« Astroparticles and Neutrinos »

Reynald Pain

IN2P3
Institut national de **physique nucléaire**
et de **physique des particules**

FCPPL
Hefei Apr. 2015

www.in2p3.fr

IN2P3, ONE OF 10 CNRS INSTITUTES

CNRS

10 institutes
(**1 100** research units
(95% in partnership)

34 000 *researchers, engineers, technicians*

€ 3.3 billion *budget*

IN2P3: MISSIONS

TO PROMOTE AND UNIFY RESEARCH ACTIVITIES IN THE FIELD OF SUBATOMIC PHYSICS

COORDINATION

Programmes on behalf of the CNRS and universities

CEA partnership

NUCLEAR PHYSICS, PARTICLE AND ASTROPARTICLE PHYSICS

EXPLORATION

The infinities, from particles to the cosmos

PROVIDING

Competencies, expertise

Interdisciplinary research, teaching, training, innovation

LINKS WITH SOCIETY

IN2P3: KEY FIGURES

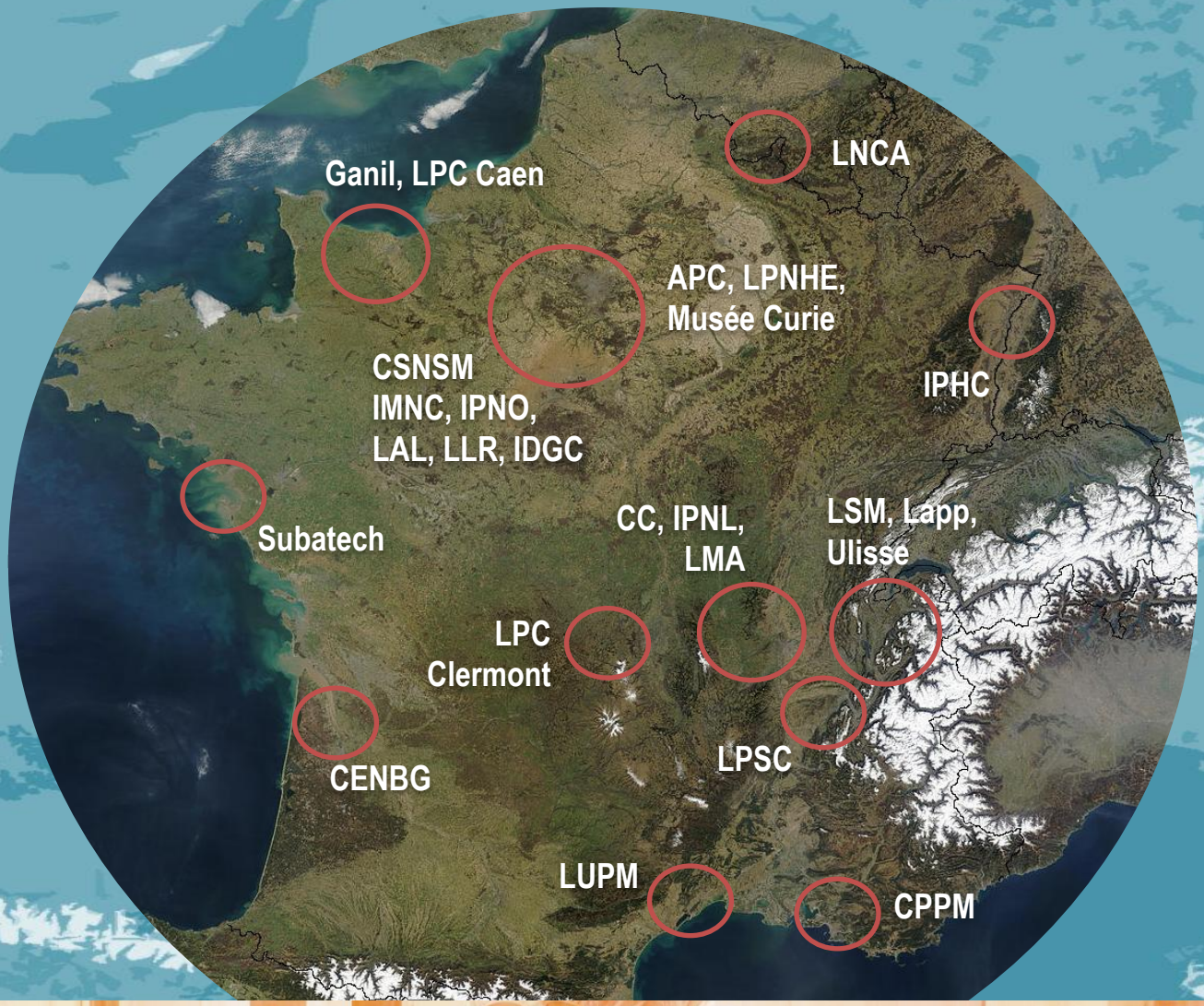
40 major international projects
17 *international research networks*

