KAT statement for ESPPU

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The KAT document

- Genesis:
  - Started drafting during/after KET non-collider workshop, continued during astroparticle meeting in Bad Honnef
  - Iterated with community and KAT
  - Current version to KET on 17 Jan.

- Main focus:
  - Astroparticle acivities in/relevant for particle physics
  - Particle physics activities addressing common science questions
  - CERN activities
  - Recommendations

- Objectives:
  - Coordinate with KET/particle physics
    → Avoid contradictions, add cross-references
  - Submit to ESPPU as independent document

APP activities and interest in PP

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- Measurement of neutrino mass
  → KATRIN, ECHo, Project 8; KATRIN++
- Neutrino oscillations, mass ordering, interactions
  → Oscillations, mass ordering: IceCube+Upgrade+Gen2, JUNO, KM3NeT
  (also: sensitivity to BSM effects & quantum gravity)
  → CEvNS: CONUS, NUCLEUS
- Neutrino nature (Dirac vs. Majorana)
  → 0νββ: LEGEND-200 → LEGEND-1000
- Neutrino accelerator beams (rooted in PP):
  → DUNE, Hyper-K, possibly ESSnuSB: CP violation, also APP program
- Dark matter:
  → Direct searches: XENONnT, CRESST, XLZD, DELight
  → Indirect searches: gamma-rays, neutrinos, CR, AMS
  → Axions, ALPs, FIPs, … (rooted in PP): strong interest; same for SHiP
- Gravitational waves
  → Low/high-frequency GWs directly relevant for PP; gravitation as such
  → LIGO, VIRGO, KAGRA, ET (Earth); LISA (space); PTAs (radio astron.)

Operational
R&D/construction/
demonstrators
Future

CERN supporting/complementing APP

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- Exploration of the very forward regime of hadronic interactions
- CERN neutrino platform for neutrino physics at particle accelerators
- Hosting/supporting axion experiments: MADMAX, CAST
- Technology development and transfer for Einstein Telescope (financed by ET community)
- R&D efforts towards new detector technologies, organised in collaborations such as e.g. DRD2 (liquid detectors), with APP groups
- Production and implantation of radionuclides
- Advancement of theoretical physics in fields that are also central to APP
- Support for Recognised Experiments from APP
- Efforts in fields such as computing, software, open science, outreach and training, commonly organised with the astroparticle and other communities, in particular through JENA

The German astroparticle community gratefully acknowledges this CERN programme and strongly recommends its continuation and strengthening.

ESPPU guidelines, question 4c

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To what extent should CERN participate in nuclear physics, astroparticle physics or other areas of science, while keeping in mind and adhering to the CERN Convention? Please use the current level and form of activity as the baseline for comparisons.

We also identify further opportunities for contributions by CERN that would foster the common, particle-physics related objectives. The required resources are estimated to correspond to a moderate ramp-up of those deployed for the activities described above.

- **Extending the neutrino platform** to selected further neutrino experiments not based at accelerators, thus synergistically combining different approaches to neutrino research.
- Providing a **common analysis platform for neutrino experiments**, also employing CERN's broad and leading theory expertise.
- Support for the **development of technology and experimental techniques** applicable for projects in the realm of astroparticle physics, and contributions to test and construction of these projects.

Recommendations (1)

- KAT [] strongly supports a **forceful experimental and theoretical program rooted both in astroparticle and in particle physics** []. We are determined to coordinate activities with KET in order to optimise the use of resources deployed, and the science harvest achieved.
- KAT suggests to **intensify the cooperation** between the astroparticle and particle physics communities and proposes CERN to support this process and to **define the particle physics activities rooted in astroparticle physics as one of its scientific priorities**. A coordinating effort should be directed towards a **medium- and long-time panning** so as to ensure that all initiatives [] are duly considered in decision processes.
- We acknowledge that KET and KAT [] pursue complementary approaches [] that synergistically contribute to scientific progress **without inefficient duplication of efforts**. We confirm that the astroparticle community has the interest and will to effectively and in close coordination engage in projects with a science program reaching into both particle and astroparticle physics, even if their funding is rooted in either of the fields.

Recommendations (2)

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Caveat: Not yet finally decided for KAT strategy document

- The project prioritisation of KAT will not be in contradiction with the applications for the **BMBF FIS process** (only projects for which the German contribution to construction exceeds 50 M€), and with the **forward projection of our previous recommendations**, e.g. for the last ErUM-Pro strategy talks from 2022.
- For the BMBF FIS process, applications for the following astroparticle projects have been submitted: **Einstein Telescope**, **IceCube-Gen2** (the next-generation upgrade of IceCube), **LEGEND-1000** and **XLZD**.
- KAT will continue to support the particle-related astroparticle research activities with high priority. This applies in particular: to the **neutrino mass measurement**; to **direct dark matter searches**; to the search for **neutrino-less double-beta decay**; to the **cosmic-ray, gamma-ray, gravitational-wave and neutrino observatories** targeting astrophysical research and simultaneously providing essential input for particle physics investigations.