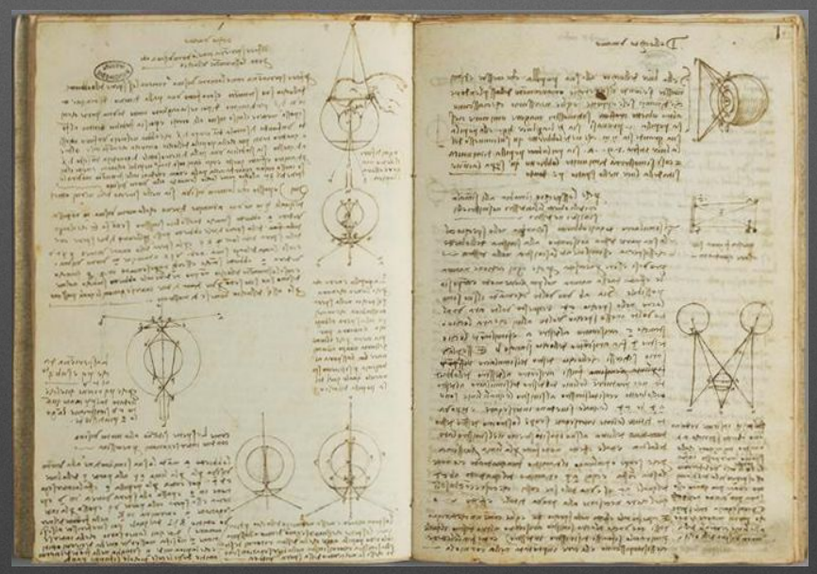
Europe role in a global adventure

A purely personal reflection



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Bari - Wiv 2019- June 8, 2019

The questions

- What our universe is made of ?
- Why had we a chance to be here ?

The way to answer

- smashing particles
- listening to the voice of the universe

The key to success

- Combining particle physics, astroparticle physics, astropysics, cosmology
- an intellectual grand unification

How Europe shall contribute

- Preserve its extraordinary successful laboratory - CERN- and designing the best possible future for it

- develop a coherent plan for contributing to the uproarious field of astroparticle physics

Key words

- Energy frontier
- Dark world
- Multimessenger physics

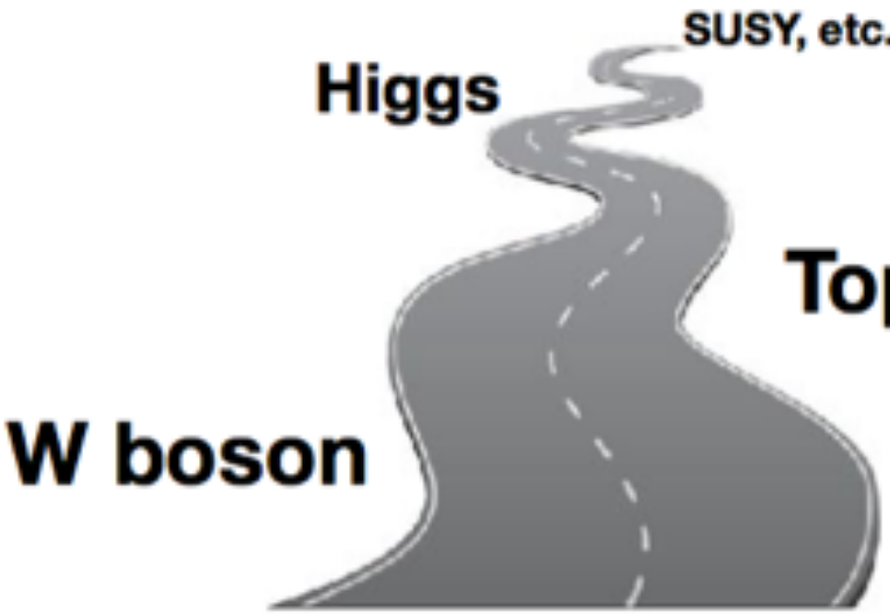
Smashing particles

- LHC now (until sometime in the 30’s)

- what next ?

