

Astroparticle and Neutrino

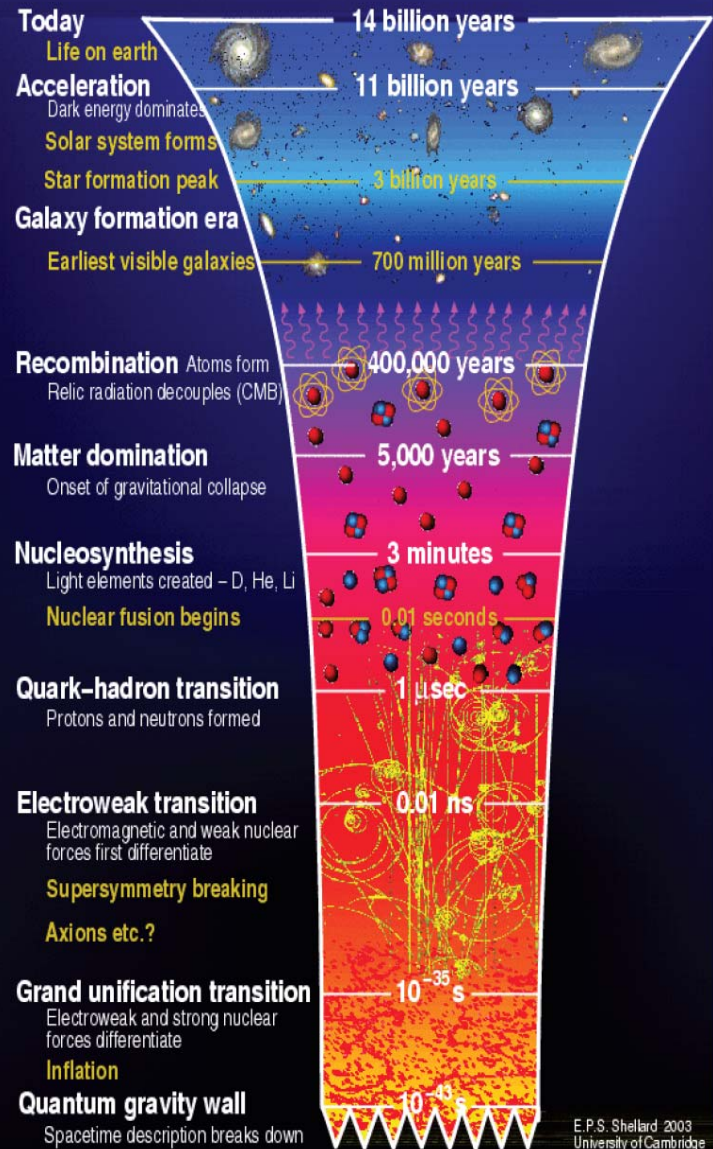
S. Katsanevas

Scientific Council IN2P3

5 Mai 2011



The 3 themes of Astroparticle Physics



What is the Universe made of?

I. CMB and Inflation

II. Nature of dark matter

III. Nature of dark energy

Understand cosmic accelerators and their role in the formation of cosmic structures. Probe for new particles or violations of fundamental laws.

IV. High energy cosmic messengers (γ , ν , CR)

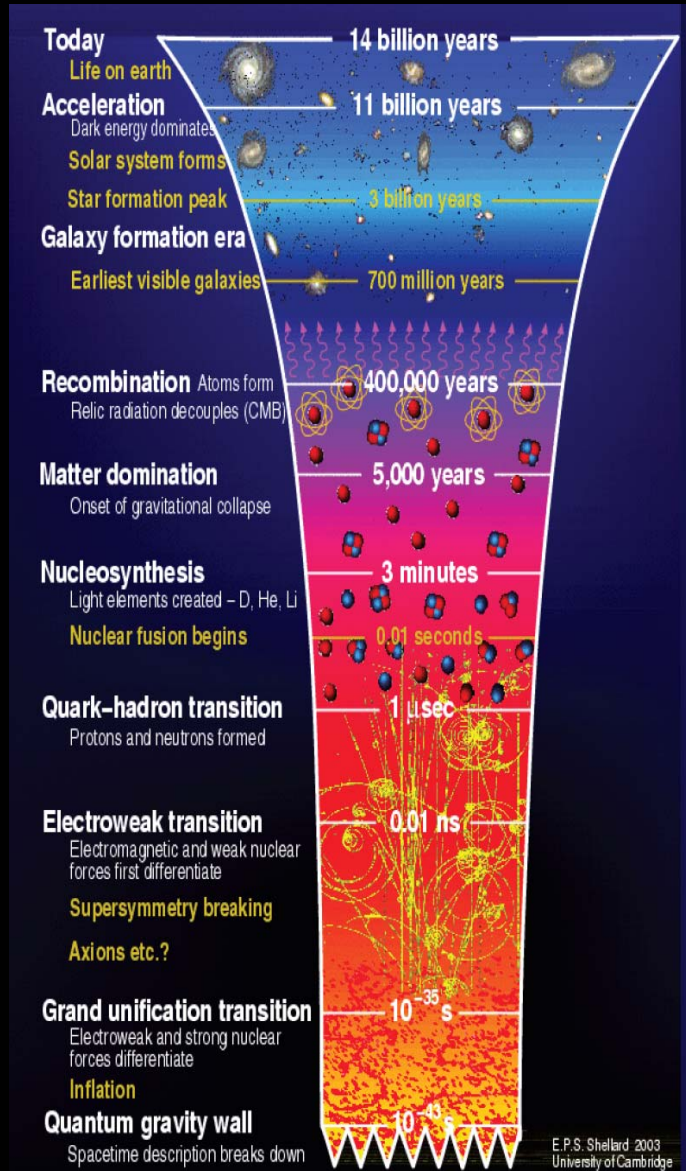
V. Gravitational waves

Probe matter and interactions at the highest energies beyond those of accelerators, through rare decays.

