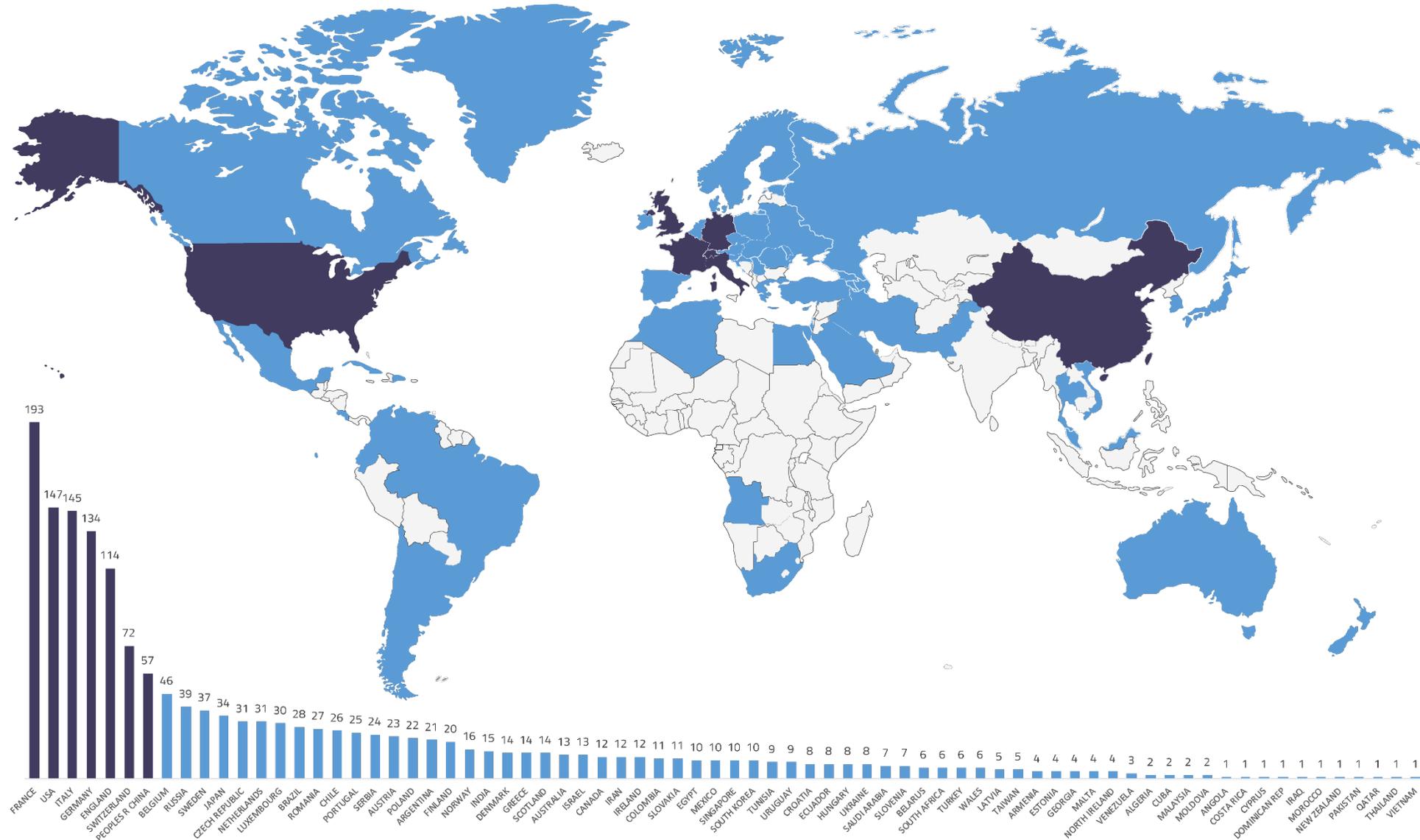


PHD FROM ABROAD: **51%**  
POSTDOC FROM ABROAD: **58%**  
TOTAL STAFF FROM ABROAD: **31%**

TOTAL COUNTRIES: **33**

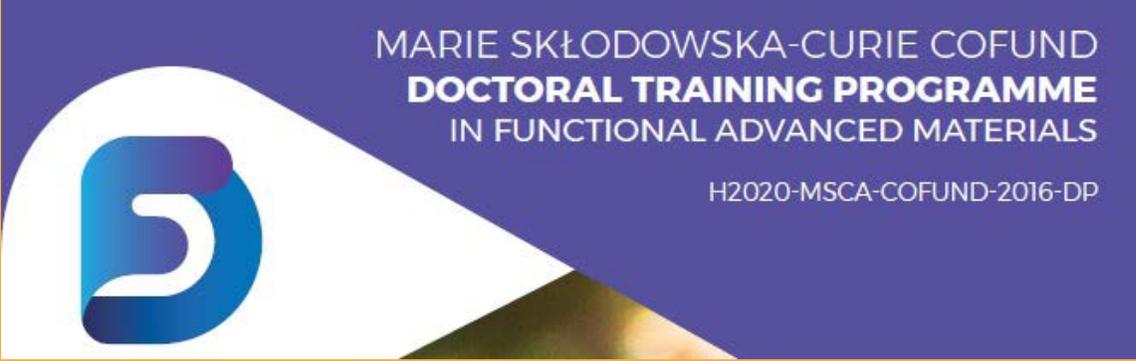
\*(10 Nov 2020)

# International collaborations 2016-2020\*



\*(10 Nov 2020)

# International training activities



MARIE SKŁODOWSKA-CURIE COFUND  
**DOCTORAL TRAINING PROGRAMME**  
IN FUNCTIONAL ADVANCED MATERIALS  
H2020-MSCA-COFUND-2016-DP

<https://projects.icmab.es/docfam/>



## Coordination:



## Partner Organisations:



**2017-2022**  
**22 PhDs (9 @ ICMAB + co-shared)**  
**16 Countries**

## With the support of:



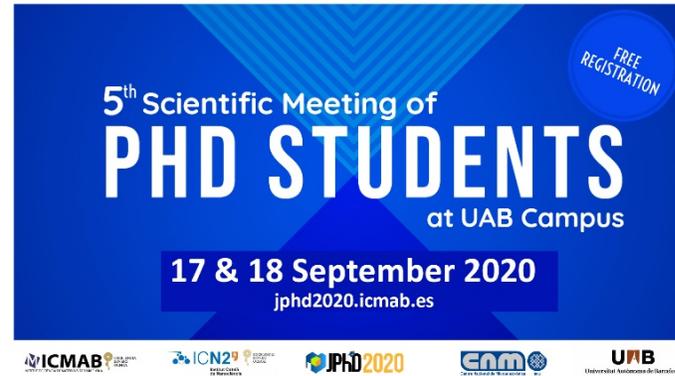
# Training Activities UAB Campus (2020)

## ICMAB-ALBA Joint Workshop February 24, 2020

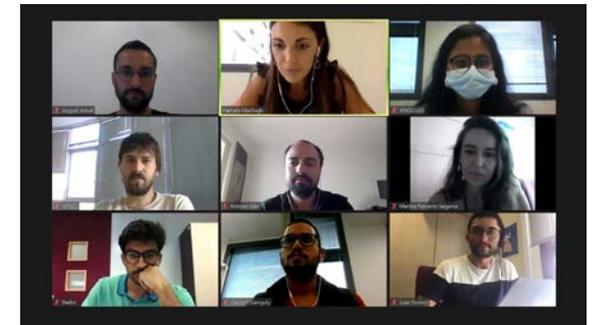


- Around 40 participants
- New collaborations
- Seed for new projects

## 5<sup>th</sup> Scientific Meeting of PhD Students at the UAB Campus



- 80 participants from 11 institutions
- 18 poster presentations, 24 oral presentations, 4 workshops
- 4 invited speakers
- Awards for best oral and poster



# Outreach & communication activities



“Vermut de nanociència” for the Festival 10alamenos9  
Bojos per la Ciència  
MATHEROES  
Press releases  
Women in science  
...



