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The ELT Emulator - MELT - an Optomechanical Test Bench for Wavefront Control, Phasing, and Telescope Control

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Summary

We present an optomechanical test bench setup for testing and validating key functionalities to be used on the Extremely Large Telescope (ELT) during the period of verification, commissioning, and up to the handover to science.

The main objectives of the minuscule extremely large telescope (MELT) are to deploy and validate the telescope control system, to deploy and validate wavefront control for commissioning and operations, as well as to produce and validate key requirements for the phasing and diagnostics station of the ELT.

MELT hosts optomechanical key components such as a segmented primary mirror, which is the Active Segmented Mirror (ASM) with its piezo-driven 61 segments and a diameter of 15 cm, designed for the Active Phasing Experiment APE. It also deploys a secondary mirror on a hexapod, an adaptive fourth mirror, and a fast tip/tilt mirror together with their control interfaces that emulate the real telescope optomechanical conditions.

Several beam paths after the telescope optical train on MELT are conditioned and guided to wavefront sensors and cameras sensitive to wavelength bands in the visible and infrared to emulate wavefront commissioning and phasing tasks. This optical path resembles part of the phasing and diagnostics station (PDS) of the ELT, used to acquire the first star photons through the ELT and to learn the usage and control of the ELT optomechanics.

The ELT main axis control is emulated with a moveable diffraction-limited source that emits white light from the visible up to the K band through a turbulence generator. A single conjugate adaptive optics system is used with an ELT real time computer to test and validate offloading scenarios to M5 and the main axis. In addition, it is used to deploy and validate wavefront control algorithms and the influence of adaptive optics on M1 phasing using the baseline SH high order WFS. The bench also allows to test different phasing concepts that will support this baseline. A pyramid WFS will also be deployed at a later stage.

Purposely misaligned optics will emulate the optically imperfect telescope with its optics mounted with mechanical tolerances after assembly and integration. Pupil rotation and derotation optomechanics create a realistic beam stability that needs active pupil stabilization used to meet the stringent pupil registration requirements.

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