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Studies of the electro-optic noise in crystalline coatings and cryogenic coating mechanical losses toward future upgrades of gravitational wave detectors

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Next generation gravitational wave detectors will provide further insight into the Universe thanks to their improved sensitivity. Low thermal noise mirror coatings play an important role in realizing such gravitational wave detectors as coating thermal noise is one of the limiting noise sources in the most critical frequency region.

Crystalline coatings, which have demonstrated low thermal noise, are one of the candidates for the mirror coatings. However, crystalline coatings may be susceptible to electro-optic (EO) noise. We have developed an experimental setup and investigated the EO noise in crystalline GaAs/AlGaAs coatings. We have set an upper limit on the EO noise which is well below the strain sensitivity.

Study of coating mechanical losses at cryogenic temperature is indispensable for future gravitational wave detectors such as the Einstein Telescope, and vital to understand the fundamental loss mechanisms of the coating materials. For these purposes, we have developed cryogenic gentle nodal suspension (GeNS). This setup enables us to measure mechanical losses over a wide temperature range between 15 - 300 K.

We will present the current status and future prospects of these coating experiments.

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