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First measurements of the HOLMES neutrino mass experiment

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Concerning particle physics and cosmology, the neutrino mass measurement will shed light on several important open issues. Neutrino mass information can be extrapolated from a beta-decay spectrum analysis. Not relying on any theoretical hypothesis but energy-momentum conservation, this is known as direct measurement. In this field, the state-of-the-art is represented by the KATRIN spectrometer which will improve its sensitivity at most to O(0.2 eV).

An alternative for future research is the calorimetric approach. By embedding the beta source inside the detector the decay products are fully contained and several systematic effects are avoided. The HOLMES experiment will prove the feasibility of this approach by ion-implanting a source of ^{163}Ho in Transition Edge Sensors (TESs). These microcalorimeters ensure high energy and time resolutions. They also allow a distribution of the total activity over a large number of pixels that we read out using the μ-wave multiplexing technique. ^{163}Ho electron capture (EC) was proposed for direct neutrino mass determination because of its low Q-value ($\sim$2.83 keV) that increases the fraction of useful events in the region close to the spectrum endpoint.

An array of 64 TESs has already been measured. The EC spectrum reconstruction will be performed with a robust set of data filtering routines while its endpoint region will be analyzed with Bayesian-based algorithms. Once the first ^{163}Ho low-dose implantation was accomplished, a preliminary measurement with a pixel activity of O(1 Bq) began in late 2023. Using an external source, the experiment calibrated the ^{163}Ho spectral features. By increasing the amount of collected data during 2024, HOLMES will assess an initial upper limit on m_ν of about $\sim$ 30 eV. In my contribution, I will summarize the results obtained so far from the HOLMES first measurements.

Collaboration

HOLMES collaboration

Role of Submitter

I am the presenter

Primary author: ORIGO, Luca (Università di Milano Bicocca / INFN)

Co-authors: BEVILACQUA, Adriano (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Genova, Genova, Italy);   GIACHERO, Andrea (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Milano-Bicocca, Milano, Italy);   NUCCIOTTI, Angelo (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy);   ALPERT, Bradley (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   REINTSEMA, Carl (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   SCHMIDT, Dan (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   BECKER, Daniel (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   SWETZ, Daniel (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   LABRANCA, Danilo (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy);   SCHUMANN, Dorothea (Paul Scherrer Institut (PSI), Villigen, Switzerland);   BENNETT, Douglas (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   CELASCO, Edvige (Dipartimento di Fisica, Universit'a di Genova, Genova, Italy);   FERRI, Elena (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Milano-Bicocca, Milano, Italy);   MAUGERI, Emilio (Paul Scherrer Institut (PSI), Villigen, Switzerland);   SICCARDI, Fabio (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Genova, Genova, Italy);   GATTI, Flavio (Dipartimento di Fisica, Universit'a di Genova, Genova, Italy);   HILTON, Gene (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA);   CERUTI, Giancarlo (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Milano-Bicocca, Milano, Italy);   PESSINA, Gianluigi (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Milano-Bicocca, Milano, Italy);   GALLUCCI, Giovanni (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di

Genova, Genova, Italy); ULLOM, Joel (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA); GARD, John (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA); MATES, John (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA); FOWLER, Joseph (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA); VALE, Leila (National Institute of Standards and Technology (NIST), Boulder, Colorado, USA); PARODI, Luigi (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Genova, Genova, Italy); FAVERZANI, Marco (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); GOBBO, Marco (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); BORGHESI, Matteo (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); DE GERONE, Matteo (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Genova, Genova, Italy); LUSIGNOLI, Maurizio (Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Roma 1, Roma, Italy); CERBONI, Noemi (Paul Scherrer Institut (PSI), Villigen, Switzerland); CAMPANA, Pietro (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); MORETTI, Roberto (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); CAROBENE, Rodolfo (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); DRESSLER, Rugard (Paul Scherrer Institut (PSI), Villigen, Switzerland); RAGAZZI, Stefano (Dipartimento di Fisica, Universit'a di Milano-Bicocca, Milano, Italy); KÖSTER, Ulli (Institut Laue-Langevin (ILL), Grenoble, France)

Presenter: ORIGO, Luca (Università di Milano Bicocca / INFN)

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