

R&D activity to develop a passive mitigation strategy for electrostatic charging in future gravitational wave detectors

Electrostatic charging on the surfaces of the optical elements is a limiting noise source for gravitational wave detectors (GWD) already at room temperature. The charge accumulation has been already observed in LIGO and possibly in Virgo.

The electrostatic charging mechanism of the mirrors may be mainly caused by local electrostatic (LIGO) or electro-magnetic (Virgo) controls.

Another possible mechanism may be due to the ionic pumps that may release low energy electrons.

Such potential electron sources are located in the mirrors' towers and distributed along the beampipes to grant the required Vacuum in the detector.

To cure such issue, Ligo developed a mitigation method, based on exposing the mirrors to few mbar of a N_2 plasma flux. This method cannot be used on a mirror at cryogenic temperature due to the significantly thick condensed gas layer that would inevitably be formed on mirrors. Some other strategies to actively remove charges from optics at cryogenic temperature are currently under study. However, the development of new technologies to passively mitigate electrostatic charging may help preserving the performances envisaged by future GWD.

Here we present our collaboration R&D activity to develop a passive mitigation strategy for the electrostatic charging based on electrostatic collectors that, opportunely polarized at an optimized voltage, can catch electrons coming from the ion pumps, hence reducing one of the possible sources of such detrimental effect.

Primary authors: LIEDL, Andrea; PASQUALETTI, Antonio; SENTENAC, Daniel; Mr VIVIANI, Giacomo (INFN - LNF); GARGIULO, Julien; FRANCESCON, Luca; SPALLINO, Luisa; Dr ANGELUCCI, Marco (INFN - LNF); Mr PIETROPAOLI, Marco (INFN - LNF); Mr CHIMENTI, Paolo (INFN - LNF); CIMINO, Roberto

Presenter: Dr ANGELUCCI, Marco (INFN - LNF)

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