CENTRE DE PHYSIQUE DES PARTICULES DE MARSEILLE

CPPM

UMR7346

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

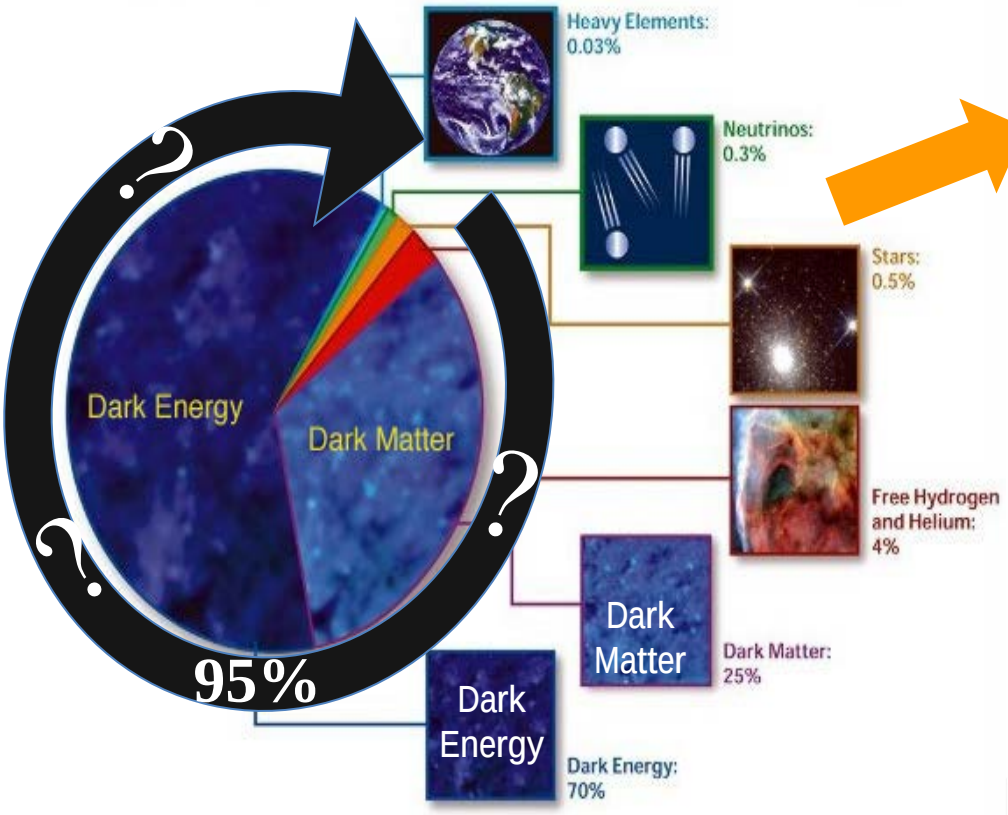
cnrs IN2P3 Les deux infinis

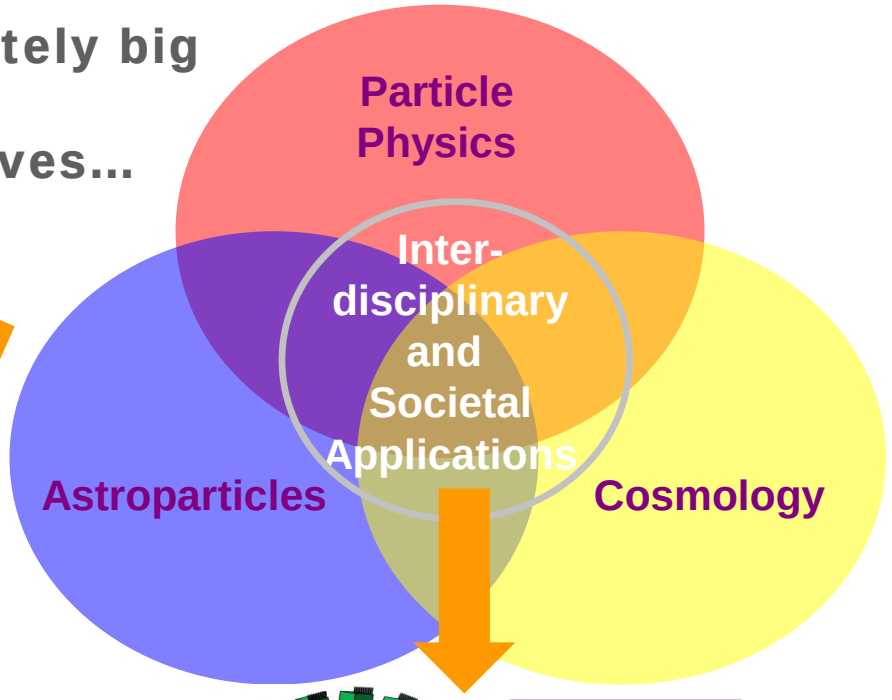
Eric Kajfasz (kajfasz@cppm.in2p3.fr)

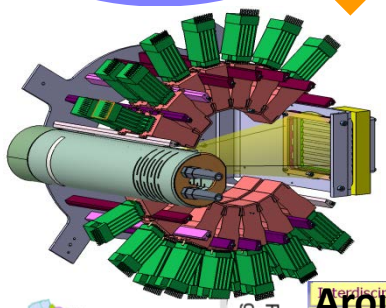
Aix*Marseille université

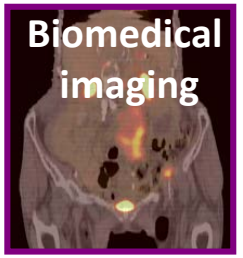
Our missions

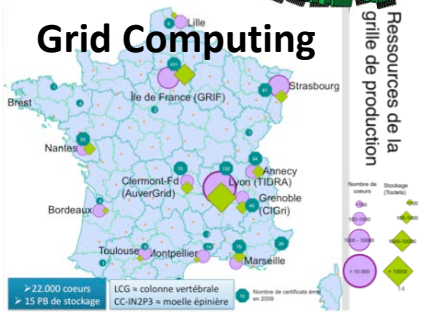
From the infinitely small to the infinitely big
Understand our Universe,
What it is made of and how it evolves…

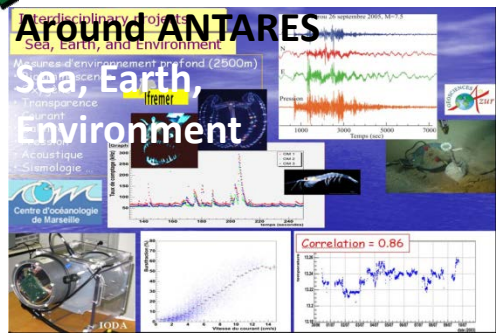








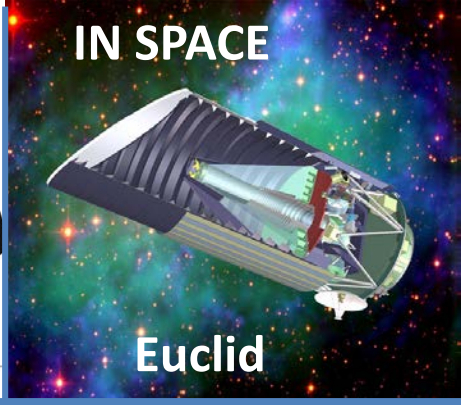


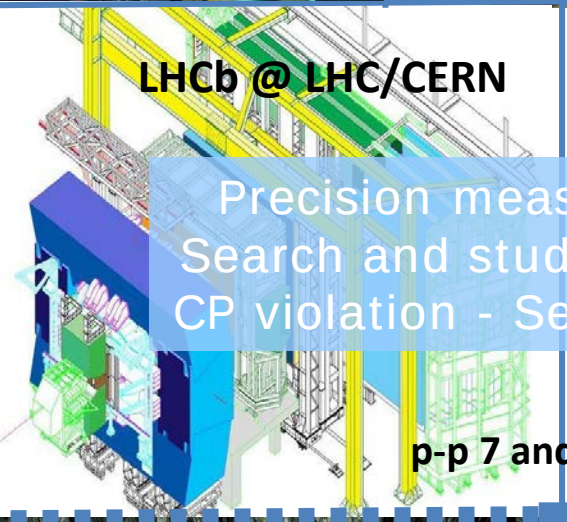


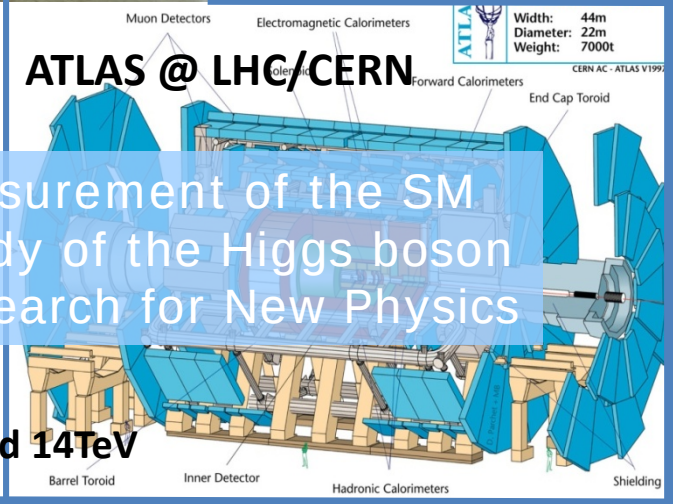
AT ACCELERATORS

ON TOP OF MOUNTAINS

IN SPACE







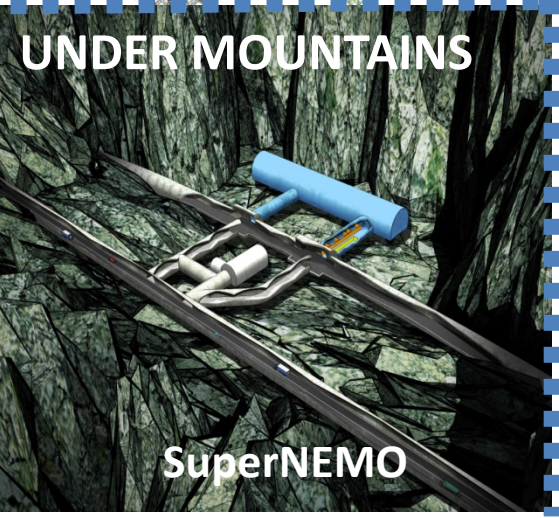
Precision measurement of the SM
Search and study of the Higgs boson
CP violation - Search for New Physics

CENTRE DE PHYSIQUE DES PARTICULES DE MARSEILLE
CPPM

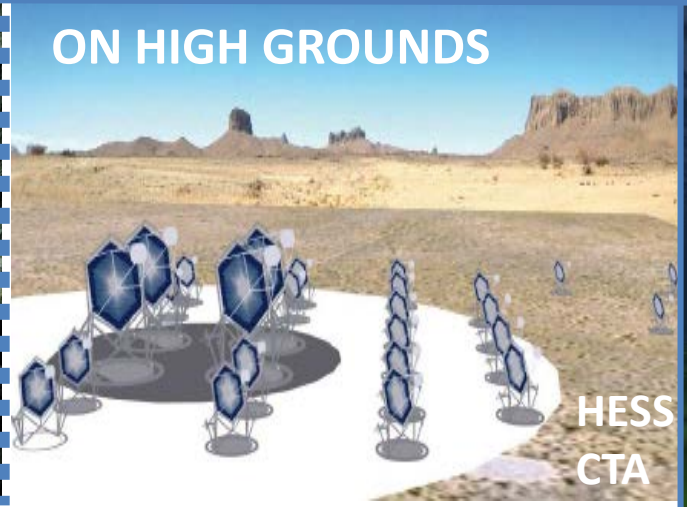
International Scientific Collaborations all over the Planet

...

