Contribution ID: **18** Type: **not specified**

In-situ tritium decontamination of the KATRIN Rear Wall

Wednesday, May 24, 2023 2:00 PM (1 hour)

The KATRIN collaboration aims to determine the neutrino mass with a sensitivity of 0.2 eV/c² (90% CL). This will be achieved by probing the endpoint region of the β-electron spectrum of gaseous tritium with an electrostatic spectrometer. A gold-coated stainless steel disk defines the reference potential for the high precision neutrino mass measurement and it terminates the β-electron flux as the physical boundary of the tritium source. This so-called Rear Wall is exposed to tritium, which leads to ad- and absorption. This in turn leads to systematic uncertainties for the neutrino mass measurements that need to be understood and mitigated. In maintenance phases, during which the gaseous tritium source was emptied ($<10^{-5}$ of nominal gas density), the activity accumulated on the Rear Wall during normal operation was monitored using β-induced X-ray spectrometry (BIXS) and direct observation of emitted β-electrons with a silicon detector. The
dependency of the observed activity increase on the integral tritium throughput was investigated and found to converge from a limited exponential growth to a continuous linear growth. This poster gives an overview of the results we obtained using several methods of in-situ decontamination of the Rear Wall while continuously monitoring the activity. The decontamination methods included
heating during continuous evacuation, flushing the system with nitrogen, deuterium or air with residual humidity at different pressures and illumination of the Rear Wall with UV-light. These well-known methods led only to a small (≈ 15%) decrease in the observed activity. However, a decrease of the surface activity by three orders of magnitude in less than a week was achieved by
combination of different methods using UV light, a heated surface and a low (5 mbar–100 mbar) pressure of air inside the chamber, leading to the production of highly reactive ozone. This proved to be by far the most efficient method, drastically reducing the contribution of the Rear Wall surface activity to the β-spectrum of the gaseous source.

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Session Classification: Poster session

Track Classification: Poster presentations