

Theoretical AstroParticle Physics in Spain: some figures

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Domènec Espriu



UNIVERSITAT DE BARCELONA



Programa Nacional de Física de
Partículas

Some figures...

**Spain's GNP^a: 1.45 TCHF (0.92 T€ = 21,500 €/per capita).
Sustained growth for the last 10 yrs >3%.**

Total R&D: 16 GCHF (1.2%).

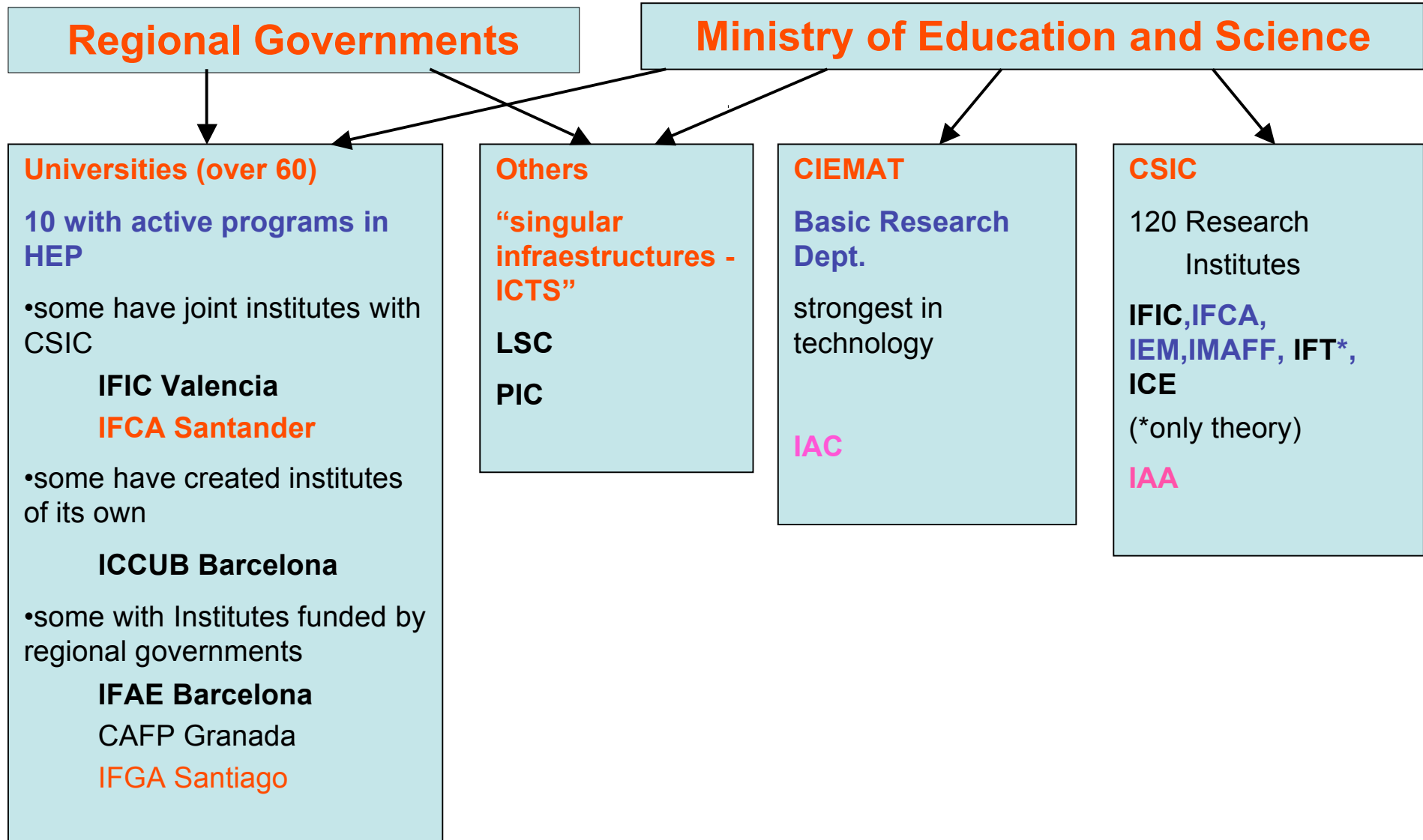
**Public sector expenditure (0.8%, 4th in Europe)
5th contributor to the CERN budget (8% = 80 MCHF).**

**Budget for basic R+D has increased >50%
during last 4 years.**

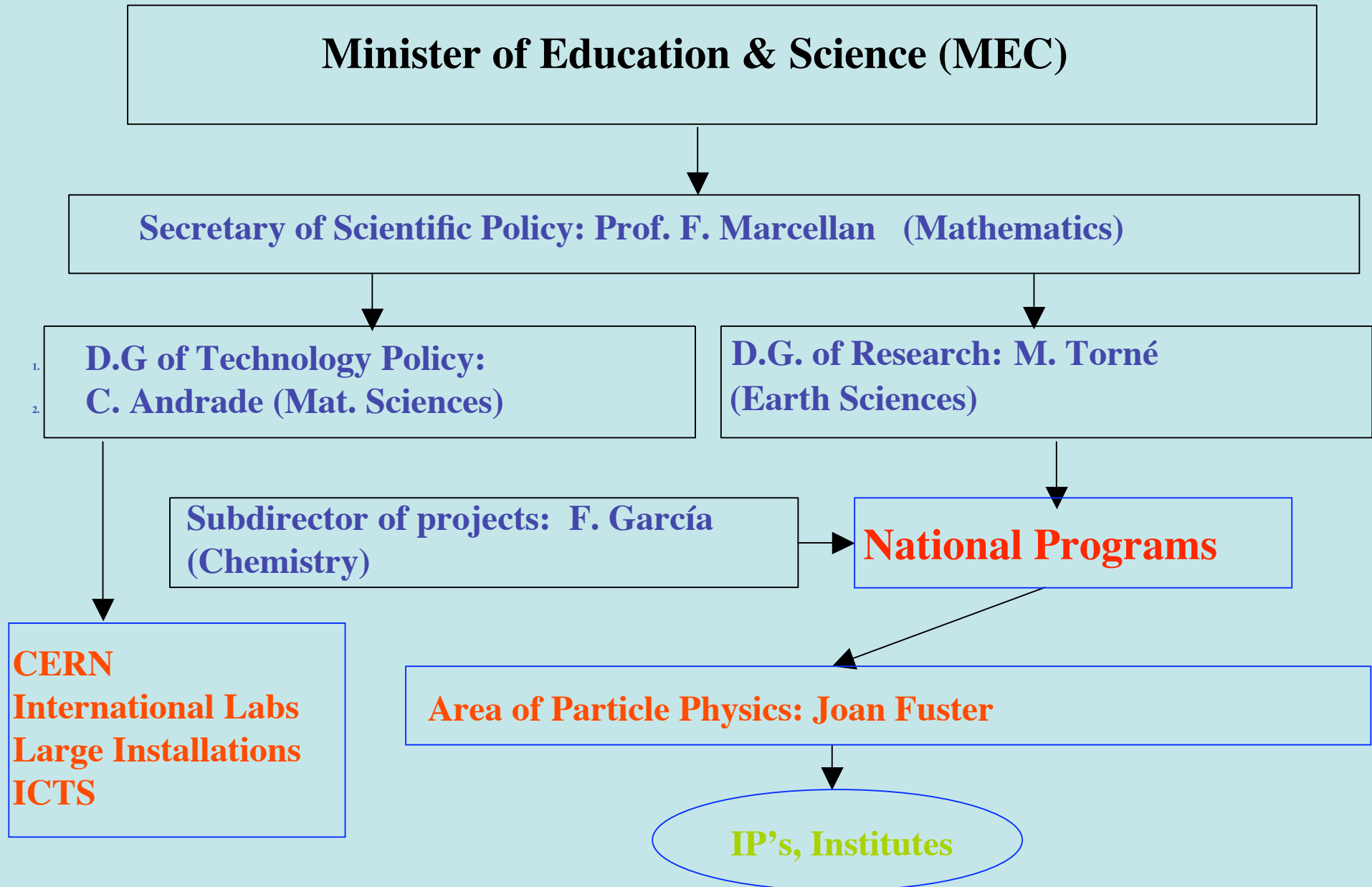
Overall R+D expenditure has doubled during last 4 years

^a 2006 data

HEP Research in Spain



Government/Physicists relations



Funding

Most research money (>95%) comes from competitive calls.

