Astroparticle Physics for Europe

ASPERA

ASPERA
Astroparticle Physics
European Research Area
Network

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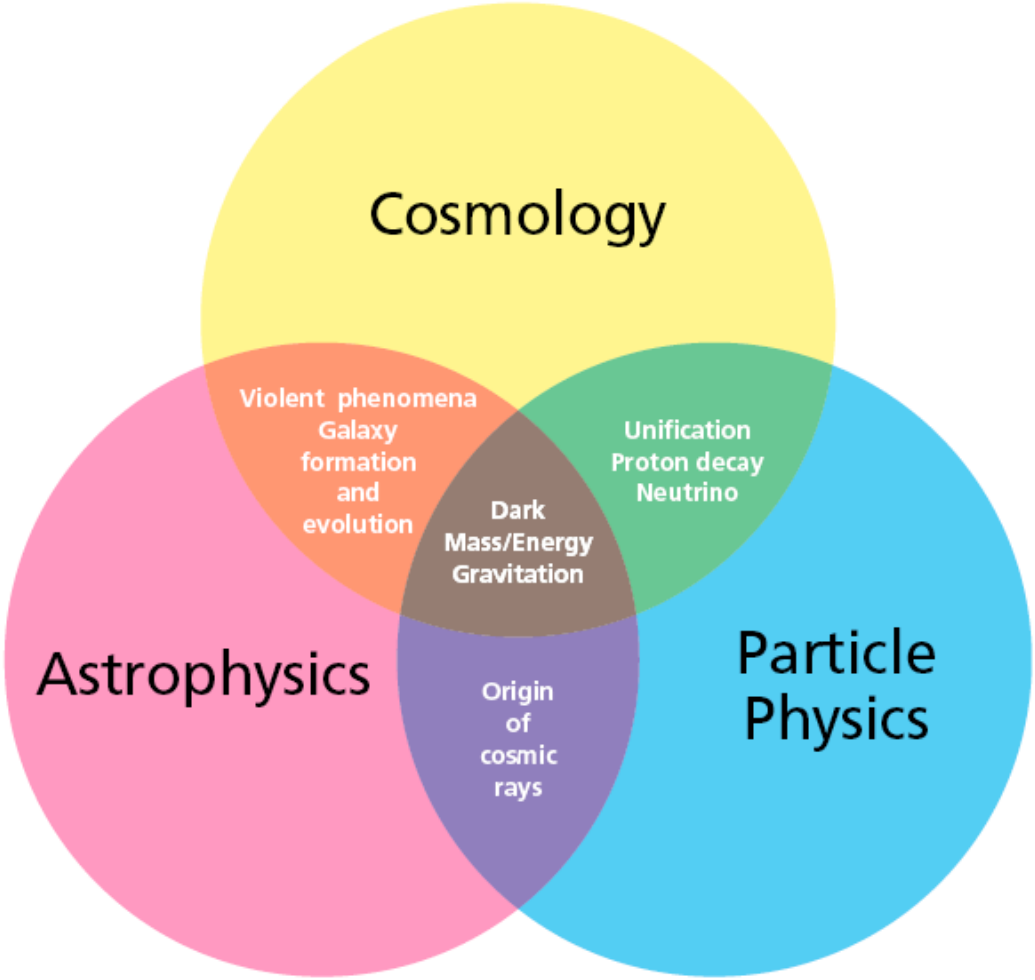
JENAM 2009

Hertfordshire 20 April



Or how to establish a sustainable European coordination in an interdisciplinary domain

What is ASPERA ?

Astroparticle Physics for Europe

ASPERA

'per aspera ad astra'

- **ASPERA-I FP6 ERANET**
  - **(July2006-July2009, 2.5 M€)**

- **Study APP personnel and funding**
  - **2500 researchers and 70 M€/year**
  - **A study on the emergence of the field**

- **Roadmap for R&D + Infrastructures**
  - **A European Strategy document**
  - **A document on R&D**

- **Linking of existing infrastructures**
  - **Underground laboratories**
  - **Theory centres?**

- **Common call for R&D/Design studies**
  - **Launched 2nd April 2009**
  - **Funding in Autumn 2009**

- **Common outreach, databases, portal, …**

www.aspera-eu.org

14 countries +CERN

Associates:

- **Slovenia**
- **Croatia**

Key questions of AstroParticle Physics (APP)

