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Gas electron tracking detector for beta decay experiments

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For 3D-tracking and identification of low-energy electrons a new type of gas-based detector was designed that minimizes scattering and energy loss.The current version of the detector is a combination of a plastic scintillator,serving as a trigger source,and a hexagonally structured multi-wire drift chamber(MWDC),filled with a mixture of helium and isobutane gas.The drift time information is used to track particles in the plane perpendicular to the wires,while a charge division technique provides spatial information along the wires.The gas tracker was successfully used in the miniBETA project as a beta spectrometer for the measurement of weak magnetism form factor in nuclear beta decay.The precision of the three-dimensional electron tracking,in combination with low-mass,low-Z materials and monitoring of backscattering from the electron energy detector,facilitated a reduction of the main systematics effects.

In the talk the results of the detector characterization will be presented.These results originate from performance studies with cosmic muons and low-energy electrons (<2 MeV) conducted for several pressures (300–700 mbar) and isobutane add-mixture percentages (10–50%).At certain conditions,a spatial resolution better than 0.5 mm was obtained in the plane perpendicular to the wires,while resolutions of 4–8 mm were recorded along wires.Thanks to precise tracking information,it is possible to eliminate electrons and other particles not originating from the desired decay with high efficiency.Additionally,using the coincidence between MWDC and trigger,background from gamma emission typically accompanying radioactive decays,was highly suppressed.An overview of the possible types of detector events will be provided together with the tracker's ability to correctly recognize them.The latter was done by Monte Carlo simulations with Geant4 and Garfield++.Finally,the preliminary results from the beta spectrum study will be reported as well.

The presented experimental technique is also applied to the beta decay correlation experiment for tracking of electrons in neutron beta decay (BRAND project).Furthermore,it could be implemented for cloud size monitoring in ion traps.

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