

PECFA MID-TERM REVIEW FRANCE (Part 2)

OUTLINE

- Astroparticles and Cosmology
- Theoretical Physics
- Grid Computing
- Interdisciplinary activities and Technological transfers
- Communication and outreach

What is the role of high energy phenomena in the formation of cosmic structures?

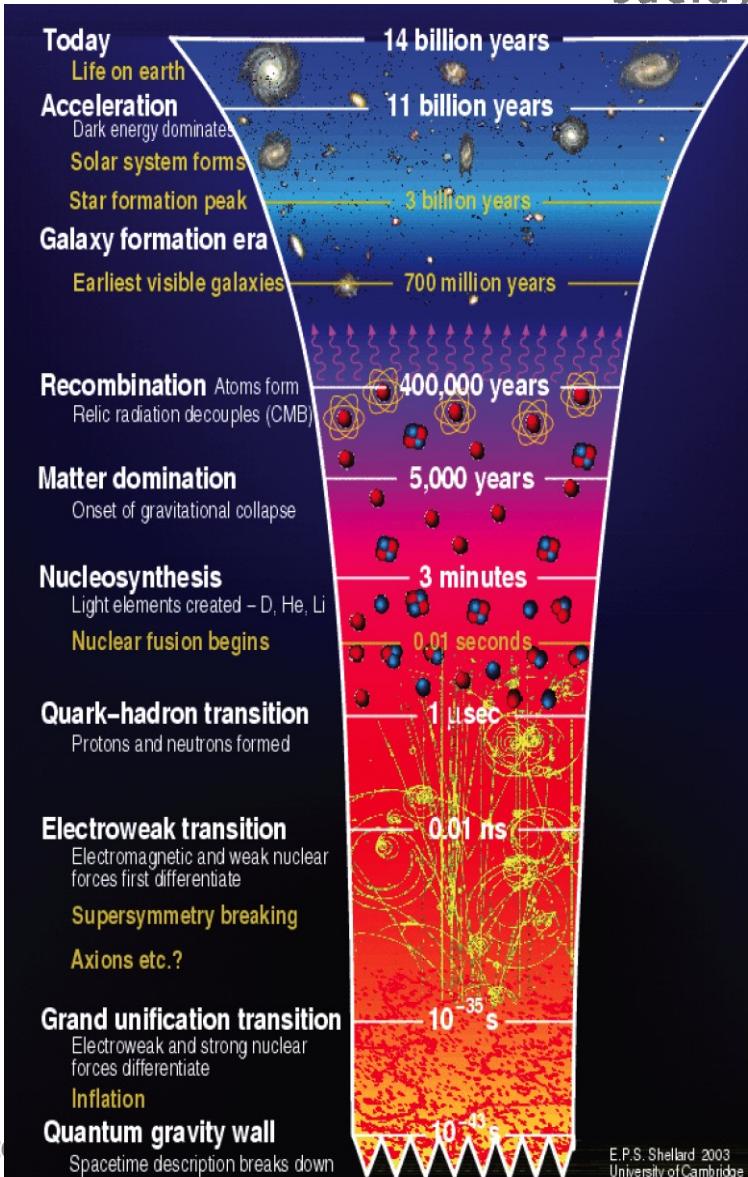
- Multi-messenger studies (γ , CR, ν , GW)
- *Origin of Cosmic Rays, Search for new particles (dark matter, antimatter), Limits of fundamental laws*

What is the Universe made of?

- Nature of dark matter and energy
- *Probe EW scale, Gravitation*

Can we probe matter and interactions at the smallest scales?

- Rare decays: proton lifetime , neutrino properties
- *Access GUT scales*



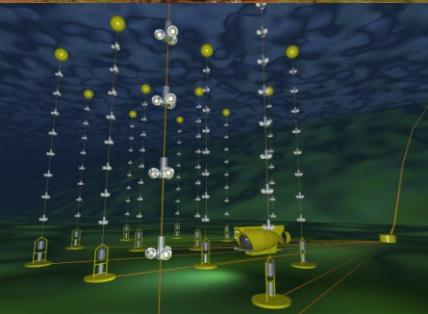
ASTROPARTICLES AND COSMOLOGY

New messengers (ground, 195 FTE)



HESS (2004) → HESS2 (2012) → CTA

- HESS/HESS2 33% of budget, TGE
- CTA Project manager electronics, mechanics, mirrors, site
- 60 scientists and engineers



ANTARES (2008) → KM3net, TGE

- KM3net : single design, multisite? Relations with ICECUBE
- Large interdisciplinary potential → deep ocean observatory
- ANTARES. France 50% of budget (50% INFN, NIKHEF, Erlangen, Spain)
- 40 scientists and engineers



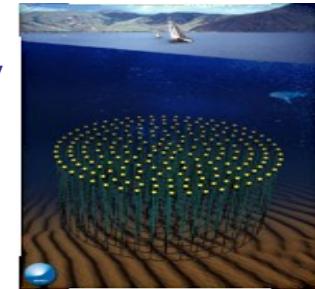
Virgo (2008) → Adv Virgo (2014-15)

- Very good coordination with advLIGO
- Cost CNRS 50%, INFN 50%
- 30 scientists and engineers



AUGER (2008) → R&D extensions/radiodetection

- 15% of budget
- 45 scientists and engineers



R&D, balloons
(CREAM) etc
20 FTEs



New messengers (space, 35 FTE)



FERMI (2008)

Gamma-ray space telescope

- CC-IN2P3 only data processing center outside SLAC
- 50% of papers IN2P3 corresponding author
- 10% of non-US contribution
- 15 scientists and engineers



AMS (2011)

to search in space for dark matter, missing matter & antimatter on the international space station

- 10-15% of payload
- 10 scientists and engineers



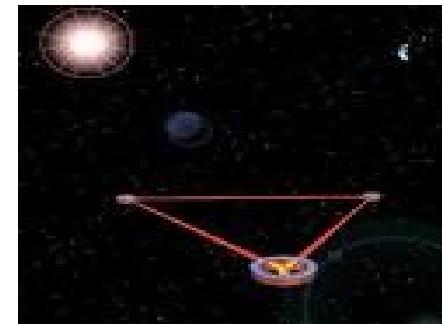
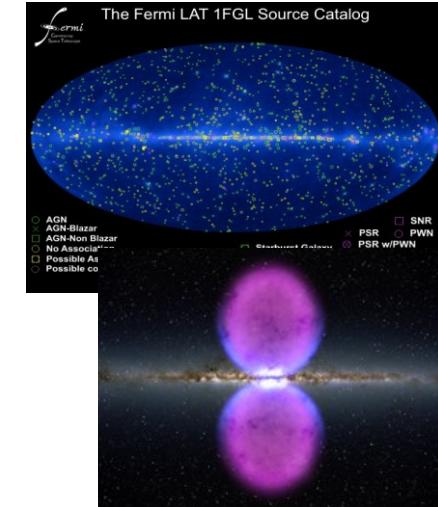
LISPATHFINDER (2012) → LISA(2020)

- IN2P3 leader in France
- CNES investment + IN2P3 engineers
- 10 scientists and engineers



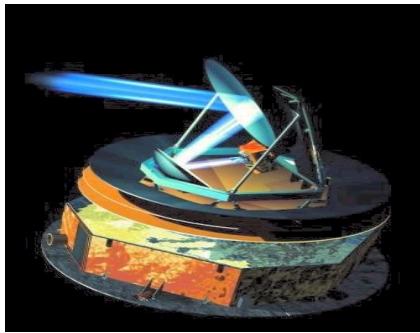
JEM-EUSO (2015)