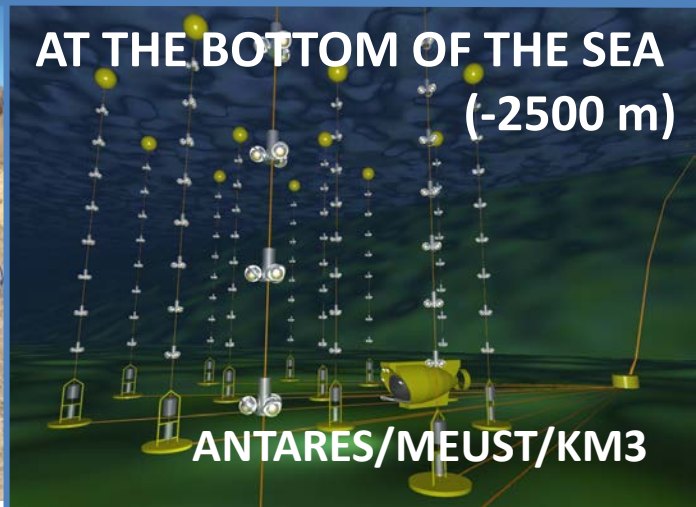
UNDER MOUNTAINS



ON HIGH GROUNDS



AT THE BOTTOM OF THE SEA
(-2500 m)



AT ACCELERATORS

H1 @ HERA (Hambourg)

D0 @ Tevatron (Chicago)

ON TOP OF MOUNTAINS

IN SPACE

Volume 716, Issue 1, 17 September 2012 ISSN 0370-2693

ELSEVIER

PHYSICS LETTERS B

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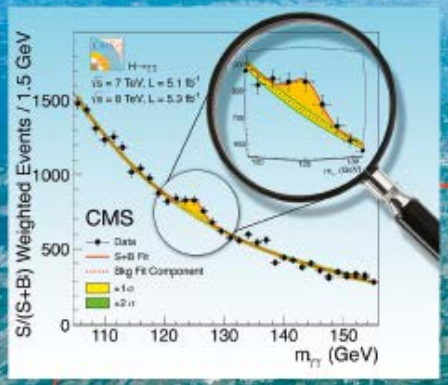
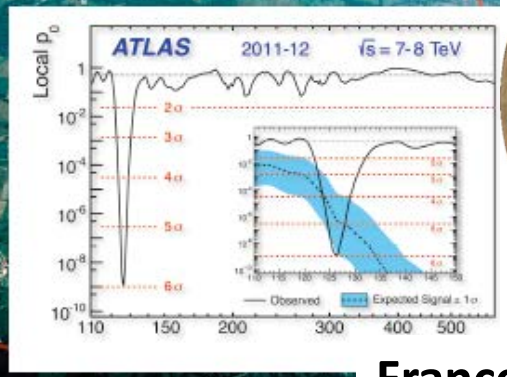




The Economist

In praise of charter schools

Britain's banking scandal spreads

Volkswagen overtakes the rest

A power struggle at the Vatican

When Lonesome George met Nora

JULY 7TH–13TH 2012 Economist.com

A giant leap for science

Finding the Higgs boson

François Englert & Peter W. Higgs

AT ACCELERATORS

H1 @ HERA (Hambourg)

e-p 319 GeV

D0 @ Tevatron (Chicago)

p-pbar 2TeV

ON TOP OF MOUNTAINS

SNLS/SNFactory

BOSS/eBOSS

MS-DESI

LSST

IN SPACE

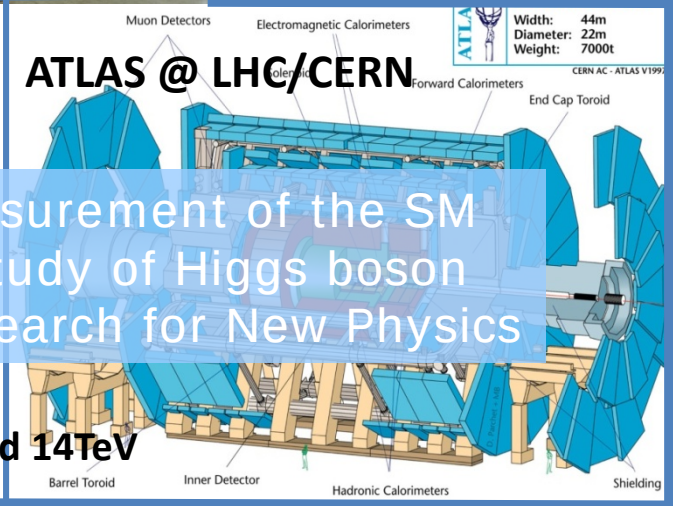
Euclid

Characterize Dark Energy
Cosmological parameters
multi-probe approach

LHCb @ LHC/CERN

p-p 7 and 14TeV

ATLAS @ LHC/CERN



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International Scientific Collaborations all over the Planet

...

UNDER MOUNTAINS

SuperNEMO

Nature of the neutrino

ON HIGH GROUNDS

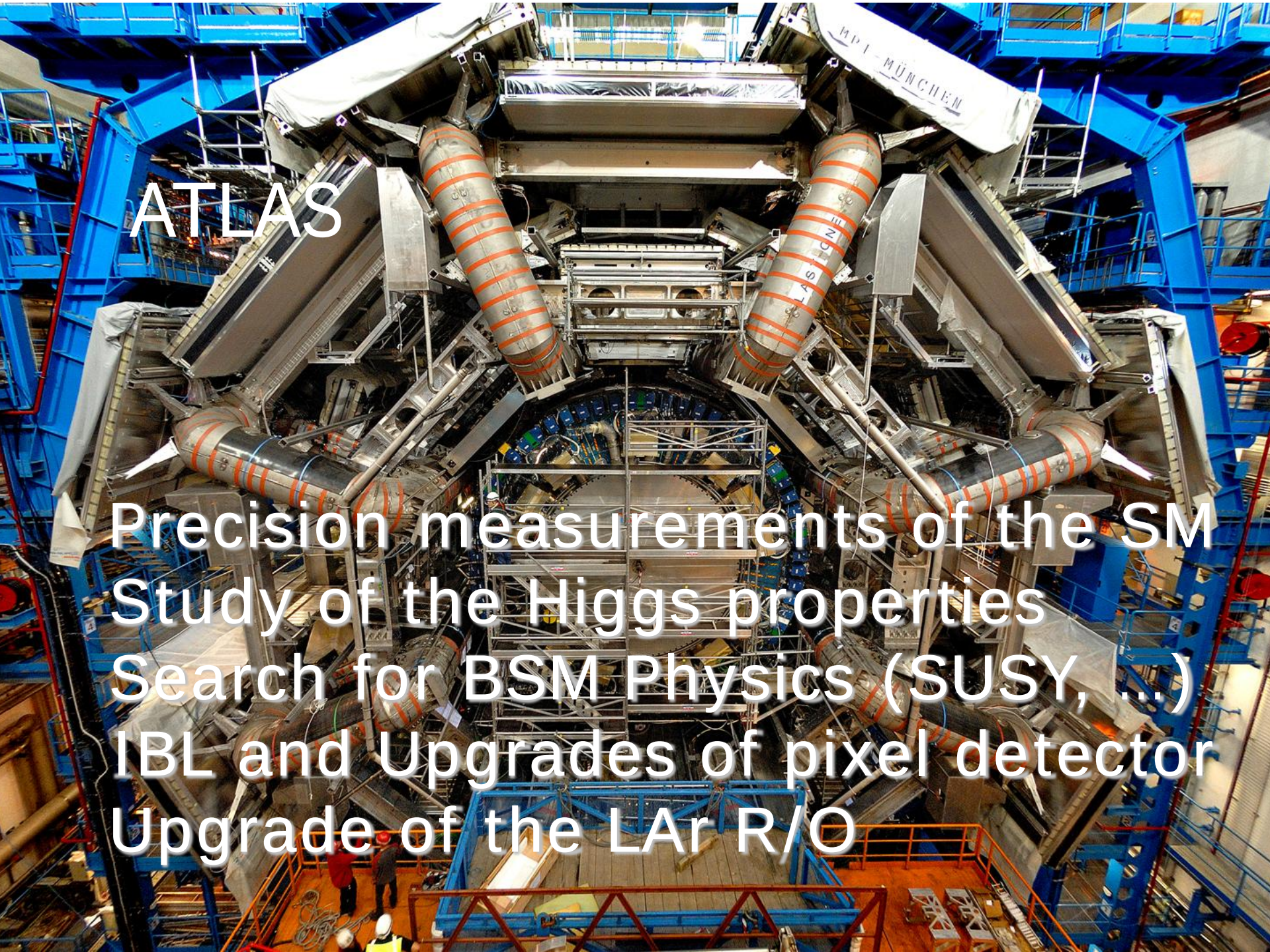
HESS

CTA

AT THE BOTTOM OF THE SEA (-2500 m)

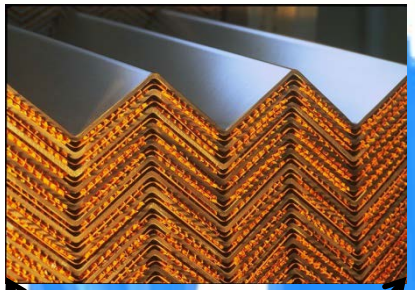
ANTARES/MEUST/KM3

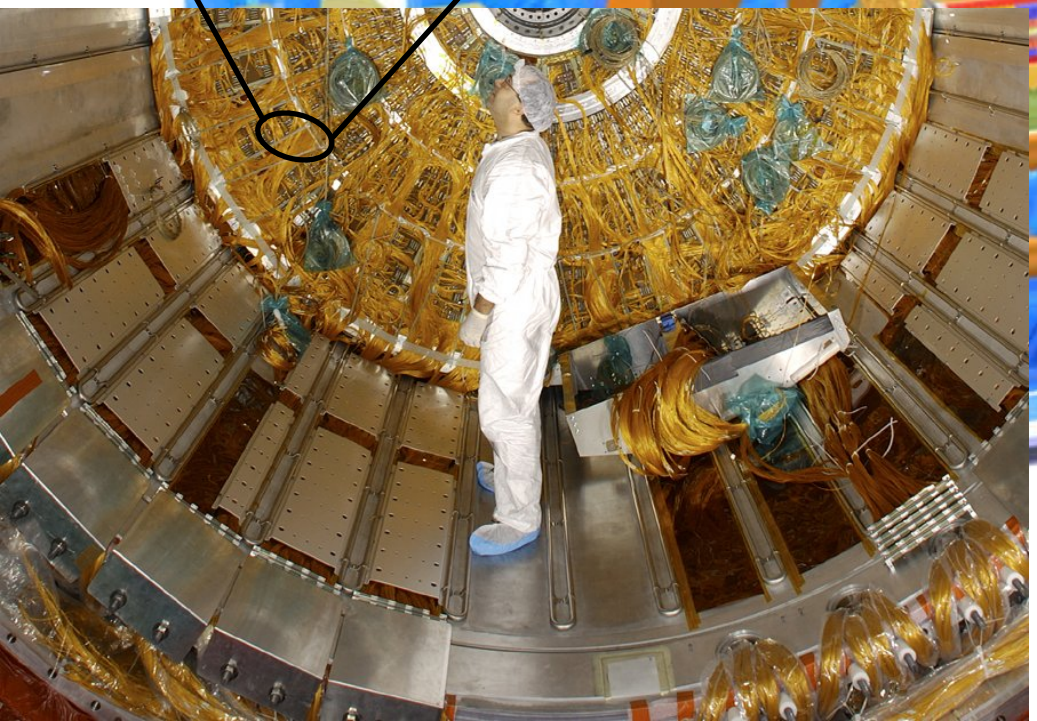
Neutrino and Gamma Astronomy
Sources of CR acceleration
multi-messenger approach

