

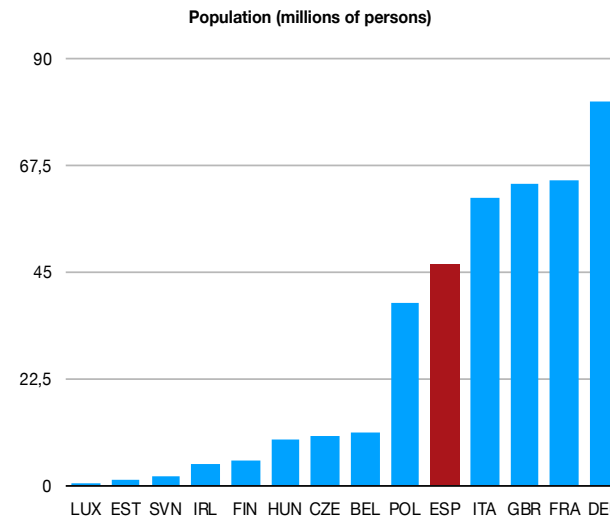
# Particle and Nuclear Physics (FPN) Mid-term Spain

17<sup>th</sup> November 2022

Celso Martínez Rivero –IFCA(CSIC/UC)-

Thanks to MJ G.Borge for the material

# Spain in Numbers



Population: 46 659 302 (2018)

*5th of the EU → 9,2 % of EU*

Geo. Size: 505 370 km<sup>2</sup>

*2nd of the EU*

Spain contributes with ~ 8% of CERN budget.

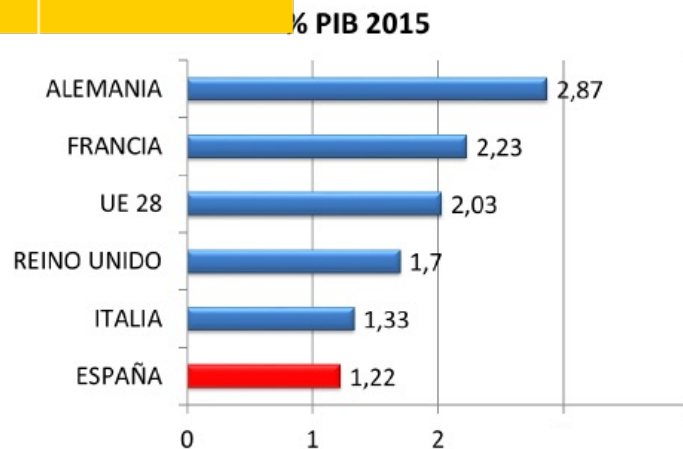
The CERN contribution is 66% of the Spanish contribution to International Organisations and Research Infrastructures



