

The MCAO module for the E-ELT

<http://www.bo.astro.it/~maory>

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On behalf of the MAORY Consortium



MAORY is the MCAO module for ELT => Diffraction Limit

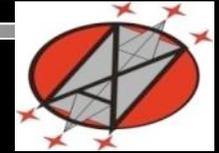
We are doing our best....

Today workshop “**Imaging at ELT**”

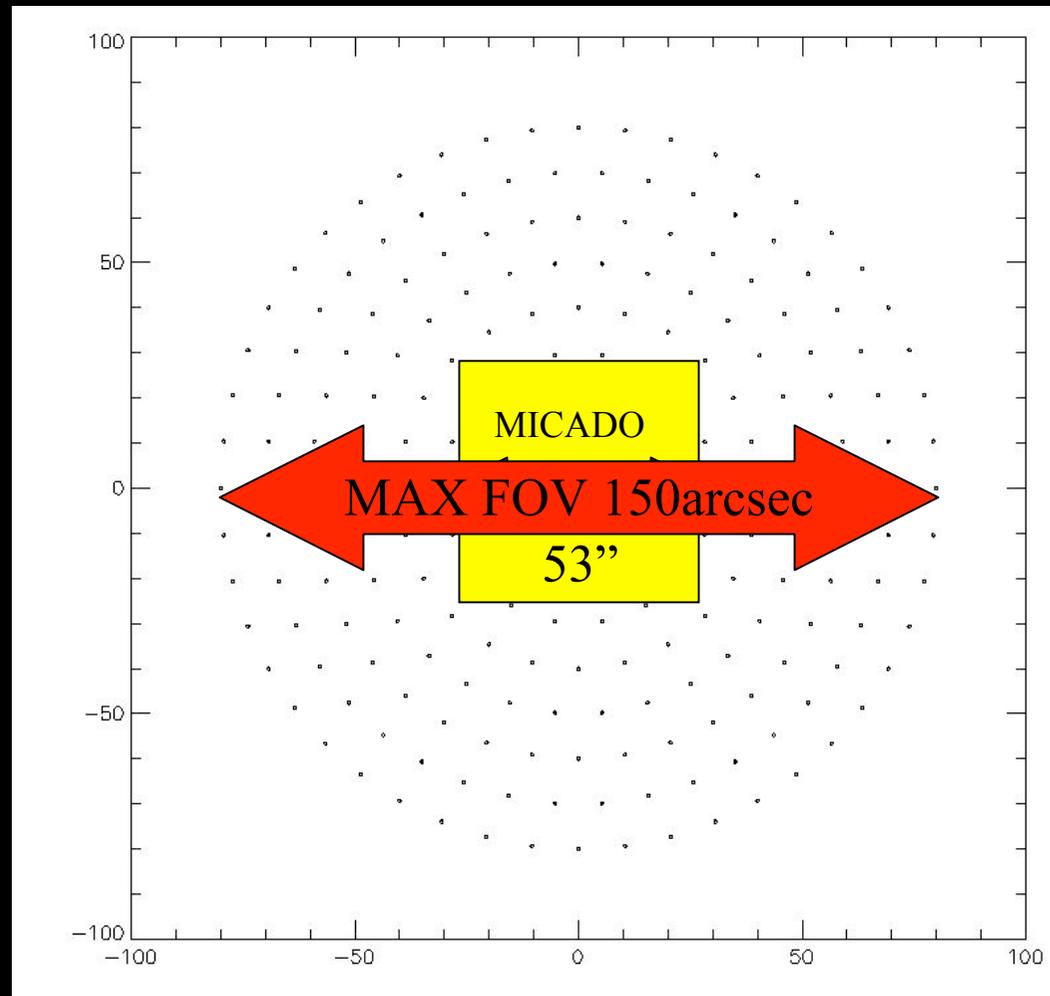
MAORY + CAMERA like MICADO

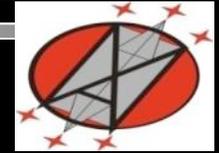
Report of Network 4 “**Wide Field Imaging at ELT : from GLAO to diffraction limit**”

In this contest MAORY can play a role in the Diffraction Limit space
but if we speak of imaging at **Diffraction Limit** we must define what we
mean for “**WIDE FIELD**”