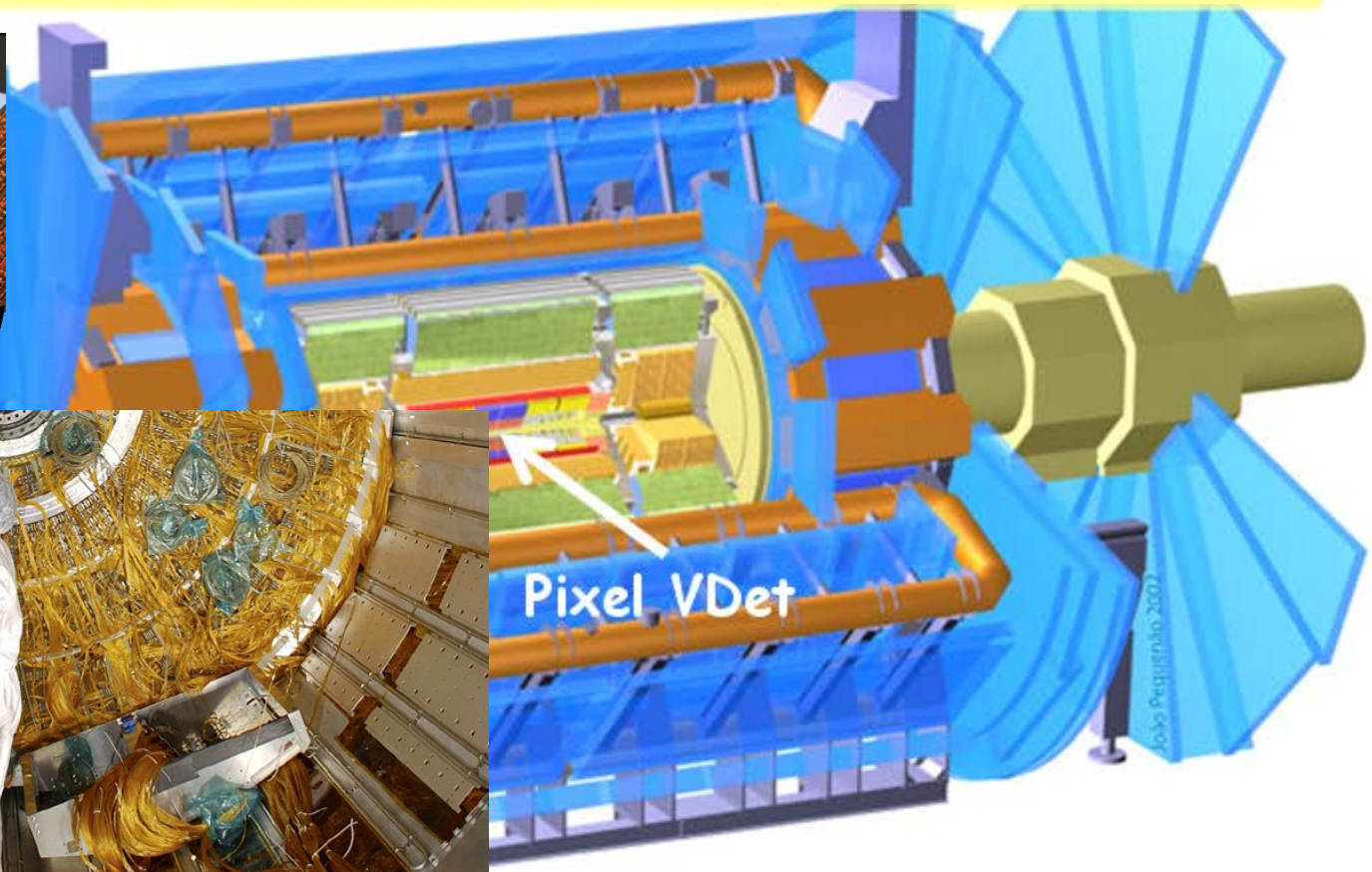

ATLAS
Precision measurements of the SM
Study of the Higgs properties
Search for BSM Physics (SUSY, ...)
IBL and Upgrades of pixel detector
Upgrade of the LAr R/O

ATLAS

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



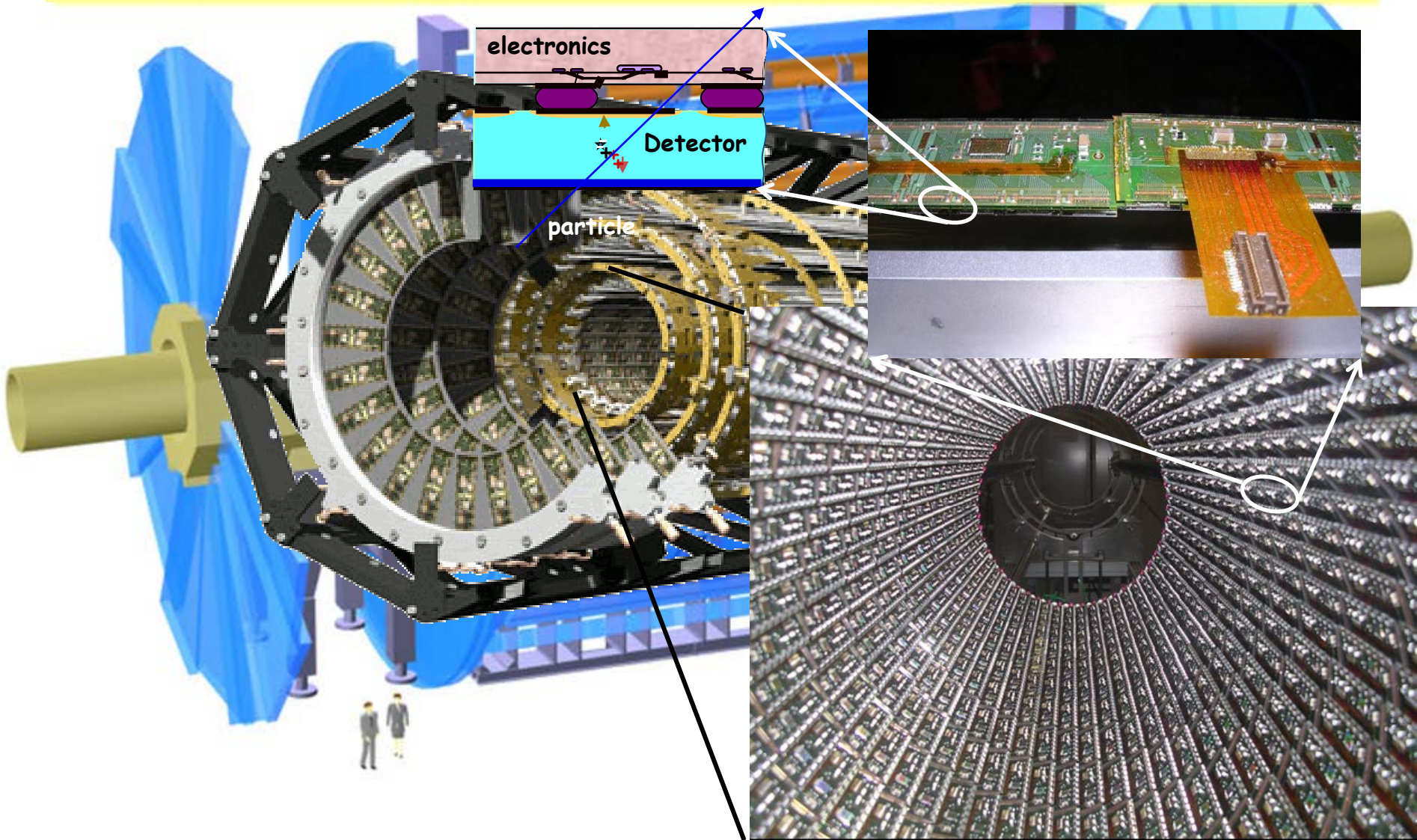


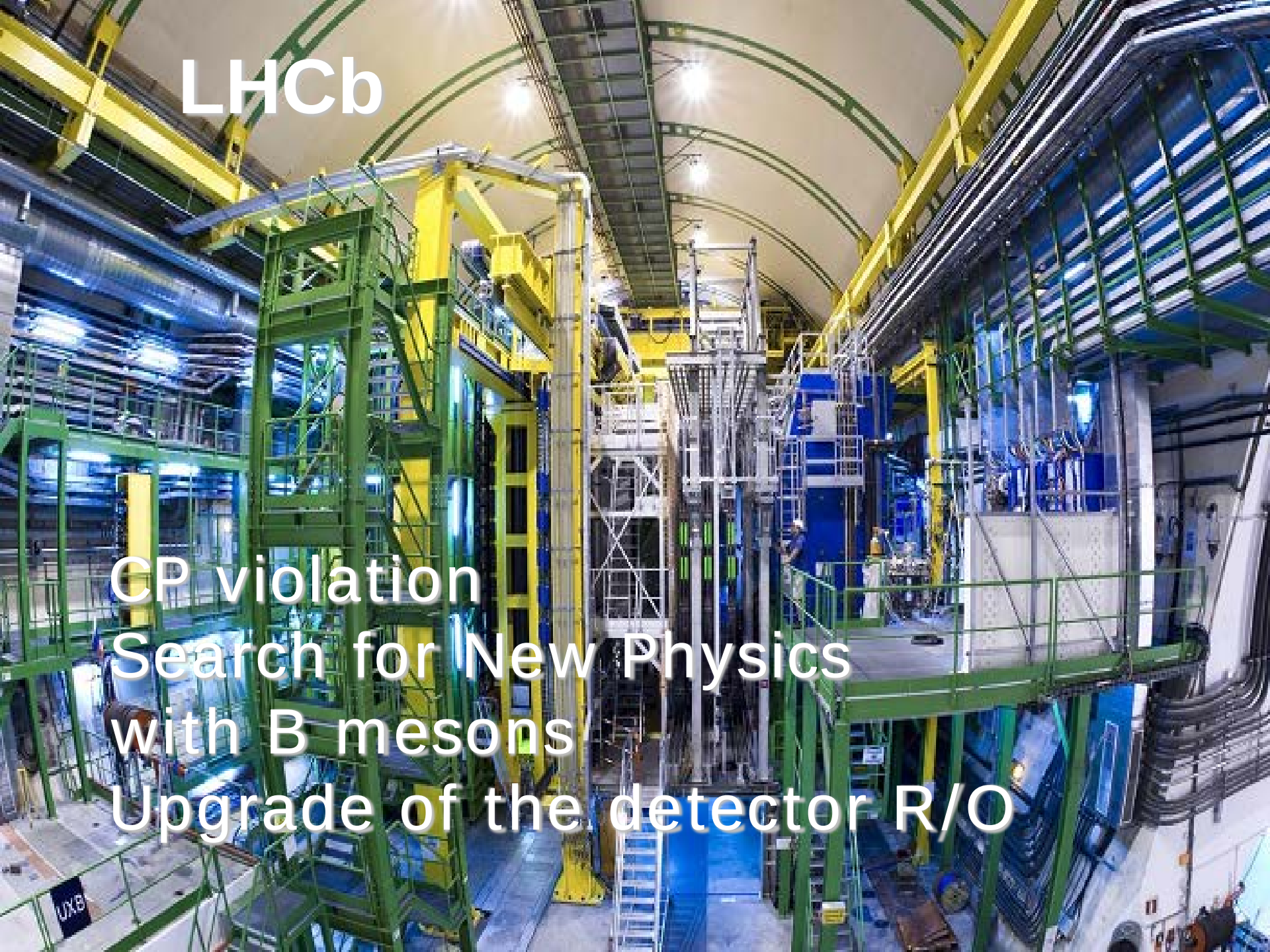


CENTRE DE PHYSIQUE DES PARTICULES DE MARSEILLE
CPPM

ATLAS

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

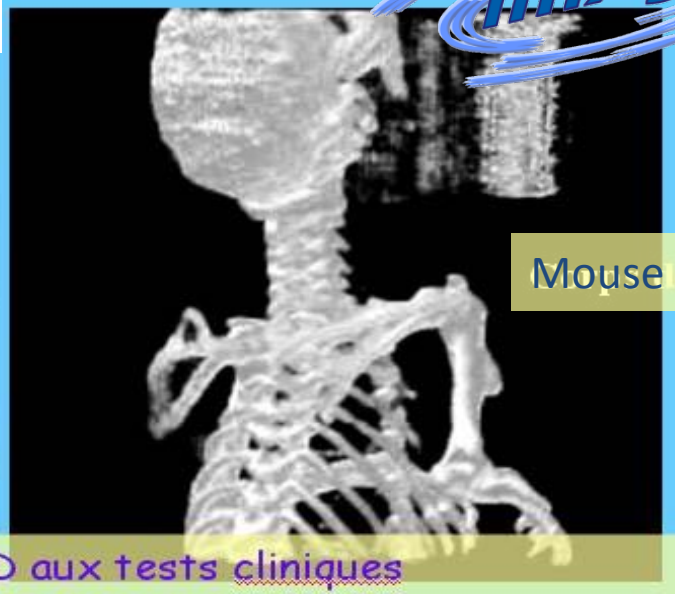



LHCb
CP violation
Search for New Physics
with B mesons
Upgrade of the detector R/O

