



ECFA Mid-Term Report

ECFA meeting 2006-12-01

Outline

- HEP in Spain
 - Organization
 - Human resources
 - Scientific contributions
 - Funding
- Education - Students
- LHC Computing
- Last RECFA meeting
 - Recommendations & follow-up
- Conclusions

HEP Research in Spain

Particle Physics

Experiment & Theory

Nuclear Physics

Experiment
Some Theory

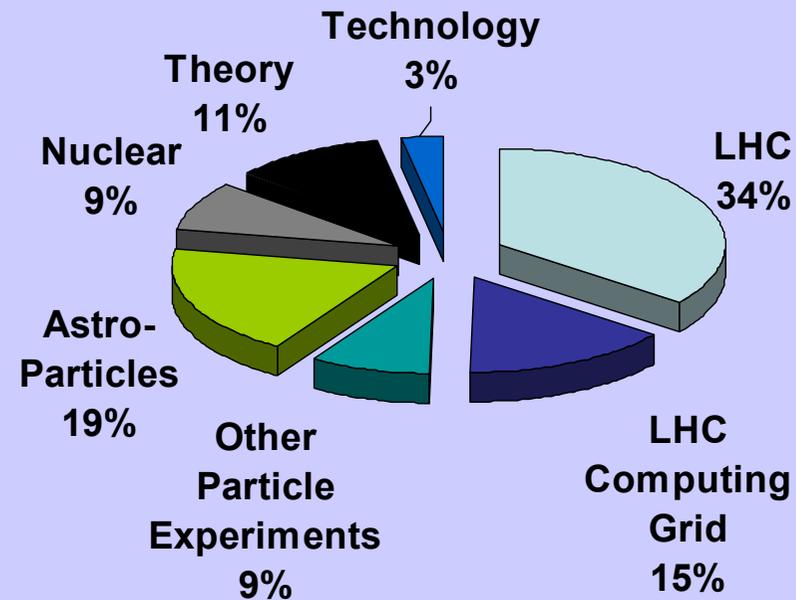
Astroparticle Physics & Cosmology

Theory & Experiment

Information Technology

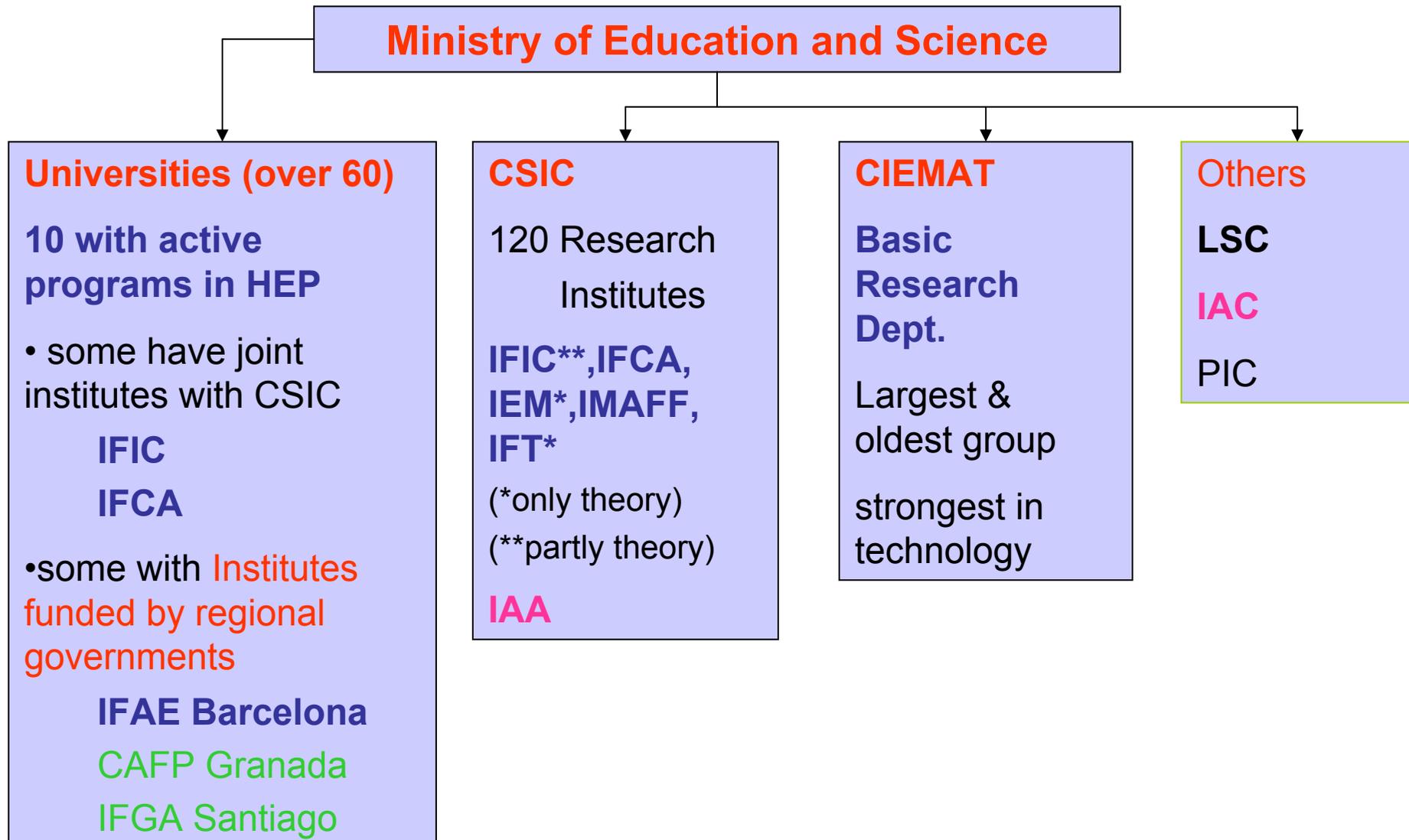
R&D in Accelerators and Detectors

Physics Applications



Average Funding 2002-2006

HEP Research in Spain



The Spanish National Plan 2004-2007 for Scientific Research, Development & Technological Innovation

Organised in 11 areas and 31 National Programs

Area of Space Science, Mathematics & Physics

- National Space Program
- National Astronomy & Astrophysics Program
- **National Particle Physics Program**
- National Mathematics Program
- National Physics Program



National Plan Instruments

Funds allocated to research groups in form of

- **Projects (2-3 year)**
 - 2 evaluation processes**
 - a) peer review
 - b) experts committee
 - + public presentation and defense**
- **“Special Actions”**

Personnel

- Fellowship program (**predoctoral**)
 - FPU (National Level), FPI (Project related), others (Regional...)
- Ramón y Cajal program (**“tenure track” positions centrally selected**)
- Juan de la Cierva (**project related PostDocs centrally selected**)
- Support for technicians (**co-financing**)

Permanent scientific Staff & infrastructure depend generally on Institutions

Human resources

HEP staff & graduate students in Spain

(projects supported by PNFPA as of 1-1-06)

Permanent scientific staff: 230

Temporary scientific staff: 135

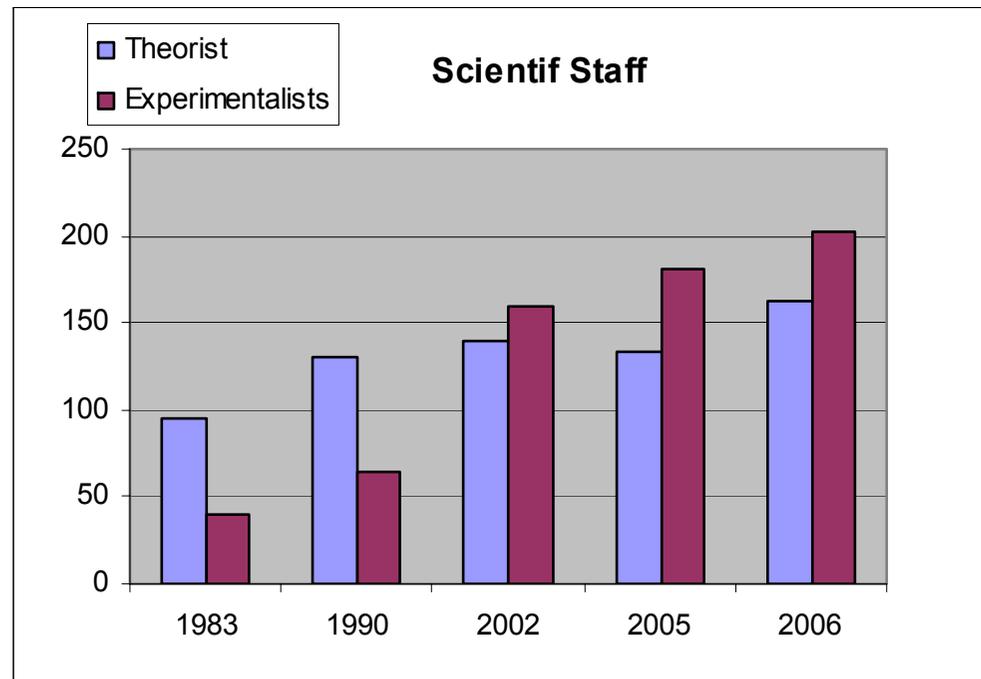
Graduate students: 212

Technical: 72

Total 437

Including Experimental
Nuclear Physics
& LHC Computing

Experimentalists: 203
Theorists: 162



Experimental Particle Physics Survey

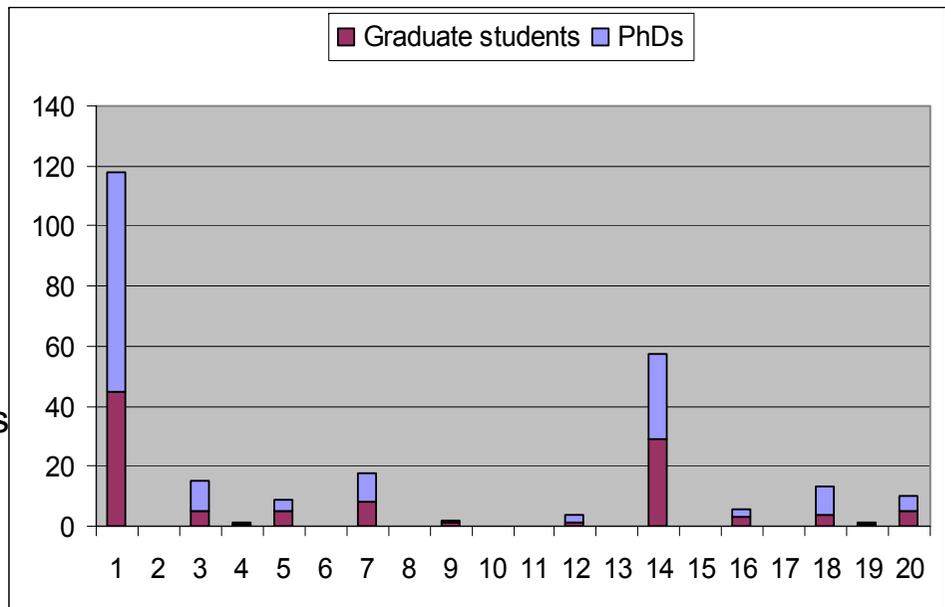
	Total	Total/Population FTE/million hab. (40.4 m)	Total/Population Average CERN Member states	Total/GDP FTE/G€ (835 G€)	Total/GDP Average CERN Member states
Graduate Students	107	2.6 65%	4.0	0.13 72%	0.18
PhDs	147	3.6 40%	8.9	0.18 44%	0.41
Total	254	6.3 48%	13.0	0.30 51%	0.59

