RISTRETTO: Current Status and Error Budget of Its High-Performance Multi-Stage XAO System

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Abstract

RISTRETTO is an instrument to be mounted on the VLT developed by the University of Geneva with support from the Laboratoire d'Astrophysique de Marseille and ONERA. It is designed to characterise temperate rocky planets around M-dwarfs, such as Proxima b, using reflected light. Achieving this requires a contrast of approximately 10-7 necessitating a highly efficient extreme AO system. The high performance targeted by the RISTRETTO instrument translates into a very restrictive error budget for the AO system with total WFE of $<$ 70nm RMS, corresponding to SR $>$ 70% in the visible, and low order WFE within 3 cycles of less than 10nm RMS. One specific feature of RISTRETTO is to consider a NIR WFS wavelength range (between 1 and 1.6 μm) for scientific VIS spectroscopy.

Error terms negligible in other XAO systems with larger working angles must be now considered. These include the Chromatic Pupil Shift (CPS), the low-wind effect, mechanical and thermal oscillation, etc. To meet those requirements, a two-stage architecture combining two WFS and two DM may be considered. The WFS, most likely a non-modulated Pyramid associated with a double Zernike, will be smartly integrated on one single fast low noise large format IR camera.

In this workshop, I will present the status of RISTRETTO's AO system. I will introduce its error budget, focusing on the model developed for the CPS error. Then, I will speak of the impact of the error budget on the system architecture, particularly on the WFS choice and wavelengths.

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Keywords: RISTRETTO, Multi, Stage, Chromatic Pupil Shift, Error Budget, Zernike WFS