GOBIERNO  
DE ESPAÑA

MINISTERIO  
DE CIENCIA  
E INNOVACIÓN

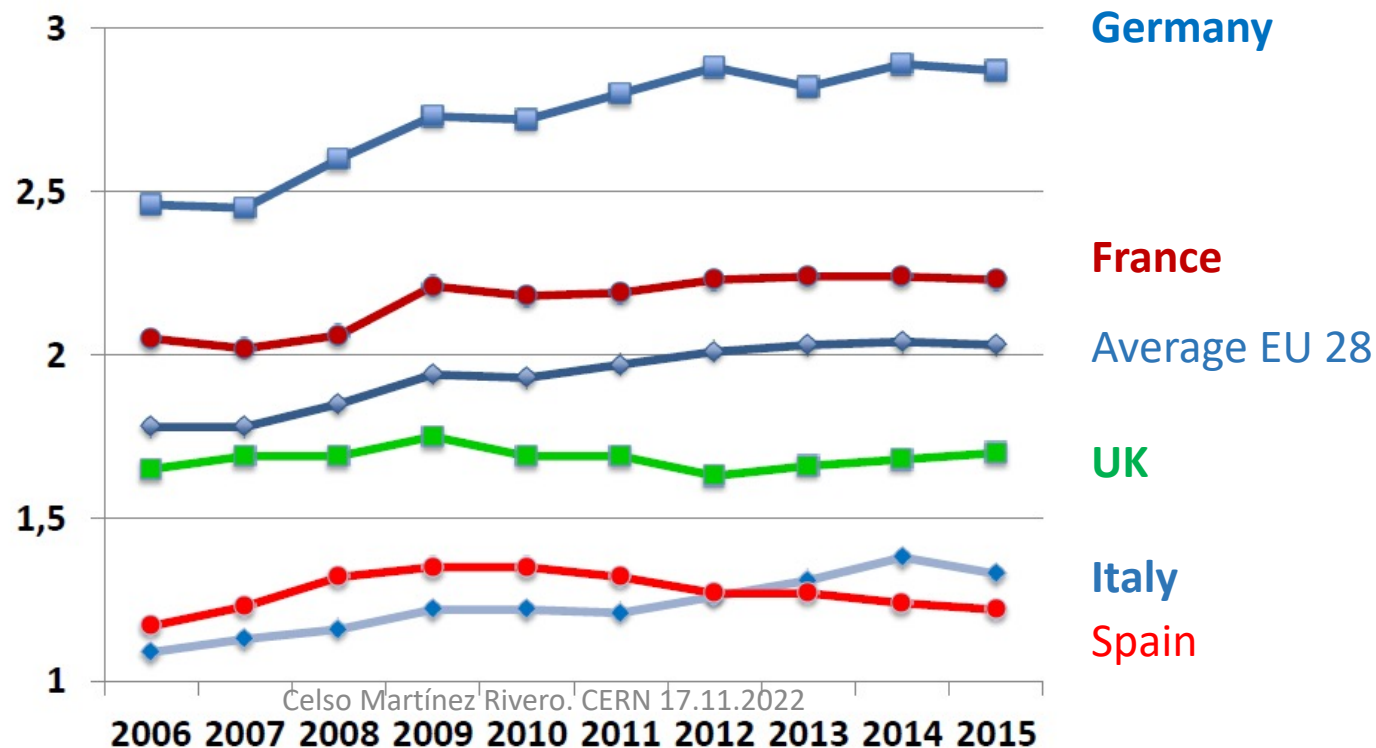
# Spain in Numbers



Main Economies in EU

Investment in R&D (from 2015)

Evolution of % Gross National Product 2006-2015



# FPN: Which areas?

## Collider **Physics**

Experiment (all) & Theory (all)

## Nuclear **Physics**

Experiment (all) & Theory (some)

## Astroparticle **Physics & Neutrinos & Cosmology**

Experiment (most) & Theory (some)

