

Centre
de Physique
des Particules
de Marseille

CPPM

UMR7346



© Francis Quintric

A joint CNRS/AMU research lab of excellence

over 150 people strong

**(40 perm. scientists; 35 postdocs and PhD students;
75 engineers, technicians and admin. Staff;
60 visiting scientists from all over the world, each year)**

At the heart of the Universe and Matter

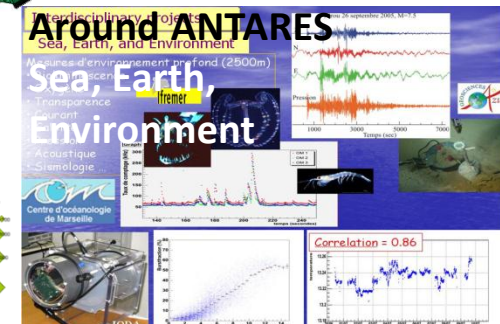
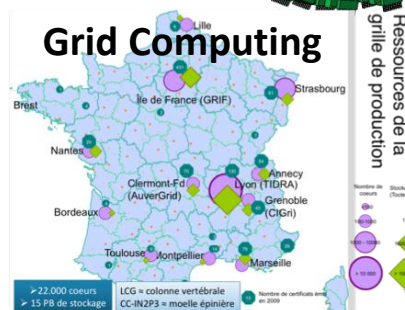
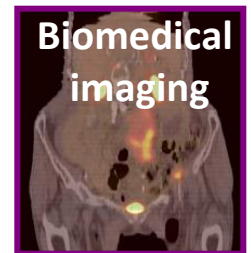
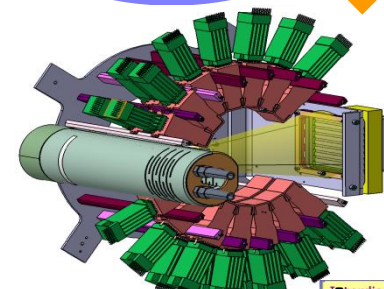
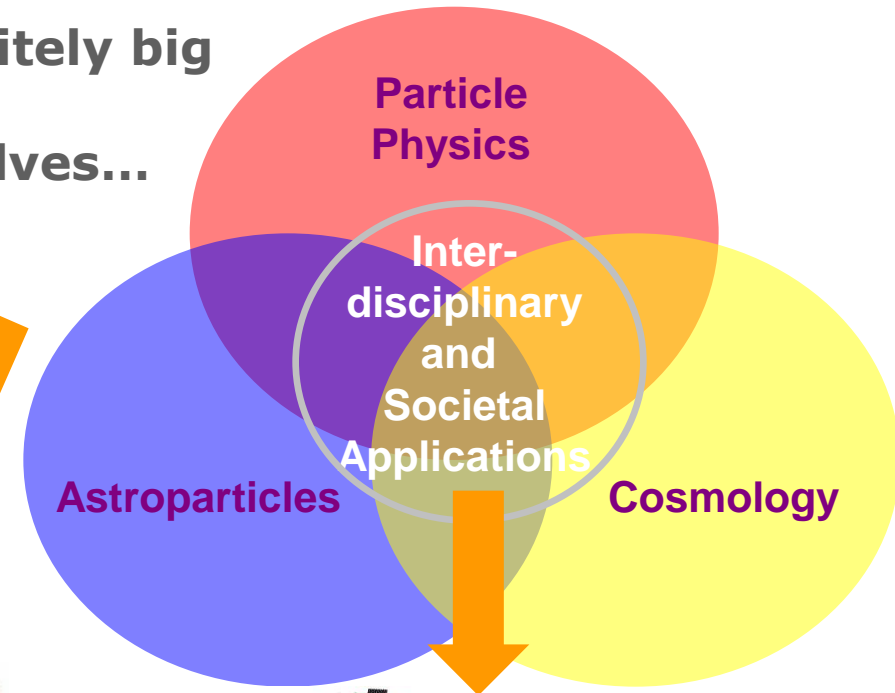
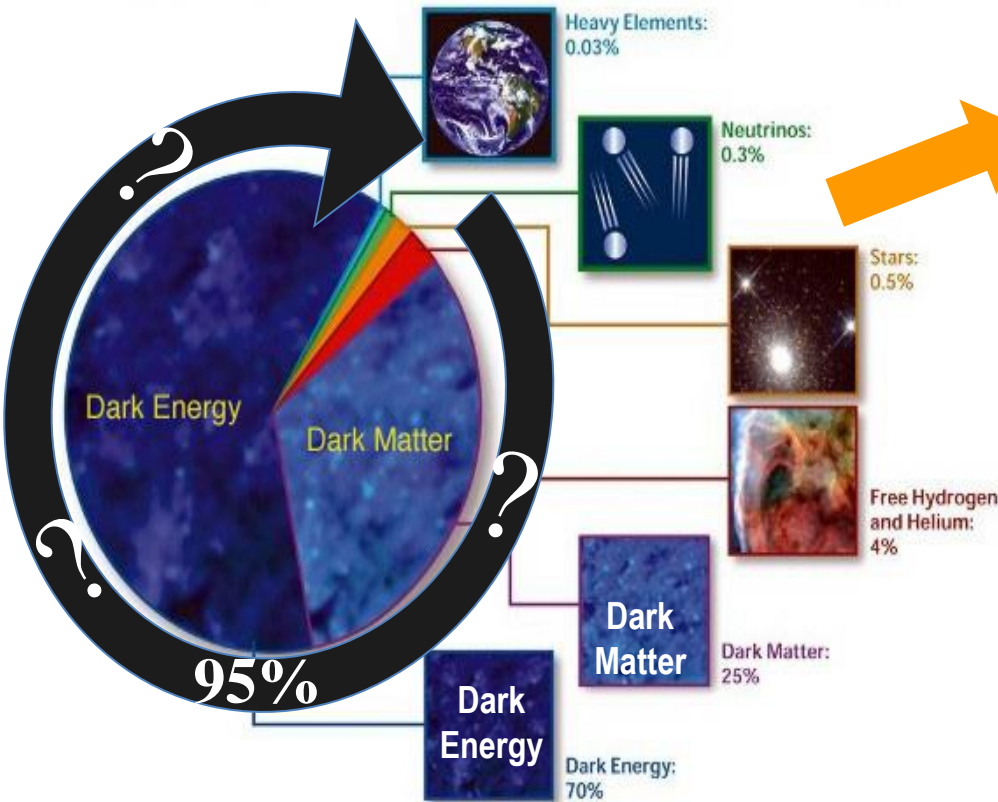


Eric Kajfasz (kajfasz@cppm.in2p3.fr)



Our missions

From the infinitely small to the infinitely big
 Understand our Universe,
 What it is made of and how it evolves...



AT ACCELERATORS
H1 @ HERA
 (Hambourg)
 e-p
 319 GeV

D0 @ Tevatron
 (Chicago)
 p-pbar 2TeV

ON TOP OF MOUNTAINS
 SNLS/SNFactory
 BOSS

LSST

IN SPACE
 Euclid

Characterize Dark Energy
 With a multi-probe approach

LHCb @ LHC/CERN

ATLAS @ LHC/CERN

Search for New Physics

Width: 44m
 Diameter: 22m
 Weight: 7000t

Muon Detectors, Electromagnetic Calorimeters, Forward Calorimeters, End Cap Toroid, Barrel Toroid, Inner Detector, Hadronic Calorimeters, Shielding

International Scientific Collaborations all over the Planet

...
 ...