VI. Neutrino mass

VII. Proton lifetime and neutrino properties

The 3 themes and IN2P3 projects



What is the Universe made of?

- I. PLANCK R&D bolometers (QUBIC)
- II. EDELWEISS, Xenon EURECA, Xenon Xt
- III. SNF, SNLS, BOSS LSST, EUCLIDE

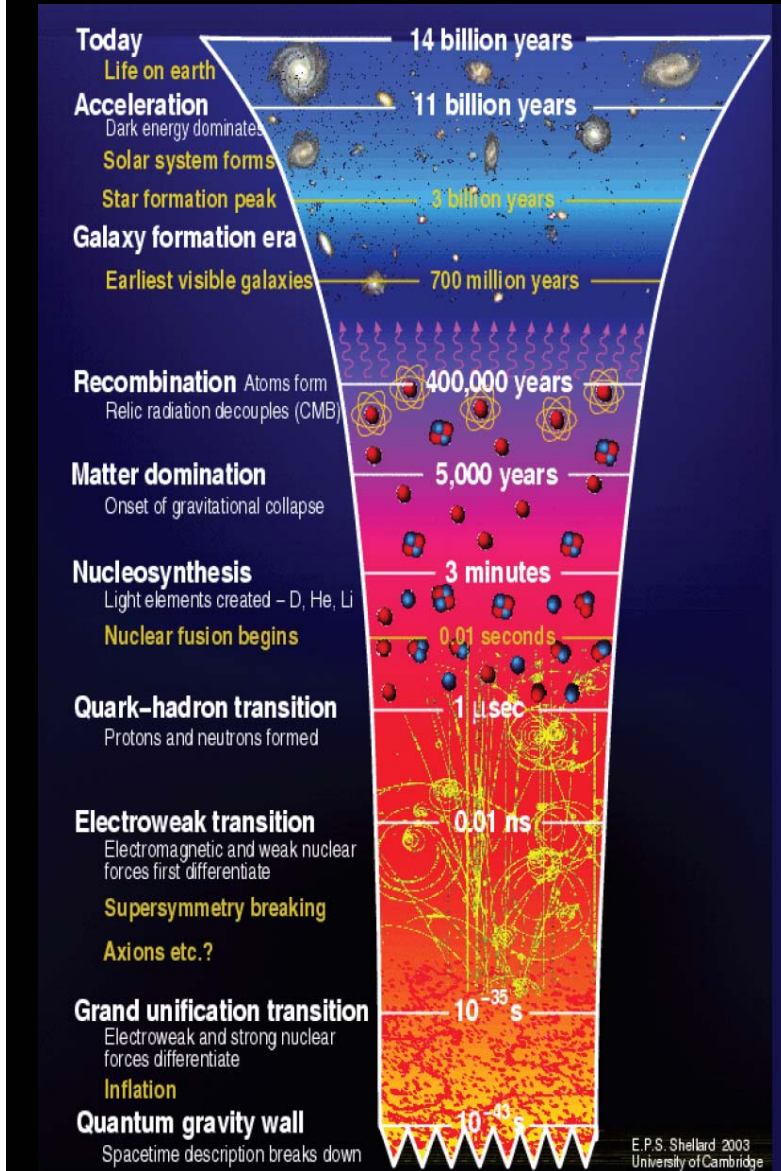
Understand cosmic accelerators and their role in the formation of cosmic structures. Probe for new particles or violations of fundamental laws.

- III. AUGER/AMS R&D radio, EUSO, LHAASO
- IV. HESS/FERMI CTA
- V. ANTARES KM3
- VI. VIRGO/LISAPF advVIRGO, (LISA, ET)
- VII. GRANIT

Probe matter and interactions at the smallest scales or highest energies beyond those of accelerators, through rare decays.

- VII. NEMO SuperNEMO
- VIII. OPERA/DCHOOZ/T2K R&D Mt

The 3 themes and infrastructures



What is the Universe made of? Probe matter and interactions at the smallest scales or highest energies beyond those of accelerators, through rare decays.

I. EURECA/SuperNEMO Extension LSM

Understand cosmic accelerators and their role in the formation of cosmic structures. Probe for new particles or violations of fundamental laws.

II. ANTARES

MEUST

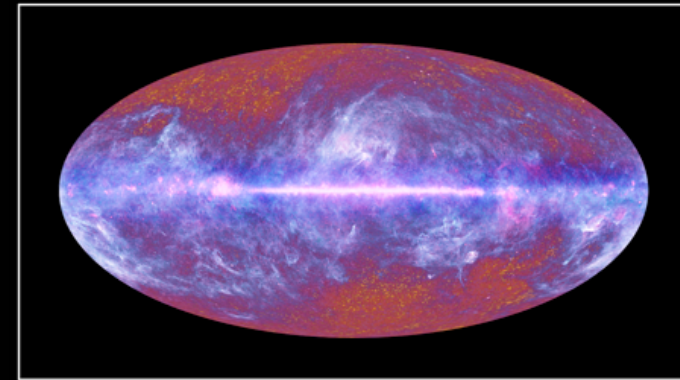
III. advVirgo

EGO/LMA

LSM/MEUST exhibit a very rich interdisciplinary potential: geosciences, environment, ...

