Pushing high contrast with new wavefront control methods

Valentin Fonteneau*[1], Maud Langlois[2], Camille Graf[3], Michel Tallon[4], and Eric Thiébaut[2]

[1]Centre de Recherche Astrophysique de Lyon – Université Claude Bernard Lyon 1, Centre National de la Recherche Scientifique – France

[2]Centre de Recherche Astrophysique de Lyon – Univ Lyon, Univ Lyon1, ENS de Lyon, CNRS, Centre de Recherche Astrophysique de Lyon UMR5574, F-69230, Saint-Genis-Laval, France – France

[3]Centre de Recherche Astrophysique de Lyon – Ecole Normale Supérieure de Lyon, Université Claude Bernard Lyon 1, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique – France

[4]Centre de Recherches Astrophysiques de Lyon (CRAL) – CRAL – Université de Lyon, Lyon, F-69003, France ; Université Lyon 1, Observatoire de Lyon, 9 avenue Charles André, Saint-Genis Laval, F-69230, France ; CNRS, UMR 5574, Centre de Recherche Astrophysique de Lyon ; Ecole Normale Supérieure de Lyon, Lyon, F-69007, France, France

Abstract

The direct detection of exoplanets and circumstellar environments is the goal of the next generation of giant telescopes. These science goals require high angular resolution, very high contrast and real-time control of the wavefront. The XAO experimental bench of CRAL is used together with end-to-end numerical simulations to optimize the XAO performances for the future instruments such as SPHERE+ on the VLT, PCS on the ELT or the interferometric sparse pupil telescope prototype SELF. We will present recent studies including the iMz wavefront sensor (WFS) based on an integrated Mach-Zehnder interferometer which allows to measure very accurately the aberrations to be corrected in close loop by an XAO system. This WFS presents the advantage of allowing to retrieve a coronagraphic science path with almost zero non common path aberrations (NCPA) because the light reflected onto the Lyot mask is used for wavefront sensing by the iMz. This configuration is thus very efficient to reach very high contrast. We will present latest high contrast results obtained in simulation and experimentally using these wavefront control schemes to compensate for turbulence combined with wavefront shaping to create a dark hole.

Keywords: XAO, coronagraph, dark hole

*Speaker