UNDER MOUNTAINS

SuperNEMO

ON HIGH GROUNDS

CTA

AT THE BOTTOM OF THE SEA (-2500 m)

Neutrino Astronomy and multi-messenger approach

ANTARES/MEUST/KM3



EM calorimeter

Pixel detector

HL Trigger

IDs: e and gamma, b-jets

Top quark production

Higgs search and study

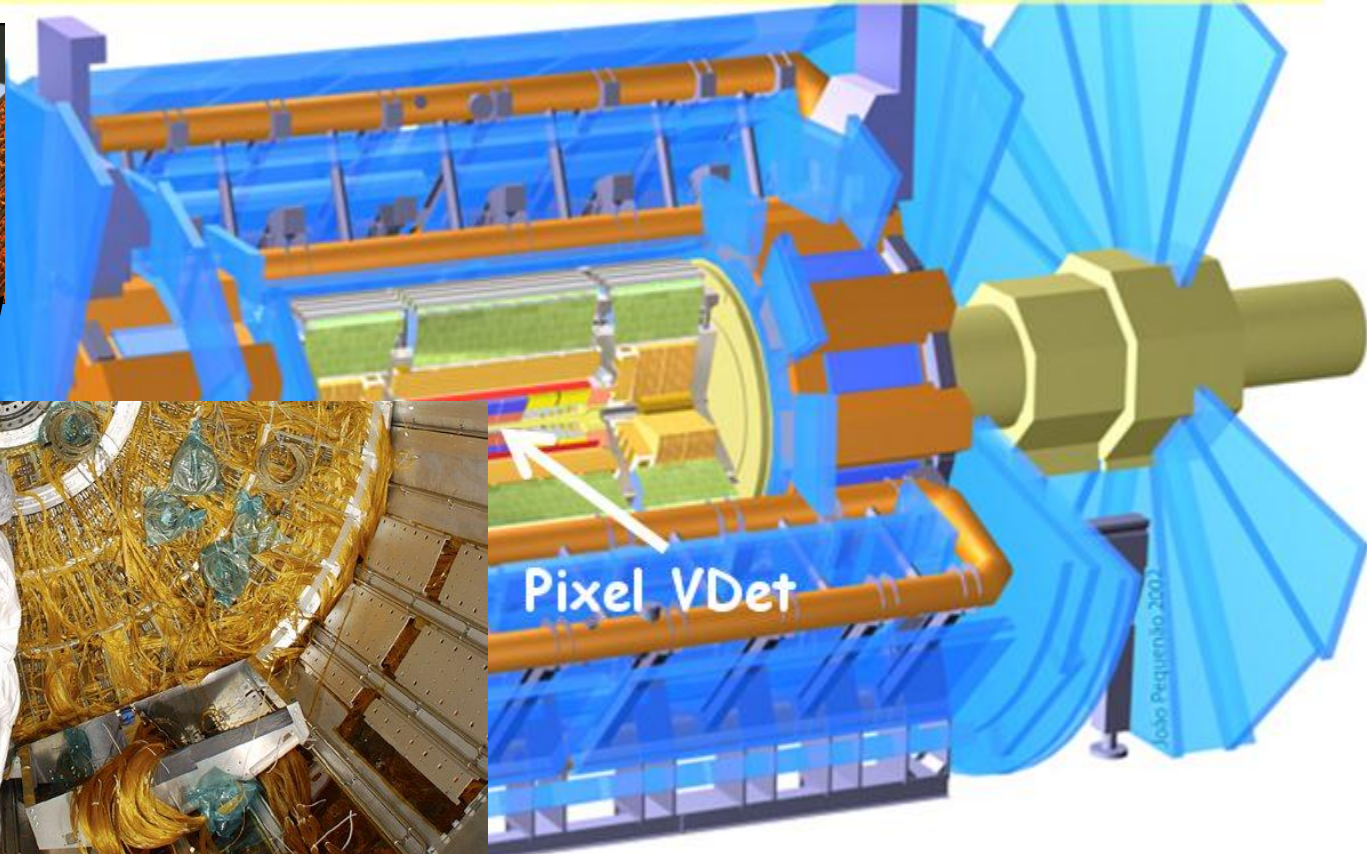
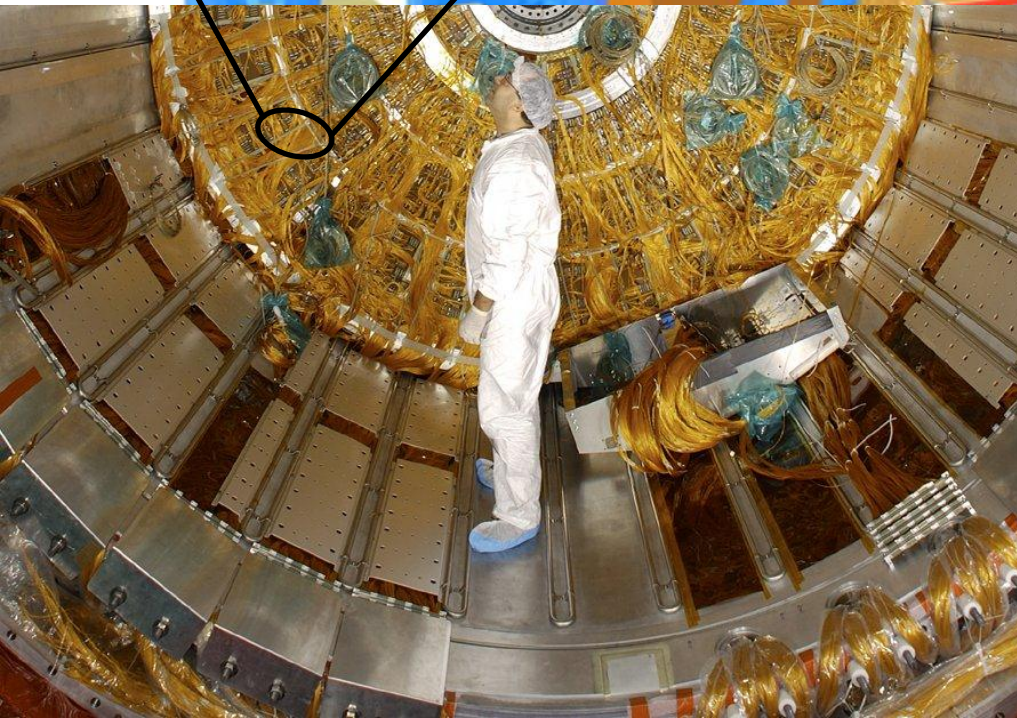
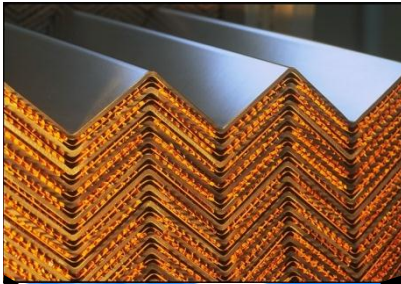
BSM Physics (SUSY, 4th gen.)

Upgrades: IBL and Pixel detectors

ATLAS

ATLAS

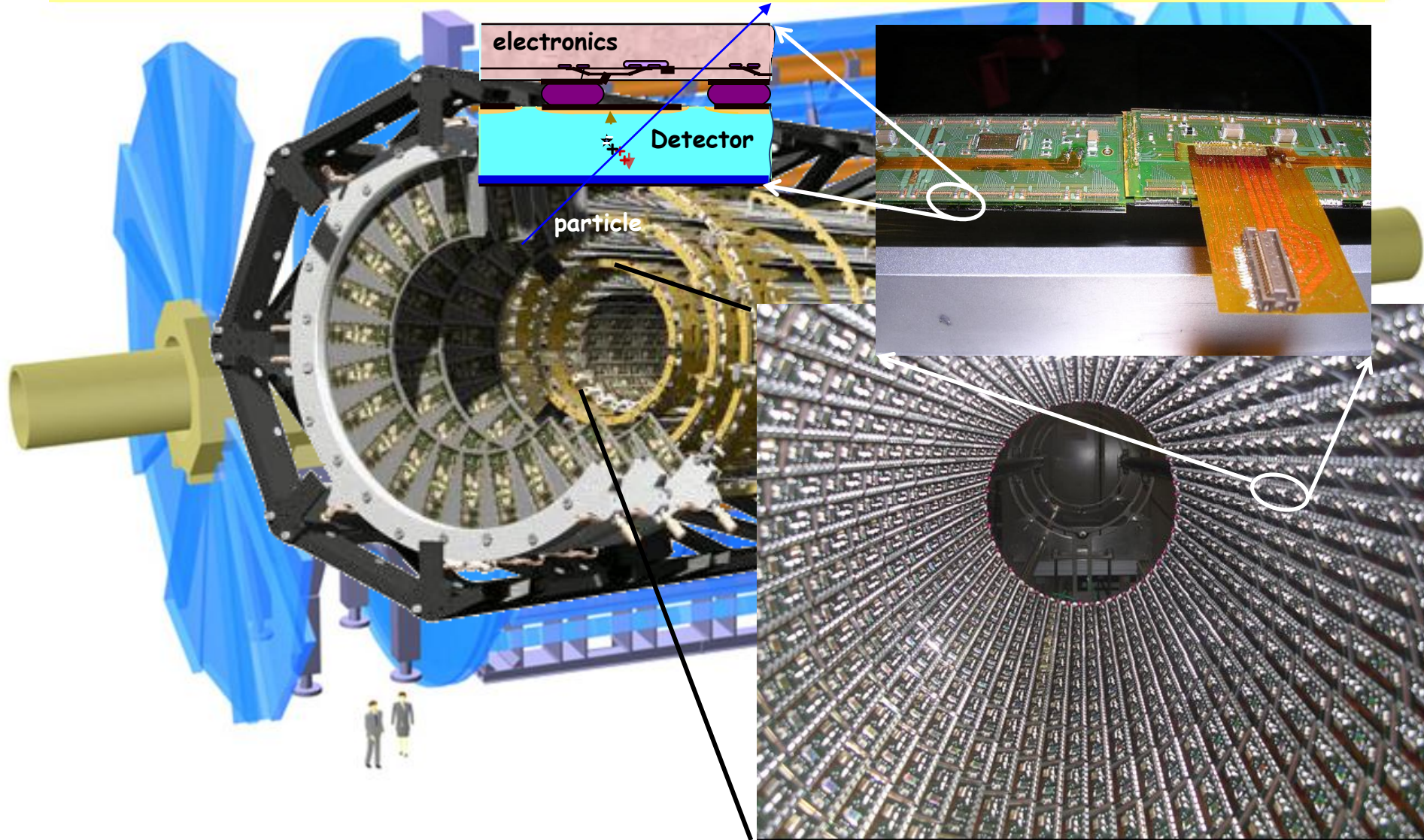
***Understand mechanisms for unification of forces,
mass generation, and TeV physics.
Precision Top physics, discovery and study of the Higgs boson and
Search for beyond the Standard Model Physics***