Cosmology I (CMB+DM)

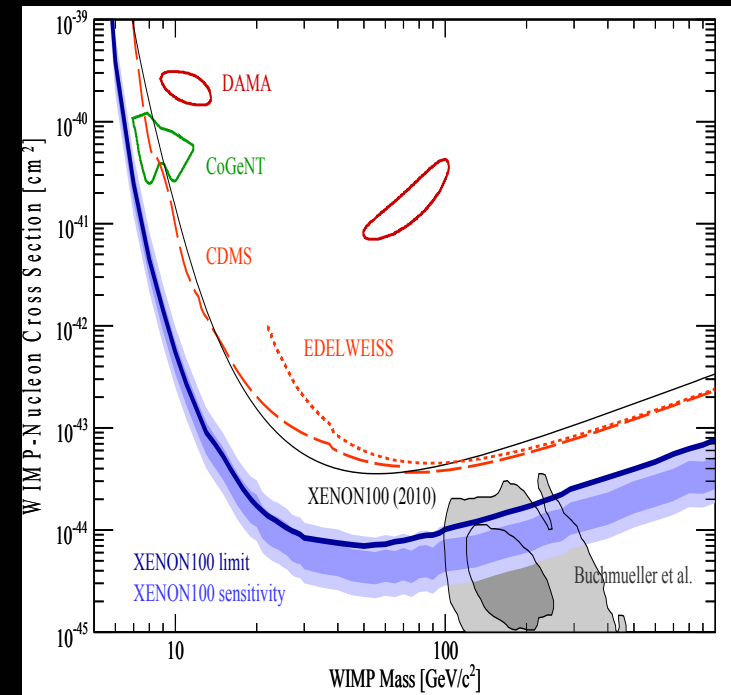
- CMB Planck:** First maps of the sky published.
 - Cosmological parameters will be published early 2013
 - R&D for Bolometer matrices high priority in a national context (IN2P3, INP, INSU, CEA) in preparation of a large CMB polarisation project*
 - Smaller projects to be examined by the CS (QUBIC)
- DM1 EDELWEISS:** New publication in March.
 - Goal: 3000 kgdays in 2012 or $< 5 \times 10^{-9}$ pb and test of techno for EURECA
 - Discussions with CDMS, towards merging of statistics (more if affinities...)
 - Decision in 2012-2013 for EURECA*
- DM2 Xenon (Subatech):** New Publication in April, sensitivity 7×10^{-9} pb
 - Xenon Xtons in LSM ?*



La carte intégrale du ciel par Planck

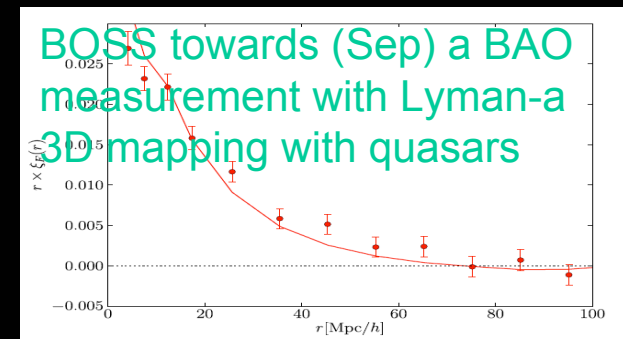
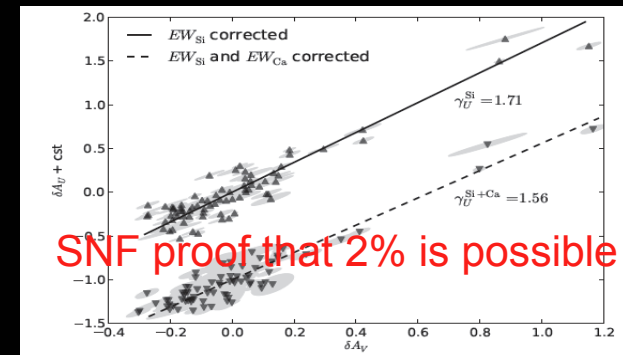
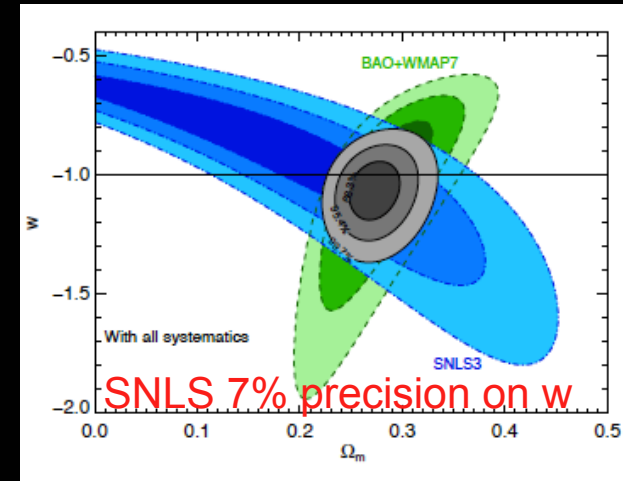


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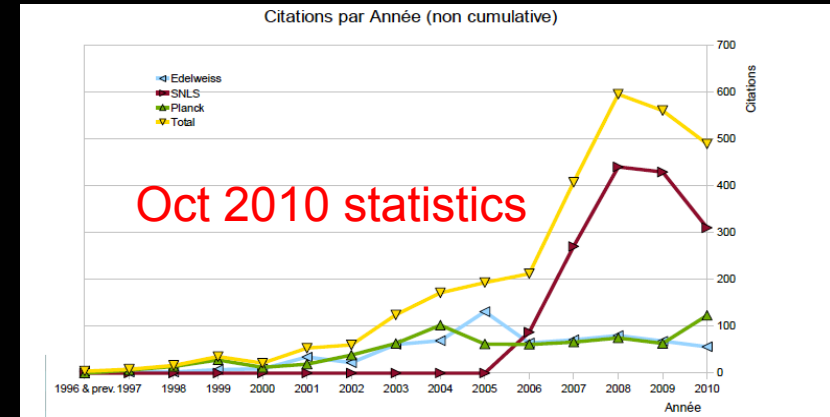
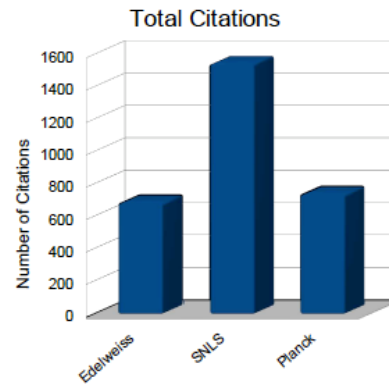
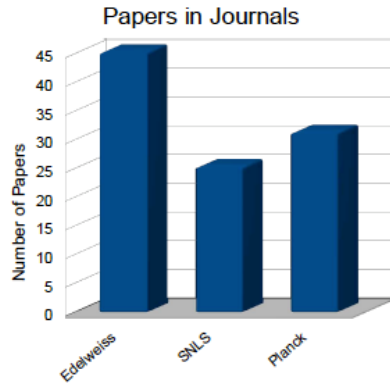


