

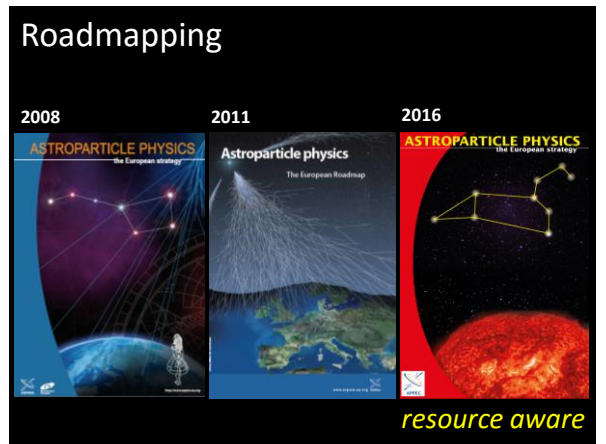
**Links to CERN, ESO, ESA, ...** APPEC observers: CERN & ESO

**CERN: European Particle Physics Strategy 2006:**  
 7. A range of very important non-accelerator experiments take place at the overlap between particle & astroparticle physics ...  
 Council will seek to work with APPEC to develop a coordinated strategy in these areas of mutual interest.

**CERN: European Particle Physics Strategy update 2013:**  
 j. A range of very important non-accelerator experiments ... particle & astroparticle physics, such as searches for proton decay,  $0\nu\beta\beta$  decay and dark matter and study of high energy cosmic-rays ...  
 In the coming years CERN should seek a closer collaboration with APPEC on detector R&D with a view to maintaining the community's capability for unique projects in this field.

**ESA: Euclid, eLISA, CORE+, ...**  
**ESO: negotiating with CTA as Southern hemisphere site**

**Generally: astroparticle physics = astronomy+particle physics**



### Roadmap process

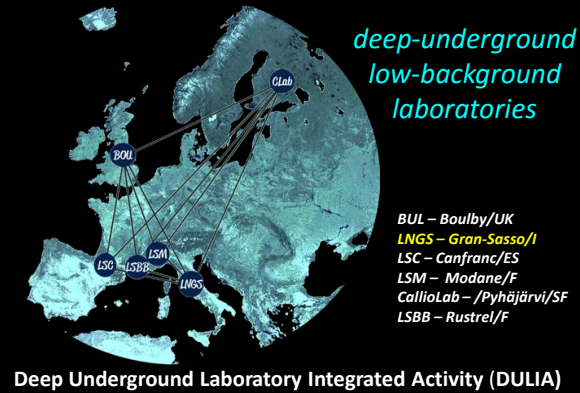
- Executive summary
- Introduction
- Research themes (3)
  - Theory, R&D, Computing
- EU APP community
- Global aspects
- Societal relevance
- Inter-disciplinary aspects
- Organizational aspects
- Recommendations



### APPEC roadmap 2016 – Town Meeting

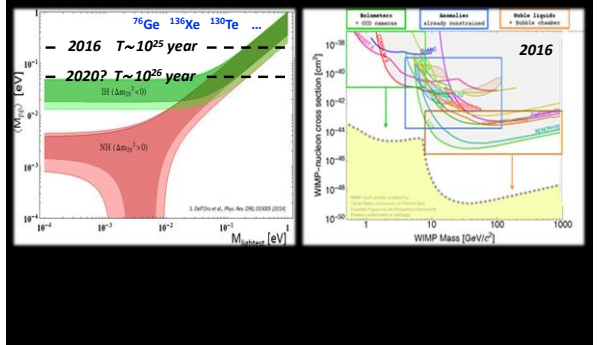


### Unique & crucial infrastructure



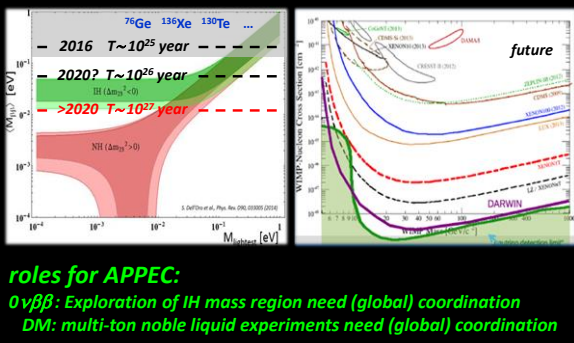
### $0\nu\beta\beta$ -decay direct dark matter