Projects are typically funded for 3 years, and exceptionally for 5 years (only one with interests in ThApP at present)

Theoretical projects tend to be comprehensive (one or two per institution) and ThApP is just one more of the activities (makes accounting difficult!)

Staff personnel is paid separately by the institutions and in no way is included in the figures given here. This includes 5 and 3 year fellowships that are centrally awarded (and a few 18 months one).

Postdoc money, on the contrary comes from the projects, and resources are still insufficient to have a vigorous autonomous postdoctoral program.

There are several sources for graduate fellowships. Most of them are awarded by the regional educational authorities and the Ministry of Education and Science based on academic record. A handful are handled by the projects themselves. In general there is no shortage of fellowships for worthy students, even if the system certainly lacks flexibility.

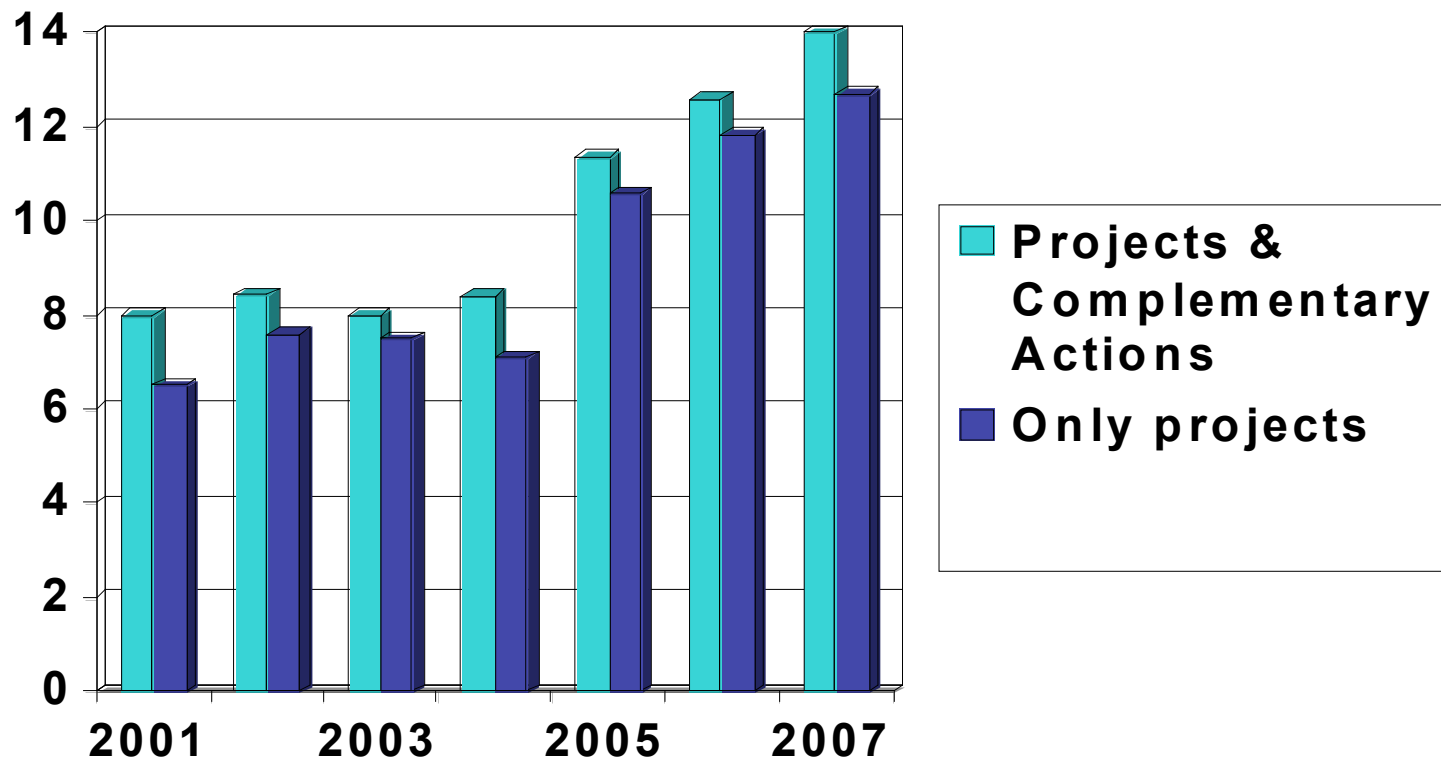
In the last two years the MEC has financed large groups/projects (**CONSOLIDER**).

One of them is **CEPAN** (funded with 12M€ for 5 years) whose main delivery is a National Center for Astroparticle, Particle and Nuclear Physics. Other two such projects are **PAU** and **CUP** (see below).

Funding circuit

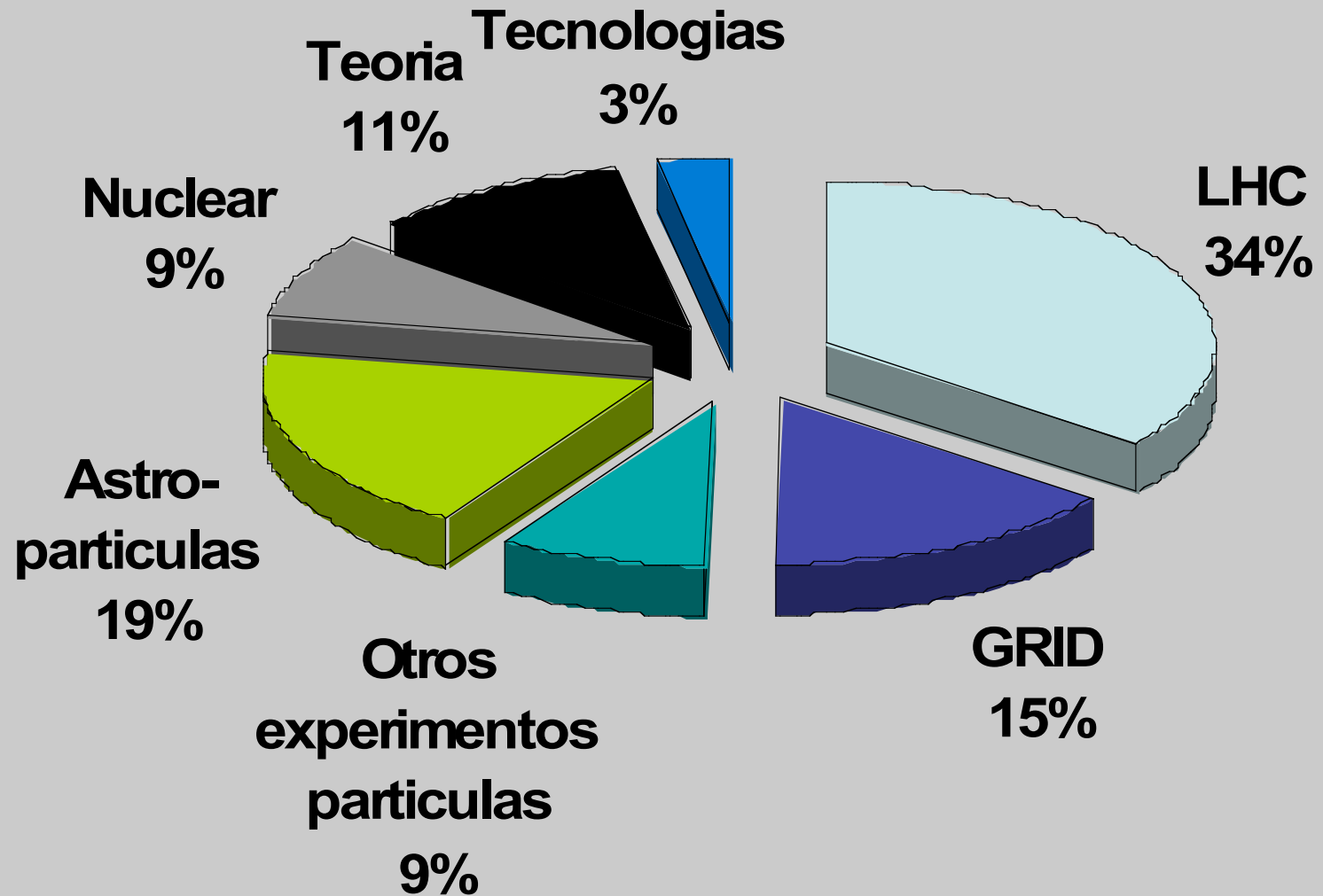
1. Competitive call is published.
 2. Projects are submitted and checked from the administrative viewpoint.
 3. Projects are sent to ANEP for anonymous peer review (typically 2 referees per project).
 4. Area coordinator negotiates an overall budget with the MEC.
 5. HEP Panel is nominated.
 6. Projects are defended in front of the Panel. Referees queries are answered.
 7. In principle HEP and A&A are evaluated by different panels, but when project overlap clearly joint advice is sought.
 8. Panel reaches a final decision on funding.
- Typical project success rate ~90%, funding success rate ~60%
 - The overall process takes 10-11 months

