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SDDs for high-rate and high-resolution electron spectroscopy

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The TRISTAN project is the upgrade of the KATRIN experiment that will search for sterile neutrinos with mass in the keV range through precise measurements of the entire Tritium β-spectrum.
For this purpose, the current KATRIN detector must be replaced with a multipixel detector based on Silicon Drift Detectors (SDDs). SDDs have a small anode capacitance that is reflected in a small equivalent noise charge and therefore in a very high energy resolution close to the Fano limit in Silicon. Moreover, thanks to this small capacitance, the signal risetimes are of the order of few tens of nanoseconds. These features make SDDs ideal for high-rate spectroscopy. In particular, they are commonly used for X-ray measurements. Electron spectroscopy is a relatively novel application, it is therefore necessary to characterize SDDs response to electrons.
We focused our attention on two aspects: the detector dead-layer and the electron backscattering probability. We performed precise measurements in a dedicated setup consisting in a SDD matrix and an electron-gun as a monochromatic and collimated electrons source. In both cases we compared our results with Geant4 Montecarlo simulations.
The precise knowledge of SDDs response to electrons is mandatory in order to accurately reconstruct the continuous β-spectrum that will be measured in TRISTAN.
We have also investigated the possibility to use a SDD as a versatile and compact β spectrometer that can be operated with standard technologies. The goal is to make precise measurements of some interesting β-decaying isotopes that can have an impact in neutrino and nuclear physics.

Collaboration

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