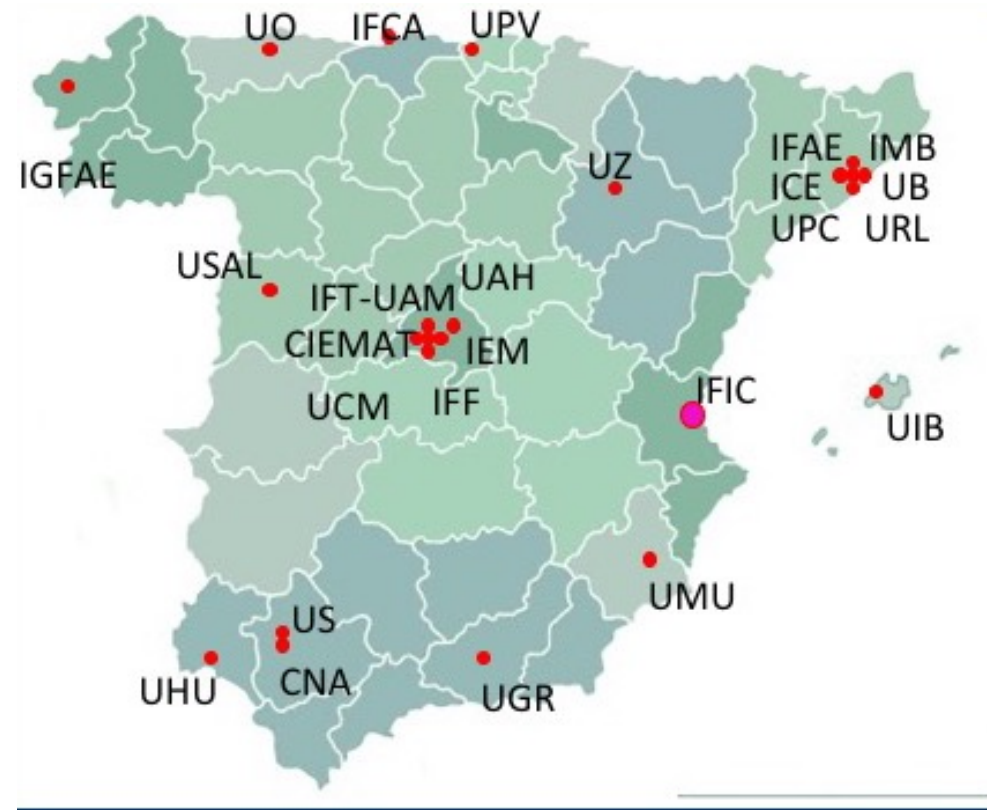
## Information **Technology**

GRID (all), e-Science (some)

## R&D in Accelerators and Detectors (some)

## Physics **Applications**

Medical Physics (some)



# FPN Landscape

COLLIDERS	ASTRO/ COSMO/ NEUTRINOS/	NUCLEAR PHYS	R&D	THEORY
ATLAS	T2K	ISOLDE	ACCELERATORS	LHC Pheno
CMS	DCHOOZ	N-ToF	DETECTORS	Lattice
LHCB	WA105/protoDUNE	FAIR-RELATED	MEDICAL PHYS.	String/EFT
GRID	CAST/IAXO	AGATA		Nuclear Phys.
ILC/CLIC/FCC	LSC-RELATED (ArDM, ANAIS, NEXT, TREX,..)	OTHERS		.....
	DES/PAU/DESI			
	CTA / MAGIC			
	ANTARES/KM3NeT			
	Pierre-Auger DAMIC			
EFT=132	EFT = 105			EFT= 179

# FPN Research in Spain

## Ministry of Science and Innovation and Ministry of Universities

## Regional Governments

Universities: (50 public + 33 private)

Over 18 with active programs in HEP

Some have joint Institutes with CSIC

IFIC Valencia

IFCA Santander

IFT Madrid

Some others are Institutes (co-) funded by regional governments

IFAE Barcelona

ICCUB Barcelona

IGFAE Santiago

CSIC

(Spanish Research Council)

~139 Research Institutes

IFIC, IFCA,

IEM, IFT

IAA, ICE, CNM-IMB

CIEMAT

Basic Research Dept.

+

Technology, Accelerators...