Technological Spin-off and Transfer

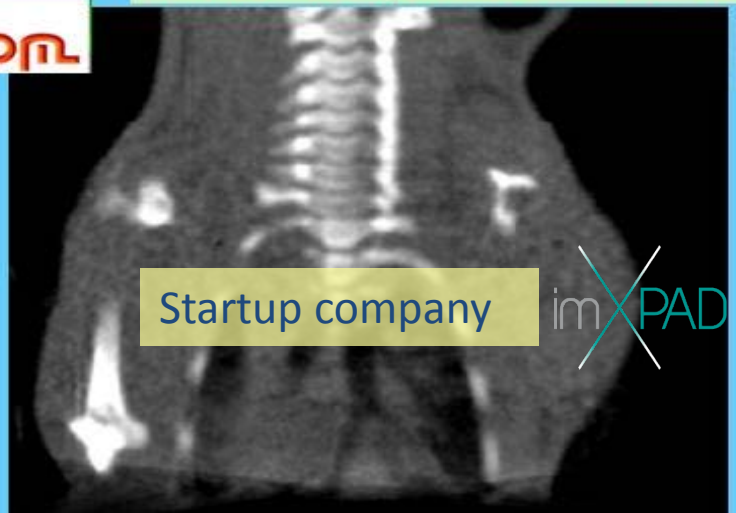
Biomedical imaging

X-Ray Pixel detector

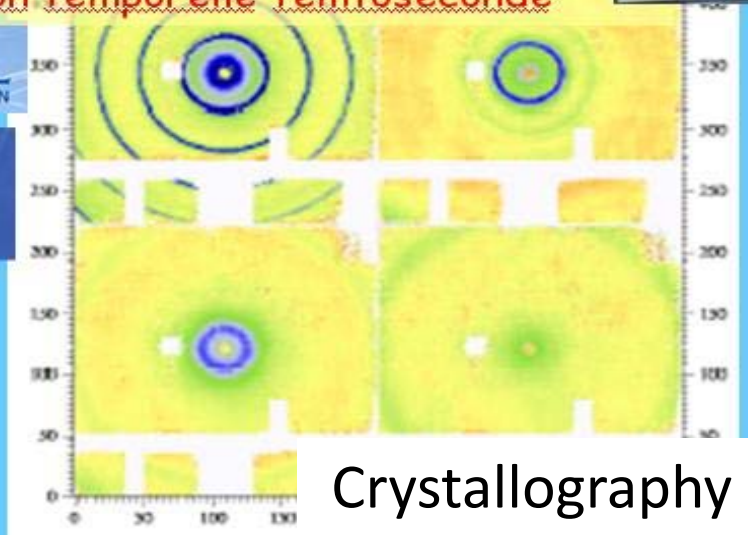


Mouse body

- Plateforme erimed : 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



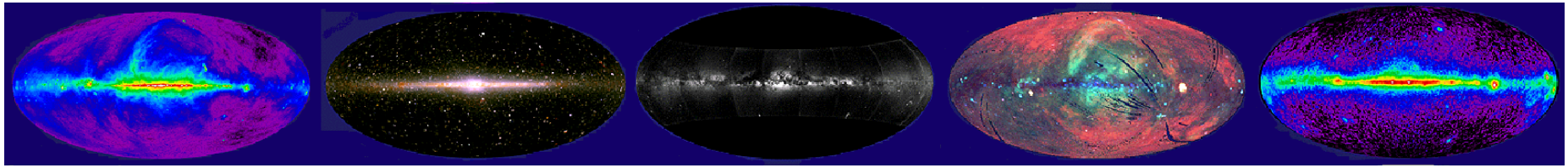
Startup company



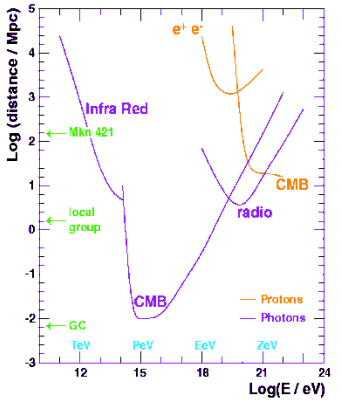
Crystallography

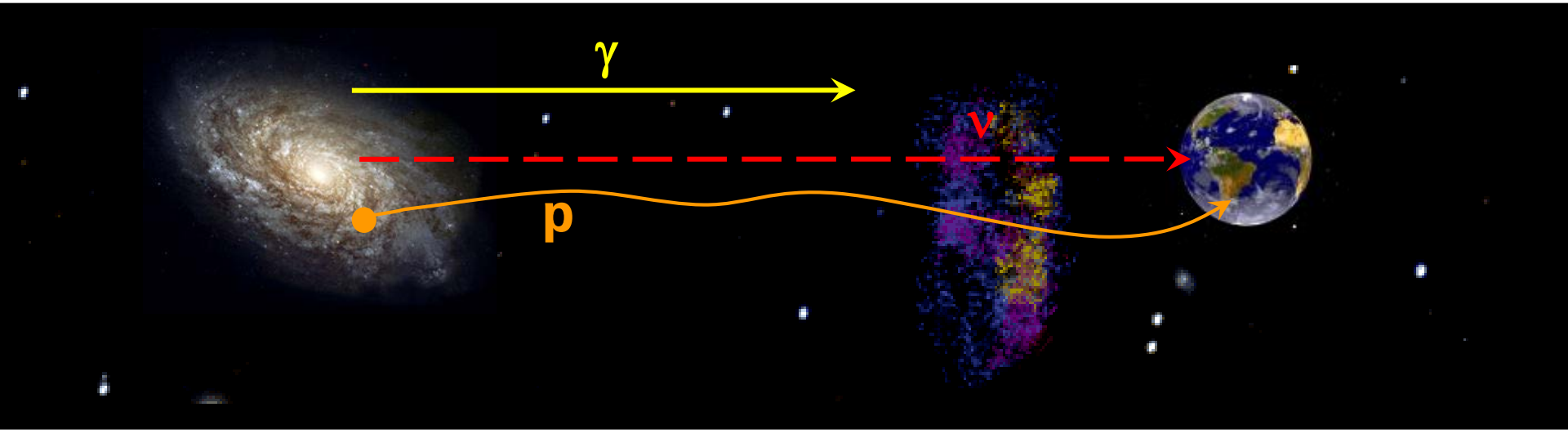
Astroparticles

So far we know the Universe thanks to photons…



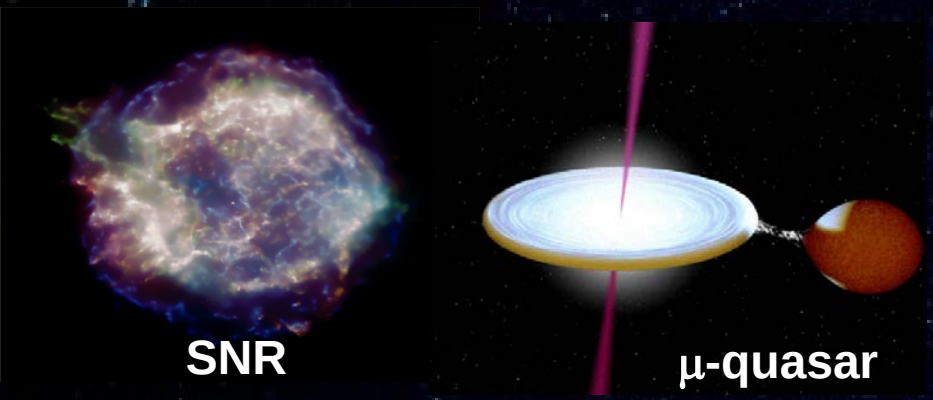
The neutrino, a new messenger
to probe the Universe
further back and deeper



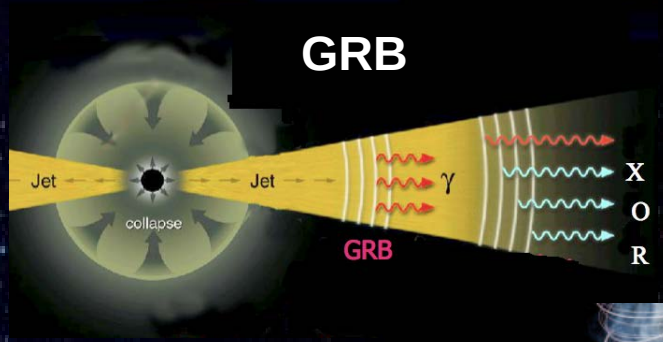


High Energy Astroparticles

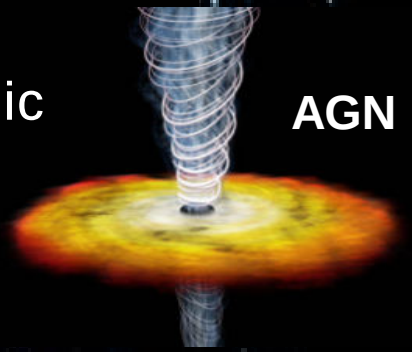
Cosmic accelerators



Galactic



Extragalactic



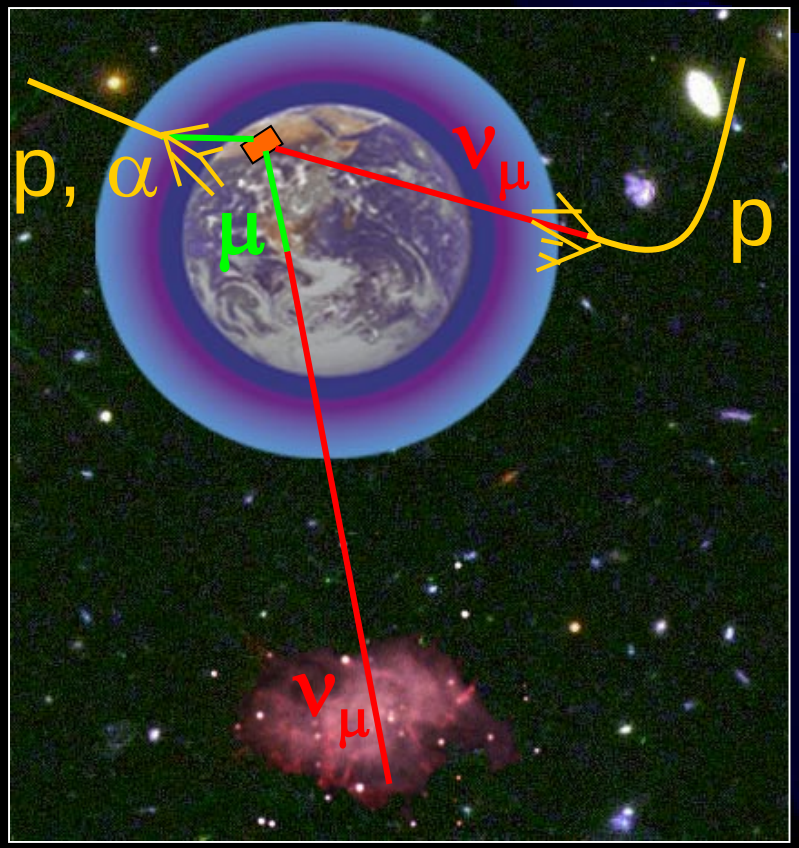
...