Yearly expenditure in the Particle Physics Program



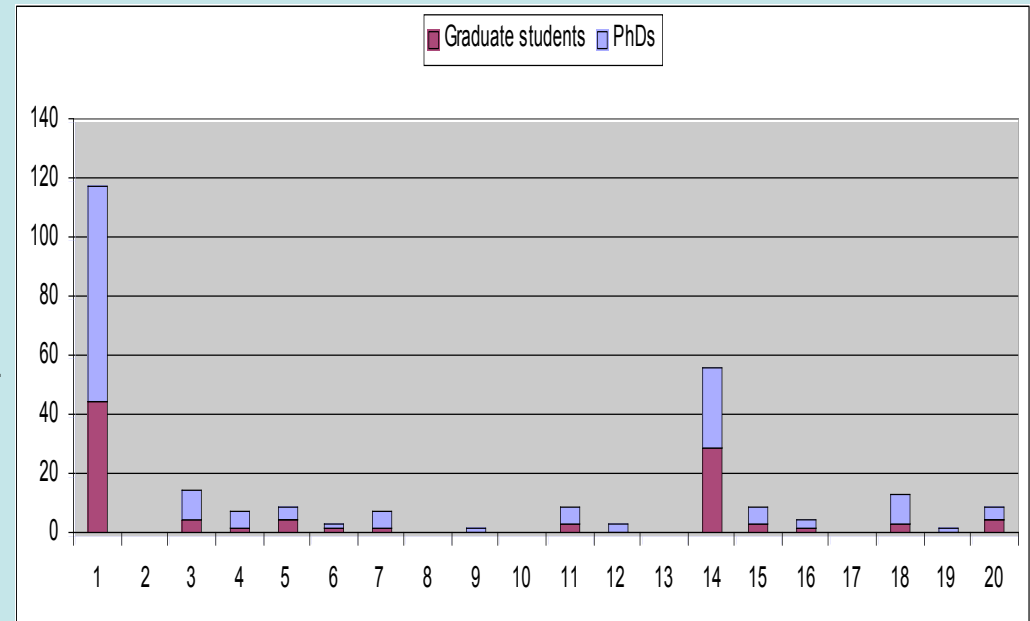
Quantities are in M€

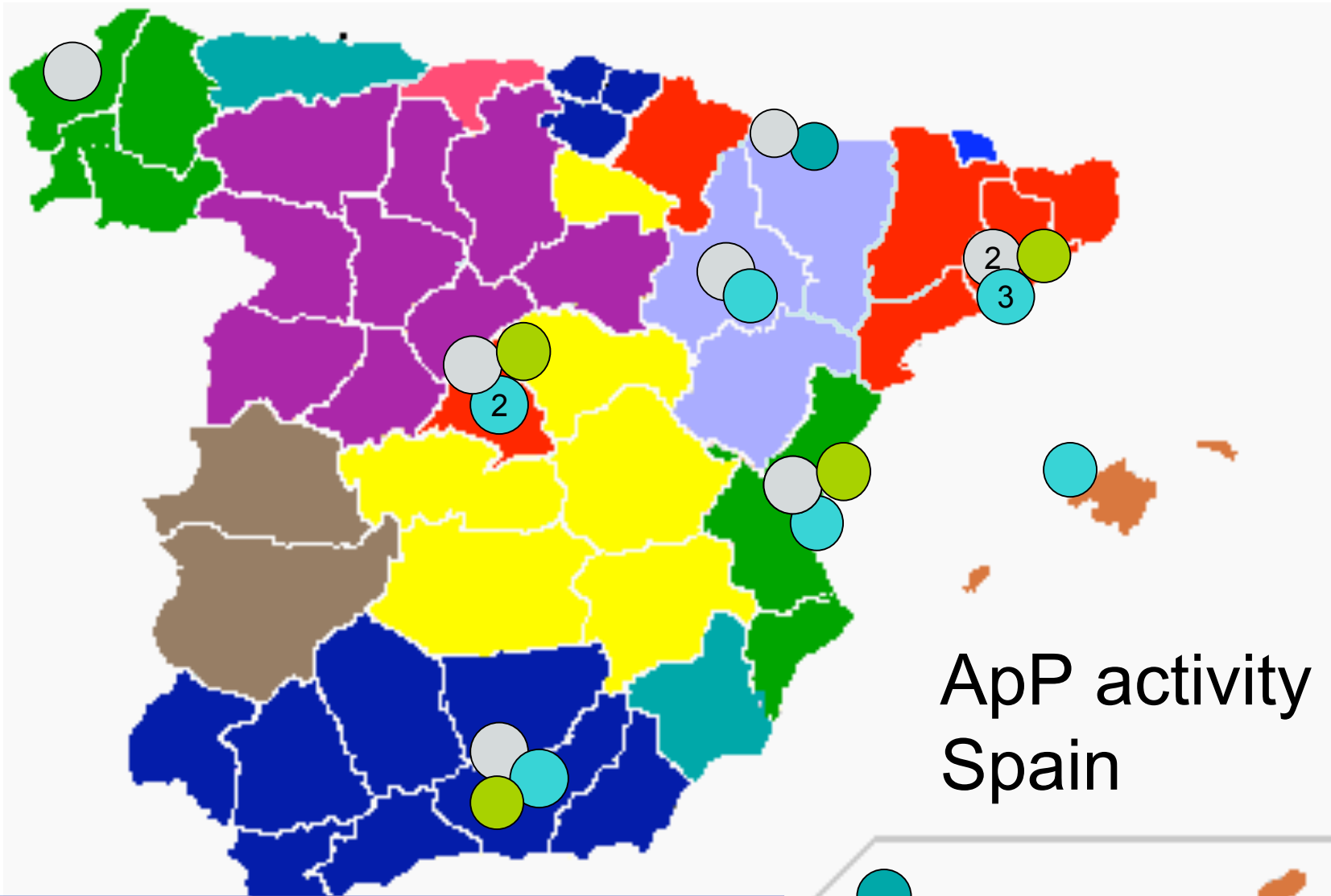
FPA2002-2006



Experimental Particle Physics Survey

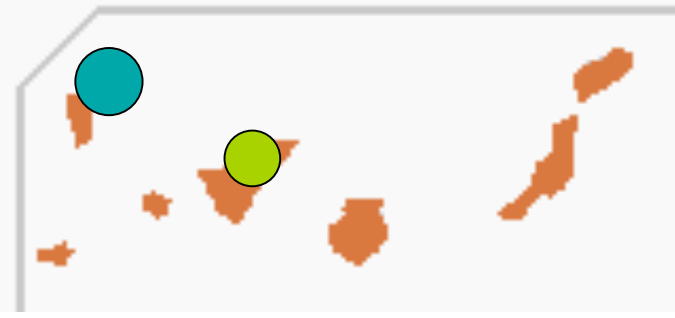
- 1 LHC: ATLAS, CMS, LHCb
- 2 LHC: ALICE
- 3 Ongoing Tevatron experiments
- 4 Preparations for a linear collider
- 5 Ongoing accelerator neutrino programmes
- 6 Preparing for future accelerator neutrino programmes
- 7 Ongoing non-accelerator based neutrino programmes
- 8 Preparing for future non-accelerator based neutrino programmes
- 9 Ongoing b-, quarkonium-factories
- 0 Next generation b-, quarkonium-factories
- 1 **Double beta decay & electron neutrino mass**
- 1 Future precision measurements of particle properties (e.g. EDM, g-2,)
- 2
- 3 Ongoing heavy ion physics
- 4 **Astroparticle physics**
- 5 **Observational cosmology**
- 6 HERA
- 7 Spectroscopy, muon/neutrino DIS (COMPASS...)
- 8 Detector R&D
- 9 Accelerator R&D
- 0 Other Projects

