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Adaptive Optics techniques for compensating wavefront errors in gravitational interferometers.

In gravitational interferometry increasing the measuring laser power is a straightforward way to improve the instrument sensitivity, and it has been one of the main points in the upgrades of the existing detector like VIRGO and in the design of future projects like ET. However, the dissipated portion of the high circulating power in Fabry-Pérot arm cavities is enough to heat up and deform the suspended mirror substrates, introducing wavefront distortions that compromise sensitivity. To mitigate these effects many solutions have been studied, and they all share the concept of using a separate source of power (lamp, laser, resistors) to suitably heat the optics and compensate for the aberrations in the interferometer beam. In the framework of the ETIC-PNRR project, INAF-ADONI is setting up an optical bench dedicated to further expand the concept making use of technology and experience borrowed from the adaptive optics (AO) systems developed by INAF for earth-based astronomical observations. The idea is to modulate the heating laser intensity pattern by introducing a local curvature in the wavefront using a deformable mirror (DM). In respect to actual technologies, this would simplify the generation of a structured and optimized intensity pattern on the compensating plate (CP) surface. That means that non-axis symmetrical aberrations can be managed, in principle allowing to compensate not only for the thermal absorption effects, but for wavefront errors due to optics manufacturing or coating imperfections. The final objective of the experiment is to verify the ability to identify the DM deformation to induce a target pattern of optical path difference (OPD) in a glass test piece (GTP), representing the CP, and stabilize time-dependent variations in closed-loop. In this poster we present the functionality of the test bench and the current status of the experimental activity.‘

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