But also Indirect detection of Dark Matter

WIMP

Accretion in the Sun
Followed by self-annihilations

Neutrino detection principle



3D-array of
Optical modules

Cherenkov
Light
from μ

γ

43°

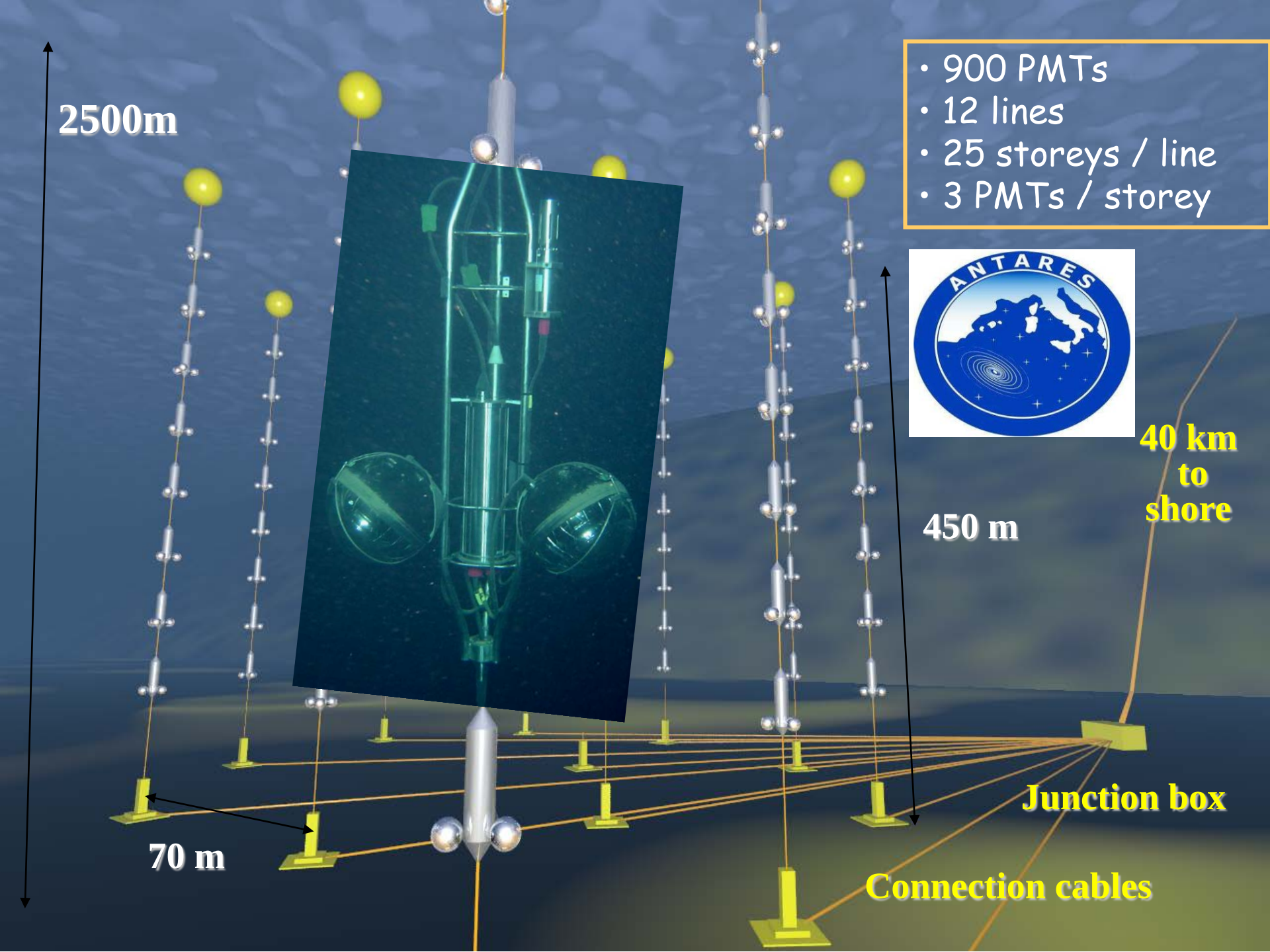
2500 m
deep

μ

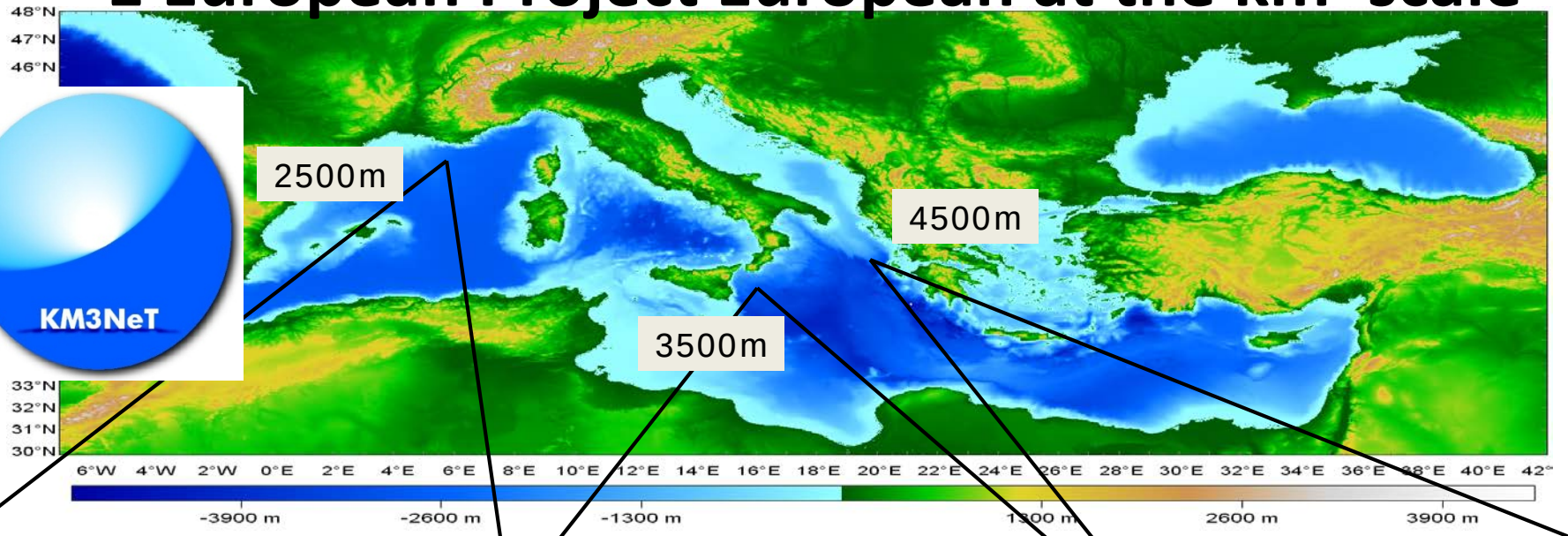
interaction

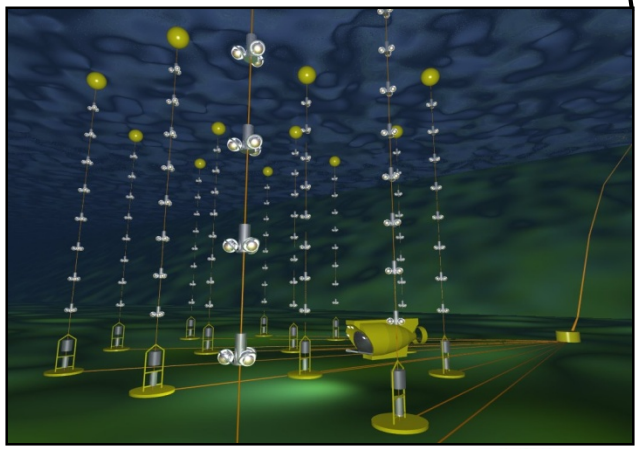
Measure :
Time & position
of photon arrival

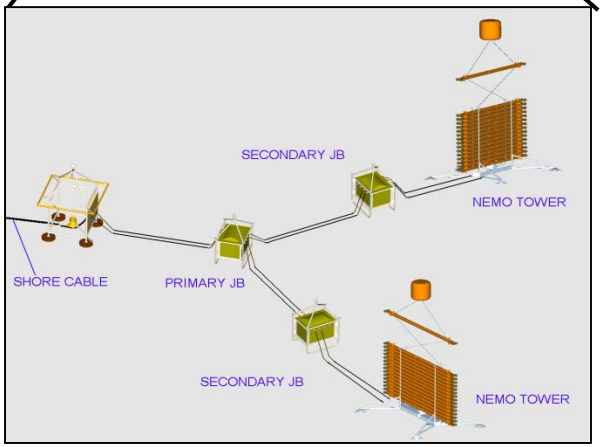
trajectory μ (~ ν)

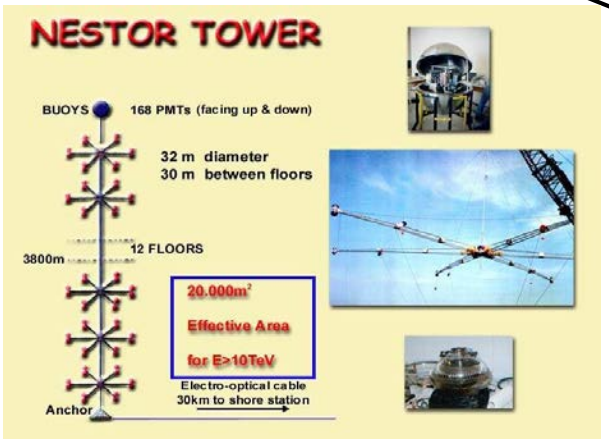

2500m
• 900 PMTs
• 12 lines
• 25 storeys / line
• 3 PMTs / storey
ANTARES
40 km to shore
450 m
Junction box
70 m
Connection cables