# Scientific-Equipment Platforms of ICMAB

- Clean room facility (200 m<sup>2</sup>)
- Low Temperature and Magnetometry
- Scanning Probe Microscopy
- X-ray diffraction
- Electron Microscopy
- Thin film PLD growth
- Thermal Analysis
- MBE
- Spectroscopies
- Thermal Analysis
- Soft materials
- Cell growth (ICN2)

- Advanced Photolithography Facilities
- Micro-contacts Facilities
- Etching Systems
- Thickness characterization Facilities
- Deposition Systems
- Chemical Synthesis
- Rheological and wettability Charact.
- Spectroscopic Characterization Facilities
- Thermal processing equipment

Managed by skilled technical staff (22)  
~30 % ICMAB lab space  
> 5.000 exp/year



# Internationalization & large scale infrastructures

Competences of specialized academic laboratories ↔ large scale analytical facilities



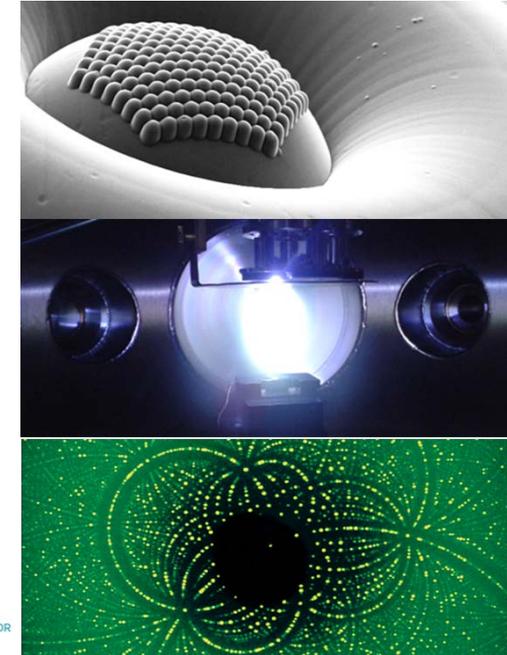
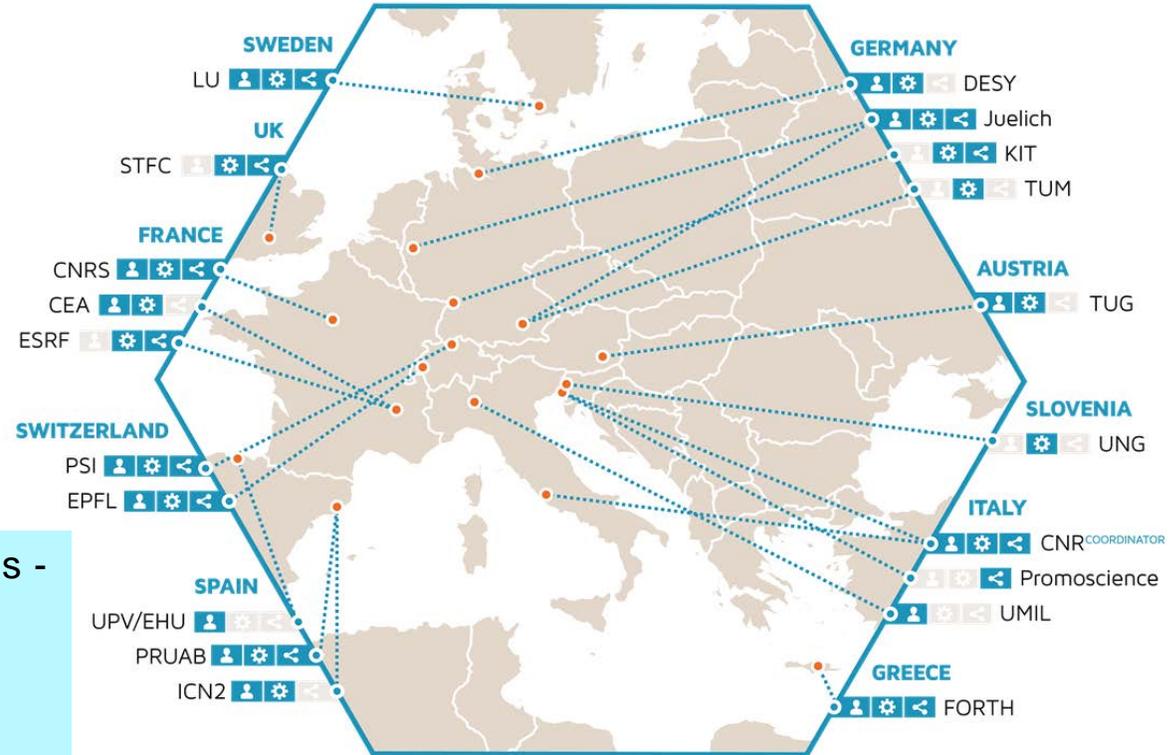
**The widest range of tools for research at the nanoscale**  
Free transnational access to academia & industry