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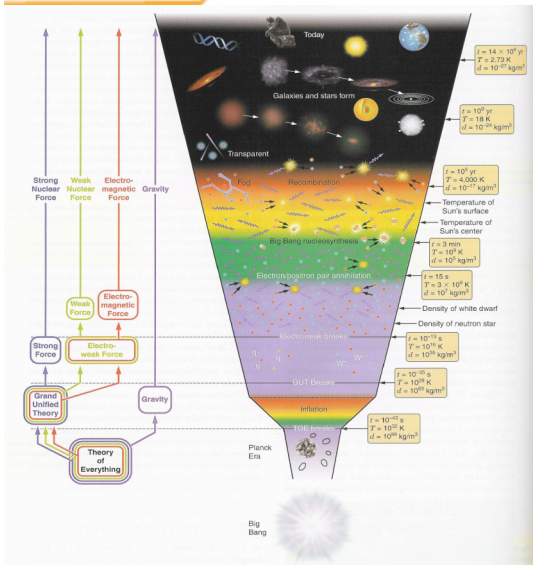
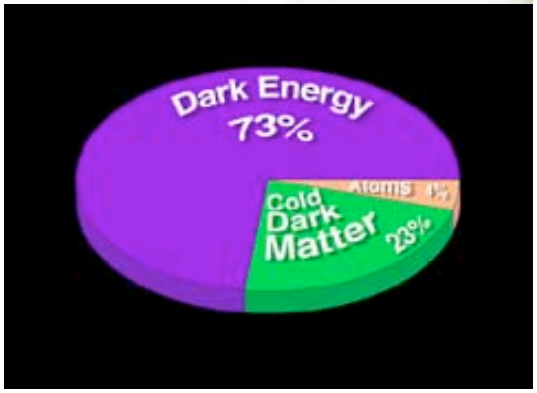
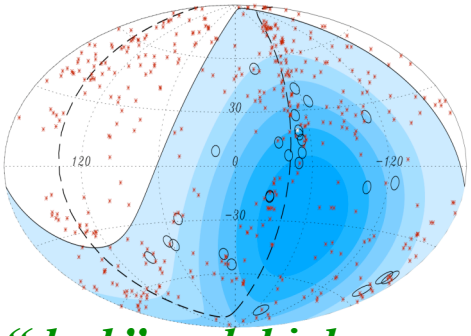
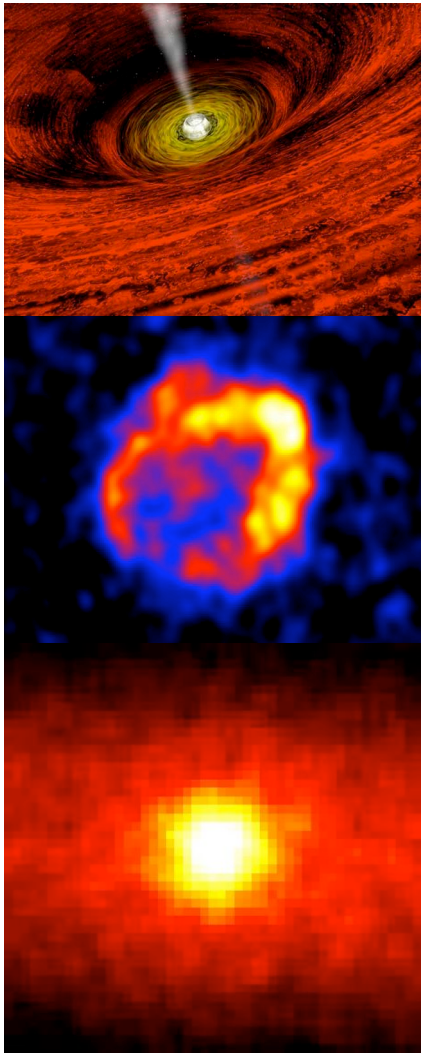




✓What is the Universe made of ?
✓Do protons have a finite lifetime ?
✓What are the properties of neutrinos and what is their role in cosmic evolution ?

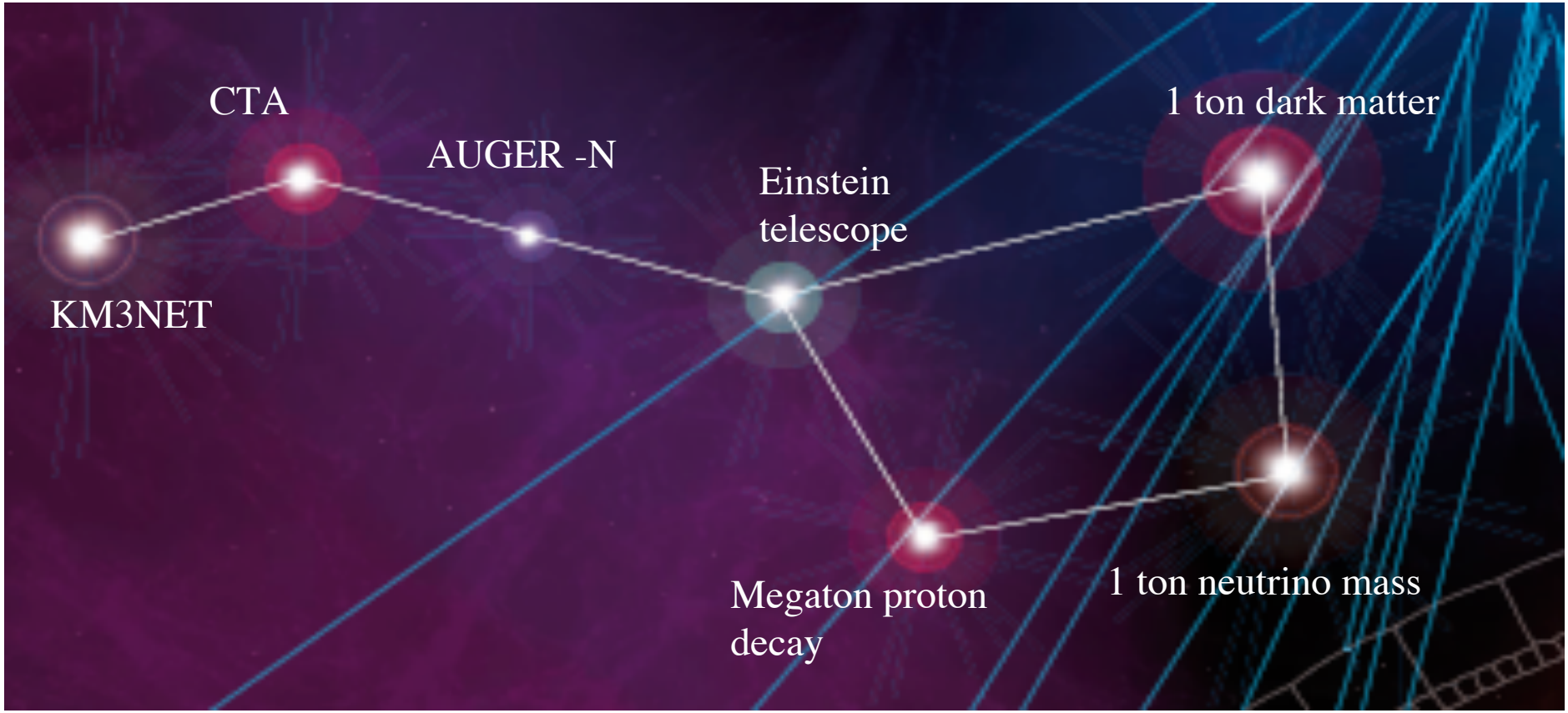
✓What is the view of the sky at extreme energies ? What is the origin of cosmic rays?
✓What do neutrinos tell us about the interior of the Sun and the Earth, and about Supernova explosions ?
✓What will gravitational waves tell us about violent cosmic processes and about the nature of gravity ?