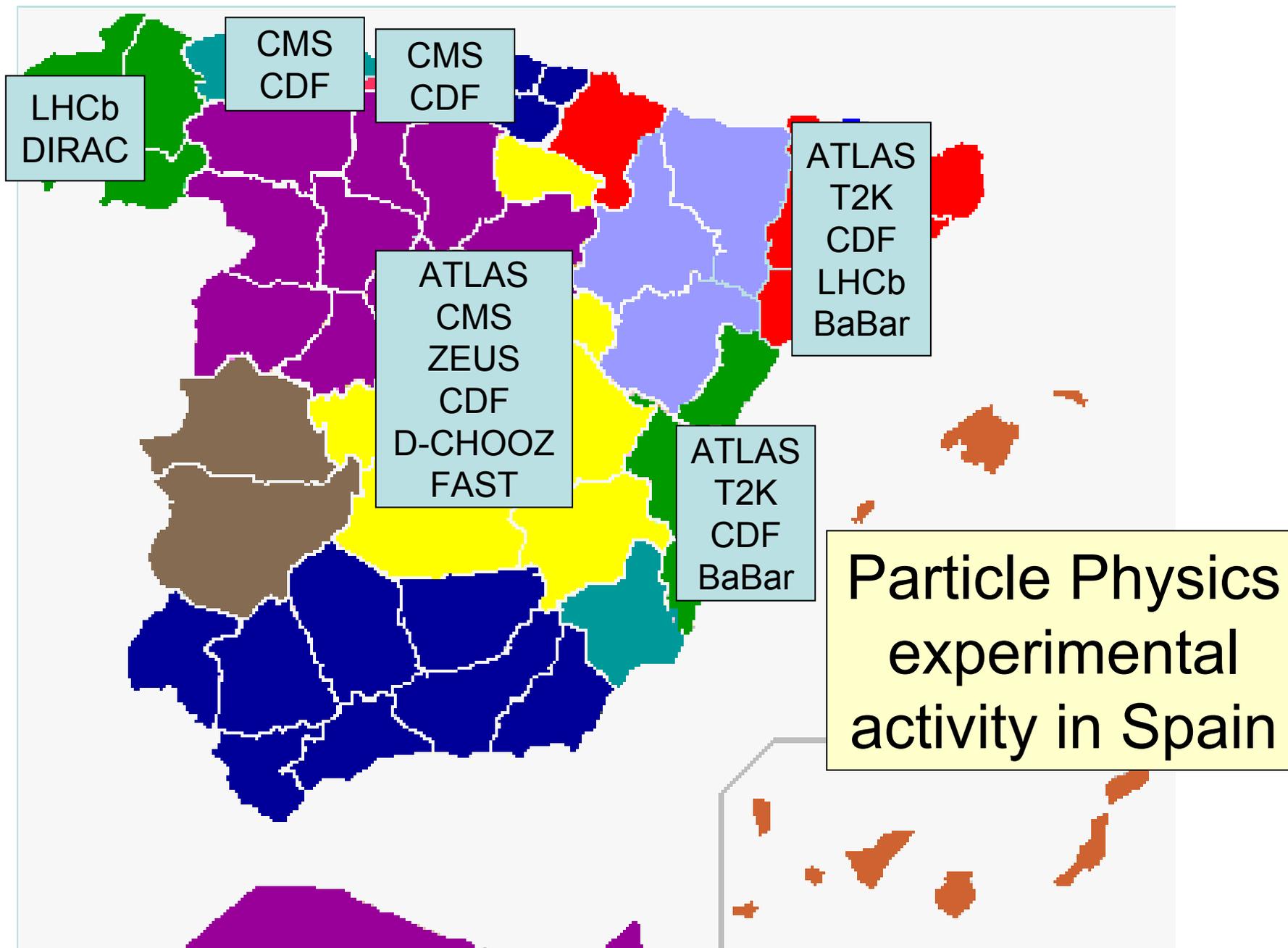
Spain = **8.7%** Population of CERN 20 member states
8.2% Gross Domestic Product

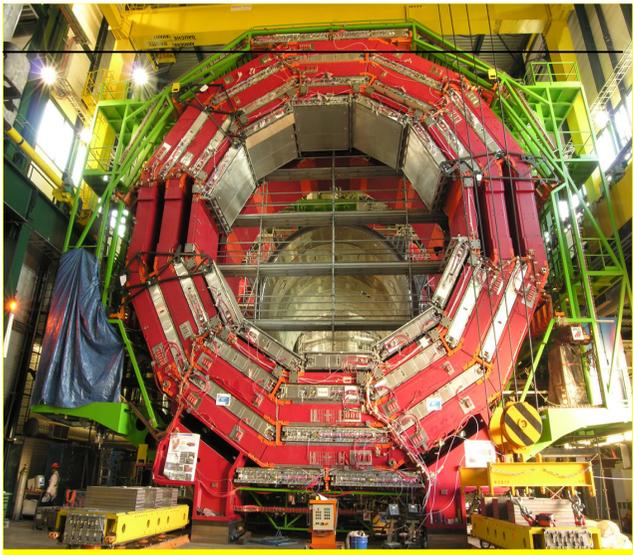
Scientific contributions

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
- 10 Next generation b-, quarkonium-factories
- 11 Double beta decay & electron neutrino mass
- 12 Future precision measurements of particle properties (e.g. EDM, g-2,)
- 13 Ongoing heavy ion physics
- 14 **Astroparticle physics**
- 15 Observational cosmology
- 16 **HERA**
- 17 Spectroscopy, muon/neutrino DIS (COMPASS...)
- 18 **Detector R&D**
- 19 Accelerator R&D
- 20 Other Projects







CMS Experiment: Contribution to the detector construction

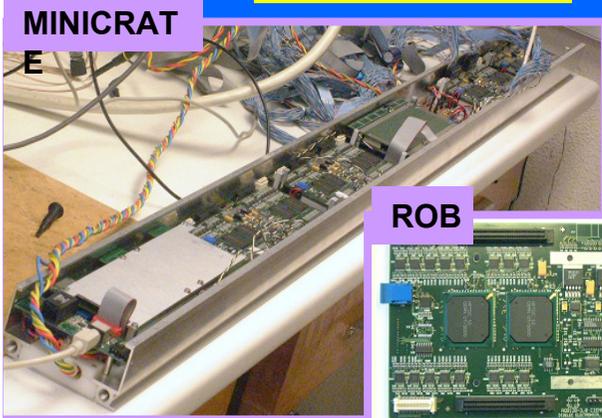
➤ Barrel Muon Drift Chambers (CIEMAT)

Design and production of 70 chambers (~ 25 % of the total , 700 readout channels /chamber)
 Aim: to identify, trigger, and measure the position (to 100 μm) and angle (to 1mrad) of muon tracks with efficiencies better than 99%

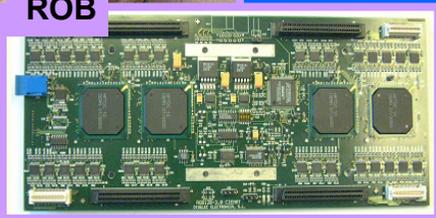


Installation at CERN

Chamber Assembly Hall at CIEMAT



MINICRATE



ROB

➔ 85% of production completed (may 2005)

➤ Muon Chamber Readout Electronics (CIEMAT)

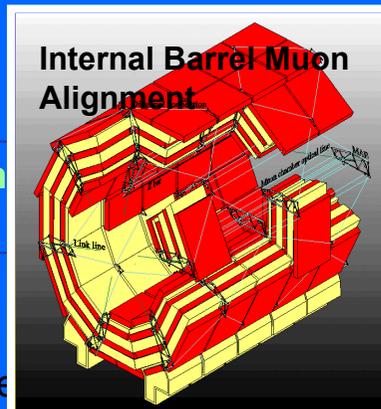
Design and fabrication of the muon chamber readout system

- **ROB (Readout Boards)** located in the "minicrates", to process the signals from the Front End; contain TDCs (128 channels each board)
- **ROS (Readout Server Board)** to collect signals from Minicrates and to transmit them to DDU and DAQ system.