No input to take the decision
Neither now nor next

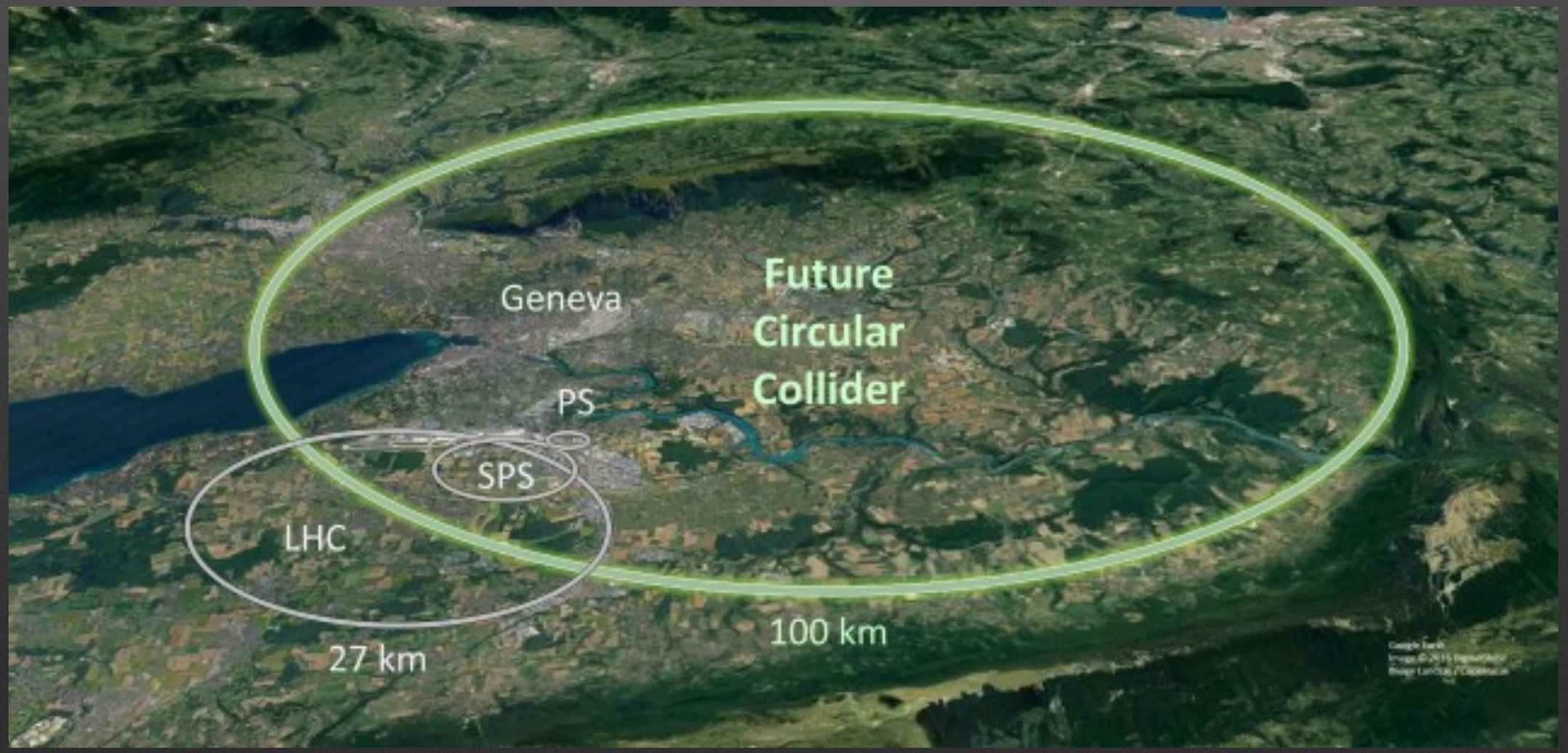
HEP before the LHC



HEP before the F.C.

No way out, challenge the open sea

CERN future (in my mind)



the ideal way forward (amongst the many options)

- Find the money for the 100 km tunnel
- Hope that Asia take the challenge of the e+e- machine
- Fill the tunnel with ‘degraded’ and ‘cheap’ LHC dipoles
- Push the energy frontier to ’45 +/-5 TeV’
- So that….

in 20 years from now

- we will be studying the Higgs properties
- we will push the search for direct discover BSM physics

and….

- skipping the ‘extremely expensive and extremely difficult’ step of 16 T Nb3Sn magnets

- we might concentrate on HTS technology (much requested from the market)

- so that the following round will be a machine at en energy in excess of 100 TeV

I know the objection

- how can we justify the cost in front of politicians ?
- my answer is a mix of different elements:

Colombo attitude

developing HTS technology

Preservation of leadership in this field by Europe

CERN has gathered a community of 10k people
No other machine could keep them at work

However R&D on accelerator is also a must

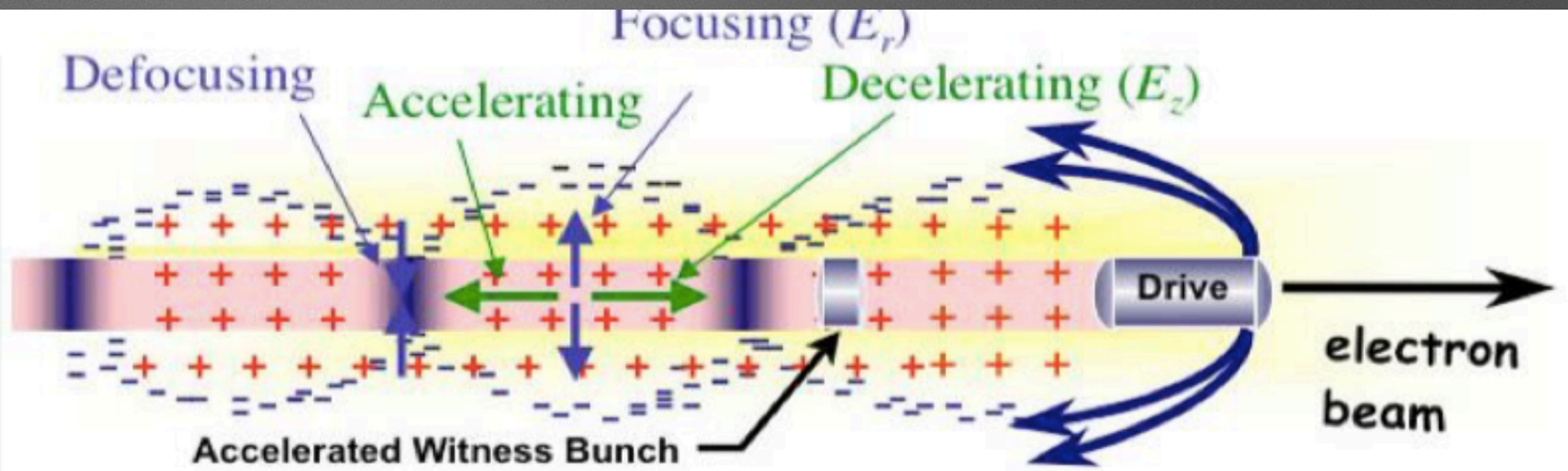
- we need a revolution (sooner or later, better sooner) like the one of B. Touschek with AdA

PWFA
Global effort

Mainly replace the main linac of linear colliders with novel technology acceleration

Plasma acceleration achieves very high gradients (> GV/m)