3 100
researchers, engineers and technicians

70 M€
annual budget
(excluding salaries)

25 *laboratories*

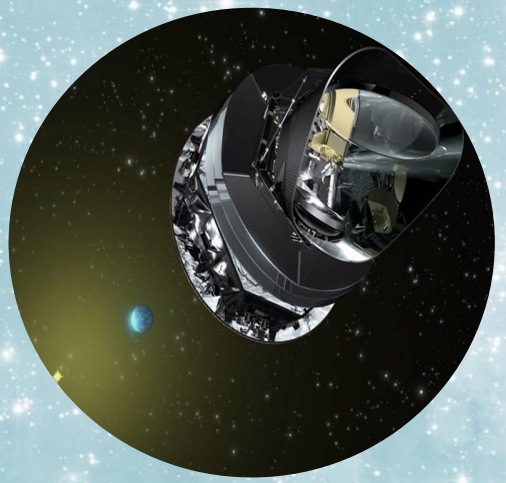
NETWORKED LABORATORIES



SCIENTIFIC THEMES

Astroparticle physics and neutrinos

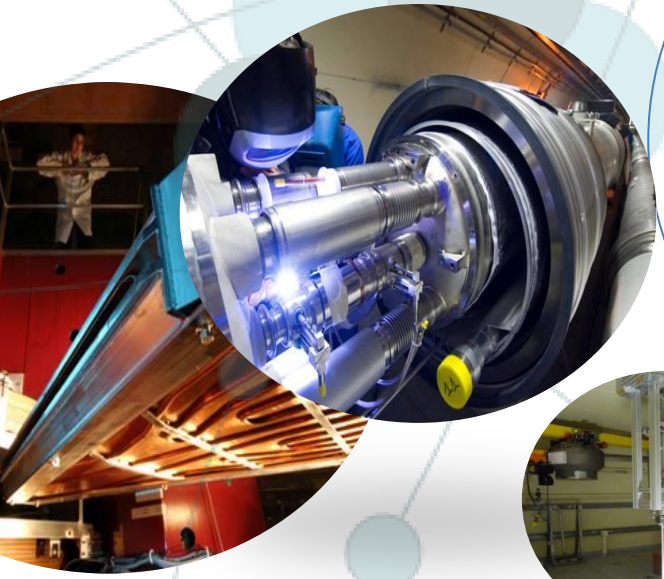
Universe's composition and behaviour



Particle physics
Nuclear and hadronic physics

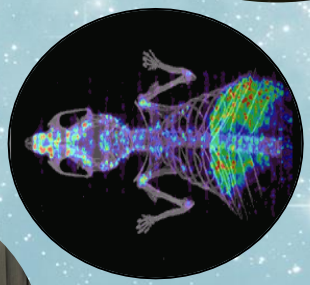
Matter's most elementary constituents and fundamental interactions

Structure of nuclear matter



Theory
Instrumentation
Computing grids
Accelerator R&D

Nuclear energy
Medical applications



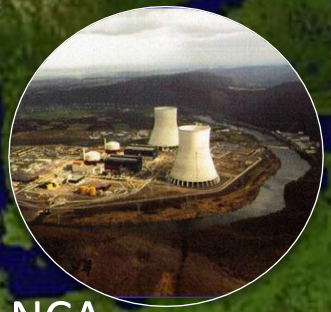
ASTROPARTICLES AND NEUTRINOS PHYSICS

UNIVERSE' S COMPOSITION AND BEHAVIOUR

- Universe history
- Dark matter and dark energy
- Cosmic rays
- Gravitational waves
- Neutrinos

