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Temperature and concentration dependence of the heat capacity contribution of holmium ions embedded in metallic absorbers of MMC detectors developed for the ECHo experiment

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We have investigated dilute alloys of small amounts of holmium in gold and silver in order to determine the impact of their heat capacity contribution on the performance of the microcalorimeters in the neutrino mass experiment ECHo. In particular, we focus on alloys with atomic concentrations of $x_{\mathrm{Ho}} = 0.01\,\% \text{ - } 3\,\%$ at temperatures between 10 mK and 800 mK. Due to the large total angular momentum $J = 8$ and nuclear spin $I = 7/2$ of holmium, the specific heat of Au:Ho and Ag:Ho depends on the detailed interplay of various interactions. This makes it rather difficult to accurately determine the specific heat of these materials numerically. We have measured the specific heat of the materials in question using three different experimental set-ups, two of which were optimized for different temperature ranges and are based on the well-established relaxation method, where the thermal relaxation following a well-defined heat pulse is monitored to extract the specific heat. The third set-up relies on the temperature response of two pixels of the same double meander MMC detector, one with a Ho-doped and one with a Ho-free absorber, after being hit by a K\alpha x-ray from an ^{55}Fe-source. The results obtained with the three set-ups agree within the expected error margin. We will discuss the temperature- and concentration-dependent measurements as well as the qualitative understanding of the underlying physics.

Less than 5 years of experience since completion of Ph.D

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