Others co-funded

LSC

PIC

ALBA

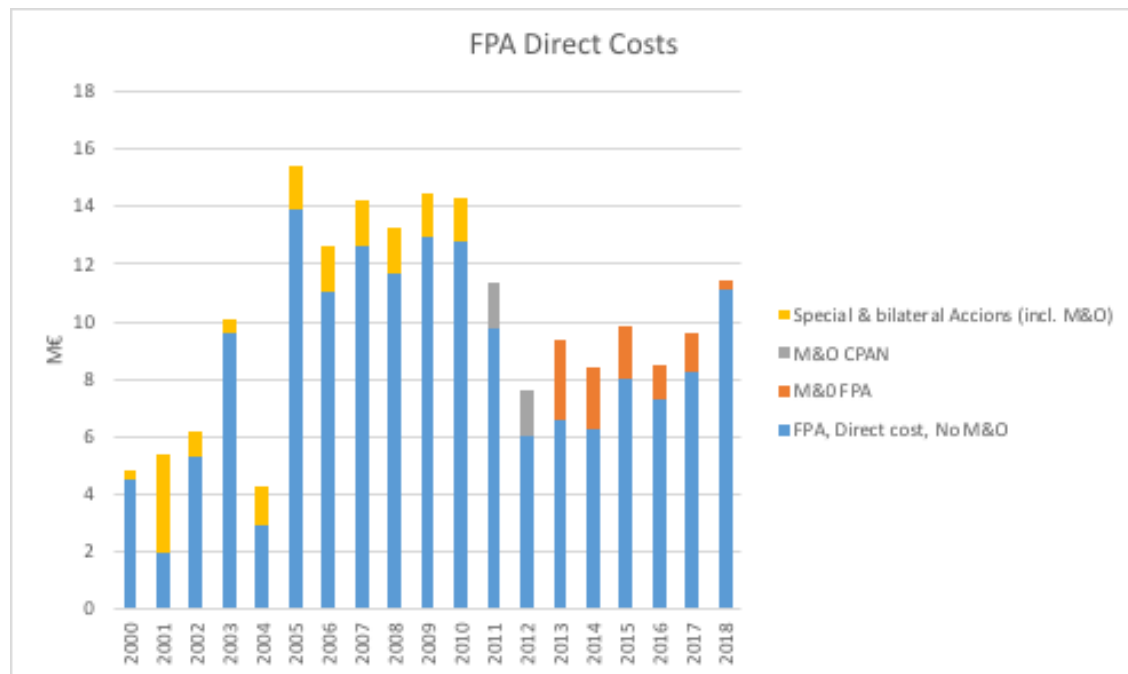
IAC

CNA

These Institutions are the main sources providing personnel (permanent) and infrastructures

# FPN Research in Spain

Funding agency: AEI (Research Agency in Spain)



- The increase (or decrease) depend on the total numbers of projects presented to AEI.

## NEW!:

- 12 M€ in 2019 (53 out of 62 projects approved) 14 FPI's\*
- 7 M€ in 2020 (30 out of 38 projects approved) 7 FPI's
- 10 M€ in 2021 (46 out of 58 projects approved) 10 FPI's
- Since 2013 the **M&O** of the experiments are included in the competitive called for projects:
  - In 2022 it will be payed by the AEI (but only in 2022!)
- New: Core Cost for Phase-2 upgrade of LHC payed directly from ministry of Science in 2022 (see slide 17)
- HEP-networks play an important role in helping to organize our community –with little money- but today most of them have very minimal or inexistent funding

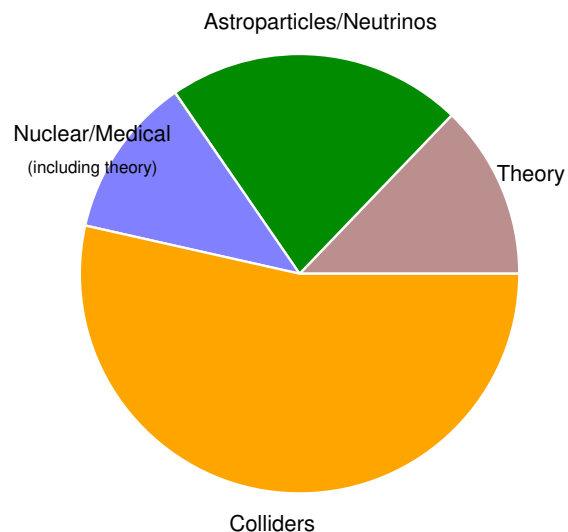
\*FPI: (preDoc: Formación de Personal Investigador)



# FPN Research in Spain

Funding agency: AEI (Research Agency in Spain)

FPA/FPN funding per area (2016-2018)



The average sharing of funds for the period **2016-2022** is :

- Collider 40%
- Astroparticles: 22%
- Nuclear: 18%
- Theory : 20 %

PostDoc: “**Ramón y Cajal**” contracts during these last years in FPN:

- **2019: 7 out of 97 requests**
- **2020: 11 out of 103 requests**
- **2021: 20 out of 237 requests\***

\* In 2021 both “Ramón y Cajal” and “Juan de la Cierva incorporación” were joined in one call.



