

Full characterization of the turbulence generator MAPS for MCAO

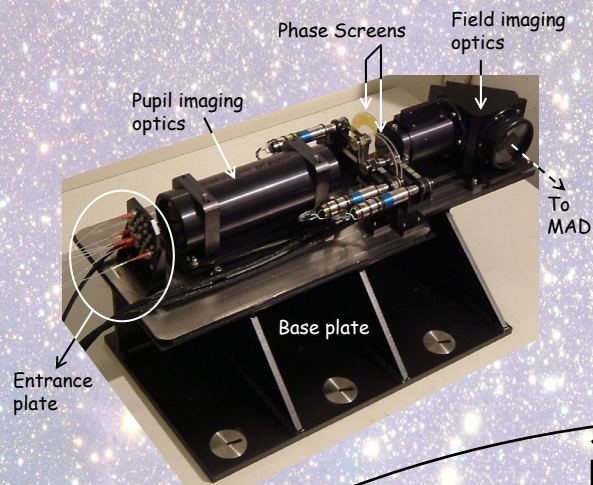
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SYSTEM DESCRIPTION

The **M**ulti-**A**tmospheric **P**hase screens and **S**tars tool is a telescope simulator and atmospheric turbulence generator developed for the laboratory testing of the MCAO Demonstrator (MAD) of ESO [5490-17].

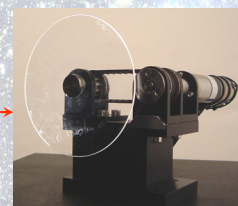
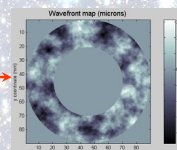


- Simulates the VLT Nasmyth focus
- Located at the input of MAD
- Curved field
- Up to 34 sources
- 4 magnitudes
- Various stars asterisms
- Wavelength range 0.5-2.5 μm

Based on refractive phase screens

- 3 layers of turbulence (0, 6 and 8.5 km)
- Paranal-like C_n^2 profile
- Paranal-like adjustable wind speeds (set to 3, 7 and 13 m/s)
- Paranal Outer scale (22 m)
- 2 seeing conditions
- Turbulence wavelength range 0.5-2.5 μm

Simulation of phase maps

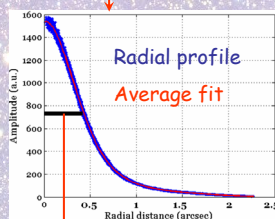
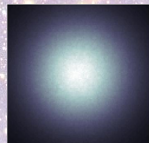


Realization of the Phase Screens by ion etching on glass substrate

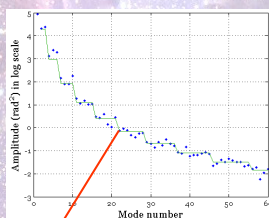
SEEING CHARACTERIZATION

Method 1:

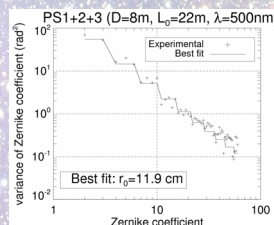
Measurement of the FWHM of long-exposure visible images of a spot whose WF is perturbed by a rotating PS, or a combination of them, thanks to a CCD camera at the exit focal plane of MAPS, and a source at 500 nm



Method 2: Static WF measurements thanks to a Shack-Hartmann WFS. Estimation of the Fried parameter r_0 of the turbulence from a fit of the WF variance by a Kolmogorov spectrum.



Method 3: Closed loop voltages fitted to the Influence Functions of the DM, and corrected by the residual measured by the WF sensor. Fit of the WF variance by a Kolmogorov spectrum.

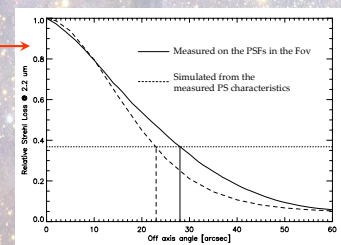


Isoplanatic patch:

Obtained from PSFs in the FoV of MAD used in closed loop as a SCAO system. A relative loss of Strehl Ratio of 63% is reached at a distance of the Guide Star equal to the isoplanatic angle.



Effect of the outer scale on the isoplanatic angle:



Measured $\theta_0 = 28 \pm 3''$
@ 2.166 μm
(Simulated $\theta_0 = 23 \pm 1''$
@ 2.166 μm)

Measurement on the individual 3 PS $\rightarrow$ Vertical distribution of the turbulence: 0 Km: 64%, 6 Km: 22%, 8.5 Km: 14%

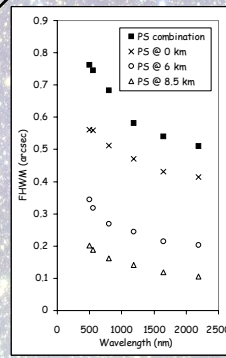
Computation of the coherence time: $\tau_0 = 3.2 \text{ ms}$

Computation of the Kolmogorov isoplanatic angle:

$\theta_0 = 2''$ @ 0.5 μm , $12''$ @ 2.166 μm

Turbulence chromatism:

FWHM measured at different wavelengths with CAMCAO show an evolution in $\lambda^{-0.42}$ due to a finite L_0



APPLICATION

Laboratory testing of MAD: Evaluation of the MCAO performances in the simulated 2' FoV [6272-62].