- Powered with beam or laser

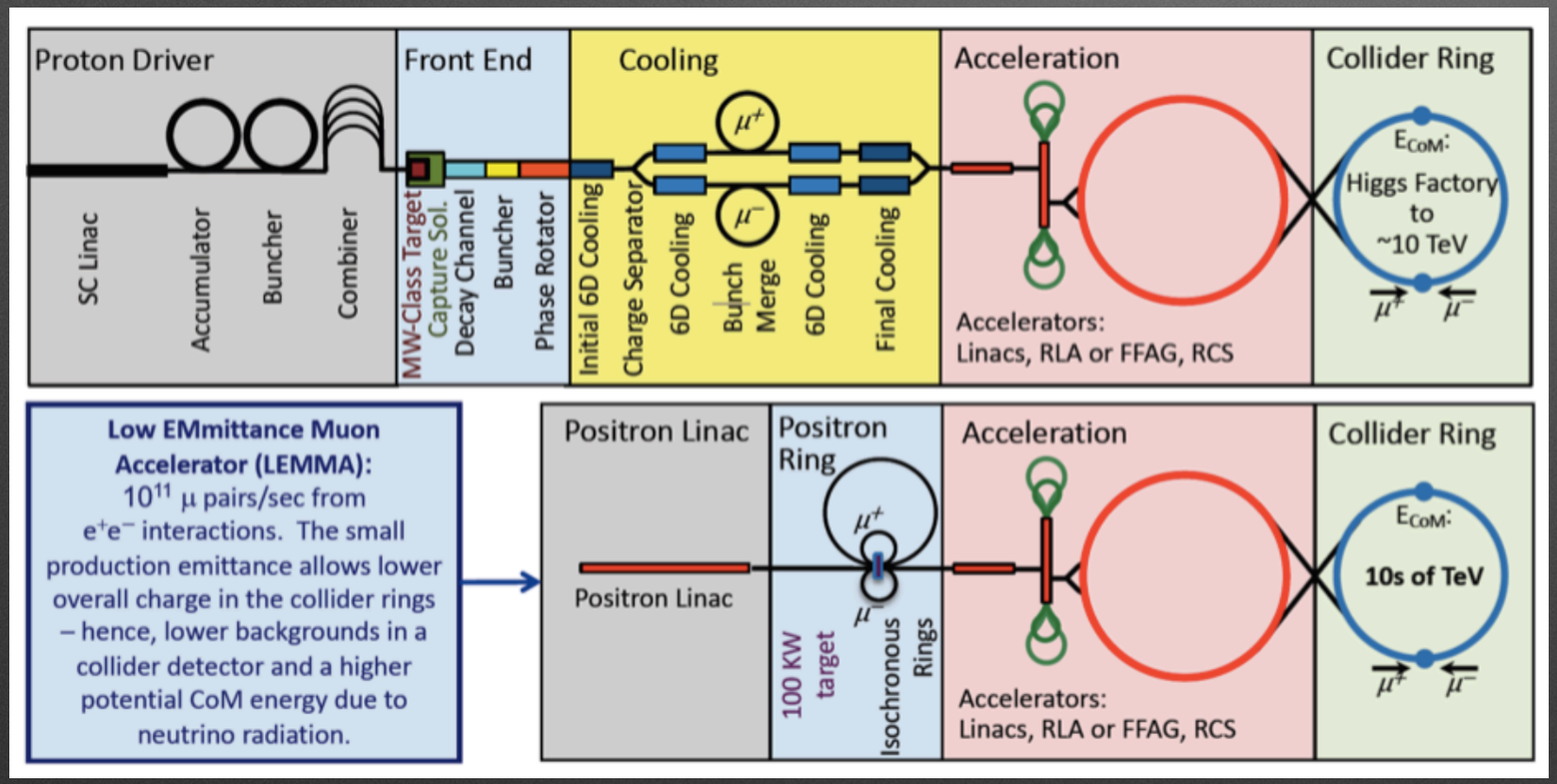


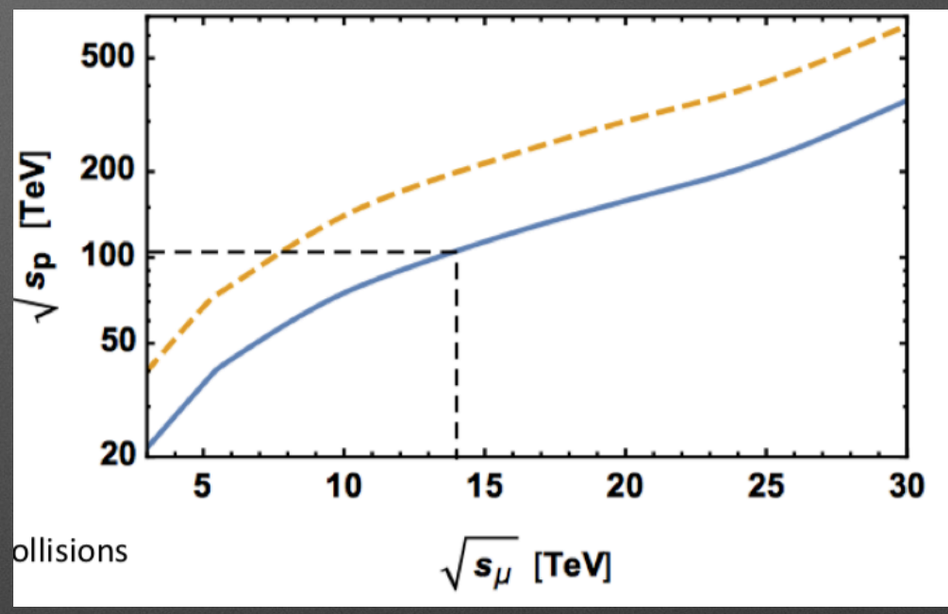
The EuPRAXIA Research Infrastructure:
A Required Intermediate Step Towards Plasma Accelerators for the Energy Frontier

The road to colliders passes through first applications that need compact accelerators:

- Early HEP applications, FELs, Thomson scattering sources, medical applications, injection into next generation storage rings …