# FPN Research in Spain

Funding agency: AEI (Research Agency in Spain)

**Spanish Excellence Programme (started in 2012):**

**These nominations represent a recognition of scientific excellence, extra funding and additional PhDs grants.**

- *Severo Ochoa Centres –SO- (1 M€/year):*

IFT (Instituto de Física Teórica, Madrid)

~~IFAE (Institut de Física de Altes Energies, Barcelona)~~

~~IFIC (Institut de Física Corpuscular, València)~~

- *María de Maeztu Units –MdM- (0,5 M€/year):*

~~CIEMAT (Física de Partículas – Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Madrid)~~

~~ICCUB (Institut de Ciències del Cosmos, Barcelona)~~

~~IGFAE (Instituto Gallego de Física de Altas Energías, Santiago de Compostela)~~

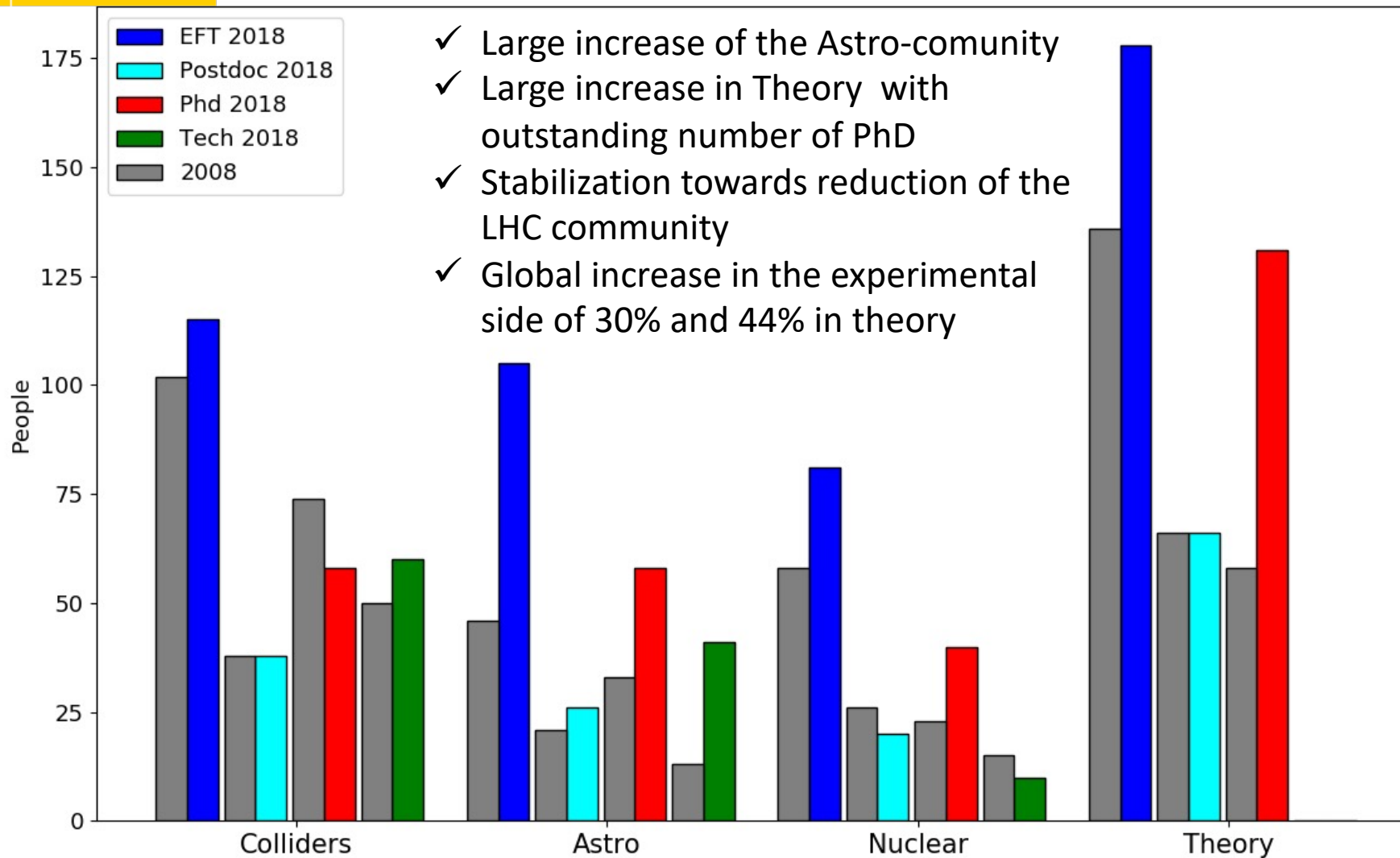
~~IFCA (Instituto de Física de Cantabria, Santander)~~