2015-2021



Nanoscience Foundries and Fine Analysis - Europe|PILOT

H2020-INFRAIA-2018-2020 4 years  
(2021-2025)



See L. Fonseca talk

# Next generation EU funds: Reinforcement of Catalan R&D&i system

NEXT  
GENERATION  
CATALONIA



## ALBA Science, Technology and Innovation Park (ASTIP)

Research, technology and industrial innovation for a competitive economy focused on green energy, digital transition and health



- Transformation into ALBA II (4<sup>th</sup> generation synchrotron)
- COMplex Materials and TEChnologies Center (COMTEC)
- Advanced Multiscale Bio Imaging Center (AMBIC)
- SYNchrotron benefits to inDUSTRY Center (SYNDUSTRY)

COMTEC: ICMAB, ICN2, IFAE

SYNDUSTRY: EURECAT, UAB



Barcelona Institute  
of Science and



Example of successful on going collaborations among ASTIP institutes

**Aberration Corrected Monochromatic Transmission Electron Microscope, Plus Focused Ion Beam equipment for sample preparation**  
**Nanoscience and Nanotechnology, Advanced Materials, Photonics**



**NEW PROPOSAL (2021)**

**Instalation Correlative In-situ for Advanced Materials for Energy (In-CAEM)**

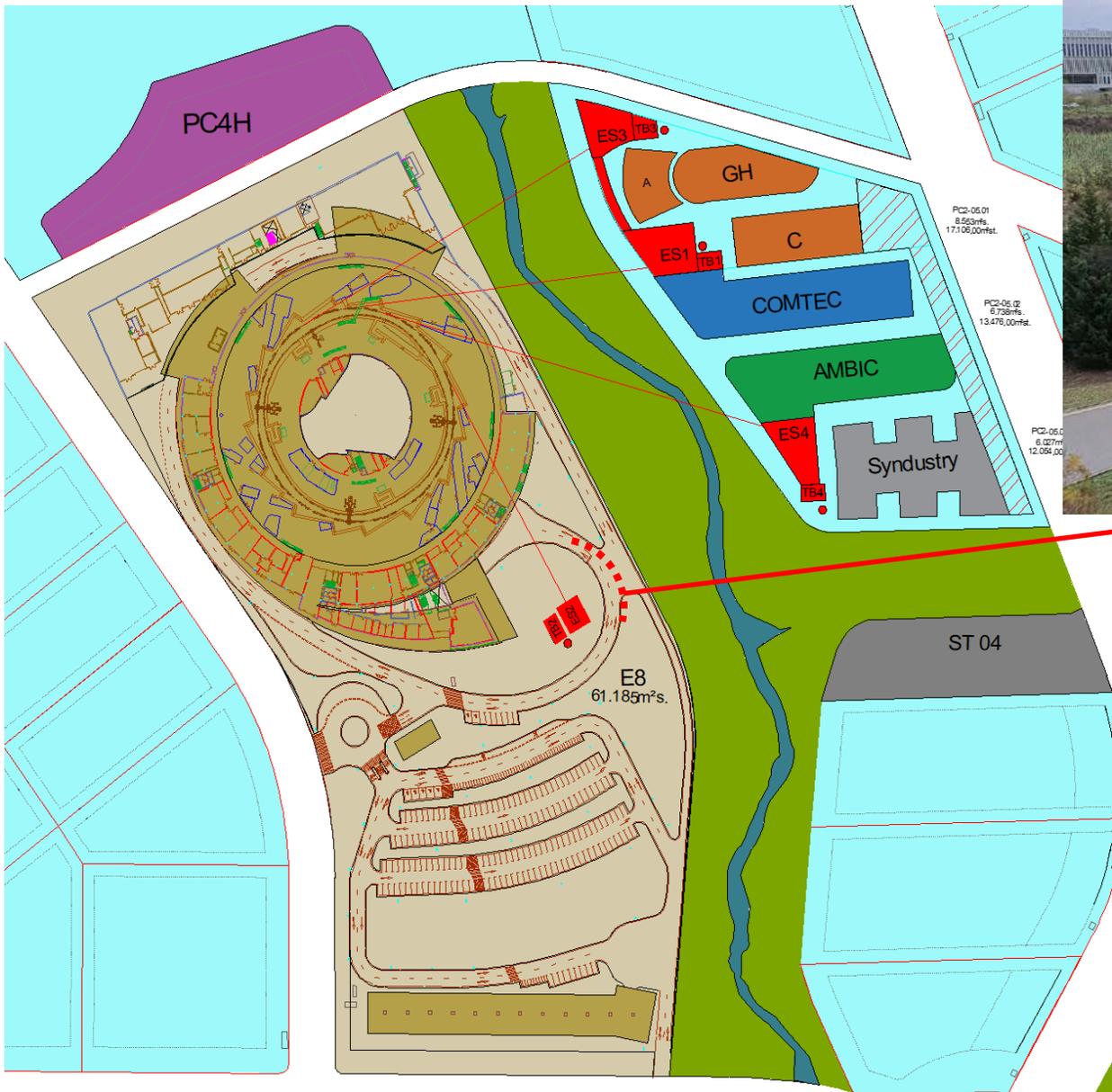
# Advanced Microscope Platform Seed of ASTIP

Co-funded and co-owned by different institutions  
 To be placed at ALBA  
 Microscopes to be in operation in 2022



**Specialized transmission cryo-electron microscope for structural biology applications**  
 - 200 kV maximum acceleration voltage  
 - last generation direct electron detector  
 - automated sample load system  
**Single Particle Analysis & cryo-electron Tomography**

# Next generation EU funds: ASTIP



ASTIP combines in a single location a **unique national facility** with national and Catalan **leading research institutions, educational programs**, and an **incubator concept**.