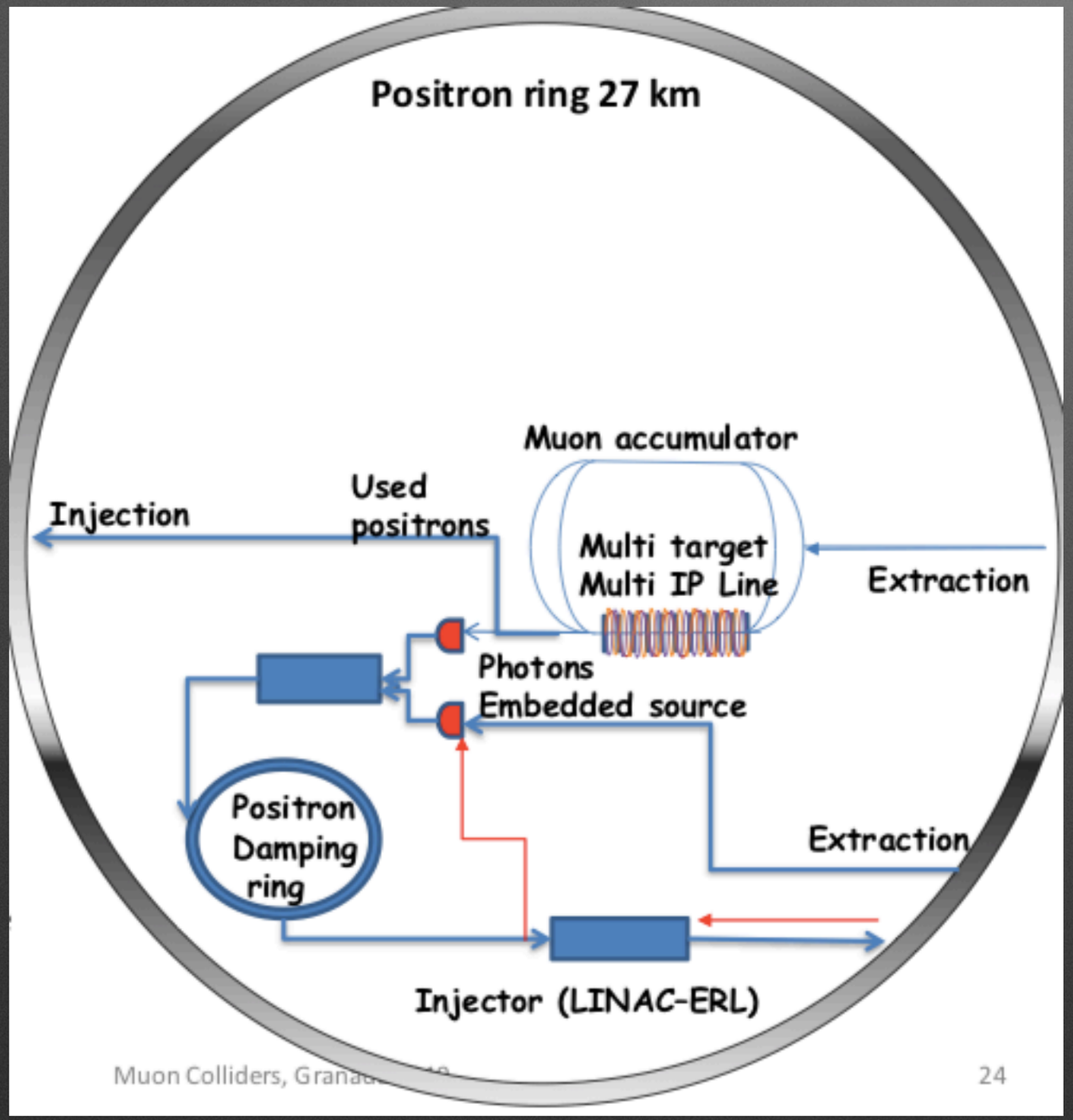
Muon Collider

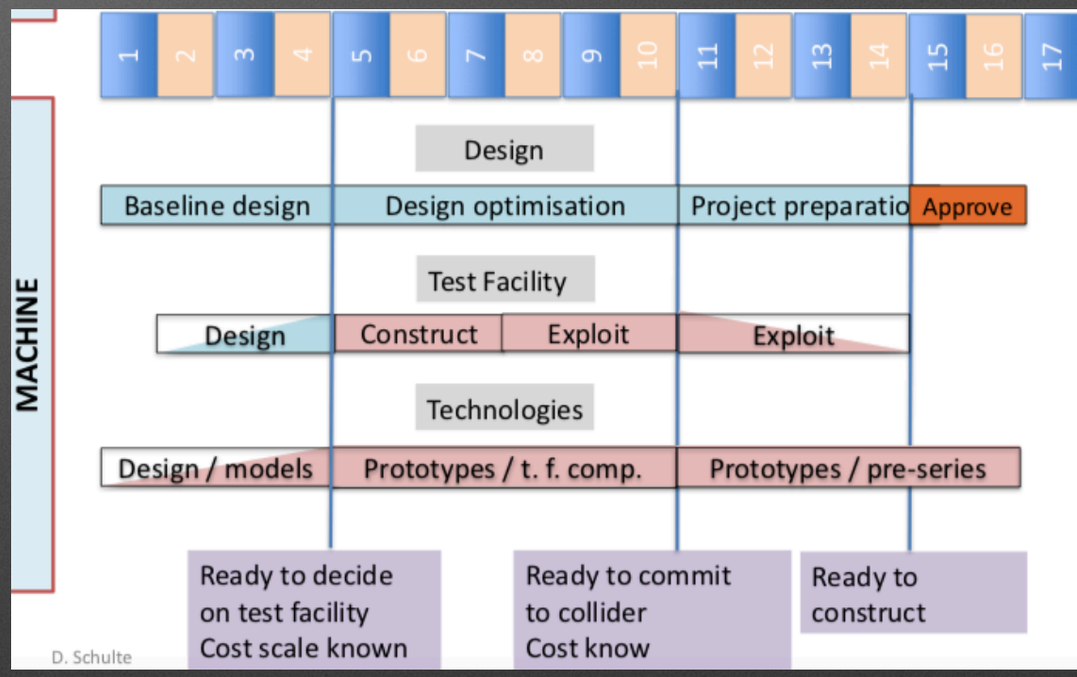




ollisions

LEMMA





Consolidate the positron driver scheme addressing specifically the target system, bunch combination scheme, beam emittance preservation, acceleration and collider ring issues.

The Middle Earth

- Neutrinos might hold the key to both the mystery of the antimatter disappearance and the New Physics

Leptogenesis

Majorana mass

CP Violation

- Action far from Europe.
- Help with people, idea, technology……
- Excitation for future result is motivated but remember than from a very precise knowledge of CKM we have not got much improvement in our knowledge of flavour mistery

DBD or ‘electrons creation’

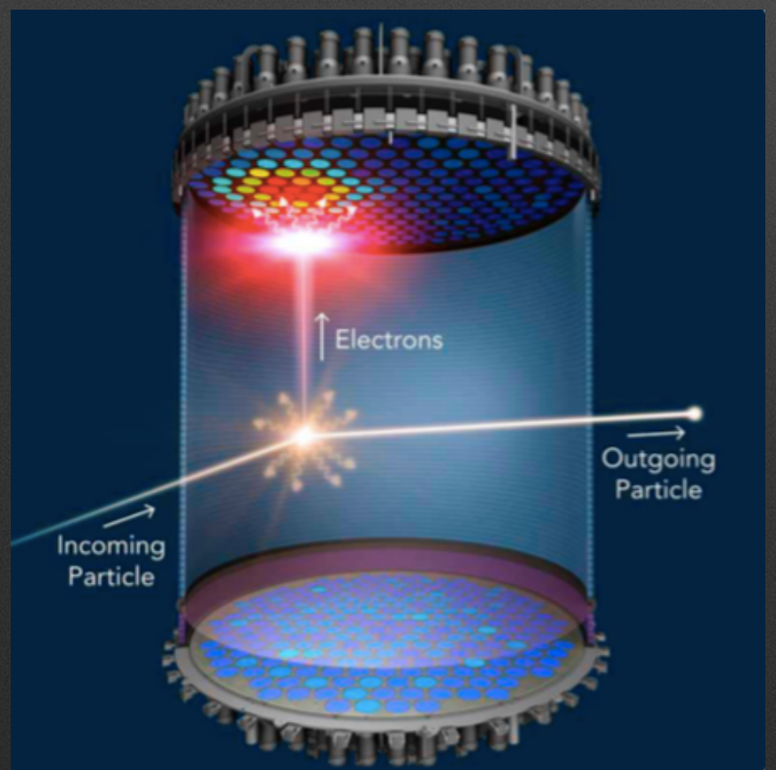
- Exploit LNGS experiment and their technology to the limit (GERDA/LEGEND and CUORE/CUPID)
- However…..if you need to reach a half life that requires masses of order 10-100-1000 tons this requires a change of technology
- Enrichment becomes prohibitive and in case of Xenon even the world total production would be a limitation