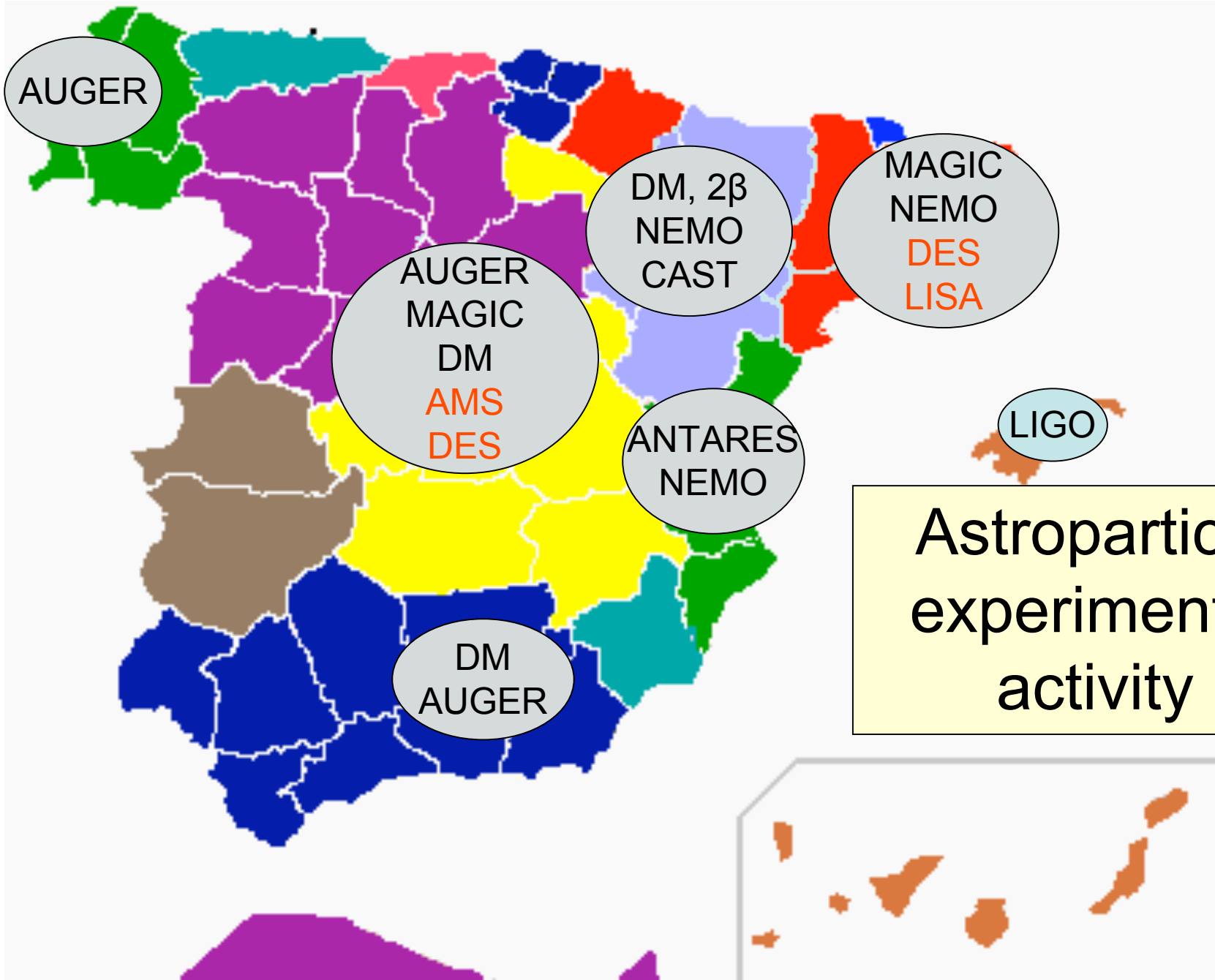




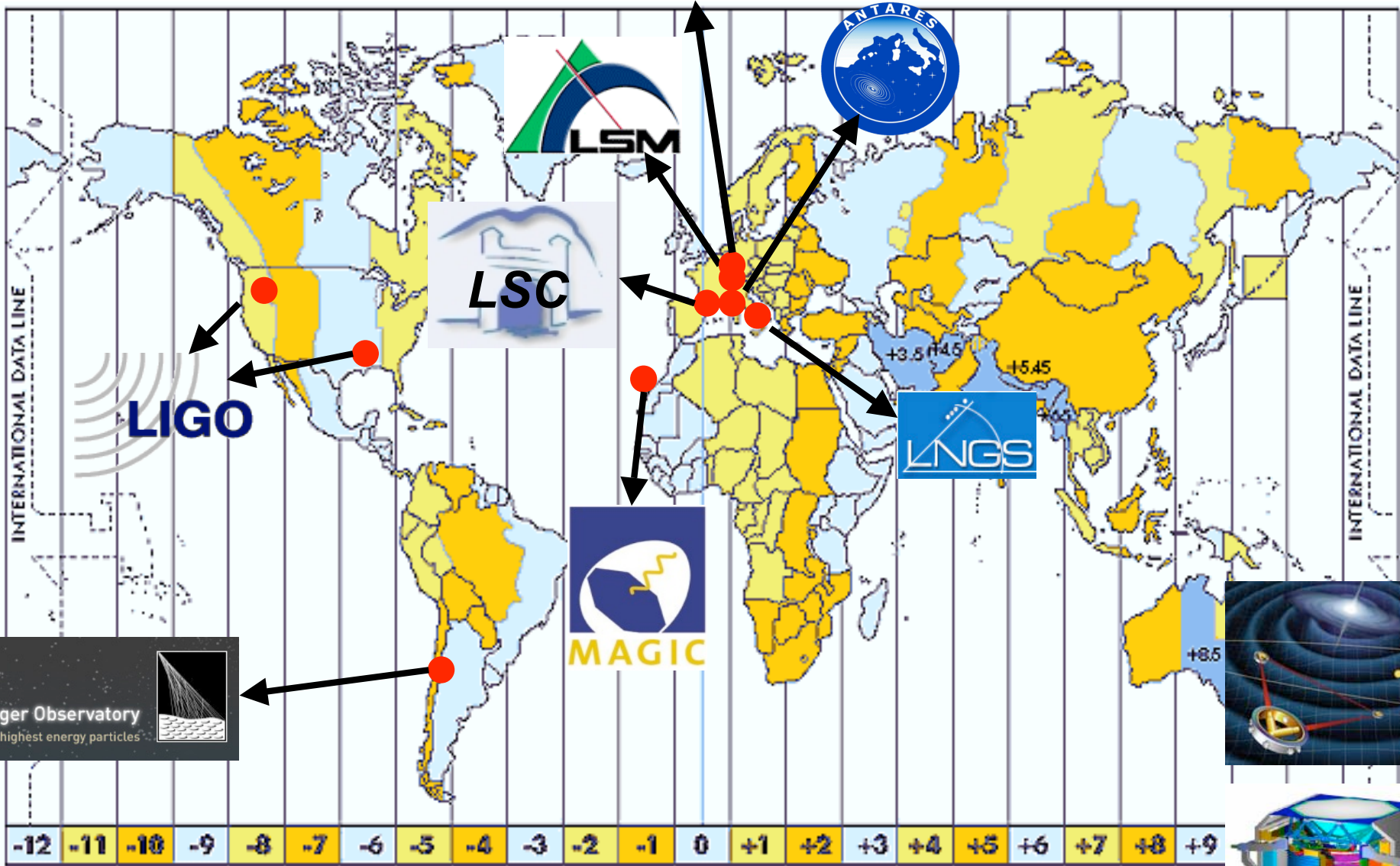
ApP activity in Spain

- Experimental group(s)
- Theory group(s)
- Scientific infraestructure
- Main Astrophysics group

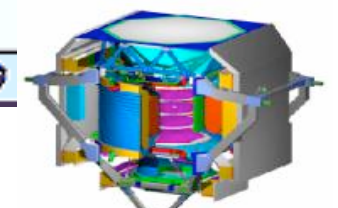
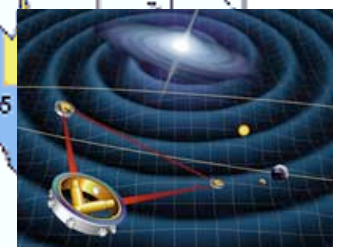




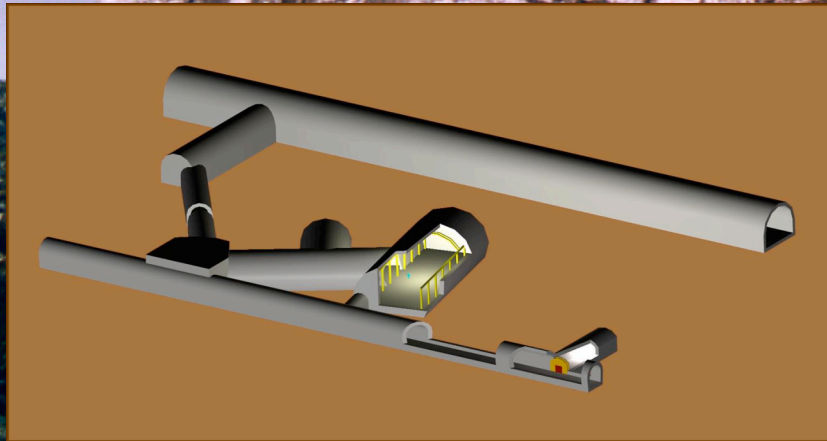
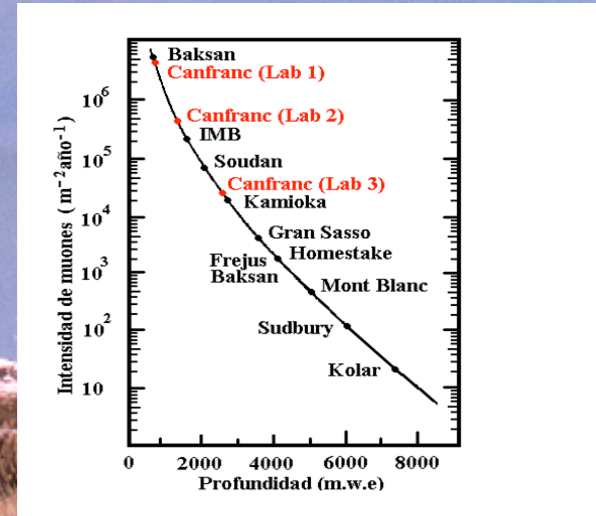
CAST
CERN Axion Solar Telescope



Auger Observatory
se's highest energy particles



AMS



THE CANFRANC UNDERGROUND FACILITY

- MAGIC is a 17m diameter Cherenkov telescope aimed at the exploration of the 50 GeV – 10 TeV g-ray band.

