**INTRODUCTION**

During the LBT FLAO commissioning, the Pyramid Wave-Front Sensor (PWFS) demonstrated on sky its potential as component of a NGS SCAO system. These results confirmed the expected PWFS sensitivity in presence of a point-like guide source. The performances of the PWFS using an extended object as reference in astronomical applications have not yet been deeply investigated. In this work we present some preliminary investigation on this topic.

**LAB SETUP: LBT-FLAO#2 IN THE TEST TOWER**

We performed the tests with the FLAO#2 system of LBT during the its acceptance period in the Arcetri test tower. The system is composed by the Adaptive Secondary mirror (672 actuators) and the PWFS with 30x30 of maximum sampling. We simulated the atmospheric turbulence injecting a command history on the deformable mirror.

The source used in the tests is a white light lamp coupled with an optical fiber. Changing the dimension of the fiber we simulated different angular size of the system reference source.

**LAB CLOSED LOOP WITH EXTENDED REFERENCE SOURCE**

The sensitivity of the PWFS is affected by the extension of the reference source because this is acting like a tip-tilt modulation. As in the case of modulation, the sensitivity reduction acts only on the modes having a radial order that corresponds to an angle smaller than the applied modulation angle or, in this case, to the size of the extended object.

This consideration has been confirmed by the measurement taken with a reference source of 0.2" of size. In the figure below we can note that, in this case, the correction efficiency is reduced in modes lower than ~80, for the higher ones we measured the same correction as in the case of the diffraction limited source and same magnitude.

This simple computations shows that the source elongation in the vertical direction has an impact on the PWFS sensitivity comparable to the one experienced by the SH WFS for both 8m and ELT class of telescopes.

In the ELT case, the spot elongation impose to the PWFS to increase the FoV of each SA up to the size of the elongated spot in the worst conditions that mean 10-15" with a pixel sampling of about 10x10 pixels per SA. In the PWFS case, the FoV is increased simply enlarging the field stop on the glass pyramid, while the pupil sampling is still requiring 2x2 pixels per SA only. That means a gain of a factor 2.5 in the number of pixels and consequently in the corresponding signal.

**SODIUM LAYER THICKNESS EFFECT: A THEORETICAL ESTIMATION**

Defocus on the focal plane

Wavefront error in the pupil plane

Pyramid WFS and Shack-Hartmann

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