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Mitigation of the electrostatic charge on test mass mirrors in gravitational wave detectors

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To successfully integrate cryocooled optics in the complex system of future gravitational wave detectors, it is mandatory that cryogenics is compliant with the operative methods adopted to properly control and possibly mitigate all noise sources. Among others, electrostatic charging on test mass has been shown to be a limiting noise source for gravitational wave interferometers. Within the LIGO collaboration, a mitigation method proposed and successfully applied consists in the exposure of the mirror to some tenth of mbar of N_2 plasma. It is difficult, if not impossible to apply this method, as it is now, when mirrors are at cryogenic temperatures, since a significantly thick condensed gas layer will develop on the mirror surface severely affecting its performance. Here we present the basic background of a novel method to neutralize test masses electrostatic charge, that can be performed in UHV and can be applied to cryogenic mirrors. We propose the use of selected energy electrons (between 10 to 100 eV) which can impinge on the mirror surface. According to their energy, the secondary electron yield (which is the number of electrons emitted per incident ones) could be ≤ 1 or ≥ 1, i.e. removing or adding electrons to the mirror's dielectric surface or part of it. We will highlight the advantages offered by this new method and the further studies required to pass from the idea here proposed to the desired enabling technology.

Primary author: ANGELUCCI, Marco (LNF)

Co-authors: SPALLINO, Luisa (LNF); MAZZITELLI, Giovanni (LNF); MUSENICH, Riccardo (GE); Dr PASQUALETTI, Antonio (European Gravitational Observatory (EGO)); SORRENTINO, Fiodor (GE); CHINCARINI, Andrea (GE); GEMME, Gianluca (GE); CIMINO, Roberto (LNF)

Presenter: ANGELUCCI, Marco (LNF)

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