



Astroparticle Physics European Consortium

European Astroparticle
Physics Strategy
2017-2026



Presentation of the **EU Astro-Particle Physics Strategy 2017-2026**

*Antonio Masiero
Chairman of the APPEC
General Assembly*

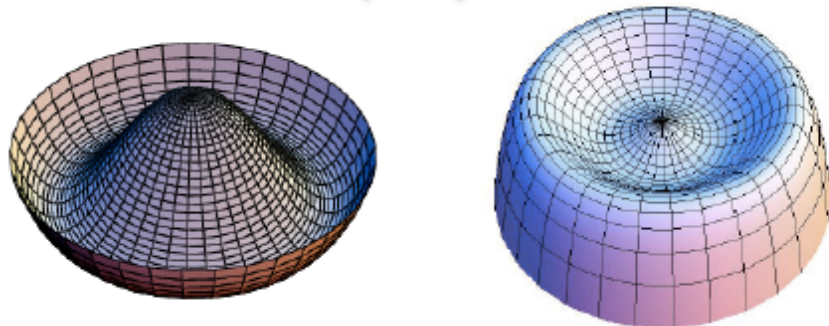
Bruxelles, January 9th, 2018

- PARTICLE STANDARD MODEL**

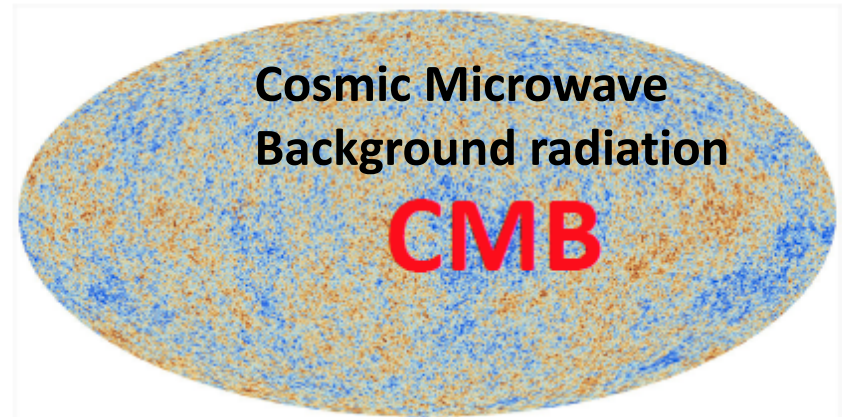


The **Higgs boson** and the destiny of the Universe

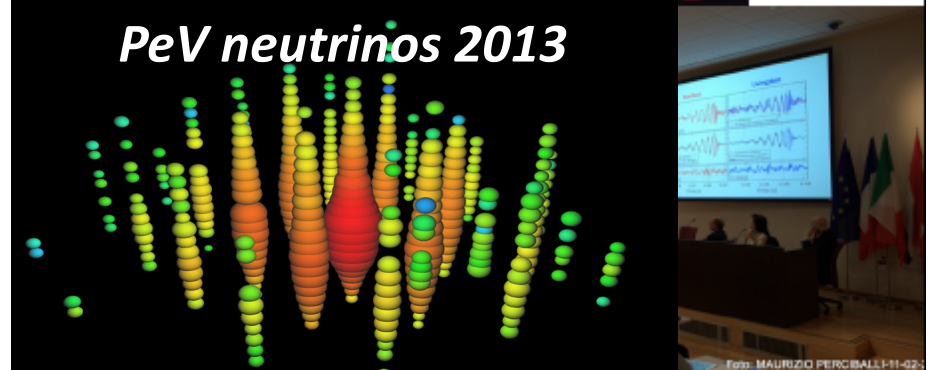
STABILITY ↔ **INSTABILITY**



- COSMOLOGY STANDARD MODEL**



PeV neutrinos 2013



5 numbers, 5 indications of physics beyond the Standard Models of Particle Physics and Cosmology: NEUTRINO MASSES, DARK MATTER, DARK ENERGY, ANTIMATTER and VACUUM ENERGY

