

Neutrinos and how to measure their mass

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Nearly 70 years since the discovery of the neutrino, and 25 years since it was established that they have non-zero mass, the absolute neutrino-mass scale remains unknown. Due to its unique characteristics, determining neutrino mass requires new measurement techniques to be developed. Currently, there are four approaches: using cosmological models, inference from time-of-arrival from supernovae, through observation of neutrinoless double beta decay, and the kinematics of beta decay processes.

I will review the theoretical basis underlying neutrino mass measurement and present key experiments in the field. Due to the great variety in measurement techniques, I will focus on two experiments which I have personal experience with: KATRIN and Project 8. Whereas these experiments' common technical goal is a lab-based (non-accelerator) precision energy reconstruction of tritium beta decay electrons, the experiments differ in detection approaches, which I will summarize in the talk.

Larisa Thorne: “My scientific career was sparked by an endless supply of books about space and natural sciences. After my bachelor degree was completed (UC Santa Barbara, 2013), I transitioned away from observational astrophysics to nuclear physics (at Carnegie Mellon University). This was partially a practical decision, but it allowed me to engage in research with a professor I worked well with. The path still wasn't always direct: I had to switch about 1.5 years into my PhD when my experiment at Jefferson Lab couldn't proceed. This is what gave me the opportunity to engage in neutrino physics, so I switched to that and did my PhD (completed June 2021) in neutrino mass analysis with the KATRIN experiment. I stayed in neutrino mass physics by joining the group of Martin Fertl here at JGU Mainz as postdoc in July 2021. Here we are performing R&D for an atomic tritium source for the Project 8 experiment. On the side, I am project lead for a collaboration with Tritium Laboratory Karlsruhe and am the KATRIN Mainz Institutional Representative.”