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HIGH CONTRAST IMAGING OPTICAL SPECIFICATIONS FOR FRIDA

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High Contrast Imaging using coronographic spots and pupil apodization masks was specified as an upgrading for FRIDA.

Studies have been carried out to determine the possible stops and masks options on the optical design for these purposes and has been presented in Science with GTC III and elsewhere. After show a high contrast simulation result with FRIDA, we present the influence of residual optical aberrations at different spatial frequencies on the FRIDA performance for High Contrast Imaging.

On Figure 1 we present the numerical results achieved with the simulation of a concrete case. The present approach considers the characteristics of "GTC+GTCAO+FRIDA". The AO corrected images have a Strehl ratio $S = 0.55$ in H-band. FRIDA is assumed to work in IFS mode at $R = 1500$ in fine scale ($0.01''$/pix in the spatial direction). In our plots, we considered a 4.6 mag star in H band with an exposure time of one hour. Classical Lyot (CLC) is the coronagraphic solution adopted for the simulation while halo free removal and SSDI methods are the post processing techniques computed here. In addition, we plotted the photon and readout noise thresholds.

With CLC, a maximum of 10^8 photo electrons is reached (11 mag in intensity). Since the maximum number of photons per exposure per pixel is 10^5, 1000 exposures with an integration time $t = 3.6$ s are required to achieve these results. With the association of evoked techniques, we could reach the photon or readout noise limit and image an 18 mag substellar mass companion at a distance of 0.2 arcsec from a 4.6 mag star. Comparison with the observational results of Thatte et al. (2007, MNRAS, 378, 1229) using the SINFONI AO system allows us to be optimistic about the ability of FRIDA to provide high contrast imaging.

On Figure 2 radial profiles for a Colored Apodizer Phase Mask (CAPM) coronagraph are presented for random aberrations with a Power Spectral Distribution (PSD) proportional to ν^2 (ν the spatial frequency on the pupil). These aberration results were taken in account for the specification of crucial FRIDA optical components. It was determined the roughness of FRIDA Pre-Optics optical components must be lower than 1 nm rms.

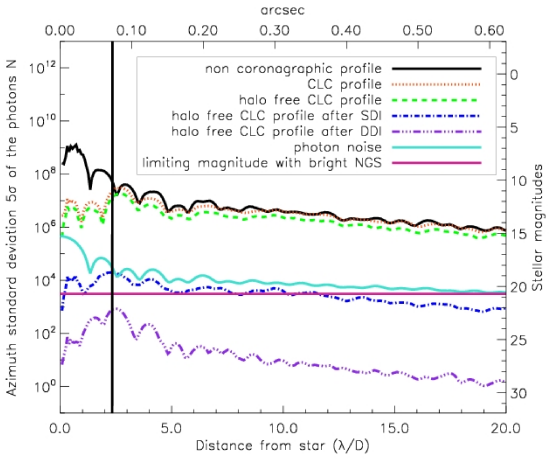

Fig. 1. Simulations with GTC+GTCAO+FRIDA in H band for a Strehl ratio of 0.55. FRIDA in IFS mode.

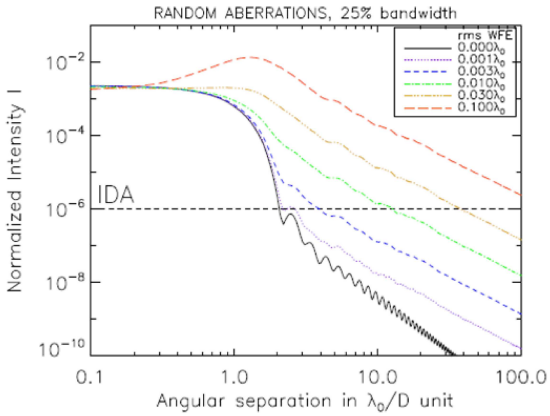

Fig. 2. Radial Intensity profiles of the coronagraphic images achieved with the CAPM coronagraph for different rms wavefront error values random aberrations with a PSD proportional to ν^2.

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