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Towards 60eV FWHM Pulser Resolution in 2.5kg HPGe Point Contact Detectors

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Neutrino and astroparticle physics experiments involving detection of rare and weak interactions, like GERDA, MAJORANA, TEXONO, CDEX , CoGeNT have driven the development of large mass ultra low noise detectors.
With respect to other solid-state materials, germanium presents major advantages for high-sensitivity γ-ray detection. Its excellent electrical properties (lowest band gap and good carrier mobility) are coupled with the best energy resolution of any material. Large single crystals of HPGe (several kg), with impurity concentrations in the range can be grown on an industrial scale, which lead to high levels of detection efficiency.
Low-noise electronics have become key features in the design of high-purity germanium (HPGe) detectors, and has allowed the reach of record detector resolutions. At the same time, as relevant events sometimes have a detection rate as low as 1 event/year/kg of HPGe, an ultra-low radioactive background for all the detector parts, including the front end electronics, is also crucial to the success of these experiments.
This work focuses on the results obtained in the efforts of designing a large (>2 kg) HPGe detector having a modified "point contact"central electrode, combined with an ultra-low noise electronic front end. Measurements on manufactured detectors show record electronic noise performances (65eV FWHM pulser resolution on a 1.5kg HPGe crystal), which translate into a noise threshold below 200eV, making it the ideal instrument for Dark Matter and neutrino experiments. This paper will describe the progress towards reaching similar or better electronic noise performance in even larger HPGe detectors, with current focus to go towards 2.5kg crystals.

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