Methodology: understand the primordial, "dark" and high energy Universe by using
new messengers : VHE γ , neutrinos, gravitational waves, particles, hypothetical dark matter particles
rare processes : rare radioactive decays, proton decay, dark matter interactions…

Roadmap priorities: the magnificient seven



High Energy Universe infrastructures

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European context (ASPERA,ASTRONET, ESFRI)

I. Neutrino telescope in the Mediterranean (KM3Net)

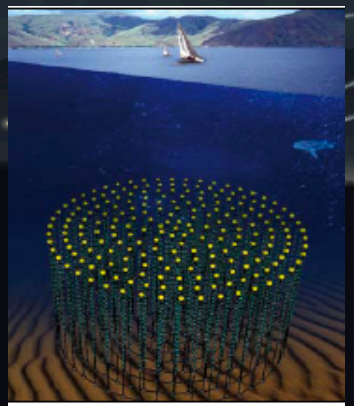
II. High Energy Gamma Ray Cherenkov Telescope Array (CTA)

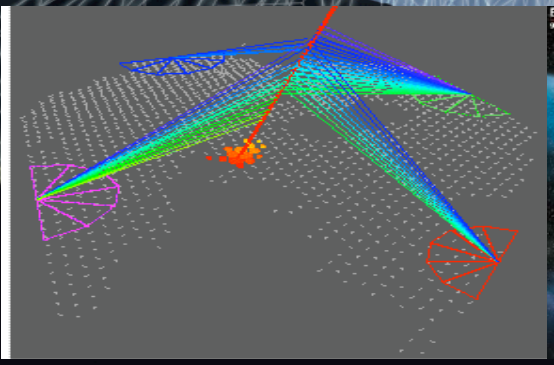
International context (US Decadal Survey, GWIC roadmap)

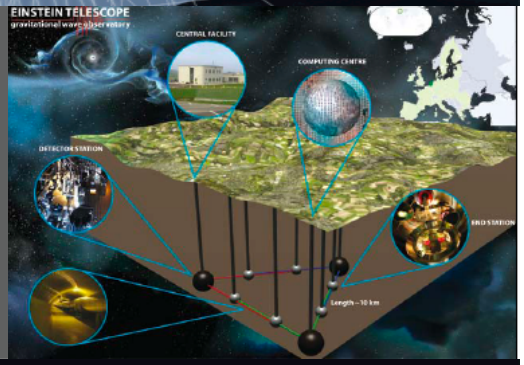
I. Beyond the Auger South Observatory (Auger-North)

II. Einstein Telescope for gravitational wave detection (ET)

Complementary to a space program (FERMI, JEM-EUSO, LISA)







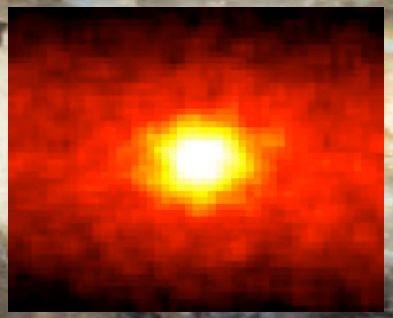
Underground Science large infrastructures

European context

In order to study rare processes on needs to go underground

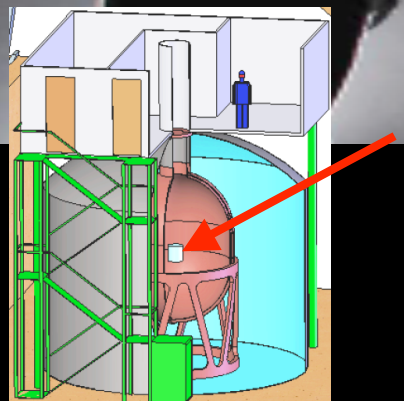
V. Dark matter detectors towards the ton (bolometers, noble liquids)

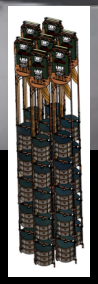
VI. Neutrino mass detectors towards the ton (calorimeters, tracking calorimeters)

