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Advancements in the ETIC-ADONI Optical Test Bench

The ETIC-ADONI optical bench is an experiment carried out within the PNRR ETIC project (Einstein Telescope Infrastructure Consortium). It is located at the Astrophysical Observatory of Arcetri in Florence, and its objective is to investigate the application of a deformable mirror (DM)—already employed by INAF in adaptive optics (AO) for ground-based astronomical observations—to the thermal compensation systems (TCS) of third-generation Gravitational Wave Detectors. While the currently operating TCS can only correct the main beam radius of curvature (ROC), a DM used to shape the compensating beam intensity profile may enable the correction of higher-order aberrations, ultimately paving the way for an adaptive closed-loop system.

In our setup, we shape the wavefront of a high-power laser source (1064 nm, 1 W) using an Alpao DM (277 actuators, 22.5 mm diameter), and illuminate a Glass Test Piece (GTP, Schott KG5) in vacuum with the propagated beam. The GTP has been chosen for its property of absorbing IR radiation while remaining transparent in the visible band. We expect the thermalization timescale to be in the order of hours. When the equilibrium state is reached, the GTP new temperature distribution will induce the corresponding thermal lensing and thermal distortion aberrations on the wavefront, measurable with an interferometer operating at 633 nm. Our goal is to measure the Optical Path Difference (OPD), defined as the difference between the wavefront obtained with a flattened DM and that obtained after applying a command to the mirror. Simulations predict a maximum OPD amplitude of about 10 nm. In this work, we present both the simulations result and the current status of the experimental implementation.

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