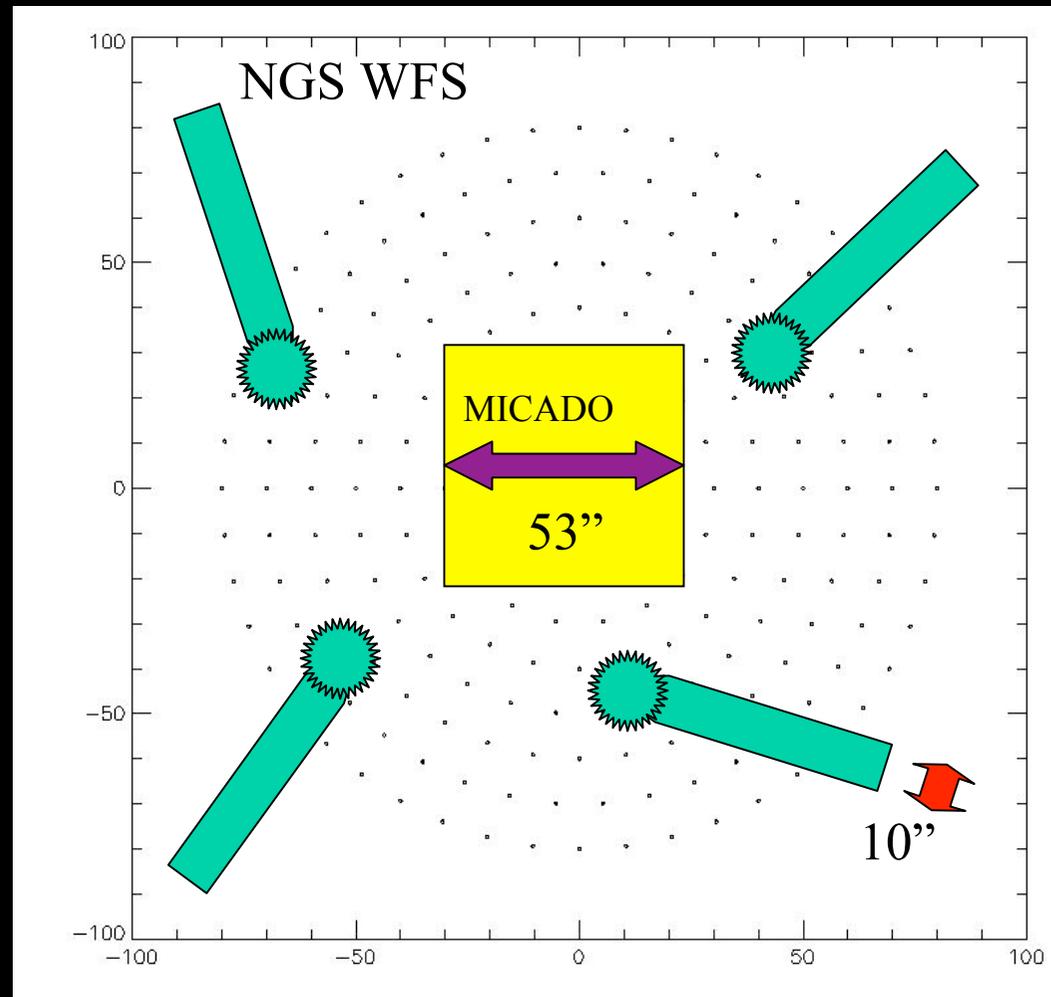


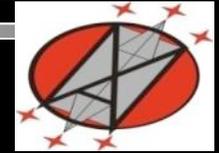
MAORY field of view



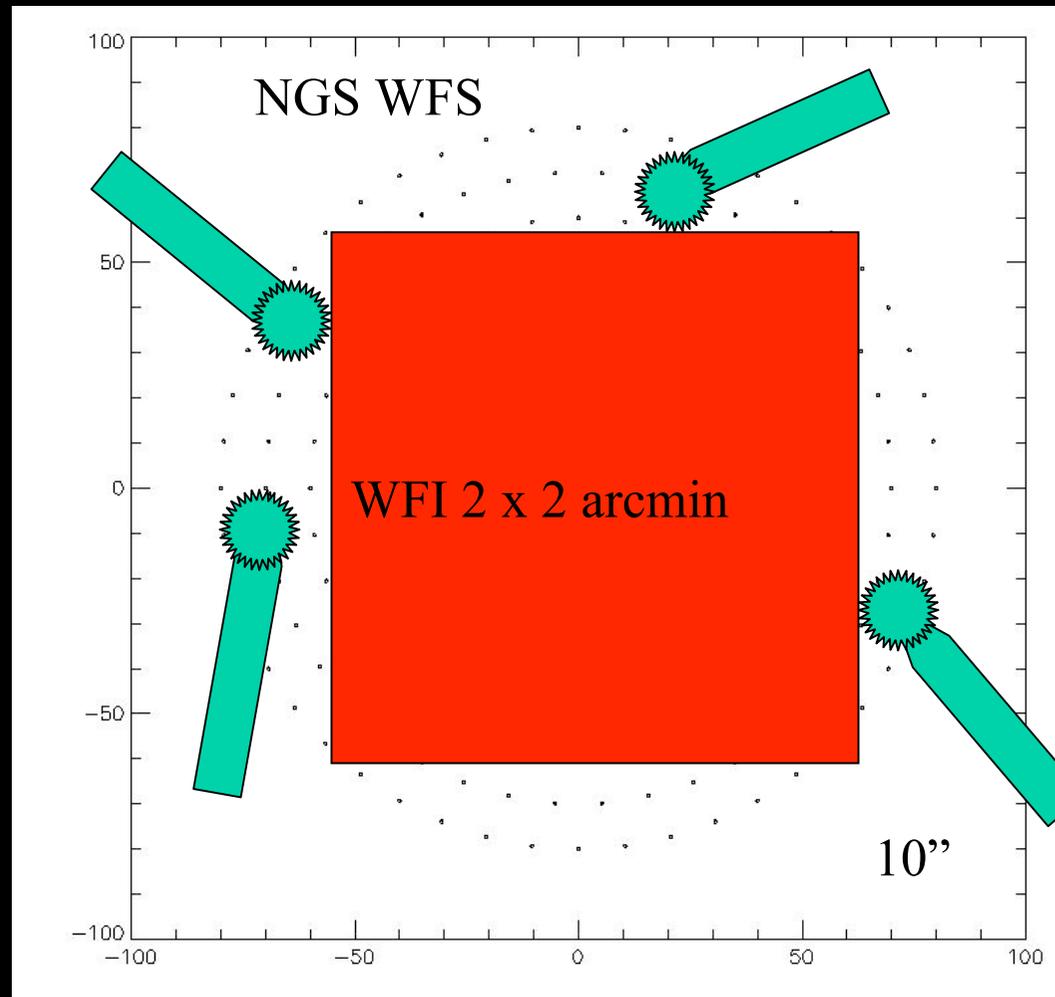


MAORY field of view





MAORY field of view





..so a reliable DL WFI could be 2.0 X 2.0 arcmin

=> more than 2 x 2 MICADO !!

Of course we can increase pixel size :

pixel size 10 mas => 3x3 4K detectors to cover 2x2 arcmin

pixel size 15 mas => 2x2 4K detectors to cover 2x2 arcmin



If we consider “Wide Field Imager” with FOV $\sim 5 \times 5$ arcmin

\implies we must move on the GLAO space not in the DL - MCAO space

in the Diffraction Limit MCAO space

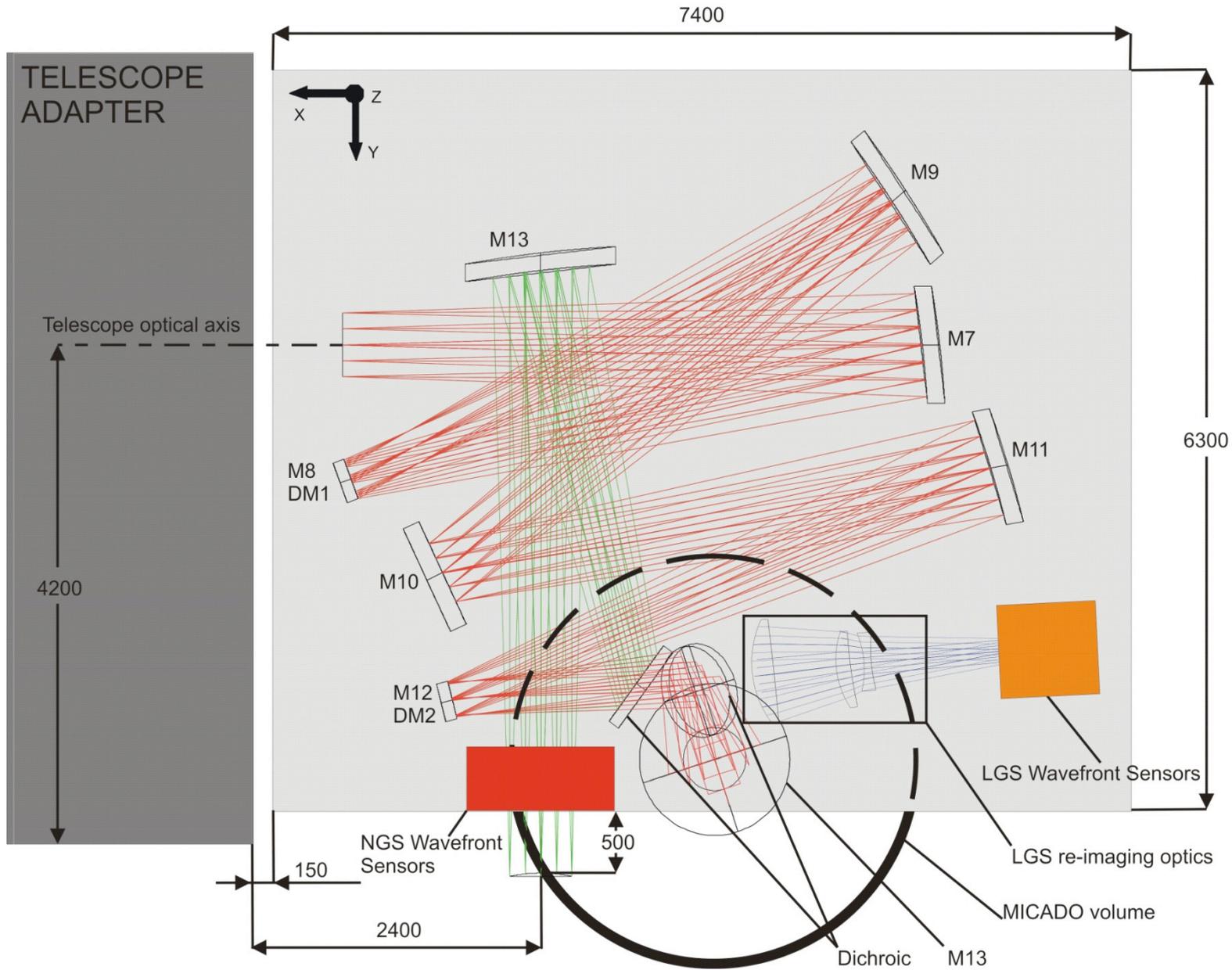
- The mirror size scale with corrected FOV \implies huge dimension of the module
- number of pixels : impossible !!!
- huge cost (module and detectors)