ATLAS

***Understand mechanisms for unification of forces,
mass generation, and TeV physics.***

***Precision Top physics, discovery and study of the Higgs boson and
Search for beyond the Standard Model Physics***



Data in ATLAS @ LHC ...



- 40 million proton-proton collisions/s
- Filtering necessary:
200 collisions /s stockées
1 MBy of data /collision
for a total of 1 PBy /an
- To analyze such a huge amount of data
need hundreds of thousands of CPUs
=> European and World data Grid

1 MegaByte:
A Digital picture

1 GigaByte :
Amovie en DVD

1 TeraByte :
*= Yearly production of
Books in the world*

1 PetaByte :
*= yearly production of an
LHC experiment*

1 ExaByte :
*= yearly production of
informations worldwide*



L0 muon trigger

CP violation: ϕ_s measurement
 B^0 and $B_s \rightarrow \mu\mu$ measurements

Upgrade: 40MHz readout of
the whole detector

LHCb

LHCb

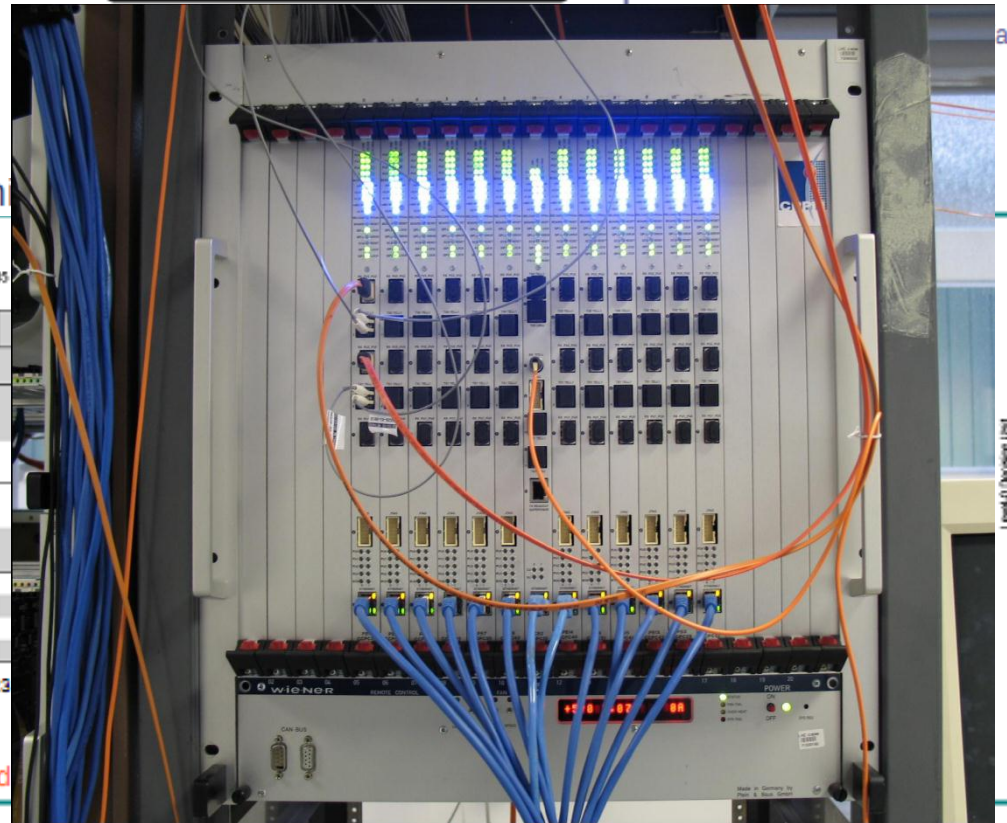
LOMUON TRIGGER

Bunch crossing rate 40 MHz

L0 trigger rate 1 MHz

HLT1 rate ~30 kHz

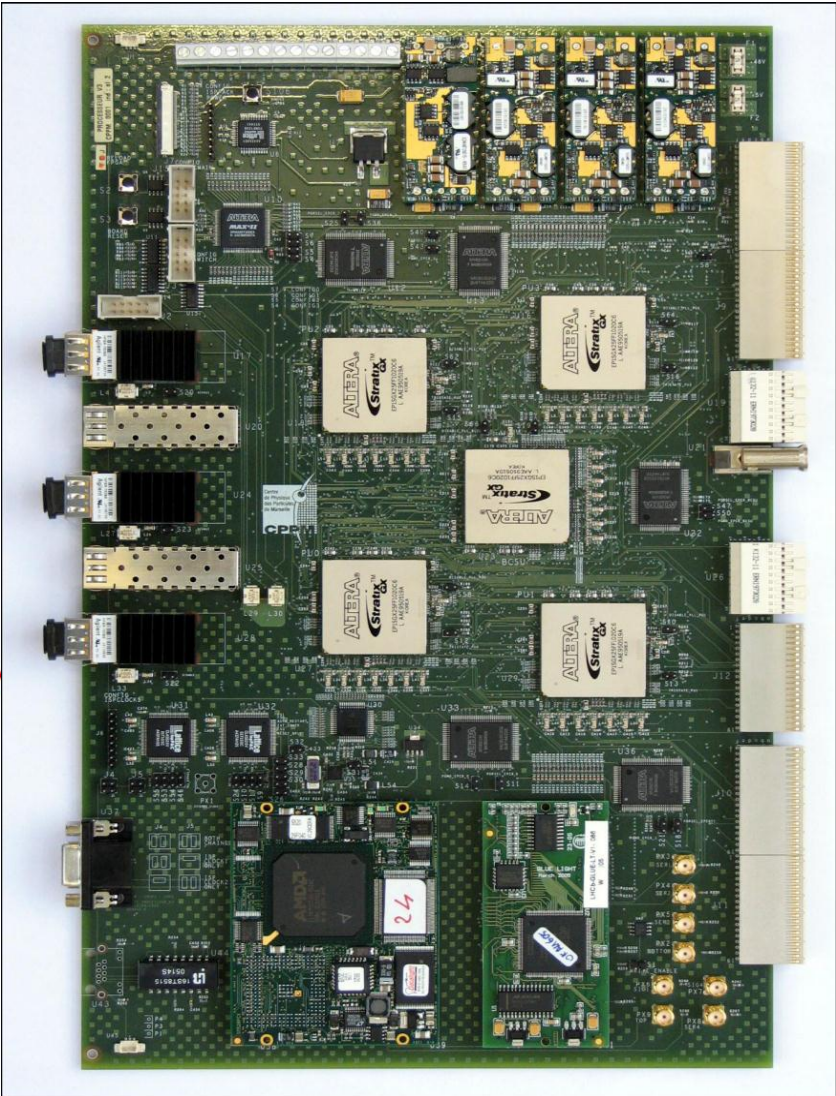
} custom electronics



- pointing geometry
- 5 stations
- 4 regions with different granularities
- 192 towers

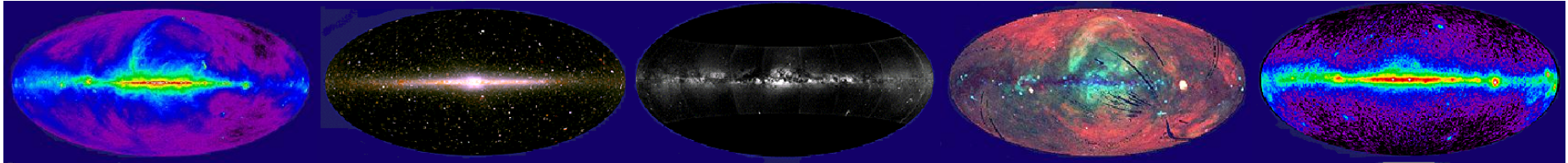
L0muon :