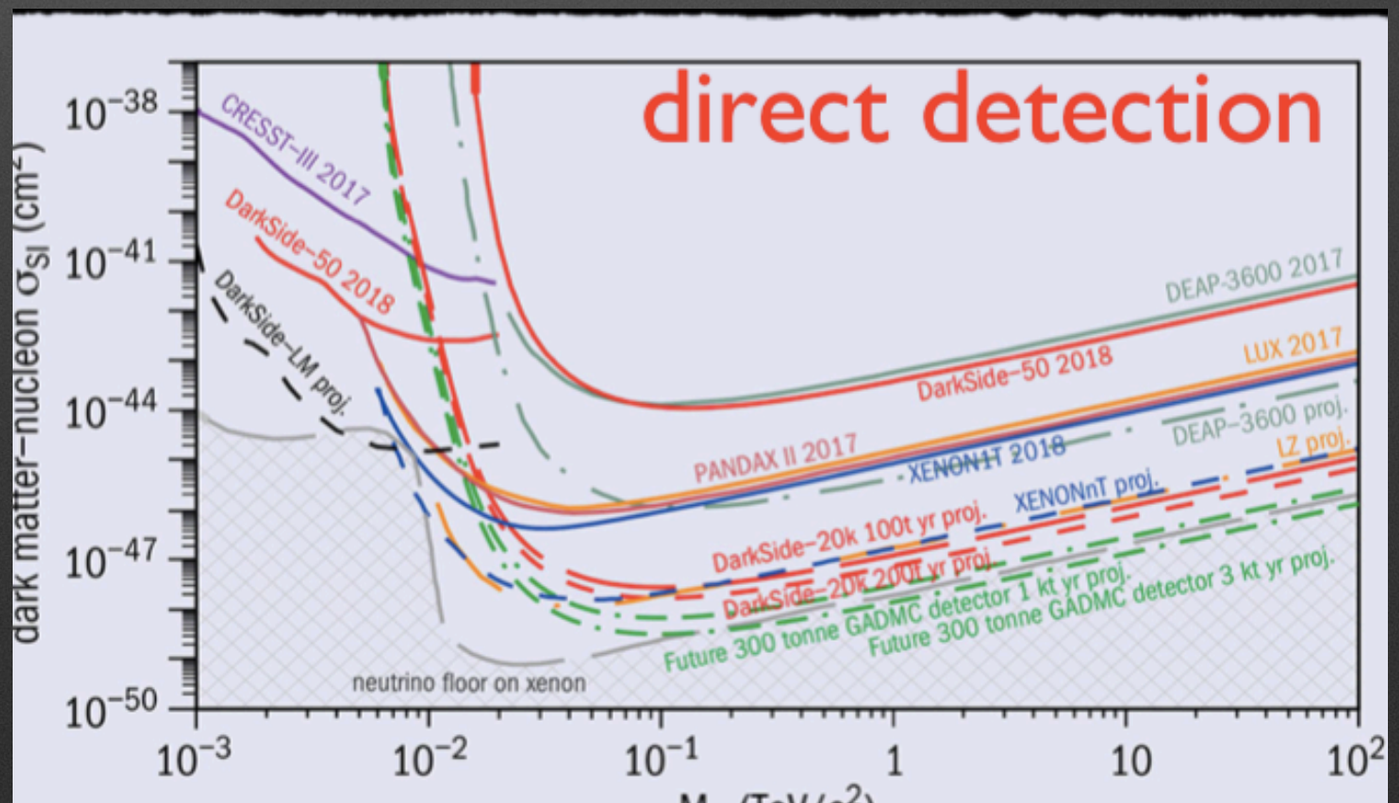
Dark Matter as a substantial slice of the Universe pie

- A duty of bringing the existing lines of research at LNGS to their limit (get to the neutrino floor)