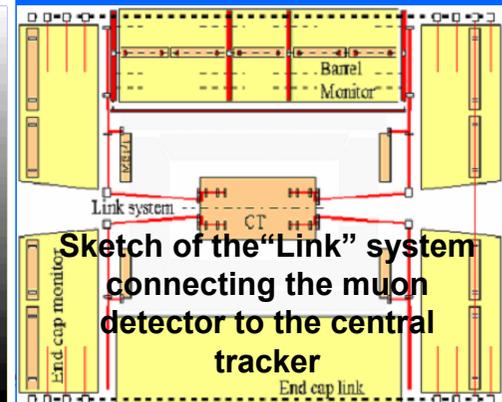
➤ Alignment System (CIEMAT – IFCA)

Monitor the relative positions of muon chambers with respect to the central tracker (200 μm precision)

- Design of the opto-mechanical system
- Tests and calibration of all system components
- Associated Electronics Spain Mid-Term Report



Internal Barrel Muon Alignment

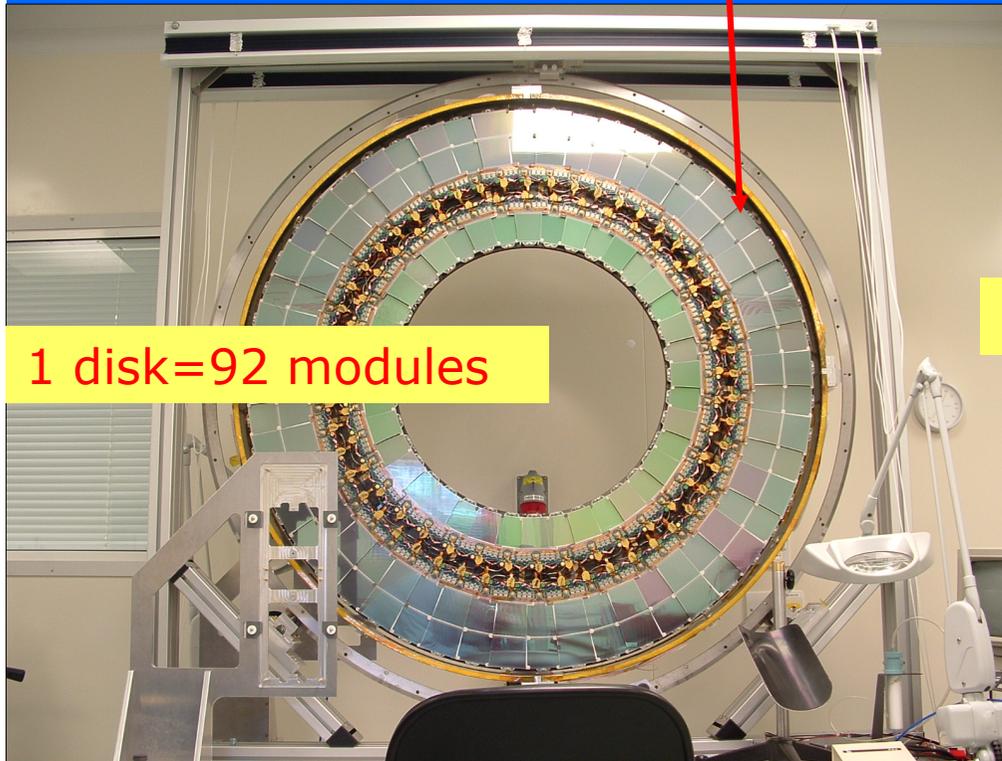
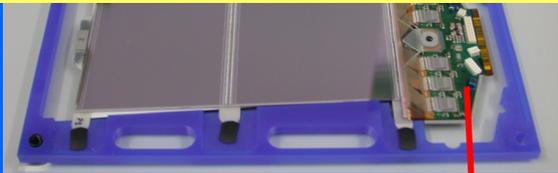


Sketch of the "Link" system connecting the muon detector to the central tracker

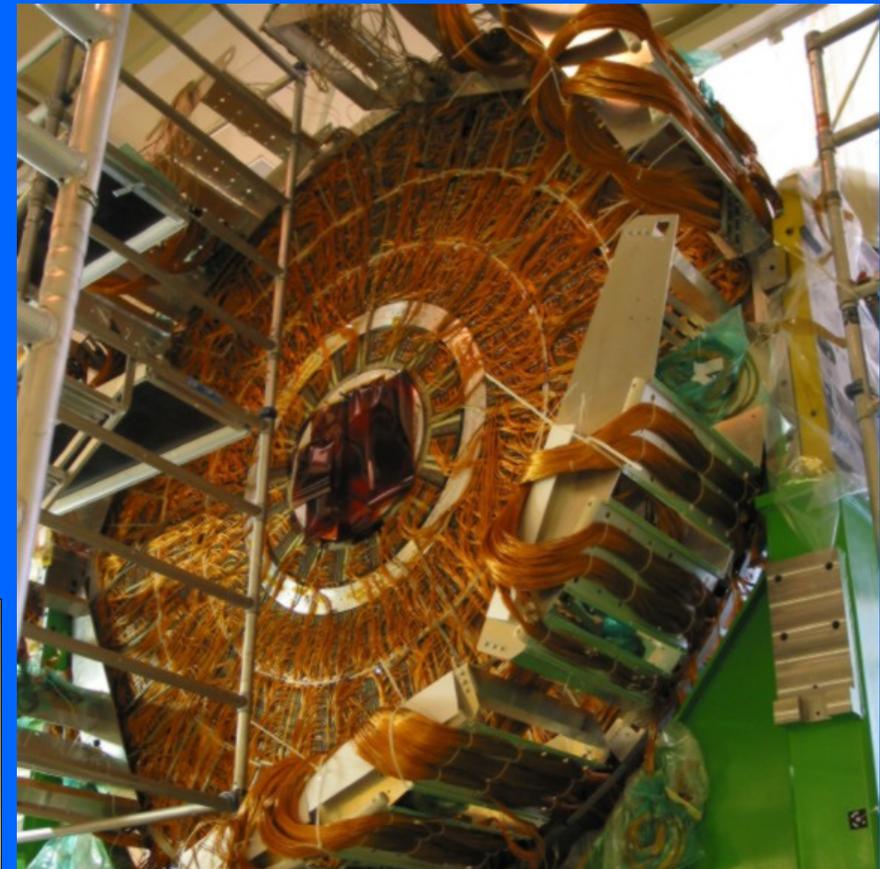
VALENCIA - IFIC:

- 280 Si Strip Tracker modules
- equiv. to 3 of 18 EndCap disks
- 430 kStrips altogether.

1 module = 2 wafers + 6 chips



1 disk=92 modules



LAr EM EndCap C, assmbld @ CERN

MADRID - UAM:

- Pb absorber stacks for one LAr EM End Cap wheel
- HV, summing, test boards, totaling 6700.

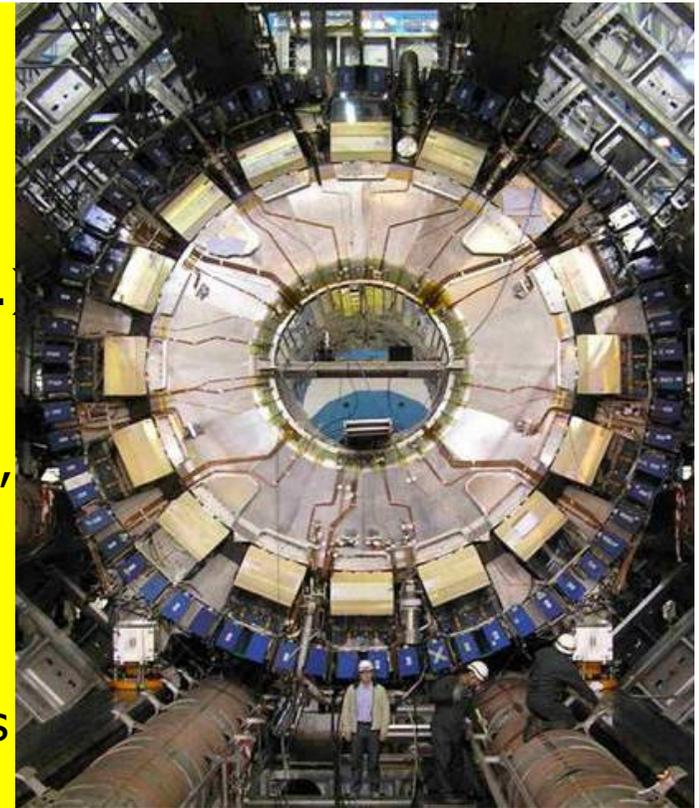
64 modules, CERN, May '03



One module, IFAE



-Barcelona- IFAE: mech.& opt. assembly of one **TileCal** Endcap (64 mod. (w/IFIC: part of mech. ass'y), calib. electronics, 10 k channels
-Valencia IFIC: 10 k channels Read Out Drivers (32 ROD mod.)



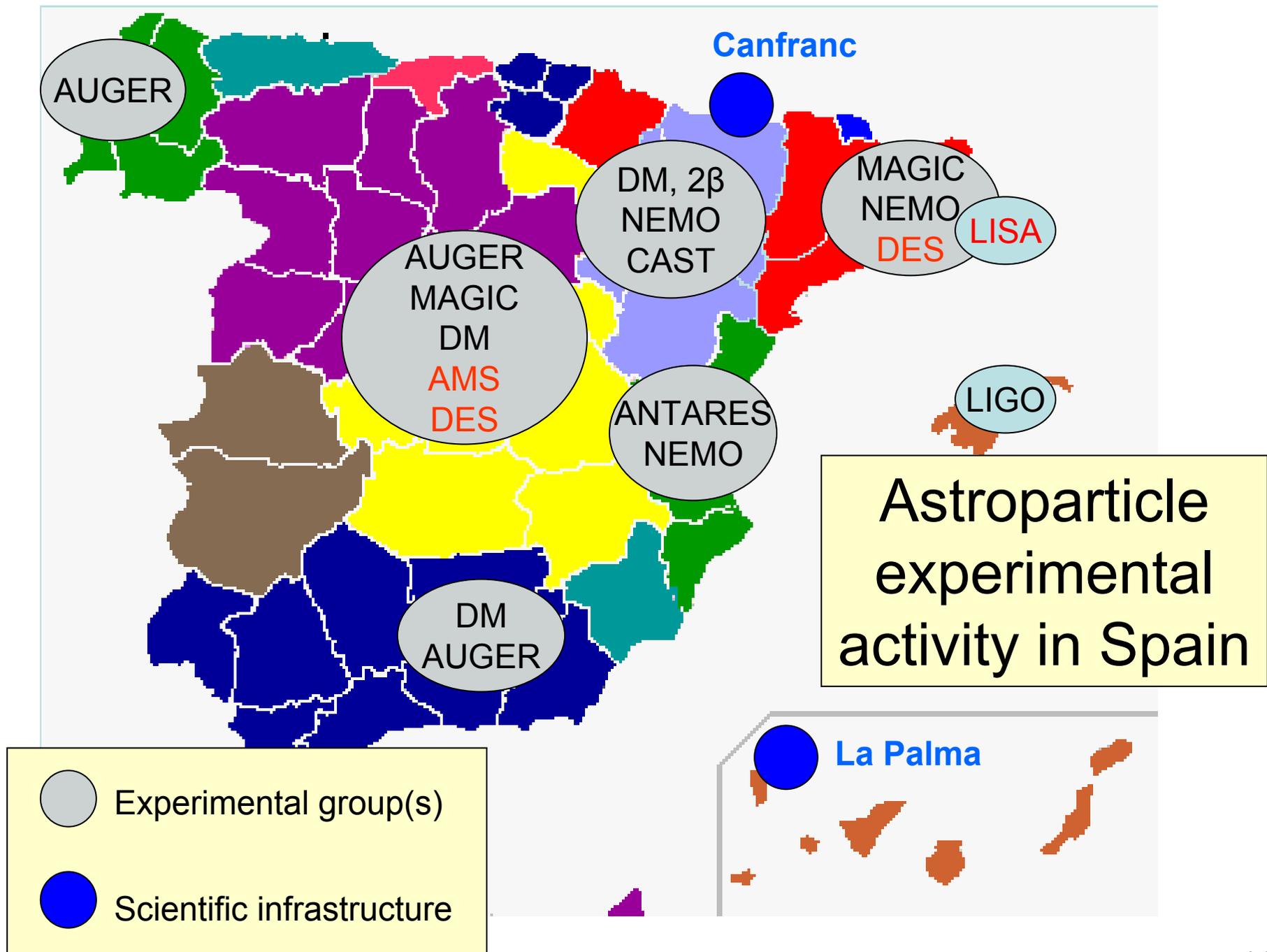
ATLAS Spanish Common Project: 8 Barrel Toroid Vac. Vessels (25mx5m)