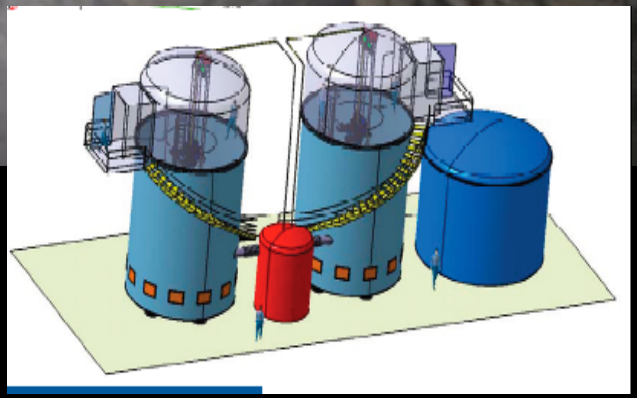


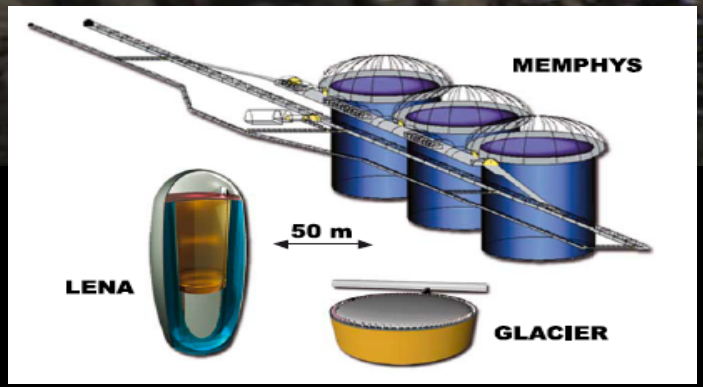
International context

VII. Proton decay and neutrino (astro)physics towards the megaton scale (water, liquid scintillator, liquid argon)







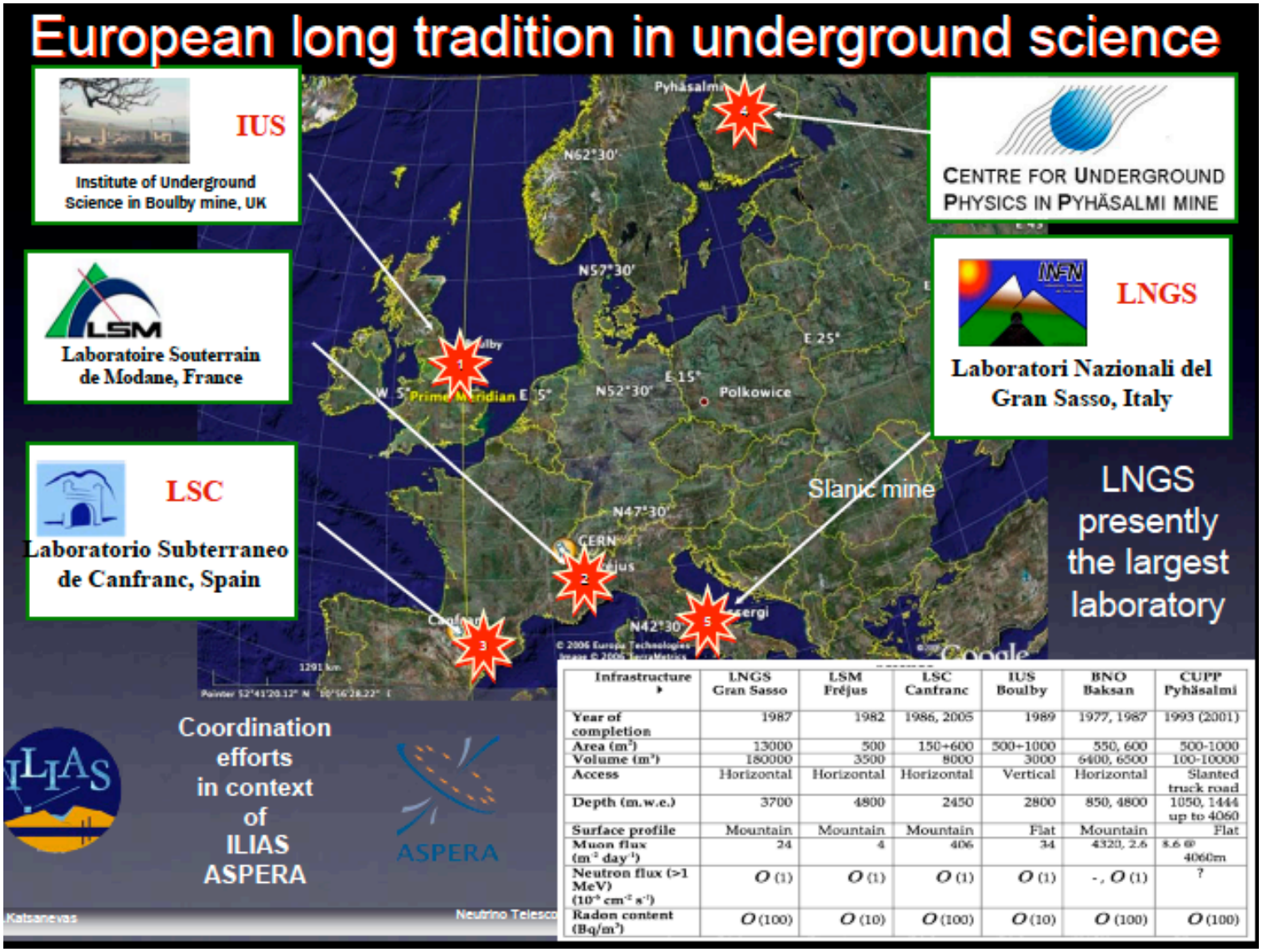


Linking of Underground labs

Close ties in the context of ILIAS

Preparing a closer coordination in a distributed platform scheme: EULABS

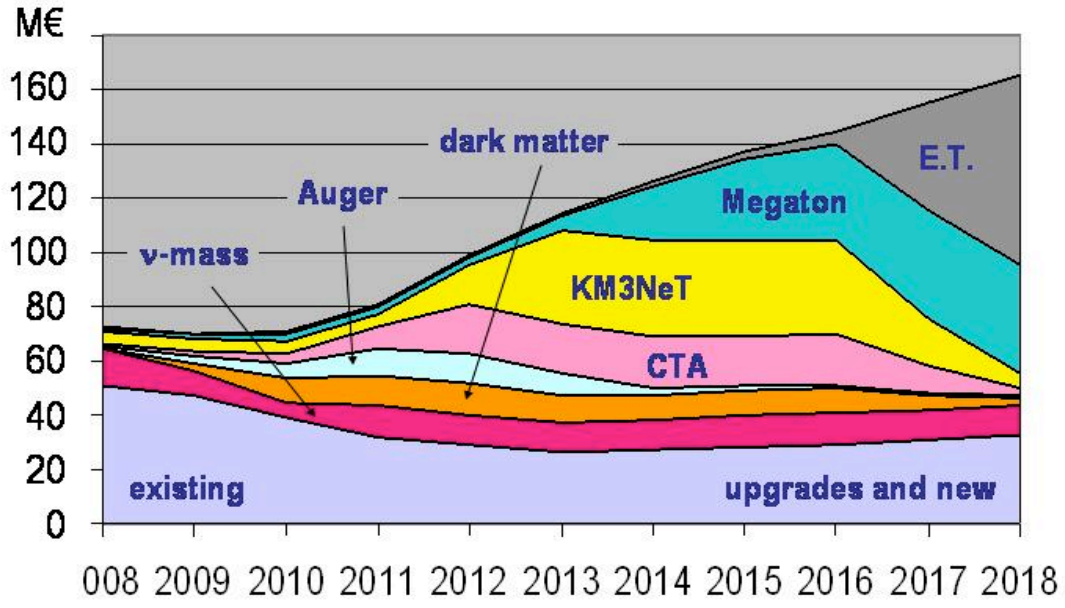
New labs emerging (Poland, Romania) Overall potential evaluated in the context of LAGUNA (FP7 DS)



