

HEP in Portugal

intermediate report

to the Plenary ECFA by
Rui Ferreira Marques
Univ. of Coimbra
and



1 – Structure of Portuguese R&D activities in HEP

Domains of Expertise and Players

2 – LIP activity

Experimental HEP in accelerators

Experimental Astroparticle Physics

Instrumentation and Technologies

- detector R&D,

- computing / GRID

Medical Physics

3 – Activity of various laboratories/institutions

ISOLDE, n-TOF, etc. – ITN and university teams

Detector R&D – Uni. Coimbra, Uni. Aveiro

Theoretical Particle Physics – university institutes

CFTP, CENTRA, CFC, CFIF, ...

Accelerator technologies – IPFN / PPC

4 – Portugal–CERN relationship

Business

Training of Engineers (Agência de Inovação)

Teachers School and Masterclasses

IDPASC



**Ministry for Science Tecnology
and Universities**
(until last summer)

**Ministry for Education
and Science**
(at present)

FCT

Foundation for Science and
Technology

**Part of such financing
already mixxed to EU
Strucural Funds**



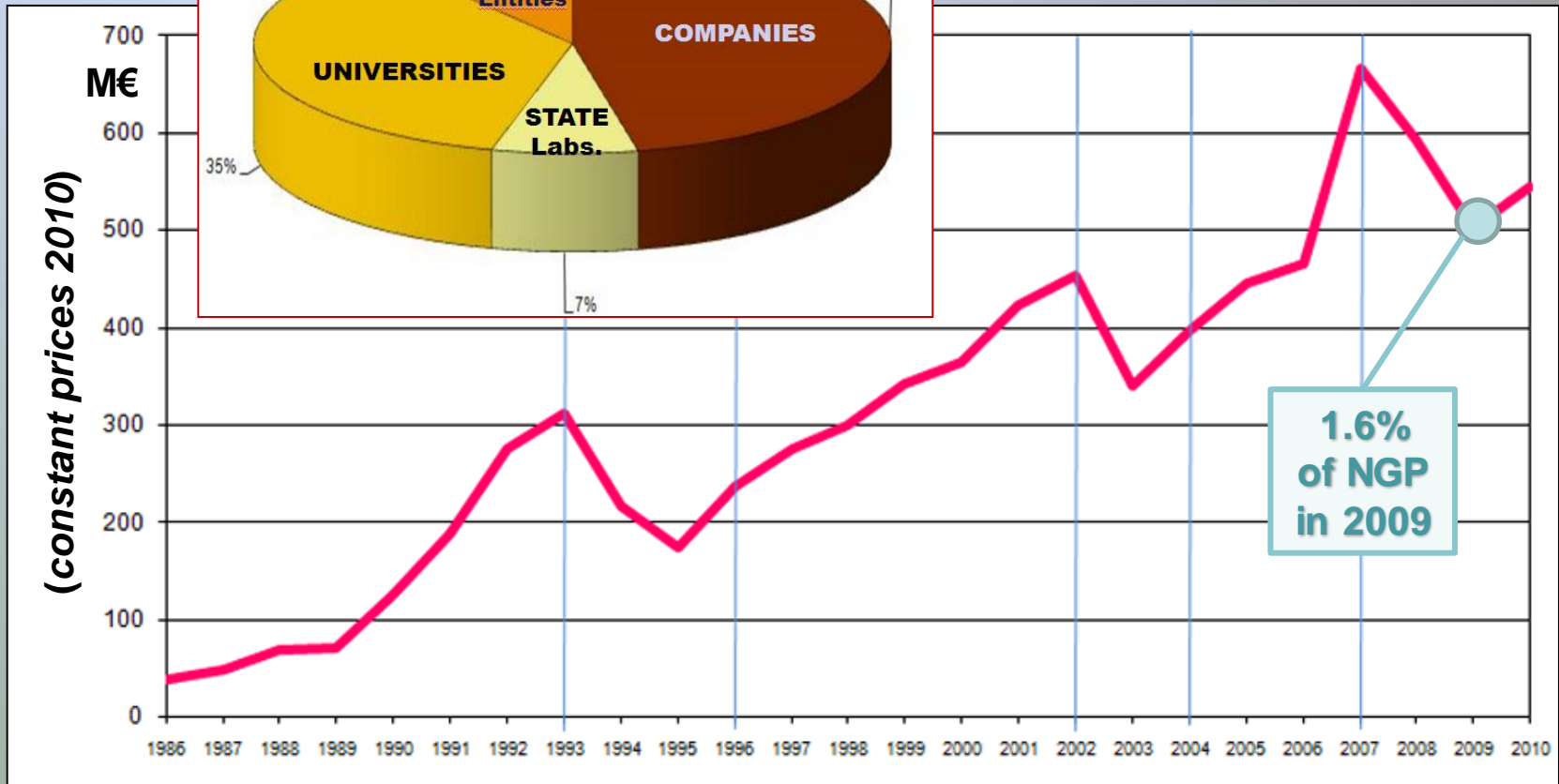
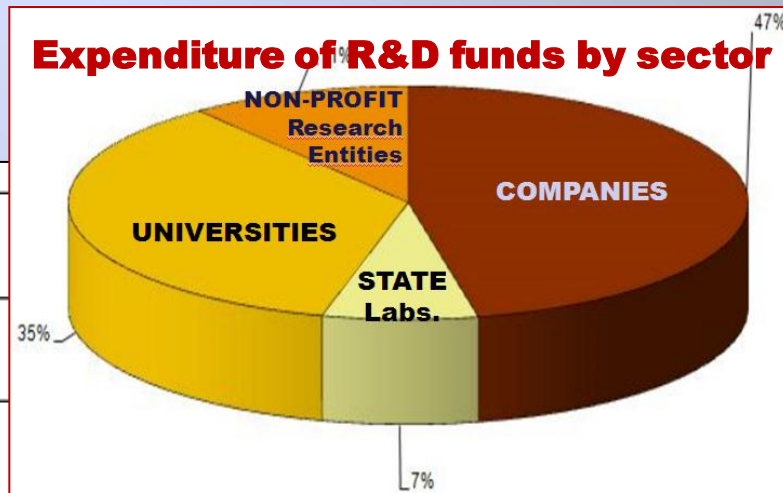
- *International agreements (CERN, ESA, ESO, ESRF, EMBL, ...)*
- *National commitments with Large Experiments like ATLAS + CMS (but also Auger, SNO, LUX, etc...)*

- *Most operational programmes (national budget + EU structural funds)*
 - > *funds for projects (“CERN Fund” included)*
 - > *research grants (MSc, PhD & post-Doc)*
 - > *5-year research positions (CIÊNCIA 2007 + 2008 ...)*
- *Assessment of the research groups (by international expert teams)*

INSTITUTES

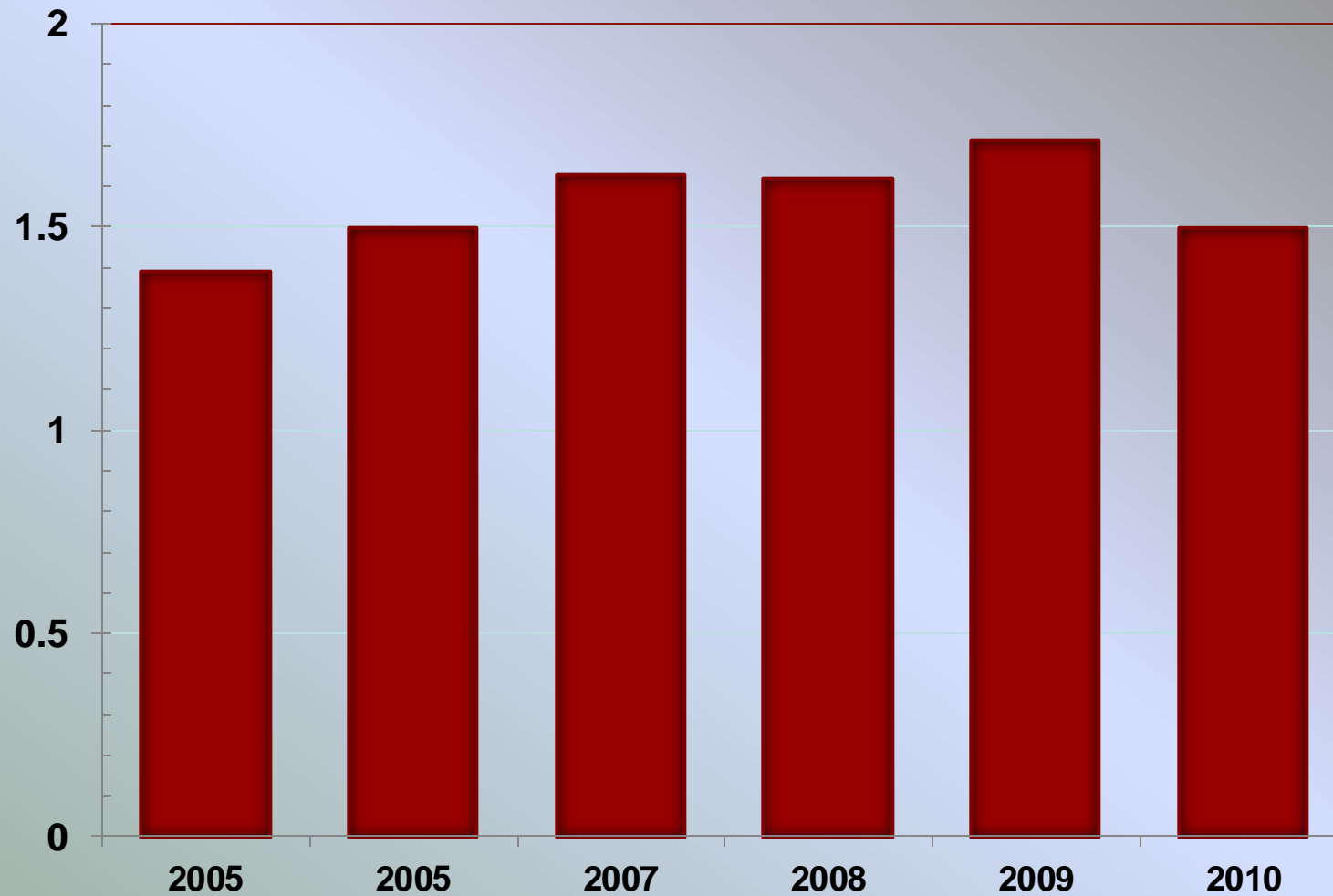
- Associate Laboratories (e.g. LIP)
 - University Groups (theory and experimental)
 - National Laboratories (e.g. ITN)