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







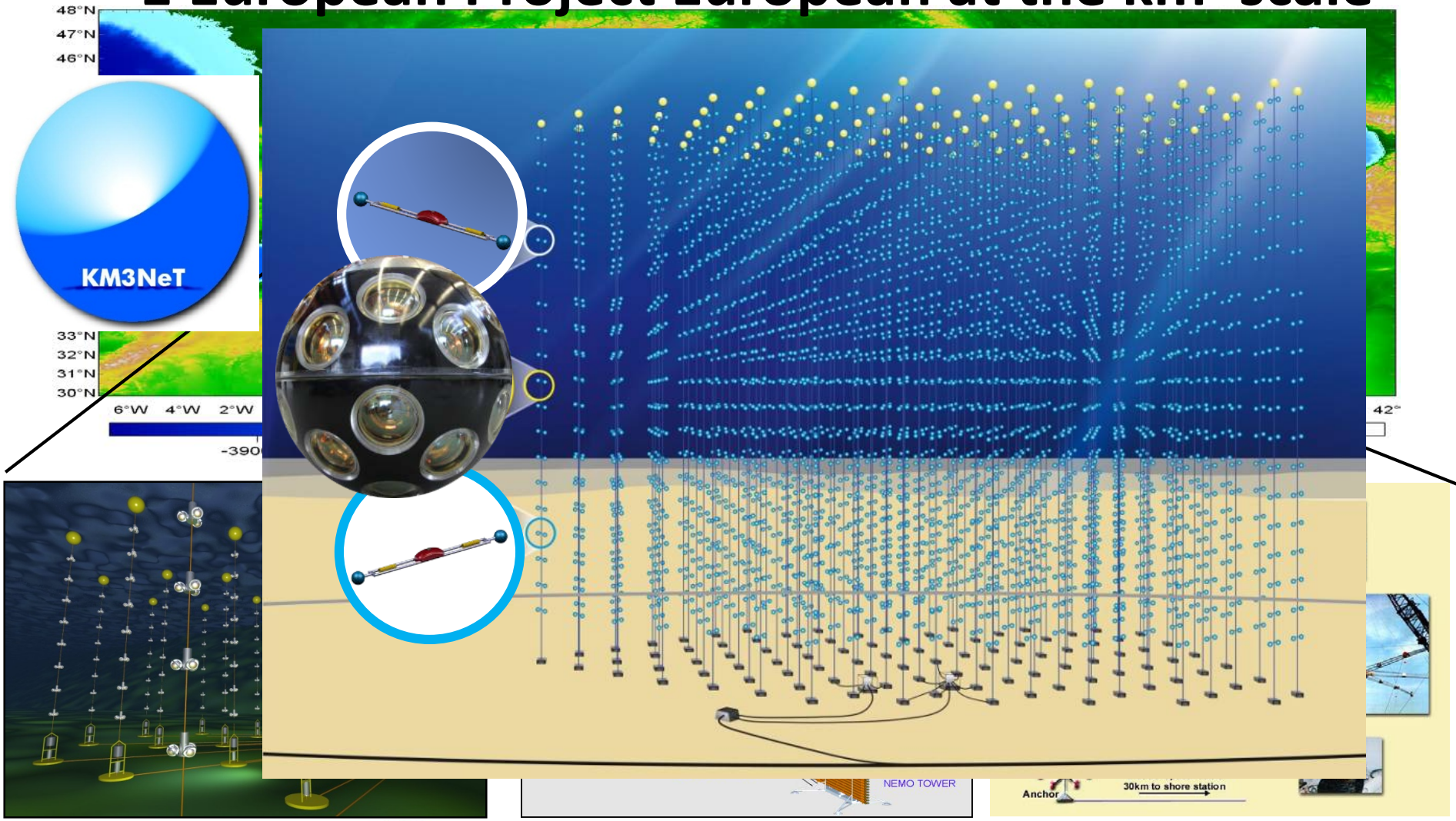


ANTARES → MEUST

NEMO

ΝΕΣΤΩΡ

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

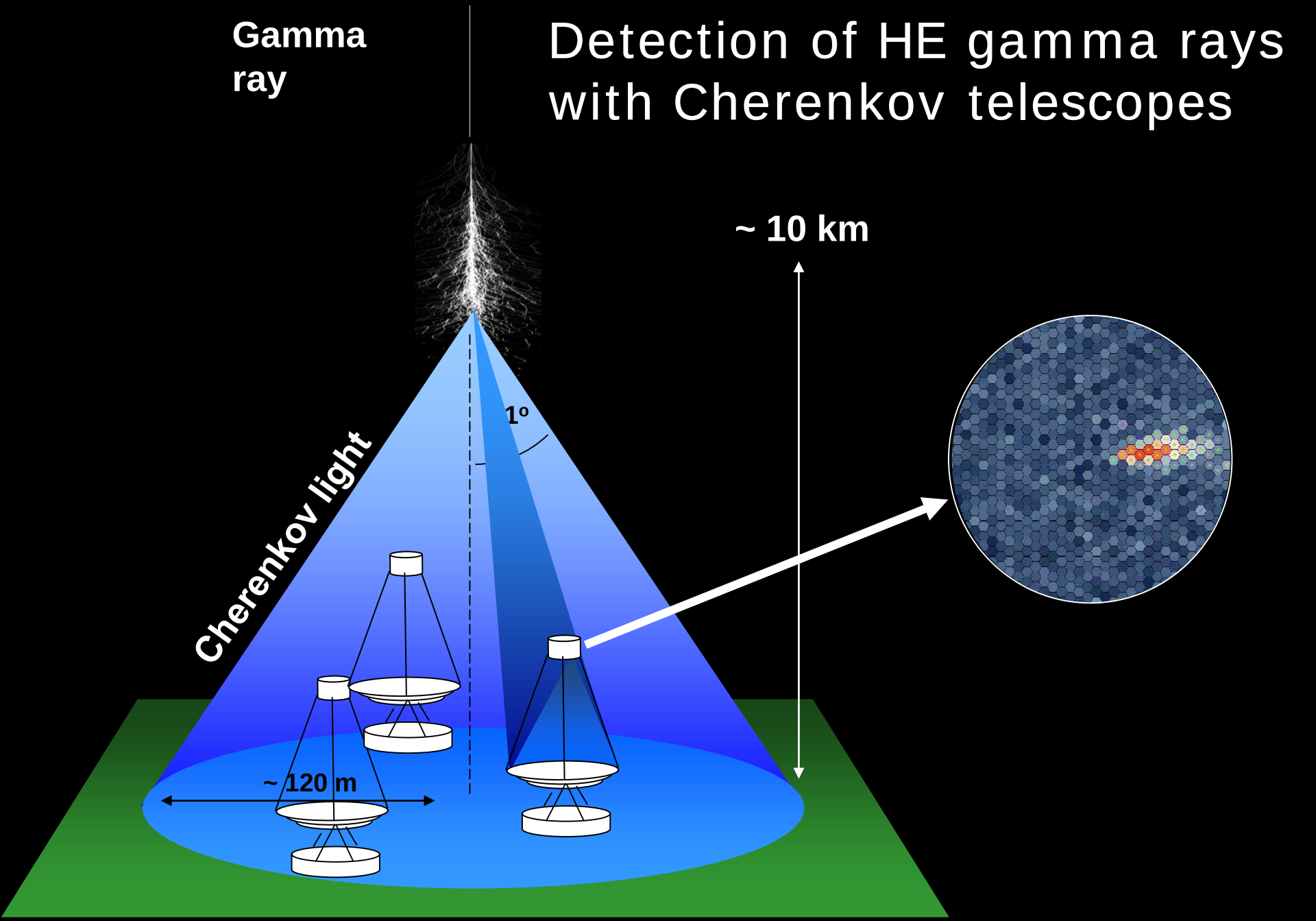


ANTARES → MEUST

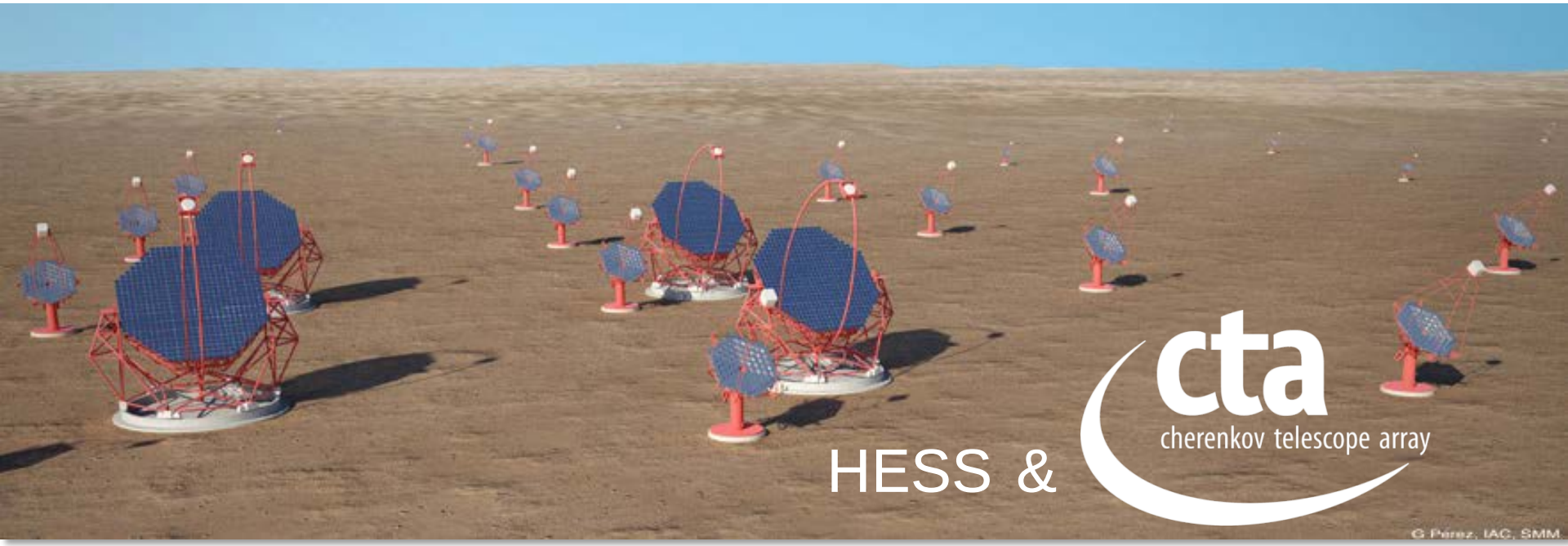
NEMO

ΝΕΣΤΩΡ

Detection of HE gamma rays with Cherenkov telescopes



Gamma-ray astronomy



Galactic Gamma-Ray Sources

Supernova Remnants
Pulsar Wind Nebulae
Pulsar Physics
Star-Formation Regions
The Galactic Centre
X-Ray Binaries & Microquasars

Extra-galactic GR Sources

Active Galactic Nuclei
Extragalactic Background Light
Gamma-Ray Bursts
Galaxy Clusters