Infrastructure	LNGS Gran Sasso	LSM Fréjus	LSC Canfranc	IUS Boulby	BNO Baksan	CUPP Pyhäsalmi
Year of completion	1987	1982	1986, 2005	1989	1977, 1987	1993 (2001)
Area (m²)	13000	500	150+600	500+1000	550, 600	500-1000
Volume (m³)	180000	3500	8000	3000	6400, 6500	100-10000
Access	Horizontal	Horizontal	Horizontal	Vertical	Horizontal	Slanted truck road
Depth (m.w.e.)	3700	4800	2450	2800	850, 4800	1050, 1444 up to 4060
Surface profile	Mountain	Mountain	Mountain	Flat	Mountain	Flat
Muon flux (m^{-2} day^{-1})	24	4	406	34	4320, 2.6	8.6 @ 4060m
Neutron flux (>1 MeV) (10^{-6} cm^{-2} s^{-1})	O (1)	O (1)	O (1)	O (1)	-, O (1)	?
Radon content (Bq/m³)	O (100)	O (10)	O (100)	O (10)	O (100)	O (100)

Timeline and budget

- *By 2012 start the construction of* :
  - *CTA and KM3net*
    - 200 M€ scale projects
- By *2012 milestone for technology decision of:*
  - *One ton dark matter and neutrino mass* detectors
    - 50-100 M€ scale projects
- Discuss with international partners the realisation of
  - *Auger North* in US (2012?)
    - For Europe 30-50 M€ scale project
  - *Megaton detector* ***(Japan, Europe, US,…)***
    - Total cost 500 M€ (>2015)
  - *Einstein Telescope*, GW antenna
    - Total cost 300 M€
    - Start of construction after first results of advVIRGO and advLIGO (by 2015)
    - Complementarity to LISA



- ✓Budget 50% increase over available European budget for astroparticle (700 M€/10 years)
  - ✓Share wth other continents
  - ✓Regional funding? (e.g. KM3Net)
  - ✓Stretch in time

The ASPERA common call

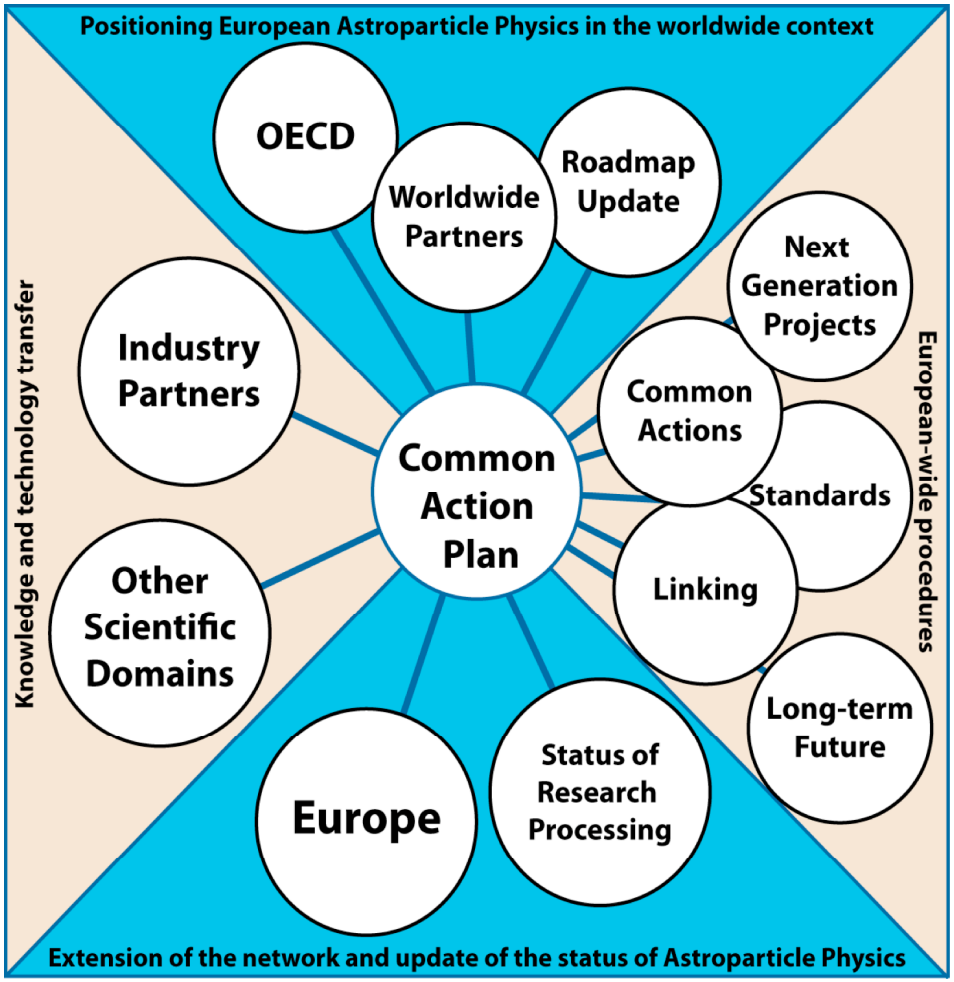
- **Targeted R&D and design studies in view of the realisation of:**
  - **Cherenkov Telescope Array for high energy gamma ray astrophysics**
  - **Direct dark matter searches**
- **Launched 2nd April 2009, deadline 4th of June 2009,**
  - **Start of contracts Autumn 2009**
- **Seven participating countries: Germany, France, Italy, UK, Netherlands, Spain, Poland**
  - **Proposals should involve at least 3 countries**
  - **Budget: 4 M€ (virtual pot)**
- **Pilot launch. Hope to launch 2 more common calls in context of ASPERA-2 for the preparation of the rest of the 7 magnificent**

What is ASPERA II ?