Budget of the main national R&D funding institutions made available to projects, fellowships and infrastructure through competitive funding



Source: http://www.unic.pt/index.php?option=com_content&task=view&id=3141&Itemid=221

Yearly totals of the "CERN Fund" [M€]



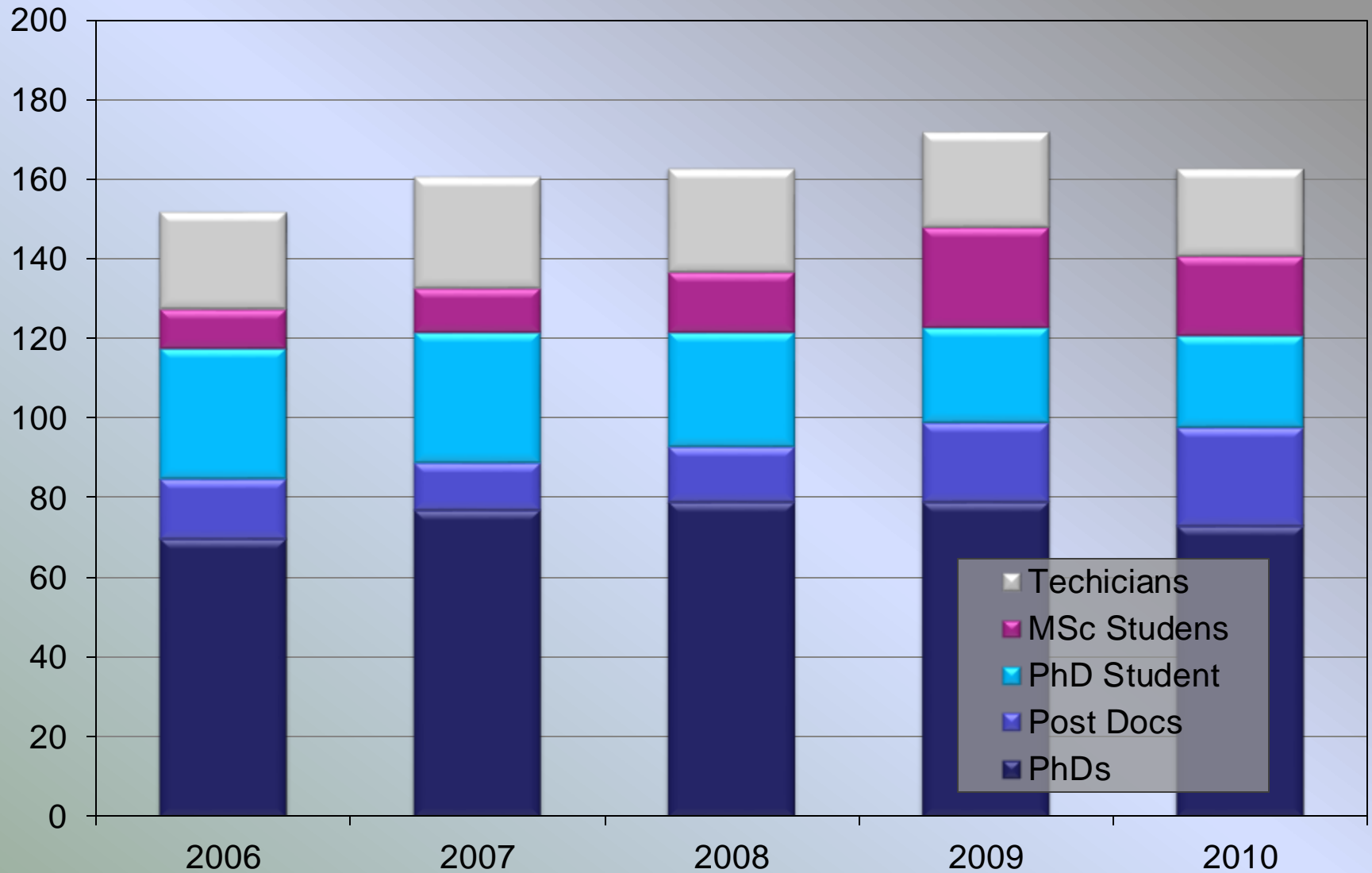
HEP @ PT: AREAS of EXPERTISE and PLAYERS

- A Experimental Particle Physics with accelerators
 - CERN: ATLAS+CMS (LIP) and COMPASS (LIP + UA)
 - GSI: HADES, R3B (LIP + UL)
 - PSI: $\mu p / \mu He$ (UC + UA) } *non HEP*
- B Experimental Astroparticle Physics and Cosmic Rays
 - Auger + LUX + AMS + SNO (LIP)
 - XENON (UC + UA)
- C Instrumentation and Technologies associated with HEP
 - Detector R&D / RD51 (LIP + UC + UA)
 - GRID & Computing (LIP)
- D R&D on Particle Acceleration Technologies (IPFN)
- E Other CERN-related areas of activity
 - ISOLDE (ITN, UL, UA) + n-ToF (ITN)
 - Medical Physics, etc. (LIP)
- F Theoretical Particle Physics ([CFTP](#), [CENTRA](#), [GR@V](#), [CFC](#),...)

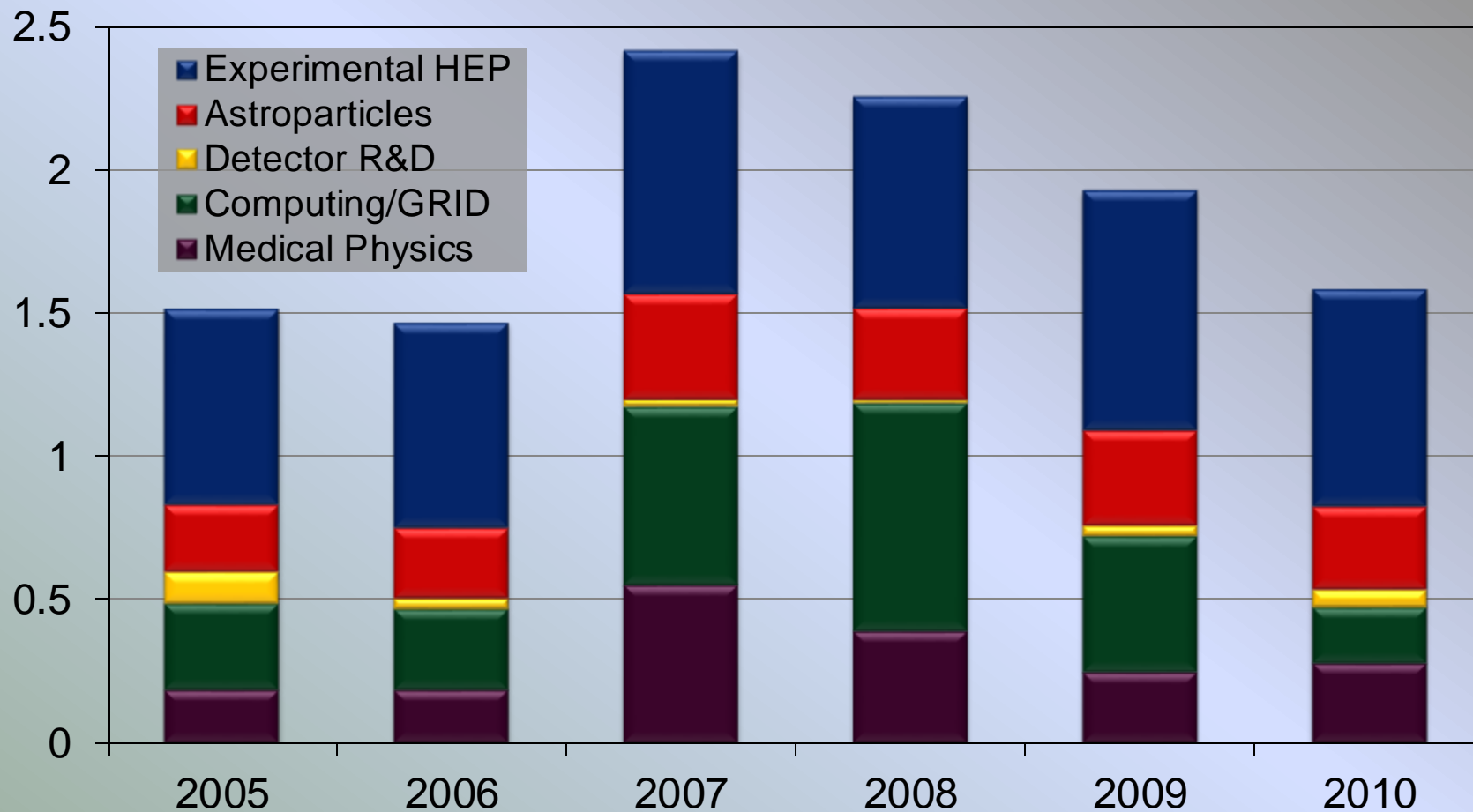


- Created in 1986, when Portugal joined CERN, LIP is an ASSOCIATE LABORATORY since November 2001 (one out of 25 laboratories; just 2 in Physics)
 - Most of the experimental commitments of Portuguese teams at CERN are LIP's responsibility (HEP and ~100% Heavy Ions, etc.)
 - Two established centres: Lisbon (the largest, ~2/3) and Coimbra (~1/3); a third pole is now growing at the University of Minho
 - LIP was rated EXCELLENT in all evaluations carried out by FCT with international panels of experts.
 - International Advisory Committee members: Tiziano Camporesi, E. Arantes de Oliveira, Christian Fabjan, P. G. Innocenti, Herwig Schopper, C. van Eijk
 - LIP Collaborators (as per 2010 Yearly Report):
 - 73 senior researchers (University staff + 9 LA researchers + 11 CIENCIA)
 - 25 post-docs
 - 23 PhD students
 - 22 technicians
- fellowship "tenure track" 5 year contracts

