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Sensitivity studies for eV scale sterile neutrino searches with KATRIN

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KATRIN has recently reported an unrivalled sub-eV direct constraint of the neutrino mass from tritium beta-decay spectrum measurements [1]. Along with the neutrino-mass search, KATRIN has published first results of searching for a fourth (sterile) neutrino with a mass in the eV-range using the precision beta-decay spectra [2],[3].

The fourth neutrino mass-eigenstate introduces an additional branch into the tritium β -spectrum which manifests as a kink in the model of the differential spectrum. Position and amplitude of this kink correspond to the sterile neutrino mass m_4 and effective mixing angle $\sin^2(\theta) = |U_{e4}|^2$, respectively. In this work sensitivity studies to light sterile neutrinos based on additional science runs and the effect of systematic uncertainties are presented. The analysis region is a two-dimensional parameter space given by $m_4^2 < 1000 \text{ eV}^2$ and $\sin^2(\theta) < 5 \times 10^{-1}$. A scanning grid with 50×50 points in the $(m_4^2, \sin^2(\theta))$ plane is chosen and sensitivity contours are calculated within this parameter space. Future strategies for a combined analysis of successive measurement campaigns are discussed.

References:

- [1] Direct neutrino-mass measurement with sub-electronvolt sensitivity, KATRIN Collaboration, Nature Phys. 18 (2022) 2, 160-166
- [2] Bound on 3+1 Active-Sterile Neutrino Mixing from the First Four-Week Science Run of KATRIN, DOI: 10.1103/PhysRevLett.126.091803,(2021), KATRIN Collaboration
- [3] Improved eV-scale sterile-neutrino constraints from the second KATRIN measurement campaign, DOI: 10.1103/PhysRevD.105.072004,(2022), KATRIN Collaboration

Category

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Primary author(s) : Ms. MOHANTY, Shailaja (IAP, Karlsruhe Institute of Technology)

Presenter(s) : Ms. MOHANTY, Shailaja (IAP, Karlsruhe Institute of Technology)

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