
MagCcado: Development of magnification control technology for the ELT / MICADO camera

Pascal Jaufmann^{*†1}, Jörg-Uwe Pott², and Oliver Sawodny¹

¹University of Stuttgart – Germany

²Max Planck Institute for Astronomy – Germany

Abstract

The Multi-AO Imaging Camera for Deep Observations (MICADO) of ELT is designed to work both with single- and multi-conjugate adaptive optics systems (SCAO and MCAO, respectively). During its initial phase of operation, the instrument will primarily utilize the opto-mechanically less complex SCAO mode. As correction for atmospheric turbulence and structural vibrations is limited to a single guide star in the center, the image magnification remains variable, resulting in lower Strehl ratios for stars near the edge of the field.

In our work, strategies to measure and control the fast image magnification (also known as plate scale) variations are developed, enlarging SCAO's usable field of view. This is of particular interest in the area of extremely large telescopes, since the ELT has an aperture similar to the outer scale of atmospheric phase disturbance, giving the corrected point spread functions (PSFs) a diffraction-limited core even outside the isoplanatic angle (Clenet et al. 2014). A recent study shows that wind-driven piston movement of ELT mirror 2 (M2) is one of the worst offenders for plate scale variations (Rodeghiero et al. 2018), we hence study the impact of different wind load frequencies and piston amplitudes at M2. Our work shows that the expected ELT M2 vibrations significantly reduce off-axis Strehl ratio if not compensated for under strong winds. The derived plate scale distortions are also put in context of the magnitude of atmospheric tip-tilt jitter in SCAO operation. Sensing concepts such as accelerometer based sensing and fast readout of the science detector are suggested to measure plate scale changes which are not visible to a SCAO wave front sensor. Finally, we systematically explore to which extent the current adaptive ELT mirrors could successfully compensate for the expected plate scale effect during closed loop SCAO operation.

Keywords: SCAO, image magnification, plate scale, control, accelerometers

^{*}Speaker

[†]Corresponding author: pascal.jaufmann@isys.uni-stuttgart.de