ASPERA-II FP7 ERANET (July 2009-July2012, 2.5 M€)

Goals

- Include more European countries
- Update the roadmap and coordinate with other continents
  - OECD (FALC?)
- Knowledge transfer
  - Synergies with other fields:
    - large networks, underground science
  - Industry
    - transfer innovating technologies
    - organize large procurements
- Accompany the realization of the roadmap
  - Joint programming
    - common program committees,
    - further common calls
  - Sustainable form of coordination



Towards global coordination

Astroparticle Physics for Europe

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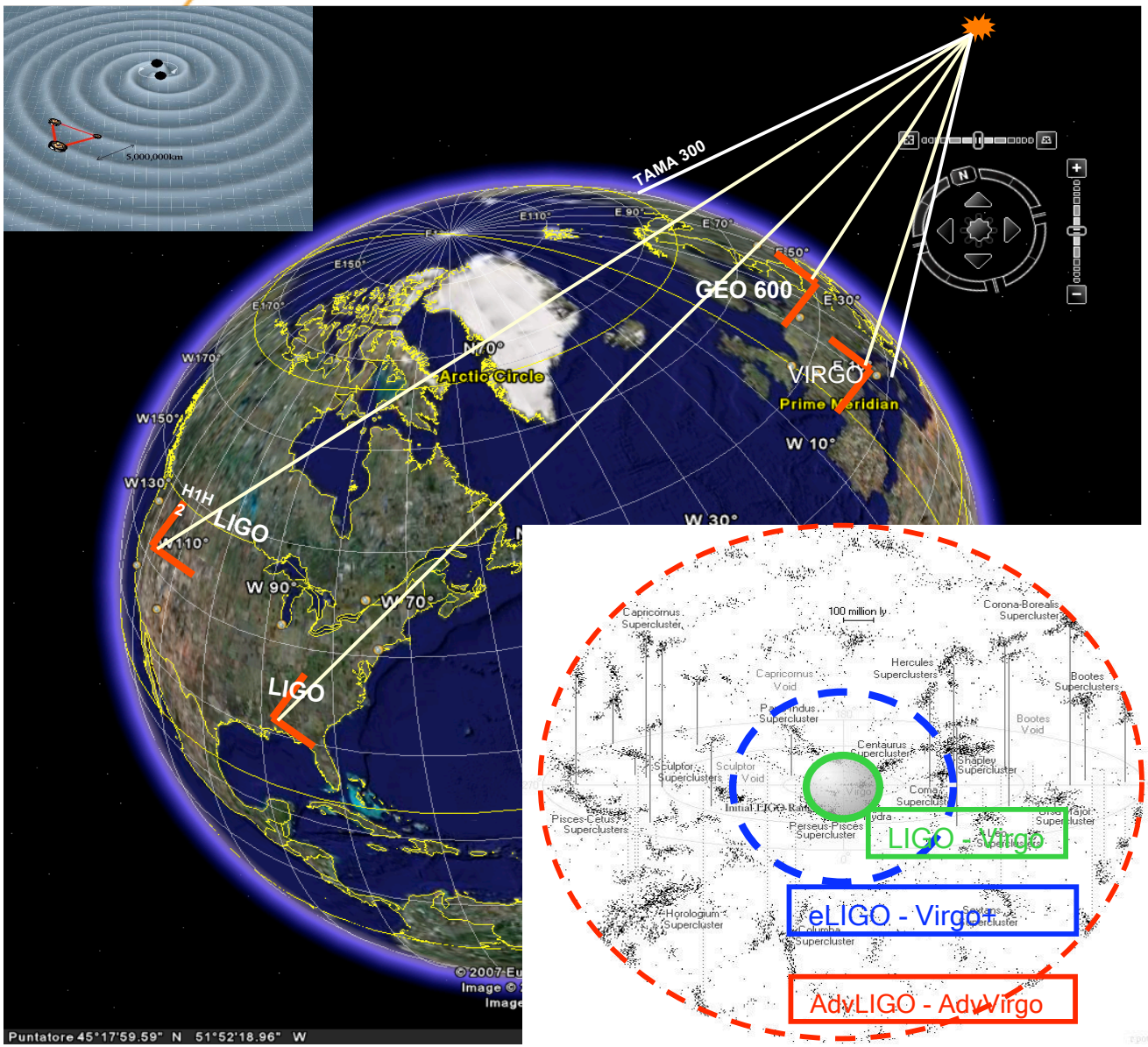


An inspiring example: World network of gravitational wave antennas:

- ✓ **Sensitivity increase**
- ✓ **Source direction determination**
- ✓ **Polarizations measurement**

Global coordination can be of 2 types:

1.Network e.g. GW antennas

1.A global infrastructure e.g. AUGER Observatory in Argentina

✓OECD Global Science Forum study on Astroparticle Physcs in progress. would give its results by 2010.

OECD roadmap

The project would be completed in two years, and would be divided into two phases:

- **Phase 1: would be completed in approximately one year (fall of 2009). The topics listed below would be addressed and described in a brief (20 pages) policy-level report.**
  - The definition of the field and a description of its links to neighbouring scientific domains
  - The major scientific challenges in the field, and the types of equipment and facilities .
  - Existing and proposed large experimental projects and facilities world-wide,
  - The processes through which plans and priorities are made and through which projects are funded, managed and assessed.
  - International cooperation in the field, including potential benefits, opportunities and obstacles

  At the conclusion of the first phase, the results would be reviewed by the Global Science Forum, and a decision made whether to proceed to Phase 2.
- **Phase 2: would last approximately one year (fall of 2010). The principal activity would be the creation of a consensus global roadmap for astroparticle physics for the next 10-15 years. This document would enumerate a set of large facilities, with preliminary cost estimates, priorities assigned, and in an optimum time sequence for implementation. Opportunities for international coordination and cooperation would be identified, both in the conduct of the research, and in policy-making.**