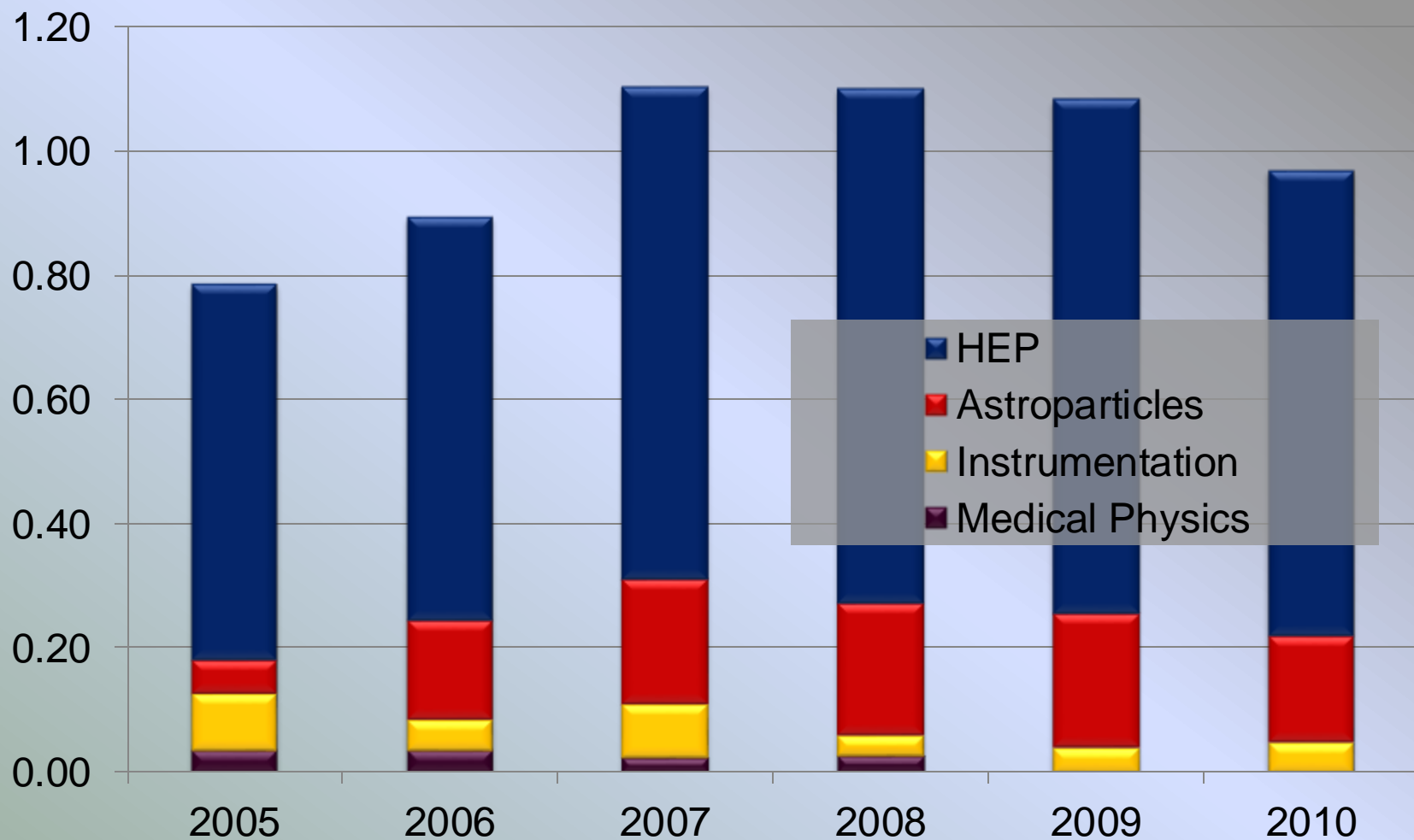
LIP: Scientific & Technical Personnel (2006- 2010)

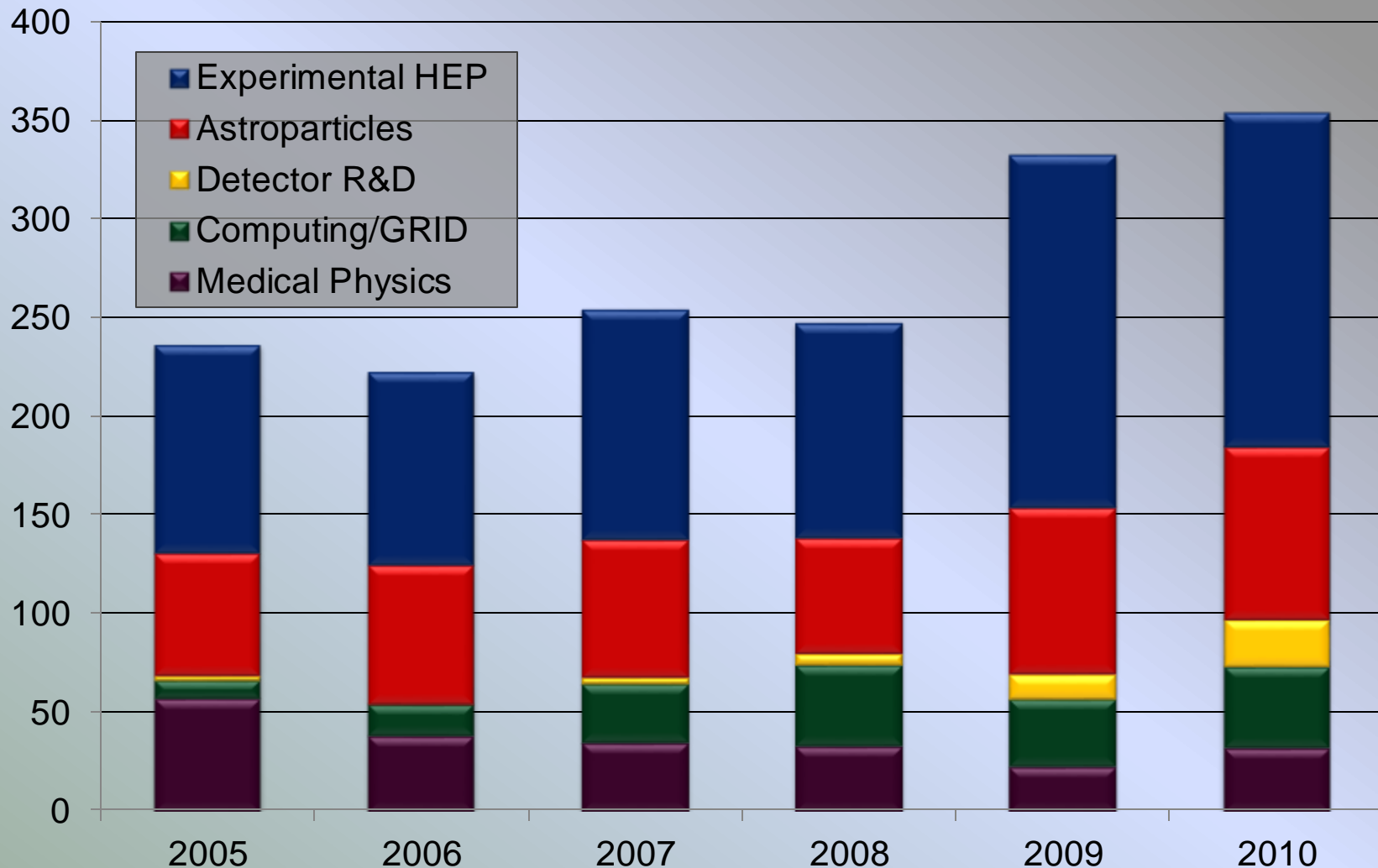


LIP projects funding per area per year (2005 – 2010) (M€)



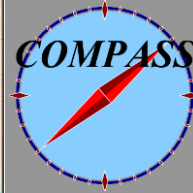
LIP projects financed via “CERN Fund” (M€)



LIP: Scientific Output (papers, conferences, theses, etc.) per area per year (2005 - 2010)

