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Development of a light-scattering measurement facility for the characterization of stray light sources in GW optics

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Stray light is suspected to be a major culprit for the excess noise measured in present gravitational wave interferometers, and is projected to be even more dangerous for the next generation of instruments which will attempt to further push the sensitivity limits. Stray light originating in different areas of the detectors and through various mechanisms can impact the performance either directly, by contributing phase noise at the readout, or by spoiling the performance of control loops. It is therefore essential on one hand to suppress the sources of stray light, and on the other to reduce the fraction which recouples with the main beam and the noise it produces.

In this perspective we are setting up a facility to measure the scattering properties of high quality optical surfaces to be used in GW detectors, with emphasis on the angular distribution and targeting a wide range of scattering angles. This facility will also be used for the characterization of new optical coatings for GW interferometers containing an engineered distribution of nano-crystals.

In parallel, we are studying the dust contamination on the optics in Various Virgo environments, starting from the Quantum Noise Reduction subsystem, in order to predict and eventually mitigate its contribution to stray light, which preliminary estimations place at or above the level contributed by surface roughness. This work will help understanding light scattering from dust in realistic conditions and set cleanliness requirements and cleaning protocols for the experimental environments of upcoming facilities and GW detectors.

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