- Stars and galaxies are only $\sim 0.5\%$

- Neutrinos are **$> 0.1\%$**

- Rest of ordinary matter

(electrons, protons & neutrons) are 4.4%

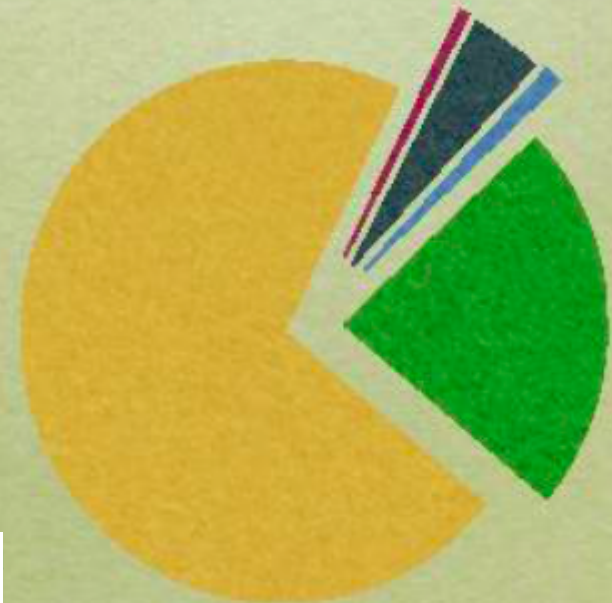
- Dark Matter **$\sim 27\%$**

- Dark Energy **$\sim 68\%$**

- Anti-Matter **0%**

- Higgs Bose-Einstein condensate

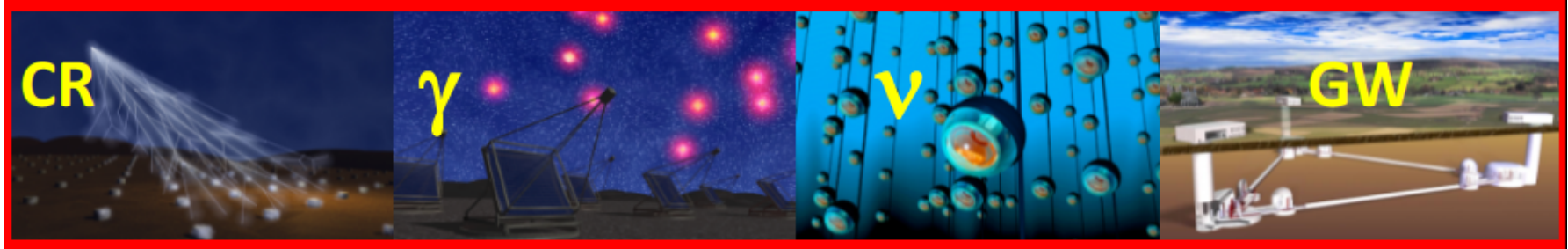
\sim **$10^{62}\%$** ??