Cosmology II DE

- **SNF/SNLS** : New notable publications in March/April
 - End of data taking. Only analysis in progress
 - Very high visibility (Snae probe world experts)
- **BOSS** (First publications) □ BAO analysis in September
 - *Small scale participation in “intermediate” BAO projects BigBOSS or SUMIRE ?*
- **LSST** First priority of US Decadal survey 2010
 - IN2P3 only solidly established foreign partner □ CNRS (if funded by TGE)
 - Major contributions in electronics and focal plane (reviewed by previous CS, -filters)
 - *LSST is a very high priority*
- **Euclide** Good priority in ESA cosmic vision
 - IN2P3 contributions
 - Expertise in NIR detectors, focal plane
 - Data Centre and analysis
 - Key role in interface with Berkeley team becoming a key subcontractor for the focal plane
- *CS could evaluate overall DE strategy in 2012-2013*



Cosmology III



SNLS most cited paper after WMAP

Ressources

•Budget

- AP IN2P3 500 K€/year (+ANR, +CNES)
- LSST in TGE (300 K€) for 2010, 0 K€ 2011-2012

•Personnel (FTE) 150 (4K€/FTE)

- DE: 60 , CMB: 45, DM: 30, Other cosmo: 15

Milestones

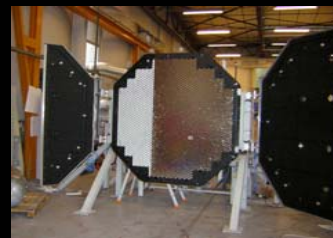
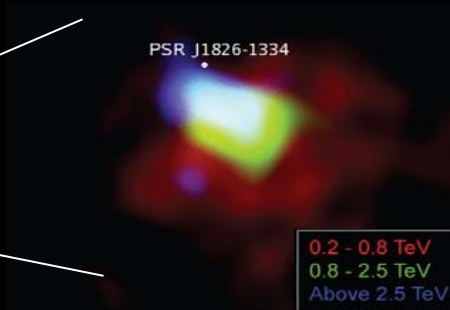
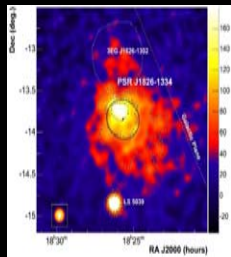
- Euclide 2011
- EURECA/LSST 2013 (BUT for LSST MOUs etc starting now)

New Messengers I

HESS (2004)

- >100 sources, detailed studies □
- 50% corresponding authors IN2P3

HESS2 (2012) Camera finished, telescope in construction



•FERMI (2008)

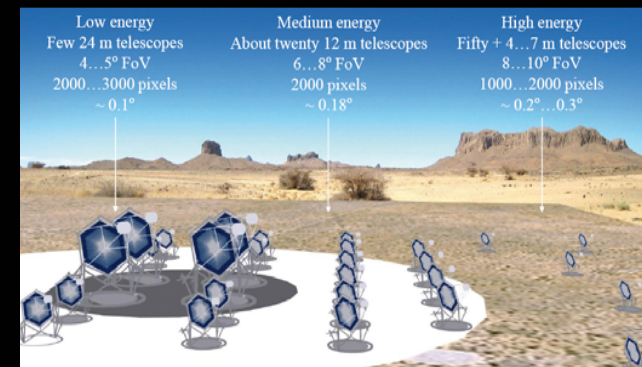
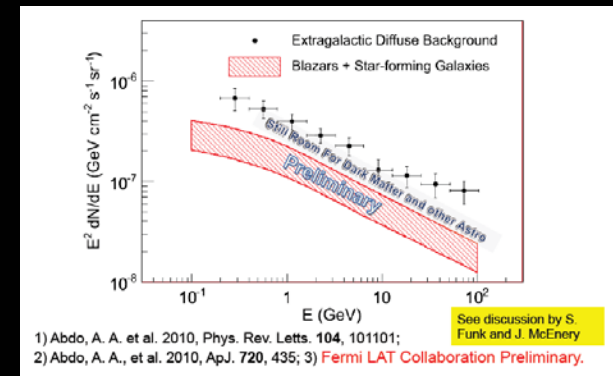
- Towards 100 publications/year, ERC grant (Lemoine)

- 50% publications corr. author. IN2P3, CC-IN2P3 only CC outside SLAC

•CTA (2015-2020), DS (ASPERA), PP(FP7)

- Cost 200-250 M€ ,Project Manager IN2P3
- First meeting of RRB April 2011
- Start of Construction 2014-2015