COSMIC RAYS DARK ENERGY UNIVERSE SUPERNOVAE BIG BANG GRAVITATIONAL

LARGE INFRASTRUCTURES in France

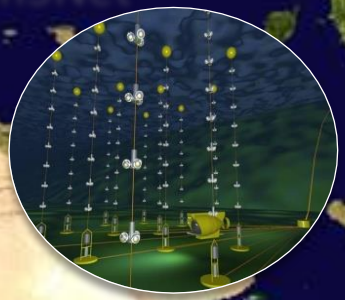


Dchooz/LNCA

CC-IN2P3

Edelweiss, Nemo / LSM

Antares &
Km3Net



ASTROPARTICLES AND NEUTRINOS PHYSICS

IN2P3 is not the only player in the field

- CEA/IRFU
- INSU : « Astronomy & Astrophysics »
- INP : theoritical Physics

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Conception graphique : Anna Thibeau (IPNL)

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DARK ENERGY SUPERNOVAE GRAVITATIONAL

ASTROPARTICLES AND NEUTRINOS PHYSICS

Astroparticles and neutrinos ?

- Particle Astrophysics
- Neutrino Physics and Astrophysics
- Dark Matter and Dark Energy

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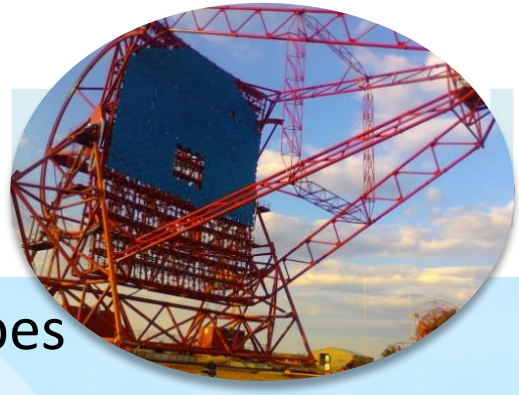
Particle Astrophysics

High Energy Gamma Rays



Ongoing participations in FERMI and HESS telescopes

- 5th telescope installed in 2012
- VELA pulsar (30 GeV) and sources detected in satellite galaxy
- limited upgrades HESS 1 telescopes -> 2020+

Large participations in CTA : preparation phase + R&D. Focus on building cameras for MST : construction funding expected from 2017

Participation in SVOM : gamma rays burst satellite

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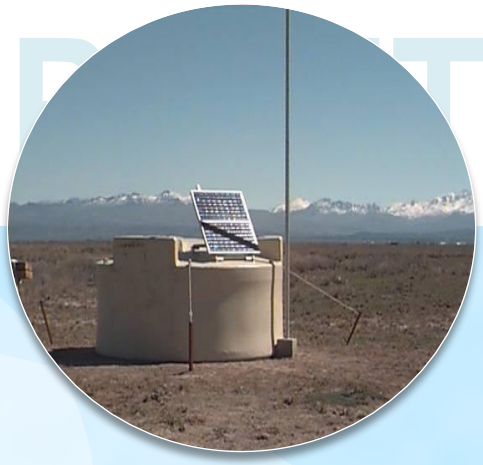
Particle Astrophysics

High Energy Cosmics Rays



Ongoing participation in Auger observatory.
Consortium renewal in 2016 -> 2025
Limited upgrades foreseen from 2016 on

Ongoing participation in AMS (RICH detector + EM calorimeter) – positron fraction excess confirmed in 2014
Run 5+ more years

Some participations in EUSO (balloon), LHAASO, TREND and GRANT

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Particle Astrophysics

Gravitational waves

VIRGO (+ CNRS/INSU and CNRS/INP)
-Finish construction of Advanced VIRGO (expected “lock” end 2015)
-Joint run with LIGO foreseen to start towards end 2016
-Renewal of the EGO consortium in 2015 for 5 years

Participation in Einstein telescope design study
LISA (ESA) : participations in preparation studies + LISA Pathfinder (CNES)