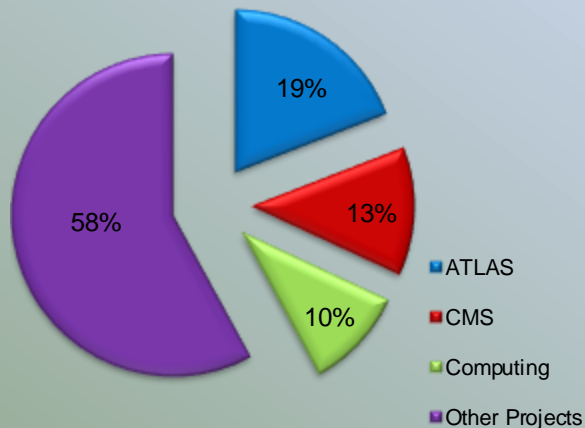


Experimental HEP in accelerators: CERN Experiments

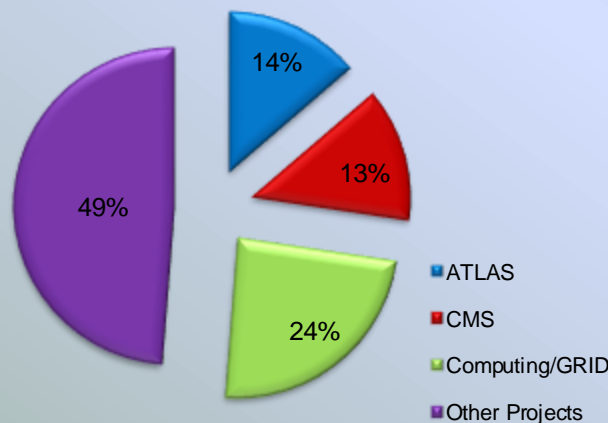


Project	Researchers	Post-Docs	PhD Students	MSc Students	Technicians
ATLAS	6,4	2,2	6,9	3,9	0,5
CMS	3,5	8,0	1,0	2,5	1,1
Phenomenological Studies at LHC	1,9	1,6	0,5	1,5	0,1
Sub-total	11,8	11,8	8,4	7,9	1,7
COMPASS	3,0	1,0	3,0	3,0	1,0
Total	14,8	12,8	11,4	10,9	2,7

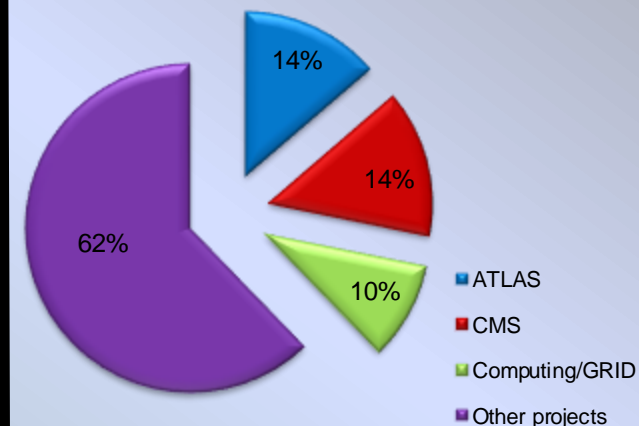
LIP: Human Resources (2005-2010)



LIP: Funding distribution (2005-2010)

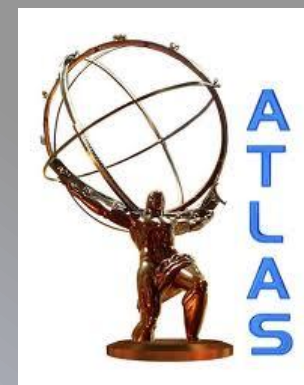


LIP: Papers & Conferences (2005-2010)





Experimental HEP in accelerators: PARTICIPATION IN ATLAS



P.I.: Amelia MAIO (LIP + Uni. Lisbon)

Commitments

- **W production reconstruction and cross section measurement;**
- **Top quark Working Group: reconstruction of ttbar final states and Wtb vertex studies;**
- **Calibration and performance of the LVL2 jet trigger in data acquisition;**
- **TileCal: operation, calibration and monitoring.**

**Also: Membership of Editorial Board (A. Onofre), 2009-2011
Run Co-ordination (J. Maneira) for TileCal commissioning**

Global financing (2005-2010): 1.5 M€

Human Resources (FTE in 2010)					
Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
ATLAS	6.4	2.2	6.9	3.9	0.5



Experimental HEP in accelerators: PARTICIPATION IN CMS

P.I.: João VARELA (CERN + LIP/IST)

Deputy Spokesperson of CMS (2012-2013)

Commitments:

- Physics studies:**

Measurement of the t-tbar production cross section and the top quark mass in the dilepton channel;

First measurement of the t-tbar production cross section in the dilepton channel with tau leptons in the final state;

Probing the heavy flavor content of Top quark decays;

Search for a Higgs boson decaying into two photons in the CMS detector;

Search for the charged Higgs boson in the $H^+ \rightarrow \tau^+ \nu$ decay mode in top quark decays;

Searches for the scalar Top quark. Measurement of the polarization of quarkonia states.

- Operation and maintenance of the ECAL Trigger/DAQ h/w and online s/w**

- Optical links for the upgrade of the CMS calorimeter trigger system at HL-LHC**



Global financing (2005-2010): 1.5 M€

Human Resources (FTE in 2010)					
Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
CMS	3.5	8	1	2.5	1.1



Experimental HEP in accelerators: PARTICIPATION IN COMPASS

P.I.: Paula BORDALO (LIP + IST)



Commitments:

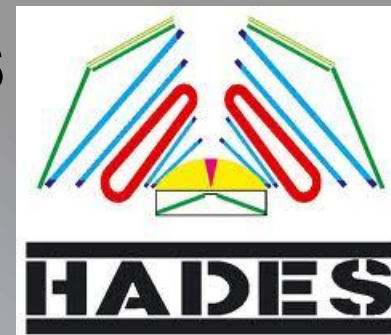
- Responsibility for the **Detector Control System (DCS)** of the experiment 2003;
- Open charm spin asymmetry studies (COMPASS golden channels) in view of extracting the gluon polarzation;
- Spin asymmetry studies of high p_T events, aiming to the derivation of the gluon polarization, $\Delta G/G$, in the nucleon;
- Asymmetries study of low x_{Bj} and low Q^2 DIS (Deep Inelastic Scatering) channel;
- Studies for COMPASS-II (2014): setup optimization.

Global financing (2005-2010): 0.96 M€

Human Resources (FTE in 2010)					
Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
COMPASS	3	1	3	3	1



Experimental HEP in accelerators: **HADES**



P.I.: Alessio MANGIAROTTI (LIP)

Commitments:

- **Responsibility for the ongoing commissioning of the RPC TOF Wall (fully built by LIP for the spectrometer upgrade), including maintenance, calibration, debugging, etc.;**
- **Future participation in topics of the physics program directly related to the exploitation of this detector.**

Global financing (2005-2010): 0.49 M€

(Construction supported by GSI funds, upon contract with LIP)

Human Resources (FTE in 2010)					
Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
HADES	0.66	0	0	0	0.2



Experimental HEP in accelerators: NEULAND – An RPC neutron detector for R3B

PI .: Rui F. Marques (LIP + UC)
+ P. Fonte (LIP + ISEC)

Collaboration of LIP (Instrumentation) with a team of CFN-UL already committed with FAIR (Physics Studies)



Commitments:

- R&D on an innovative TOF detector for fast (GeV) neutrons (NEULAND) based on timing RPCs;
- Participation with a prototype in an upcoming experiment devoted to the characterization of the proposed prototypes (conventional plastic scintillator sandwich versus RPCs).

Global financing: 120 k€ for 3years (from 2011)



Astroparticles: **Ultra High Energy Cosmic Rays**

P.I.: Mário Pimenta (LIP + IST)

Commitments:

- **Systematics of light propagation/collection in the fluorescence detector;**
- **Measurement of the electromagnetic and muonic shower profiles;**
- **Search for exotic and rare events;**
- **Theory and models for high energy interactions;**
- **R&D for the next generation of high energy cosmic ray experiments.**

Global financing (2005-2010): 740 k€

Human Resources (FTE in 2010)					
Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
HECR	6.63	2.13	2.05	0.97	1.47



Astroparticles: Dark Matter search at **ZEPLIN** and **LUX**



P.I.: Isabel LOPES (LIP + UC)

Commitments

- **Key tasks performed in ZEPLIN-III**
 - Most of the software, including data acquisition and system control;
 - Strong involvement in data analysis: data reduction software and vertex reconstruction algorithm;
 - Design and construction of slow control monitoring and control hardware.
- **Goals for the participation in LUX (from 2011)**
 - Measurement of the reflectance of the LUX PTFE panels to the xenon scintillation (gaseous and liquid media),
 - Design and construction of a xenon purity monitor;
 - Data analysis: adapting vertex reconstruction algorithm of ZEPLIN-III

Global financing (2005-2010): 0,41 M€

Human Resources (FTE in 2010)

Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
ZEPLIN	2.3	3.8	0.5	1	0.6



Astroparticles: **SNO & SNO+**

P.I.: José MANEIRA (LIP + UL)

Chair of SNO+ Collaboration Board



- **LIP joined SNO in 2005**
- **Responsibilities:**
 - Optical calibration in the third phase (shared with Carleton University), essential for a small uncertainty in the energy scale;
 - Neutrino oscillation analysis for the final SNO paper, combining the 3 phases;
 - The most precise determination of θ_{12}
- **Founding member (2007)**
- **Past activities:**
 - Simulations to set requirements on external backgrounds and new detector elements (hold-down ropes)
 - Solar neutrino sensitivity studies
- **Ongoing activities/responsibilities:**
 - Design, construction, tests and installation of a new optical fiber-based calibration system for the PMTs
 - Sensitivity studies for reactor antineutrinos (WG chair)
 - Optical calibration (WG chair)

Global financing (2005-2010): 45 k€

Human Resources (FTE in 2010)				
Project	Researchers	Students PhD	Students MSc	Technicians
SNO	0.4	0.8	0.1	0.1

Astroparticles: AMS

P.I.: Fernando BARÃO (LIP + IST)

Commitments:

- RICH :Charge and velocity reconstruction methods;
- Prototype test and performance evaluation;
- Data analysis: isotopic separation.