**New for 2022**

**From seven centers SOMM (Severo Ochoa and María de Maeztu) in 2019 in FPN we have nowadays only two! -> big decrease!**



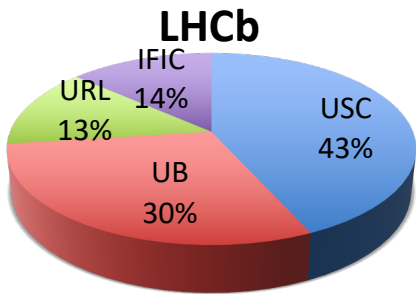
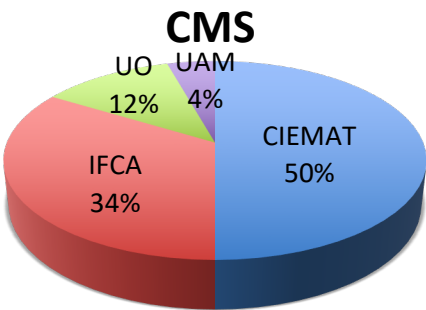
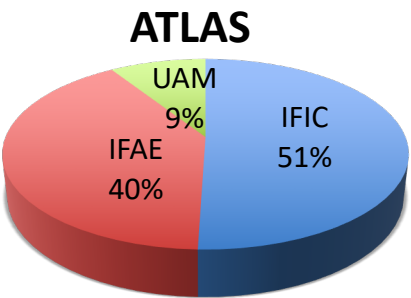
# Human resources in Spain



# LHC network

Current Spanish participation in the LHC collaborations

	# of physicists, engineers and technicians / Doctors	Intitutions
ATLAS	90 /46	IFIC, IFAE, UAM, CNM
CMS	92 /42	CIEMAT, IFCA, UO, UAM, ITAINOVA, CNM
LHCb	37 / 28	USC, UB, URL, IFIC

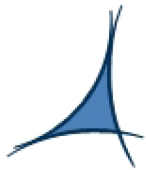


Extra funds for the upgrade are coming from MICIN in 2022! (see slide 17)

# LHC computing GRID



**PIC (Tier 1)**  
**IFAE & CIEMAT**  
**Barcelona**



**ATLAS (Tier 2)**  
**IFAE (Barcelona)**  
**IFIC (Valencia)**  
**UAM (Madrid)**



**CMS (Tier 2)**  
**CIEMAT (Madrid)**  
**IFCA (Santander)**



**LHCb (Tier 2)**  
**USC-IGFAE**  
**(Santiago)**



Tier	K€/year (2007-2014)	K€/year (2016-2019)
Tier 1 (PIC)	772	730
Tier2-ATLAS	487	260
Tier2-CMS	349	280
Tier2-LHCb	111	-

- Contribution to GRID from 5% → 4%
- Search for new avenues (HPC-BSC)

