APPEC Report

prepared by Teresa Montaruli, U Geneva

CHIPP plenary meeting
CERN, August 21, 2017

APPEC Astroparticle Physics European Consortium

APPEC News

- Last GA meeting: June 21, 2017, DESY Zeuthen
- New chair and secretary: Antonio Masiero (Italy), J. de Kleuver (NL)
- Teresa Montaruli nominated unanimously vice-chair of GA
- Next joint secretariat meeting in September (maybe at CERN)
- A. Masiero resigned as chair of SAC; Gisela Anton as interim chair; new SAC before new chair; G. Anton did not accept; other nominations being considered, CH proposed LB

APPEC News

- Last GA meeting: June 21, 2017, DESY Zeuthen

APPEC News

- The final version of the roadmap is now available (was sent to SAC and GA)
- 21 recommendations were accepted at the meeting in Stockholm (September 7, 2016)
- The preliminary version was/is available at: https://www.chipp.ch/documents/APPEC_roadmap_final_mai2017.pdf21
- Only final comments are possible (T. Montaruli sent to relevant members and asked for input)
- Launch of roadmap expected for November 2017 (delayed from initial date)
- Please send suggestions from CHIPP for a list of names to invite, also from related fields and CERN (for instance: Chair of CHIPP, SNF Div 2/FLARE representatives, SEFRI representatives (B. Moore., X. Raymond, …), PIs of experiments,…

APPEC News

- The German request to postpone the roadmap launch event is connected to a problem of representation in APPEC of the German community of KAT (Helmholtz and MPI - funded by BMBF and the Ministry and Universities funded by the Federal States). The possibility that KAT becomes a member and the other remains Helmholtz is being considered, rather than having Helmholtz and BMBF

- There will be a call for expression of interest for hosting the Theory Centre for Astroparticle Physics by the end of September. **CERN is one of the two places which are more interested together with Italy. CHIPP should support this EoI.**

- A review process was initiated, which will be led by S. Katsanevas (FR), C. Stegman (G), J. Seed (UK), J. Kleuver (NL), S. Leray (CEA), on how ApPEC should function after the roadmap launch in order to implement it. A timeline of recommendation implementation should be formulated.

APPEC News

- The CTA implementation should be one of immediate priority since delays are an issue. Even if the intention is not to restart processes that already took place, a revision of the MoU becomes important to understand who can be the members of GA (people delegated by agencies, institutions, ministries, communities,…) and what is their mandate for the implementation of the roadmap.

- This discussion will happen in the next meeting on December 1, 2017 in Barcelona. Also, the new mandate of the SAC concerning the implementation of the roadmap has to be discussed.

- APIF has a new Chair: R. Blandford takes over from M. Turner. It was reported on last meeting: Europe should have a larger representation; there were also remarks on the need for global coordination for the future of DM and GW.