- 4 crates
- 48 processing boards
- 192 processing units
- 4 controller boards
- 6 TELL1s (DAQ)

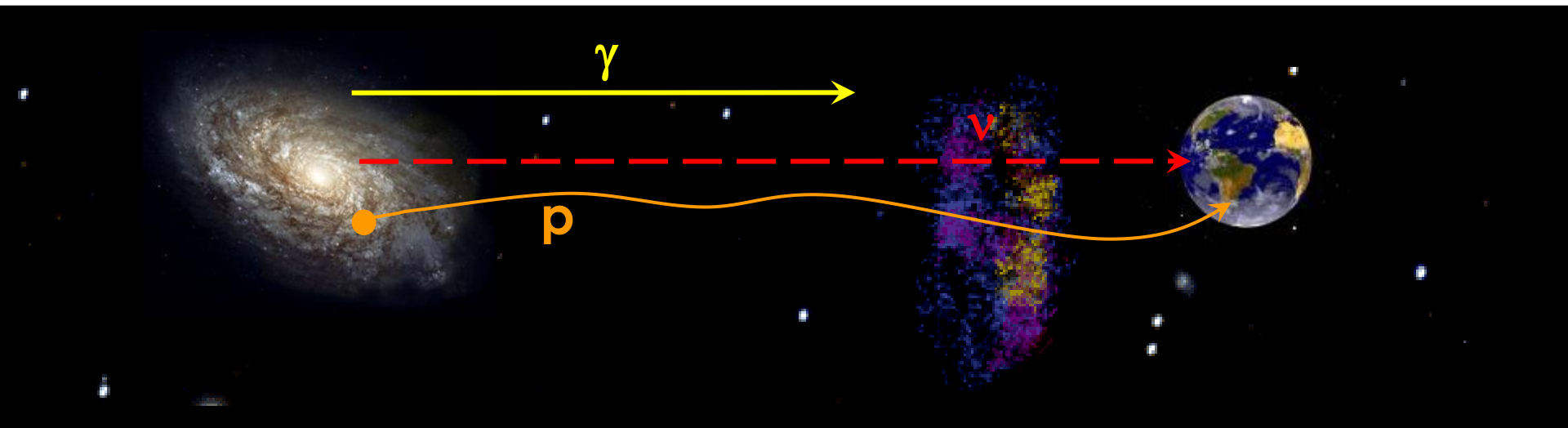
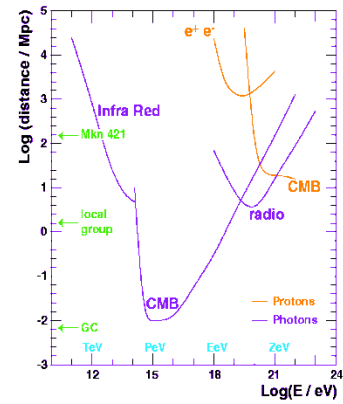


Astroparticles

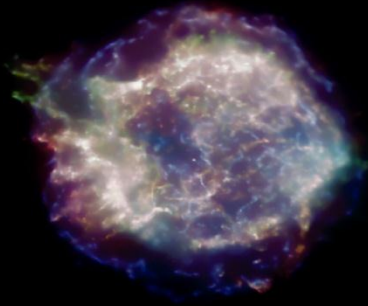
So far we know the Universe thanks to photons...



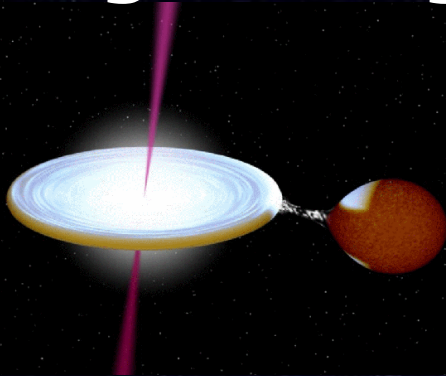
A new messenger,
the neutrino!



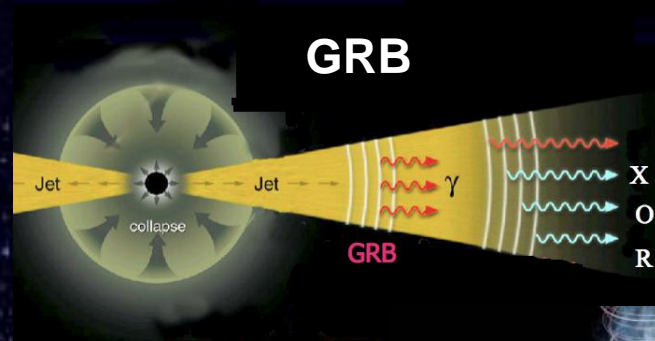
Potential Sources of High Energy neutrinos



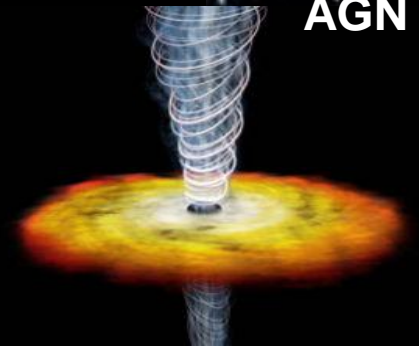
SNR



μ -quasar



GRB



AGN

But also Dark Matter ...

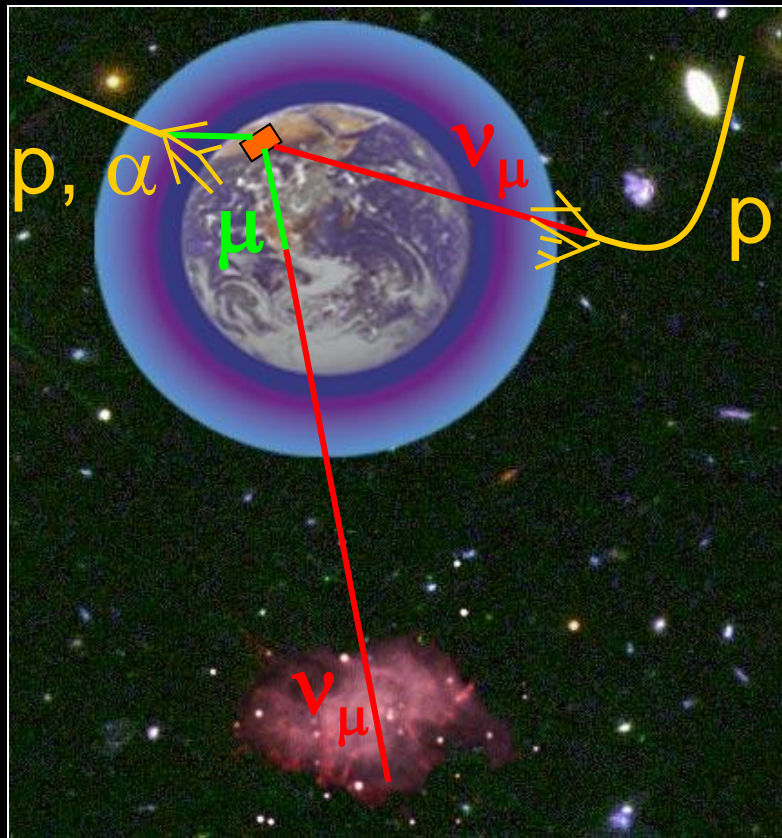
WIMP



Sun

Accretion in the Sun
Followed by self-annihilations

Neutrino detection principle



3D-array of
Optical modules

Tcherenkov
Light
from μ

2500 m
deep

43°

γ_μ

Measure :
Time & position
of photon arrival

interaction

trajectory μ ($\sim \nu$)

