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The CUORE pulse tubes noise cancellation technique

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The 1-ton scale CUORE detector is made of 988 TeO₂ crystals operated as cryogenic bolometers at a working temperature of ~10 mK. In order to provide the necessary cooling power at 4K stage, a total of five Pulse Tubes refrigerators (PTs) are used. The PTs make the cryogenic system reliable and stable, but have the downside that mechanical vibrations at low frequencies (1.4 Hz and related harmonics) are injected into the experimental apparatus. We have developed an active noise cancellation technique in order to reduce such effect by taking advantage from the coherent interference between the pressure oscillations originated by different PTs. The technique that will be presented consists in controlling the relative phases of the pressure waves running inside the CUORE PTs lines, in order to achieve the lowest detector noise. By reducing the power of PTs harmonics by a factor up to 10^3 - 10^4 , this technique allows to drastically suppress the overall noise RMS on the CUORE detector.

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

N

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Y

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