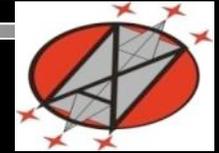
This morning Miska shows the performance for a GLAO WFI over 5 arcmin

..... Now I will show the MCAO performance for “WFI” over 2 arcmin



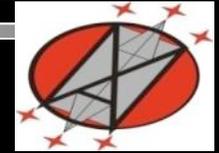
PRELIMINARY LAYOUT AND DIMENSIONS



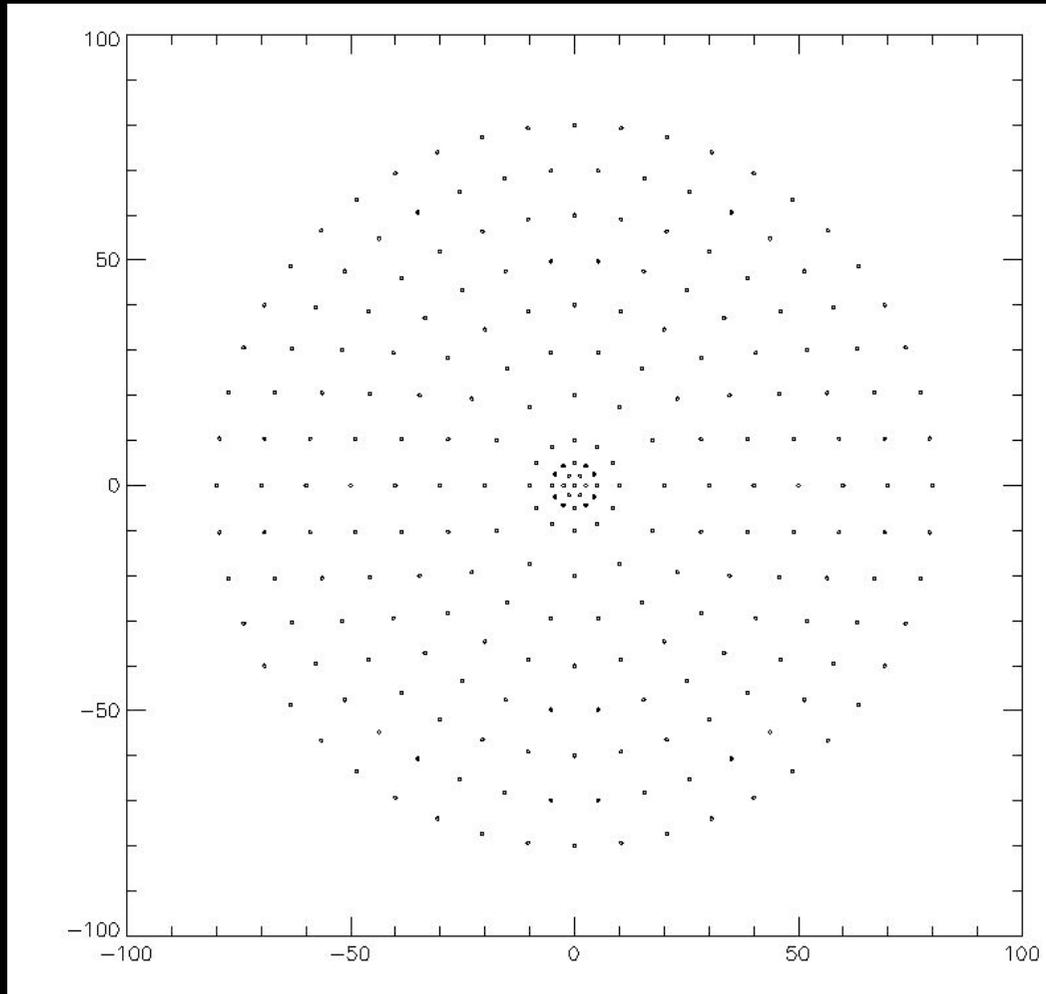


SIMULATED PSF **from ONERA team (C. PETIT, J.M. CONAN)**

- ANALYTIC MODEL
- Turbulence profile with 9 layers : 0 → 18 Km
- Seeing 0.80 and 0.6 arcsec at 5000 Å
- Central obstruction 0.3 on the diameter
- 6 Laser Guide Stars on 2 arcmin ring
- 3 Deformable Mirrors conjugate at 373 m (M4) 4 Km and 12.7 Km
- 84 actuators across M4 diameter



SIMULATED PSF DISTRIBUTION



241 PSFs

on a field of 2.6'

with LGS on

Ø 120 arcsec

19 PSFs Ø 10 arcsec
(spacing 2.5 arcsec)

19 PSFs Ø 20 arcsec
(spacing 5 arcsec)

37 PSFs Ø 1 arcmin
(spacing 10 arcsec)

127 PSF Ø 2 arcmin
(spacing 10 arcsec)

217 PSF Ø 2.5 arcmin
(spacing 10 arcsec)



STREHL RATIO VALUES

The PSF have been obtained from the residual power spectral density of the atmospheric turbulence. They do not include some error sources that can only be accounted for by means of correction factors.

LGS CONE EFFECT (POSITION AND WAVELENGTH)

ERRORS DUE TO THE NGS WFS

THE UNCORRECTED OPTICS ERRORS

AO CALIBRATIONS ERRORS

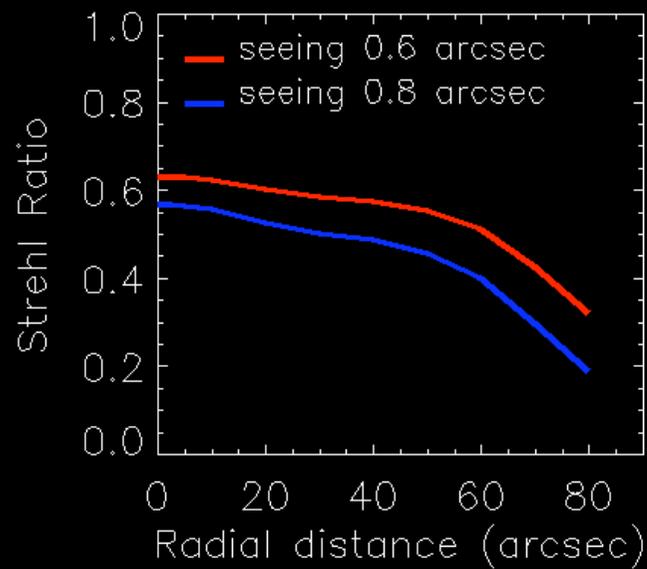
} **WAVELENGTH**

ALL THE STREHL RATIO PRESENTED HERE INCLUDE THE ABOVE ERROR SOURCES IN ORDER TO HAVE SR WITH A COMPLETE ERROR BUDGET

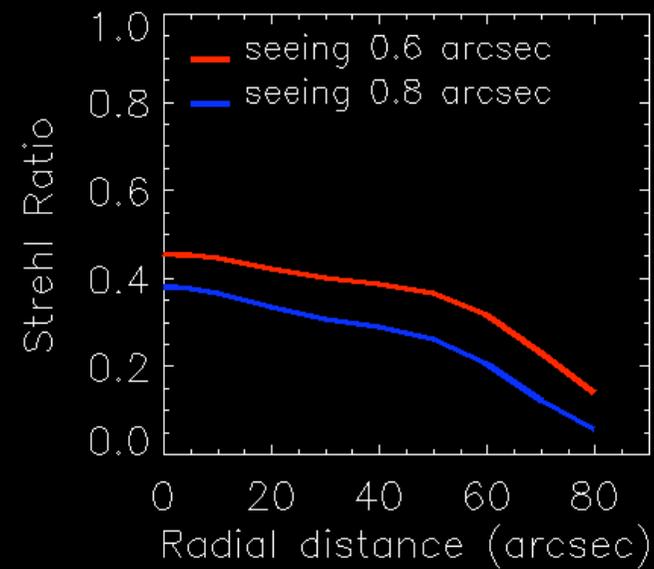
Correction uniformity in terms of RMS variations with respect to the average Performance