- CNES investment + IN2P3 engineers
- overlap with Auger



ASTROPARTICLES AND COSMOLOGY

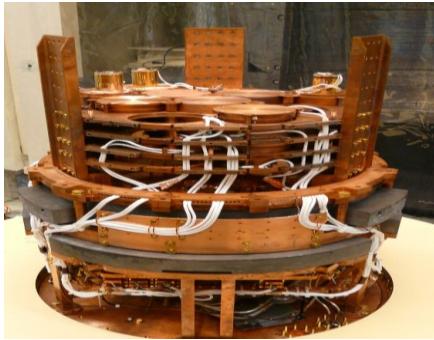
Cosmology (ground + space , 165 FTE)



CMB: Planck (2009) → R&D on bolometer matrices

- CC-IN2P3 major centre
- CNES investment IN2P3 engineers
- 35 scientists and engineers

Nuclear Astrophysics:
20 FTE

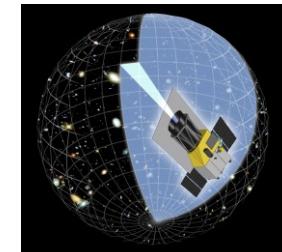
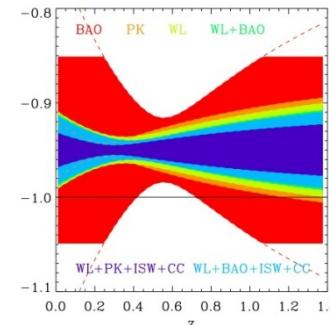
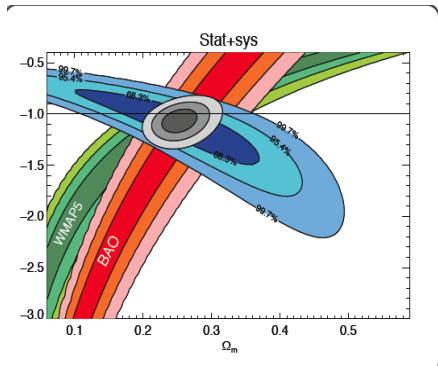


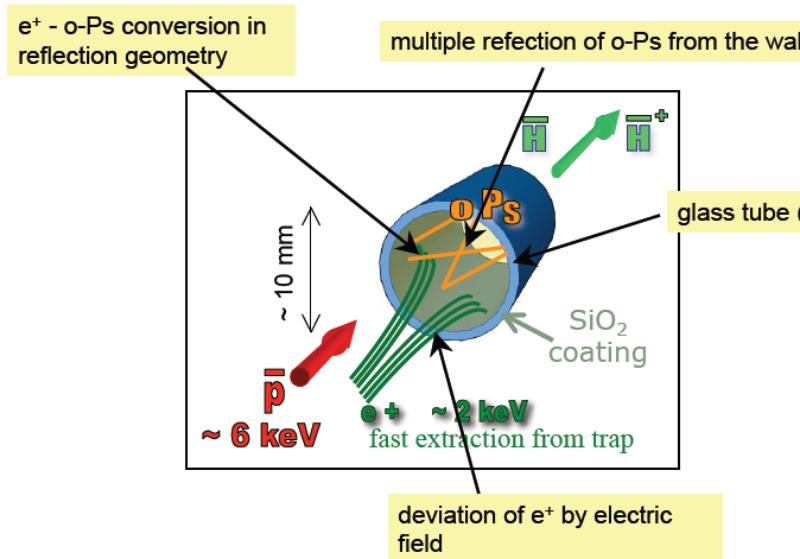
Dark matter : EDLWEISS-II(2009) in LSM

- Germanium bolometers
- France 80% of budget, 20% Germany+UK
- Coordination EDELWEISS+CDMS
- 30 scientists and engineers
- team on XENON100

Dark energy : Strong tradition

- Leadership in SNFS/SNLS (2002-2010)
- BOSS
- LSST, BAO-Radio, BigBOSS
- EUCLID/WFIRST
- 70 scientists and engineers





Gbar

Measurement of the behavior of antimatter (anti-hydrogen) in a gravitational field

- Intense source of positrons
- Production of thermalized positronium
- Use anti-protons (ASACUSA at CERN or Fermilab)

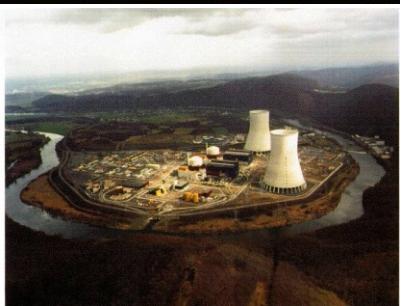
3 physicists, 2 PhD students, 300k€ ANR



CAST

- Search for axions produced in the Sun
- 9T prototype of an LHC magnet
- Micromegas detectors
- 5 physicists

Neutrino (ground and underground, 110 FTE)



OPERA (2008) $\nu_\mu \rightarrow \nu_\tau$ CERN to GS

- Strong IN2P3 involvement (20-25 %)
- 25 scientists and engineers

T2K (2010) $\nu_\mu \rightarrow \nu_e$

- θ_{13} and CP violation measurements
- 3 micromegas TPC modules tested
- 25 scientists and engineers

DCHOOZ (2010), $\nu_e \rightarrow \nu_e$

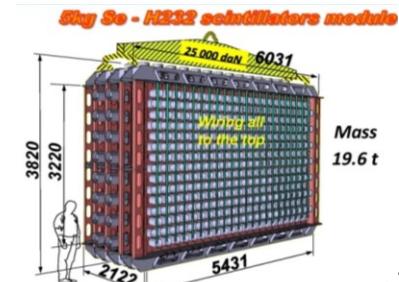
- Filling is finished, first ν light in December
- near excavation on schedule
- 20 scientists and engineers IN2P3/CEA

NEMO3 (2003-2010) → SuperNEMO (1st mod 2013)

(UK, US, Czech R, Japan, Russia)

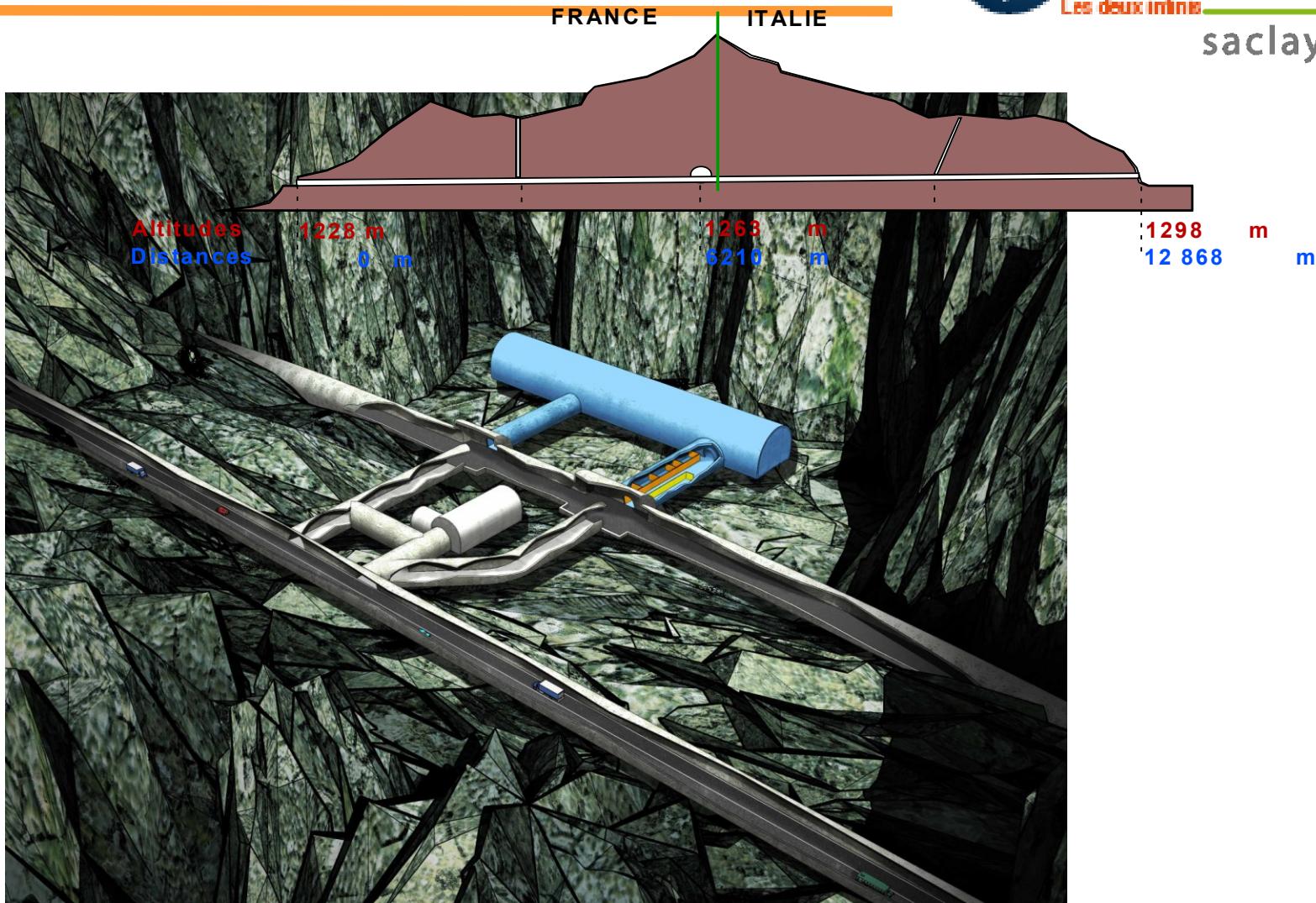
- 100 kg of isotopes
- Factor 10 in sensitivity
- mass sensitivity of about 50 meV
- 30 scientists and engineers