ANTARES

2500m

- 900 PMTs
- 12 lines
- 25 storeys / line
- 3 PMTs / storey

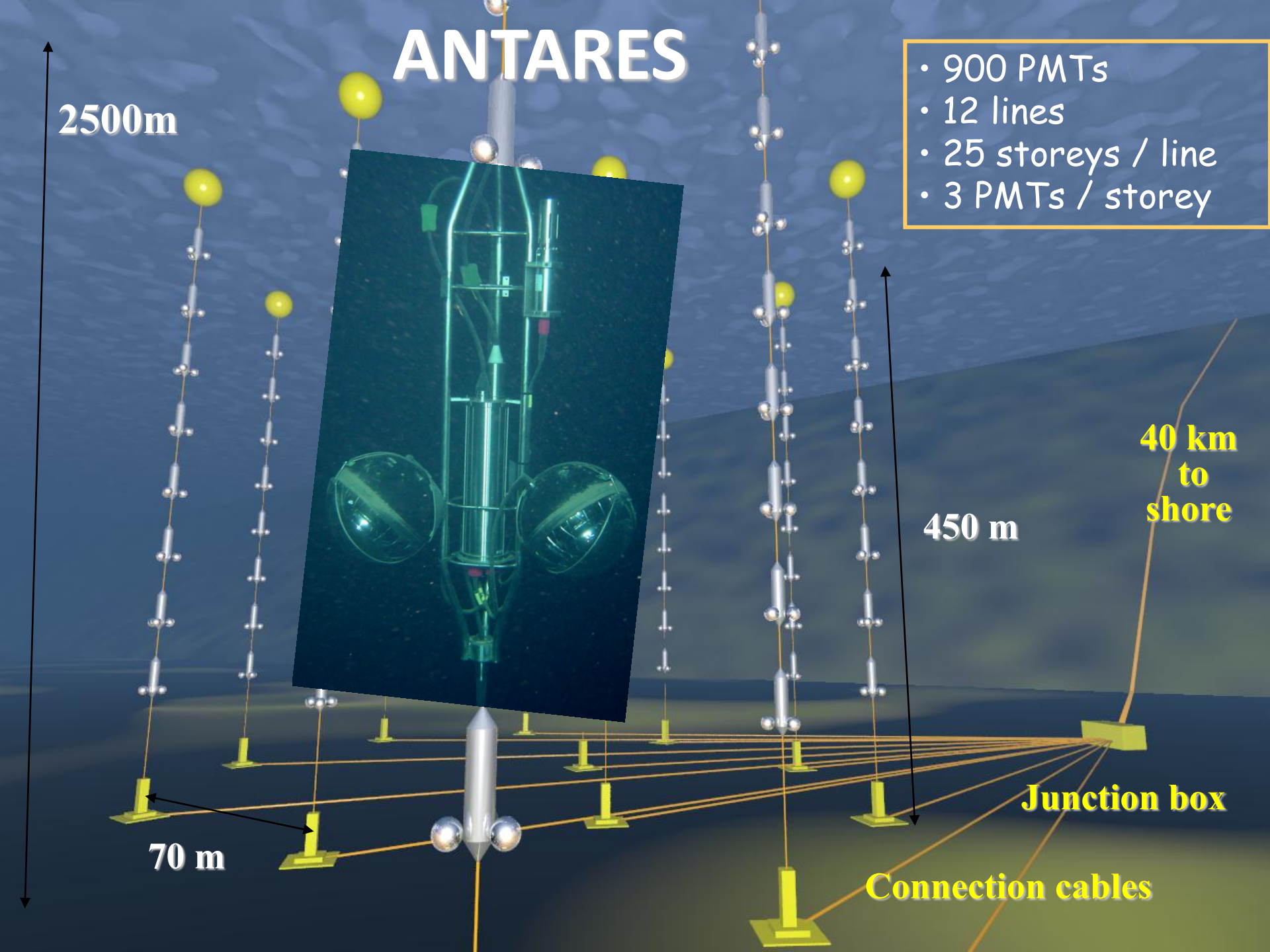
40 km
to
shore

450 m

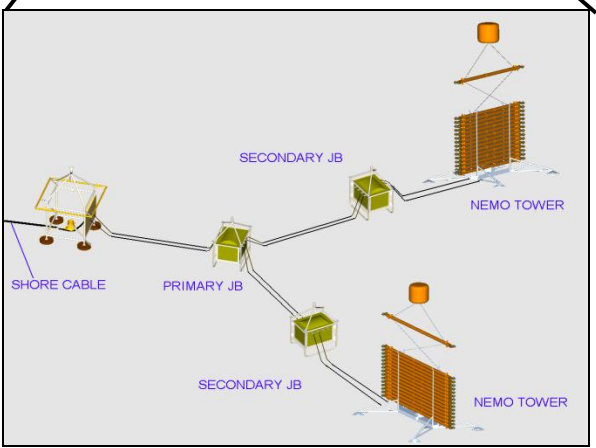
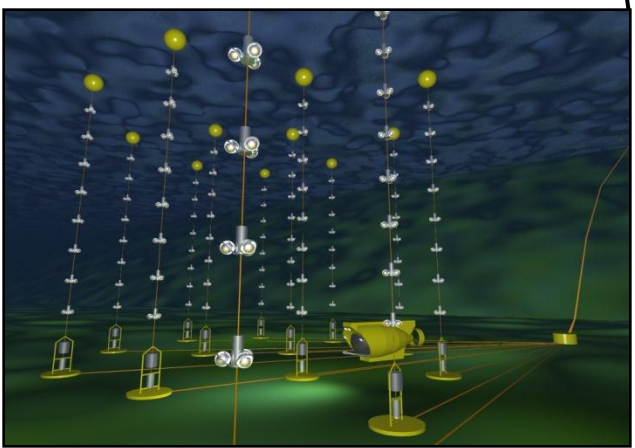
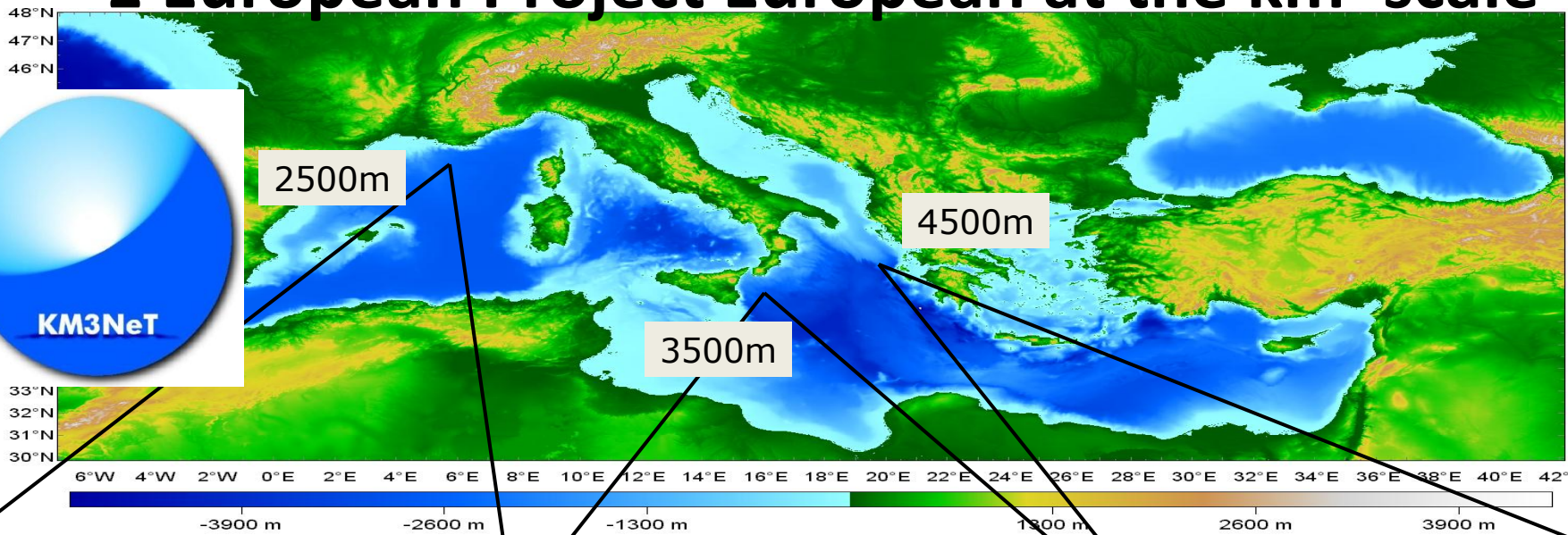
70 m