# Astroparticle & Neutrinos & Cosmology



**RENATA**

Spanish National  
Astroparticle Network

19 Institutions

34 research groups

83 permanent staff

47 fixed term

81 students

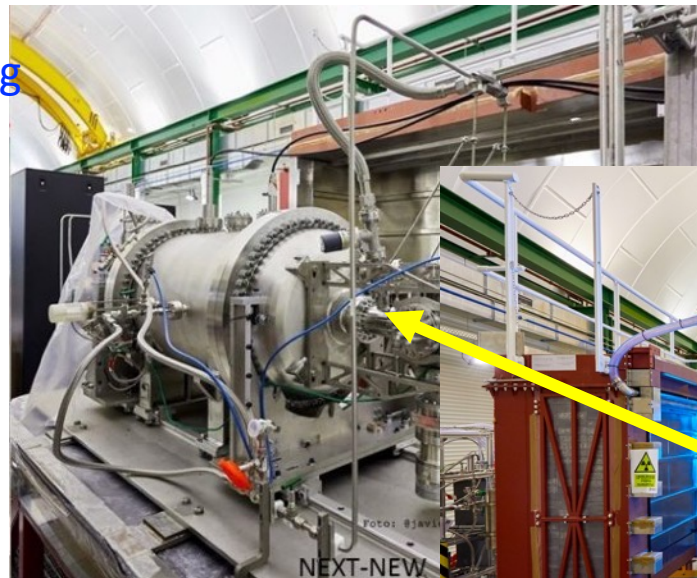
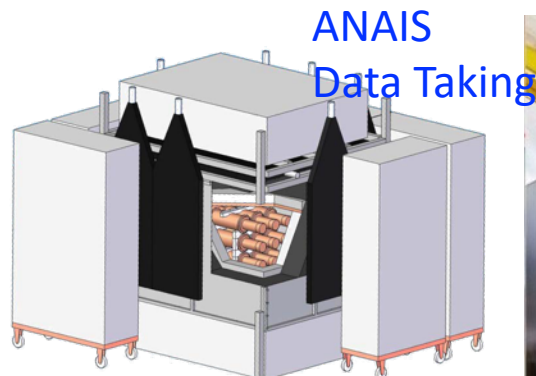
Similar to LHC-  
Community

**Large grow in the last  
decade!**



# Canfrac Underground Facility (LSC)

- The LSC is an underground facility dedicated to experimental research on Nuclear Astrophysics. Operative since 1985. Run by the UZ from 1985-2006.
- After an important enlargement, LSC is operated by a consortium (MICIN,DGA, UZ) and open to international experiments: **DM,  $\beta\beta 0\nu$  searches.**
- It is located under the Tobazo Mountain (1980 m high) in the Somport road tunnel.



- Expected energy resolution achieved.
- First run with purified  $^{136}\text{Xe}$



# Nuclear Physics



~230 physicists & engineers

130 permanent and 63 PhD,

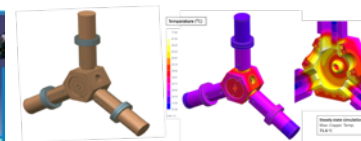
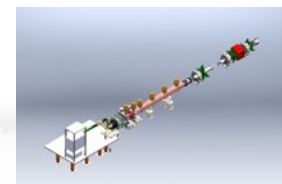
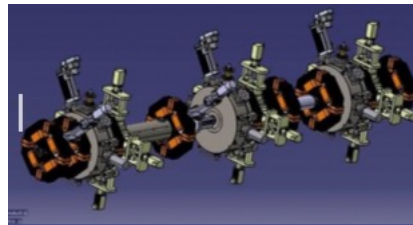
62% applies to HEP

- 14 University groups, 3 CSIC institutes, CIEMAT
- 12 Exp. Groups, 9 Theory groups
- Many groups combine experimentalist and theoreticians
- Community articulated around three facilities and a major instrument: AGATA, FAIR, ISOLDE, n-ToF

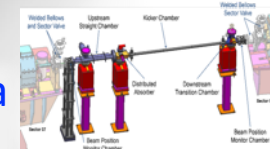


# R&D and Future accelerators Network

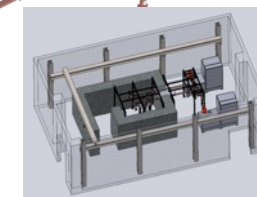
COordinación  
Nacional  
Española para la  
Ciencia y  
Tecnología de  
Aceleradores