Megaton WC R&D
Design Study for LSM
10 FTE



ASTROPARTICLES AND COSMOLOGY

high priority: LSM extension

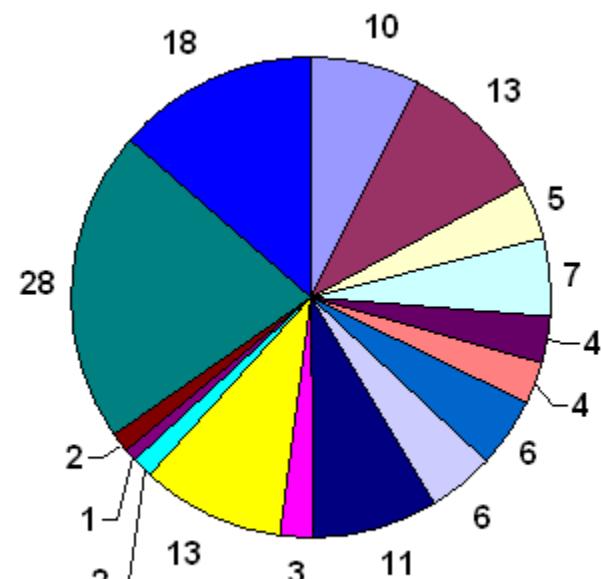


Host dark matter and Neutrino mass (Eureca, XENON?, SuperNEMO)
Decision by mid-2011

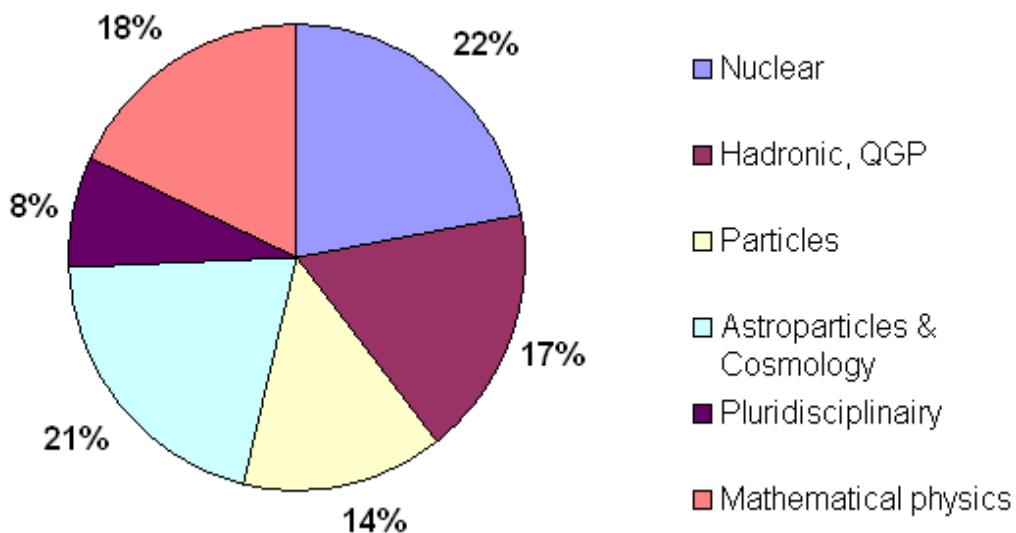
Covers a whole spectrum from Low to High Energy Physics ...

- Nuclear structure; hadronic matter ; hadron spectroscopy; hadronic physics
- N fermion problems: from the atomic nucleus to neutron stars
- Dynamical processes (fission, fusion, and alpha decays),
nuclear reactions for astrophysics
- Field theory; Phase Transitions, Renormalization Group, Fundamental interactions
- Quantum Chromodynamics (perturbative and non-perturbative);
- Heavy ions Physics, QGP
- Symmetries; Supersymmetry
- BSM physics (including neutrino properties, very early Universe, ...)
- Implications of Particle Physics models in Astroparticles and Cosmology
(cosmic radiation, antimatter, dark matter, dark energy, ...) and relations to
observations
- Statistical and dynamical Properties of finite interacting systems
- Complex systems and non-linear phenomena
- Pluridisciplinarity in particular with biology
 - Modelling of complex systems at the interface between medicine, biology and physics

THEORETICAL PHYSICS



- SUBATECH
- IPNO
- LPC CLMT
- CENBG
- GANIL
- LPC CAEN
- IPHC
- LPSC
- IPNL
- IMNC
- APC
- LPNHE
- LAL
- CSNSM
- LPTA
- CEA/IPhT



GRID COMPUTING

<http://www.france-grilles.fr>

France Grilles Grand Public Communauté Scientifique

Vous êtes ici: Accueil du site

Qu'est ce que France Grilles ?

France Grilles est un Groupement d'Intérêt Scientifique (GIS) qui rassemble sur le territoire national et fortement impliqués dans la recherche scientifique.

Le GIS est piloté par l'Institut Des Grilles du CNRS.

Ses missions :

- Etablir une infrastructure nationale de calcul et de stockage pour le massif des données scientifiques,
- Promouvoir l'usage des Grilles dans toutes les disciplines scientifiques,
- Développer la collaboration entre grilles et entre elles et les autres plateformes de calcul et de stockage.

Le Groupement d'Intérêt Scientifique France Grilles est composé de plusieurs partenaires et partenaires associés.