Global financing (2005-2010): 40 k€

Human Resources (FTE in 2010)

Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
AMS	0.9	1.6	0	0	0

Instrumentation

RD51

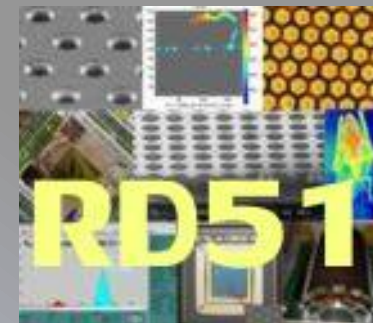
P.I.: Rui F MARQUES (LIP + UC)

Commitments

- Study physical phenomena in MPGDs;
- Applications:
 - i) A patterned RPC-based PET tomograph for small animals;
 - ii) RPC ToF-tracker - combination of a time-of-flight detector and a high-accuracy tracker.

Global financing (2005-2010): 50 k€ (2 years)

Human Resources (FTE in 2010)		
Project	Researchers	Technicians
RD51	0.7	0.3



NMI3 (FP6/FP7) - Gaseous Anger camera neutron detector

P.I.: Francisco Fraga (LIP + UC)

Collaboration with ILL and other neutron facilities

Commitments

- Absolute scintillation yield of CF₄;
- Assessment of MPGD with high pressure CF₄;
- PMT Anger camera Monte Carlo simulation package (ANTS).

Global financing (2005-2010): 140 k€ (FP7)

Human Resources (FTE in 2010)				
Project	Researchers	Post-Docs	Students PhD	Technicians
nmi3	2.3	1	1	0,4





GRID INFRASTRUCTURE

Three federated clusters:

- LIP-Lisbon 35%
- LIP-Coimbra 15%
- NCG 50%

Commitments

- Participation in the Worldwide LHC GRID
- Provide a national grid computing service
 - National community responsibility
- Participate in the Iberian infrastructure
- Participate in international initiatives



WLCG
INGRID

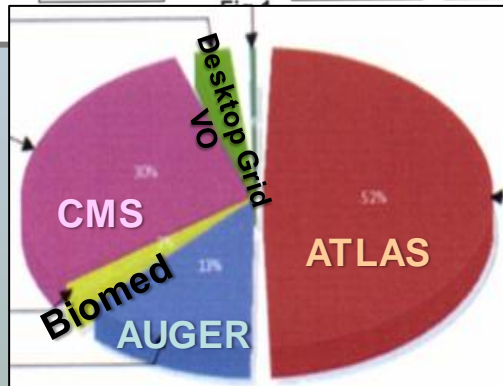
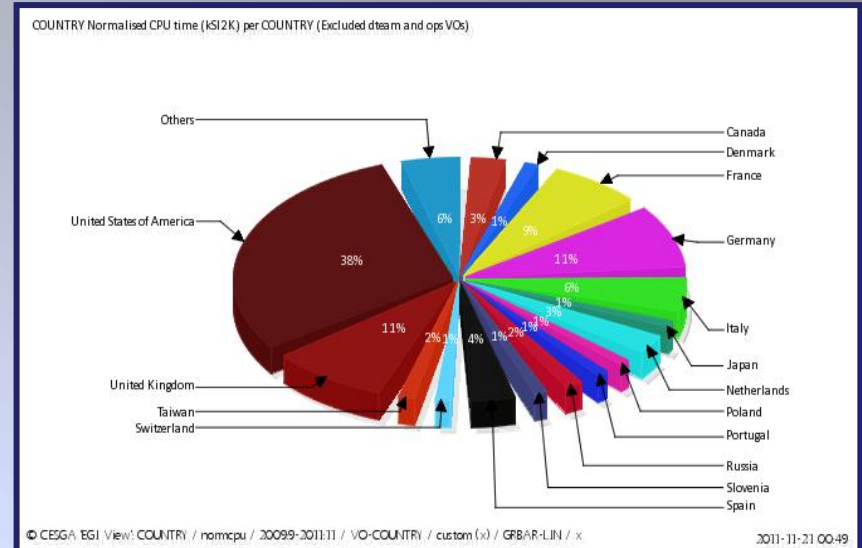
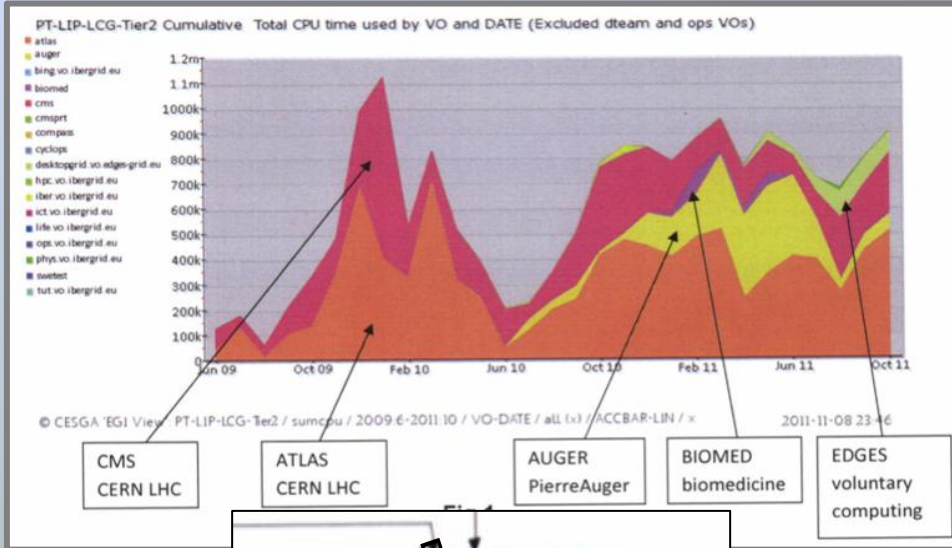


IBERGRID
EGI



National Impact

International Impact



8th largest processing capacity provider among ATLAS and CMS Tier-2 centers in 2010

Running Projects	Period	Funding (k€)
European Grid Initiative - Inspire project	2010 – 2014	485
TIMBUS - digital data and processes preservation	2011 – 2014	112

Medical Physics: Positron Emission Tomography - ClearPEM

P.I.: João VARELA (CERN + LIP + IST)

Collaboration with private company F



Commitments:

- **Clinical evaluation of the ClearPEM and ClearPEM-Sonic scanners** (machines now at ICNAS, UC, and hospital **La Timone, Marseille**);
- **Evaluation of the ClearPEM detector modules in a 7 Tesla MR scanner** (at EPFL, Lausanne);
- **Development of electronics and data acquisition in the frame of the EndoTOFPET-US project (FP7).**



Global financing (2005-2010): 572 k€

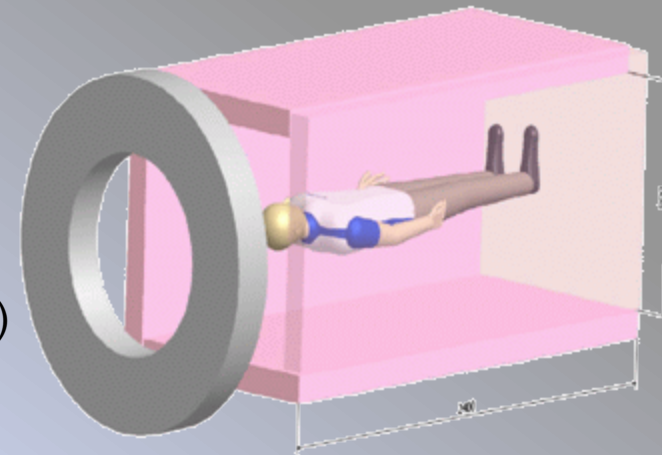
Human Resources (FTE in 2010)

Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
ClearPEM	0.55	2.82	1.7	2.1	1.09

Medical Physics: Whole Body Single Bed RPC-PET Scanner

P.I.: J.J.P.de Lima (LIP / ex-Prof. FMUC)
+ P. Fonte (LIP+ISEC)

Collaborators: UC (IBILI and ICNAS), GSI (Darmstadt)
and Jagiellonian University (Krakow, Poland)

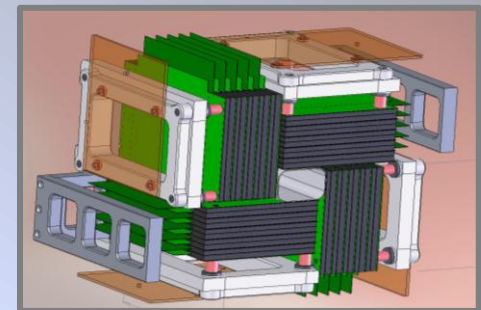


Commitments:

- **Successful simulation and small prototype studies**
⇒ *higher efficiency at lower cost*
- **Construction of prototype modules under way**
- **Future: test and assessment of the full-size prototype.**

By-product:

RPC-PET scanner for small animals (for pharmacological studies) under test
(*R&D in the framework of RD51*)



Global Financing (from 2010): 120 k€ (for 3 years)

Human Resources (FTE in 2010)					
Project	Researchers	Post-Docs	Students PhD	Students MSc	Technicians
RPC-PET	1.15	0	0	0	0.6

Minor (but not to forget) projects

Medical Physics and Radiation Physics

- **Monte-Carlo studies on optimization of radiotherapy (RT)**
- **New ideas for online RT monitoring**
- **Use of PET cyclotrons for radiobiological studies(connections to LEIR)**
- **Study of the radiation environment on the surface of other planets (under ESA contract)**