| | K band | | H band | | J band | | I band | |
|------|--------|------|--------|------|--------|------|--------|------|
| | SR rms | TLR |
| 2' | <0.1 | 0.13 | <0.1 | 0.13 | <0.1 | N/A | <0.1 | N/A |
| 1' | <0.1 | 0.06 | <0.1 | 0.17 | <0.1 | 0.07 | <0.1 | N/A |
| 20'' | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | 0.02 | <0.01 | 0.01 |
| 10'' | <0.01 | 0.01 | <0.01 | 0.01 | <0.01 | 0.01 | <0.01 | 0.01 |

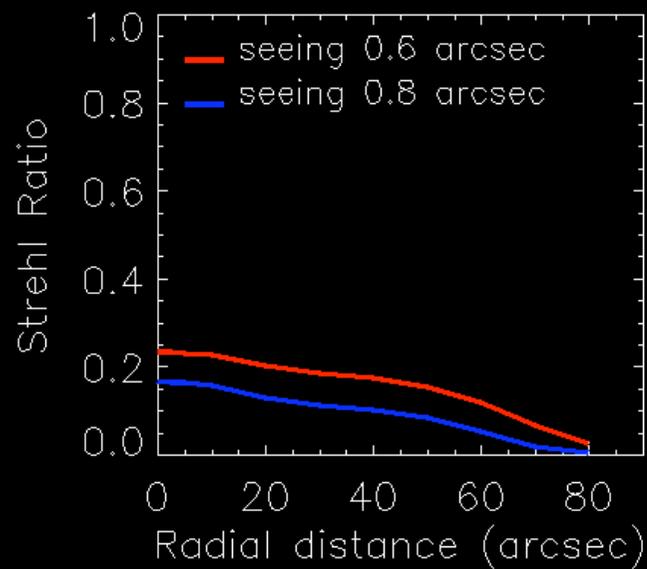
K band



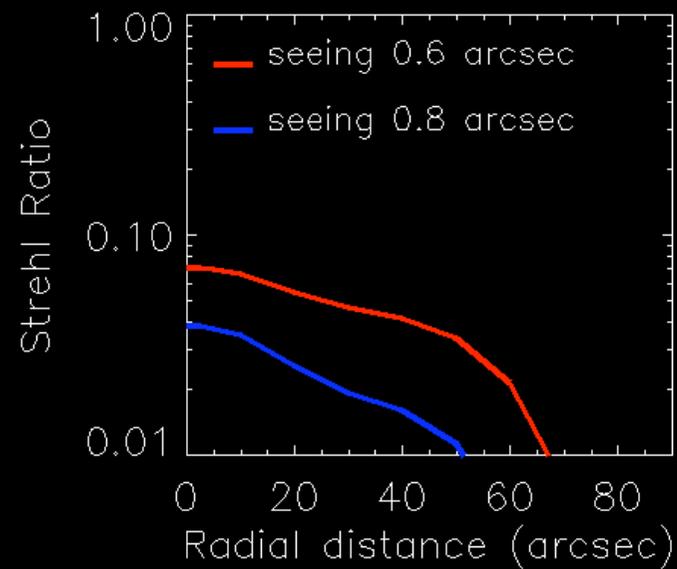
H band



J band



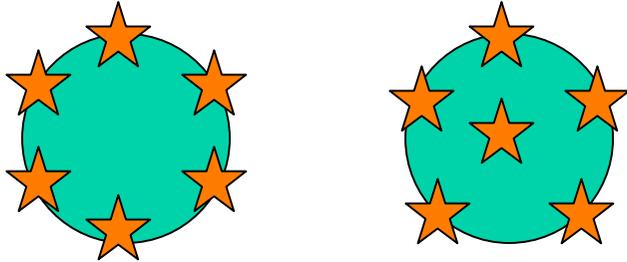
I band



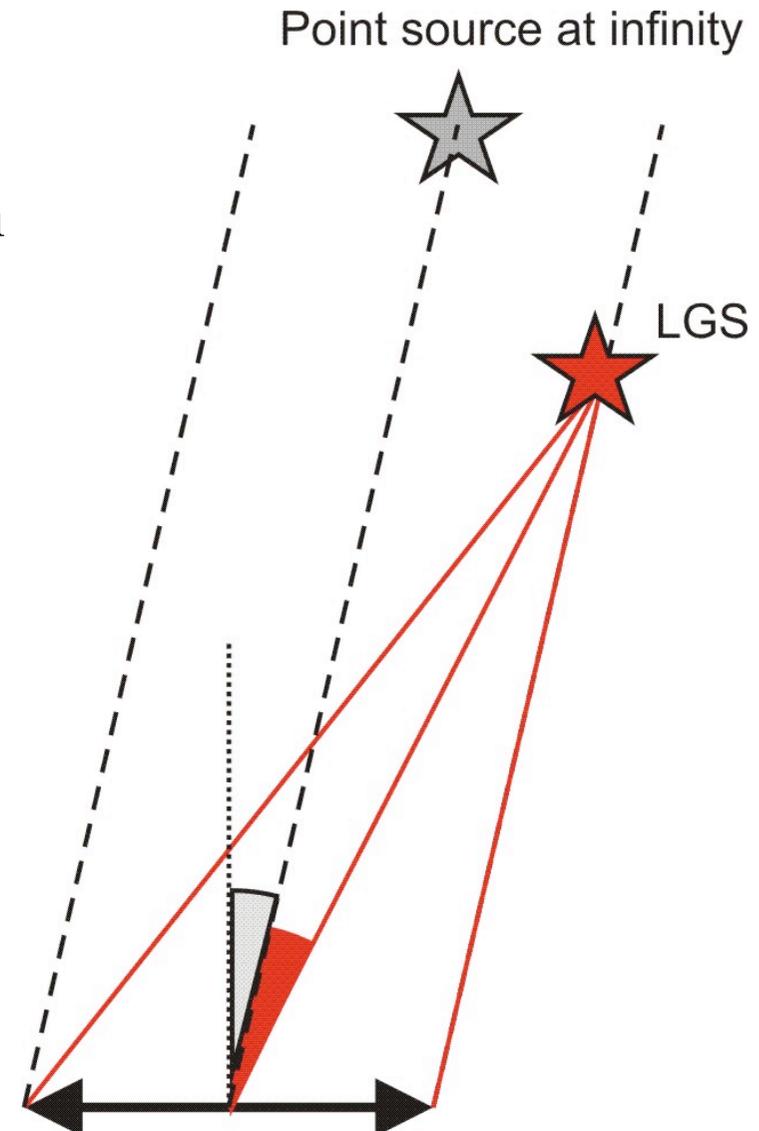


LGS CONFIGURATIONS

Which configuration => open question



However not closer than
2 arcmin to avoid tomography
error due LGS cone effect





SKY COVERAGE

SR values for 1 arcmin field

| SEEING | K | H | J | I | SKY COVERAGE |
|----------------------------------|------|------|------|------|--------------|
| 0.8 arcsec (best performance) | 0.53 | 0.33 | 0.13 | 0.03 | 26% |
| 0.8 arcsec | 0.48 | 0.28 | 0.09 | 0.02 | 38% |
| 0.8 arcsec | 0.41 | 0.21 | 0.06 | 0.01 | 48% |
| 0.6 arcsec (best performance) | 0.60 | 0.42 | 0.20 | 0.05 | 33% |
| 0.6 arcsec | 0.54 | 0.35 | 0.14 | 0.03 | 48% |
| 0.6 arcsec | 0.46 | 0.27 | 0.06 | 0.01 | 57% |

