Research Report
ICRR Inter-University Research Program 2020

Research Subject:

Cryostat vibration reduction using Pulse Tube phase control.

Principal Investigator: N. Kimura

Participating Researchers:

木村誠宏, 鈴木敏一, 山田智宏, 山元一広, Ettore MAJORANA, Luca NATICCHIONI, Piero RAPAGNANI, Fulvio RICCI, Angelo Cruciani, Carlo BUCCI, Antonio D'ADDABBO, Stefano Pirro.

Summary of Research Result :

The project of implementing phase control in a Sumitomo pulse tube cryocooler started, but suddenly suffered of pandemic issues in 2020-21 due to unsuitable logistics conditions. We foresaw an activity scheduled in Italy for the first part and then in Japan for the second part, exploiting a time slot in the context of KAGRA upgrade towards Observational run 4 (O4).

The milestone of the first phase was the experimental feasibility assessment, to be performed adapting the scheme operated at Gransasso National Laboratory (LNGS-INFN, Aquila) for a Sumitomo cryocooler, in use at the Roma INFN Lab. The scheme used at LNGS is applied to a Cryomech refrigerator, whose throttle valve is driven by an independent stepper motor. Our scheme is different because a three-phase controller is needed for the valve's motor. Pandemic issues in 2020-21 overlapped with a maintenance cycle required on our refrigerator (Sumitomo @ Darmstadt) October-December 2020. Meanwhile, the electronics prototype is complete, and the engineers visited in February the laboratory and considered operatively the actions to be done. By the end of May, the group will finally test the operation of pulse phase control using their driver. Once tested, a dedicated electronics will be promptly designed to use the three-phase provided by the compressor to control the throttle valve motor.

As a collateral activity we developed and tested a cryogenic geophone, derived from a modification of a commercial model. The sensor has been tested and calibrated and represents a very user-friendly system that can easily be used to measure cryostat vibration at least close to the PT stages.

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