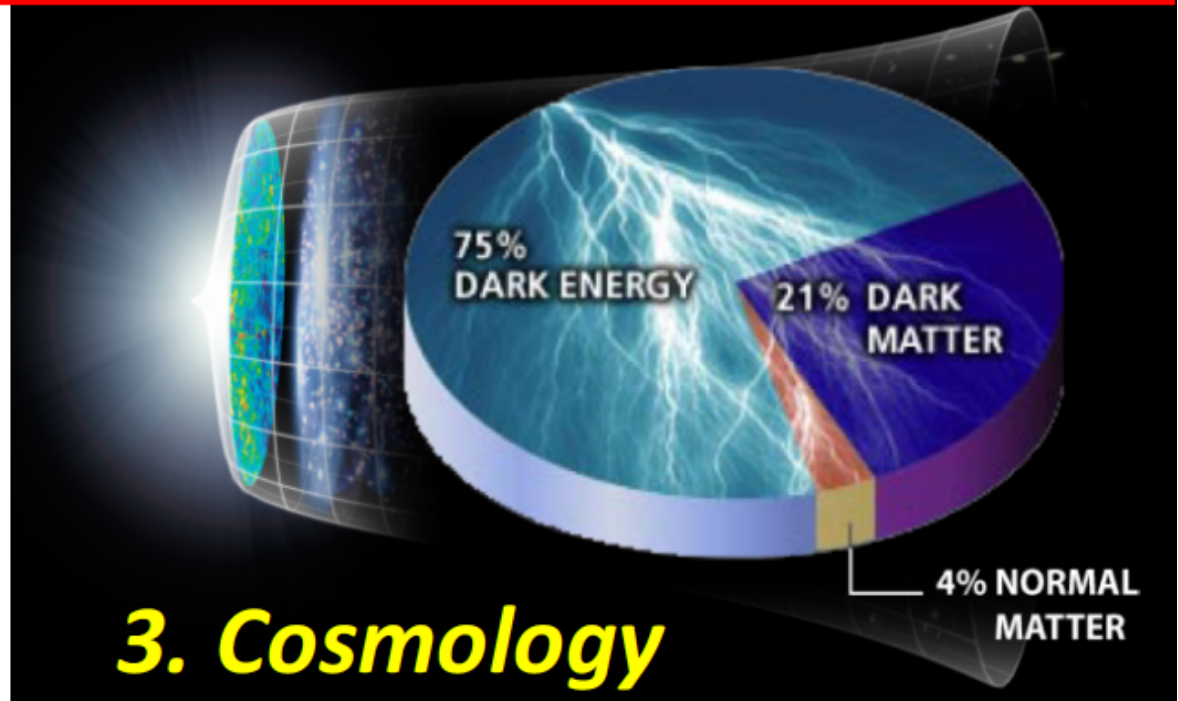
thanks to H. Murayama

Going beyond the physics Standard Models: the APP 3-pronged approach

1. High-energy Universe: multi-messengers



2. Neutrino's



Crucial ingredients



community

*EU: few 1000
scientists*

science
excellent

technology
state-of-the-art

Concerns

*coherent program
connected community*



*EU national funding alignment ...
(‘easy’ in USA, Japan, China)*



*Technical readiness & convergence
Realistic time schedules
(Exploitation costs!)*

F. LINDE

Bottom line: in EU we need to strengthen the APP organisation even further ...

Strategic objectives

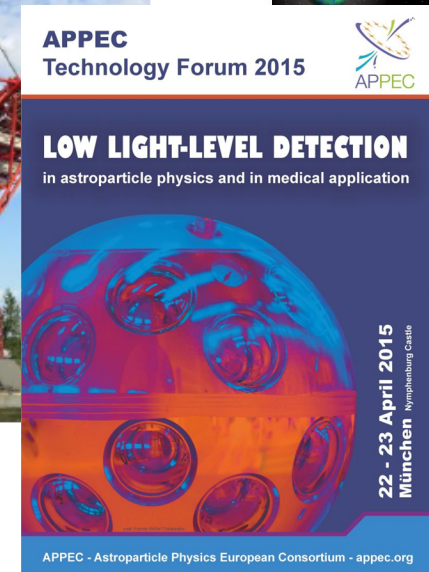
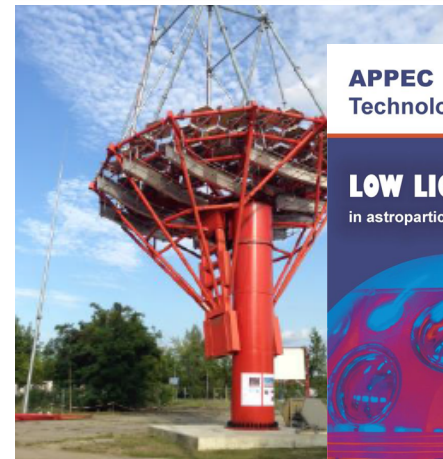
- Coordination of European Astroparticle Physics
- Develop and update long term strategies (roadmap)
- Express collective views on APP in international fora

Implementation objectives

- Coordination between existing/developing national activities
- Convergence of future large scale projects/facilities
- Organisational advice for implementation of large facilities
- Launch common calls funded by a (virtual) common pot

APPEC actions

- **Promotion of global and/or European strategies on specific topics**
(for instance, global neutrino meetings, European CMB coordination in a global context; for the future : global strategy for integrated activities of large underground RIs, global strategy for multi-messenger approach)
- **Strong Interaction Interaction with EU**
(e.g. **ERANET ASPERA (2006-2012)**, **I3 on underground science and GW**: ILIAS, DS Einstein Telescope ET (GW), DARWIN (DM), LAGUNA/LBNO (ν)
- **Stimulus for large astroparticle RI**
(e.g. strong help in the preliminary stage of the CTA project , coordination for ESFR1 successful proposal of KM3Net,...)
- **Calls for R&D on common projects**
(ex. CTA, ET, DARWIN, etc.)
- **Technology Fora**
- **Interdisciplinarity and Data Policy Fora**
(e.g. **interdisciplinarity with Geosciences**)