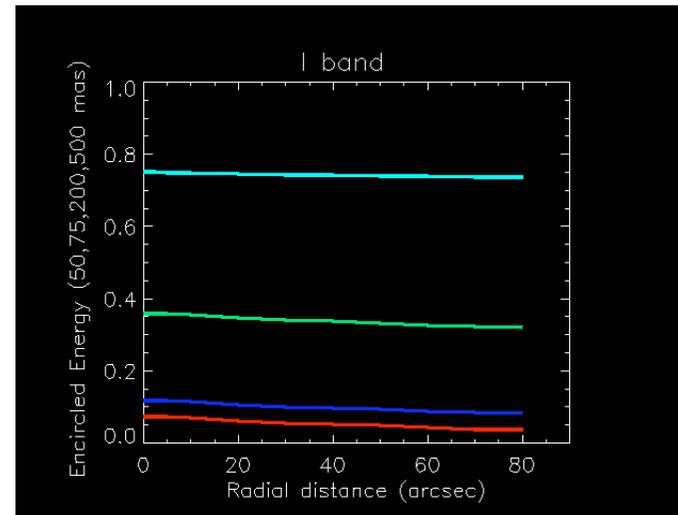
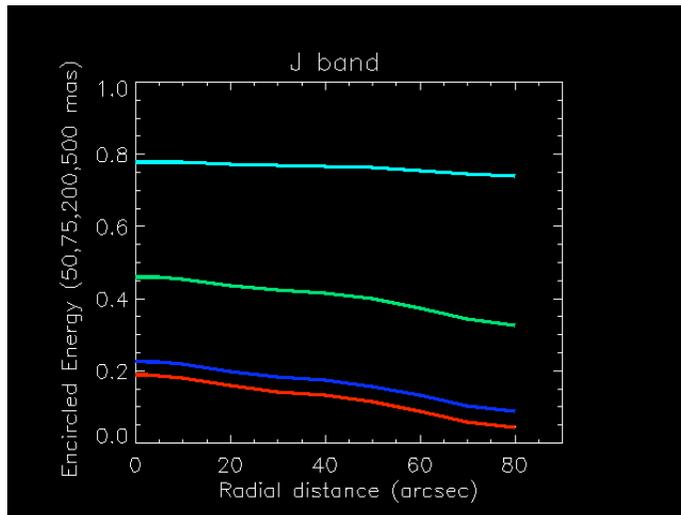
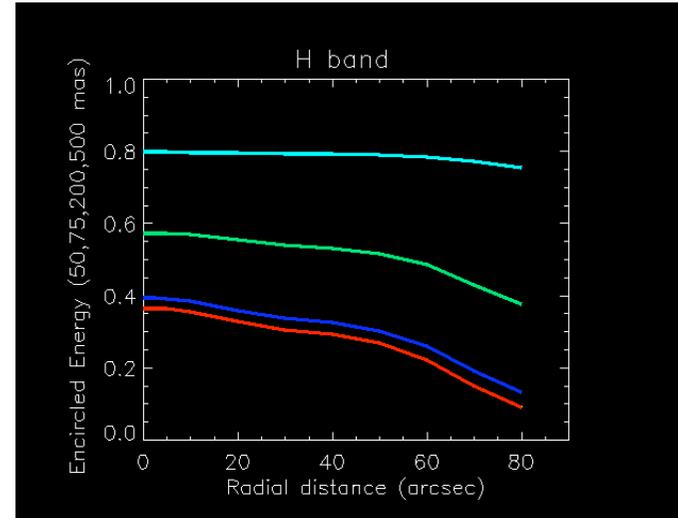
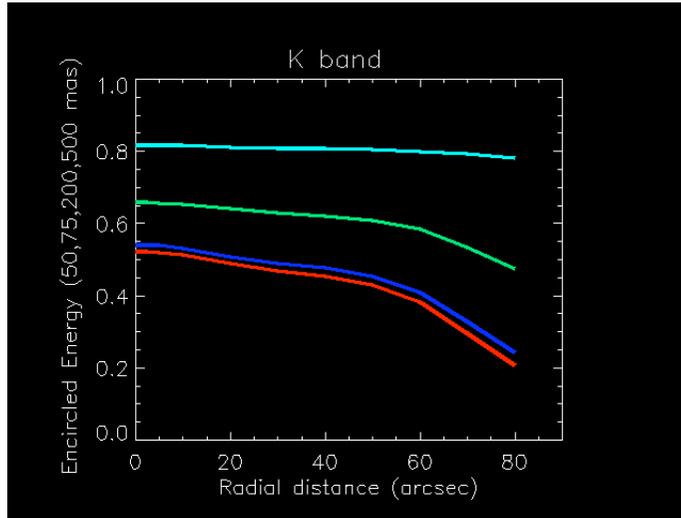
ENCIRCLED ENERGY



The EE has been calculate as the fraction of the PSF energy enclosed in a circle of 50 mas diameter (as required in the TLR document) and using circles of 75, 200 and 500 mas diameter thinking to other potential EELT instrument coupled with MAORY