APPEC News

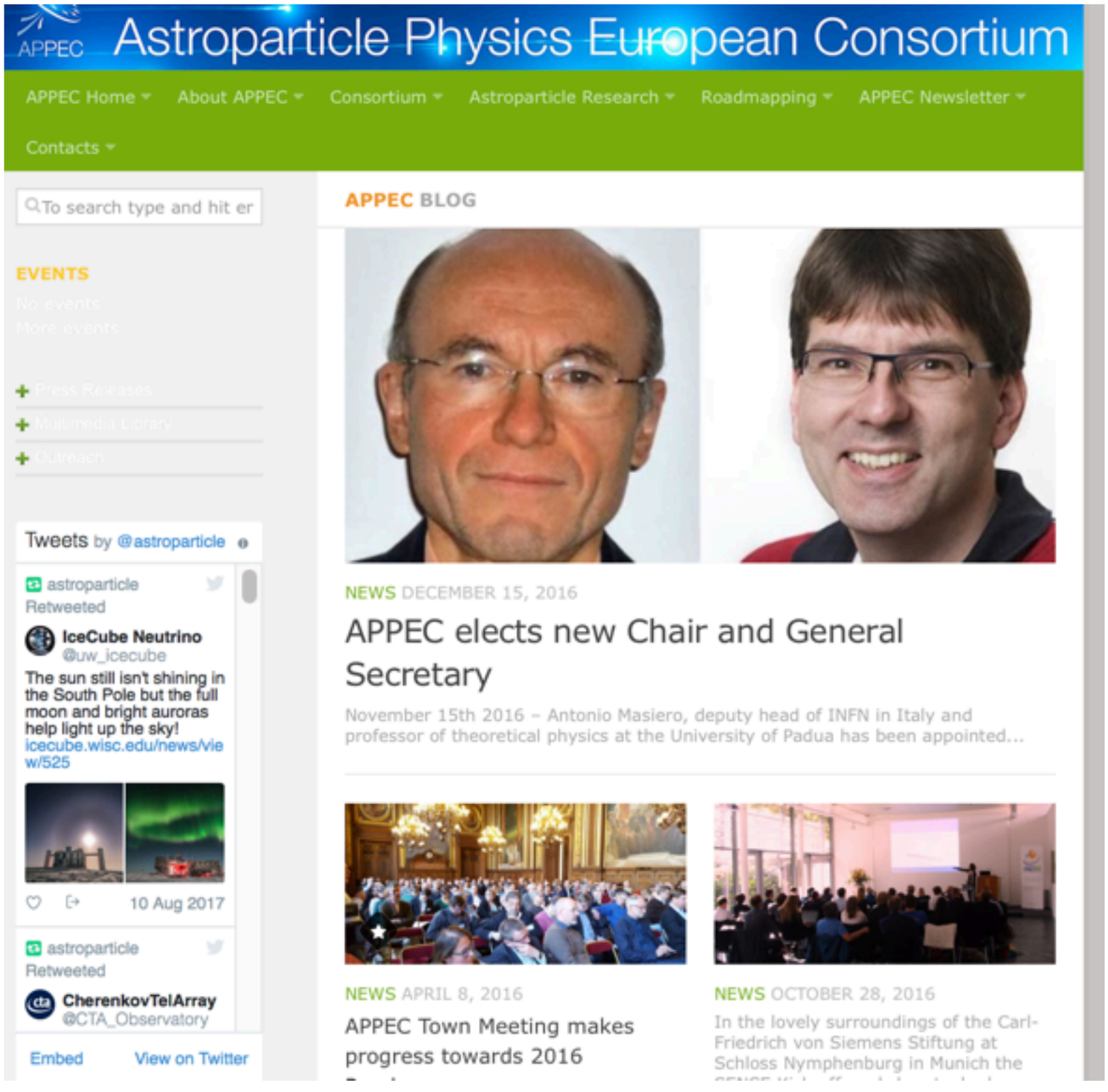
- The proposal for the next Technology Forum in 2018 concerns holder instruments for GW and electronics.

- Discussions about Geo.8 which works similarly as APPEC but in the field of Earth Sciences. Contacts have to increase with them because there can be a great synergy with ApP.

- The application to APPEC from Greece, represented by NOA (National Observatory of Athens), a large institution, which was supported by the Ministry, was discussed. Similarly, the request by the Czech Republic will be presented for approval at the next GA.

- The new APPEC web site is up since past July: http://www.appec.org

APPEC website



APPEC Roadmap

European Astroparticle Physics Strategy 2017-2026

Astroparticle physics is the rapidly evolving field of research that lies at the point where astronomy, particle physics and cosmology meet. Experimentally, it combines the advanced instrumentation harnessed by particle physicists with the highest standard of imaging of the cosmos undertaken by astronomers. Theoretically, it connects the Big Bang Model of cosmologists to the Standard Model of particle physicists; the former gives a detailed description of the evolution of the macro-cosmos while the latter describes the micro-cosmos with stunning precision. Scientifically, it aims to gain insights into long-standing enigmas at the heart of our understanding of the Universe – for example:

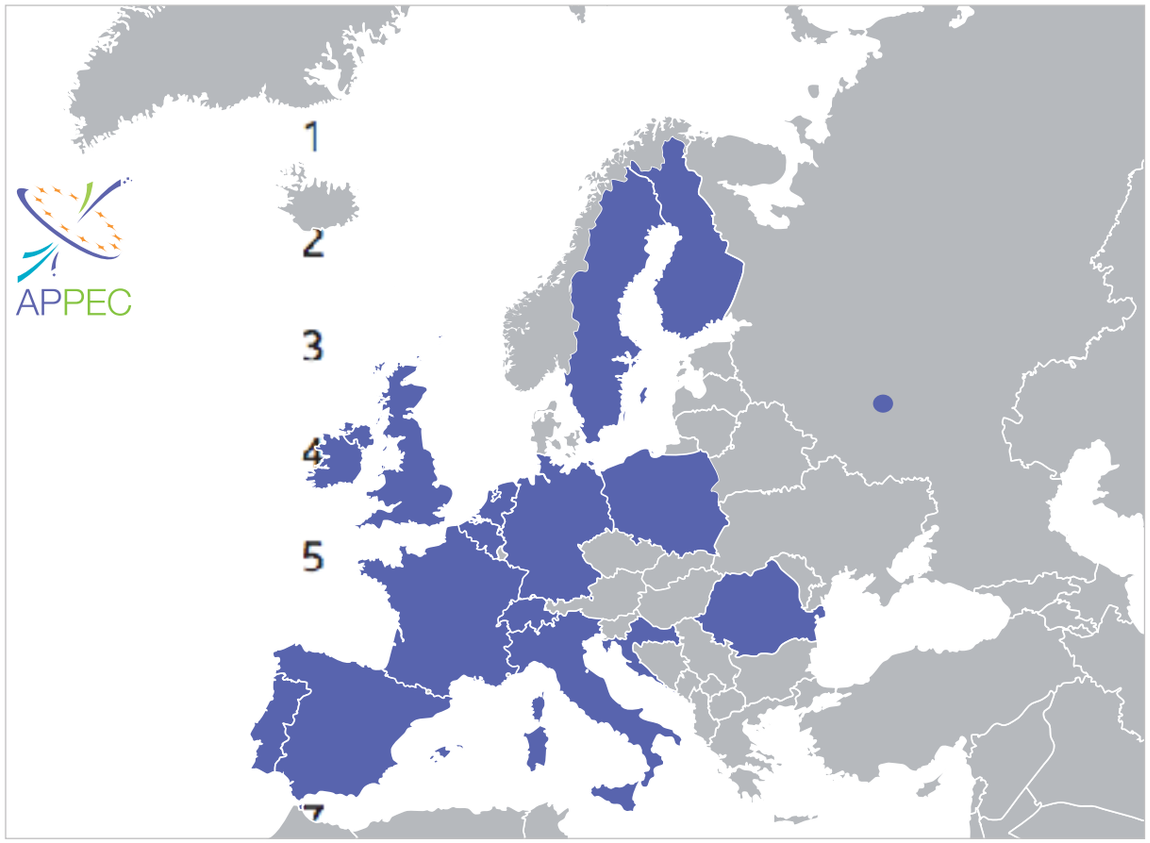
- **The Extreme Universe:** *What can we learn about the cataclysmic events in our Universe by combining all of the messengers – high-energy gamma rays, neutrinos, cosmic rays and gravitational waves – that we have at our disposal?*

- **The Dark Universe:** *What is the nature of Dark Matter and Dark Energy?*

- **Mysterious neutrinos:** What are their intricate properties and what can they tell us?

- **The Early Universe:** *What else can we learn about the Big Bang – for instance, from the cosmic microwave background (CMB)?*

APPEC Roadmap



Roadmap recommendations: summary

Scientific issues – large-scale multi-messenger infrastructures:

supports CTA realisation and its long-term operation

endorses KM3NeT ambition to realize a large volume neutrino detector by 2020 and a dedicated low energy detector for mass hierarchy. Looks forward for positive USA decision for IceCube-Gen2.

