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Status and Perspectives of the KATRIN Experiment

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"The KATRIN experiment is aiming to directly measure the absolute neutrino mass scale from the kinematics of tritium beta-decay. KATRIN is located at KIT (Karlsruhe Institute of Technology) and is currently under construction. The experiment will analyze the shape of the high energy end of the tritium beta-spectrum. A nonzero neutrino mass reduces the endpoint energy and distorts the spectrum, especially in the vicinity of this endpoint. This spectrum will be analyzed with a 24 m by 10 m electrostatic spectrometer combined with magnetic collimation (MAC-E-Filter). To reach the design sensitivity of 200 meV, high energy resolution, high signal count-rates and a low background are required.

This talk will focus both on the current status of the experiment with special emphasis on the spectrometer related backgrounds as well as on future perspectives of the KATRIN experiment making use of the its unique source properties.

Background due to stored electrons arising from radon 220 and radon 219 alpha-decay as well as tritium beta-decay in the volume of the main spectrometer is the anticipated main background source. A single nuclear decay can produce an enhanced background level for up to 10 hours. To alleviate the background arising from stored electrons, a novel method based on stochastic heating by using the technique of electron cyclotron resonance (ECR) will be applied. Both measurements and corresponding simulations demonstrate that a high frequency field tuned to the cyclotron frequency of the stored electrons breaks their storage condition by stochastic heating within less than 5 ms. This method will allow for an almost background free spectrometer.

KATRIN makes use of a gaseous molecular tritium source of extremely high activity and stability. These unique source properties allow KATRIN to extent its physics reach from its main goal of measuring the neutrino mass in the sub-eV range to look for contributions of possible neutrinos in the multi-keV range constituting a possible candidate for Warm Dark Matter. A heavy sterile neutrino would manifest itself as a tiny kink and subsequent spectral distortion deep in the beta spectrum, further away from the endpoint. In this talk a sensitivity study of a KATRIN-like experiment to detect keV neutrinos will be presented. Different statistical analysis techniques, the effect of systematic uncertainties and possible technical realizations will be discussed."

Author: MERTENS, Susanne

Presenter: MERTENS, Susanne

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