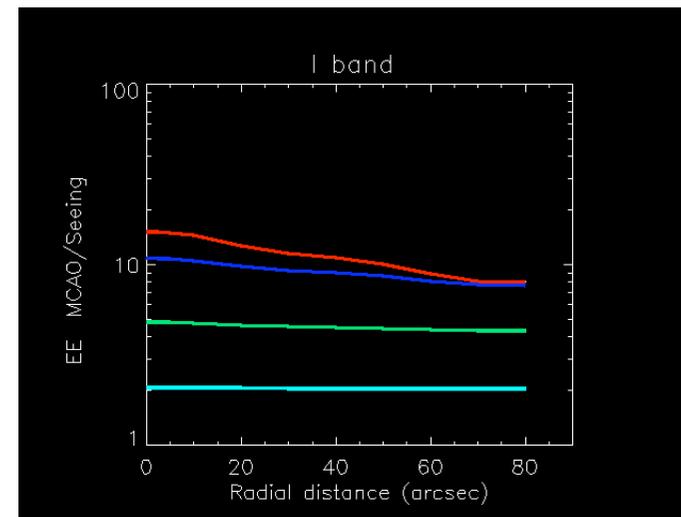
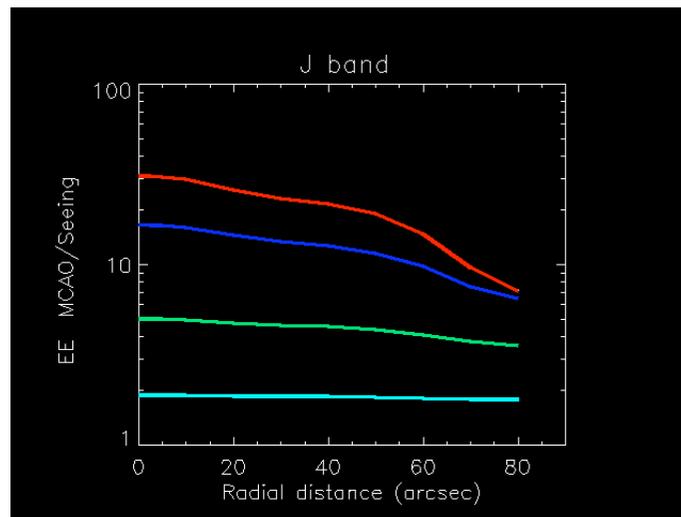
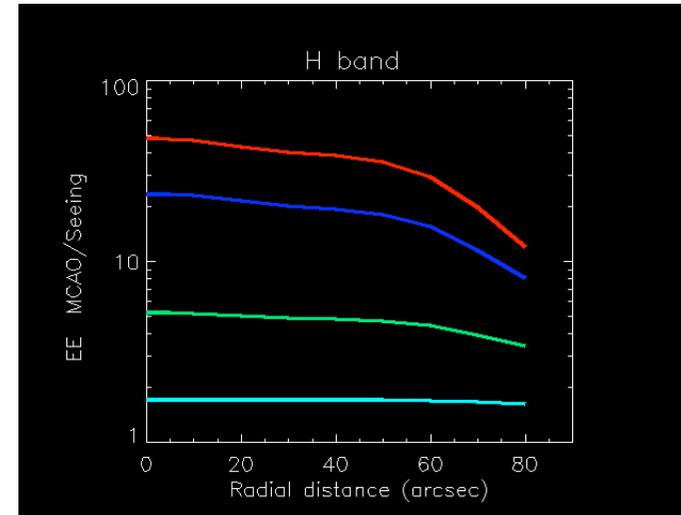
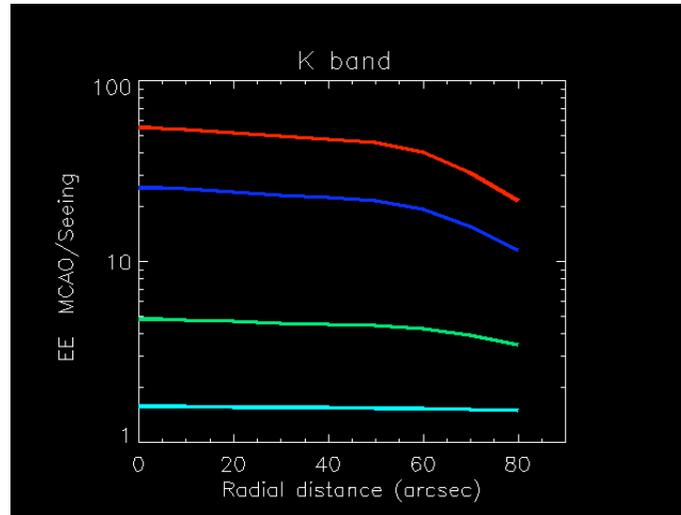


EE radial profile



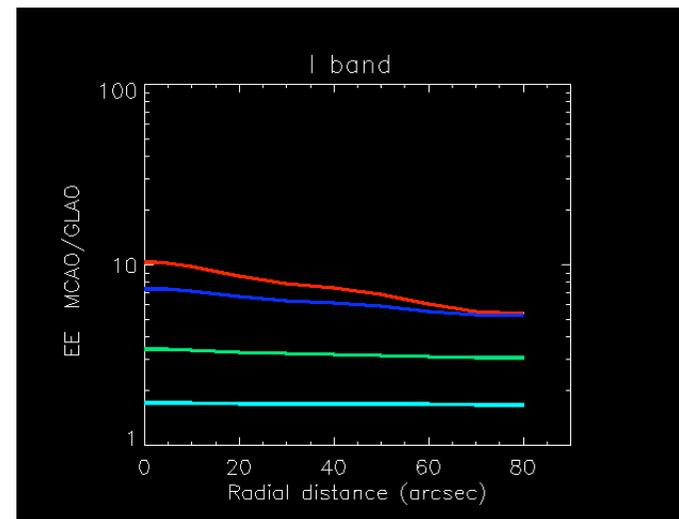
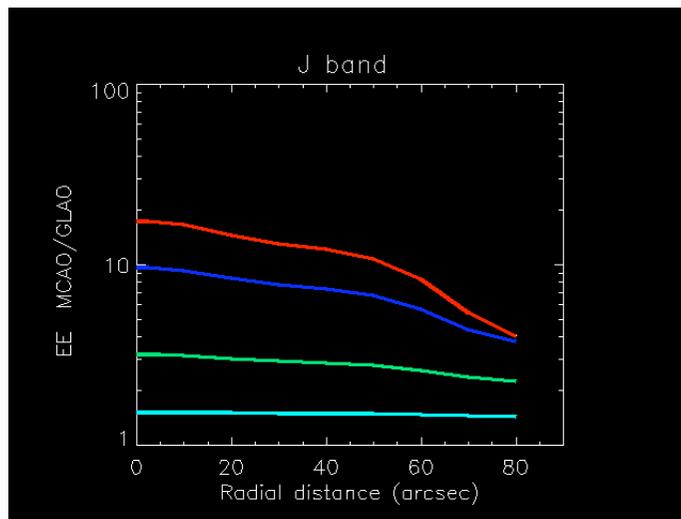
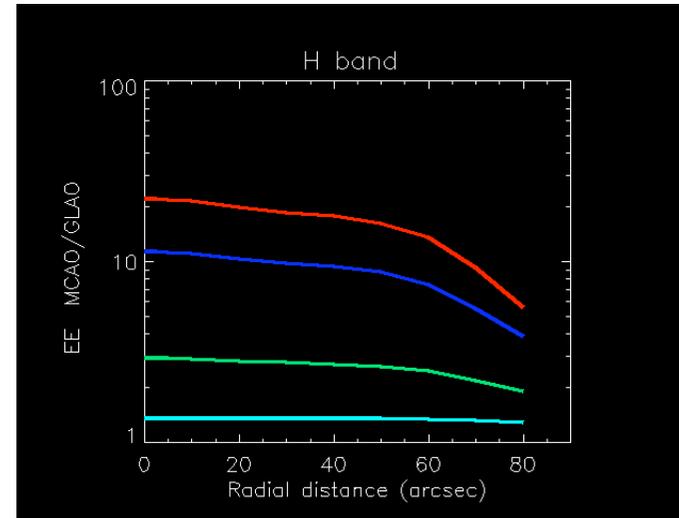
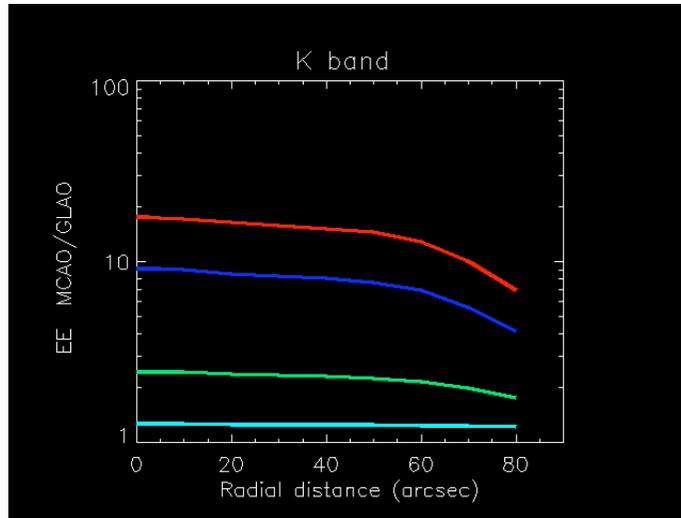