Neutrino Physics and Astrophysics

Neutrino Astrophysics leads to Neutrino Physics

ANTARES (12 lines of 75 PMs offshore Toulon).
Successful R&D

KM3NeT: EU funded preparatory phase : 2 sites

- a large volume in Italy (High Energy Neutrinos cf IceCube) : ARCA
- A denser array offshore Toulon France (targeting MH using atmospheric neutrinos) : ORCA

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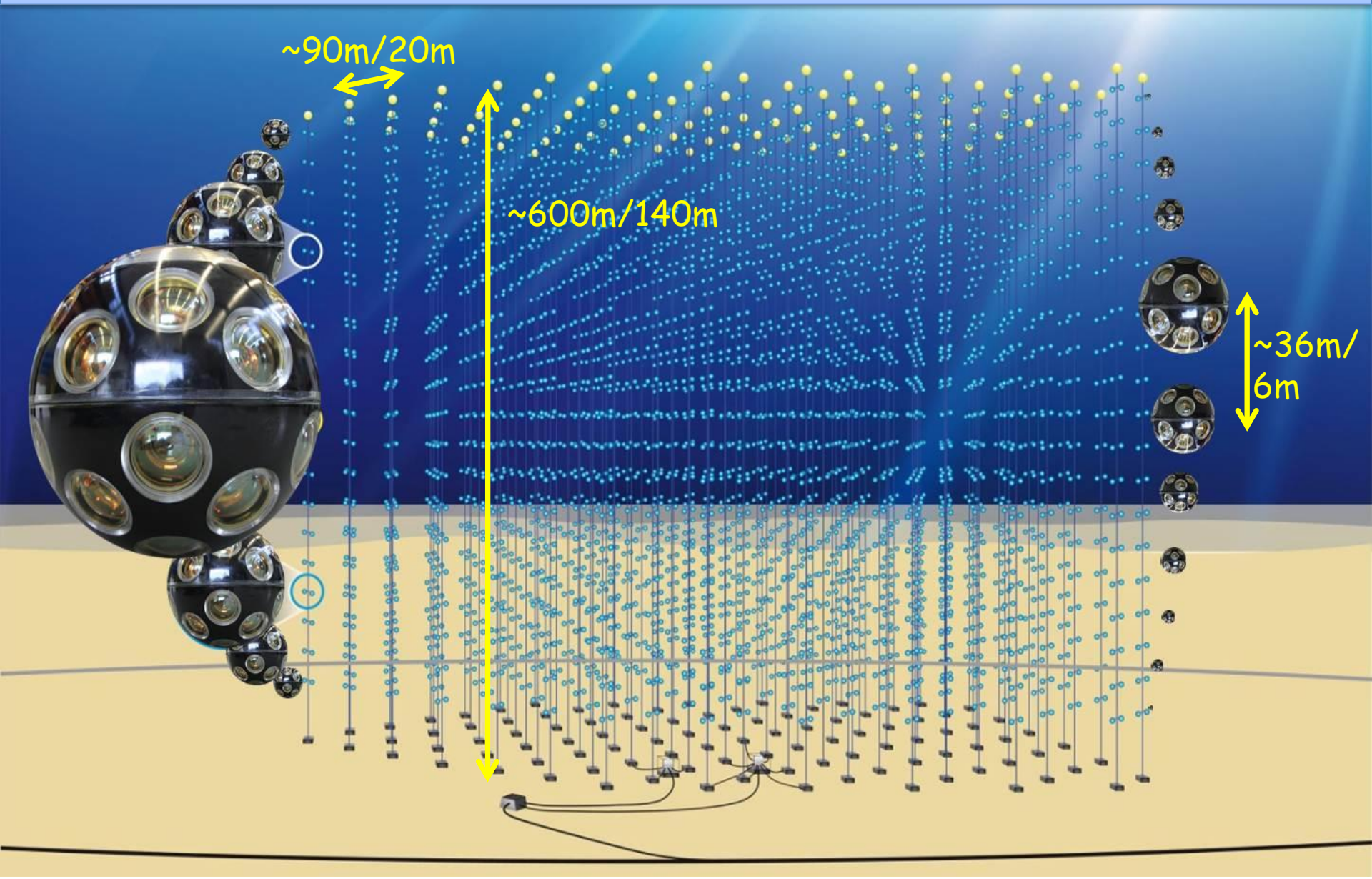
The next-generation Neutrino detector: KM3NeT



