Contribution ID: **308** Type: **Poster**

Frost and electrostatic charge formation in mirrors of future gravitational wave detectors: mitigation strategies for two potential showstoppers

Thursday, 26 May 2022 15:59 (1 minute)

The mitigation of all potential noise sources detrimentally affecting gravitational wave (GW) detection is mandatory for present and future GW interferometers. Here we approach two apparently uncorrelated issues: the electrostatic charge forming on test masses at room and cryogenic temperature, and the build-up of a frost layer on cryogenically cooled mirrors.
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 have been individuated as a viable solution to reduce thermal noise and to obtain the desired detection sensitivity at low frequency. Operating at temperatures down to ~10 K presents several extraordinary challenges, one being on the cryogenic vacuum system hosting the cold mirrors. Gases composing the residual vacuum will tend to cryosorb on the mirror surface 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 (between 10 to 100 eV) electrons are known to be very efficient in inducing gas desorption. Also, by properly tuning the energy of the incident electrons, an electron beam can be used to neutralize both positive and negative charges on the mirror's dielectric surface. Electrons are also known to interact only with the very top layers (some nm) of any irradiated surface and seems ideal to neutralize charge and induce frost desorption without damaging the mirror surfaces'optical properties.
Here we present an experimental proof of principle suggesting that low energy electrons may be indeed used as a mitigation method to cure surface charging and frost formation.

Collaboration

Primary authors: SPALLINO, Luisa (Istituto Nazionale di Fisica Nucleare); ANGELUCCI, Marco (Istituto Nazionale di Fisica Nucleare); CIMINO, Roberto (Istituto Nazionale di Fisica Nucleare)

Presenter: SPALLINO, Luisa (Istituto Nazionale di Fisica Nucleare)

Session Classification: Detectors Techniques for Cosmology and Astroparticle Physics - Poster session