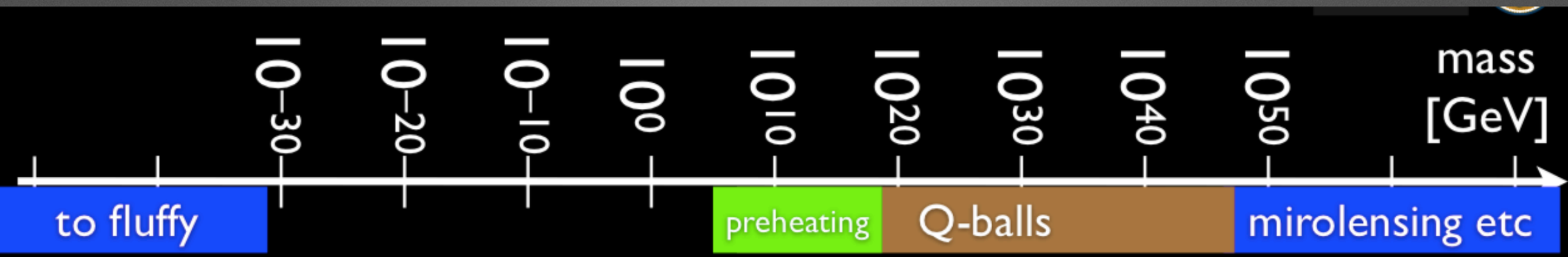
- Xenon nT

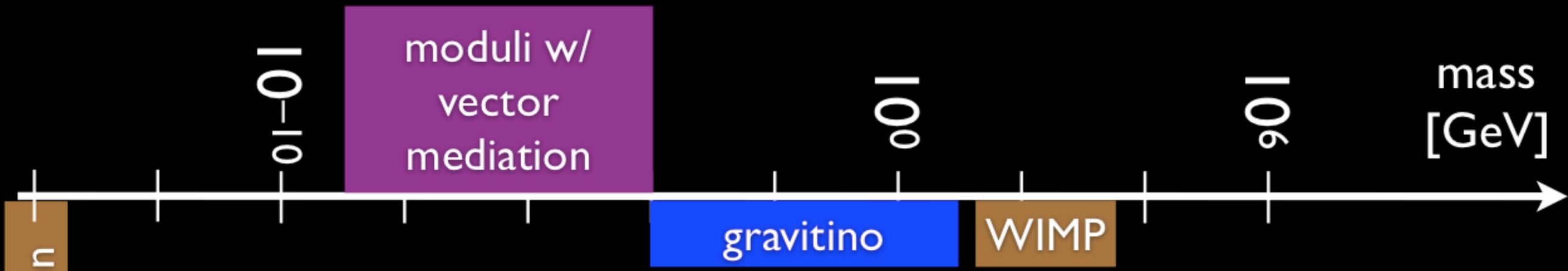
- Dark Side 20k (moving eventually to ARGO 300k)





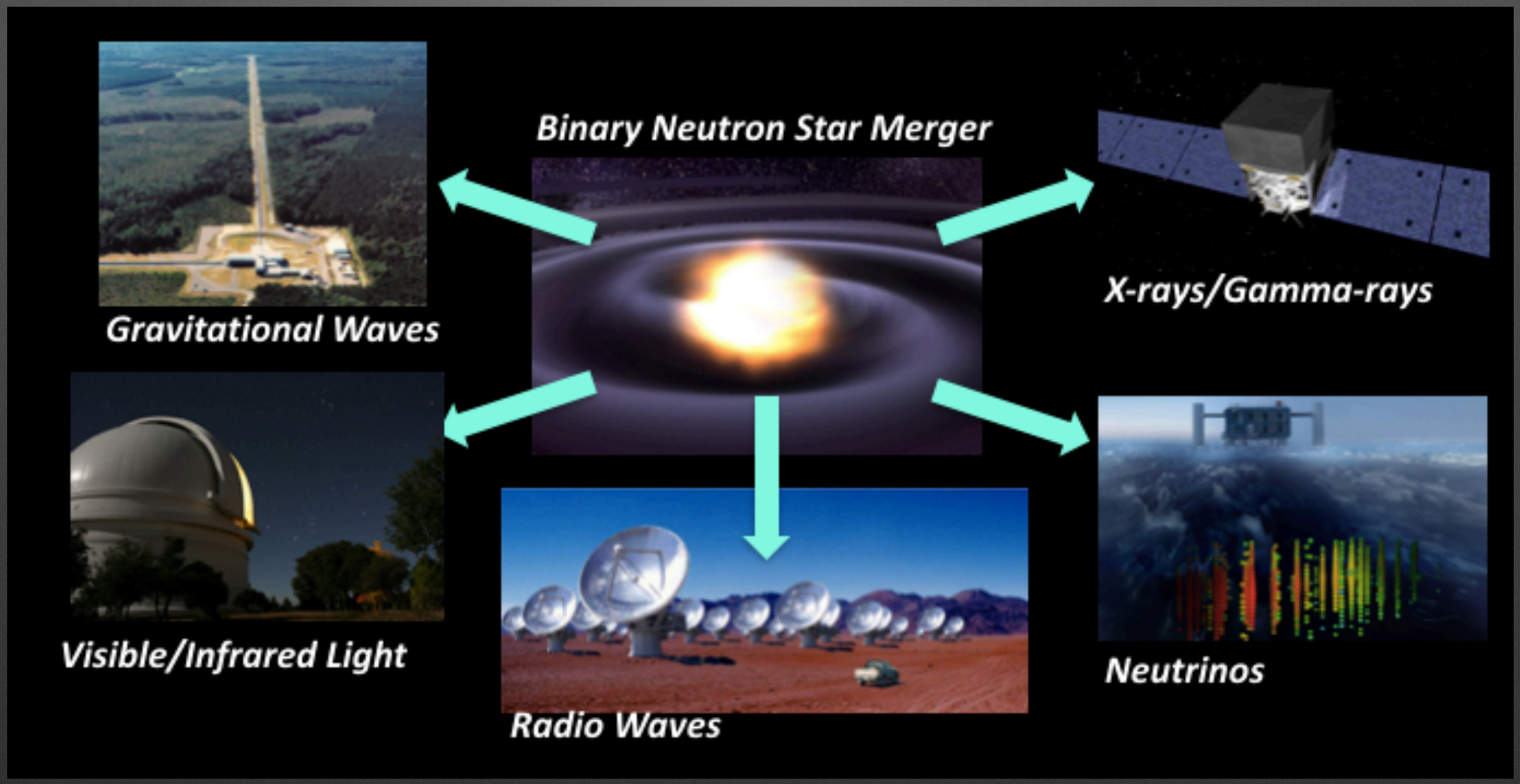
However you better have an unbiased view of the landscape