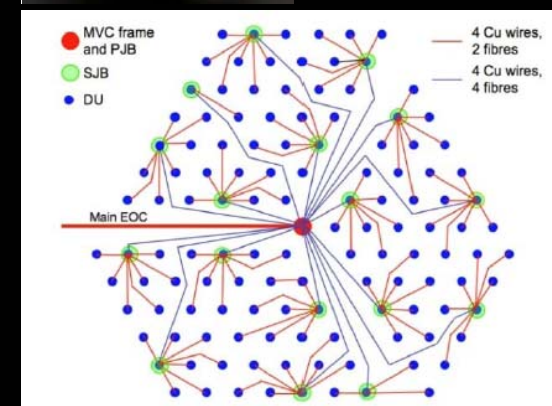
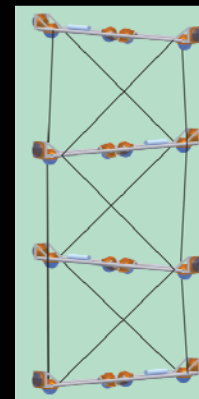
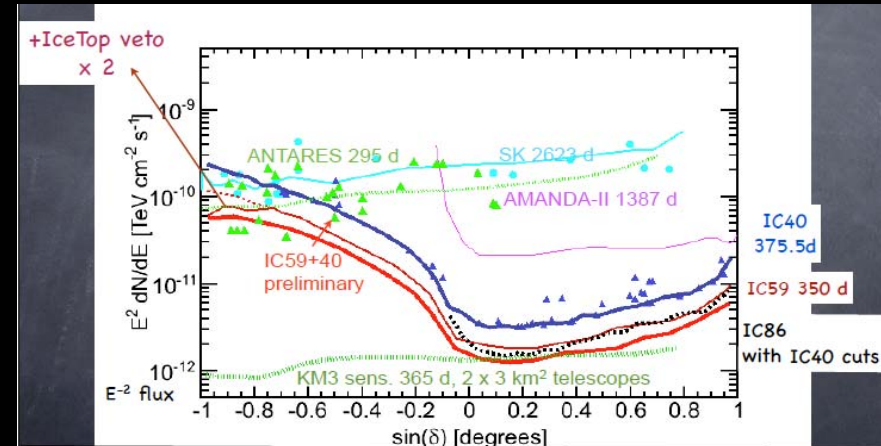
Review of HESS2 and contributions to CTA in 2012



New Messengers II

- ANTARES (2008)
 - ANTARES first publications explore uncharted territory
 - Very rich interdisciplinary potential
- KM3net (2015-2020) DS(FP7), PP(FP7)
 - KM3net TDR released, main design
 - Multisite option considered (At least 2 units of 100 strings each)
 - Cost 100 M€/unit
 - Regular RRB meetings
- MEUST: prototype phase of KM3net in France
 - Budget 8 M€ secured (of which 4M€ CNRS). Towards doubling the sum with regional money and foreign contributions.
 - The full project (23 M€) includes a Marine Science Technology Centre (INSU priority) and synergies with EMSO

Examine MEUST and future in 2012-2013



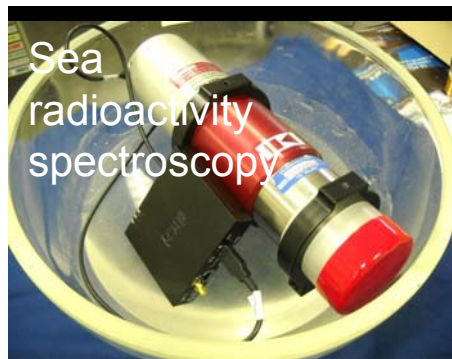
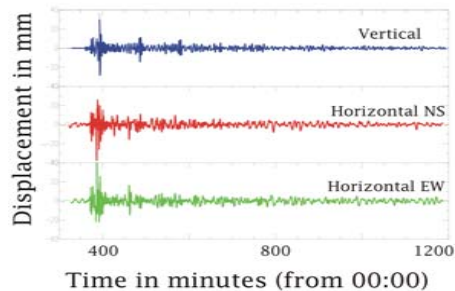


The ANTARES community is pioneering deep-sea pluridisciplinary observatories with continuous Gbit/s link

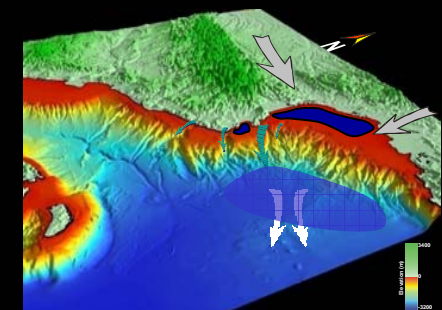
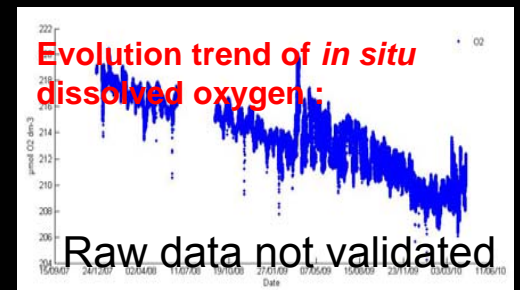
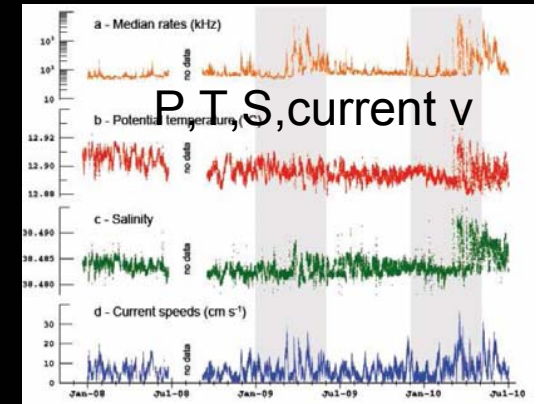
ListentotheDeep.org



Japan earthquake 2011 March 11 at Antares site



Single photon, micron resolution, 10kHz repetition rate camera



Deep water formation brings nutrients to the deep (increase bioluminescence)

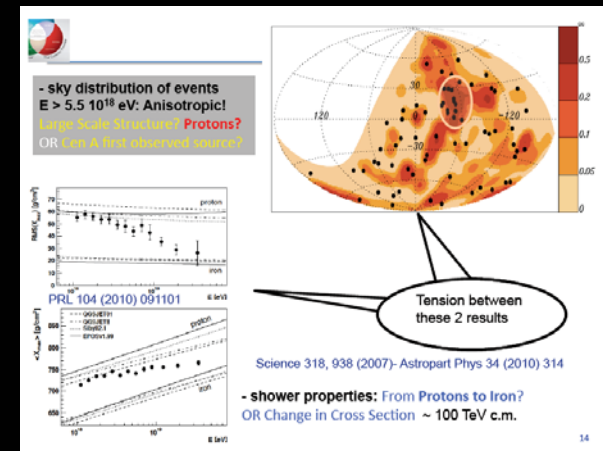
New Messengers III

- AUGER (2008)
 - « GZK like » cut, no top down models, but new mysteries (anisotropy composition)
 - Very IN2P3 visibility
 - No AUGER-NORTH in the US, so ?
 - R&D Radiodetection (MHz and GHz)
 - JEM-EUSO (electronics) decisions in 2011?
 - Interest by some for LHAASO

