Contribution ID: **180** Type: **Poster**

Measurement of the nuclear transition energies of ^{83m}Kr for absolute calibration of the KATRIN energy scale

Monday 28 August 2023 20:24 (1 minute)

The KATRIN experiment aims to measure or exclude the effective electron neutrino mass m_ν down to 0.2 eV/c^2 (90 % C.L.) by measuring the tritium beta spectrum near its endpoint E_0, and performing a fit including the parameters E_0 and m_ν^2. Since these are highly correlated, a systematic shift influencing the obtained neutrino mass would be visible in the endpoint and thus tritium Q value. Q has been derived from the mass difference of $^3He^+$ and ^3H with 70 meV precision (cf. PRL. 114, 013003 (2015)).
This has not been applicable to KATRIN so far due to uncertainty of the measured plasma potential in the tritium source.
The KATRIN Q value can also be determined by absolute calibration with conversion electron lines from co-circulating ^{83m}Kr.
This is however limited by nuclear gamma transition energy uncertainties of ^{83m}Kr to 0.5 eV accuracy. The excited nucleus of ^{83m}Kr decays in a two-step cascade of 32.2 keV and 9.4 keV highly converted gamma transitions.
In new measurements performed at KATRIN, a large set of conversion electron lines, including a new line, was measured with a gaseous and a condensed krypton source. Following the method described in EPJ C 82 (2022) 700, the ^{83m}Kr gamma transition energies can be determined, which can allow for reduction of tritium Q value uncertainty to ˜0.1 eV. This poster presents the status of the analysis.

Supported by BMBF under contract number 05A20PMA.

Submitted on behalf of a Collaboration?

Yes

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Session Classification: Poster session

Track Classification: Neutrino physics and astrophysics