NGI part of the EGI

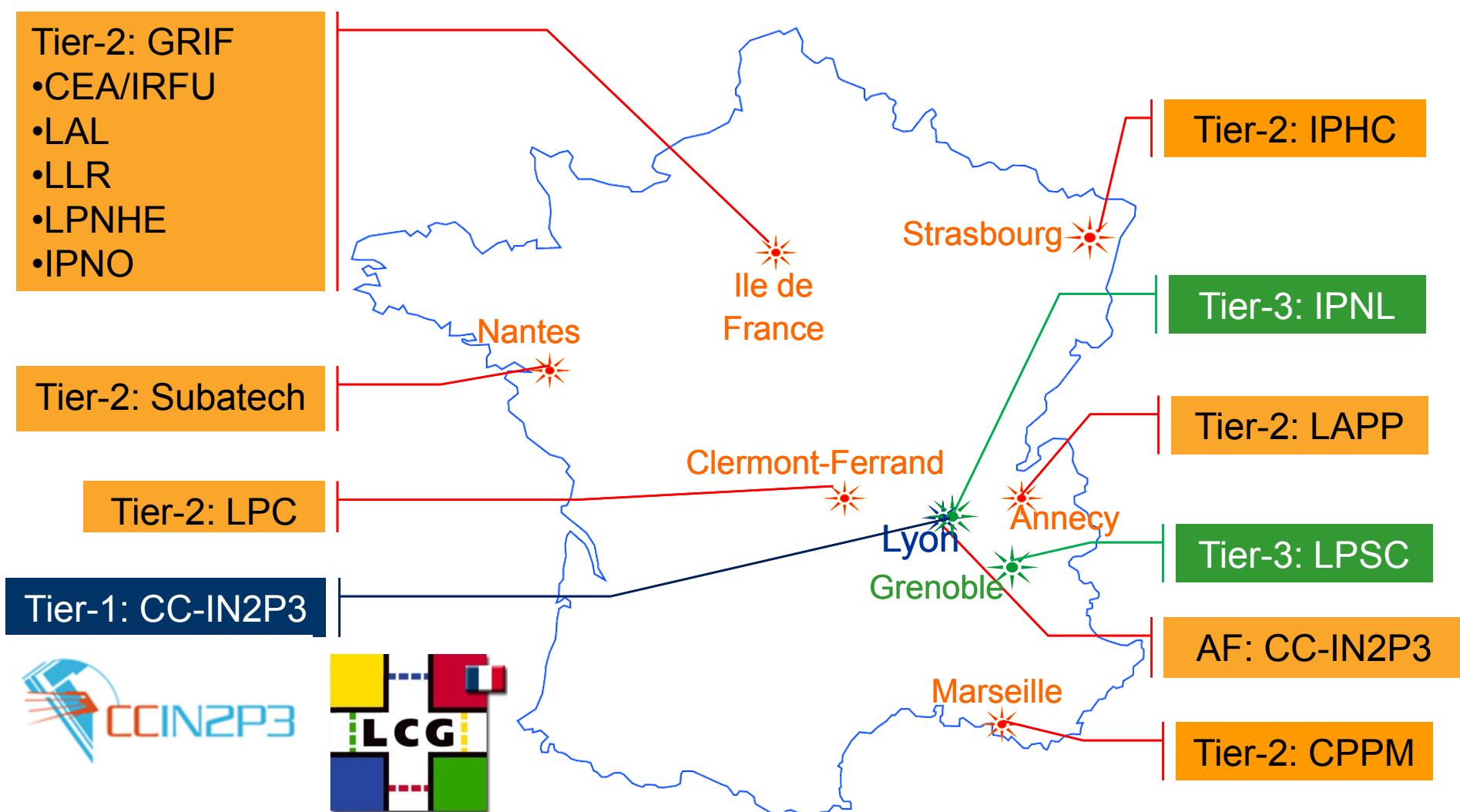
LCG is its spine
CC-IN2P3 its marrow

- >22.000 coeurs
- > 15 PB de stockage
- LCG = colonne vertébrale
- CC-IN2P3 = moelle épinière
- Nombre de certificats délivrés en 2009

U. Bassler/E.Kajfasz

Production
GRID Resources

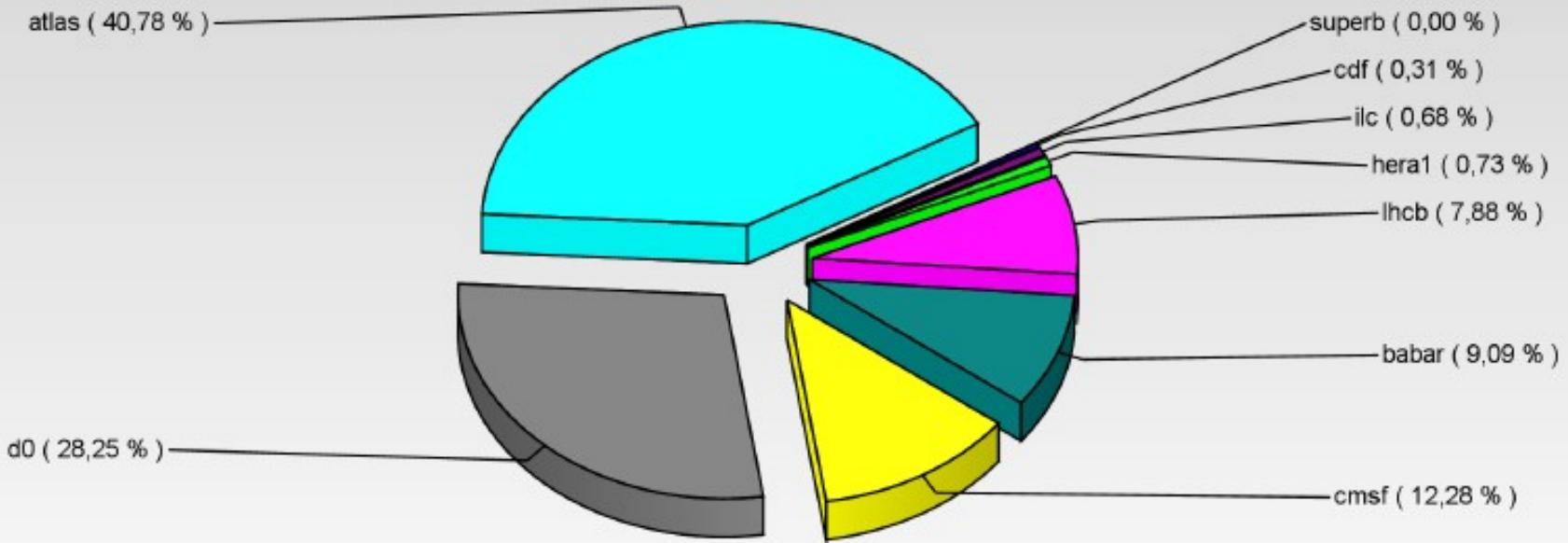
GRID COMPUTING LCG-FRANCE



Marque	Modèle	Nb	Processeurs	Fréquence	Mémoire	Stockage	Puiss. unitaire HS06	Puiss. totale HS06 (UI)*
DELL	PowerEdge 1950	400	2x Intel Xeon E5450 Quad Core	3,00 GHz	16 Go	160 Go	76	30400 (152000)
IBM	System x iDataPlex	400	2x Intel Xeon E5430 Quad Core	2,66 GHZ	16 Go	160 Go	66,2	26480 (132480)
DELL	PowerEdge M610	288	2x Intel Xeon E5540 Quad Core Hyperthreaded	2,53 GHz	48 Go	250 Go	130	37325 (186624)
DELL	PowerEdge C6100	112	2x Intel Xeon X5650 Hexa Core Hyperthreaded	2,66 GHz	72 Go	500 Go	219	24528 (122640)
Total	-	1200	-	-	34688Go	256000Go	-	118733 (593664)