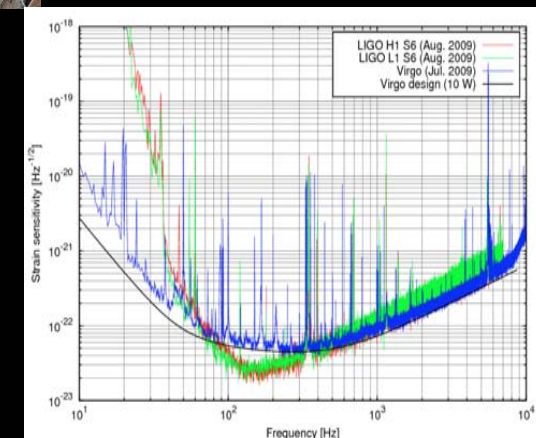
The CS should examine the UHECR strategy in 2012

AMS: At the launching pad (12 May 2011?)

- VIRGO (2008) Adv Virgo 2015
 - VIRGO world sensitivity, operating in network with LIGO
 - AdvVIRGO approved in 2009 . First detection expected in 2016-2017
 - First priority in TGE (letter INSU/IN2P3 to A. Fuchs)
 - Update of the TDR expected for May 2011
 - Annual cost EGO/VIRGO 10 M€ (50% CNRS) . Extra cost 16 M€ (50% CNRS). Importance of LMA.

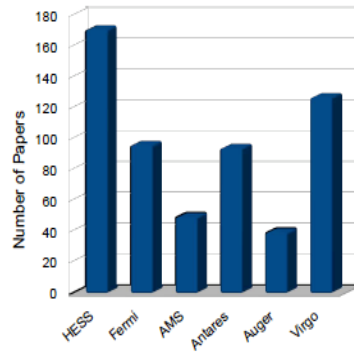


Also towards
LISAPathFinder
launch in 2013

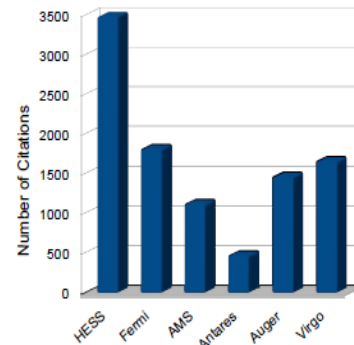


High Energy Messengers IV

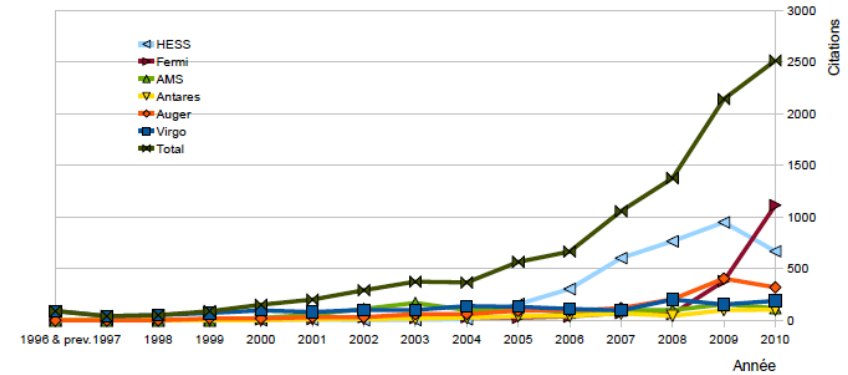
Papers in Journals or Proceedings



Total Citations



Citations par Année (non cumulative)



2500 citation/ year in Oct 2010 HESS/Fermi citation drivers

Ressources

•Budget

- AP IN2P3 1500 K€/year (+ANR)
- VIRGO/HESS2 in TGE (5-6 M€)

•Personnel (FTE) 200 (7,5K€/FTE des AP)

- HESS/CTA/FERMI: 55 , Grav: 55, Auger/AMS: 56, Antares: 30, Other: 15

Milestones

Decisions on construction funding CTA, KM3net 2013-2014

Neutrino I

- OPERA (2008) $\nu_\mu \rightarrow \nu_\tau$
 - First candidate seen. More ? Surprises ?
 - By end of 2012 90% of nominal beam will have been delivered

Continuation in 2014? An issue for the CS in 2013

- DCHOOZ (2011), $\nu_e \rightarrow \nu_e$
 - Data taking since 10 days
 - Ground breaking for Near Station Imminent (ASN permission) for a near detector ready by end 2012
 - First results (> CHOOZ) in September TAUP

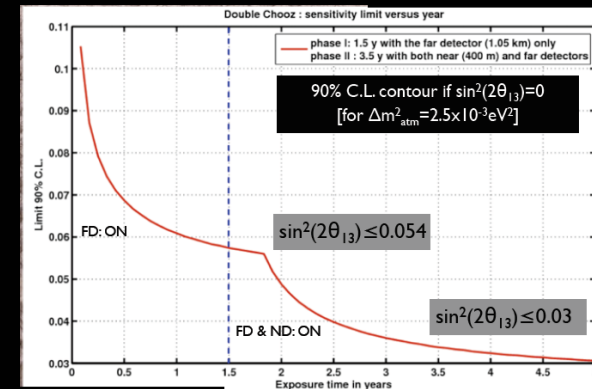
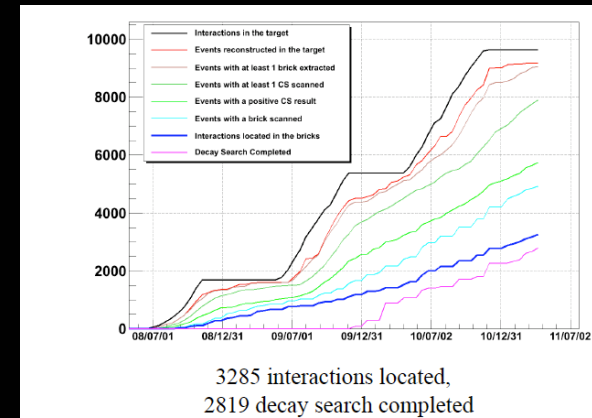
- T2K (2010) $\nu_\mu \rightarrow \nu_e$

- First analyses presented on 20% of events collected till the earthquake. 150 kW beam achieved.