- MAGIC has successfully pioneered the use of all-aluminum mirrors, carbon fiber frame, active mirror control, optical analog transmission and fast digitizers in Cherenkov telescopes.

- It was commissioned beginning of 2005 and has entered the first cycle of regular observations.

- During its commissioning phase MAGIC has detected the Crab Nebula and the AGNs Mrk 421 and 1ES1959 at energies below 100 GeV. There is a preliminary confirmation of Sgr A at energies above 1 TeV.

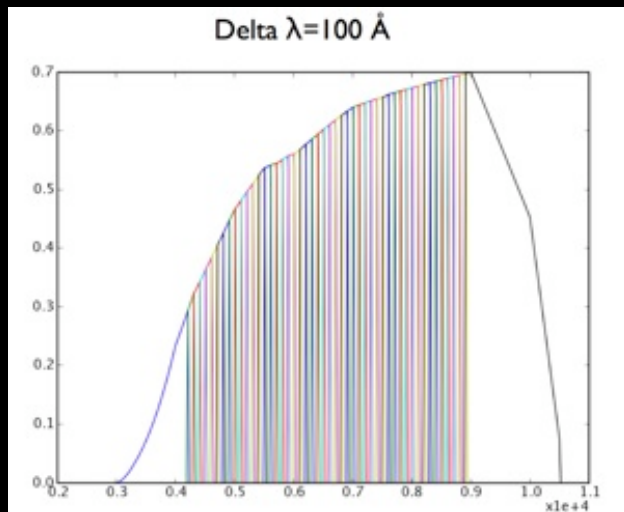
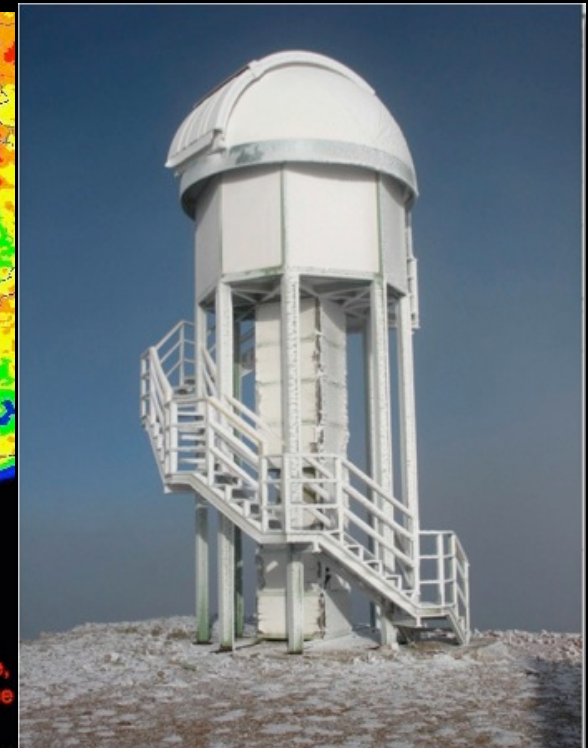
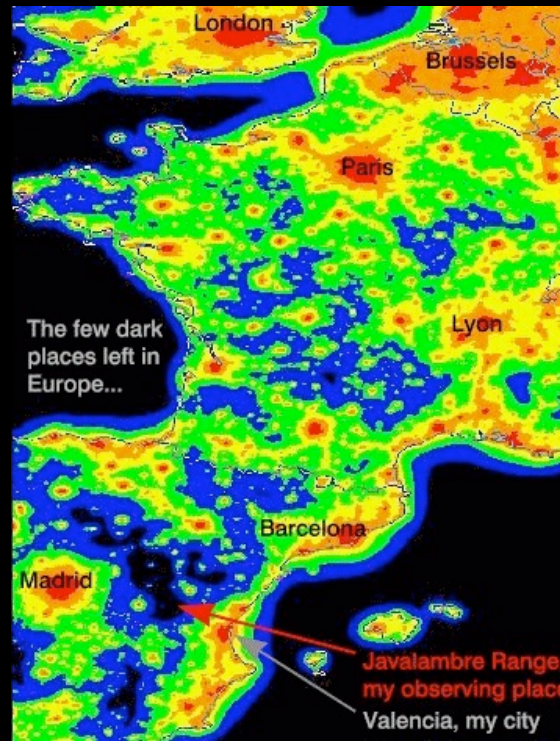
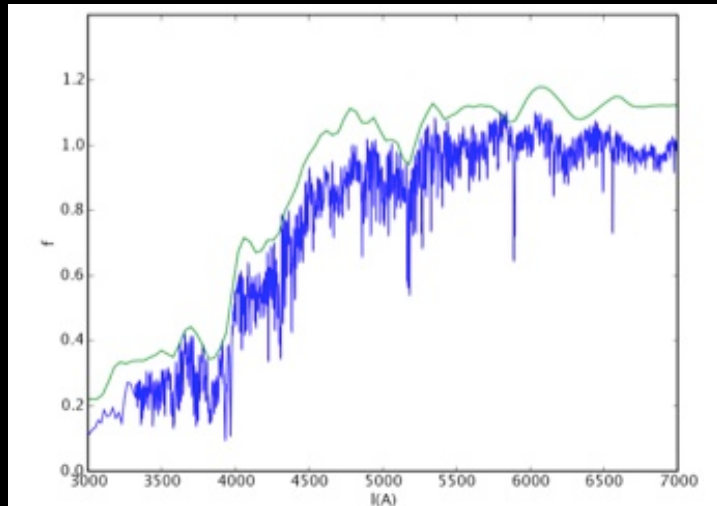
- The collaboration is building a second telescope that will operate in coincidence starting in 2007.