Junction box

Connection cables

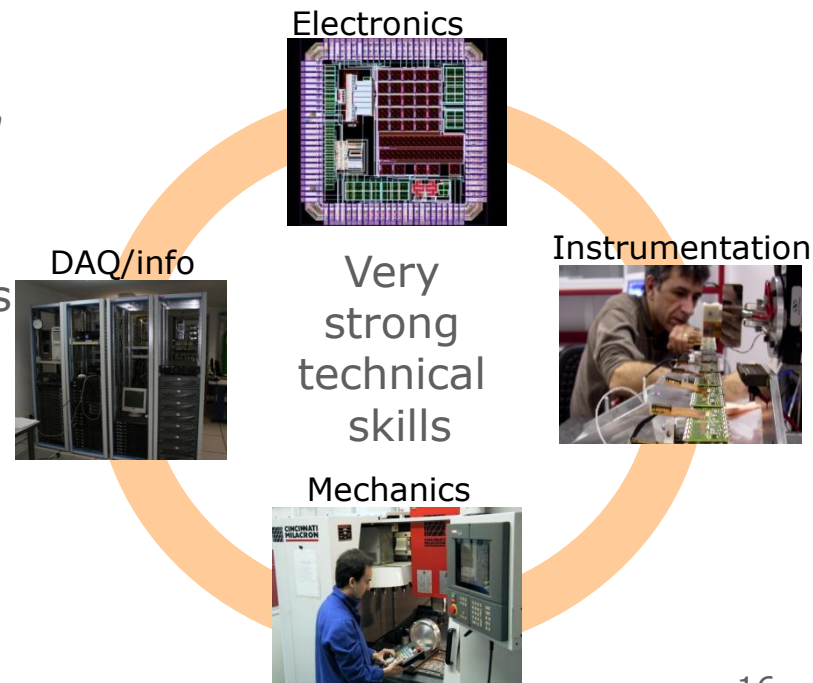


3 Pilot Projects in Mediterranean Sea => 1 European Project European at the km³ scale



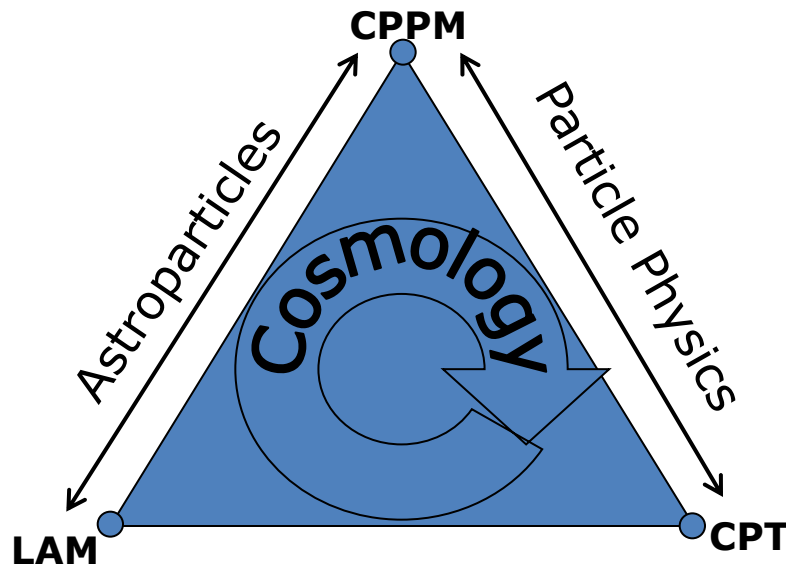
Laboratory technical skills

- Recognized technical skills and leadership
 - Micro-electronics (planar and 3D)
 - Pixels detectors for particle physics (ATLAS)
 - Transfer to:
 - X-Ray imaging (imXgam) => **4 patents and startup company imXPAD**
 - ... but also robotized avionics
 - Data acquisition and processing
 - Fast acquisition (FPGA based) and fiber optics transmission (LHCb)
 - Characterization of IR detectors for space missions
 - Submarine Infrastructures (ANTARES)
 - Equipressure systems
 - Submarine connectors
 - **2 patents; startup company PowerSea strong interest from the industry (sustainable energies)**
 - Interaction with Competitiveness Clusters
 - OPTITEC, SCS, Mer PACA, Pégase, Eurobiomed,...



Various local collaborations

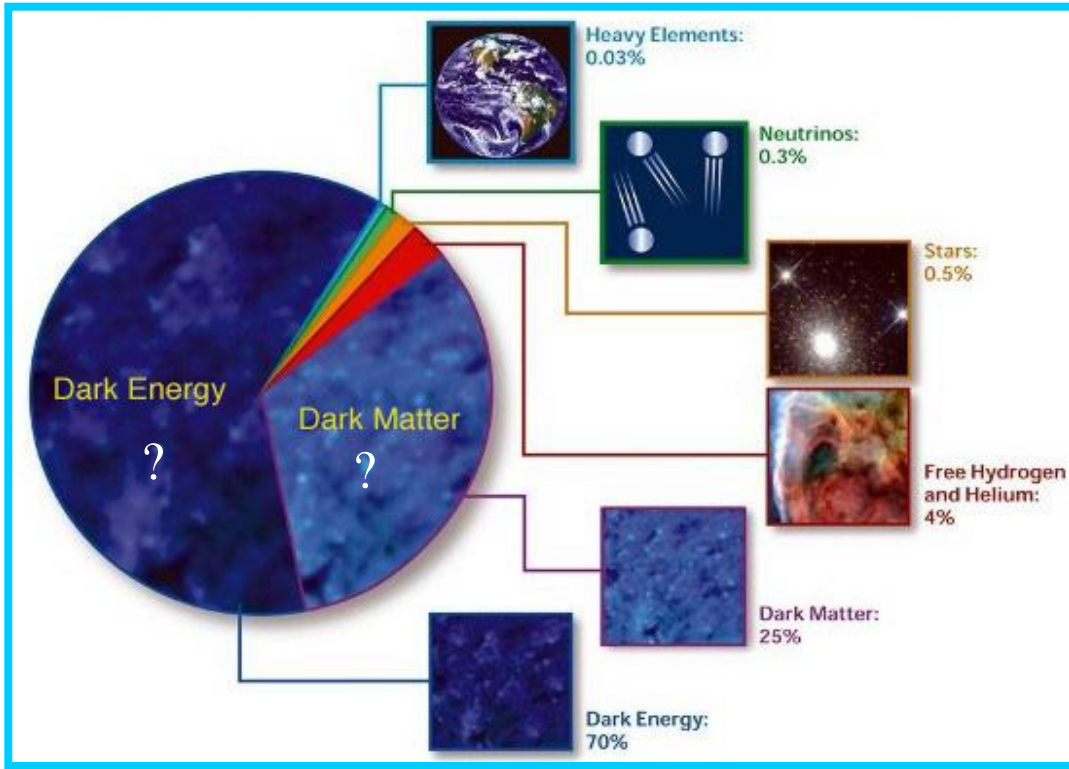
- Local collaborations with:
 - Centre de Physique Theorique (CPT)
 - Laboratoire d'Astrophysique de Marseille (LAM)
 - Centre d'Océanologie de Marseille (COM)
 - Institut de Biologie du Développement de Marseille (IBDM)
 - Laboratoire Mouvement Perception (LMP)
 - Laboratoire Lasers, Plasmas et Procédés Photoniques (LP3)
 - Centre d'Immunologie de Marseille Luminy (CIML)
 - Some contacts with CEA-Cadarache



Investments for the Future Programme: LabEx

- OCEVU: Origins, Constituents et EVolution of the Universe
 - Coordinated by Aix-Marseille University
 - 10 M€ over 8 years

Partners:
 Aix-Marseille Université
 Univ. Montpellier 2
 Univ. Paul Sabatier (Toulouse)
 CNRS: IN2P3, INP et INSU



CPPM
 CPT
 LAM
 L2C
 LUPM
 IRAP

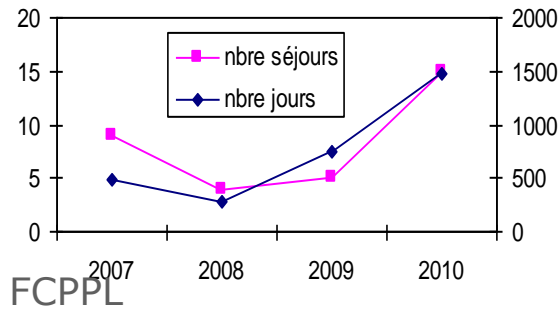
Well defined projects in:

Research
Education
Transfers

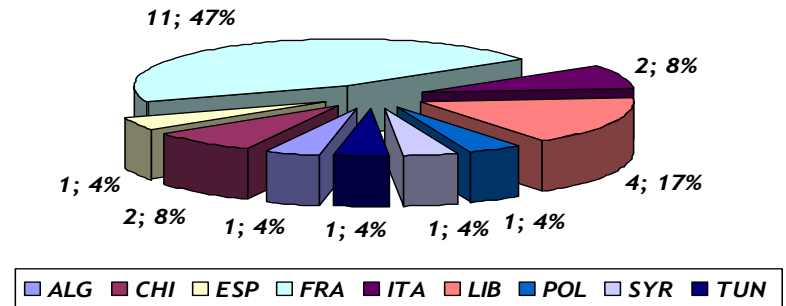
Combine our strengths in:
 Cosmology and (Astro-)Particle Physics
 Observation, experimentation, and theory