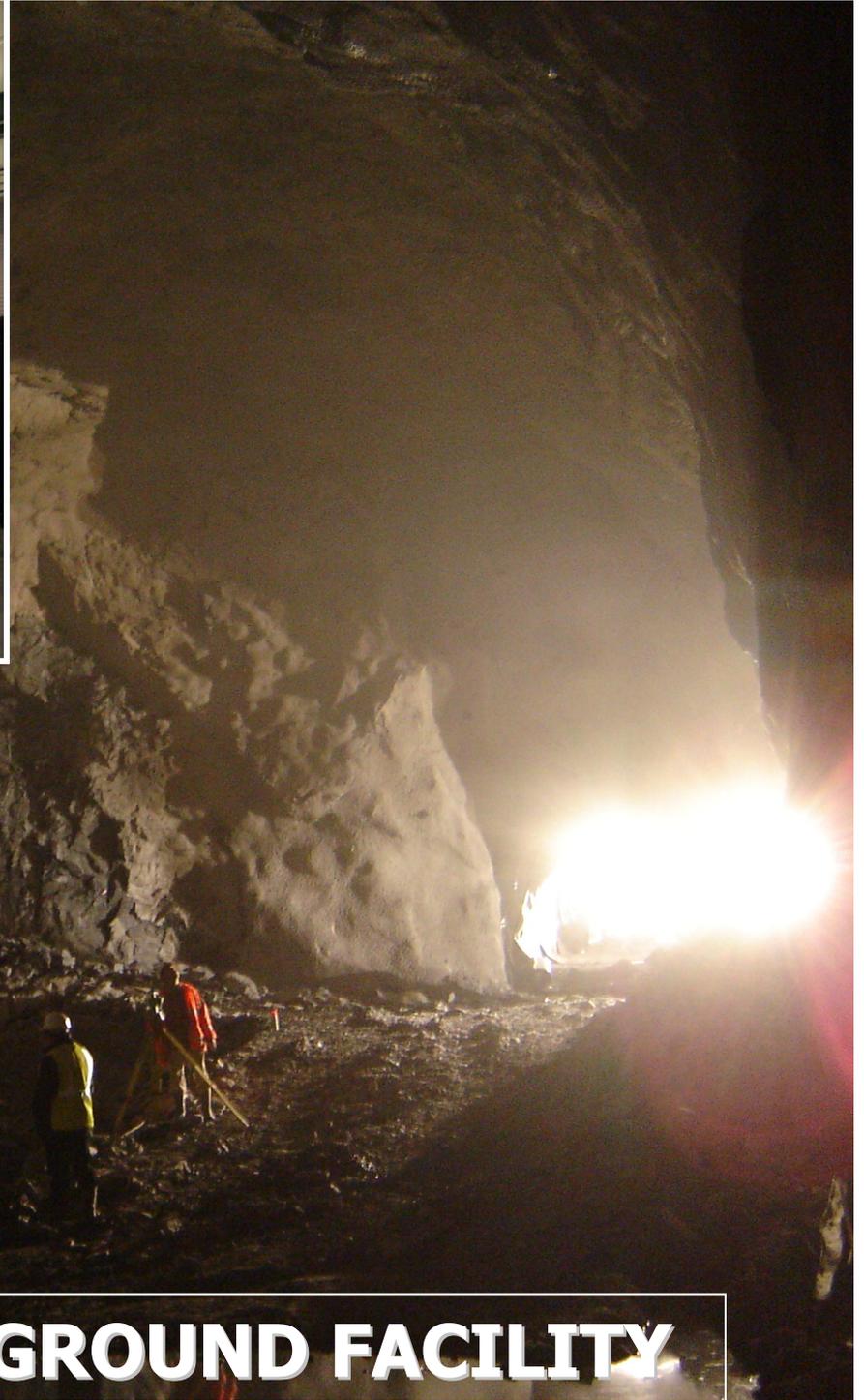
Calib. Electronics



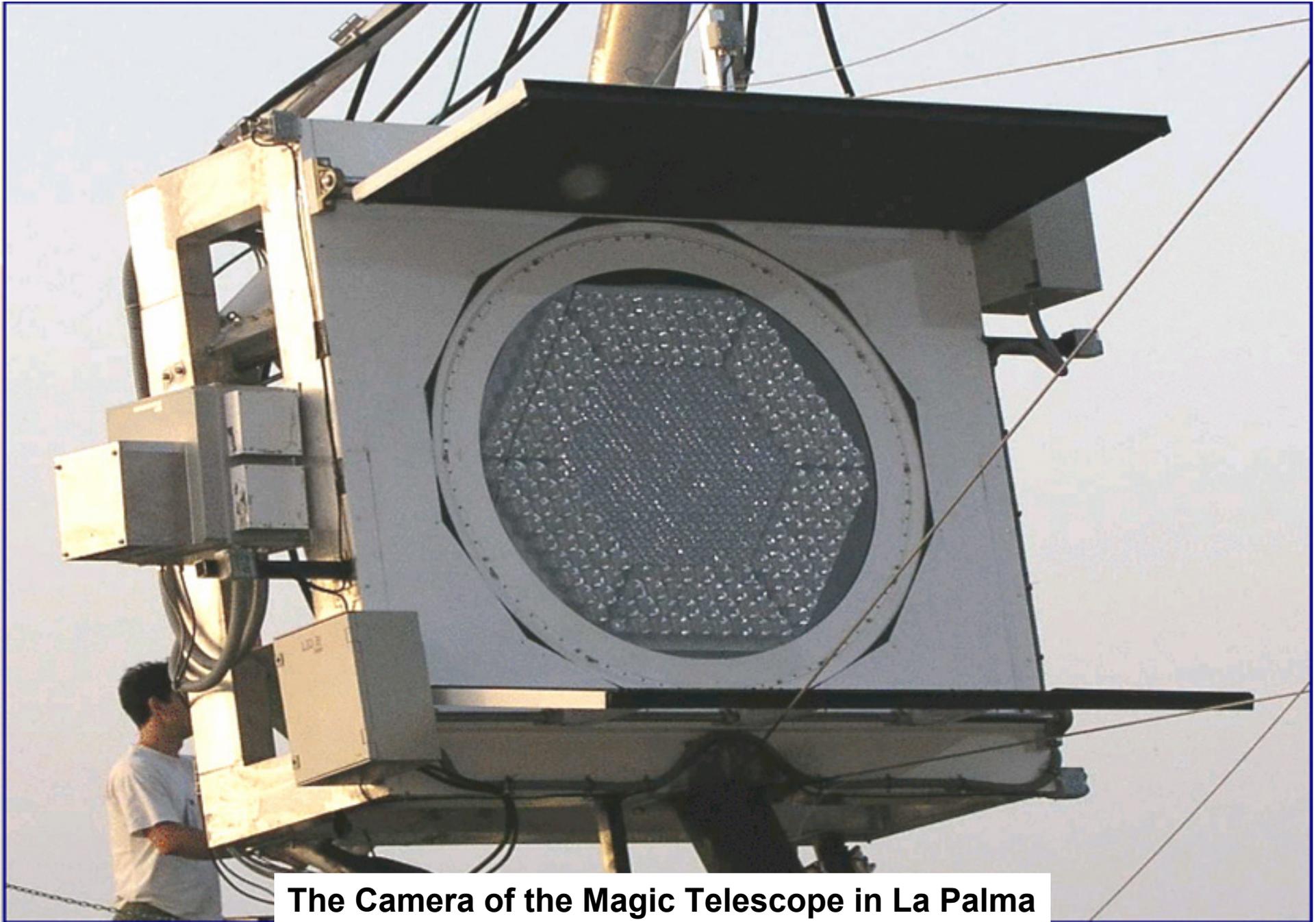
Valencia ROD mod.