Fundamental Physics

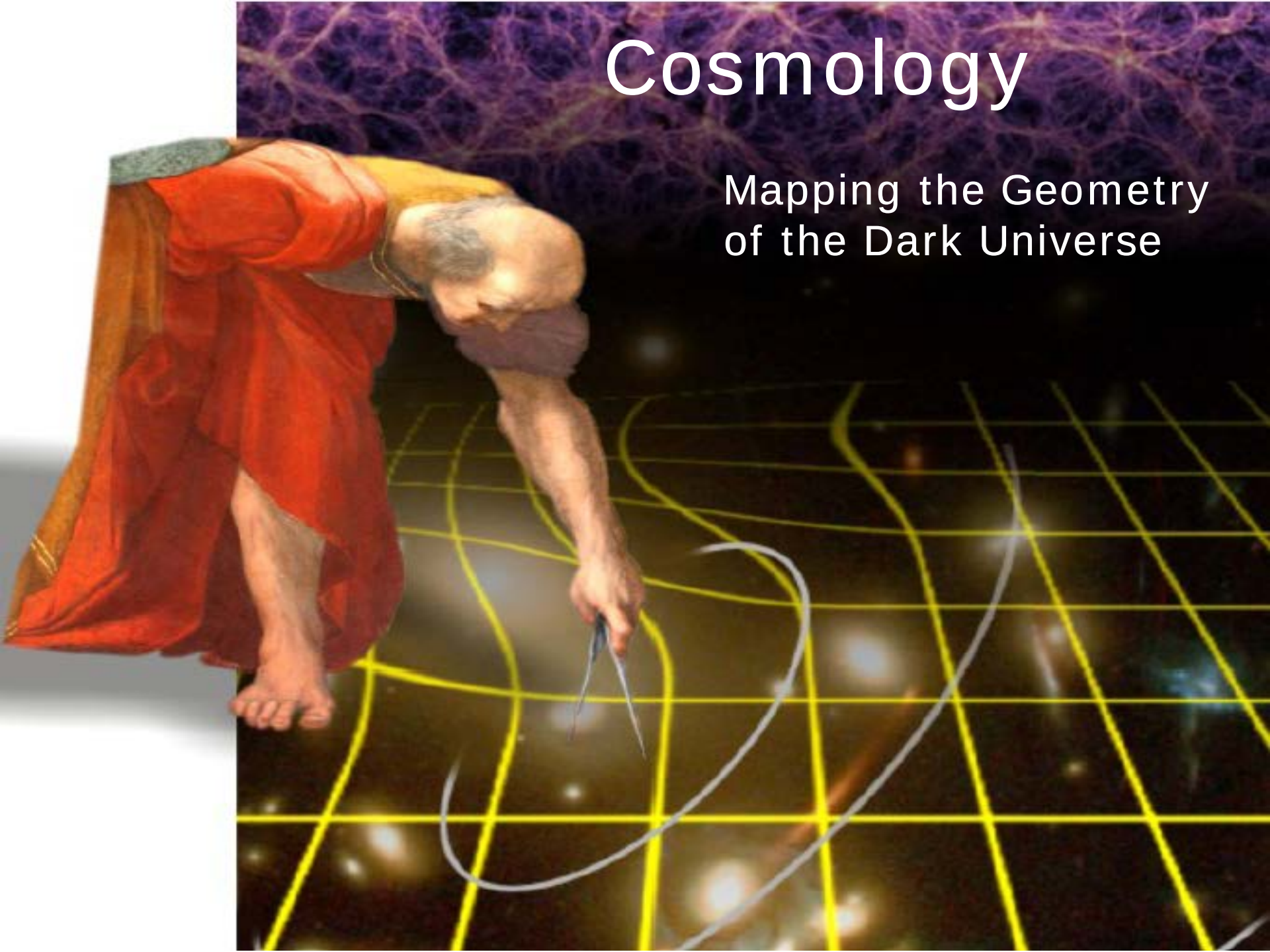
Dark Matter
Quantum Gravity
VHE GR probing Space-Time
Charged Cosmic Rays
Bridging the gap TeV-PeV

CTA

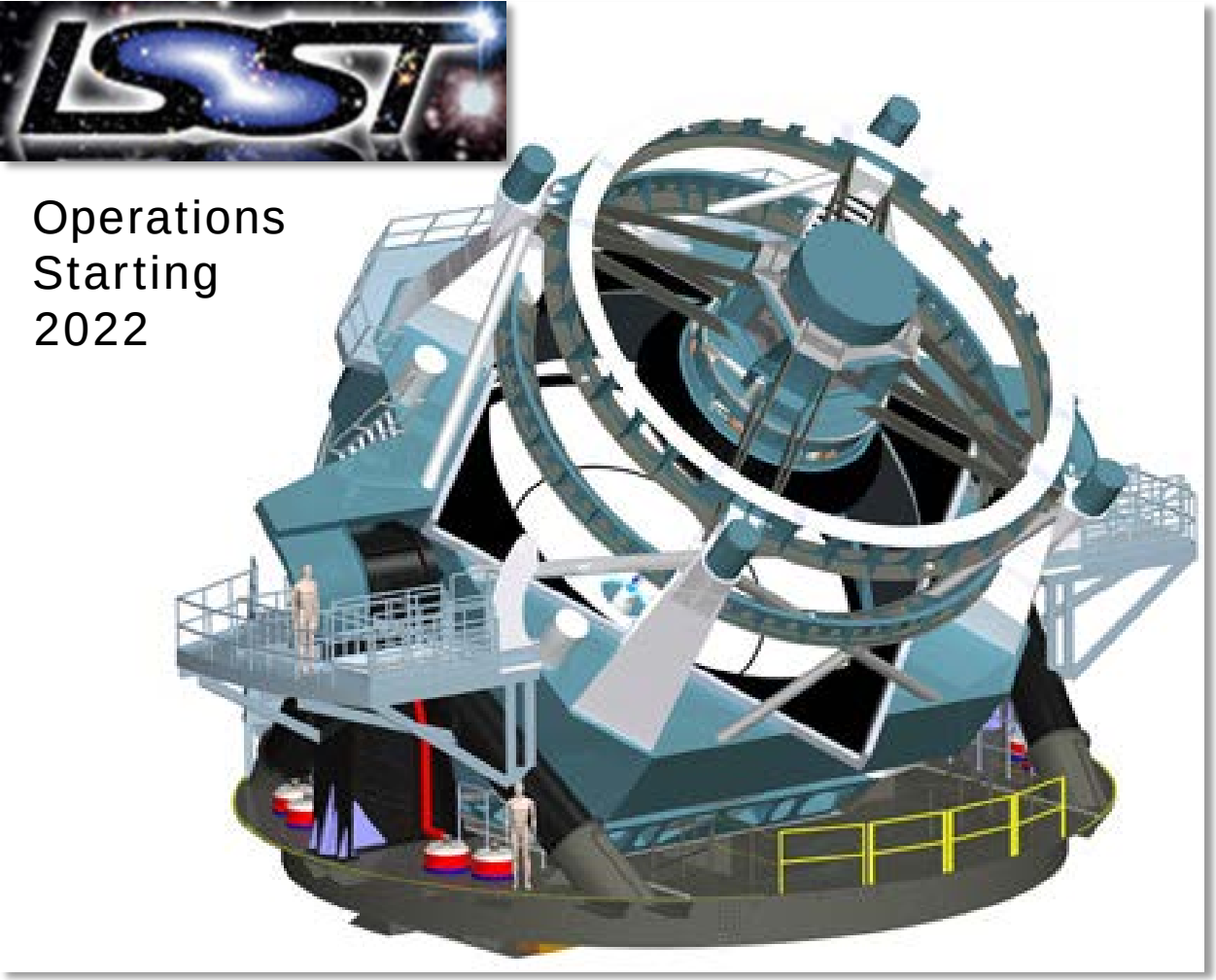
10-fold sensitivity and energy range of current instruments
~1000 sources and new phenomena expected
28 countries, 186 institutes and > 1000 scientists

Cosmology

Mapping the Geometry of the Dark Universe



Operations Starting 2022



BIG
An 8.4-meter ground-based telescope that will survey the entire visible sky deeply in multiple colors every week from a mountaintop in Chile.

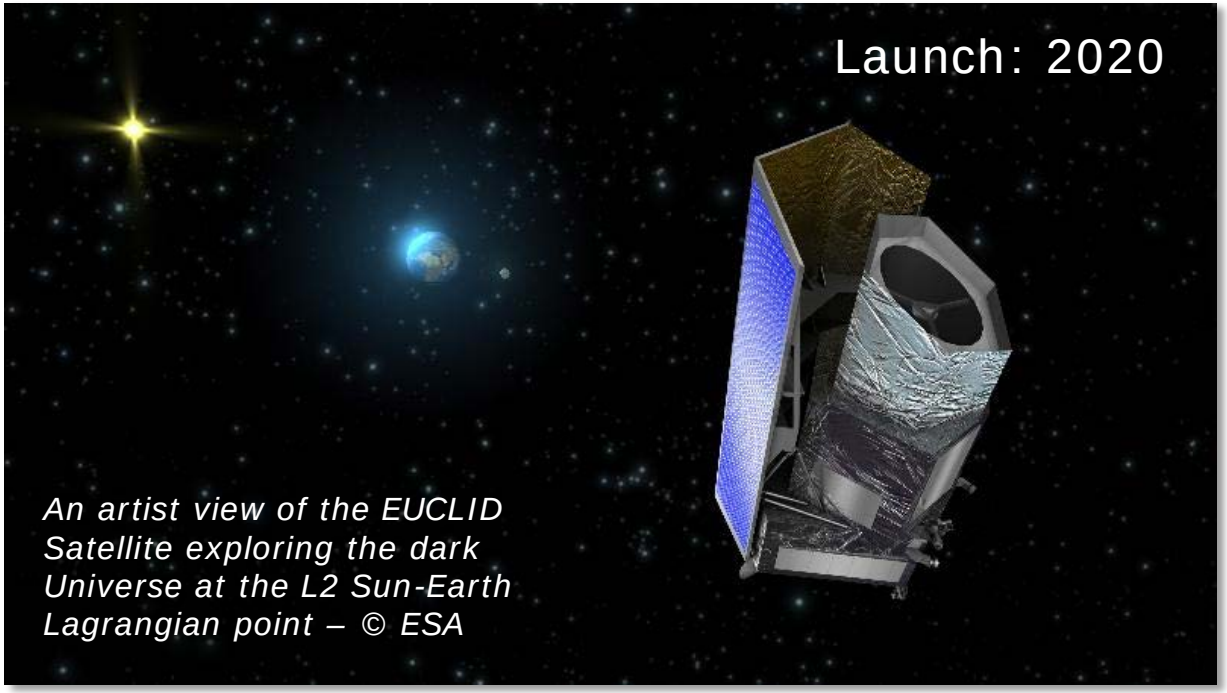
WIDE
A large aperture, wide field survey telescope and 3200 Megapixel camera to image faint astronomical objects across the sky.

DEEP
LSST's images will trace billions of remote galaxies, providing multiple probes to elucidate dark matter and dark energy..

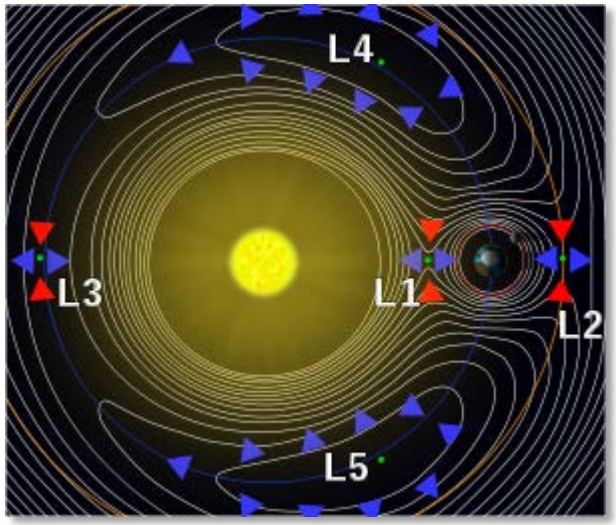
FAST
LSST will rapidly scan the sky, charting objects that change or move: from exploding supernovae to potentially hazardous near-Earth asteroids.

Euclid

...