3 – Activity of several other laboratories/institutions in HEP, Accelerator Experiments, Astroparticles or CERN-related areas:

- ITN and university teams (Lisbon and Aveiro):**
ISOLDE, n-TOF
- Uni. Coimbra + Uni. Aveiro***
Detector R&D, Experiments
- CFTP, CENTRA and other university groups:**
Theoretical Particle Physics


ITN + U.Aveiro + U.Porto + U.T.A.D + U.Lisboa: ISOLDE


	2006	2007	2008	2009	2010	2011	TOTAL
	68	65	65	80	180		578
Financing (k€)	+36	+35	+35	+45	+35	120	+186
Researchers	7	8	10	8	13	24	n.a.
Post.Docs							n.a.
PhD Students	3	2	5	7	6	10	n.a.
Master Students	4	5	6	5	8	8	n.a.
Technicians							n.a.
Papers (Intl. Journals)							49+20
PhD Theses							8
Masters Theses							3
Books							
Meetings organized							
Comum. to Conferences							
Seminars							

TOPICS:

- Central role in the Isolde infrastructure maintenance
- R&D on channeling measurements with short living isotopes

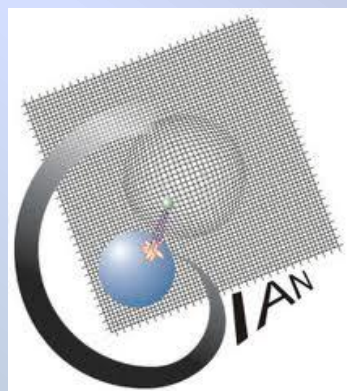


n-ToF

	2006	2007	2008	2009	2010	2011	TOTAL
Financing (k€)	?	?	?	30	30	30	90
Researchers				4	6	4	n.a.
Post.Docs							n.a.
PhD Students				2	2	3	n.a.
Master Students							n.a.
Technicians							n.a.
Papers (Intl. Journals)			5	5	6	5	21
PhD Theses							
Masters Theses							
Books							
Meetings organized							
Comum. to Conferences					3	1	4
Seminars							

Topics of work:

- Instrumentation (beam monitoring)
- Analysis for the extraction of neutron cross sections



Instrumentation Centre (Univ. de Coimbra)

	2006	2007	2008	2009	2010	2011	TOTAL
Financing (k€)							~1.3 M€
Researchers	15	19	18	20	21	15	n.a.
Post.Docs	3	3	3	1	1	3	n.a.
PhD Students	2	2	5	10	14	15	n.a.
Master Students	6	3	15	15	4	?	n.a.
Technicians							



Close collaboration with a (smaller) group of Univ. de Aveiro whose data could not be made available.

Papers (Intl. Journals)	18	36	17	32	30	25	158
PhD Theses	3	0	2	1	3	?	9
Masters Theses	6	3	15	15	4	?	43
Books							0
Meetings organized					1	1	2
Comum. to Conferences	44	20	22	26	40	?	152
Seminars							

TOPICS / PROJECTS:

- Dark matter detection (**XENON**); Double beta decay (**NEXT**); **p-He/ μ -He Lamb Shift** (PSI, CH)
- R&D in micropattern gaseous detectors (**RD-51**)



ipfn INSTITUTO DE PLASMAS
E FUSÃO NUCLEAR

IST

**IPFN is an
Associate
Laboratory**

	2006	2007	2008	2009	2010	2011	TOTAL
Financing (k€)	130	130	235	235	200	95	~1.0M€
Researchers	3,5	3,5	3,5	3,5	3,5	3,5	n.a.
Post.Docs	0	1	1	0	1	1	n.a.
PhD Students	3	4	5	5	5	4	n.a.
Master Students	2	2	2	2	2	2	n.a.
Technicians	0,5	0,5	0,5	0,5	0,5	0,5	n.a.

Papers (Intl. Journals)	4	5	7	8	9	9	42
PhD Theses	0	1	1	0	2	1	5
Masters Theses	0	1	0	1	1	0	3
Books	0	0	0	0	0	0	0
Meetings organized	1	0	1	0	1	0	3
Comum. to Conferences	8	10	14	16	18	18	84
Seminars	5	4	4	5	6	5	29

TOPICS: Laser wakefield acceleration and proton acceleration by intense lasers in solid targets (for therapy and imaging)

- **plasma sources and diagnostics** for laser-plasma accelerators
- **theory and modeling** of laser-plasma accelerators



*Includes the majority of theoretical
particle physicists working in Portugal*

IST

	2006	2007	2008	2009	2010	2011	TOTAL
Financing (k€)	12	13	12	12	11	11	71
Researchers	13	10	12	11	11	11	n.a.
Post.Docs	8	8	5	4	7	8	n.a.
PhD Students	3	2	0	0	7	7	n.a.
Master Students	2	2	2	2	2	2	n.a.
Technicians	1	1	1	1	1	1	n.a.

Papers (Intl. Journals)	60	53	54	69	75	70	381
PhD Theses	4	1	0	0	4	3	12
Masters Theses	3	4	5	4	2	6	24
Books	2	1	1	2	0	1	7
Meetings organized	2	3	3	10	4	4	26
Comum. to Conferences	30	32	4	40	43	34	213
Seminars	41	20	25	24	31	20	161

- HOT Topics:**
- **CP violation** (hadronic and leptonic sectors);
 - **SS extensions of the SM**, with and without R parity violation;
 - **Neutrino physics**, including flavor violation in the leptonic sector and possible baryogenesis via leptogenesis.

... relevant for **LHC, ILC, CLICK**; also studies of **dark matter, inflation** and **hadron physics**



CENTRA (IST)

	2006	2007	2008	2009	2010	2011	TOTAL
Financing (k€)	4	4	4	24	27	27	90
Researchers	1	1	2	2	2	1	n.a.
Post.Docs	1	1	0	1	1	1	n.a.
PhD Students	0	0	0	0	1	2	n.a.
Master Students	0	0	2	2	0	0	n.a.
Technicians	0	0	0	0	0	0	n.a.
Papers (Intl. Journals)	5	6	6	3	7	14	41
PhD Theses	0	0	0	0	0	0	0
Masters Theses	0	0	0	2	0	0	2
Books	0	0	0	0	0	0	0
Meetings organized	1	1	1	1	1	0	5
Comum. to Conferences	?	2	0	1	4	6	13
Seminars							0

Work on QCD, related to heavy ions:

- Proton structure and nuclei with small Bjorken x : **Color Glass Condensate**
- High- p_t probes** (mainly jets) in heavy ion collisions
- Phenomenology of p-p and nucleus-nucleus collisions**: string percolation models



(IST)



(UC)

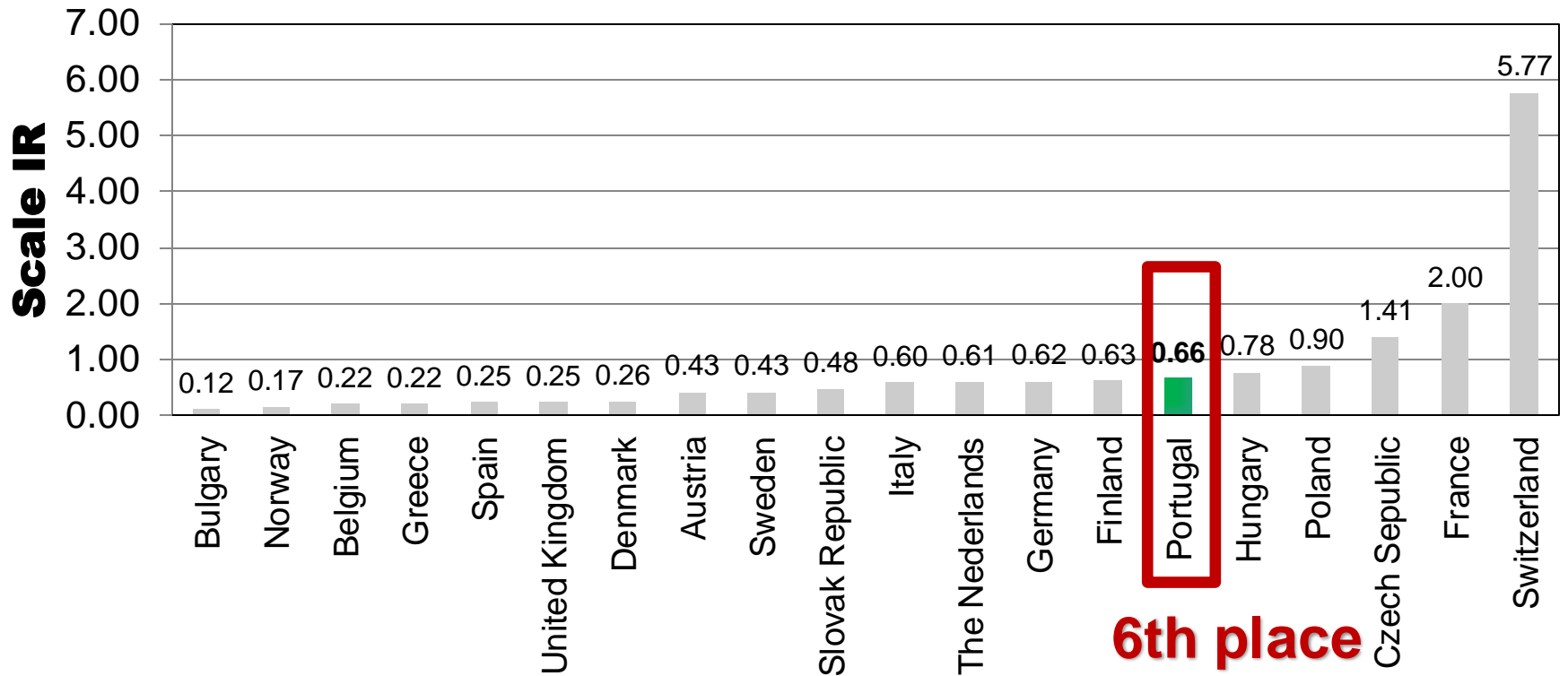
	2006	2007	2008	2009	2010	2011	TOTAL
Financing (k€)	18	14.58	20.41	12.63	27.30	18	111
Researchers	3	3	3	3	3	3	n.a.
Post.Docs				2	3	1	n.a.
PhD Students							n.a.
Master Students							n.a.
Technicians							n.a.
Papers (Intl. Journals)	6	5	5	9	7	5	37
PhD Theses							n.a.
Masters Theses							n.a.
Books	0	0	2	0	0	0	2
Meetings organized							n.a.
Comum. to Conferences	1	4	5	0	3	4	17
Seminars							n.a.

