Tunable Kernel-Nulling interferometry for direct exoplanet detection

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Abstract

Nulling interferometry is a promising technique for direct exoplanet detection. However, the performance of current devices is limited by their sensitivity to phase aberrations. This thesis attempts to overcome some of these aberrations by using a four-telescope nulling interferometer architecture, called Kernel-Nuller[1], including a recombiner that place the four signals in phase quadrature. This architecture is based on an integrated optical component containing 14 electronically controlled phase shifters, used to correct possible optical path differences induced by manufacturing defects. The first part of this thesis consisted of developing an algorithm capable of giving the delays to be injected into the component to optimize the performance of the device. We tested this technique via numerical simulations, then in the laboratory. We then plan to take advantage of the Nuller mode which will soon be installed on the VLTI as part of the ASGARD project to test this architecture under realistic observation conditions. The second step of this study lies in the analysis of the intensity distributions produced at the output of the Kernel-Nuller[1, 2] on series of observations through statistical tests and machine learning techniques in order to detect the presence of exoplanets. Here we present the preliminary results of this study.
Keywords: Interferometry, Exoplanet, Kernel-Nulling, VLTI, ASGARD

References

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