UHECRs: AugerPrime by 2019;

GW: Einstein Telescope

Scientific issues – medium-scale:

DM: continue R&D and diverse program towards convergence in 2019 on a strategy to realize one ultimate 50 ton LXe detector (DARWIN) and Argo (one LAr 300 ton detector)

Neutrino less Double beta decay: converge on a roadmap for next genera-on ton-scale detectors by 2020

Synergy with astronomy, particle physics and cosmology :

APPEC endorses EU participation in DUNE LBL, Hyper-K and JUNO reactor neutrino

Dark Energy: APPEC supports EU led satellite mission such as COrEe and complementary ground bases initiatives in USA

Cooperation between Underground labs

Roadmap recommendations

Large-scale multi-messenger infrastructures

To improve understanding of our Universe, APPEC identified as a very high priority those research infrastructures that exploit all confirmed high-energy 'messengers' (cosmic particles that can provide vital insights into the Universe and how it functions). These messengers include gamma rays, neutrinos, cosmic rays and gravitational waves. European coordination is essential to ensuring timely implementation of such infrastructures and enabling Europe to retain its scientific leadership in this field.

HE gamma rays

APPEC fully supports the CTA collaboration in order to secure the funding for its timely, cost-effective realisation and the subsequent long-term operation of this observatory covering both northern and southern hemispheres.

HE neutrinos

For the northern hemisphere (including Baikal GVD), APPEC strongly endorses the KM3NeT collaboration's ambitions to realise, by 2020: (i) a large-volume telescope with optimal angular resolution for high-energy neutrino astronomy; and (ii) a dedicated detector optimised for low-energy neutrinos, primarily aiming to resolve the neutrino mass hierarchy. For the southern hemisphere, APPEC looks forward to a positive decision in the US regarding IceCube-Gen2.

Roadmap recommendations

Large-scale multi-messenger infrastructures

To improve understanding of our Universe, APPEC identified as a very high priority those research infrastructures that exploit all confirmed high-energy ‘messengers’ (cosmic particles that can provide vital insights into the Universe and how it functions). These messengers include gamma rays, neutrinos, cosmic rays and gravitational waves. European coordination is essential to ensuring timely implementation of such infrastructures and enabling Europe to retain its scientific leadership in this field.

APPEC strongly supports the Auger collaboration’s installation of AugerPrime by 2019. At the same time, APPEC urges the community to continue R&D on alternative technologies that are cost-effective and provide a 100% (day and night) duty cycle so that, ultimately, the full sky can be observed using very large observatories.

Gravitational waves

With its global partners and in consultation with the Gravitational Wave International Committee (GWIC), APPEC will define timelines for upgrades of existing as well as next-generation ground-based interferometers. APPEC strongly supports further actions strengthening the collaboration between gravitational-wave laboratories. It also strongly supports Europe’s next-generation ground-based interferometer, the Einstein Telescope (ET) project, in developing the required technology and acquiring ESFRI status. In the field of space-based interferometry, APPEC strongly supports the European LISA proposal.

HE cosmic rays

Roadmap recommendations

Medium-scale Dark Matter and neutrino experiments

APPEC considers as its core assets the diverse, often ultra-precise and invariably ingenious suite of medium-scale laboratory experiments targeted at the discovery of extremely rare processes. These include experiments to detect the scattering of Dark Matter particles and neutrinoless double-beta decay, and direct measurement of neutrino mass using single-beta decay. Collectively, these searches must be pursued to the level of discovery, unless prevented by an irreducible background or an unrealistically high demand for capital investment.

Dark matter

APPEC encourages the continuation of a diverse and vibrant programme (including experiments as well as detector R&D) searching for WIMPs and non-WIMP Dark Matter. With its global partners, APPEC aims to converge around 2019 on a strategy aimed at realising worldwide at least one 'ultimate' Dark Matter detector based on xenon (in the order of 50 tons) and one based on argon (in the order of 300 tons), as advocated respectively by DARWIN and Argo.