There is work for almost everybody

The emerging field of Multimessenger physics

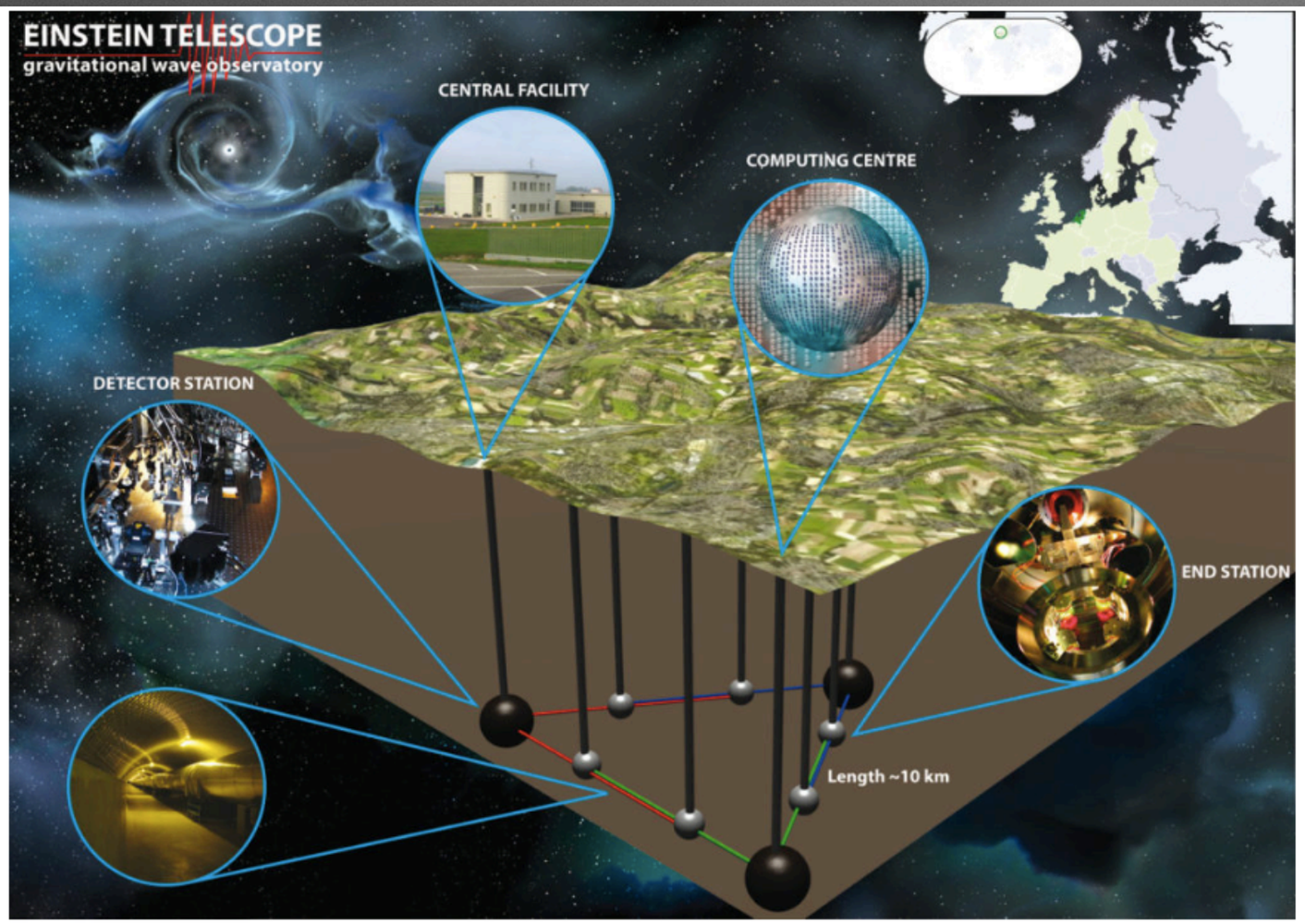


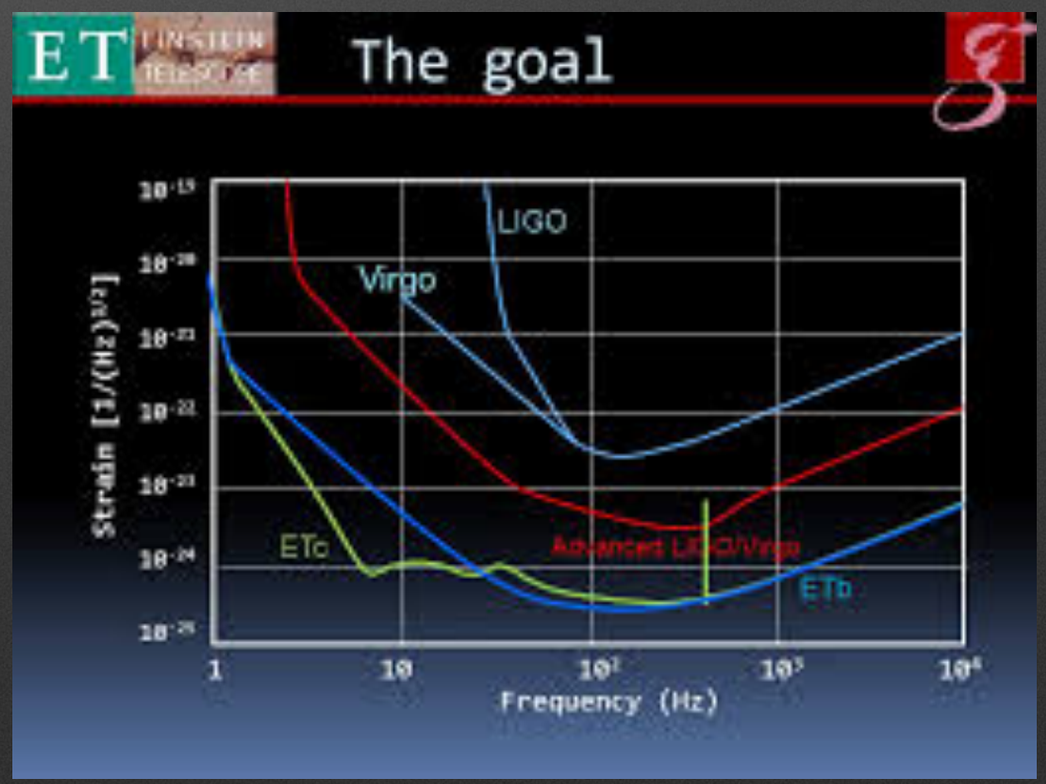
a field of mandatory collaboration

- Here particle physics, astroparticle physics and cosmology do intersect
- need everybody on board

