Validating Kernel Phase Interferometry on an IFS using SCExAO/CHARIS

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Abstract

Kernel phase interferometry (KPI) is a data processing technique for high-Strehl images that achieves moderate contrast at or within the diffraction limit of the telescope. This allows for the detection of asymmetries arising from companions or disks at higher angular resolutions than those available for current approaches with coronagraphy. Here we show that this technique can be successfully applied to the CHARIS integral field spectrograph (IFS) which sits behind the SCExAO extreme adaptive optics system on the Subaru telescope. Furthermore, by making use of simultaneous wavelength coverage provided by the IFS we are able to demonstrate that a spectral differential imaging (SDI) calibration approach is potentially more sensitive for line-emission searches than a classical reference difference imaging (RDI) approach. This is useful, since current KPI observations are typically limited by instrumental systematics as well as airmass and spectral differences between the science target and calibrator. The use of an SDI calibration is a promising avenue towards achieving photon noise limited KPI observations. Finally even with the greatly improved angular resolutions afforded by the next generation of ELTs, due to the large distances to star-forming regions, KPI will still be a powerful tool for probing the orbital separations where giant planets are known to exist, at thermal-infrared wavelengths where protoplanets are expected to be relatively bright.

Keywords: kernel phase, interferometry, data analysis, high, angular resolution, planet formation

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