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Sub-kelvin electron detectors for the LEMING muonium gravity experiment

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The LEMING experiment aims to test weak equivalence in leptonic antimatter using a novel cold muonium beam, that we recently synthesised from superfluid helium. For this experiment, it is paramount to operate particle detectors at temperatures below 1K, partially in the superfluid environment. The cryogenic detectors need to be capable of tracking positrons from decaying muons in a large solid angle and at a spatial resolution of ˜1mm, in coincidence with the low-energy atomic electrons released in the same process. Efficiency and background suppression capabilities of this detector system directly impact the sensitivity of the final measurement. We have demonstrated efficient and reliable sub-kelvin positron detection with commercial silicon photomultipliers (SiPMs) coupled to thin scintillator segments. Presently, we are working on a silicon-strip-based tracker system, further increasing spatial resolution and solid angle coverage. To detect the eV-range atomic electrons, we collect and accelerate them towards a low-threshold detector with an electric field of a few kV. We have obtained promising results using perovskite nanocrystals for this purpose, significantly outperforming plastic scintillators.

This talk will focus on the cryogenic particle detectors of the LEMING experiment, in particular the characterisation of novel perovskite scintillators as well as silicon strip detectors below 1K.

Primary experiment

LEMING

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