ORCA very competitive with other Expts

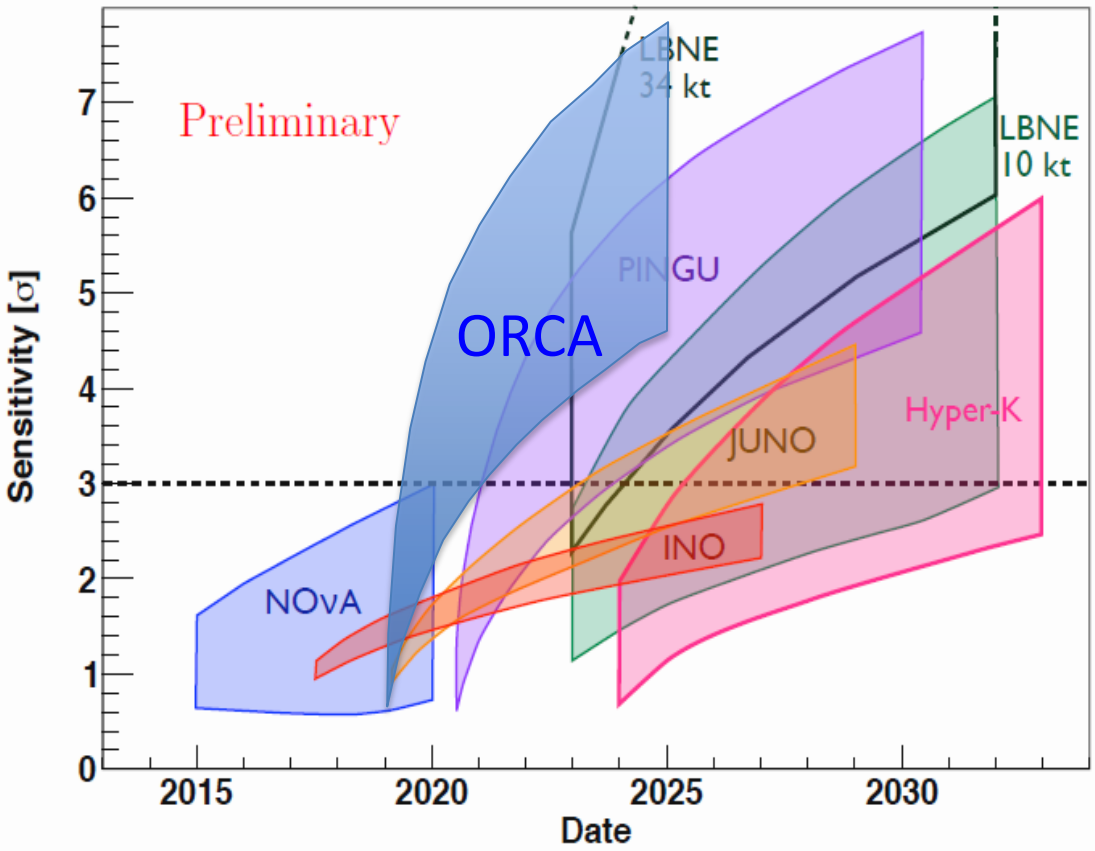
3 sigma determination of neutrino mass hierarchy in 3 years

Widths indicate main uncertaint
LBNE/NOVA: δcp
JUNO: σE (3.0-3.5%)
ORCA/PINGU/INO: θ_{23}

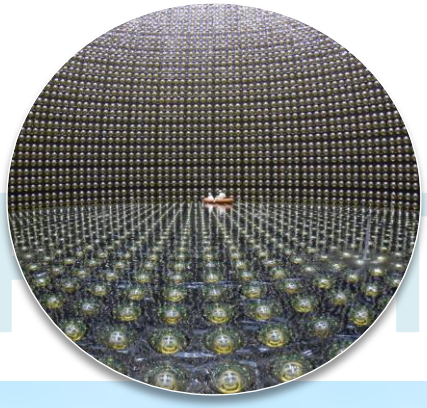
Other projections assume worst case parameters (1st oct)

ORCA timeline, assumes start deployment 2016 for 3 years

LBNE from LBNE-doc-8087-V10
PINGU from DeYoung, Arlington 2014
Others Blennow



Neutrino Physics



Neutrino Physics at Accelerators

Continued participation in T2K (recent updates Theta13)
OPERA (LNGS) : 4th nu-tau found – finalization analyses – Decommissioning (tracker moved to JUNO)

Participation in WA105 (CERN Neutrino platform) : double phase Liquid Argon R&D

In view of possible future participation in LBN experiment in the US.