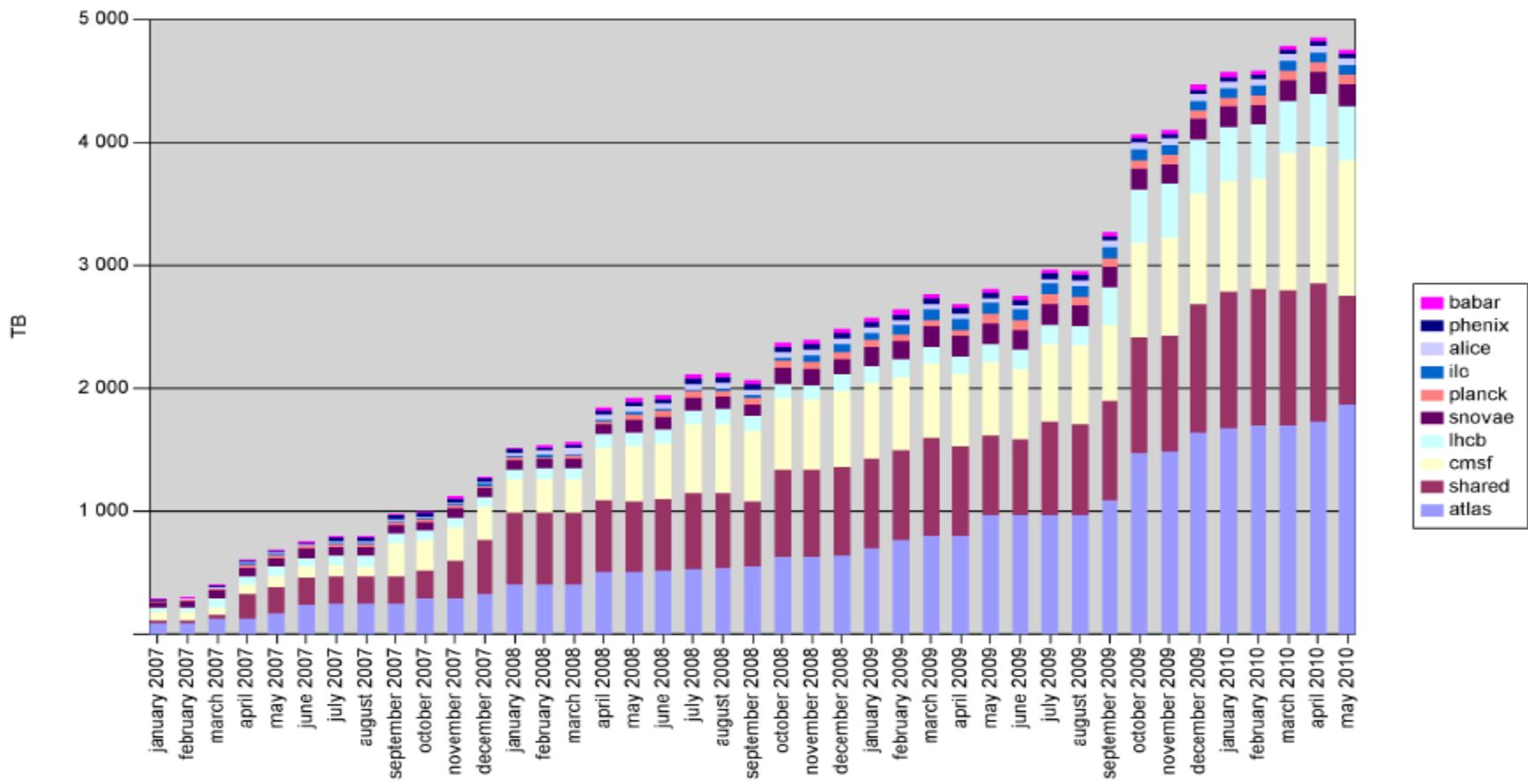
119 000 HEP-SPEC 2006
 13696 cores ... and increasing

