STARLOC: the star tracking algorithm for the MICADO Lyot coronagraphs

Elsa Huby*†[1], Pierre Baudoz[1], and Yann Clenet[1]

[1]LESIA, Observatoire de Paris – Université PSL, CNRS : UMR8109, Sorbonne Université, Université Paris Cité – France

Abstract

The ELT/MICADO instrument will be equipped with a set of classical Lyot coronagraphs: three different sizes of focal plane occulting spots will be available to optimize the observations in the J, H and K spectral bands. Given the complexity of the instrument and the size of the optical elements, a drift of the star image from the coronagraph center is expected during the observations, that would degrade the coronagraph performance. It is indeed likely that the atmospheric dispersion will not be completely compensated due to the wavelength difference between the AO (visible) and the science camera (IR). Mechanical drift due to temperature variation during the night can also induce such drift.
We have thus developed the Star Tracking Algorithm for Regular Lyot Occulting Coronagraph (STARLOC), aimed at estimating the centering error of the star image onto the occulting spot of the Lyot coronagraph, with the goal of stabilizing the star image within 0.5 mas of the coronagraph center. This method is based on the analysis of the coronagraphic image, following the principle of QACITS that was developed for vortex coronagraph. When the image of the star is not centered onto the coronagraph (i.e. the occulting spot), there is light leaking through, down to the detector. This unwanted light can be used to estimate the centering error (or tip-tilt error). The estimation is based on the measurement of the flux asymmetry in a selected region, typically an annulus, inferred from the flux integrated in four quadrants. In this presentation, we will report on the performance study of the STARLOC algorithm, in particular under the presence of static aberrations, AO residuals, photon and read-out noises, and Lyot stop shift.

Keywords: MICADO, Lyot coronagraph, tip, tilt sensor

*Speaker
†Corresponding author: elsa.huby@obspm.fr