APPEC Consortium



APPEC 2018

RIA (Ireland)

STFC (UK)

FOM (NL)

FRS-FNRS, FWO (Belgium)

CEA, CNRS (France)

SNSF (Switzerland)

LSC (Spain)

FCT (Portugal)

OSI (Finland)

VR (Sweden)

DESY, KIT (Germany)

JINR (Dubna, Russia)

NCN (Poland)

IEAP-CTU (CZ)

INFN (Italy)

IFIN-HH (Romania)

CSF (Croatia)

NOA (Greece)

Observers: CERN, ECFA, ESO, NCN, CSF



Astroparticle Physics European Consortium



General Assembly

Stavros Katsanevas 2012 – 2014

Frank Linde 2015 – 2016

Antonio Masiero 2017 –

Joint Secretariat

Thomas Berghöfer 2012 – 2016

Job de Kleuver 2017 –

Scientific Advisory Committee

Laura Baudis (chair), Michal Ostrowski, Mauro Mezzetto, Gisela Anton, Jocelyn Monroe, Petr Tiniakov, Jo van den Brand, Patrick Sutton, Ramon Miquel, Zito Marco, Andrea Giuliani, Felix Aharonian, **Pierre Binétruy**, Ignatios Antoniadis, Yifang Wang, Francis Halzen, Hank Sobel, A. Haungs, S.Katsanevas (APPEC)

Distributed responsibilities of the five APPEC Functional Centers



DESY:

International Contact,
Computing, Industrial
Relations, Common
Fund / Archive

STFC:

Outreach

APC:

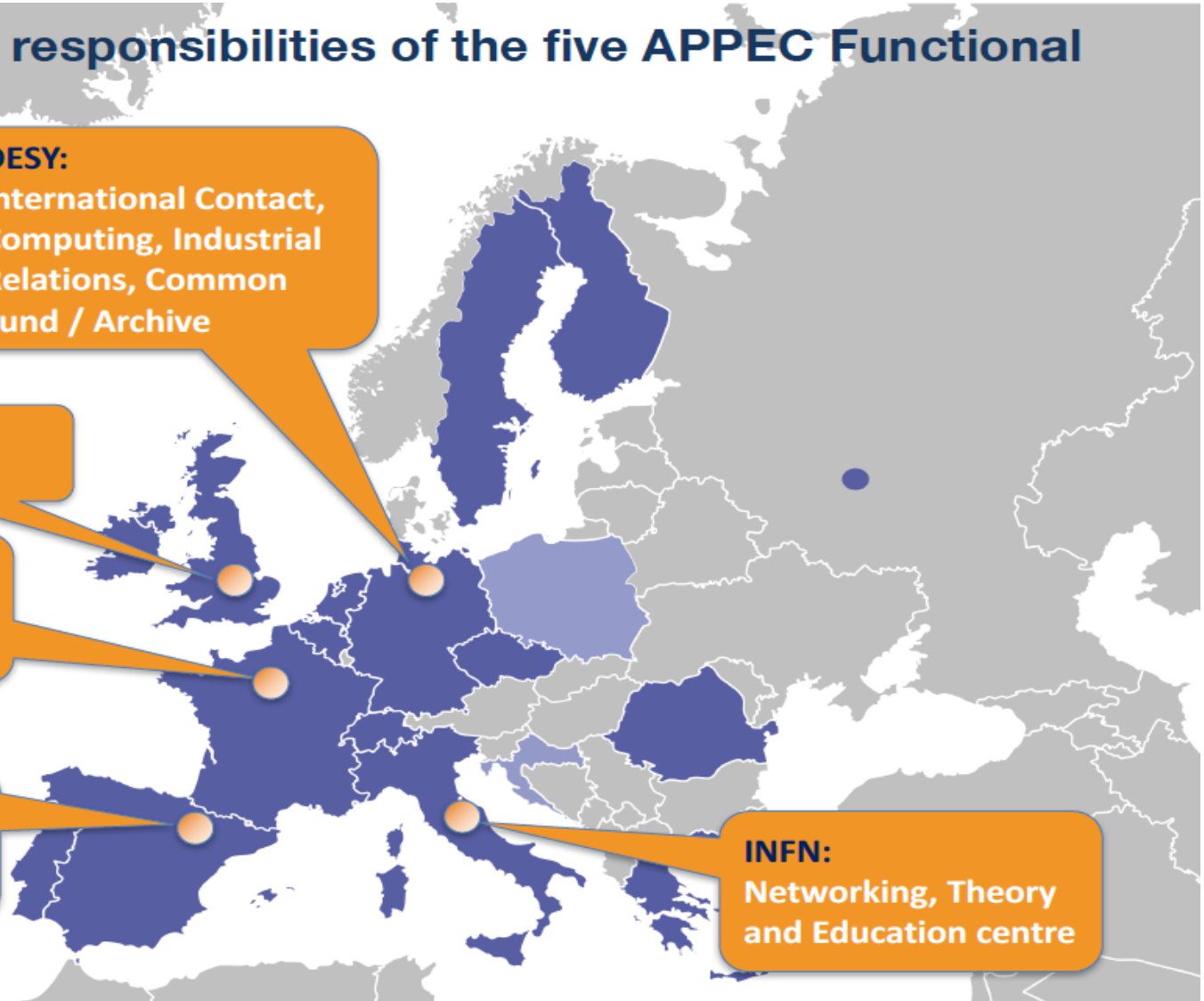
Strategic Actions,
Interdisciplinarity

LSC:

Electronic Tools

INFN:

Networking, Theory
and Education centre



APPEC Roadmaps

2008



2011



2017



resource aware

Successes and open issues of the 2011 Roadmap



• Three categories of priorities:

I. Complete the upgrades:

- ✓ Adv. Gravitational Wave antennas (Virgo)
- ✓ Underground science: ton scale DM
- Underground science: ton scale neutrino mass experiments, in process

II. Prepare construction of large CR infrastructures

- ✓ CTA, KM3Net/IceCube in ESFRI list and in process of construction
- ✓ AUGER upgrade in construction

III. Global coordination for very large projects:

- ✓ Large neutrino detectors
- ✓ Dark Energy
- CMB , in process

Bottom line: the 2011 Roadmap kept the community and the agencies on focus ...

European roadmaps in fields of science



APPEC: *Town Meeting* → *strategy*

Wednesday 6 April

09:00-10:00 Registration - Welcome coffee

		Speaker	Moderator
10:00-10:15	Openning & Introduction	Antonio Masiero <i>APPEC SAC Chair</i>	Antonio Masiero <i>APPEC SAC Chair</i>
10:15-11:00	HE-Universe - Gamma	Felix Aharonian	Christian Spiering
11:00-11:45	HE-Universe - Neutrino	Gisela Anton	Stanislaus Bentvelsen
11:45-12:30	HE-Universe - Cosmic rays	Andreas Haungs	Johannes Bluemer

12:30-14:00 Lunch - Buffet

14:00-14:30	Multimessenger study of the Universe - Theory	Roger Blandford	Antonio Masiero
14:30-15:00	Current problems in cosmology - Theory	Subir Sarkar	Lars Bergstroem
15:00-15:30	Current problems in neutrino - Theory	Eligio Lisi	Janet Seed

15:30-16:15 Coffee

16:15-17:00	Neutrino parameters with large experiments (CP violation, mass hierarchy,...)	Mauro Mezzetto	Fernando Ferroni
17:00-17:45	Lepton number violation and basic neutrino properties	Andrea Giuliani	Stefano Ragazzi
17:45-18:30	Cosmology - Dark Matter	Jocelyn Monroe	Mario Martinez

18:30-18:45 Break

18:45-19:30	T. Kajita public lecture	Takaaki Kajita	Stavros Katsanevas
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19:15-20:15 Cocktail

Thursday 7 April

09:30-10:15	Cosmology - CMB	Francois Bouchet	Stavros Katsanevas
10:15-11:00	Cosmology - Dark Energy	Ramon Miquel	Reynald Pain

11:00-11:45 Coffee

11:45-12:30	HE-Universe - Gravitational Waves	Patrick Sutton	Federico Ferrini
12:30-13:00	APP Computing	Volker Beckmann	Katharina Henjes-Kunst