very rich programs in EU – many approaches



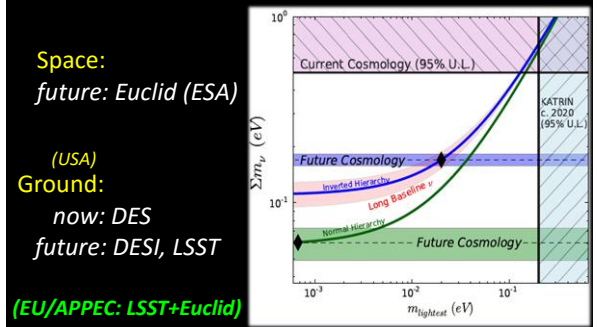
### $0\nu\beta\beta$ -decay direct dark matter

very rich programs in EU – many approaches



### Dark Universe – Dark Energy

DE: new for APPEC – exciting prospects



### The challenge: >20 M€ infrastructures

In particular those not (largely) 'covered' by ESA, USA, Japan, China, ...

**Florence CMB workshop**

International meeting Large  $\nu$ -infrastructures

**APPEC International Meeting for Large Neutrino Infrastructures**  
 23-24 June 2014  
 Ecole d'Architecture Paris  
 3 Quai Fochard et Lévesque  
 Paris - 75013  
<http://appec.org/9-features/78-gnm.html>

**Speakers:**  
 E. Lisi, J. Strait, M. Neum, T. Kobayashi, S. K. Agarwal, M. Diwan, M. Shiozawa, A. Bahain, T. Endo, K. Ganga, S. Ritz, J. Lagaune, A. Smirnov, A. McDonald, P. Huber, J. Lesauvage, Y. Wang, S.B. Kim, N. Morobbi, M. Konradi

**June 2014 (Paris)**      **Asia: JUNO (RENO-50)**      **September 2015 (Florence)**  
**April 2015 (Chicago)**      **→ USA: DUNE**      **September 2016 (Florence)**  
**30-31 May 2016 (Tokyo)**      **Japan: Hyper-Kamiokande**      **→ EU ground-based CMB?**

### High-energy Universe: multi-messenger

light  
 proton  
 neutrino  
 GW  
 high energy proton

- GW
- light
- proton
- neutrino

### High-energy Universe: multi-messenger

**we do have the signals! → sources?**

**GW150914**      **PeV neutrinos**

HE cosmic-rays  
 HE  $\gamma$ -rays

### High-energy Universe: multi messenger

Cosmic rays  
 AUGER-Argentina

Photons  
 HESS/MAGIC-Namibia/Spain

Neutrinos  
 ICEDUBE, Antarctica

Gravitational Waves  
 Virgo/LIGO, Italy/USA

### High-energy Universe: multi messenger

**Mass determination!**

Cosmic rays  
 AUGER-Argentina ('cheap')