- Restart November 2011?

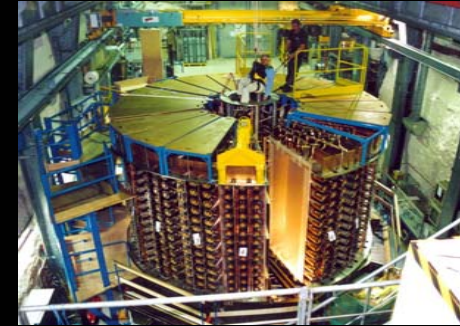
In 2013 first hints for value of θ_{13} will show the way
IN2P3 is part of the LAGUNA and LAGUNA-LBNO DS .

R&D in Mt detectors (PM Arrays, LAr electronics...). Full study of Mt excavation in Fréjus.
CERN \square Fréjus with betabeam a scenario under study (>2020)



T2K-SK events	Data	MC		Acc. BG (12JIS window)
		No oscillation	With oscillation and $\theta_{13}=0$	
Fully-Contained	33	54.5	24.6	0.0094
Fiducial Volume, $E_{\nu} > 30\text{MeV}$	23	36.8	16.7	0.0011
Single-ring e-like $P_e > 100\text{MeV}/c$	2	1.5 ± 0.7	1.3 ± 0.6	-

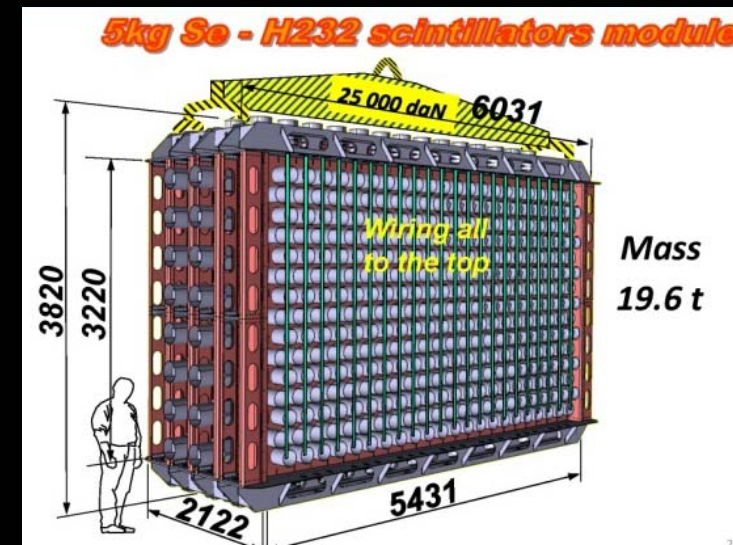
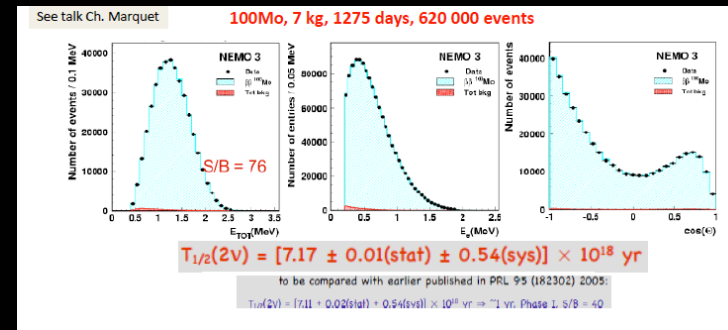
Neutrino II



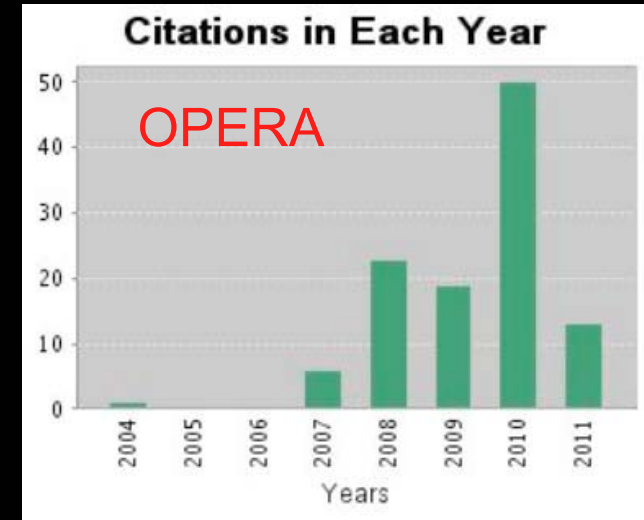
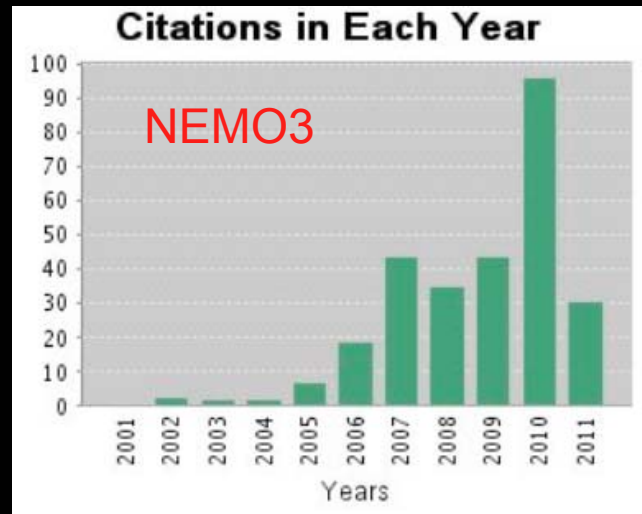
- NEMO3 (2003-2010)
 - Decommissioning 2011
 - SuperNEMO
 - 1st module
 - **This CS**

• Two associated issues:

- Can we fund the LSM extension ?
- Can we enrich Nd in large quantities ?



