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Preparing for thermal aberrations mitigation in ET: Wavefront Sensing and Control developments at AiLoV-ET

Future high-power operation of Einstein Telescope (ET) in its high-frequency dedicated incarnation (ET-HF), is expected to amplify the impact of thermally-induced optical aberrations, posing new challenges for beam quality and interferometric stability. Building on the legacy of thermal compensation systems developed for Advanced Virgo, we are currently investigating advanced wavefront sensing and control (WS&C) concepts aimed at addressing the needs of next-generation detectors within the AiLoV-ET (Advanced Optics Lab @ Tor Vergata for ET) infrastructure.

A dedicated testbench is being developed to serve as a central platform for investigating thermal aberrations and validating wavefront control strategies under realistic interferometric conditions. Around this core setup, several R&D activities are underway —including improved laser beam shaping, adaptive thermal actuation, and enhanced wavefront sensing —to support both the investigation of fundamental limitations and the development of novel compensation strategies.

This contribution will provide an overview of the WS&C activities currently underway within AiLoV-ET, highlighting the experimental platforms and technologies under development to support the ambitious goals of ET-HF.

Primary author: LUMACA, Diana (INFN Sezione di Roma Tor Vergata)

Co-authors: Dr ROCCHI, Alessio (INFN Sezione di Roma Tor Vergata); TARANTO, Claudia; Dr CESARINI, Elisabetta (INFN Roma Tor Vergata); Dr NARDECCHIA, Ilaria (INFN Sezione di Roma Tor Vergata); AIELLO, Lorenzo; CORUBOLO, Luciano Antonio (Università degli studi di Roma Tor Vergata; INFN Roma Tor Vergata); CIFALDI, Maria (Tor Vergata-INFN); IANNI, Matteo (INFN, Section of Rome Tor Vergata, Rome, Italy. University of Rome Tor Vergata, Department of Physics, Rome, Italy); SCACCO, Valerio (Università degli Studi di Roma Tor Vergata; INFN sez. Roma Tor Vergata); FAFONE, Viviana; MINENKOV, Yury

Presenter: LUMACA, Diana (INFN Sezione di Roma Tor Vergata)

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