Contribution ID: **6** Type: **not specified**

Low temperature performances of a monolithic folded pendulum sensor for the third generation of interferometric detectors of gravitational waves

Thursday, 1 March 2018 15:30 (20 minutes)

An effective low frequency sensitivity improvement of the next generation of gravitational waves interferometric detectors requires the introduction of new ideas and the development of suitable technologies. Within this framework, the cryogenic suspensions represent a very good synthesis and effective approach to this problem, as already demonstrated by the KAGRA interferometric detector.
An optimization of their performances can be obtained improving the quality of the control system, where the sensors play a relevant and critical role. In fact, they must be sensitive and large band (at low frequency), but at the same time compact, robust and light, and capable to operate at cryogenic temperatures.
Monolithic folded pendulum sensors appear to satisfy these requirements. The ultimate limitation in terms of sensitivity of this class of mechanical sensors, configurable both as seismometers or as accelerometers, is their mechanical thermal noise, function of their resonance frequency and temperature.
In this paper we present and discuss the performances of a standard UNISA monolithic folded pendulum as function of the temperature. The experimental data show its sensitivity improvement along with the temperature decrease, sensitivity limited only by the material dissipation. These results show also that this class of sensors could be already applied both to the present and to next generation of interferometric detectors of gravitational waves.

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Session Classification: Development of Enabling Technologies for Gravitational Wave Detectors