Open towards international collaborations

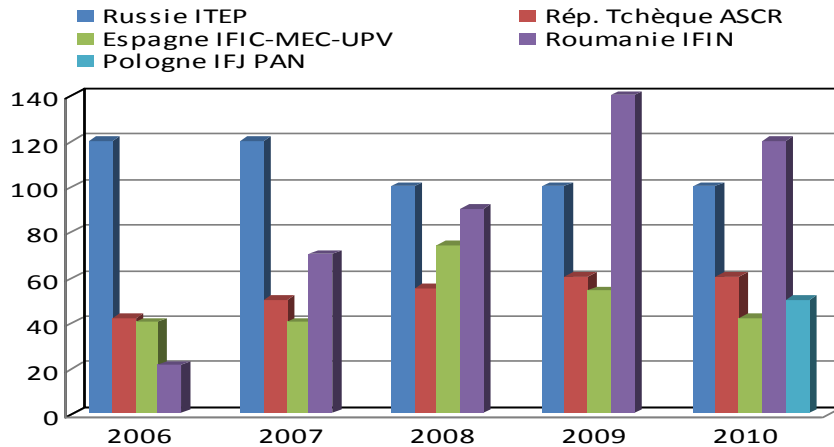
- CPPM administrative headquarters of LIA FCPPL France China Particle Physics Laboratory



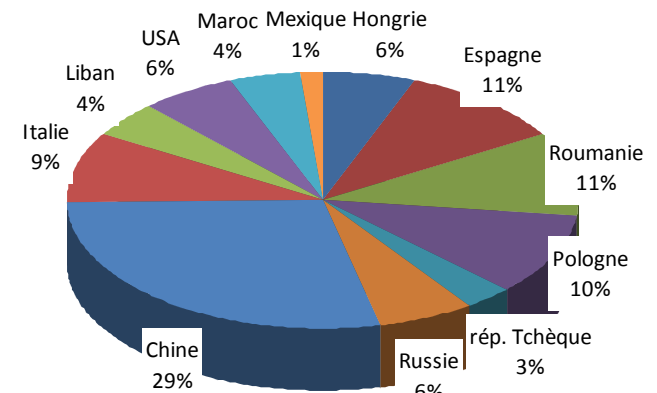
PhD students' citizenship



Specific Collaborations (# of days)



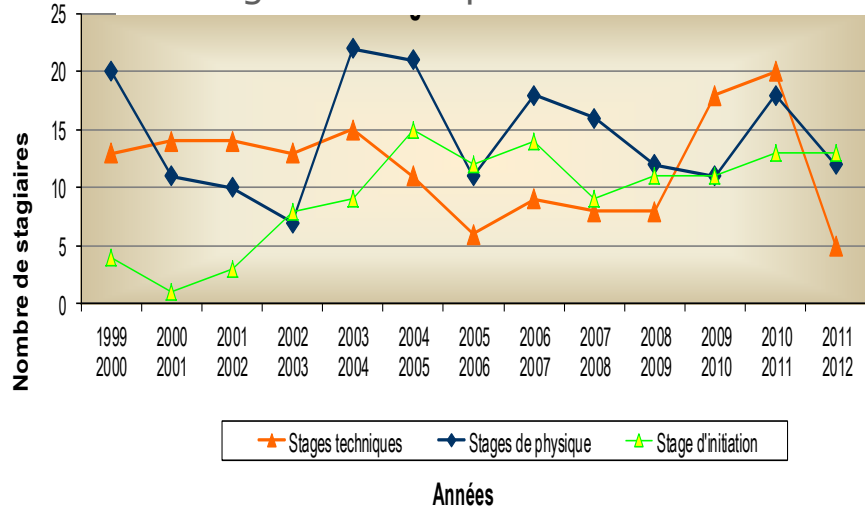
Foreign visitors (59p.) in 2010



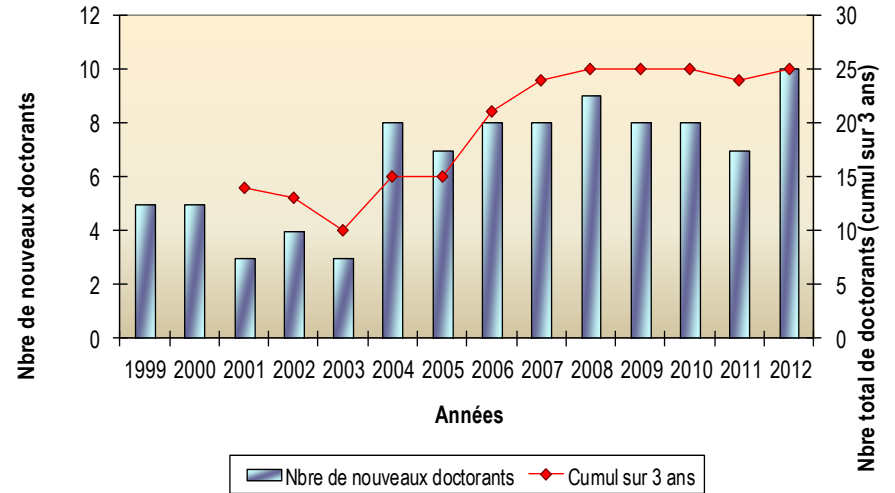
Education by research

Internships

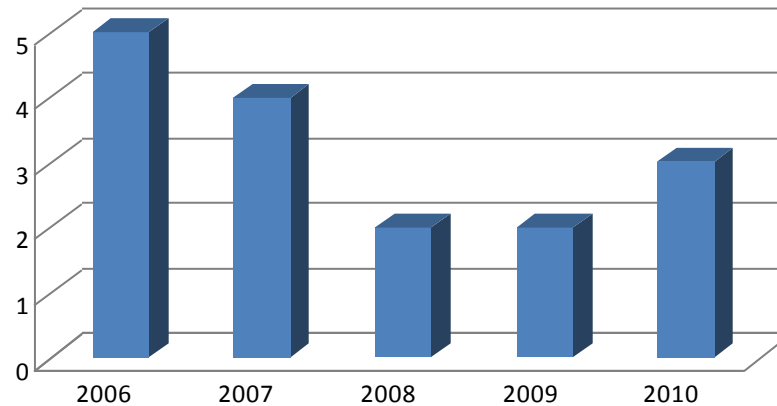
Average internship duration ~ 2months



PhD students



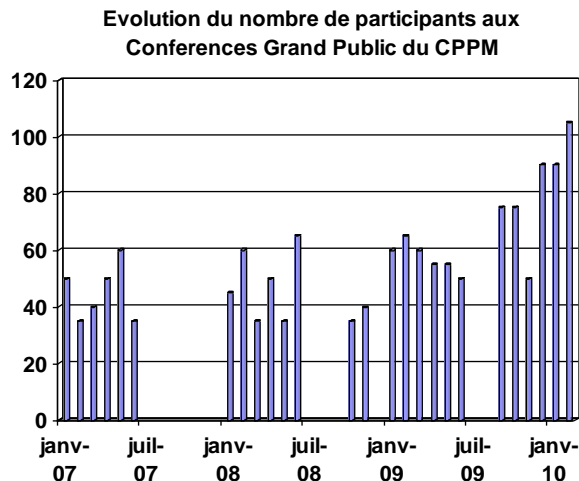
Postdocs & ATER



Education and Outreach

- Education: strong involvement (ens-chercheurs, chercheurs, IRs) at the LMD of AMU and engineering schools. Managerial responsibilities (ED, Licences, Masters 1 et 2).
- Scientific communication and outreach

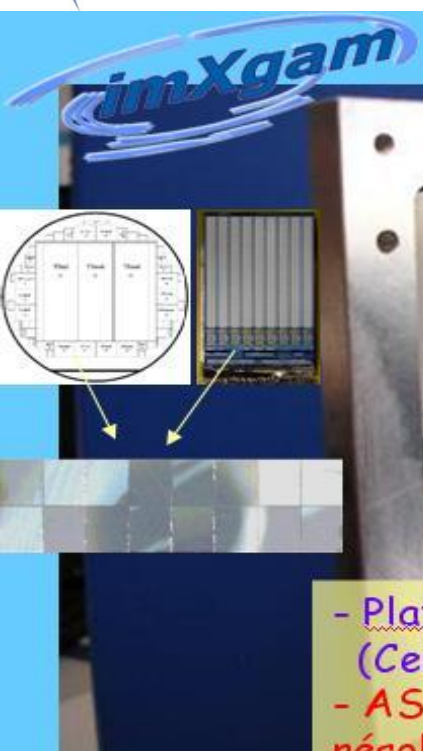
Publications, seminars,
 Conferences and schools...
 Press articles and press releases,
 Conferences in high-schools, Master Classes (with CERN)
 Exhibitions, various events, "Fête de la Science" ...
 Development of didactic tools, ...
 Yearly conference cycle for the general public




In December 2010: 145 participants!!!