MAIN TOPICS

- Unquenched meson spectroscopy
- Multichannel analysis of mesonic production data
- Chiral-symmetry breaking and restoration
- Non-perturbative approaches to QCD

4.1 Business

**Industrial Return value per CERN 20 Member States (period 2007-2010):
SUPPLIES**

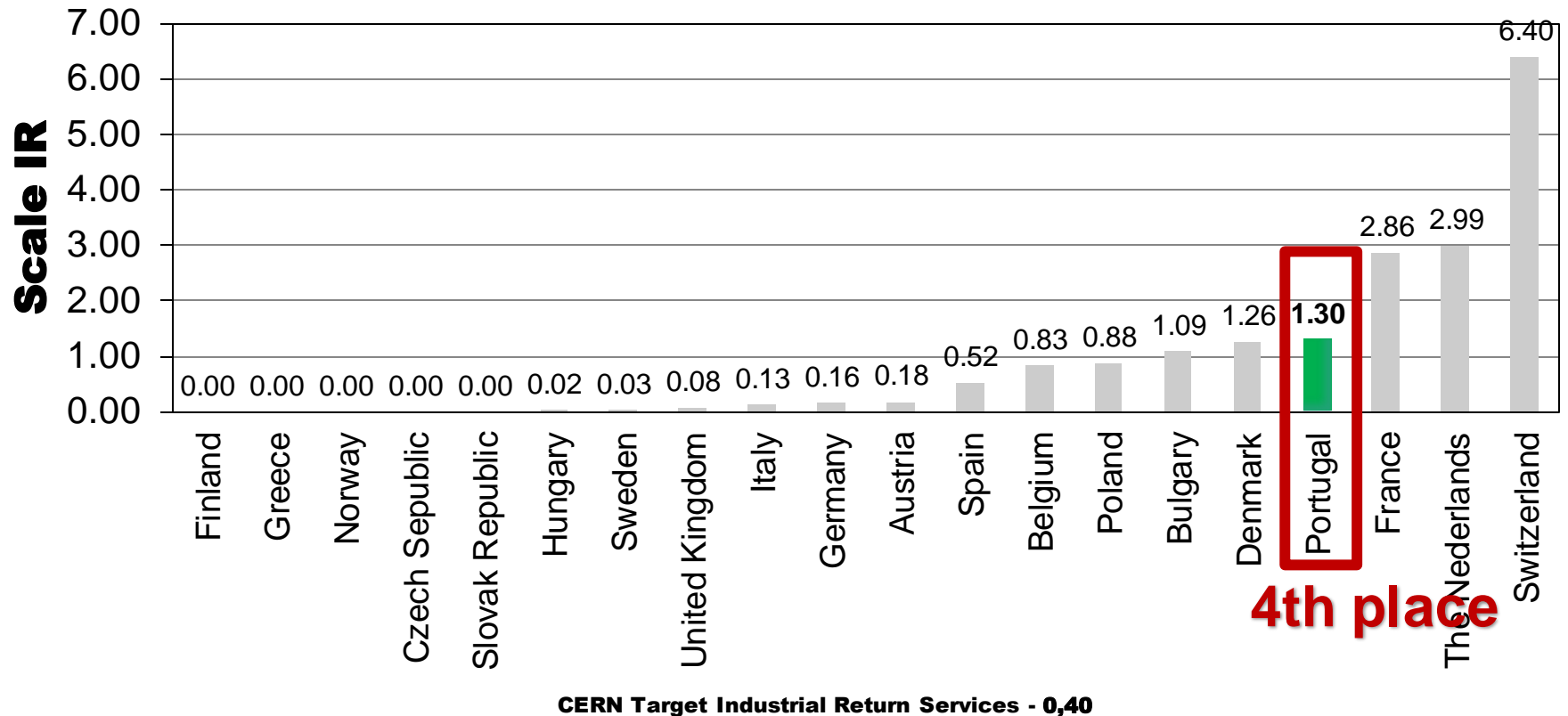


CERN Target Industrial Return Supplies - 0,89

Total of Supplies (2000-2010): 25.3 M€

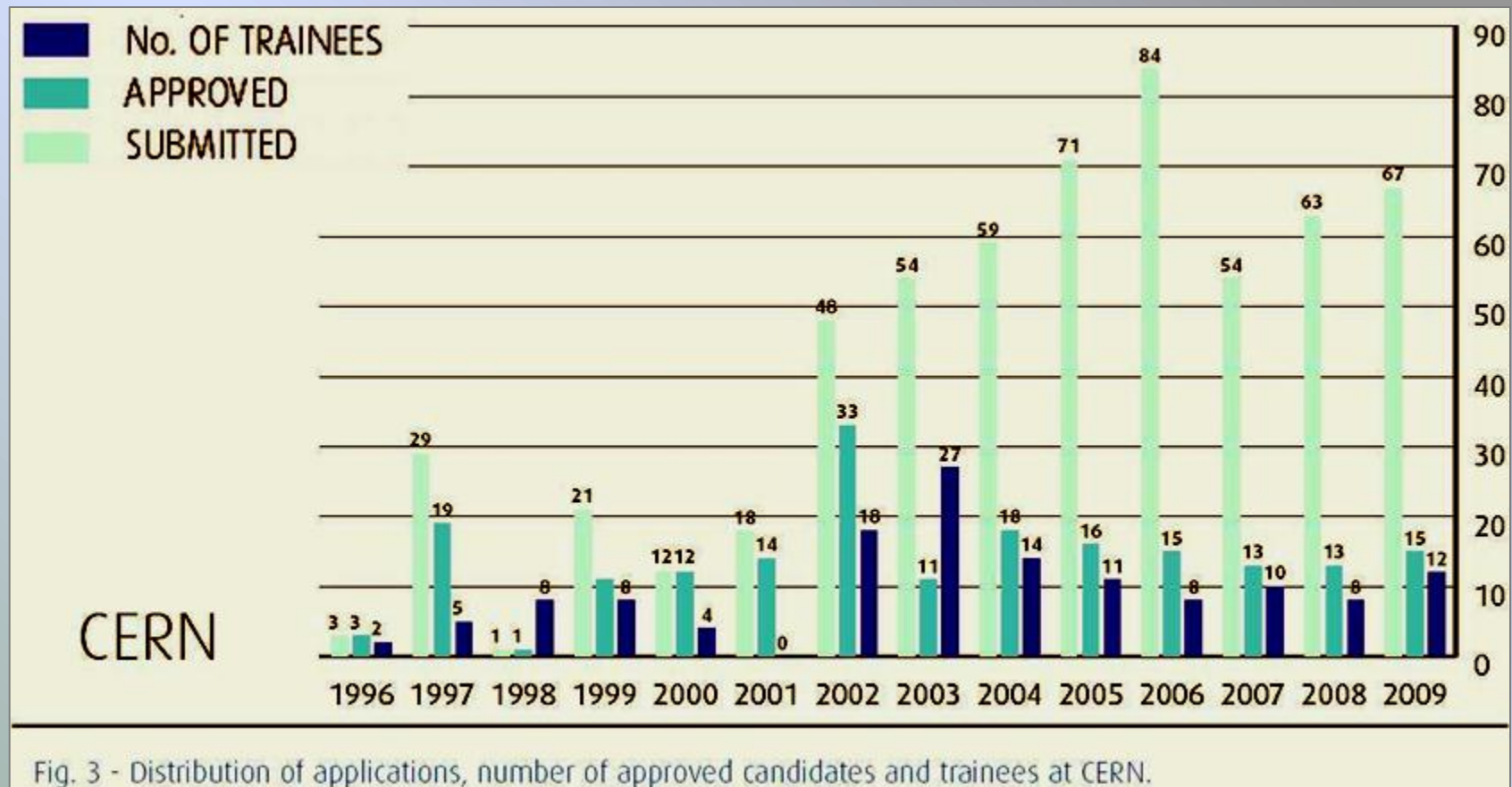
4.1 Business

**Industrial Return value per CERN 20 Member States (period 2007-2010):
SERVICES**



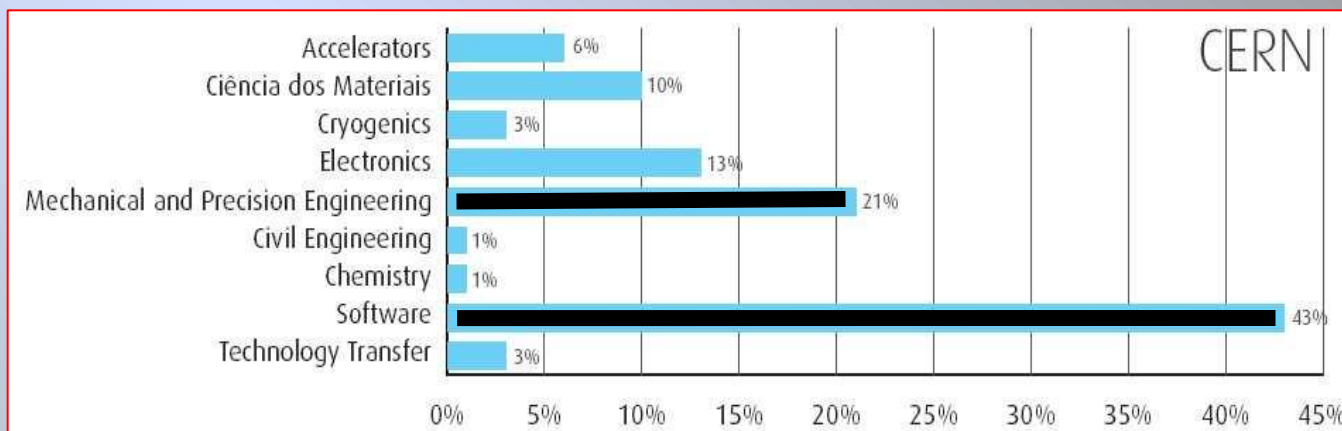
Total of Services (2000-2010): 30.7 M€

4.2 Training of Engineers (run by Agência de Inovação with LIP support)



From 1996 to 2009 (latest data available) **135 Portuguese engineers received advanced training at CERN**, participating in very challenging projects

4.2 Training of Engineers (run by Agência de Inovação with LIP support)



Technological areas of the training programmes at CERN

Where are the former trainees ?

- The majority returned to Portugal !

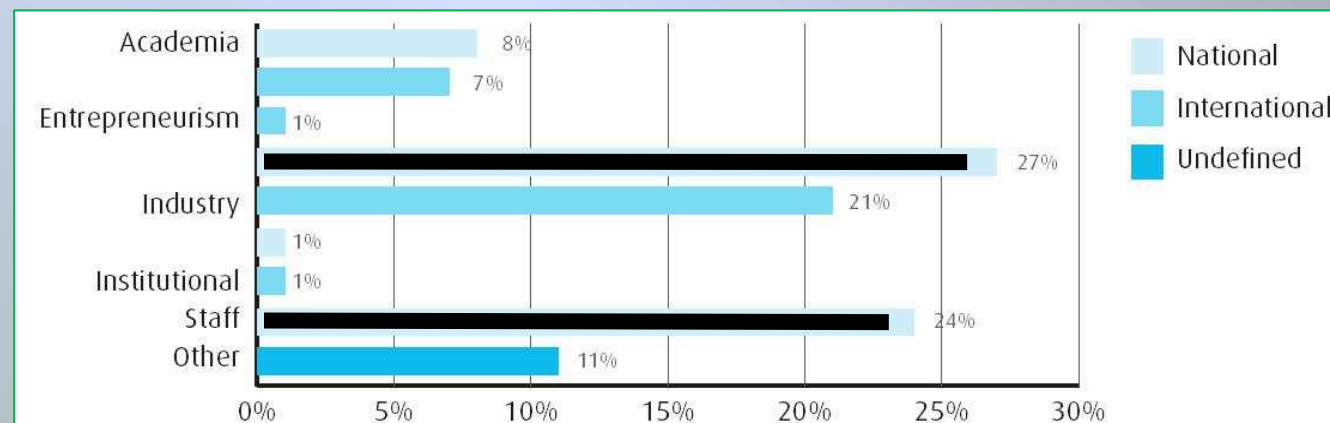
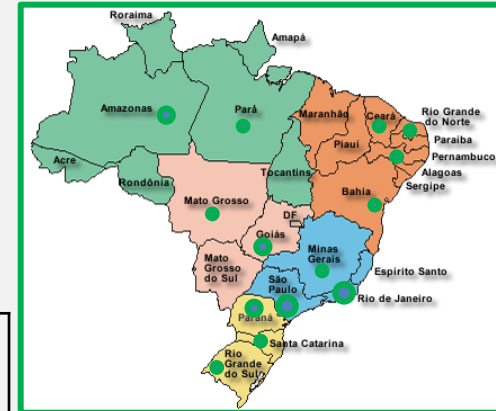
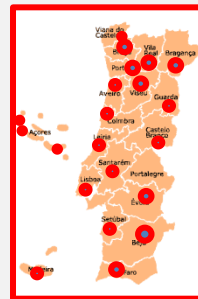


Fig. 21 – Distribution by type and location after the traineeship (CERN).

4.3 Teachers School

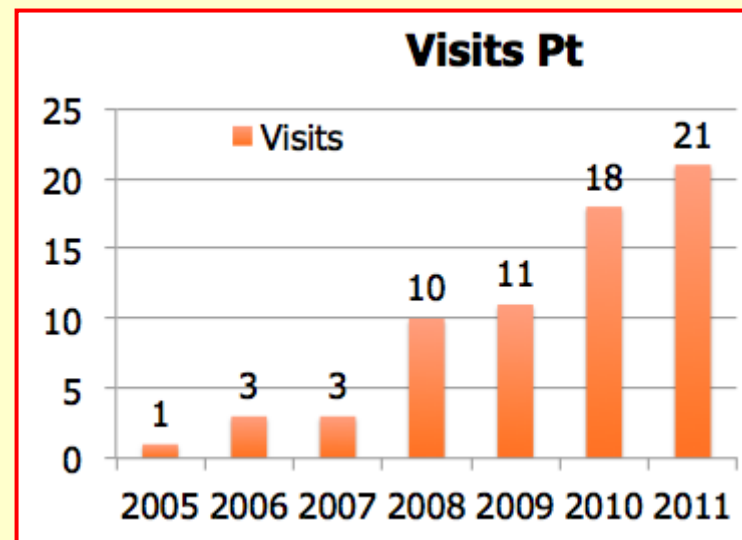
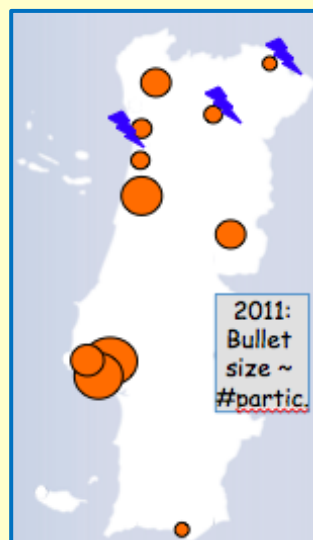
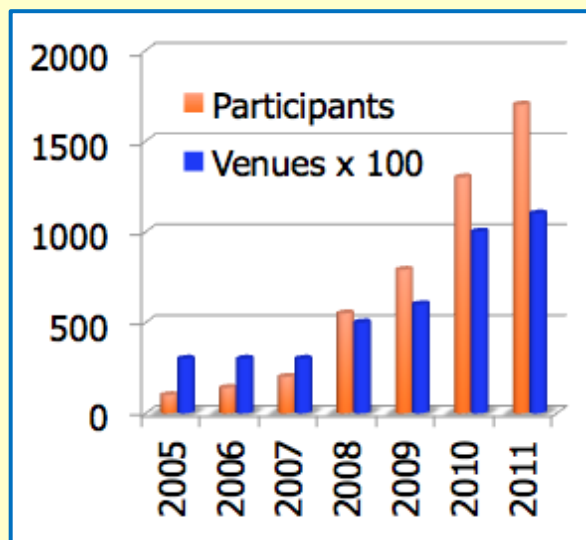
- **One week schools, at CERN, in Portuguese, for Portuguese secondary school teachers.** Co-organized by LIP, the national outreach agency CIÊNCIA VIVA and CERN. **Large interest among teachers all over the country.**