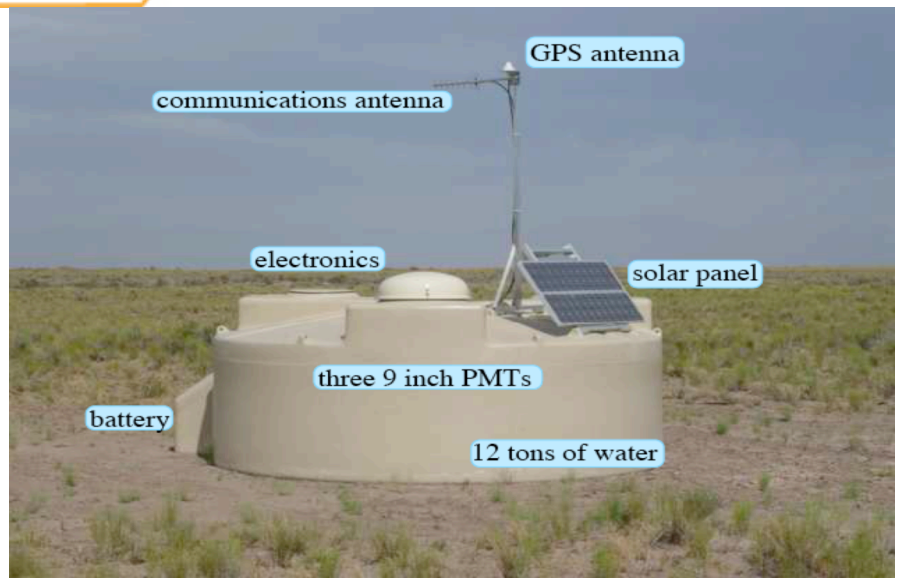
1st Meeting February 12-13 2009 , Paris, 4 WG formed,
Next meeting Cracow 14th of July

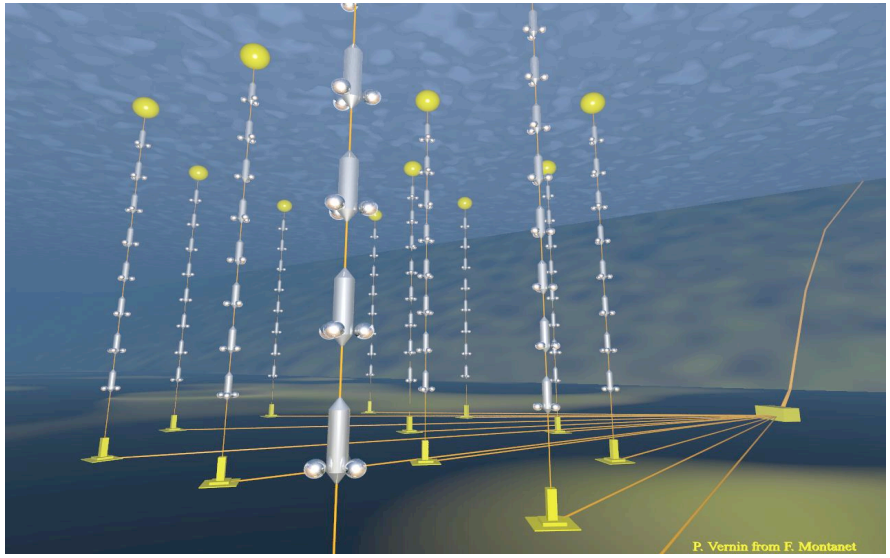
An opportunity :worldwide complementarities

- ✓ **Ultra High Energy Cosmic rays**
  - **Single global project :AUGER north , but also JEM-EUSO**
- ? **High Energy Gamma Ray Telescopes**
  - **CTA (EU) and AGIS (US)**
- ✓ **High Energy Neutrino Telescopes**
  - **ICECUBE and KM3net**
- ✓ **Gravitational wave antennas**
  - **advVIRGO/LIGO network ➔ Einstein Telescope ? (GWIC roadmap)**
- ? **Dark matter and neutrino mass detectors**
  - **Parallel efforts (ton scale masses will need worldwide sharing)**
- ? **Large undergound megaton scale detectors**
  - **DUSEL (US) , HyperK (Japan), LAGUNA (Europe, FP7), India**
  - **Related also to neutrino roadmaps (US, Japan and CERN)**
- ? **Dark Energy**
  - **Ground LSST(US) vs Space (ESA, NASA)**

- **Aggressive program in China, India, Corea**

Synergies with geosciences and environment





Astroparticle physics networks exhibit a natural synergy with climate and risk monitoring studies or geoscience observation networks. Since:

1)The atmosphere, the ocean and earth are both the target and detecting medium

2)Needs to deploy large variable geometry networks of autonomous "smart" sensors in sometimes hostile environments

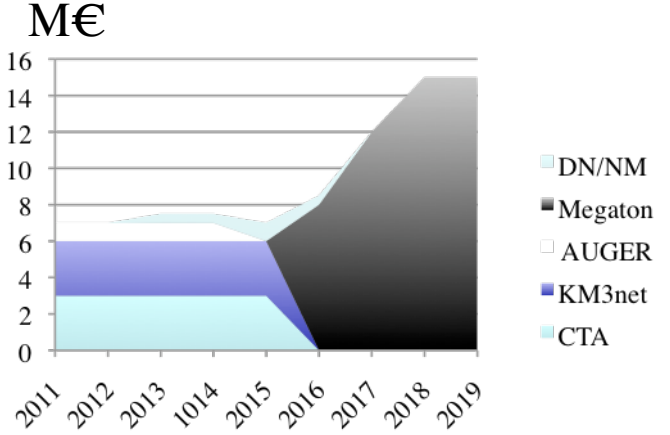
Compare e.g. the AUGER array of 1600 measuring stations covering 3000 km^2 in the Argentinian pampa or ANTARES (later KM3net) with ocean floor and sismic networks (EMSO, EPOS) or US geoscience networks EARTHSCOPE, US array, NEPTUNE etc.

The importance of organisation of industrial procurement

an exemple:

- **Photomultipliers (PM) are an ubiquitous instrument of APP physics:**
  - **CTA (100.000 small PM)**
  - **KM3net, AUGER(10.000 large PM each),**
  - **Dark matter/Neutrino (1000 low radioactive background)**
  - **Megaton detectors (100-200.000 large PM)**
- **Their cost = 20% of the total budget**
- **Up to recently there have been 2 major photomultiplier industries (+some smaller) :**
  - **Hamamatsu Japan and Photonis Europe**
- **BUT: Photonis had to stop its PM production due to the recent financial crisis**
- **APP is facing monopole conditions and eventual inabilities to cope with timely production**