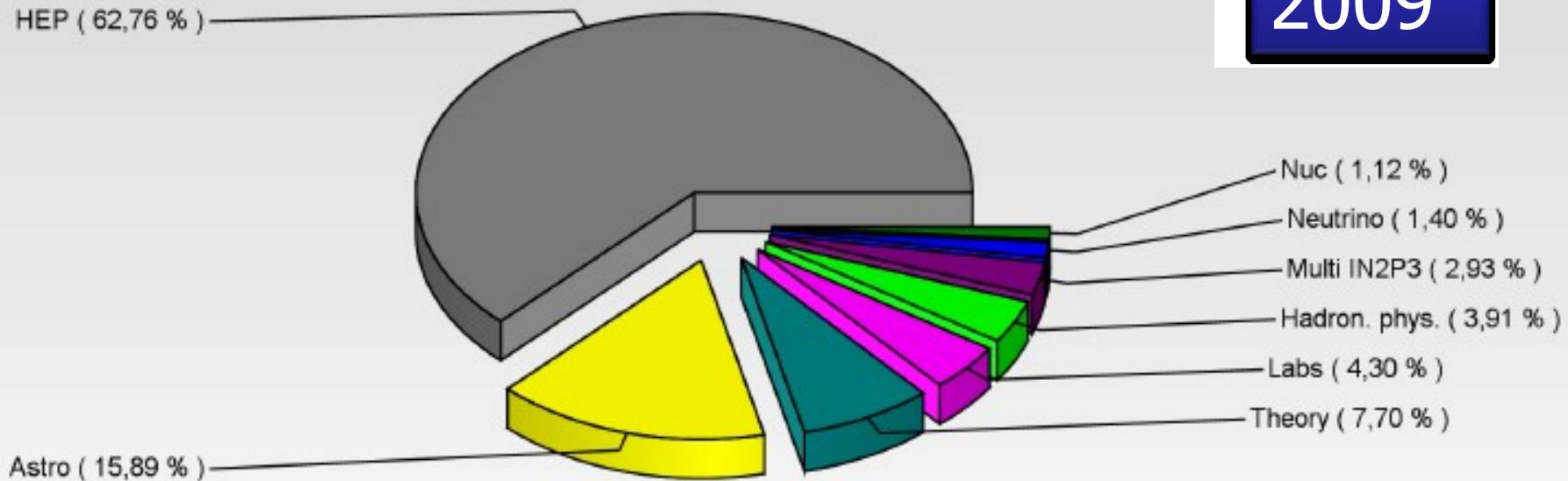
2009



Tape library of more than 7 petabytes for mass storage

Over 10 Petabytes of storage available on disk





Multidisciplinary activities: 3.8%

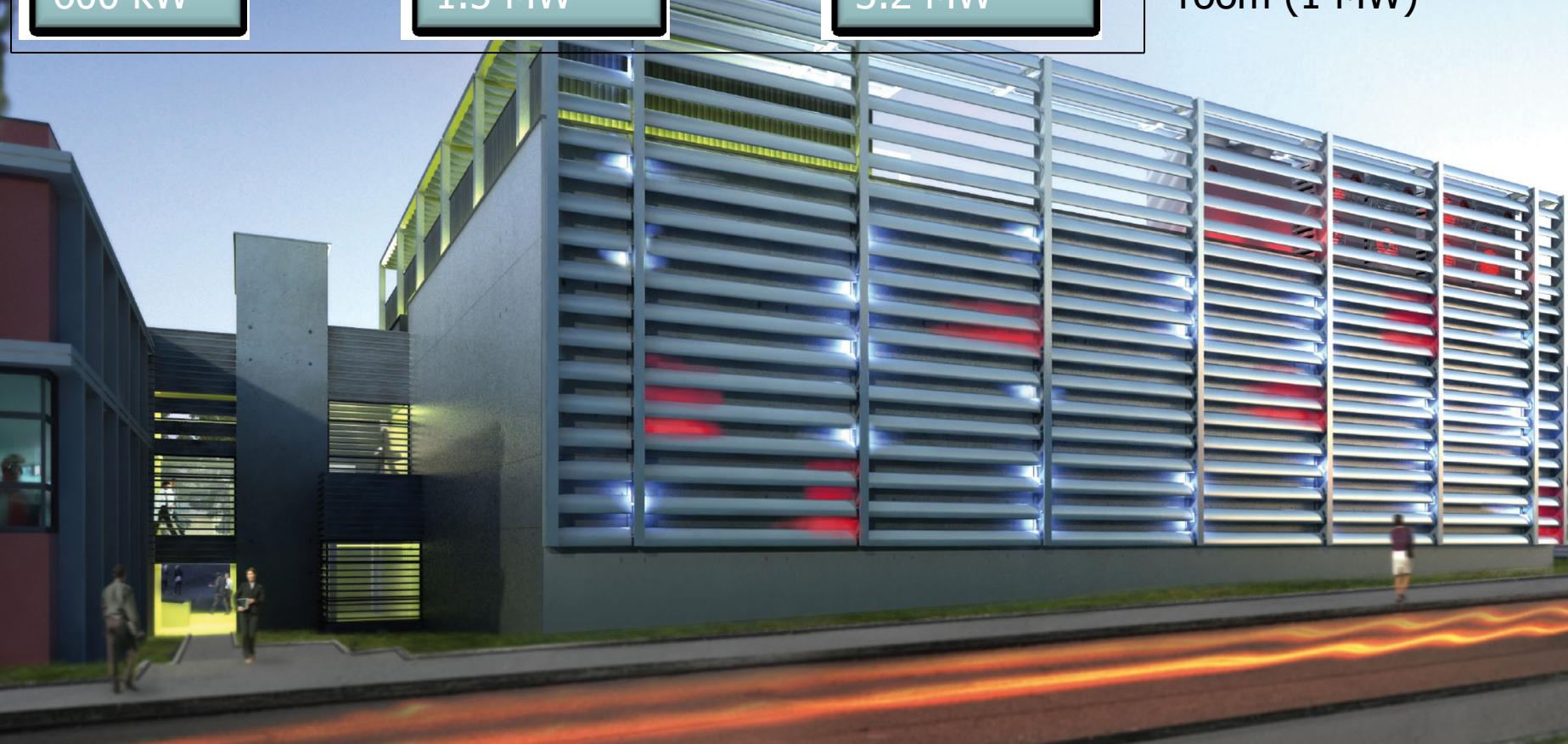
End up with:

2011
50 racks
600 kW

2015
125 racks
1.5 MW

2019
216 racks
3.2 MW

In addition to the
existing computer
room (1 MW)



Nuclear energy

- Neutronics, Basic nuclear data
- Cross-disciplinary program PACEN
 - Innovative systems for the future of Nuclear Energy
 - Transmutation of nuclear wastes
- Accelerator Driven Systems (ADS)
 - Experimental validation is needed (R&D in FP European programs)
 - High intensity accelerator developments (IPHI)
 - MEGAPIE, n-TOF, PDS-XADS
 - MUSE, EUROTRANS (subcritical system)
- Innovative systems for Nuclear Energy based on the Thorium cycle
 - TMSR, focused on the concept of a molten salt reactor
- Expertise in scientific nuclear installations (RAPSODIE)
- Fusion (IFMIF-EVEDA: deuteron beam for material irradiation)
- non-proliferation monitoring of nuclear fuel with ν flux measurement (NUCIFER) at nuclear power plants

Radiochemistry and radioactivity measurement

- Back-end of the electronuclear cycle
 - Treatment of radioactive waste, waste containers behavior, radiolysis...
- Nuclear medicine
 - Isotope production and radiation survey in hospital environment
- Environmental survey, liquid and air pollution, dating, food origin control...
- Services for dosimetry and radiation measurement
 - Measurement from very low levels including biological impact
 - Electronuclear plants dismantling.

From R&D on accelerators, ion sources & plasma

- Superconducting Magnets Technology (ISEULT/INUMAC 11.7T full-body MRI)
- High-Quality Beams for Medical Purposes
 - Fixed Field Accelerating Gradiant design
 - Beams for cancer/tumor treatment by hadrons and photons
- Radio-isotopes production for diagnostics/markers and treatment
- ECR microwaves and plasma sources for industry

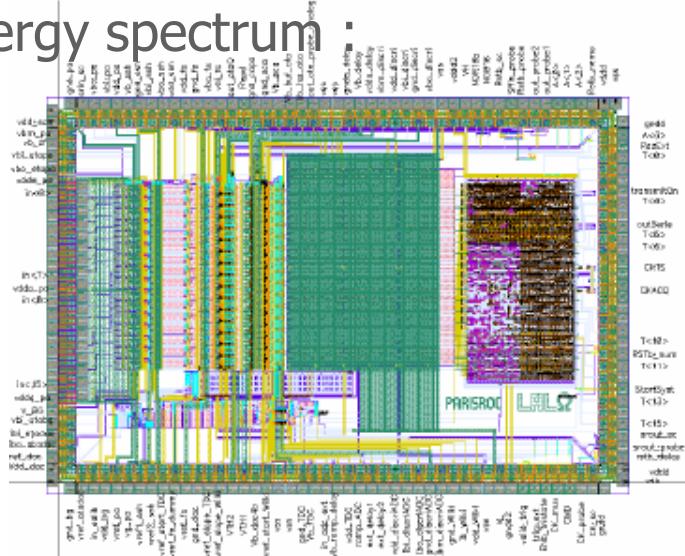
PLURIDISCIPLINARITY AND TECHNOLOGICAL TRANSFERS

Collaborative R&D on Detectors and associated electronics

Detectors across the whole frequency and energy spectrum :

IR, UV, X, γ , α , β , muons, neutrons...

- PM and SiPM
- Multi-pixel X-Ray Detectors
- Ge Detectors for very low radioactivity
- CMOS and EBCMOS
- Gaseous detectors (MPGD)



Electronics:

- Associated frontend A/D electronic and bounding with R&D on 3D implementation
- Very high speed, low noise and low energy ADC (SPIROC, HARDROC...)
- Ethernet frontends for very large number of detectors (OPERA)

Optics:

- Optical multi layers material coating
- Thin layers characterization for optical applications

