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HOLMES+ Project

HOLMES+ is the natural evolution of the HOLMES project toward an ambitious experiment capable of directly measuring a neutrino mass lower than 100 meV. Since HOLMES, together with the competing ECHo experiment, has demonstrated both the feasibility of electron-capture calorimetry with ^{163}Ho as a method for investigating neutrino mass and the availability of all the necessary technologies, it is possible to formulate a realistic and evidence-based plan for a future experiment with sub-eV sensitivity.\\
With HOLMES+, we propose to start by bridging the gap toward a large-scale final experiment by setting two main goals. First, we propose to scale up the HOLMES experiment from the current 64 to 256 detectors, while improving the quality of the ion implantation to achieve a uniform activity of about 1 Bq in all detectors. The aim is to perform a high-statistics measurement to study the problems associated with combining data sets taken with many detectors. Secondly, in parallel with the previous effort, we propose to optimize the working temperature of the detectors and the efficiency of the ion source for implantation to realize a first small prototype of the high-activity detectors needed for the large-scale experiment. We plan to realize an array of about ten implanted detectors with an activity of at least 30 Bq of ^{163}Ho, which represents an improvement over the current HOLMES' detector activity by a factor of $\sim$100.
Both the low and the high activity arrays will be hosted in the HOLMES dilution refrigerator, and both will also allow us to test new readout and DAQ systems with improved performance and a reduced cost per channel.\\
High-statistics data taken with both arrays will improve the limit on the neutrino mass to the few eV level, and we will have the opportunity to better understand potential statistical sensitivity of the ^{163}Ho experiments, possibly confirming the recent findings of HOLMES and ECHo. In fact, their data suggest that the achievable sensitivity is up to two times better than predicted by the first-order theoretical calorimetric EC decay spectrum.

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