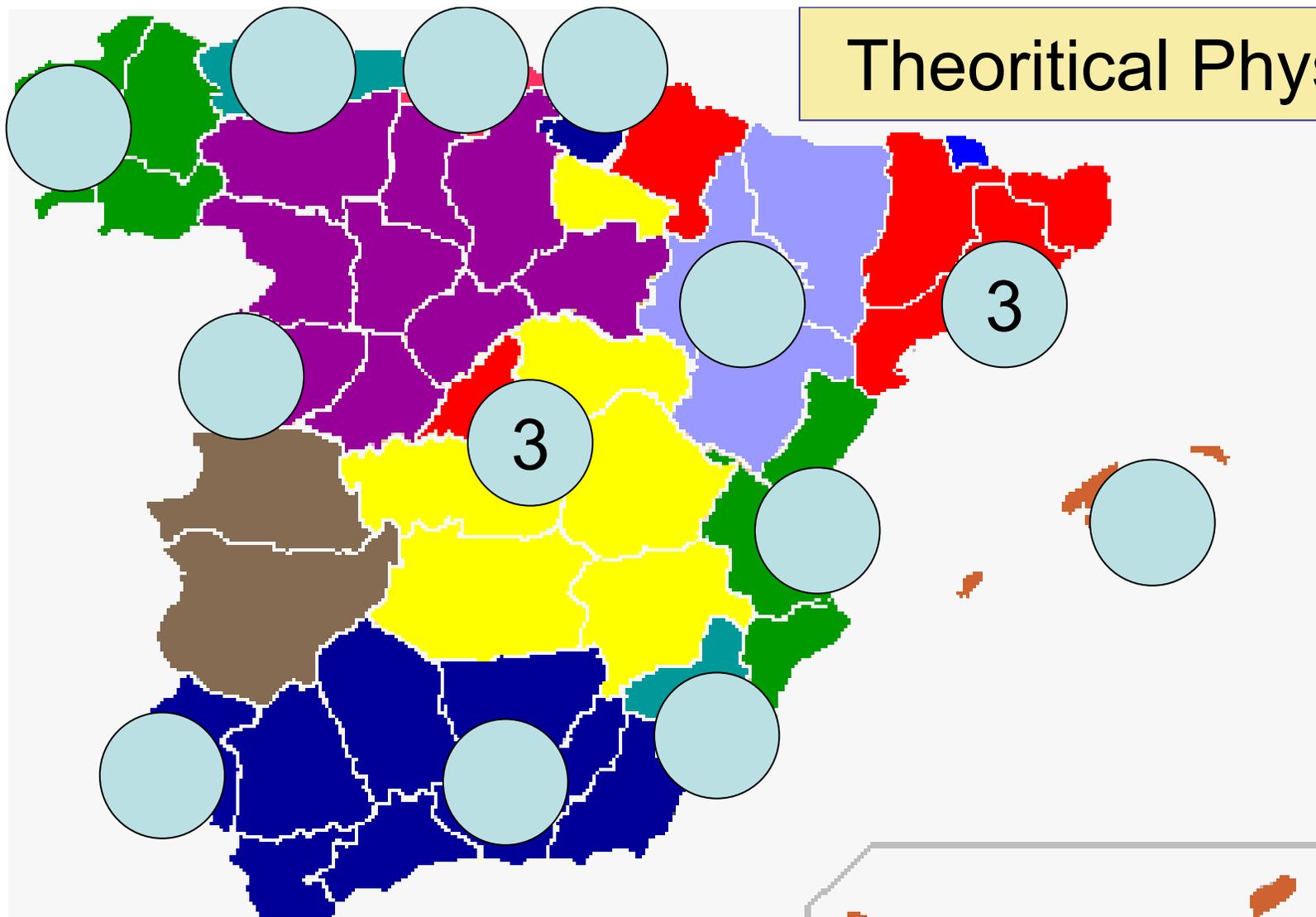


THE CANFRANC UNDERGROUND FACILITY



The Camera of the Magic Telescope in La Palma

Theoretical Physics



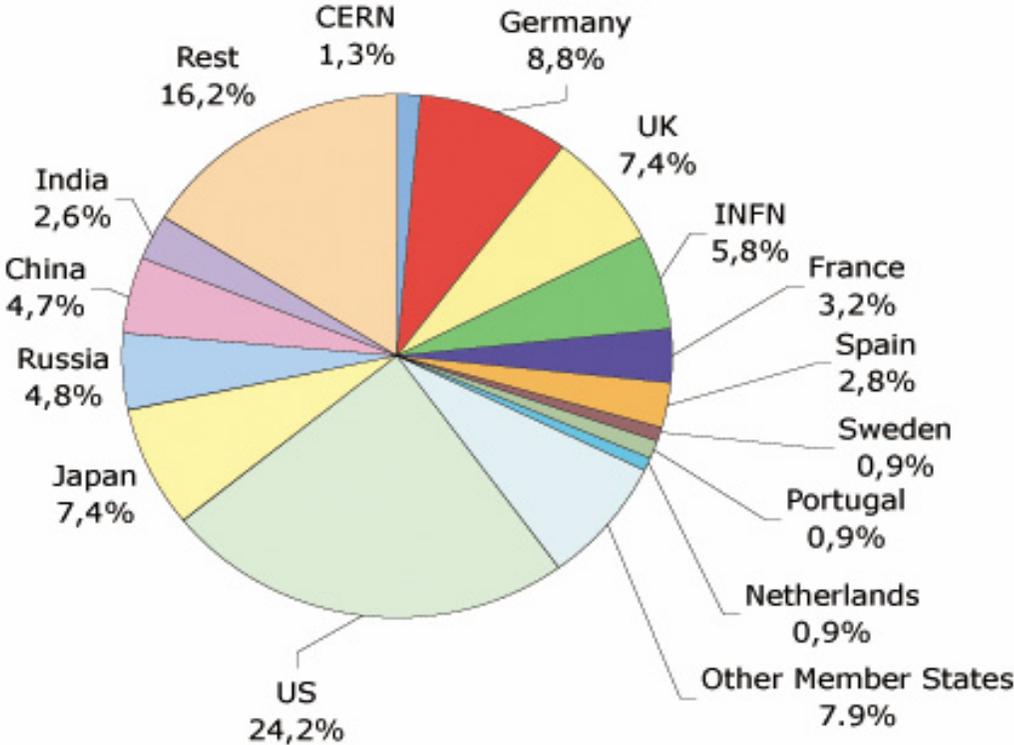
Particle, Astroparticle &
Gravity/Cosmology
Theory groups

HEP Theory

Distribution of HEP articles by country

Status: 27/10/2006 19:30

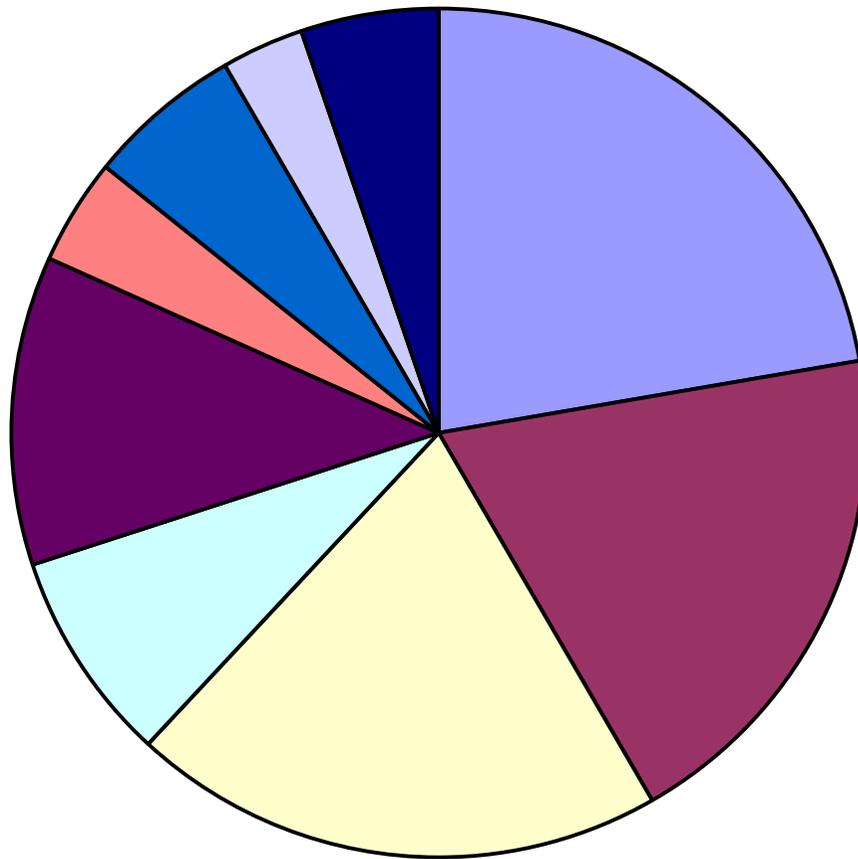
Data: 5015 preprints submitted to arXiv in 2005 and subsequently published. Co-authorship is taken into account.



	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)

