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The active Pulse Tube noise cancellation technique of the CUORE experiment

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The CUORE experiment operates 742 kg of TeO_2 crystals as cryogenic bolometers at ˜10 mK. The CUORE cryostat –the today's largest mK infrastructure in the world –provides the cooling power at 4 K by mean of five Pulse Tube (PT) cryocoolers. The success of the experiment stands on the capability to mitigate the mechanical vibrations, which can significantly spoil the detector energy resolution. In this contribution we present an innovative, simple and effective technique to drive the relative phase of the PT pressure waves, that drastically reduces the detector noise by suppressing the amplitude of PT harmonics power up to a factor 10^4. This result validates the technology and will ease the development K and sub-K environments based on cryogen-free systems and demanding low-noise and large-cooling power. Besides calorimetric searches in physics, these also include industry-oriented applications such as tunneling microscopy, quantum computing and semiconductor manufacturing.

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