ASTIP will provide:

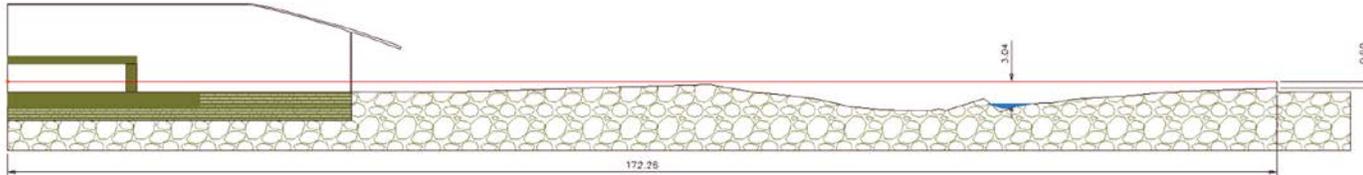
1. A strong link between the contributing research institutions creating synergetic use of instrumentation and expertise.
2. Education of future scientists in a interdisciplinary environment fit to solve the big problems of this century.
3. Provide entrepreneurs a wide range of expertise and resources to make out of ideas innovation and finally economic growth.

# COMTEC (Complex Materials and Technologies Center)

## AREAS of Expertise

- High  $T_c$  superconductivity
  - Energy Storage (Batteries, Supercapacitors)
  - Energy Generation, Conversion and Harvesting (Photovoltaic, Thermoelectric, ..)
  - Sensing devices
  - Quantum Materials
  - Materials and devices for beyond-CMOS digital technologies
  - Quantum Computing
- + enhanced PIC capacities used by the whole ASTIP and ALBA

- Combining existing instrumentation in the institutes with new facilities
- Combining use of existing ALBA BLs with a **partner ALBAII BL**
- Dedicated building (ca. 10.000 m<sup>2</sup>)



## CORE TEAM



- **EU H2020 and FP9 projects**
  - Many different topics and calls
  - Very significant budgets to cooperate
  - ERA – NET : 3 EU countries min, topics agreed yearly
- **EU NFFA large scale nanoscience infrastructures**
  - Close to synchrotron radiation centers (ESRF, ALBA)
- **Projets Internationales Coopération Scientifique (PICS) (CNRS – CSIC)**
  - Consolidate partnerships to enhance international / European ambition in specific areas
  - Requisite: previous collaboration demonstrated
  - Funding: 5.000 – 7.000 €/yr (3 years). Travel, meetings.

# Instruments for international cooperation

- **I-LINK (CSIC)**

- Consolidate international cooperations with the objective to promote competitiveness in international project calls
- Funding: < 24.000 € (< 20 months). Travel and exchanges of both teams

- **APPELS A PROJETS UNIVERSITAIRES ET SCIENTIFIQUES (Ambassade de France)**

- Événements touchant à la France ou à ses organismes scientifiques ; aspects bilatéraux de recherche franco-espagnole, ou favoriser la diffusion de publications en langue française.
- Bourses d'excellence Eiffel et bourses Avenir (Master and PhD in France)
- Bulletin d'information »Universités et Sciences en France »



*Le bulletin **Universités et Sciences en France** est élaboré par le Pôle scientifique et universitaire de l'**Ambassade de France en Espagne**.  
Institut français d'Espagne – C/ Marqués de la Ensenada, 10 – 28004 Madrid*

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[Campus France Espagne](#)



[campus france espagne](#)