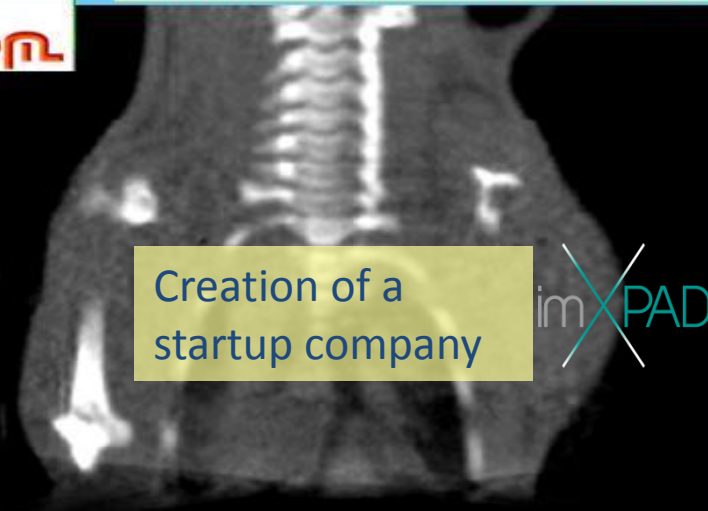


Biomedical imaging

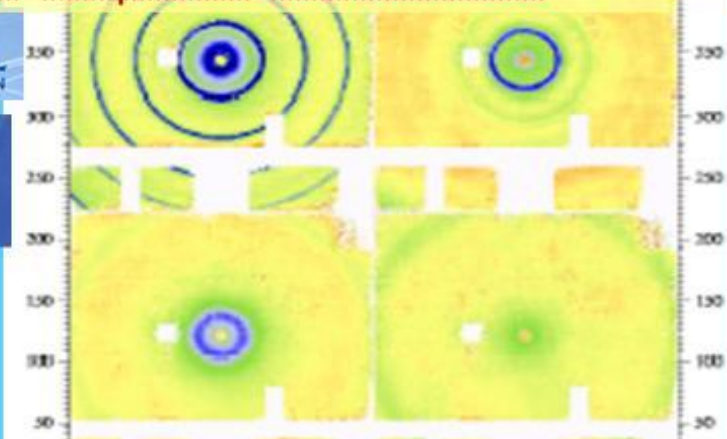


Corps de souris

- Plateforme  : de la R&D aux tests cliniques (Centre Europeen de Recherche en Imagerie Medicale)
- ASUR => développer imagerie X à très haut contraste, à très grande résolution spatiale et avec une résolution temporelle femtoseconde



Creation of a startup company

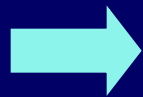


Crystallography

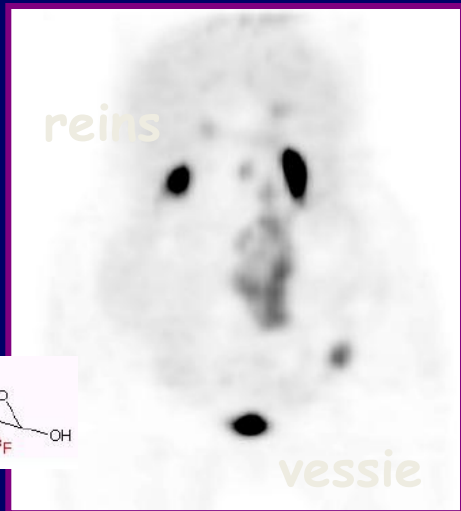
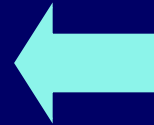
Anatomy + Biology



X-Ray CTscan



Fusion software



reins

vessie

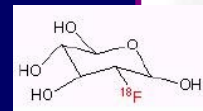
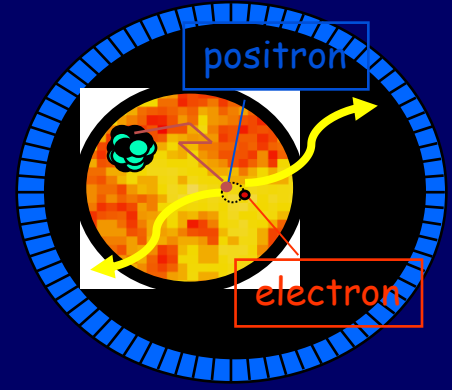
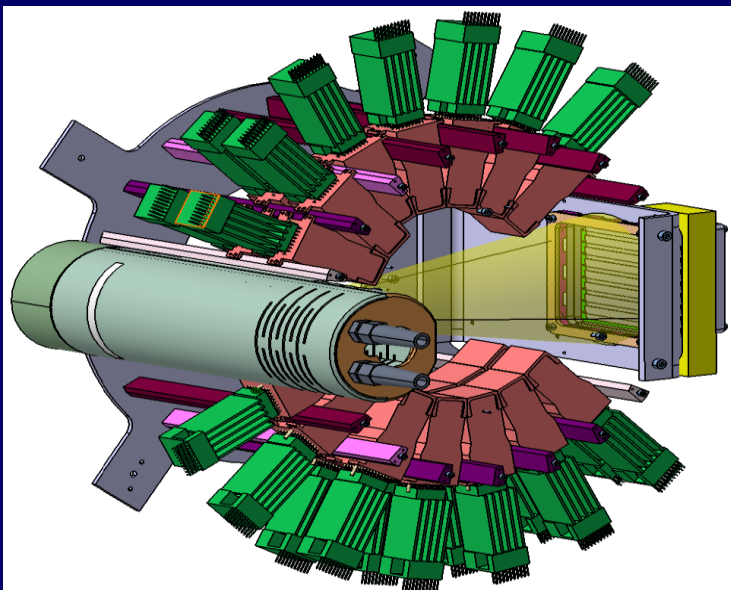
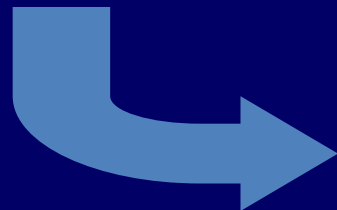
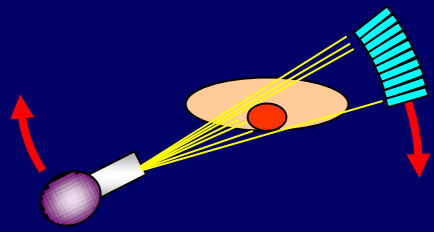
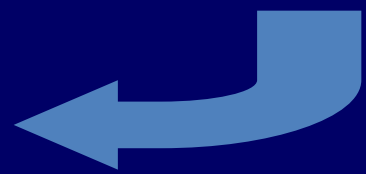


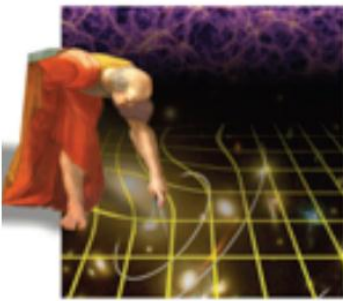
Image fusion



positron

electron





EUCLID

- NISP Instrument
 - Instrument scientist: Anne Ealet
 - Characterization et integration of the IR detectors
- Ground segment
 - Co-lead OU Sim, simulations
 - Taking part in the processing of the spectro data
- Science
 - Clustering
 - SN co-lead Charling Tao
 - Cosmological interpretation



Computing Grid Node



Added CPU and storage to become Tier2 University (AMU): 150 kEu
City of Marseille: 30 kEu

Upgrade of the computing room:
- transformer 400 kVA -> 800 kVA
- chilled water
- cabling

- CNRS: 250 k€
- CPPM: cooling and cabling: 28,5 k€
- IN2P3: 12 k€

	installed in 2008	installed in 2009	Installed in 2010	installed in 2011	installed in 2012
CPU KSi2K		809	771	1130	1158
Storage TB	10	95	552	200	504
					2012
Total CPU KSi2K					3868
Total Storage TB					1361

Studies to connect our Grid node to the AMU mesocenter (EquipEx)