13:00-14:30 Lunch - Buffet

14:30-15:00	APP - Detector R&D, Industry	Jo v/d Brand	Teresa Montaruli
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15:00-17:00	Round table with international agencies (CERN, ASTRONET, ESO, DOE, NSF, CANADA, CHINA, JAPAN)	F. Giannotti (CERN), R. Gilmozzi (ESO), K. Turner (DOE), J. Whitmore (NSF), T. Kajita (Japan), SN Zhang (China), N. Smith (Canada), C. Vincent (Astronet), M. Carena (Fermilab)	Stavros Katsanevas
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17:00-17:45 Coffee

17:45-18:15	Conclusions, APPEC, community, roadmap, funding alignment, international coordination	Frank Linde <i>APPEC Chair</i>	Frank Linde <i>APPEC Chair</i>
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Paris, April 6-7, 2016



European Astroparticle
Physics Strategy
2017-2026

Scientific issues – 13×

- *Large-scale: CTA, ν -telescopes, Auger, GW*
- *Medium-scale: Dark Matter, ν -mass, $0\nu\beta\beta$*
- ***+PP:** ν -mixing; **+ASTRO:** Dark Energy & CMB*
- *Base: theory, R&D, computing
deep-underground laboratories*

Organisational issues – 5×

- *European Commission*
- *European collaboration/coordination*
- *Global collaboration/coordination*
- *Particle physics & Astronomy*
- *Inter-disciplinary opportunities*