MAGIC @ La Palma



PAU (Physics of the Accelerating Universe)

PI: Enrique Fernández

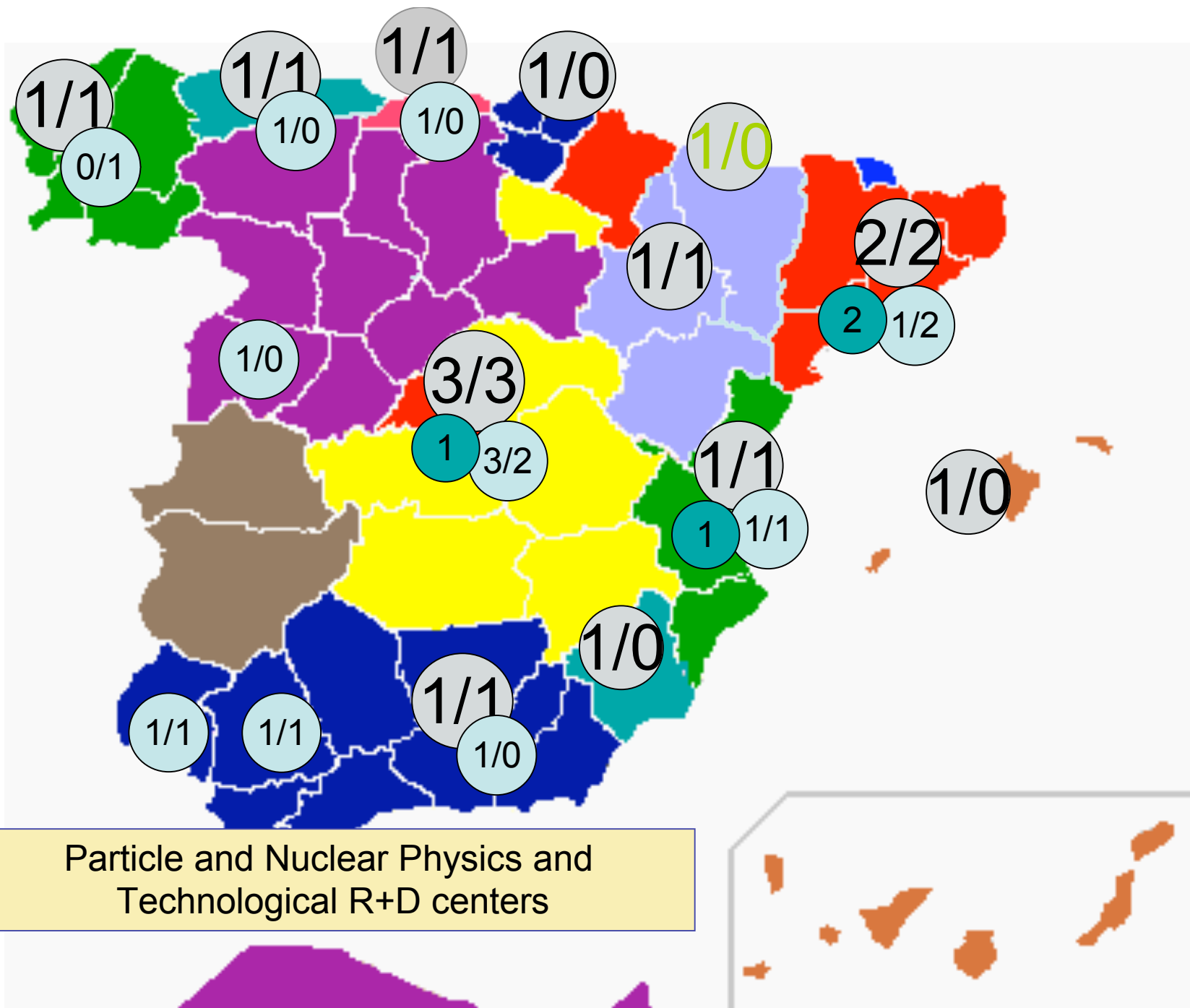


Aims to measure the BAO by using a multi channel approach. CCD camera (similar to DES) mounted on a 2.5m new telescope

100% Spanish project with driven by HEP with a few Astrophysicists

Funded for 5M for 5 years

Large theoretical component



Overall HEP theory funding in Spain

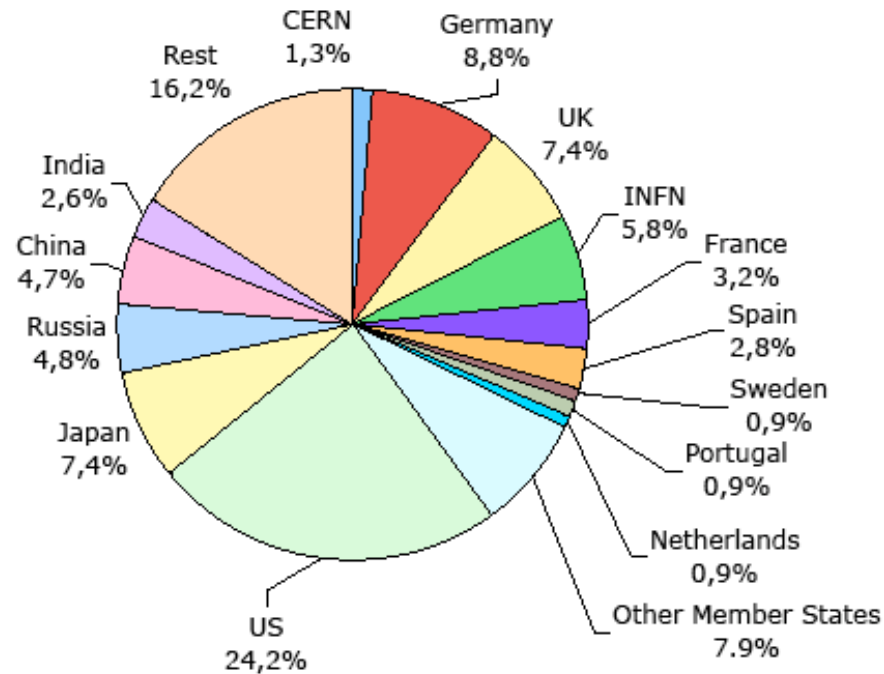
CONVOCATORIA	EDP1	EDP2	EDP3	TOTAL EDP	TOTAL SOLICITADO (sin dotacion adicional)	TOTAL CONCEDIDO (sin dotacion adicional)	NUMERO PROY.	% EXITO	FINANCIACION POR EDP
FPA 2004	42,5	25	7	74,5	1.618.921	1.063.175	10	65,67%	14.270,81 €
FPA 2005	59,5	14	35	108,5	2.594.686	1.639.225	11	63,18%	15.108,06 €
FPA2006	48	33	15	96	3.034.788	1.709.362	8	56,33%	17.805,85 €
RESUMEN				279	7.248.395	4.411.762	29	60,87%	15.812,77 €