EE MCAO / Seeing radial profile





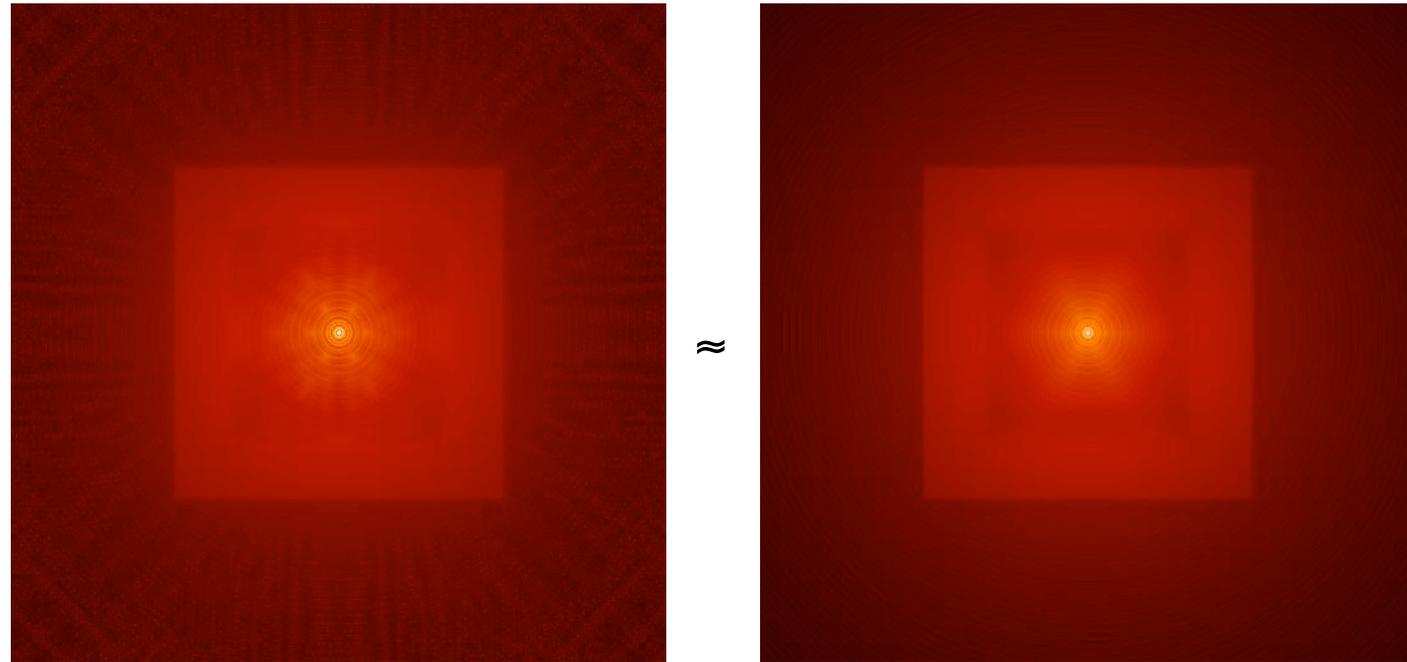
EE MCAO / GLAO radial profile





PSF model

K band PSF
SR \approx 0.6
Image size = 2.7"

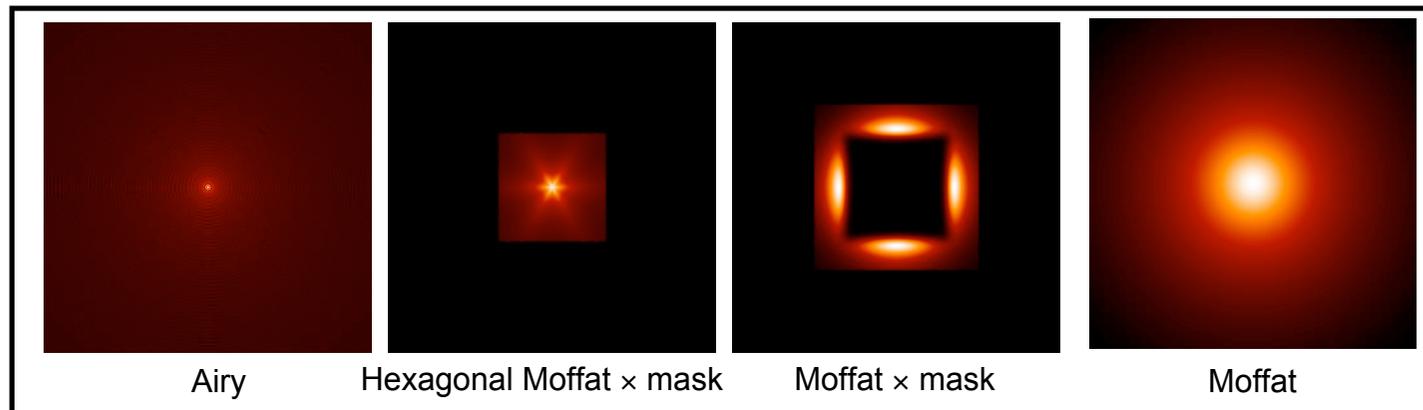


DIFFRACTION

FITTING + ALIASING ERRORS

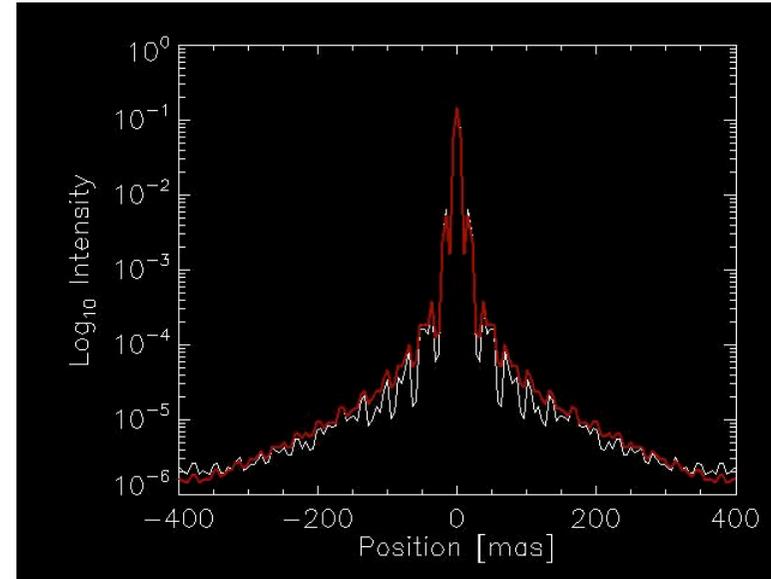
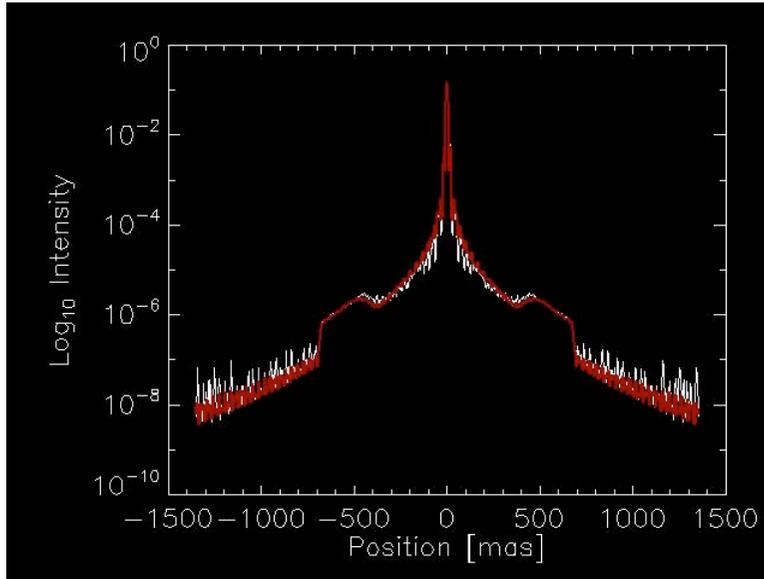