An artist view of the EUCLID Satellite exploring the dark Universe at the L2 Sun-Earth Lagrangian point – © ESA

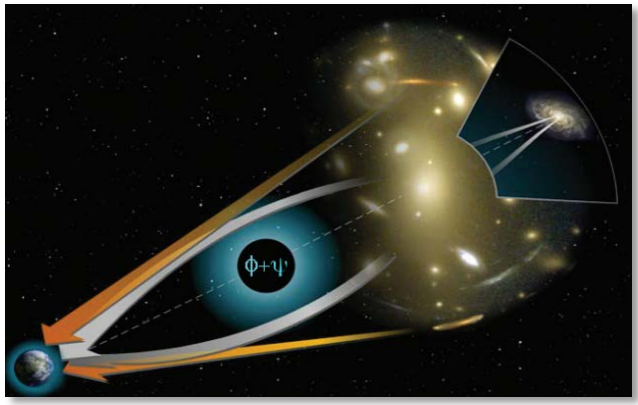


1.2 m diameter mirror telescope feeding 2 instruments:

- high quality panoramic visible imager (VIS)
- near infrared photometer and spectrograph (NISP)

- to probe the expansion history of the Universe and the evolution of cosmic structures from measurement of gravitational lensing (GL) effects and 3D structure distributions

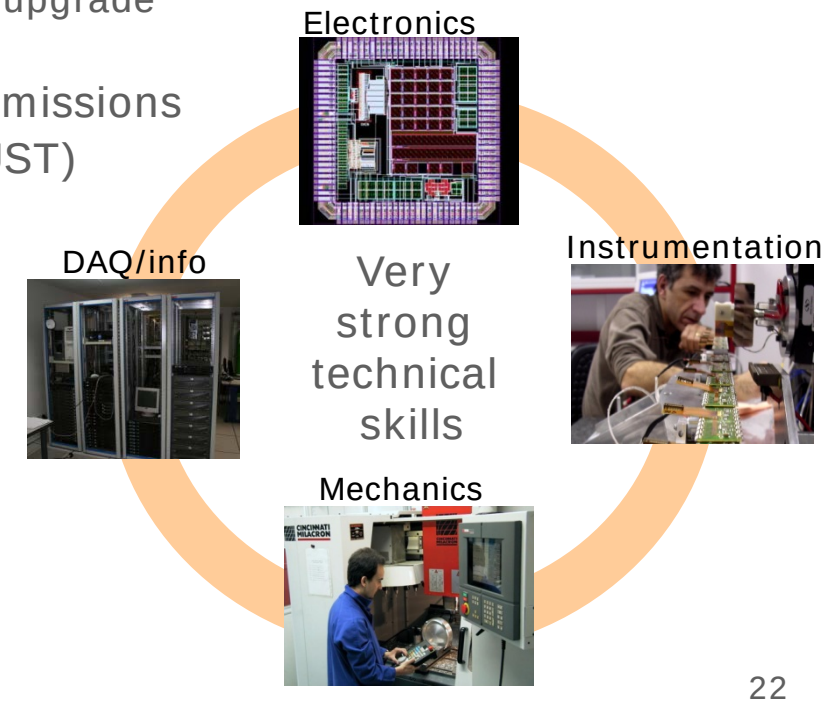
- 6 year mission: 10 billion sources out of which 1 billion used for GL and 50 million galaxy redshifts used for galaxy clustering



Top-notch techn(olog)ical skills for top-notch science

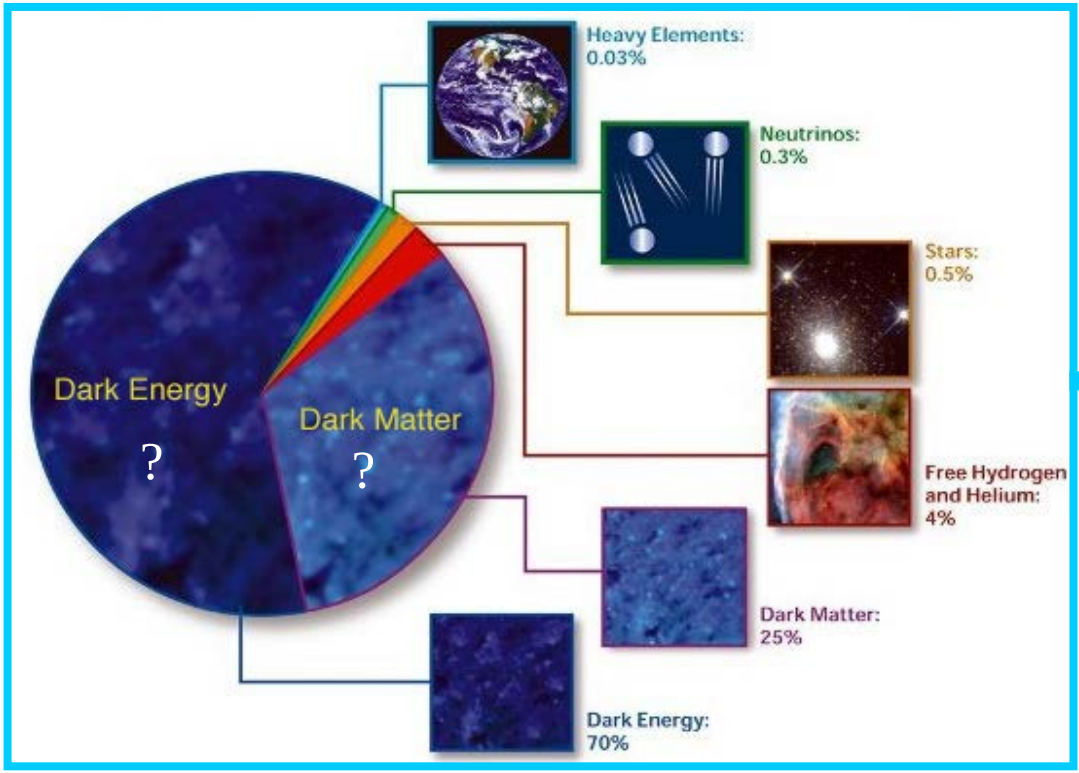
- Recognized technical skills and leadership
  - Micro-electronics (planar and 3D; radiationhardness)
    - Pixels detectors for particle physics (ATLAS)
    - Transfer to:
      - X-Ray imaging (imXgam) => ***4 patents and startup company*** imXPAD silicon and CdTe (FP7 Calypso)
      - ... but also robotized avionics (silicon fly retina – FP7 Curvace)
  - Fast acquisition (FPGA based) and fiber optics transmission (LHCb)

    But also for...
    - Hadron therapy (FP7 ENVISION)
    - ATLAS: LAr calorimeter readout and trigger upgrade
    - ALICE: readout upgrade
  - Characterization of IR detectors for space missions
  - Submarine Infrastructures (ANTARES/MEUST)
    - Equipressure systems
    - Submarine connectors
    - ***2 patents; startup company*** POWERSEA ***strong interest from the industry (sustainable energies)***
      FUI with EDF, Comex and Subsea Tech
      AMI with DCNS and EDF
  - Interaction with Competitiveness Clusters
    - OPTITEC, SCS, Mer Méditerranée, Eurobiomed, Pégase



Investissements d'avenir: LabEx

- OCEVU: Origins, Constituents et EVolution of the Universe
  - Coordinated by Aix-Marseille Université
  - 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

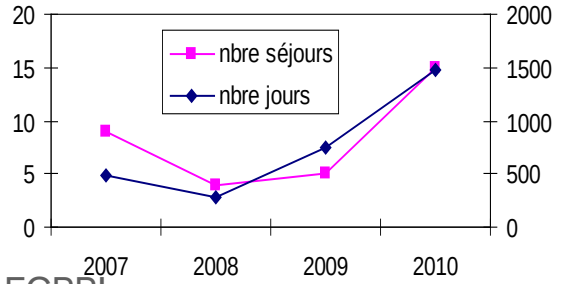
Combine our strengths in:
Cosmology and (Astro-)Particle Physics
Observation, experimentation, and theory

Well defined projects in:

Research
Education
Transfers

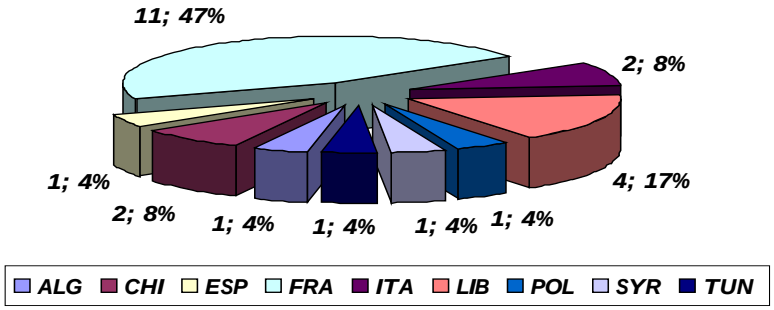
Open towards international collaborations

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

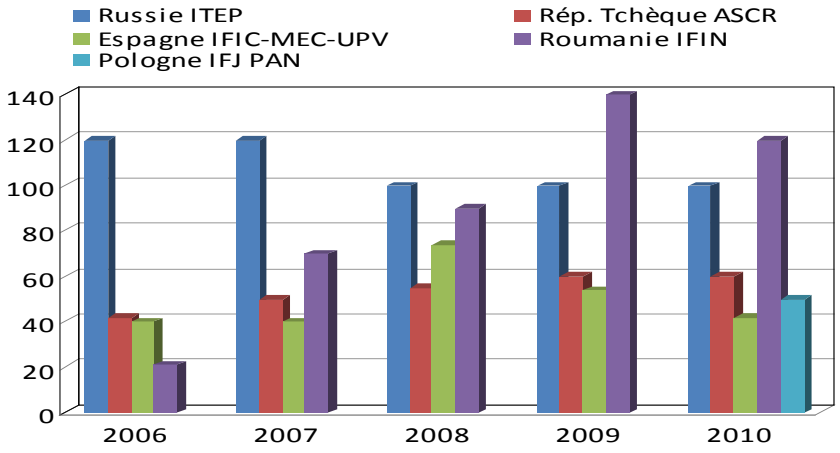


FCPPL

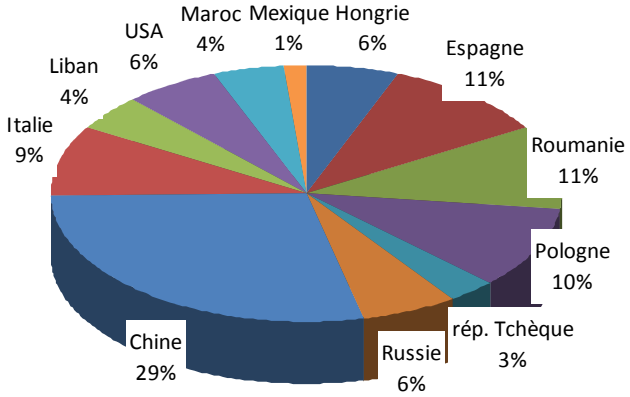
PhD students' citizenship



Specific Collaborations (# of days)



Foreign visitors (59p.) in 2010

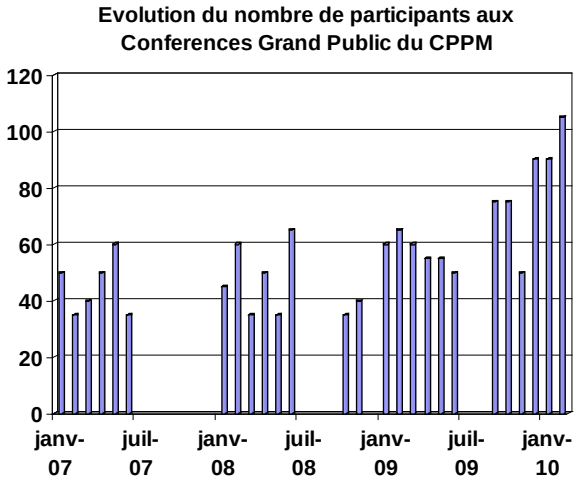


Education and Outreach

- Education: strong involvement (faculties, researchers, engineers) at the LMD of AMU and engineering schools. Managerial responsibilities (Doctoral School, Licences, Masters 1 et 2).

- Scientific communication and outreach

Publications, seminars,
Conferences and schools…
Activity reports
Articles and press releases,
Conferences in high-schools, Master Classes (with CERN)
Exhibitions, various events, Fête de la Science …
Development of didactic tools, …
Conference cycle for the general public



Up to 145 participants!!!

Sciences à l'École