Tunable Kernel-Nulling interferometry for direct exoplanet detection

Vincent Foriel [1,*], Frantz Martinache [1], David Mary [1], Nick Cvetojevick [1], Romain Laugier [2] and Sylvie Robbe-Dubois [1]

[1] *Université Côte d'Azur, Observatoire de la Côte d'Azur Nice, CNRS, Laboratoire Lagrange, France*
[2] *KU Leuven university, Leuven, Belgium*

*E-mail: `vincent.foriel@oca.eu`

Abstract

Nulling interferometry is a promising technique for direct detection of exoplanets. However, the performance of current devices is limited by the sensitivity to phase aberrations. This thesis attempts to improve this technique by using the world first active photonic component applied to astronomy. This component allow to build tunable Kernel-Nulls[1] with 14 electro-optic phase shifters, used to compensate optical path differences that would be induced by manufacturing defects. The first part of the study consists in the development of an algorithm providing the delays to be injected into the component to optimize the performance of that device. This technique is first evaluated via numerical simulations, then in lab. It is then envisaged to leverage the Nuller mode, soon to be installed on the VLTI as part of the ASGARD project, to test this architecture under real conditions of observation. The next step of this study deals with the analysis of the intensity distributions produced at the output of the Kernel-Nuller[1, 2] through a series of observations, against which statistical tests and machine learning techniques are applied to detect the presence of exoplanets. The preliminary results of this study are presented in this presentation.

Keywords: Interferometry, Exoplanet, Kernel-Nulling, VLTI, ASGARD

References

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