TECHNOLOGICAL TRANSFERS

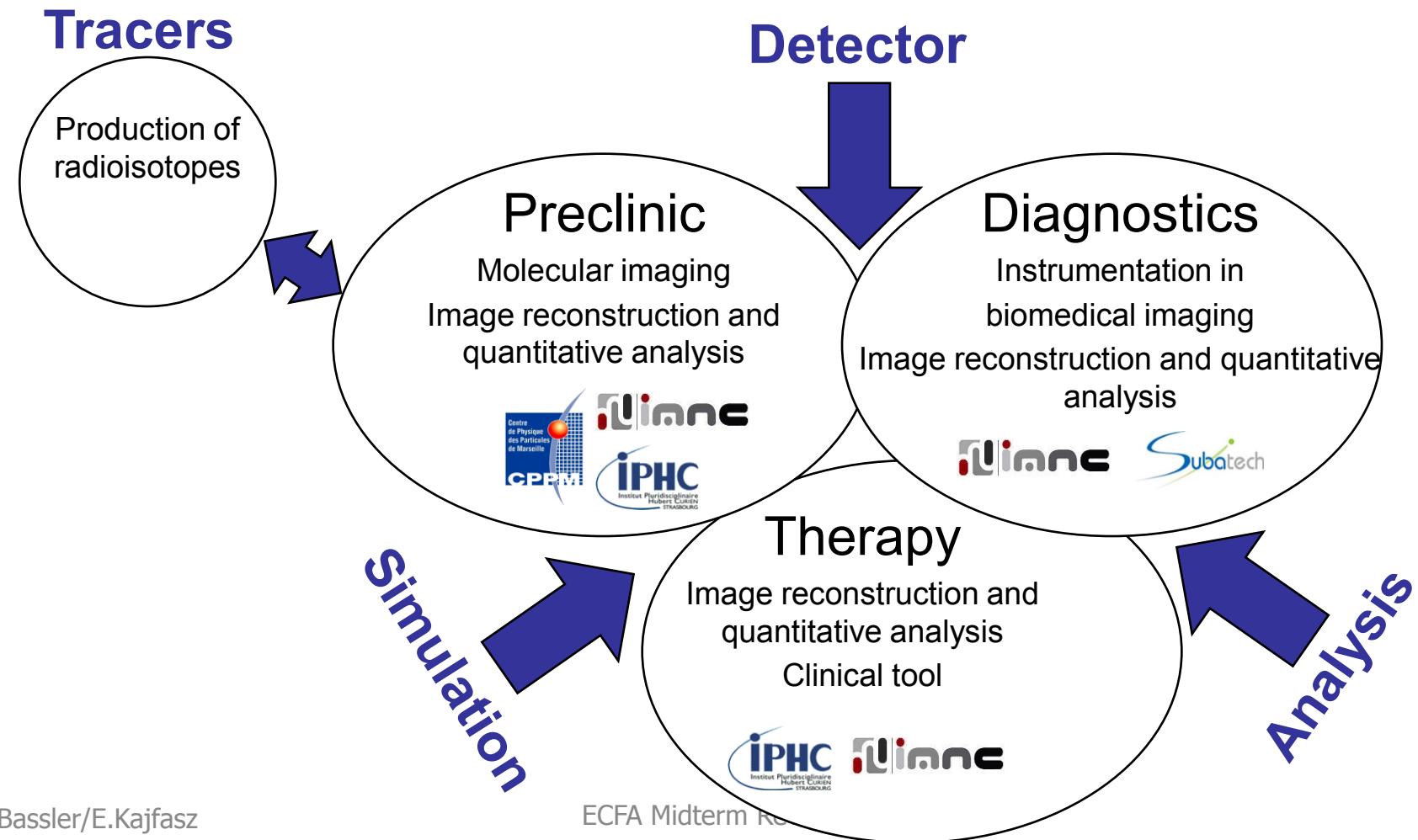
IN2P3 shares hi-tech resources



- **Collaboration with industry partners ("Club des Industriels")**
- **Provides facilities, competence and know-how in various fields**
 - Radiochemistry and research on the treatment of radioactive waste
 - Irradiation of materials
 - Dosimetry of very low radioactivity measurement
 - Microelectronics and MEMS
 - Modeling of particle-matter interaction, from high energies down to energies relevant for biological processes
 - New instruments for medical diagnosis and therapy: X-Ray pixel detectors, PET, Hadrontherapy, Nuclear medicine, beam and dose measurement ...
 - Ion sources and beams
 - Plasma application (implantation, coating, ...)
 - Precision optics
 - Intensive computer processing of large masses of data
- **over 40 patents registered and a few startup companies created**

PLURIDISCIPLINARITY AND TECHNOLOGICAL TRANSFERS

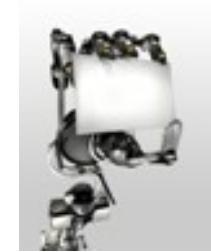
GDR MI2B: Modelling & Instrumentation for Biomedical Imaging FIGHT AGAINST CANCER



PLURIDISCIPLINARITY AND TECHNOLOGICAL TRANSFERS



startup imXPAD
spécialised in hybrid
pixel for X-ray
detection



LPSC in project
INSPIRA for safer
radiotherapy, financed
by OSEO

Transborder
technological platform
MIND at Archamps



partnership between SEM SAPHYN (SAnté et
PHYSique Nucléaire) - Basse-Normandie
Region and IBA to create the ARCHADE
research center

And many others

COMMUNICATION AND OUTREACH



The screenshot shows the LHC France website. At the top, there's a navigation bar with icons for search, refresh, and other functions, followed by a search input field and a "OK" button. Below the header is a banner featuring a photograph of the LHC accelerator. The main menu includes links to "Actualités", "Revue de presse", "Visiter le Cern", "Foire aux questions", and "Goodies". A secondary navigation bar below the banner has links to "Qu'est-ce que le LHC?", "L'accélérateur", "Les expériences", "Le défi informatique", "L'aventure humaine", and "La contribution française". On the left, a sidebar titled "Les dernières actualités" lists recent news items:

- 9 novembre 2010 Premières collisions d'ions lourds au LHC
- 18 octobre 2010 Le LHC à la fête de la science
- 12 octobre 2010 Marseille : site de niveau 2 de la grille de calcul LHC
- 8 octobre 2010

The main content area features a news article titled "Premières collisions d'ions lourds au LHC" dated November 9, 2010. The text discusses the start of heavy ion collisions at the LHC. To the right of the text is a circular image showing a collision event from the Alice detector, with a small inset showing a zoomed-in view of the collision point.

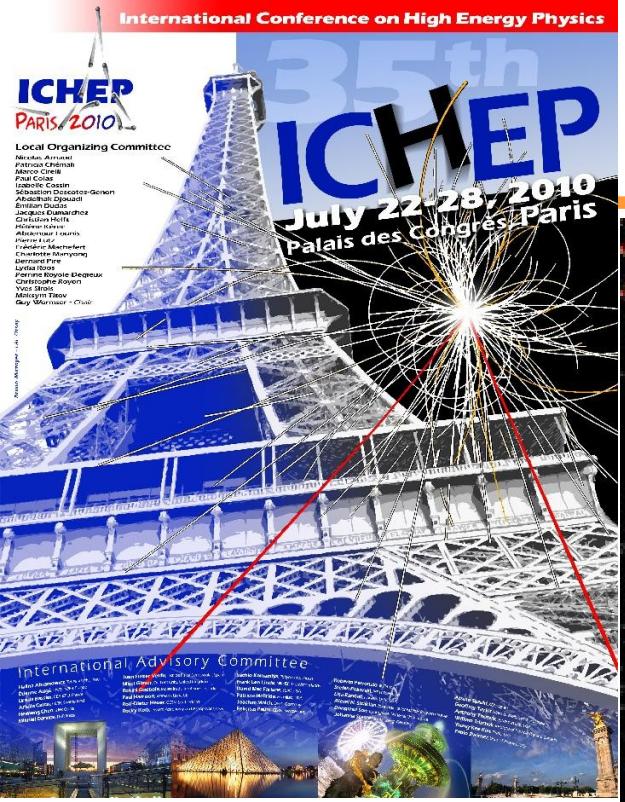
Accueil > Actualités > Premières collisions d'ions lourds au LHC

9 novembre 2010

Premières collisions d'ions lourds au LHC

Après 7 mois de collisions avec des protons, le LHC entame une nouvelle phase d'exploitation. Pendant un mois et pour la première fois, des ions plomb sont accélérés et entrent en collision dans la machine. Cette exploitation ouvre de toutes nouvelles perspectives et permettra de sonder la matière telle qu'elle existait dans les tout premiers instants de l'Univers. À partir du 6 décembre, le LHC subira un arrêt technique pour maintenance puis l'exploitation avec protons reprendra en février et le programme scientifique se poursuivra tout au long de l'année 2011.