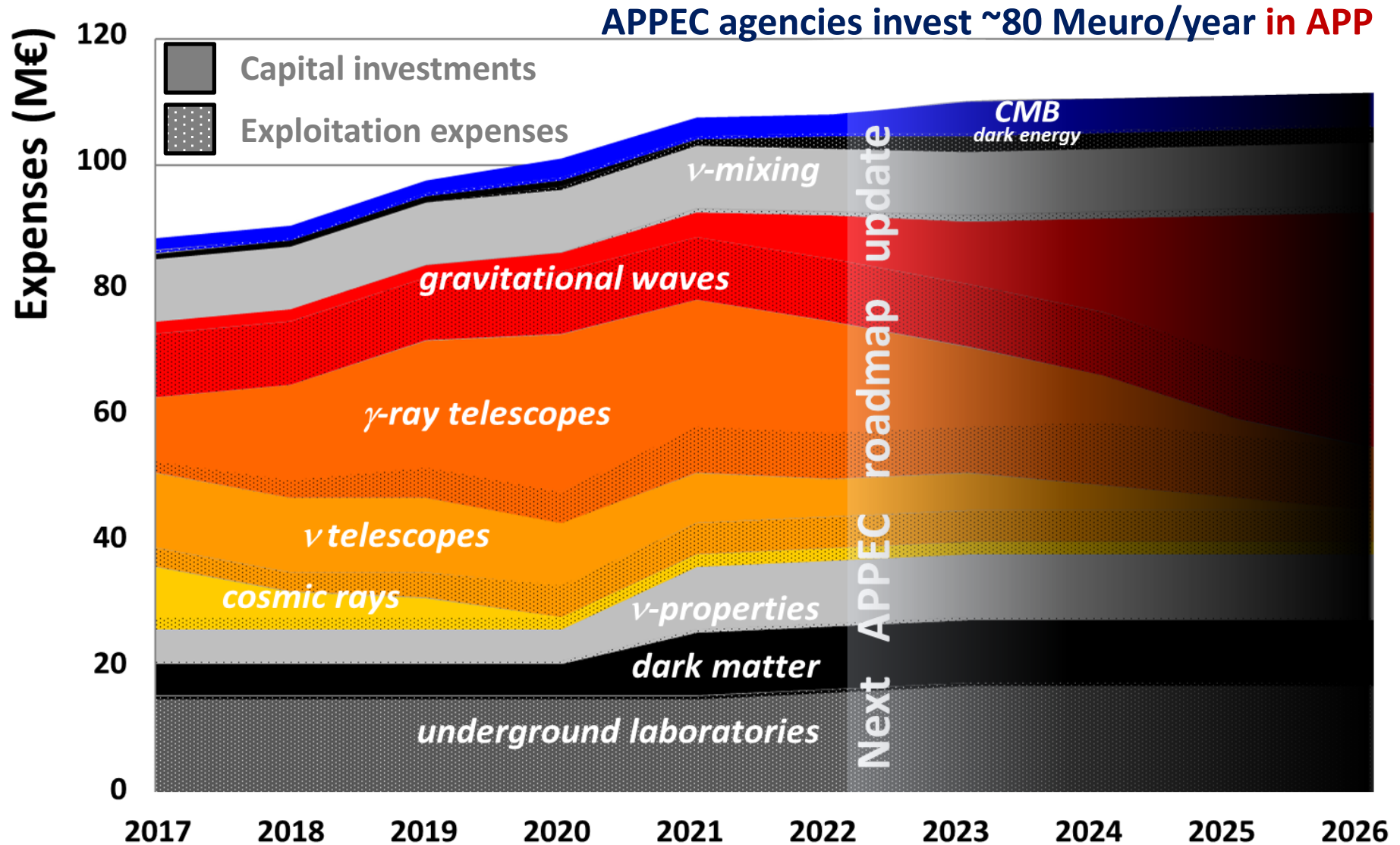
Societal issues – 3×

- *Gender balance*
- *Education & Outreach*
- *Industry*

AstroParticle Physics & CERN

- Communities intimately related ...
- Computing, R&D, Theory, ...
- APP dominates CERN's '*recognized experiments*'
- LBNF/DUNE: CERN neutrino platform
- ECFA/APPEC detector R&D panel
- *European Astroparticle Theory Center with CERN involvement?*

APPEC's 2017 strategy ...



Excludes EU structural/regional, PP, ASTRO, non-EU funding ...

Promising – *bright* – future ahead!

F. LINDE

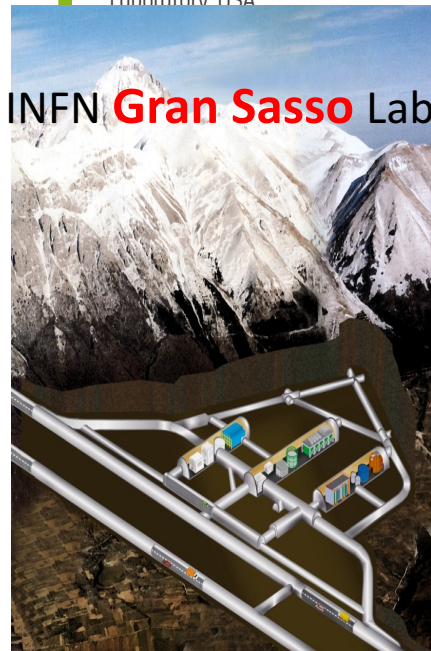
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DEEP UNDERGROUND LABs

Study of **rare processes**

– search for **dark matter, neutrino properties**



Surface: 17 800 m²
Volume: 180 000 m³



Worldwide largest underground lab in operation with easy accessibility

final considerations

- EU has really an enormous **HUMAN, SCIENTIFIC, TECHNOLOGICAL** potential in the research area of AstroParticle Physics . APPEC can significantly contribute to strengthen the top-level European position in the field, hence strengthening the EU potential for scientific and tech **growth and innovation and qualified new jobs**
- Astroparticle physics exerts an enormous **attraction power on student and young researchers** → key-role in a **scientifically and technologically top-level formation and training of young generations in EU**

- The success of the APPEC'S new resource-aware EU Astroparticle Strategy 2017-2026 relies on a **close cooperation between the APP scientific community with our various national governments and funding agencies, the EU Commission, our partners outside Europe, those working in the connected field of particle physics, astronomy and cosmology, and the strong pillars that these 3 research fields rely on – CERN, ESO and ESA**
- **APPEC acknowledges the relevant and constant support from the EU Commission: the first ERANET, I3 and DS (ILIAS, ET, DARWIN, LAGUNA) were instrumental in the success of the APPEC coordination;**

We are living in an
extraordinarily exciting time for
our comprehension of the
Universe from its smallest to its
largest space and time scales

With this roadmap APPEC intends to set a
relevant program for the establishment and
running of the planned APP RI's and an intense
R&D for future Ris, hence an overall RI area
program of potential high impact on the
growth and innovation in EU.