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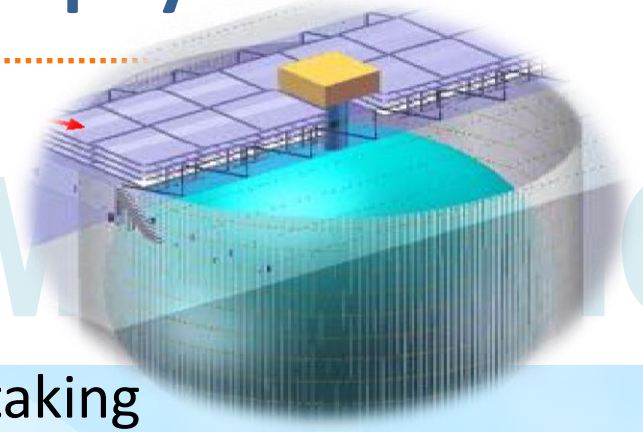
Neutrino Physics and Astrophysics



Neutrino Physics at Reactors

Double Chooz: construction completed - data taking
resume with 2 detectors – 10% precision expected on Theta13

Participation in JUNO (3 sigmas expected Mass Hierarchy in 6 years)
Use of OPERA Tracker + upgrade electronics

Neutrino spectrum anomaly (Sterile Neutrinos?)
NUCIFER (CEA), STEREO experiment at Institut Langevin in Grenoble,
Small participation in SOLID (Belgium)

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Neutrino Physics and Astrophysics

Dirac or Majorana ?

Double Beta Experiments

SuperNemo : demonstrator in construction (end 2015). Expected start data taking mid 2016.

Various initiatives investigated in parallel : scintillating bolometers with LUMINEU in France, and LUCINEU with INFN

Dark Matter and Dark Energy

Direct Search for Dark Matter

Edelweiss III (Ge Cryo) : Fréjus underground laboratory (LSM).
New run started mid 2014 - towards 3000 kg.day
Extension of LSM still in discussion.

Small participation in Xenon 100 experiment. Xenon1T in construction at LNGS.
EU funding requested for DARWIN pre studies

Other initiatives such as the MIMAC experiment

Dark Matter and Dark Energy

Indirect search for DM and DE

Participation in the Planck mission + R&D (QuBic, R&D cryo-detectors)
Ongoing participations in Supernova Cosmology projects

LSST : Strong participation in camera construction (electronics, sensors, filter exchange mechanism) and science preparation within LSST DESC

Euclid : participation in the construction NISP instrument, and science preparation within Euclid consortium

DESI : currently small participation – may increase

IN2P3
The two infinities

UNIVERSE'S COMPOSITIO

Thank you

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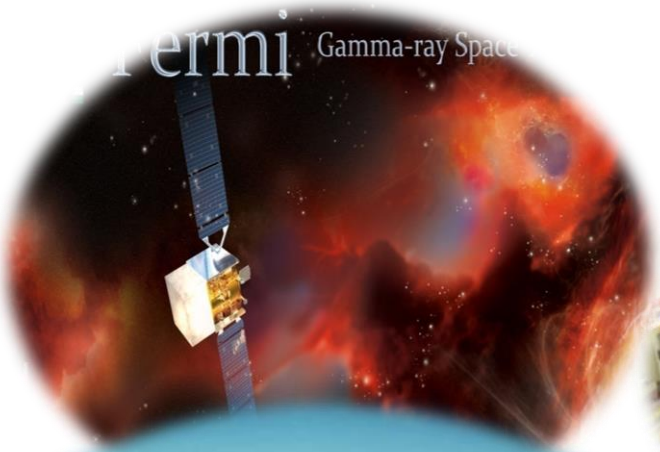
ermi
Gamma-ray Space