APPEC strongly supports the present range of direct neutrino-mass measurements and searches for neutrinoless double-beta decay. Guided by the results of experiments currently in operation and in consultation with its global partners, APPEC intends to converge on a roadmap for the next generation of experiments into neutrino mass and nature by 2020.

Neutrinoless double beta decay

Roadmap recommendations

Medium-scale Dark Matter and neutrino experiments

APPEC considers as its core assets the diverse, often ultra-precise and invariably ingenious suite of medium-scale laboratory experiments targeted at the discovery of extremely rare processes. These include experiments to detect the scattering of Dark Matter particles and neutrinoless double-beta decay, and direct measurement of neutrino mass using single-beta decay. Collectively, these searches must be pursued to the level of discovery, unless prevented by an irreducible background or an unrealistically high demand for capital investment.

From a scientific perspective and as part of a global strategy, APPEC strongly endorses European participation in DUNE and Hyper-Kamiokande experiments – exploiting long-baseline neutrino beam facilities – as well as in the JUNO nuclear reactor neutrino experiment.

Neutrino mixing and mass hierarchy

Roadmap recommendations

Medium-scale Dark Matter and neutrino experiments

APPEC considers as its core assets the diverse, often ultra-precise and invariably ingenious suite of medium-scale laboratory experiments targeted at the discovery of extremely rare processes. These include experiments to detect the scattering of Dark Matter particles and neutrinoless double-beta decay, and direct measurement of neutrino mass using single-beta decay. Collectively, these searches must be pursued to the level of discovery, unless prevented by an irreducible background or an unrealistically high demand for capital investment.

CMB

APPEC strongly endorses a European-led satellite mission (such as COrE) to map the CMB from space. APPEC will encourage detector R&D towards a next-generation ground-based experiment complementary to initiatives in the US. APPEC continues to contribute to global coordination of this field following the Florence CMB Workshop series that started in 2015.

Dark energy

APPEC supports the forthcoming ESA Euclid satellite mission, which will establish clear European leadership in space-based Dark Energy research. Because of their complementarity to Euclid, APPEC encourages continued European participation in the US-led DESI and LSST ground-based research projects. To benefit fully from the combined power of satellite-based and ground-based experiments, the exchange of data is essential.

Roadmap recommendations

Foundations

Underpinning, driving and facilitating the experiments summarised above are vibrant programmes in theoretical physics, cutting-edge detector R&D and efforts to provide the necessary computing resources. APPEC has every intention of continuing to support and stimulate all of these activities in whatever way it can. In addition, APPEC recognises the uniqueness of the infrastructures provided by Europe's deep-underground laboratories. Without these, key APPEC research objectives would become impossible to achieve.

Theory

APPEC supports an ambitious theory programme in the field of astroparticle physics, with special attention focused on adjacent disciplines such as particle physics, astronomy and cosmology. APPEC encourages the establishment of a centre for astroparticle physics theory in one of its member countries.

R&D

APPEC stimulates and supports a range of detector R&D projects through targeted common calls and technology fora that bring scientists and industries together. APPEC encourages consortia to apply for EU (technology) grants such as those achieved by SENSE for low-level light-sensor technologies. APPEC welcomes the ATTRACT initiative, which aims to accelerate development of particle-radiation detector and imaging technologies for the science community and for the wider market.

Computing open access

APPEC requests all relevant experiments to have their computing requirements scrutinised. APPEC will engage with the particle physics and astronomy communities (e.g. within the context of EU-T0) to secure for the future a balance between available European computing resources and needs. Furthermore, APPEC encourages the use of data format standards to facilitate data access between experiments. APPEC supports the transition to Open Access publication strategies and encourages the making of data publicly available (as 'open data') to foster 'citizen science', for example.

Projected capital investment per year