



Contribution ID: 97

Type: Oral

Interferometric Readout for a Monolithic Accelerometer, towards the fm/rHz

Tuesday 3 June 2014 12:00 (20 minutes)

In order to make a really precise vibration sensor, a monolithic accelerometer, in which a mass is suspended by a pendulum and an inverted pendulum, is read out using a tabletop Michelson interferometer (IFO). To measure the position of the mass, a corner cube attached to the suspended mass is used. The signals in both arms of the IFO are monitored, matched and subtracted, using this differential signal as an error signal in a feedback loop driving the voice coil actuating to the other side of the suspended mass. Pursuing to be shot-noise limited from 5Hz onwards and having an upper limit to the bandwidth of about 200Hz, the resolution is pushed towards the fm/rHz.

Summary

The upgrade for the Virgo Gravitational Wave Observatory (Cascina, Italy) necessitates for added sensing which has to be seismically isolated as well. Nikhef has built the compact isolator to do this, but to measure its residual motion in full assembly, no (commercial) sensor is available that is good enough to actually measure it. A novel vibration sensor is built at Nikhef by using an interferometric readout of a monolithic accelerometer. This system is also being researched at Nikhef in a fiber version, so that it can be used in monitoring the vibration in the magnetic and radiation environment of the quadrupole magnets a (future) linear collider such as CLiC or the ILC.

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Session Classification: I.e Novel Technologies

Track Classification: Sensors: 1e) Novel technologies