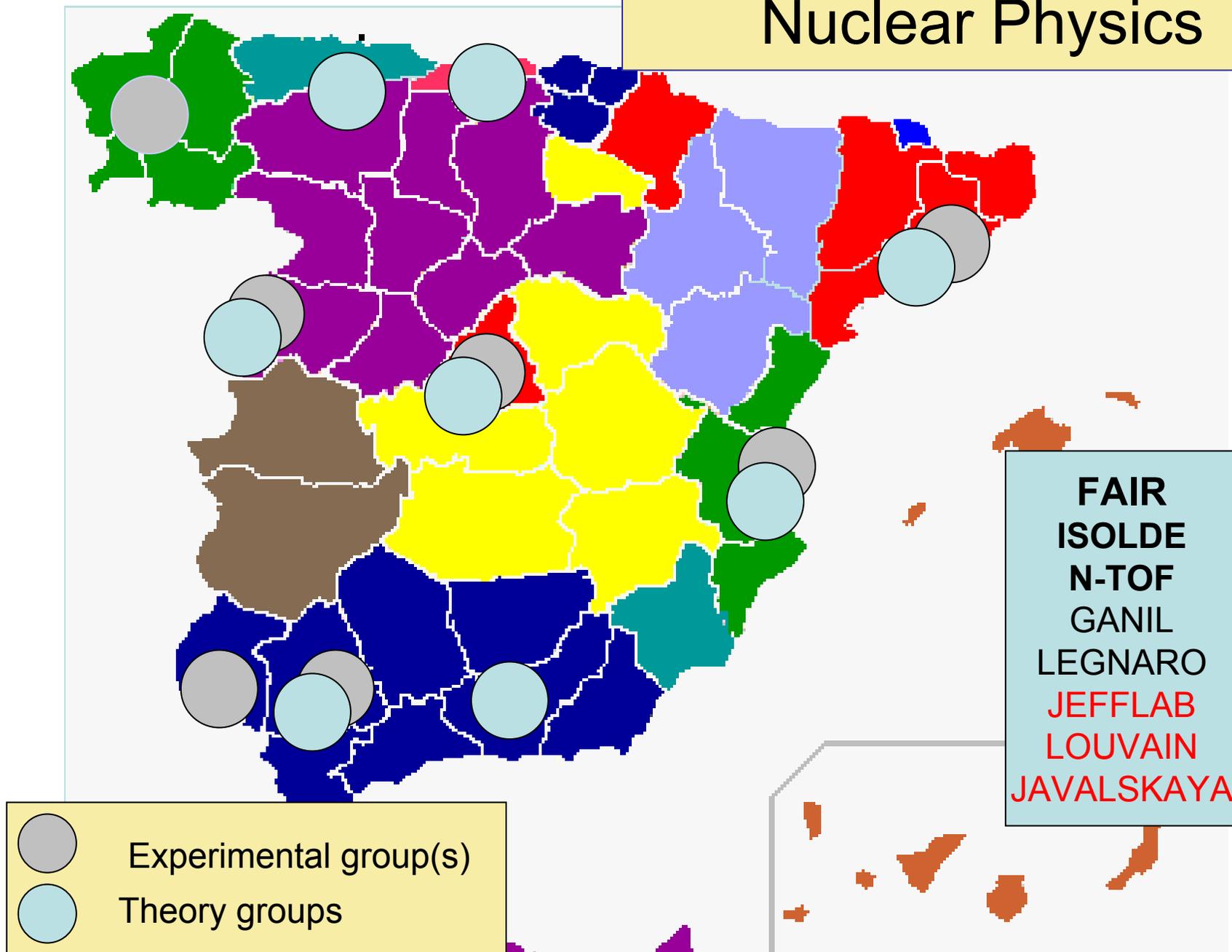
PUBLICATIONS 2005

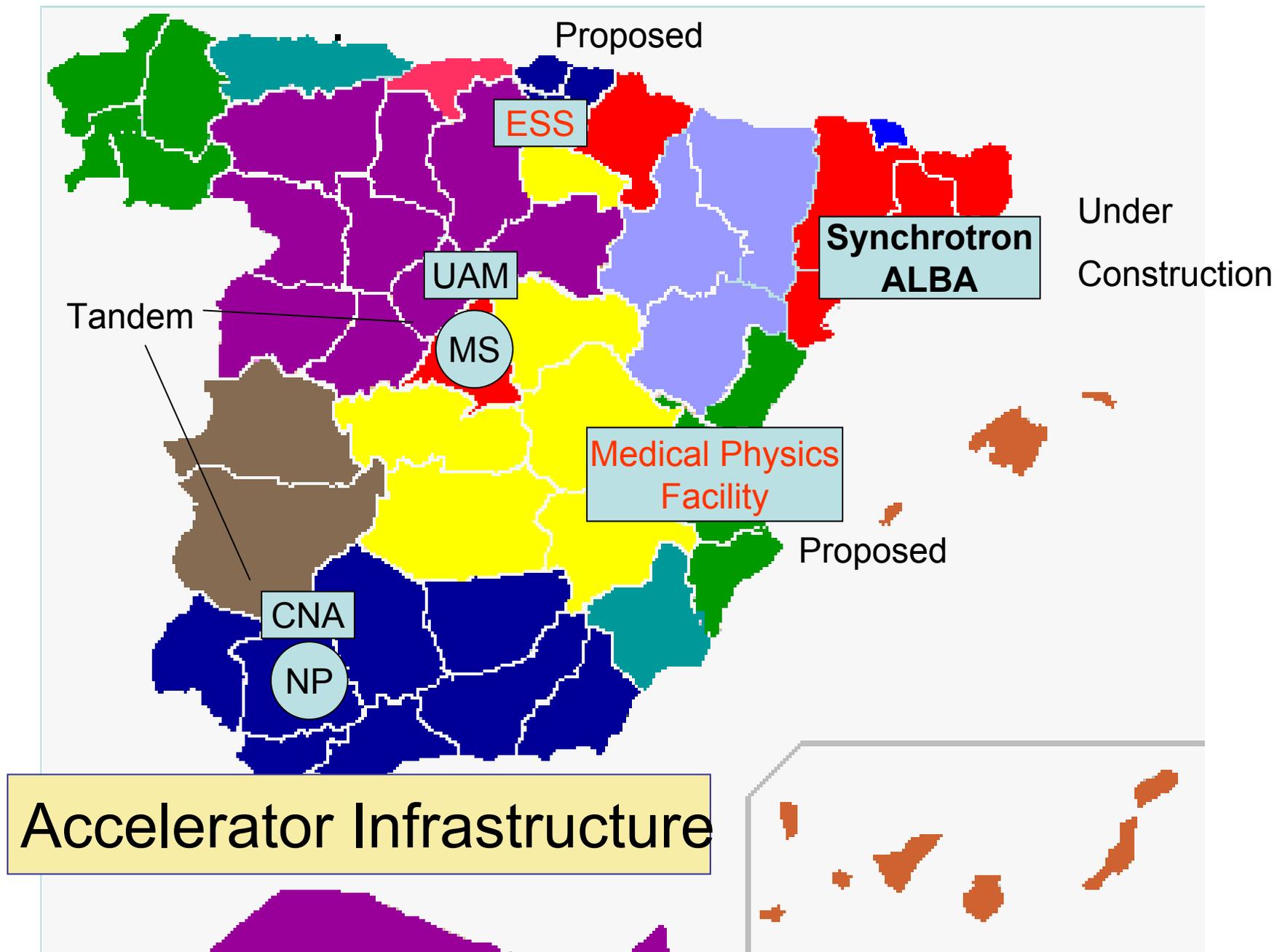


- Phenomenology
- Experimental
- Theory
- Gravitation & Cosmology
- Nuclear - Theory
- Instrumentation
- Nuclear - Experimental
- Lattice
- Astroparticle

Publications from Spain in 2005: **599**

Nuclear Physics

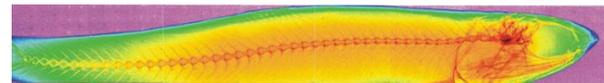
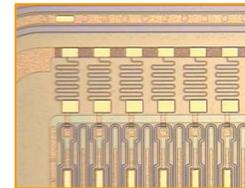
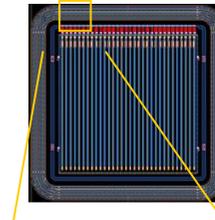




Technology

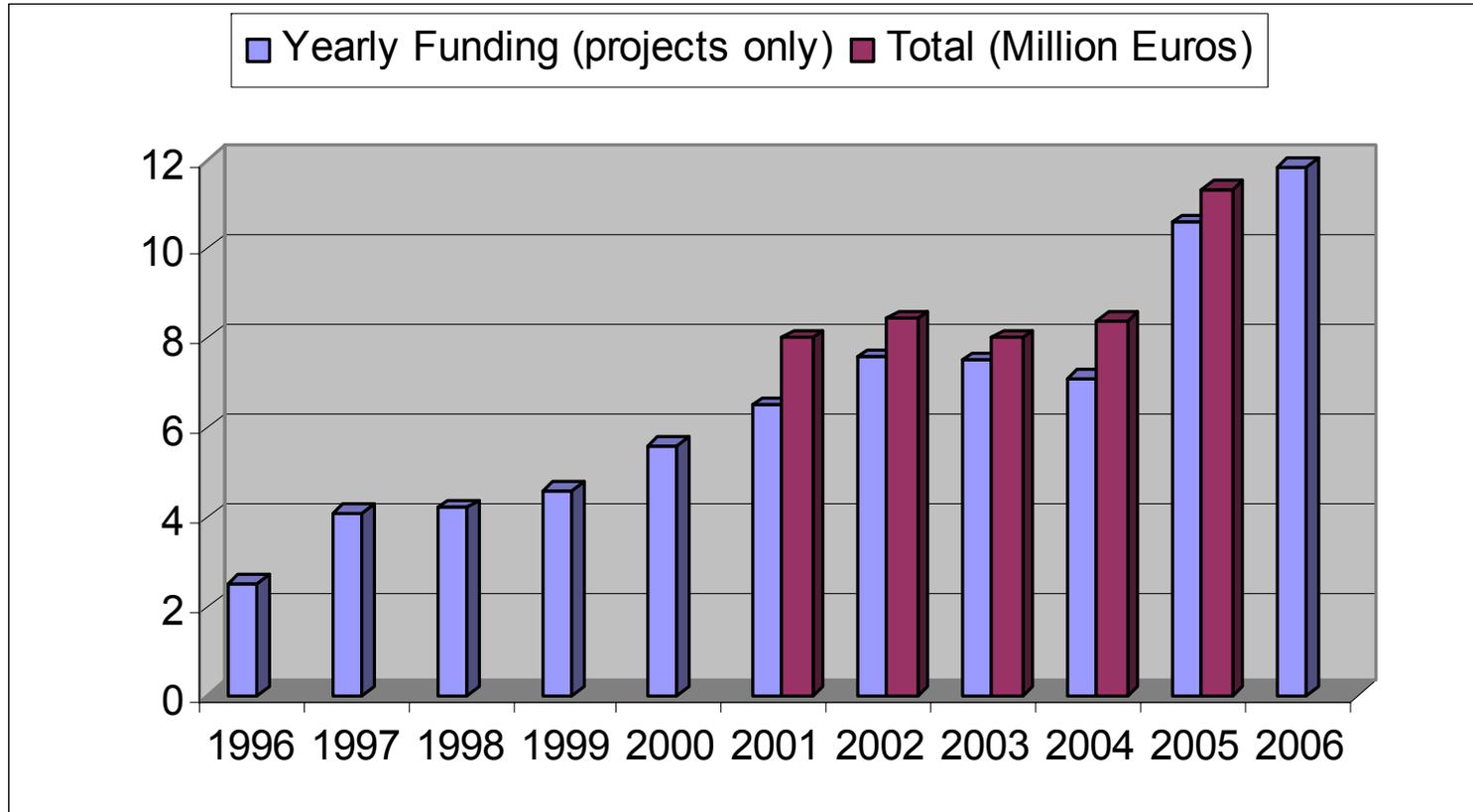
- Semiconductors:
 - Silicon detectors
 - Medical Imaging
 - Radiation Hardness
 - High density bonding
- Accelerators:
 - Magnets
 - Cryogeny
 - RF, Power Supplies

Some examples



Funding

HEP Funding



Spain's GNP (2005) : 0.89 T€ = 21,000 €/per capita).

Sustained growth for the last 10 yrs ~3%.

Total R&D: 10 G€ (1.2%).

Budget for R+D has increased >50% during last 3 years.

5th contributor to the CERN budget (8%= 51M€).

