APPEC Recommendation

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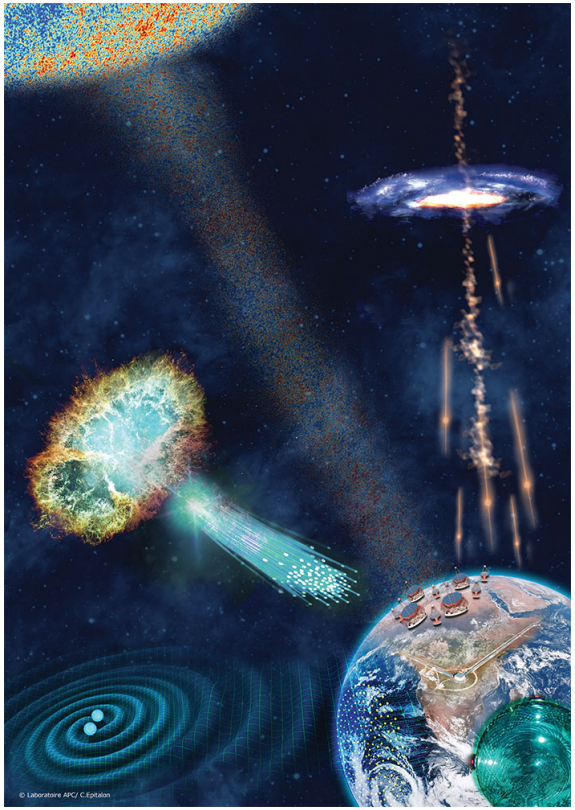
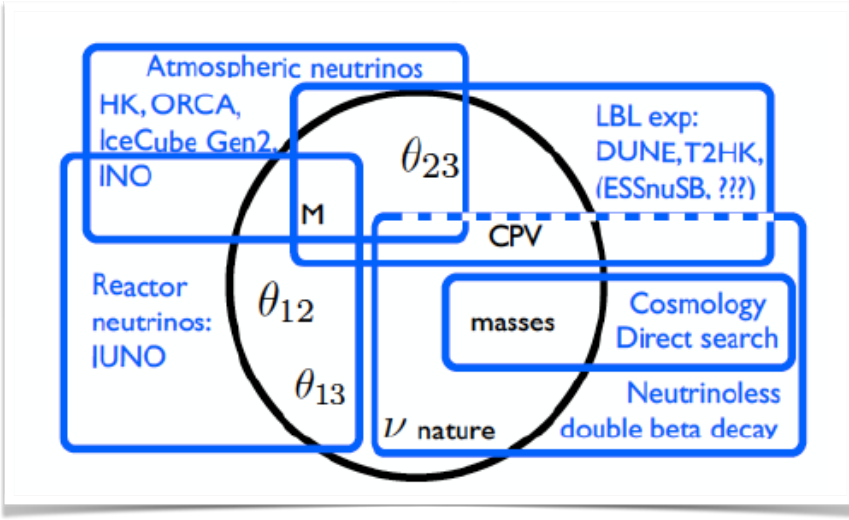
APPEC GA Chair

https://www.appec.org/roadmap



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.

Highly quoted EPPSU plot: Neutrino Physics summary by S. Pa
https://cafpe.ugr.es/eppsu2019



A panel, led by S. Pascoli and composed by A. Giuliani, J. J. Gomez Cadenas, S. Pascoli, E. Previtali, R. Saakyan, K. Schaeffner, S. Schoenert, had mandate from the APPEC SAC to produce a document on the roadmap for the necessary future steps on neutrinoless double beta (0nubb) decay, containing the status of the art, the European context and its relationship with the international one, a SWOT analysis of major experimental efforts, the theoretical view and containing recommendations.

– APPEC community Meeting (Oct. 31, 2018)

Double Beta Decay APPEC Committee Report

A. Giuliani, J. J. Gomez Cadenas, S. Pascoli, E. Previtali, R. Saakyan, K. Schaeffner, S. Schoenert

This report constitutes the roadmap document prepared by the Double Beta Decay APPEC Committee for the APPEC SAC on the future neutrinoless double beta decay experimental programme in Europe. It reviews the existing, planned and proposed technologies for neutrinoless double beta decay, their discovery potential and technical challenges, making a critical examination of resources and schedules. It also provides a concise discussion of the theoretical issues and of the status and uncertainties on the nuclear matrix element evaluation.