Barcelona  
UPC, ALBA



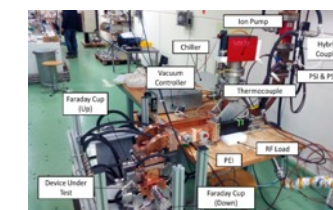
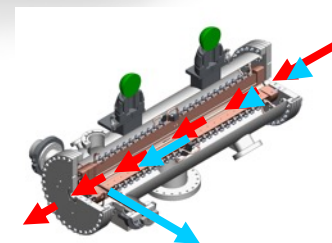
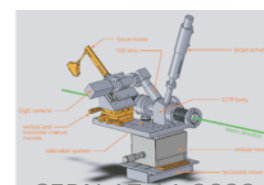
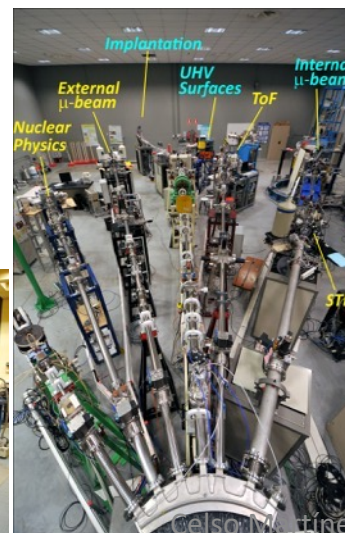
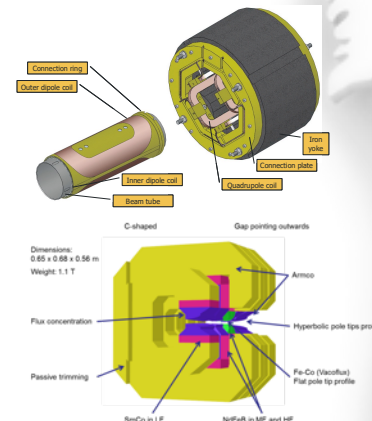
Valencia  
IFIC



Madrid  
CIEMAT, CMAM-UAM

Huelva  
UHU

Sevilla  
CNA



# New for 2022: RRF from EU

**From the RECFA letter in June 2019 to Spain:** “Make sure that an adequate anual budget is allocated to the construction and operation costs mentioned in the MoU’s with the LHC experiments”

- In part, this is done with these transfers in 2022 from the spanish ministry of science to CERN:

	PGE2021	PGE2022
CERN projects ATLAS, CMS, LHCb upgrades(50%), ISOLDE, nTOF(50%)	6.34 M€	6.34 M€
HyperK (PMT covers)	3.5 M€	3.8 M€
DUNE	2.1 M€	2.2 M€

# New for 2021/2022: New staff members

**From the RECFA letter in June 2019 to Spain:** “...with the exception of seniors scientists, the majority of engineers and some researchers are hired using Project-based budgets”

- In part, this is done with these open staff researchers/engineers in OPI's:

OPENINGS	New staff 2021	New staff 2022
CSIC, CIEMAT, CARLOS III, IAC (Tenured, Research, Professor)	312 + 34 + 10	450 + 82 + 26
CSIC, CIEMAT, CARLOS III, IAC (research assistant)	119	248
CSIC, CIEMAT, CARLOS III, IAC (Specialized technicians)	90 + 66	194 + 133

- However we have not assured the engineers needed for the LHC upgrade for Phase-2 and spanish involvement in future colliders!

# SUMMARY Mid-term Spain

**HEP in Spain is very active and enthusiastic** in both theoretical and experimental particle, astroparticle and nuclear physics. The Spanish HEP community is a fundamental partner of most of the relevant experiments in the field. Spanish physicists play important role in many experiments and facilities such LHC-experiments, CTA, ISOLDE, R<sup>3</sup>B,... etc.

## Funding:

- Our contribution to M&O, maintenance and operation, in LHC (~ 2M€) goes through the competitive program (except in this year 2022 which goes directly from AEI)
- HEP-networks play an important role in helping to organize our community –with little money- but today most of them have very minimal or inexistent funding.
- Number of staff researcher/engineers are growing in 2022
- Contribution to HL-LHC upgrades is provided by the same competitive program → Signature of MoU

**The General State Budget of 2021/2022 shows 12.7 M€ which are dedicated to the operation and construction of large instruments at CERN !**