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Commissioning of CUORE Fast Cooling System

Abstract

CUORE is a cryogenic bolometer experiment; consisting of a 1-ton scale array of 988 TeO2 crystals, designed mainly to search for Neutrinoless Double Beta Decay Decay in 130-Te isotope, an observation hypothesized to occur only if neutrinos are Majorana particles. These crystals will act both as the source of the decay and as detector and need a base temperature around 10 mK. In order to cool them, a large cryostat with five Pulse Tubes (PT) and one custom high-power Dilution refrigerator has been designed. The cryostat mass is about 15 tons and it has to be cooled at 4K by five PT; process that would take about 5 months, before the Dilution refrigerator starts to cool down to the mK stage. To speed up the process, an apparatus called Fast Cooling System (FCS) was developed to pre-cool from 300K to 60K temperature, in about 13 days, as obtained in the performance validation test Run 3.0 in Fall 2015. These results are crucial in the well-functioning and temperature stability of the experiment.

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