Comments: 53 pages, 11 figures, 3 SWOT tables. Updated recommendations and experimental information
Subjects: **High Energy Physics – Experiment (hep-ex)**; High Energy Physics – Phenomenology (hep-ph); Instrumentation and Detectors (physics.ins-det)
Cite as: arXiv:1910.04688 **[hep-ex]**
(or arXiv:1910.04688v2 **[hep-ex]** for this version)

- The SAC received the document on Jun 17, 2019 and feedback from the SAC was received on July 4 and integrated in the document during the period that followed.

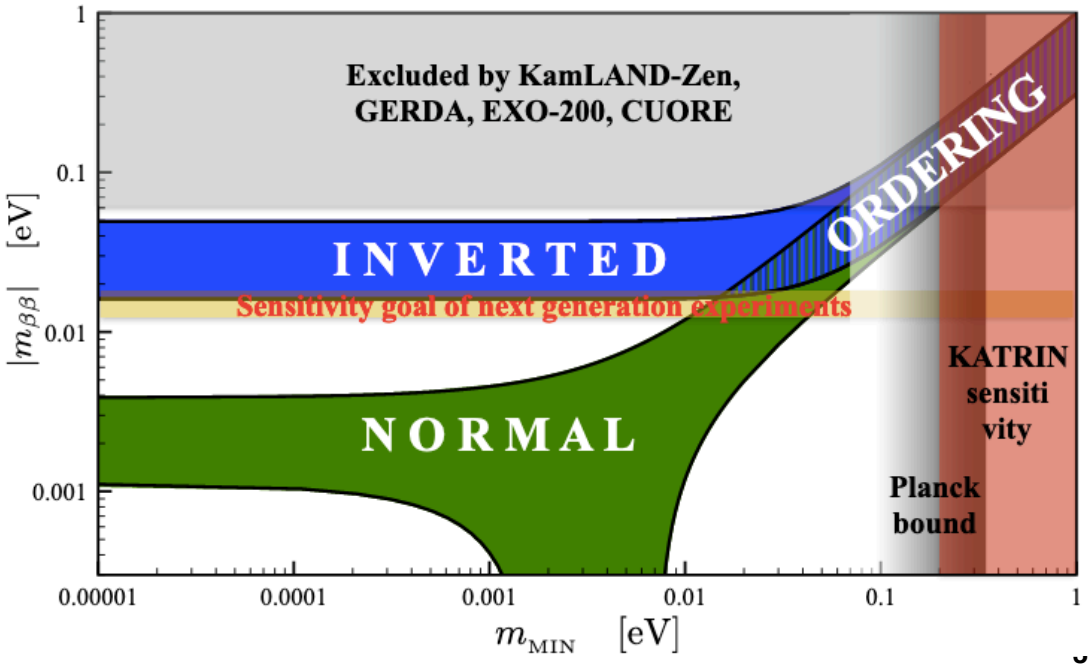
- At the beginning of October the document was released in the archive in view of a Workshop in London held on Oct. 31, 2019, organized by S. Pascoli and R. Saakyan.
- APPEC released the news describing the process set up by APPEC and the 6 panel recommendations, approved by the SAC. Additionally *the SAC recommended endorsement of at least 2 large experimental programmes in Europe*, an update on the programs in less than 3 yrs, and also endorsed R&D.
- Dec 2019: GA endorsed SAC recommendations and GA gave mandate to its Chair to further explore synergy and alignment of European funding agencies with US ones.
- At the GA meeting on Jun. 5, 2020 a round of the table consultation on the readiness of interested agencies in the two projects ready for implementation.
- Berrie Gibels, also APIF representativem represents APPEC in Snowmass 2021
- APPEC SAC is preparing a first update on the situation on the neutrinoless double beta decay projects in the mid-term review process which should be finalized in 2021: dream scenario CUPID, LEGEND, NEXT at LNGS! Next generation of ton scale experiments aiming to discover 0νββ-decay or at least to explore neutrino mass ranges below those expected with IO with very good energy resolution and very low background rate, of the order of 10^{-2} cts yr^{-1} ton^{-1} in the ROI. Best isotopes are Ge-76, Mo-100, Te-130 and Xe-136. It is important to underline that a convincing discovery of 0νββ-decay requires the observation of the decay in more than one nucleus.

