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Low energy electrons for frost and electrostatic charging mitigation in future gravitational wave detectors: a status report

In the upcoming third generation of gravitational wave (GW) detectors, the unavoidable build-up of a frost layer on cryogenically cooled mirrors and their electrostatic charging may represent two potentially critical showstoppers for GW detection. We already proposed a possible mitigation solution for both such issues, relying on irradiation with low energy electrons (from 20 to few hundreds eV) of the optical elements. 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 their energy, they can neutralize both positive and negative charges on surfaces. Therefore, low energy irradiation of mirrors'surfaces seems ideal to induce frost desorption and neutralize charge without damaging the mirror surfaces'optical properties. Here we present the status of the experimental activity carried out at LNF-INFN and the necessary R&D activity aiming to pass from a valid and demonstrated concept to the possible integration of the method in the complex low frequency tower design.

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