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Status of the HOLMES experiment to directly measure the electron neutrino mass with a calorimetric approach.

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The measurement of neutrino mass is still one of the most compelling issues in modern particle physics. Beta or electron capture (EC) spectrum end-point study is currently the only experimental method which can provide a model independent measurement. The HOLMES experiment aims at directly measuring the neutrino mass with a calorimetric approach: the source is embedded inside the detector and the energy released in the decay process is entirely contained, except for the fraction taken away by the neutrino. Both the issues related to the use of an external source and the systematic uncertainties arising from decays on excited final states are eliminated. The main goal of the HOLMES project is reaching a neutrino mass statistical sensitivity as low as 1 eV. In order to do this the released energy will be measured using 16 sub-arrays of Transition Edge Sensor based micro-calorimeters (64 TES for each array) with 163Ho source (EC) embedded inside. 163Ho is chosen as source for its very low Q-value (2.8 keV), the proximity of the end-point to resonance M1 and its half-life (4570 y). These features are optimal to reach simultaneously a reasonable activity to have sufficient statistics in the end-point, reducing the pile-up probability and have a small quan- tity of 163Ho embedded in the detector not to alter significantly its heat capacity. Each TES will have an energy resolution of ≈ 1 eV FWHM, a time resolution of about 1 μs and will be read out using microwave multiplexed rf-SQUIDs in combination with a ROACH2 based digital acquisition system. An activity of 300 Bq will be implanted in each micro-calorimeter allowing to collect about 3 × 1013 decays in three years. HOLMES will be an important step forward in the direct neutrino mass measurement with a calorimetric approach as an alternative to spectrometry and will also establish the potential of this approach to extend the sensitivity down to 0.1 eV and lower. In this contribution, we show the HOLMES experiment with its physics reach and technical challenges, along with its status and perspectives. In particular we will present the status of the HOLMES activities concerning the 163Ho isotope production, purification and implantation, the TES pixel design and optimization, the multiplexed array read-out characterization, the cryogenic set-up installation.

Working Group

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Primary author: Dr GALLUCCI, Giovanni (INFN - Genova)

Presenter: Dr GALLUCCI, Giovanni (INFN - Genova)

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