- With support from UNESCO since 2009, **the 2011 edition had participants from all Portuguese speaking countries !**

Year	PORTUGAL		BRAZIL	MOZAM- BIQUE	CABO VERDE	S. TOMÉ E PRINCIPE	ANGOLA	GUIÉ BISSAU	EAST TIMOR	Total
	Applicants	Participants								
2007	191	43								43
2008	242	45	1							46
2009	193	44	11	5						60
2010	218	45	20	4	1	1				71
2011	190	41	20	4	1	1	4	1	1	73
Total	684 ^(*)	218	52	13	2	2	4	1	1	283



4.3 Masterclasses

- Growing participation of secondary school students in Masterclasses, all over the country
- Need for **more and more venues** in main universities and politechnical schools.



- **Increasing number of visits of Portuguese schools to CERN** (family supported) in recent years – ***related to Masterclasses success ?***

Last, but not least ...

International Doctorate Network in Particle Physics, Astrophysics and Cosmology

An interdisciplinary network promoted by LIP (Mario PIMENTA) to create new high-level experts in the fields of Particle Physics, Astrophysics and Cosmology

UPCOMING EVENTS

	School IDPASC Dark Matter School Évora, Portugal, 14-18 December 2011	
	Workshop IDPASC Dark Matter Workshop Évora, Portugal, 17-18 December 2011	
	School Second IDPASC School Udine, Italy, 23 Jan. - 03 Feb. 2012	



PT ES IT FR

CERN

MAP Fis (UA+UM+UP)

U. Algarve

U. Coimbra

U. Évora

U. Genova

U. Granada

U. Lisboa

IST-UTL

STMS - U. Padova

U. Paris VII

U. Porto

U. Sant. de Compostela

U. Udine

U. Valencia

The end





The end