Photons  
 HESS/MAGIC-Namibia/Spain

**Astronomy & fundamental physics**

**PeV pointsources & astronomy? >>100 M€**

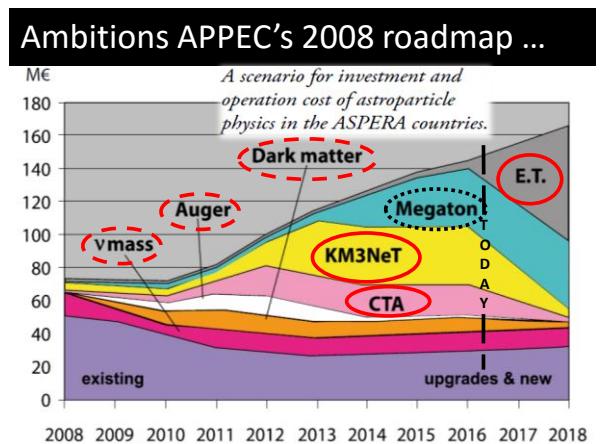
**< 0.1**

**Astronomy & fundamental physics**

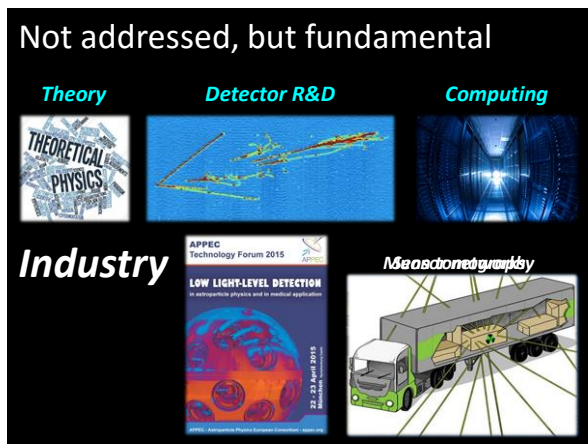
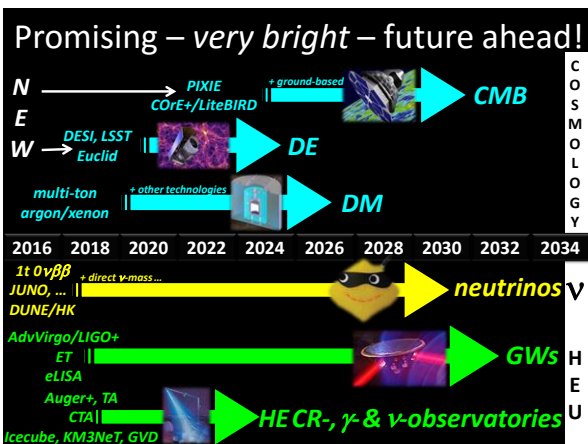
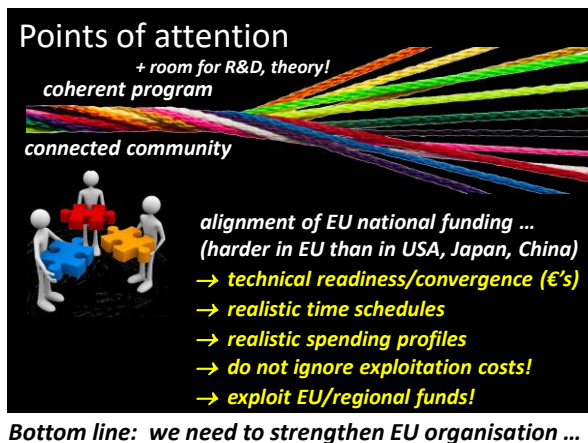
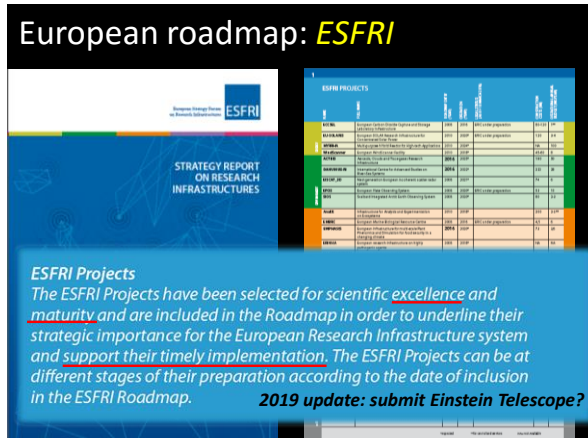
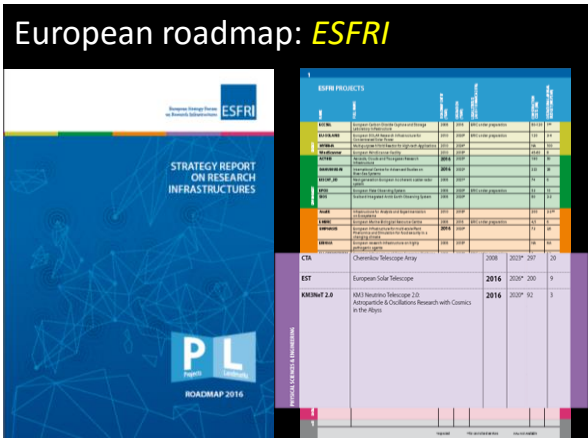
10 km<sup>2</sup> area  
 Neutrinos  
 ICEDUBE, Antarctica  
 GVD-lake

Gravitational Waves  
 Virgo/LIGO, Italy/USA

**But: first get Virgo up&running!**






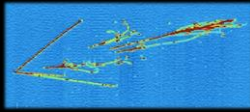


Not addressed, but fundamental


**Theory**



**Detector R&D**




**Computing**



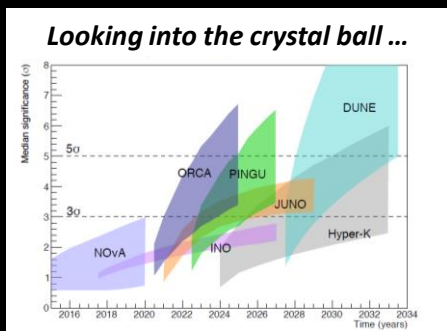
**Outreach**

- 'Hand-on' cosmic rays
- Masterclasses
- Public lectures
- Etc.
- Etc.

Join forces with IPPOG (cosmics @ schools)




Settling the  $\nu$ -mass hierarchy?



'Easy' .... apart from funding, performance & politics