Contribution ID: **27** Contribution code: **P#08** Type: **Poster**

Low energy electron to actively cure frost and electrostatic charging issues in future gravitational wave detectors

Tuesday 7 May 2024 17:37 (1 minute)

In the upcoming third generation of gravitational wave (GW) detectors, electrostatic charging, and the build-up of a frost layer on cryogenically cooled mirrors may represent two potentially critical showstoppers for GW detection. Here we approach a possible mitigation solution for both such apparently uncorrelated issues, relying on optics irradiation with low energy electrons (few hundreds eV).

Electrostatic charge has been shown to affect LIGO data taking. Its mitigation routinely requires mirror's long exposures (hours) to a relatively high pressure (tenth of mbar) of N_2 ions flux.
Cryogenic mirrors in future GW detectors are ideal to reduce thermal noise and to obtain the desired detection sensitivity at low frequency. However, operating at temperatures ~10 K presents several challenges, one being on the cryogenic vacuum system hosting the cold mirrors. Gases composing the residual vacuum will tend to cryosorb on the mirror surfaces forming a contaminant ice layer ("frost"). This can severely perturb mirror optical properties preventing detection with the design sensitivity.
Noticeably, the method used at LIGO to mitigate electrostatic charging cannot be applied on cryogenically cooled mirrors without forming on its surface an unacceptably thick condensed N_2 layer.
Low energy electrons are known to interact only with the very top layers (some nm) of any irradiated surface, are known to be very efficient in inducing gas desorption and, by properly tuning the energy of the incident electrons, can neutralize both positive and negative charges on surfaces. Therefore, low energy irradiation of mirrors'surfaces seems ideal to neutralize charge and induce frost desorption without damaging the mirror surfaces'optical properties.

Here we present the main experimental activity, ongoing at LNF-INFN, demonstrating that low energy electrons may be indeed used as a mitigation method to cure surface charging and frost formation.

Primary author: SPALLINO, Luisa

Co-authors: Dr ANGELUCCI, Marco (INFN - LNF); CIMINO, Roberto

Presenter: CIMINO, Roberto

Session Classification: Posters

Track Classification: Instrument Science Board (ISB)