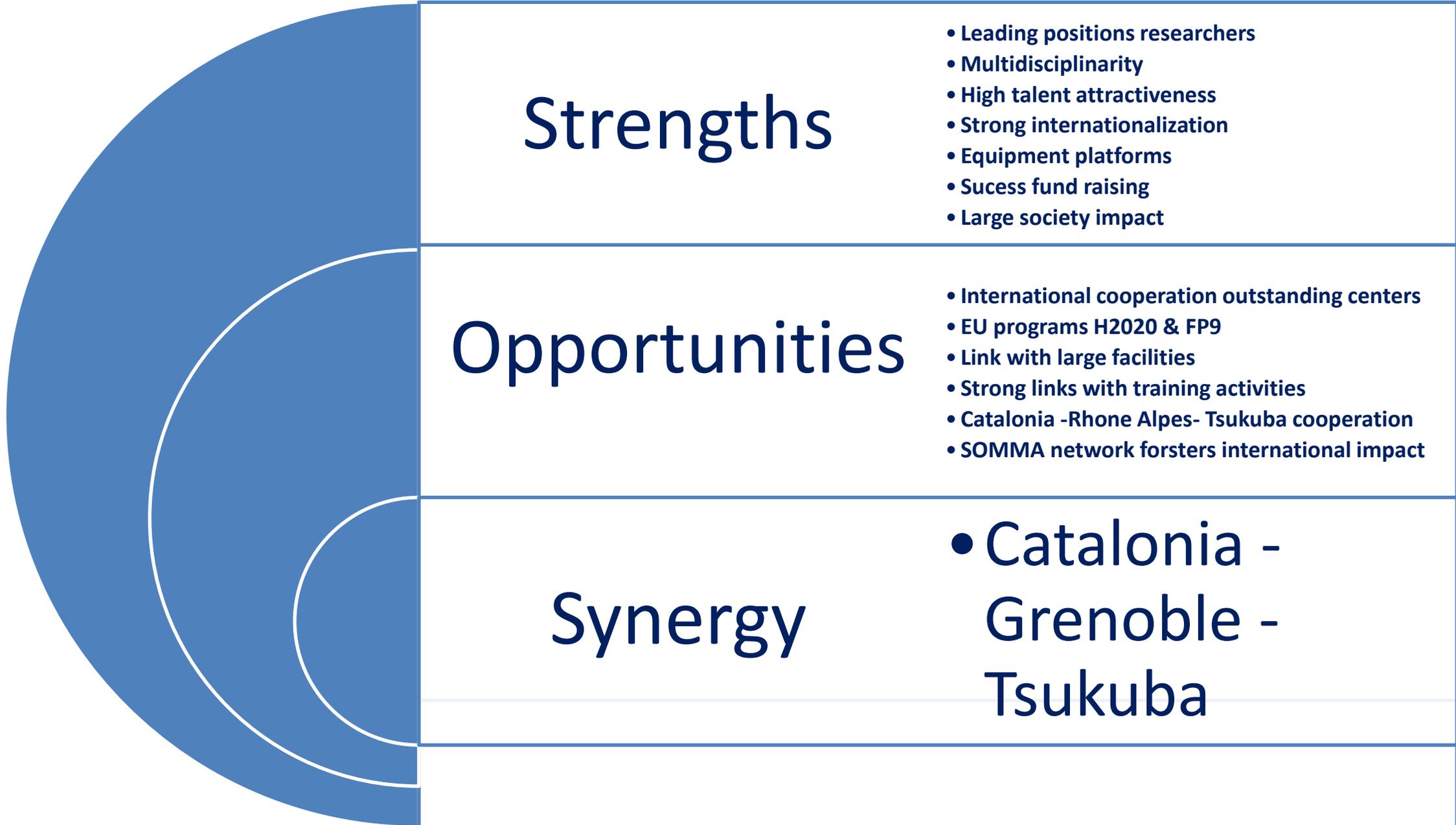
[Campus France Espagne](#)

# Instruments for international cooperation

- **Catalonia and Spain calls to exchange or recruit scientists**
  - Master and PhD fellowships
  - Beatriu de Pinós for postdocs (Generalitat de Catalunya)
  - ICREA researchers (Generalitat de Catalunya)
  - Juan de la Cierva for postdocs (Spain)
  - COFUND postdocs and PhDs
  - Ramón y Cajal for Tenure Tracks (Spain)
  - CSIC scientist positions (Spain)
- **Severo Ochoa excellence label centers (SOMMA network) (ICN2, ICFO, IFAE, IBEC, ICMAB) (> 50 % Catalonia)**
  - Calls for Master fellowships
  - Calls for PhD and postdoc positions
  - InPhinit – La Caixa PhD positions
  - BIST COFUND programs

# SWOT CATALONIA – GRENOBLE

## Clustering and Global Challenges



# Clustering and Global Challenges 2021

Thank you!

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