CERN

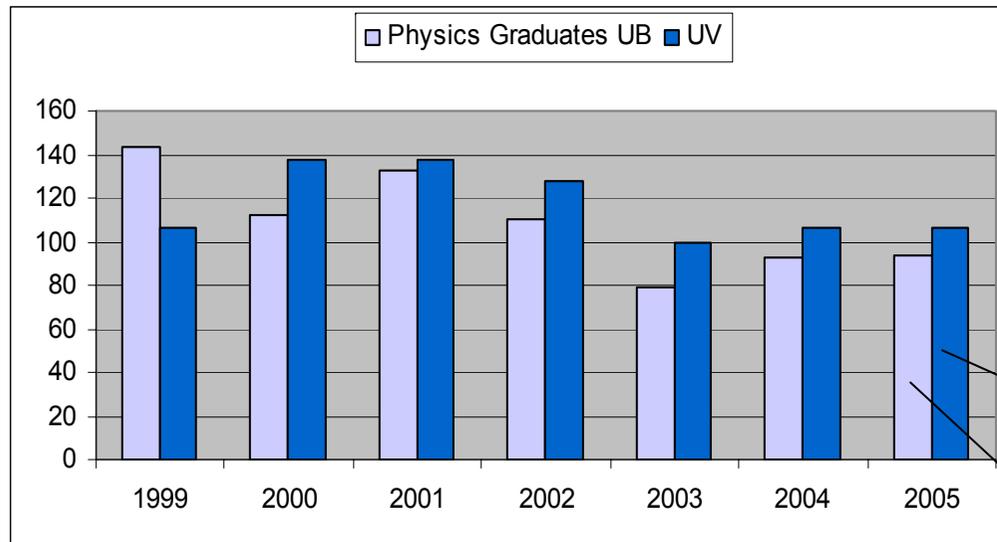
- Spanish membership
8% - 51M€ Spain = 5th contributor
- Core Contribution to LHC experiments
ATLAS (2.1%); CMS (1.5%); LHCb (2.7%)
- 2006 M&O costs
ATLAS (200 k€); CMS (170 k€); LHCb (40k€)
~10% of spanish membership fee
- CNGS Contribution 4MCHF
- CTF3 Contribution 2MCHF

Education - Students

Universities

- About 60 Public Universities in Spain
 - + ~20 private universities with more specialized offer
- 1.4 Million students (Population 40.1M)
 - 50% Social Sciences & Law
 - 26% Technical Education
 - 9% Humanities
 - 8% Health Science
 - 7% Experimental Science

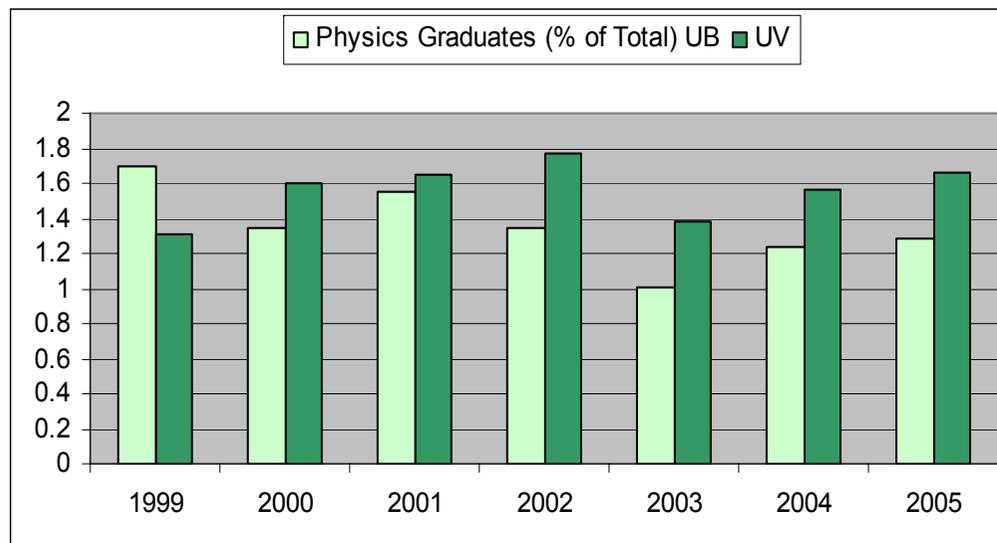
Evolution of Physics Graduate Students



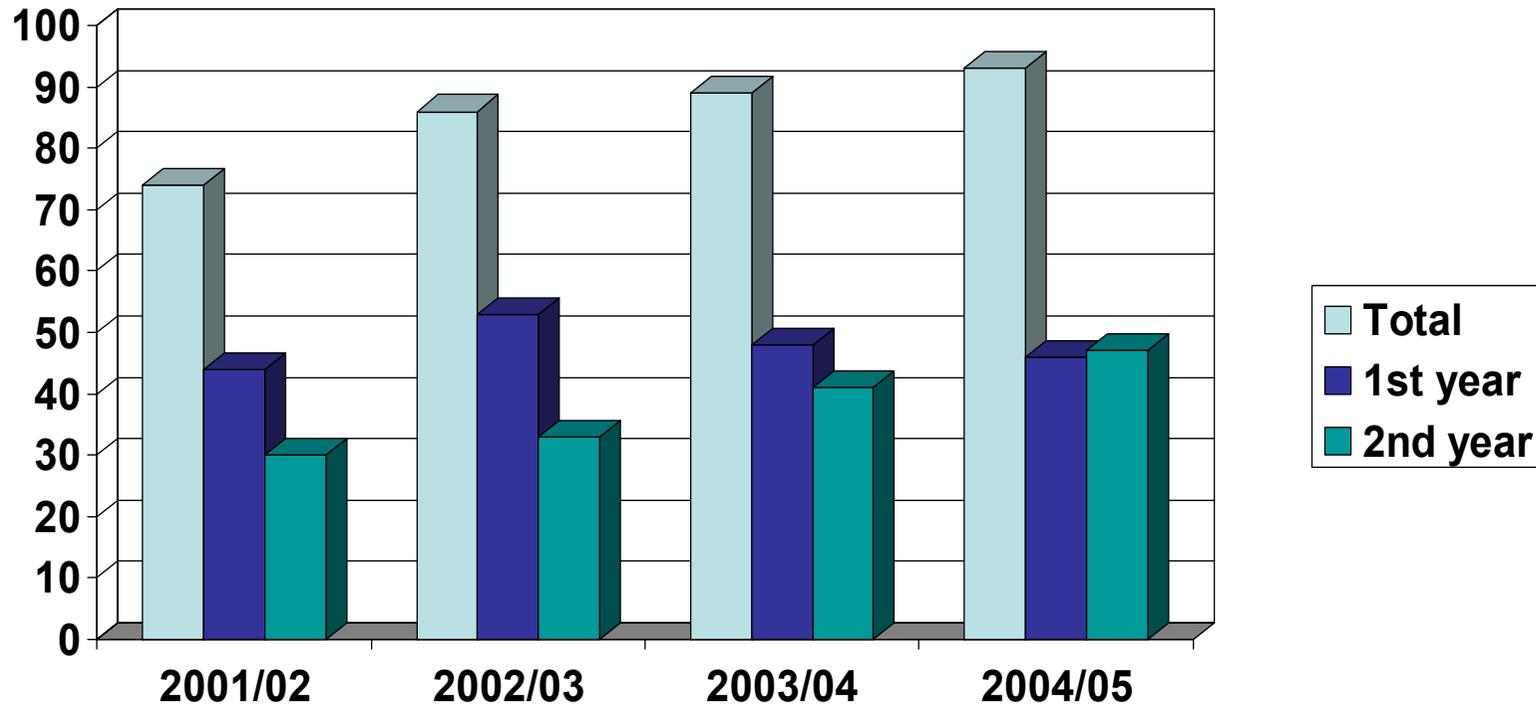
Examples of two important universities with contribution to HEP

University of Valencia

University of Barcelona



Ph D students



Evolution of the number of graduate students in Physics at the Universitat de Barcelona in the last years (students enroled in course or tutorial work for the obtention of the DEA)

LHC Computing

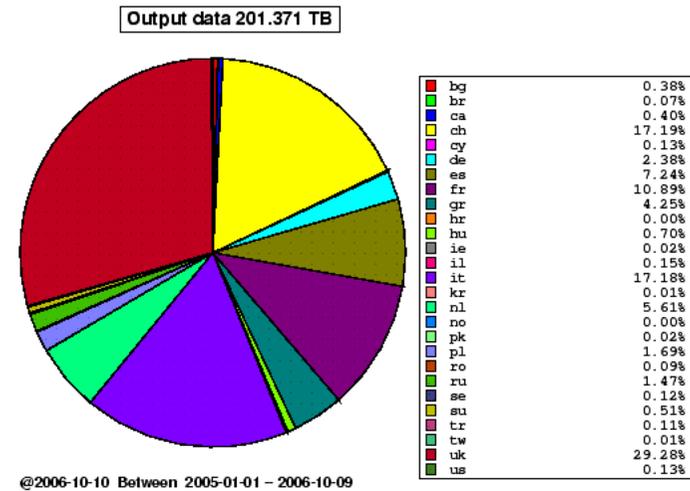
Spanish WLCG participation

Goal: ~5% of ATLAS and CMS, ~6.5% of LHCb

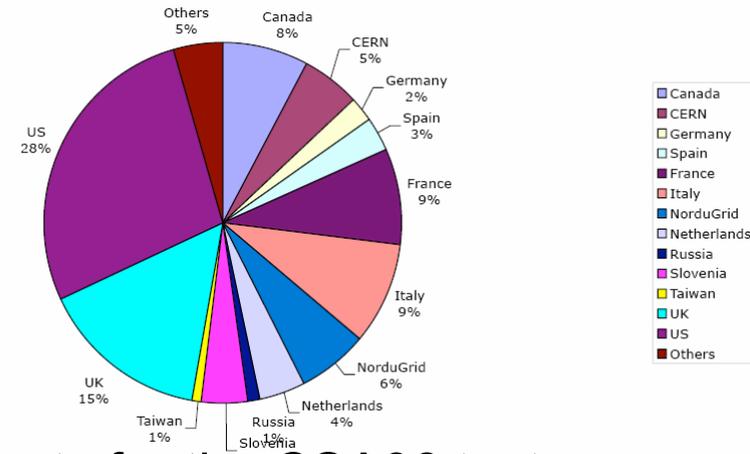
- Phase 1 (2002-2005)
 - Prototyping work funded by a coordinated project between all sites
 - Useful to clarify “best practices”, both technically and managerially, including relationships with experiments, WLCG, EGEE
- Phase 2a (2006-2007)
 - Tier-2 projects by experiment, federated to all sites
 - ATLAS: IFAE, IFIC (coordinator), UAM
 - CMS: CIEMAT, IFCA (coordinator)
 - LHCb: UB (coordinator), USC
 - Tier-1 project at PIC
 - Multi-experiment (ATLAS, CMS, LHCb)
 - Executed through CIEMAT and IFAE, as PIC is not legal entity
- Phase 2b (2008-2010)
 - Funding requests submitted as continuation of Phase 2a

