Shaped pupil coronagraph design for Subaru high-contrast imaging with reduction of the inner working angle for earth-like planet detection

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Proceedings Volume 11117, Techniques and Instrumentation for Detection of Exoplanets IX; (/conference-proceedings-of-spie/11117.toc) 111171I (2019) https://doi.org/10.1117/12.2529719 (https://doi.org/10.1117/12.2529719)

Event: SPIE Optical Engineering + Applications (/conference-proceedings-of-spie/browse/SPIE-Optics-Photonics/SPIE-Optical-Engineering-Applications/2019), 2019, San Diego, California, United States

Abstract

The Subaru telescope detects exoplanets at contrasts of 1 × 10^{-5} by using a shaped pupil coronagraph. The shaped pupil is a binary mask designed to alter the propagation of light to the image plane in a way that produces dark holes (also called "discovery regions") where off-axis point sources can be detected more easily. Our objective is to decrease the inner working angle (IWA) of the discovery regions to allow for detection of Earth-like planets found closer to the target star. The current Subaru shaped pupil has an IWA of 3.5 λ/D and an outer working angle (OWA) of 16 λ/D. These characteristics of the IWA limit the detection of planets close to the star and the low transmission level of the shaped pupil potentially intercepts the transmission of o_-axis point sources. Here we present a new pupil design that attains a smaller IWA and achieves a transmission of greater than 50%, while maintaining the current contrast level. The tradeoff is a smaller OWA, which allows for less discovery space at the outer regions of the image plane. We also explore the potential benefits of setting the desired level of transmission and maximizing the contrast, as opposed to the current method of fixing the contrast and maximizing the transmission.

Citation

KEYWORDS

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Coronagraphy
Stars
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