~20% goes to Theoretical Astroparticle Physics

Distribution of HEP articles by country

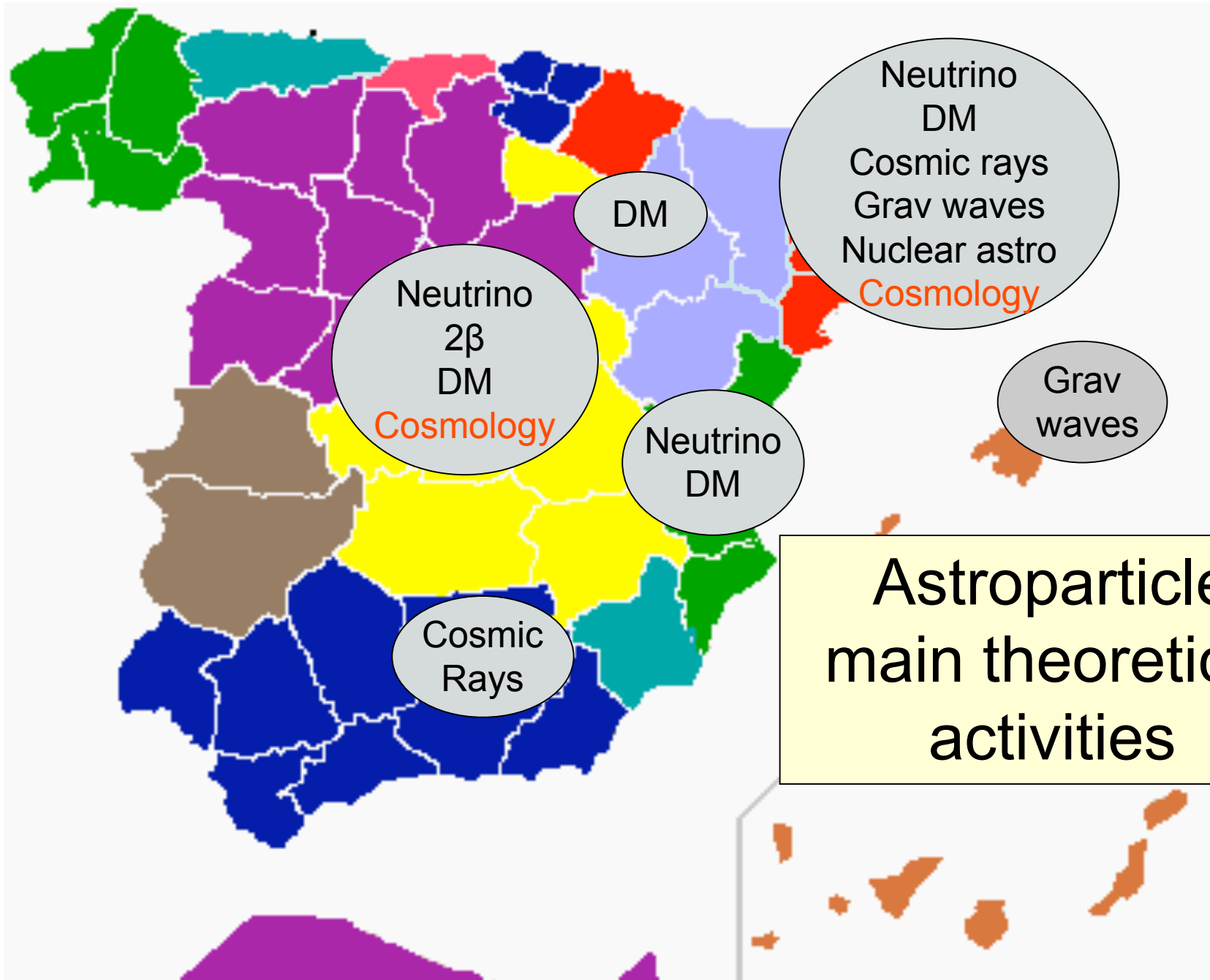
Status: 27/10/2006 19:30

Data: 5015 preprints submitted to arXiv in 2005 and subsequently published. Co-authorship is taken into account.



	Papers	CERN	Germany	UK	INFN	France	Spain	Sweden	Portugal	NL	Other MS	US	Japan	Russia	China	India	Rest
hep-ex	338	0,9%	6,8%	6,4%	11,1%	4,1%	0,8%	0,2%	0,3%	0,5%	4,8%	40,3%	5,6%	5,0%	6,4%	0,4%	6,3%
hep-lat	245	1,1%	19,5%	6,3%	5,8%	2,0%	1,2%	1,2%	0,5%	0,5%	4,0%	30,0%	9,2%	3,5%	2,3%	2,0%	11,0%
hep-ph	2207	1,7%	10,3%	6,6%	5,5%	3,3%	3,5%	0,8%	1,4%	0,5%	7,8%	23,0%	6,4%	5,6%	6,7%	2,7%	14,1%
hep-th	2225	1,1%	6,5%	8,5%	5,3%	3,2%	2,6%	1,0%	0,5%	1,4%	8,8%	22,4%	8,4%	4,0%	2,8%	3,0%	20,4%
Average		1,3%	8,8%	7,4%	5,8%	3,2%	2,8%	0,9%	0,9%	0,9%	7,9%	24,2%	7,4%	4,8%	4,7%	2,6%	16,2%

