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Lowering the energy thresholds for the CUORE Experiment: A comparison between Optimum Trigger and Derivative Trigger Algorithm performances

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CUORE (Cryogenic Underground Observatory for Rare Events) is a tonne-scale cryogenic detector located at the Laboratori Nazionali del Gran Sasso exploiting bolometric technique to search for neutrinoless double beta decay of 130Te. The experimental signature is a sharp peak at the Q value of the decay in the summed energy spectrum of the electrons emitted.
Thanks to its very low background and large source mass, CUORE is also a powerful tool to study a broad class of low energy phenomena such as solar axions or WIMP scattering. However, the possibility to conduct such sensitive searches strongly depends on the energy threshold.
Moreover, as we expect a neutrinoless double beta decay to be fully contained in one crystal, we exclude from the final energy spectrum decays depositing energy in multiple crystals within a certain coincidence window. The trigger configuration influences the anti-coincidence selection in two ways: the timestamp assigned to physical events and above all the energy threshold for coincident events.

First CUORE data were acquired with the derivative trigger algorithm, with energy thresholds ranging from 20 to 100 keV. However, another trigger algorithm based on the optimal filter technique has been developed in these years. Data are filtered in the frequency domain in order to maximise the SNR. As a result, the noise superimposed on physical events is strongly reduced and the energy thresholds can be lowered. Currently CUORE data are re-triggered exploiting this technique.

In this contribution we will present a comparison of the performances of the two trigger methods in the analysis steps for the search of neutrinoless double beta decay of 130 Te, with particular attention to the improvement obtained with the optimum trigger in the background reduction with anti-coincidence selection.

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

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