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Study of Newtonian noise from the KAGRA cooling system

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Large-scale Cryogenic Gravitational-Wave Telescope, KAGRA, is a second-generation gravitational-wave detector (GWD) in Japan. The features distinguishing KAGRA from other GWDs are its underground location and the cryogenic operation of the four main mirrors. The underground location provides a quiet site with low seismic noise, while the cryogenic operation cools the mirrors down to 20 K, reducing the thermal noises. However, as cooling system components are relatively heavy and in close proximity to the test masses, oscillation of gravity force induced by their vibration, so-called Newtonian noise, could contaminate the detector sensitivity. Therefore, we used the results from the vibration analysis of the KAGRA cryostat at 12K to estimate cooling system Newtonian noise in the 1-100 Hz frequency band.

In this talk, we present methods, considerations, calculations and results of Newtonian noise estimation. Since cryogenics will be a key technology employed in third-generation detectors like Einstein Telescope, the findings can guide the design of the cryogenic infrastructure of these third-generation detectors.

Submitted on behalf of a Collaboration?

No

Author: Dr BAJPAI, Rishabh (National Astronomical Observatory of Japan)

Co-authors: Prof. TOMARU, Takayuki (National Astronomical Observatory of Japan); Dr SUZUKI, Toshikazu (Institute for Cosmic Ray Research (ICRR)); YAMAMOTO, Kazuhiro (Japan/University of Toyama); USHIBA, Takafumi (Institute for Cosmic Ray Research, the University of Tokyo, Japan); Prof. HONDA, Tohru (High Energy Accelerator Research Organization (KEK))

Presenter: Dr BAJPAI, Rishabh (National Astronomical Observatory of Japan)

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