SEEING





PSF model



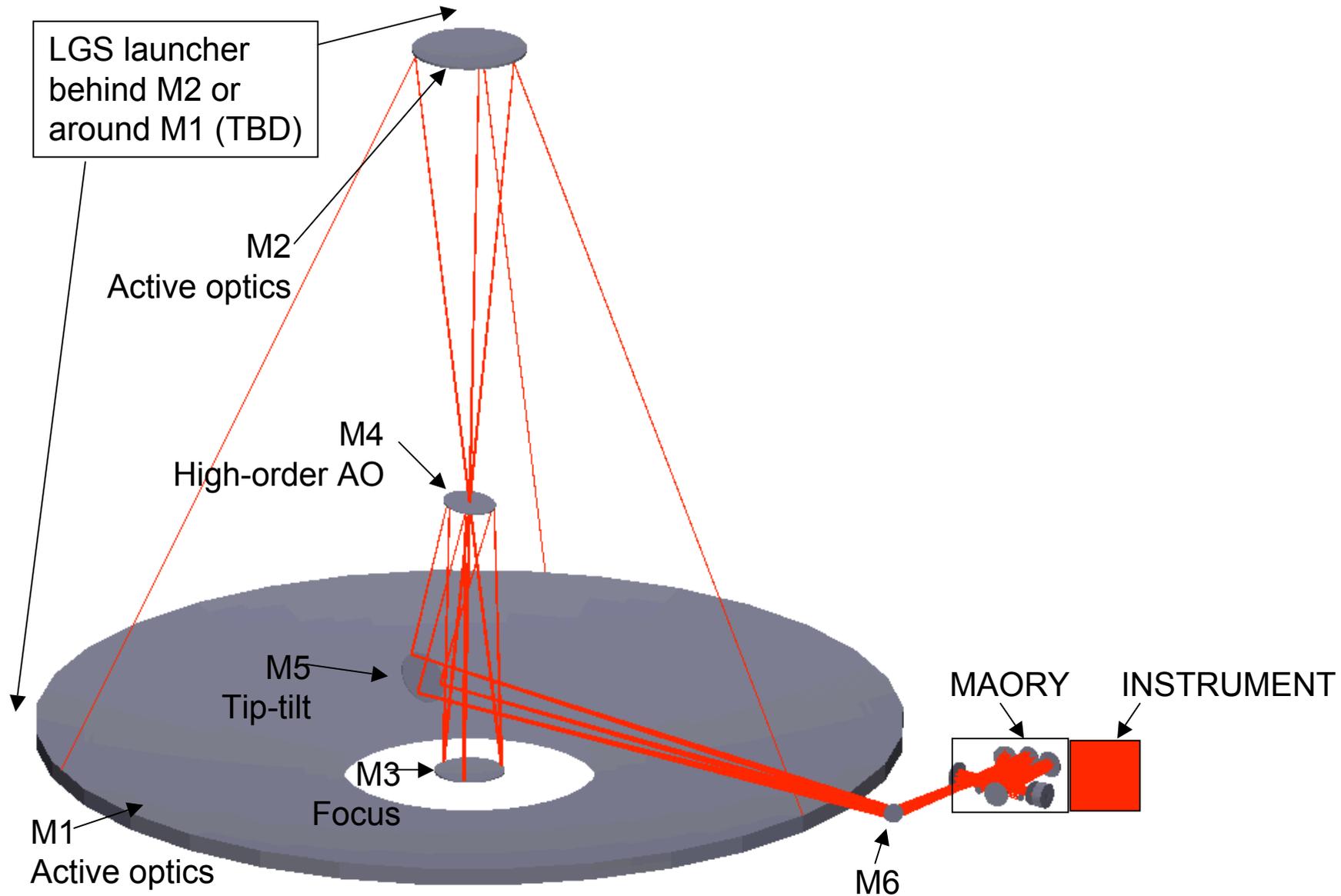
White lines: PSF. Red lines: PSF model.

Next steps

- Refine modelling
- Find correlations of PSF parameters with Strehl Ratio and seeing
- Evaluate PSF model accuracy for photometry and astrometry of crowded stellar fields



Sub-systems to control



WEB PAGE



<http://www.bo.astro.it/~maory>

WELCOME INTRODUCTION PERFORMANCE SR AND EE RADIAL PROFILE PSF FITTING DATA DESIGN
DOCUMENTS MAORY@OABO*

* these pages are password protected

MAORY

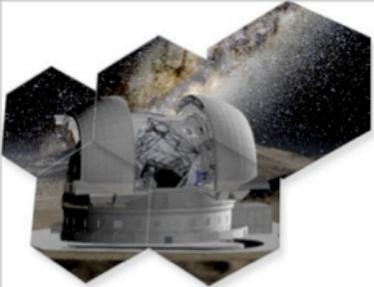
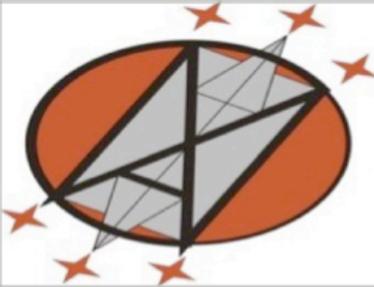
A MULTI-CONIUGATE ADPTIVE OPTICS RELAY FOR THE E-ELT

WELCOME TO THE MAORY WEB SITE

MAORY (Multi-conjugate Adaptive Optics Relay) is one of the post-focal adaptive optics modules currently under study for [the European Extremely Large Telescope](#).

In these pages you can find general informations on the module (short introduction, design, ecc), a description of the latest available performance and a list of relevant document.

A two years Phase A study for this module is in progress, within the framework of the E-ELT instrumentation studies sponsored by the European Southern Observatory (ESO). The study is performed by a consortium, led by INAF-Osservatorio Astronomico di Bologna in collaboration with University of Bologna - Dipartimento di Astronomia; the other partners of the consortium are Office National d'Etudes et de Recherches Aerospatiales (ONERA), INAF-Osservatorio Astrofisico di Arcetri, INAF-Osservatorio Astronomico di Padova. ESO has the role of study supervisor and provides support concerning the most critical technological developments (deformable mirrors, detectors, etc.). The study is funded also by the European Community through the Framework Programme 7 (Contract No. 211257).



Last Modified 09/03/2009 Editor of these pages Paolo Ciliegi [Email Me](#)

MAORY DESCRIPTION

PERFORMANCE

(SR and EE)

PSF DATA

No password

Please send an email

for new PSF release