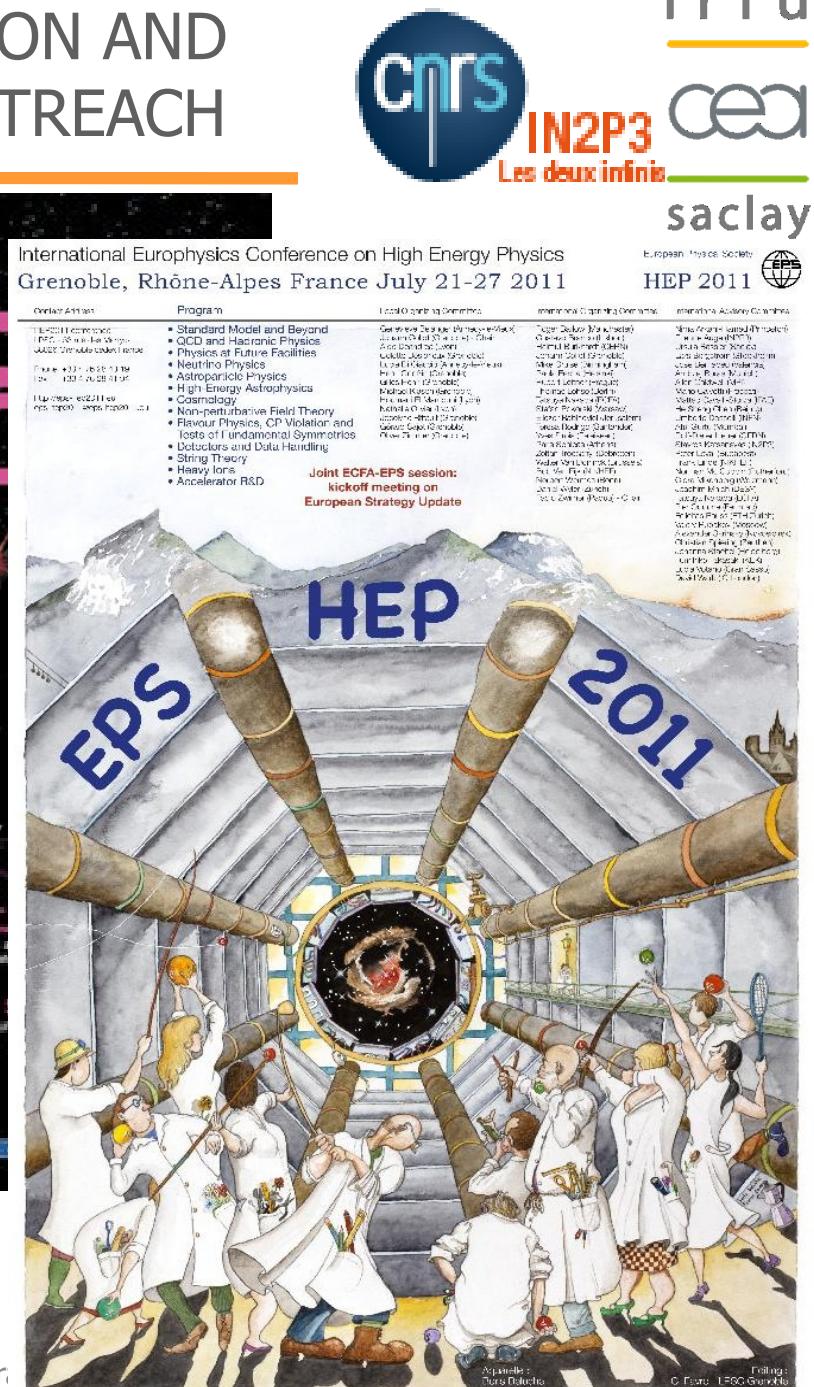
Une des premières collisions plomb-plomb dans Alice, à 2,76 TeV par paire de nucléons, le 8 nov.2010.



COMMUNICATION AND OUTREACH



ECFA Midterm Review Fr



COMMUNICATION AND OUTREACH



Popularization Review



N° 1 : De l'atome au noyau



N° 2 : Le neutron



N° 3 : Les rayons cosmiques



N° 4 : La couleur des particules



N° 5 : Les Neutrino



N° 6 : Le Modèle Standard



N° 7 : Quand l'Univers fait boum



N° 8 : En route pour l'au-delà

COMMUNICATION AND OUTREACH



Deployment of Pedagogical equipments
in High Schools – « COSMOS à l'Ecole »
Ministry program

Training of teachers



Cosmic rays and arts



COMMUNICATION AND OUTREACH

Book on the « two infinities » targeted at high school teachers and public at large. Complemented with a Web site

The screenshot shows the homepage of the website for the book "Passeport pour les deux infinis". The header features a blue background with a green and yellow abstract graphic. On the left, there's a small image of a brown book cover with a yellow infinity symbol. The main title "PASSEPORT POUR LES 2 INFINIS" is displayed in large, stylized, yellow and green letters. Below the title are four buttons: "COMMANDER LE LIVRE", "COMMANDER UN EXTRAIT", "COMMANDER LE DVD", and "Agenda". To the right of these buttons is a text block describing the operation's purpose. At the bottom, there are two book covers side-by-side: one orange and one blue, both titled "passeport pour les deux infinis" and featuring abstract scientific imagery.

Accueil

Le Projet

Salle Virtuelle

Forum Science

Livret Pédagogique

Fiches Pédagogiques

Ressources

Actualités

Conférences

Wiki

Contact Personnalisé

Nous contacter

Cette opération a pour objectif de permettre aux structures dédiées à l'enseignement ou à l'animation scientifique d'aborder les questions touchant à la recherche fondamentale. Elle permettra aux élèves ou aux étudiants des sections scientifiques une approche des domaines de l'astrophysique et de la physique des particules.

PASSEPORT POUR LES 2 INFINIS

COMMANDER LE LIVRE

COMMANDER UN EXTRAIT

COMMANDER LE DVD

Agenda

passeport pour les deux infinis

Vers l'infiniment petit

DUNOD

passeport pour les deux infinis

Vers l'infiniment grand

DUNOD

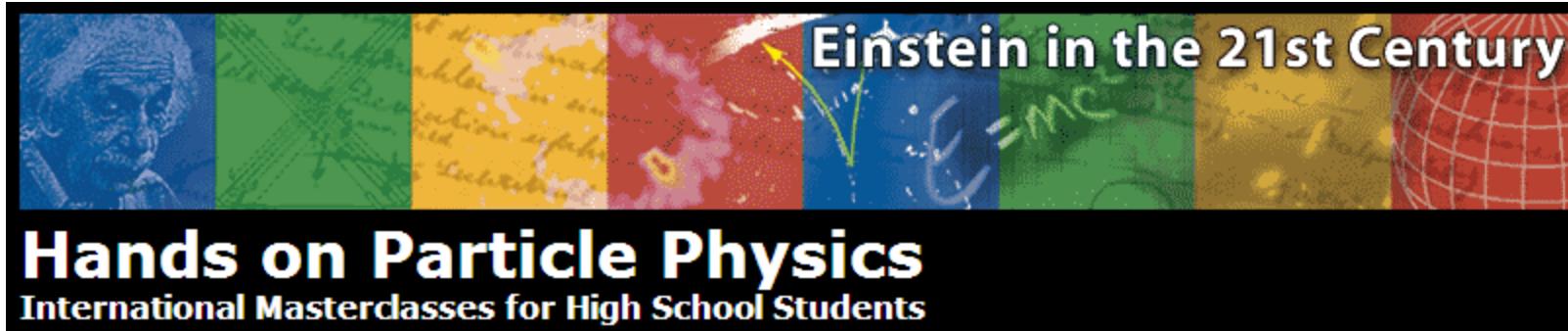
COMMUNICATION AND OUTREACH



Doctoral-Postdoctoral Thematic schools on physics, detectors, statistics, ...



« Conférences Népal », conferences in High Schools on Nuclear and (Astro-)Particle Physics, given by scientists and engineers from IN2P3 and CEA/Irfu



We take part in the master classes organized by CERN

COMMUNICATION AND OUTREACH



Physics summer schools organized by IN2P3, CEA, SFP, and teachers associations. Targeted at physics high school teachers;

2010 : Physics of the Nanoworld - ENS Cachan

2009 : Physics of the « two infinities » - Aix-Marseille Université

2008 : Physics and Sports - Université de Bourgogne Dijon

2007 : Physics and Europe - Université Louis Pasteur Strasbourg

2006 : Uncertainty and prediction in physics - Subatech Nantes

General public
exhibitions and
conferences ...