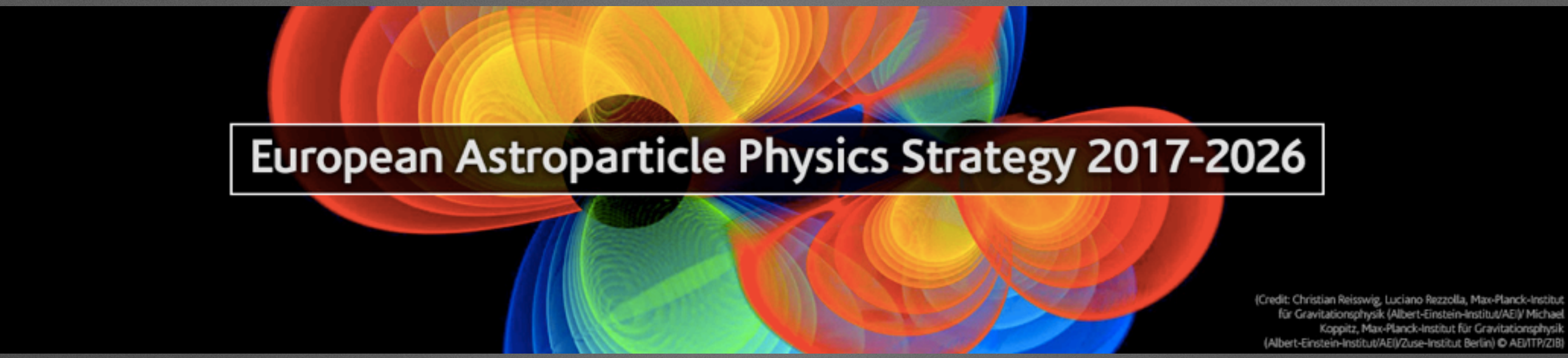
ET

Based on VIRGO experience an ambitious project to be based somewhere in Europe

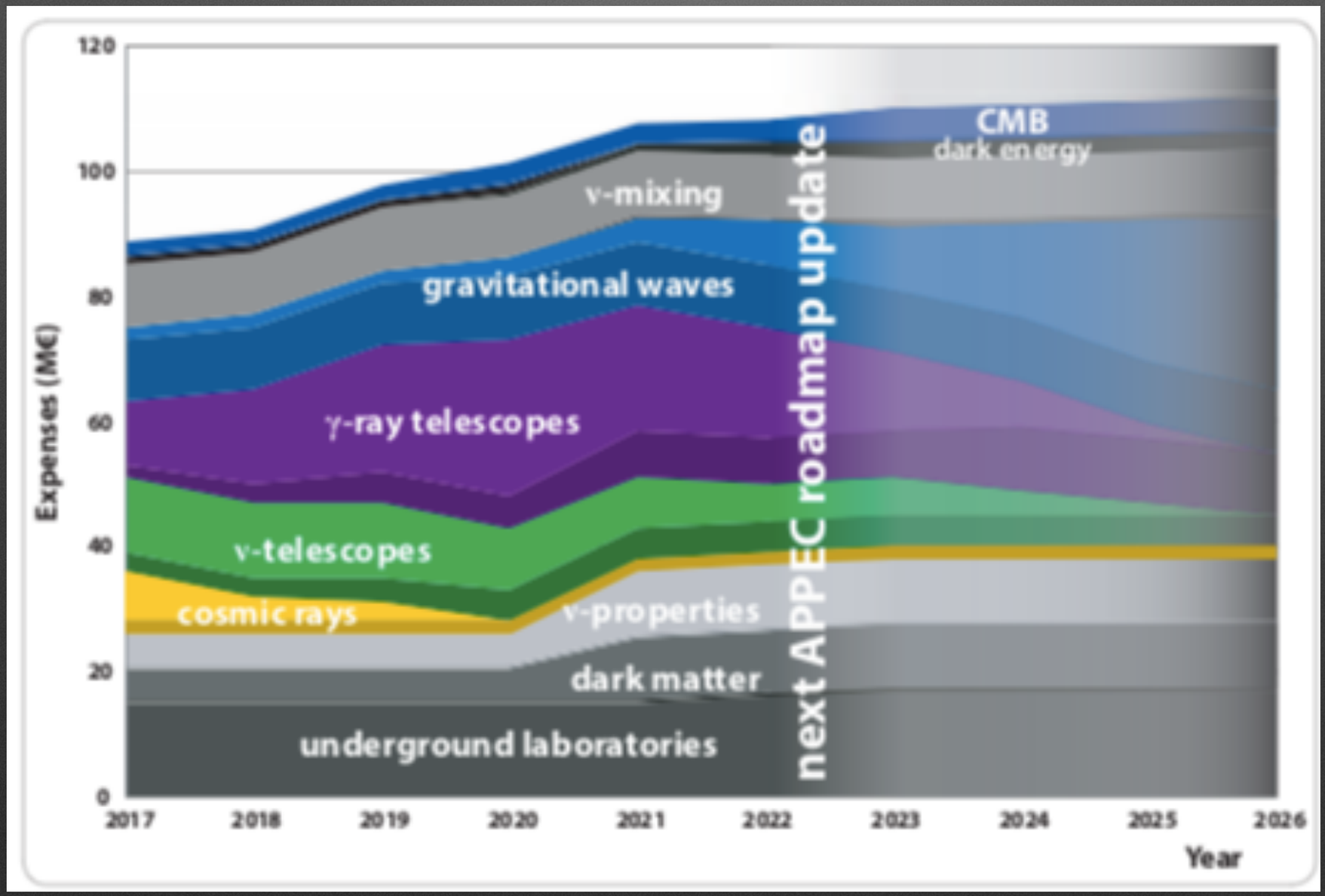


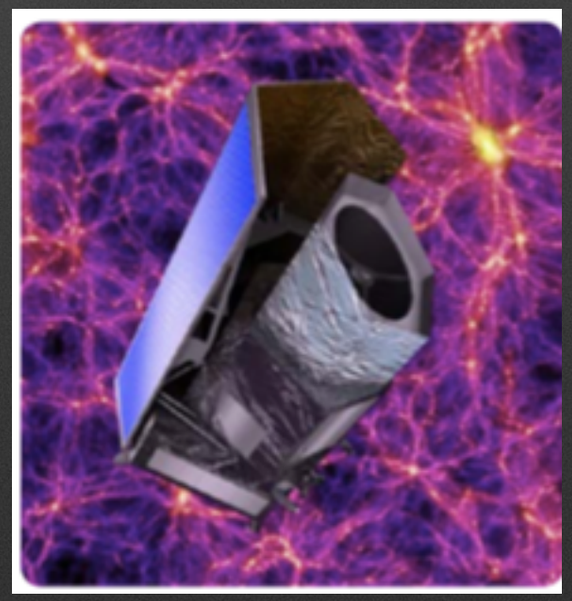


European Astroparticle Physics Strategy 2017-2026



(Credit: Christian Reisswig, Luciano Rezzolla, Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut/AEI)/ Michael Koppitz, Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut/AEI)/Zuse-Institut Berlin) © AEI/ITP/ZIB)





Conclusion

- Europe has a large impact on our field research
- CERN will be the flagship in any foreseeable future
- ET will be a landmark for the fascinating and complex field that intersects Gravity, Nuclear Physics, Astrophysics and Cosmology
- LNGS has a long way to go on both DBD and DM searches
- A growing attention to CMB/DarkEnergy sector
- All this in the frame of the Global Science

Le seul véritable voyage ... ce ne serait pas d'aller

vers de nouveaux paysages, mais d'avoir d'autres yeux

Marcel Proust