Neutrino III



Ressources

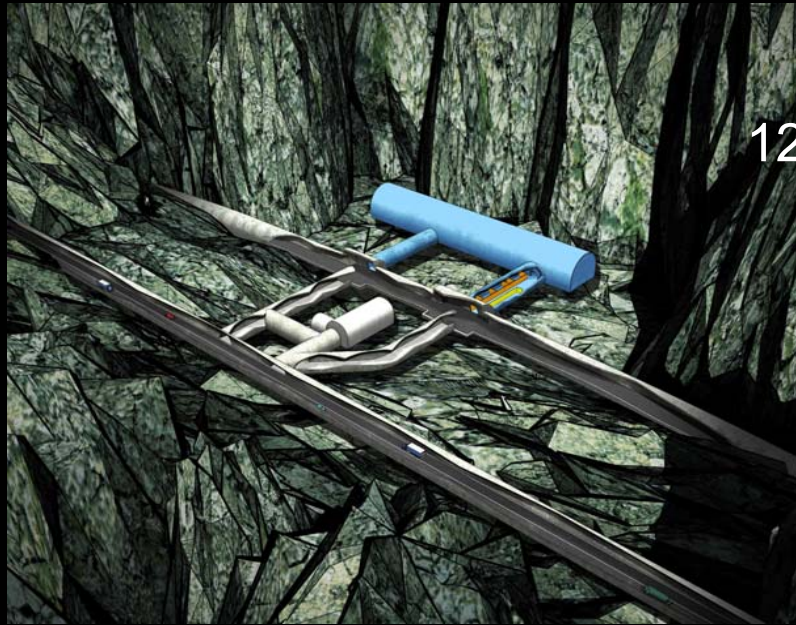
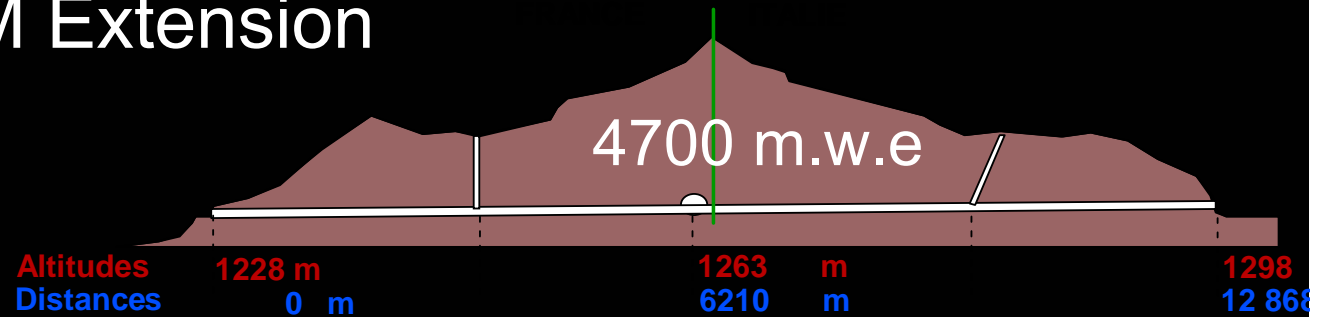
- Budget
 - AP IN2P3 750-1000 K€/year
- Personnel (FTE) 90 (10 K€/FTE des AP)
 - NEMO3: 26, OPERA: 23, DCHOOZ 15, T2K 15, Other neutrino: 11

Milestones

Decision on full SuperNEMO 2013-2014

Decision on next generation oscillation project 2014-2015

LSM Extension



Total Cost
19 M€

12 M€ civil engineering (Region, State, CNRS)
7 M€ (Equipment+ prototypes, EQUIPEX)

High Priority
for Region
and
IN2P3/CNRS
Milestone
End of 2011

Very large interdisciplinary potential: platform of very low radioactivity, for environmental studies (climatology, oceanography, glaciology, retro-observation, extreme biology and water quality studies) Applications in agro-alimentary chain, microelectronics etc.

European and Worldwide context

- ü EUROPE: Update of ASPERA Roadmap
 - ü Last conference Fall 2011 in Paris
 - ü Auxiliary work on Computing, Industrial procurement, Common R&D calls, synergies with geosciences, environment

- ü WORLD: Astroparticle Physics International Forum
 - ü First meeting in Paris April 2011
 - ü Attempt to coordinate agencies on institutional and funding matters, access, procurement, etc.

The 3 themes and IN2P3 Priorities (modulated by CS evaluations)

What is the Universe made of?

I. LSST

II. Dark Matter Strategy 2012-2013 (EURECA and/or Xenon)

III. R&D bolometer matrices and CMB polarisation

Understand cosmic accelerators and their role in the formation of cosmic structures. Probe for new particles or violations of fundamental laws.

III. Adv VIRGO (completion by 2015)

IV. CTA preparation (start construction by 2015)

V. KM3Net prototyping MEUST (decision by 2015)

VI. R&D Radiodetection and other experiment watch

Probe matter and interactions at the smallest scales or highest energies beyond those of accelerators, through rare decays.

VII. SuperNEMO 1st module and decision 2012-2013

VIII. Next oscillation neutrino exp decision 2014-2015