System in operation:

- Total **LHCb MC production** 2005-2006
 - Spanish contribution (USC,UB,PIC) **7,24%**
 - Around 300M events
 - More than 200 TB of output data
 - Almost 20M hours CPU time



- Wall Time of **ATLAS MC prod** Jan-Sep 2006 (plot)
Spanish sites contributed with about **3%**

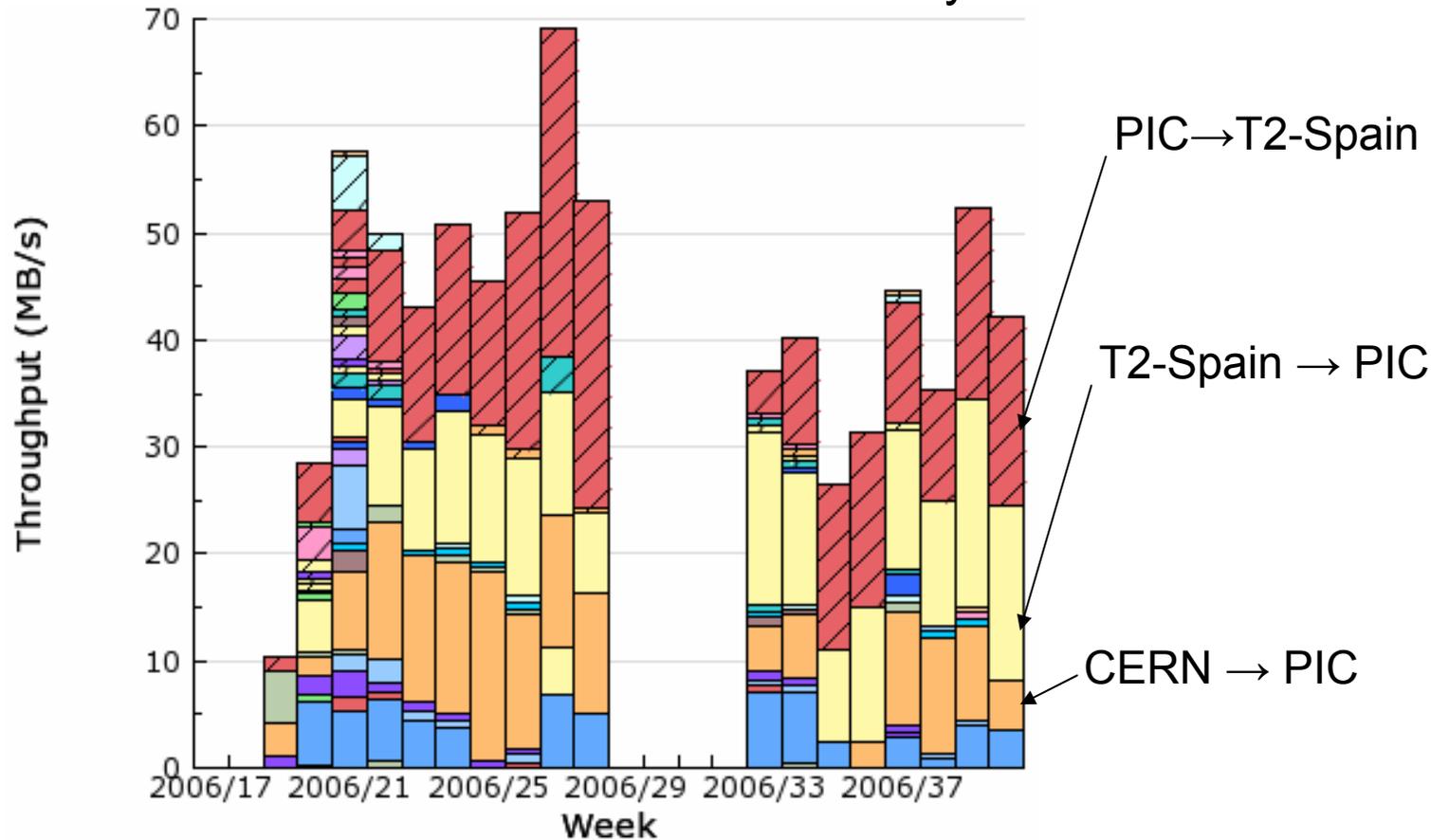


- In the **CMS recent production** of 50M events for the CSA06 test Spanish sites contribution was of **7%**

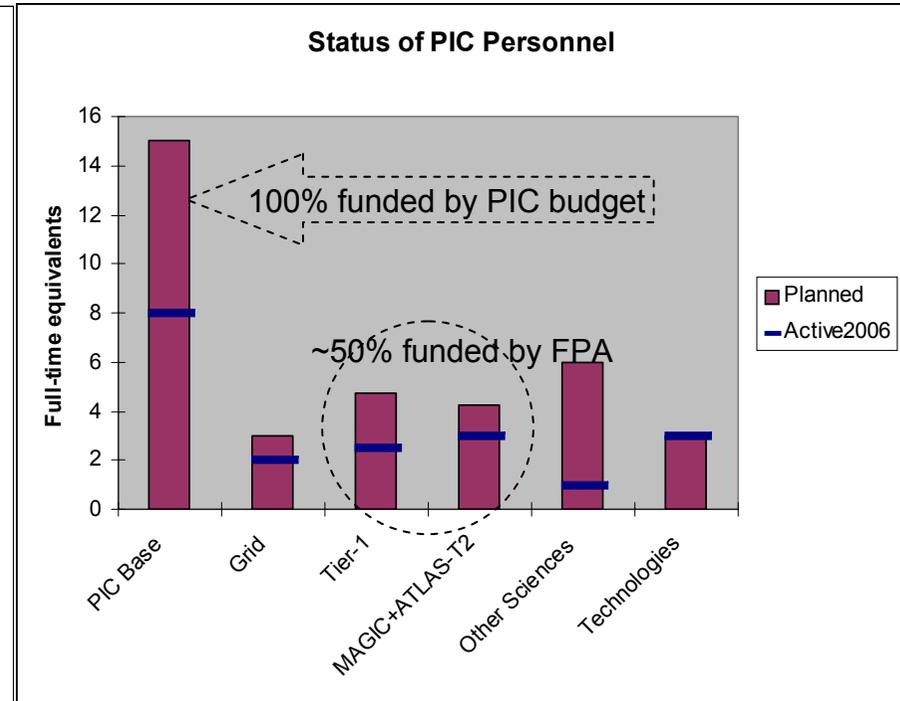
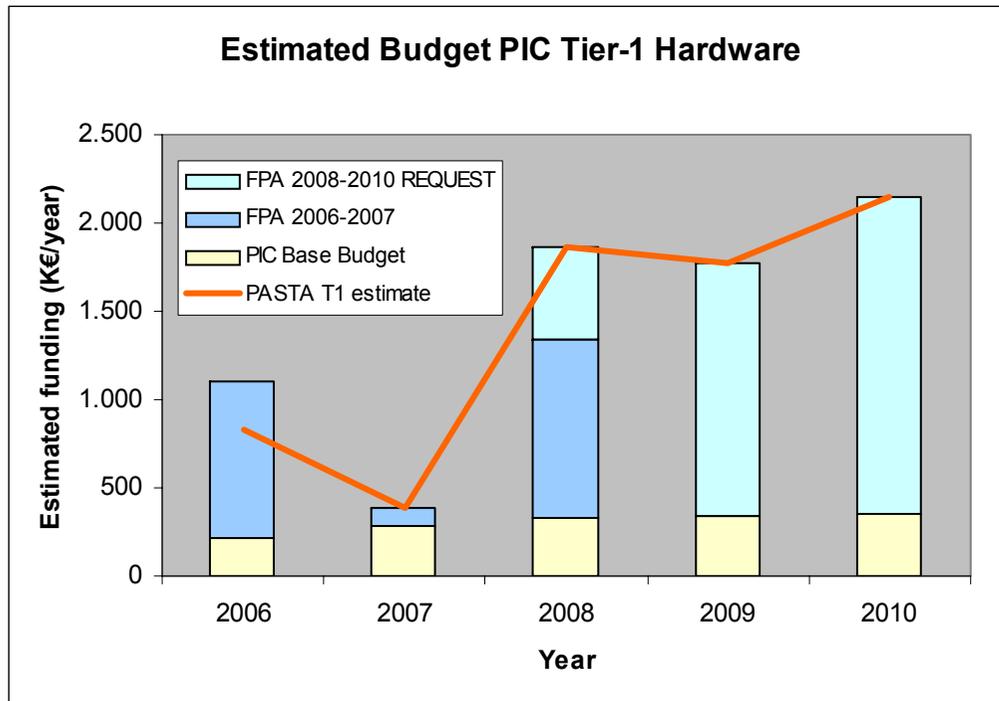
Accounting on the Grid works and is being used daily in production

CMS File Transfer Service Tests SC4 Transfers

Hundreds of TB of data transferred by the CMS Phedex system testing the T0-T1-T2 data flow chain since May 2006



PIC Tier-1 Costs and Budget Estimates (updated October 2006)



RECFA in Barcelona April 2003

Observation of RECFA in 2003 - Evolution since 2003

- Smaller community of physicists per head of population or per GDP than comparable European countries
 - recommend to continue developing Particle Physics & increase value for money obtained from CERN membership

HEP increasing, however still below average of CERN Members States, specially for technology

“Red Tematica” focussing on R&D for Linear Collider

Spanish Participation in the Clic Test Facility 3 (CTF3)
- Relation between Theory & Experiment too loose
 - suggest strenghtening phenomenology

Keep trying fomenting contacts – More phenomelogy directly related to experiments needed
- Provide the resources to support the developing computing area
 - LHC Computing well under way and adequately funded

RECFA in Barcelona April 2003

- **Need for new positions senior & junior, recommend**
 - Some senior position should be University Faculty positions
 - National Institute to help funding these positions
 - Maintain good collaboration between experimental groups and regional governments
 - Continue the Ramon y Cajal program

Ramon y Cajal program continues

Discussion about National Institute is now on the table

- **Support efforts in Astroparticle Physics & integrate in European efforts**

Astroparticle Physics growing, fully integrated in the ApPEC efforts & Road Map

New Canfranc Laboratory

“Red Nacional Temática de Astropartículas” RENATA created in October 2006
- **Better coordination between groups to prepare a suitable program for graduate courses**

Some improvement (2 weeks school organised yearly) – could be improved further