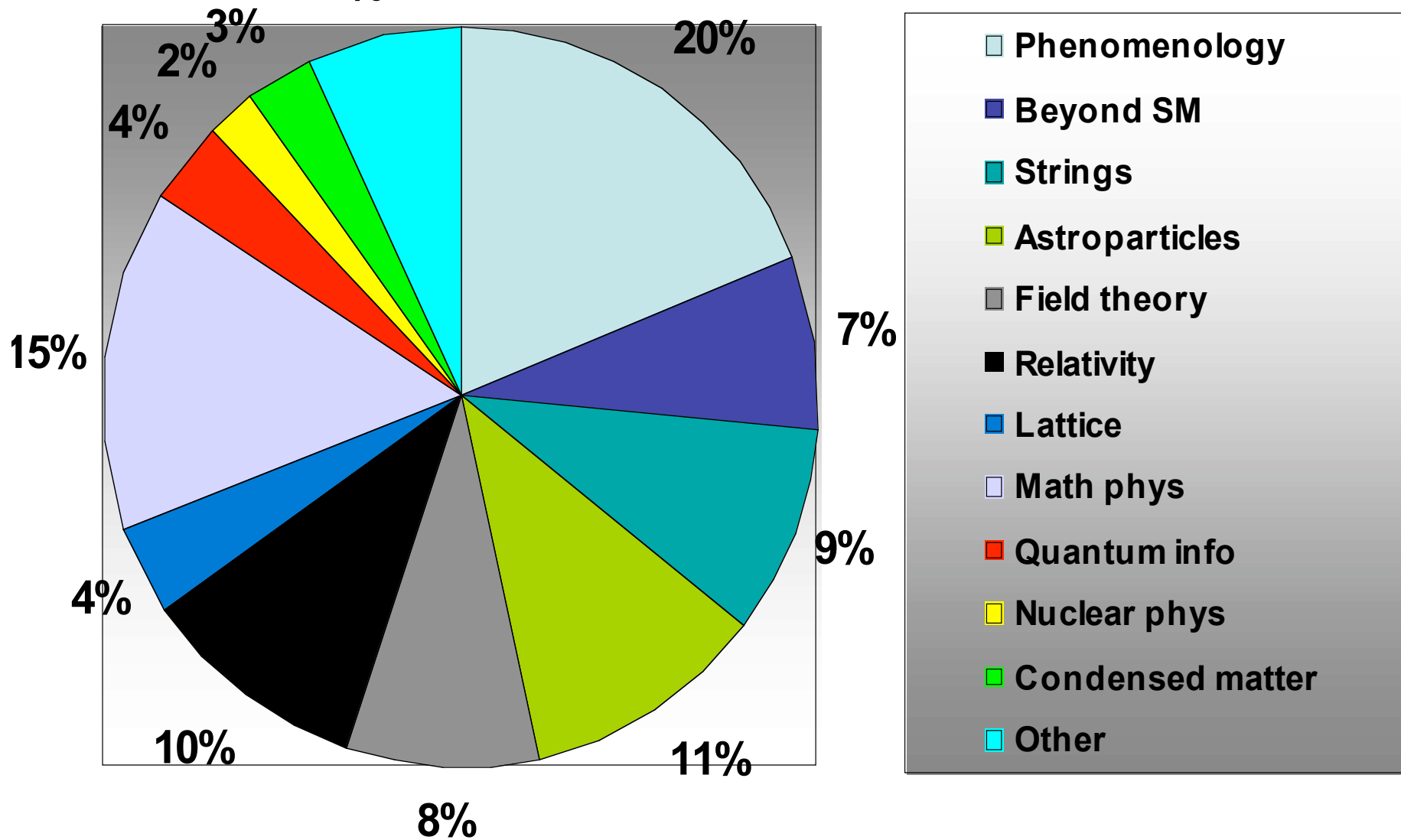
Source: CERN Scientific Information Service (contact: Salvatore Mele)



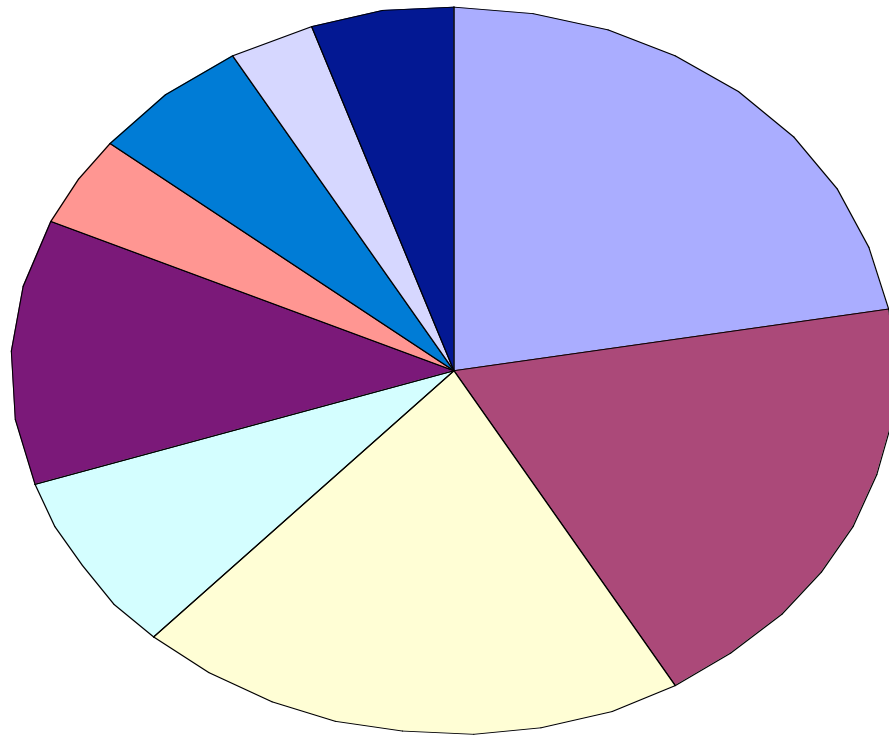
The ThApP main groups in detail (2006)

	Total FTE	Staff	Associates	Postdocs	Graduate students	Funding (projects)
Theory / UB Barcelona	8,0	2,0	0,5	1,5	4	40,00
Theory / UAM Madrid	10,5	2	2	4,5	2	59,00
Theory / IFIC Valencia	10	3	2	2	3	82,00
Theory/U. Zaragoza	6,5	1,5	1		4	98,00
Theory/U.A.B.	6	2	2		2	39,00
Theory/U. Illes Balears	4	2,5	0,5			15,7
TOTAL	45,0					333,70

Theoretical topics & interests (2003)



Publicaciones 2005



- Fenomenología
- Experimental
- Teórico
- Gravitación y Cosmología
- Nuclear Teórico
- Instrumentación
- Nuclear experimental
- Lattice
- Astropartículas

Publicaciones en 2005: 599

Datos extraídos del proyecto CONSOLIDER

Networks

- **ILIAS** or ILIAS-Next.
- **RENATA**: Astroparticle network. Coordinated by J. Valle (cosmic rays, astrophysical neutrinos, cosmology)
- **RETENU**: Neutrino network. Coordinated by C. González-García (underground physics, neutrinoless double beta decay, accelerator neutrino experiments)
- Both are currently funded for 2 years ~20 k€ for travel, meetings, etc.
- RENATA and RETENU have both submitted proposals to the CONSOLIDER program in 2008
 - RETENU → **CUP** (Canfranc Underground Physics) with proposals on double beta decay, dark matter, large underground geological studies and astrophysical nuclear reactions.
 - RENATA proposal lacks a focal experimental purpose in my view.
 - Both proposals are still preliminary and clearly need a clearer definition.

Some comments of my own..

- Overall the fraction of theorists doing ApP is commensurate with the fraction of experimentalist.
- Most ThApP is done in larger theoretical projects funded by rolling grants. Interesting to have specific projects?
- The distinction between Astroparticle physicists and Cosmologists is rather tenuous in theoretical groups.
- I personally find the distribution of topics addressed by Spanish groups too biased towards particle cosmology. We need more theorist working on hard problems of CR, HEGR, DM annihilation, nuclear astrophysics, nuclear matrix elements, etc.
- The interaction between theoretical astrophysicists and astroparticle physicists has been relatively scarce (still two different communities in Spain), but this seems to be changing. The potential of the present CONSOLIDER proposals to change this state of affairs should be exploited.
- Theory work in ApP is almost completely funded by HEP; it would perhaps be natural to attract some of the closest astrophysicists as setting up a specific panel seems out of the question. Theoretical nuclear astrophysics is also funded by a separate panel.
- I find important to foster the HEP-AA dialogue at the European level.
- The only European-wide network (ILIAS) is weak on theory and in the case of Spain has not worked too well. New ideas needed! (European-wide ApP school?, workshops at a fixed site (Benasque-Canfranc), working groups to foster interaction with experimentalists?)
- It is worrisome that there seems to be too little interaction in Spain between ApP experimentalist and theorists, even (or particularly) at the local level.
- We have been in Spain in an environment of rapidly increasing budgets for basic science, but this will not last forever. We should expect more modest budget increases during the next four years. It should not affect theory too much of course, but ...
- The main problem in Spain is the scarcity of human resources, which reflects too short a history in particle physics. Current CONSOLIDER proposals should attempt to change this.