Scope of this meeting

- Update round-table of consultation as decided in GA of Jun 2020 to align European agencies towards a consolidated position in future meetings with internationally agencies and particularly with DOE
- DOE already proposed to organise a meeting but we received no information despite having transmitted all relevant contacts. After this meeting, we should propose a detailed plan for the GA approval in December including a meeting with DOE.

- Today's agenda:
- Open session with 14+4 min updates from Spokespersons (please keep the time)
- Short Discussion
- Closed session for GA members

https://indico.cern.ch/event/968335/

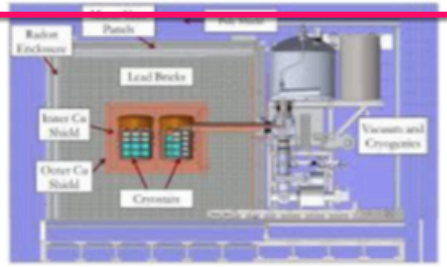


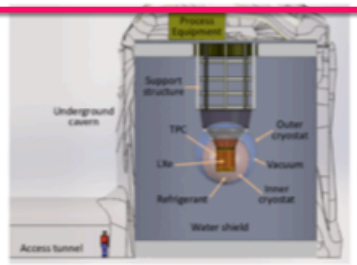
Recommendation 2: ton-scale neutrinoless double beta decay experiment

NLDBD of great interest to particle physics community (NF05);
stewarded by NP within DOE and supported by NSF in the US

NF05 https://snowmass21.org/neutrino/properties/start

- Within DOE, Office of Science, NP is the steward of neutrinoless double beta decay and the ton-scale experiment
- Critical Decision – 0, Mission Need, approved in November 2018
- TEC construction start for a ton-scale 0νββ experiment requested in the FY2020 President's Budget Request. TEC Funding of $1.44M Requested. R&D funding is continuing
- Met on the margins of IUPAP WG9 Meeting in London (8/2019) to discuss possible international collaboration
- Processes for technology down-select and site selection for a 1 ton experiment are under discussion:
  - Three front runner candidate experiments, LEGEND-1000 (Ge-76), CUPID (Mo-100), nEXO (Xe-136).
  - Three current candidate site locations: Gran Sasso (Italy), SNOLAB (Canada) and SURF (U.S)





T. Hallman, October 2019 NSAC meeting

- progress by ongoing experiments and R&D for next-generation
- progress in theory
- anticipated "down-select" still under discussion (site, technology)

From Snowmass, K. Scholberg

INFRASTRUCTURE/TOOLS QUESTIONS

- Questions From CPM Sessions:
  - How low can noise characteristics of detector systems be pushed using quantum sensors? How can we deploy quantum sensors in mid-scale experiments?
  - Computing tradeoffs between "ease of use" and agility? Successful examples to follow for data preservation and reanalysis? New ways to think about systematics analysis to better use resources?
  - What is the best way to pursue large multi-purpose (DM, $0\nu\beta\beta$, neutrinos) experiments? How to handle stovepiping?
  - What is the status of detector technologies being considered for UHE neutrinos and what physics topics do these facilitate?
- Identified Cross Cuts:
  - Describing neutrino-nucleus scattering from the Standard Model requires control of QCD over a wide range of scales and physics processes
  - AF would like input on requirements for beam details (intensity, energy, timing, etc) for neutrino experiments
  - Gravitational wave detectors and experiments using atomic techniques have complementary technology challenges in quantum sensing; significant overlap with IF in detectors/sensors/etc
  - Desire expressed for underground facilities to coordinate with the physics community and among the labs, to facilitate multiple scales of experiments, and to support full realization of US-based facility at SURF. Additional sites at SURF and SNOLAB being explored for future

Snowmass In Europe: establish an ERIC supporting underground facilities?