

Residual Wave Front Phase Estimation in the Lyot Plane for the Eclipse Coronagraphic Telescope

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Coronagraphs for extra-solar planet detection remove diffracted stellar light through the combination of a coronagraphic spot and a Lyot stop. When the entrance pupil contains a nearly perfect wave front, most of the stellar light is absorbed at the spot. Light scattered around the spot due to mid- and high-spatial frequency phase errors in the pupil appears at the Lyot plane as amplitude non-uniformities proportional to the local wave front phase residual. The non-uniformities scale with optical wavelength but maintain high contrast across a broad band. The Eclipse deformable mirror (DM) can be used to modify the Lyot amplitude distribution, providing a simple means of estimating the residual phase content and controlling the wave front. To reduce the detrimental noise carried by uncontrollable high-spatial frequency wave front components, the Lyot plane signal is filtered at the science plane to pass only the controllable spatial frequencies that contribute to the dark hole. The Lyot stop is then reimaged onto a detector. We demonstrate through simulations that this approach significantly improves the signal-to-noise ratio of the planet measurement.