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ELECTRON - Development of High Resolution Metallic Microcalorimeters for a Future Neutrino Mass Experiment with Tritium

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Metallic Magnetic Calorimeters (MMCs) are low temperature single particle detectors, whose working principle is based on quantum technology. Due to their excellent energy resolution, near linear detector response, fast signal rise time and close to 100% quantum efficiency, MMCs outperform conventional detectors by several orders of magnitude, making them interesting for a wide range of different applications. This technology would be of particular interest for the next-generation neutrino mass experiment with tritium, which would aim beyond the sensitivity goal of the most-sensitive KATRIN experiment ($m_\nu < 200\,\mathrm{meV}$).
However, although MMCs have previously been used in measurements of photons and heavy ions with great success, no information is currently available on the interaction between the MMC detectors and external light charger particles (i.e. electrons).
This is precisely the goal of the ELECTRON project, which aims to provide this missing information and demonstrate, for the first time, that MMC based detectors can be employed for a high resolution spectroscopy of external electron sources. To this end, three different electron sources will be used to study the interplay between the MMC detector and the electrons, as well as to identify potential systematic effects. Electron-gun, which offers a possibility to easily adjust the rate and the energy of the electrons, and Kr-83m, with its well defined conversion electron lines, will be used for a proper characterisation and calibration of the detectors. Once the detector behaviour is well characterised, newly developed tritium sources will be employed for the first measurements of the tritium β-decay spectrum with a cryogenic microcalorimeter, paving the way for the next generation neutrino experiments with tritium.
We present the results of the first measurement campaigns, which include the measurements of the Kr-83m spectrum together with the first ever measured tritium β-decay spectrum obtained with a cryogenic microcalorimeter.

Collaboration

Role of Submitter

I am the presenter

Primary authors: KOVAC, Neven (KIT); Dr BAUER, Fabienne (Institute of Micro- and Nanoelectronic Systems (IMS), Karlsruhe Institute of Technology (KIT))

Co-authors: APP, Tamara E. (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); Dr BORNSCHEIN, Beate (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); DE VINCENZ, Daniel (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); Dr GLÜCK, Ferenc (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); HEYNS, Svenja (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); Prof. KEMPF, Sebastian (Institute of Micro- and Nanoelectronic Systems (IMS), Karlsruhe Institute of Technology (KIT)); LANGER, Marie C. (Institute of Micro- and Nanoelectronic Systems (IMS), Karlsruhe Institute of Technology (KIT)); MÜLLER, Michael (Institute of Micro- and Nanoelectronic Systems (IMS), Karlsruhe Institute of Technology (KIT)); Dr SACK, Rudolf (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); Dr SCHLÖSSER, Magnus (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); Dr STEIDL, Markus (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT)); Prof. VALERIUS, Kathrin (Institute for Astroparticle Physics (IAP), Karlsruhe Institute of Technology (KIT))

Presenter: KOVAC, Neven (KIT)

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