➔A few actions in progress



PM cost from 5 to 15 M€/year

Towards a sustainable european structure: ApPEC

- **ApPEC created in 2001 by the national funding agencies of France, Germany, Italy, the Netherlands and UK.**
  - Later: Spain, Belgium, Portugal, Greece, Switzerland, Poland, Romania
- **ApPEC aims to**
  1. **Promote co-operation within the European Particle Astrophysics (PA) community**
  2. **Develop and promulgate long term strategies for European PA, offering advice to national funding agencies and EU**
  3. **Assist in improving links and co-ordination between European PA and the scientific programmes of organisations such as CERN, ESO and ESA**
  4. **Express their collective views on PA in appropriate international forums, such as OECD...**
- **ApPEC operates**
  - **Strategically through its Steering Committee (chairman M. Spiro),**
  - **Operationally through its Peer Review Committee (chairman C. Spiering)**

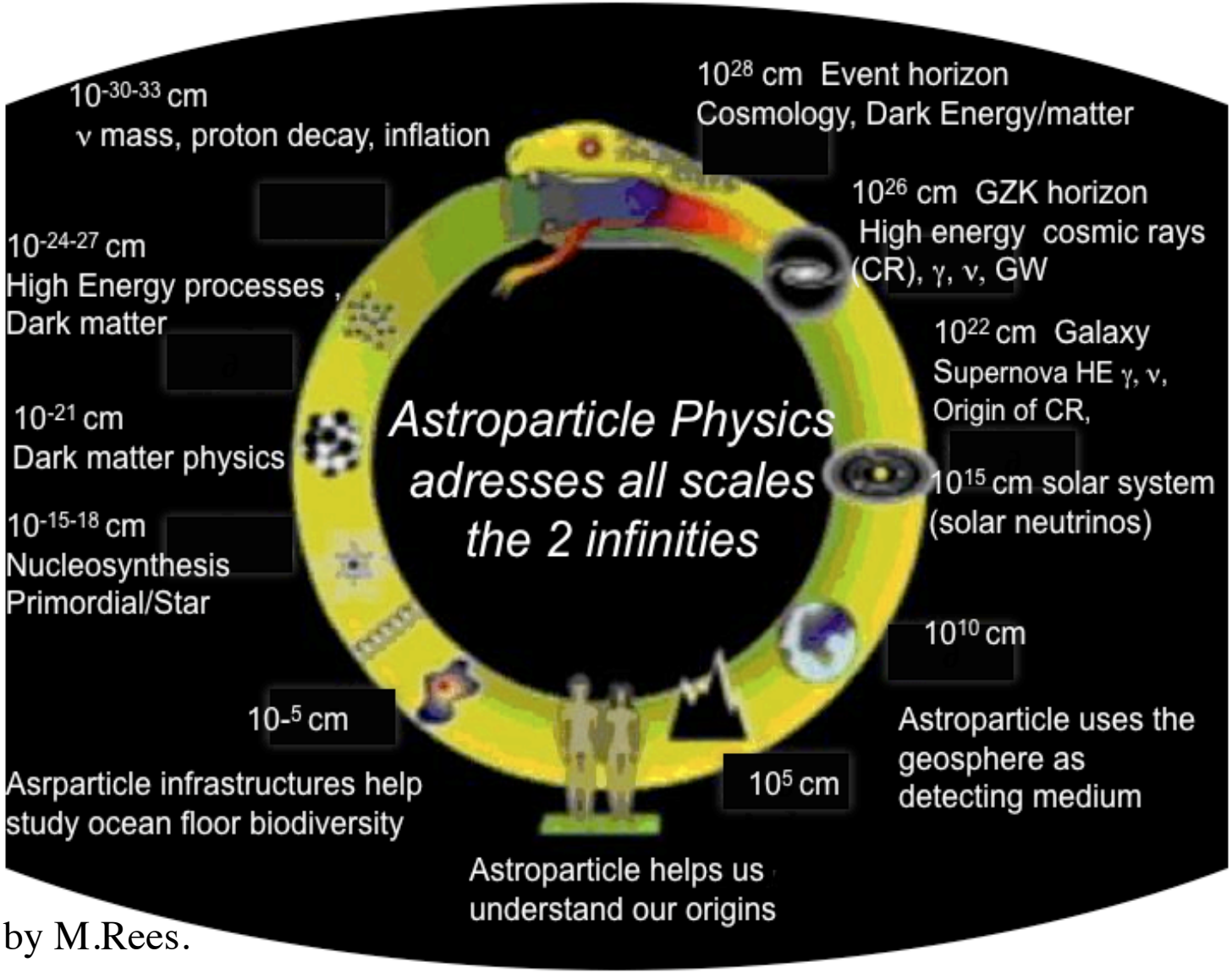
Towards a sustainable european structure

- A scenario discussed in ASPERA/ApPEC (not yet decided) :
  - Do not create a separate european or civil society scheme for each large infrastructure but try to create a pan-european structure with links to ESO and CERN to approve/fund and monitor the whole program.
    - Possible schemes: ERI , Article 169?
- Relationships with CERN
  - A representative of the ApPEC SC attends in the European Strategy sessions of the CERN Council and a representative of the ApPEC PRC is a member of the scientific secretariat for the European Strategy sessions of the CERN Council.
  - The "Working Group on the scientific and geographical enlargement of CERN" includes by right an ApPEC representative.
  - CERN asks ApPEC when Astroparticle Physics experiments ask the "recognised experiment" status from CERN. Possibilities of technical human resources help in parts of the program with overlapping expertise (e.g. cryogenics),
  - Possibility of CERN hosting for a few years the new structure (as happened with ESO)
- Relationships with ESO
  - Study and draw lessons from ESO emergence as a legal structure (not the same scale…)
  - Discuss and strengthen links

Conclusions, future actions

- ✓ **European Astroparticle Physics after a long but fruitful process of coordination has prepared a phased priority roadmap that enjoys large acceptance by the agencies and the community.**
- ✓ **Furthermore the discussion has started in Europe for the drafting of a more sustainable coordinating structure that would manage the realisation of the above program. Its eventual relationships to the existing pan European structures (CERN, ESO) are examined.**
- ✓ **Complementarities and budget demand the generalisation of this process of coordination to other regions. This process that has started in the context of the OECD Global Science Forum (1st meeting in Paris 12-13 February 2009) and could continue in other bodies (e.g. FALC).**

Astroparticle physics joins the 2 ininities



Initial image by M.Rees.