



Realizing the Potential of JWST High Contrast Imaging with Coronagraphic Phase-Retrieval

Marie Ygouf¹, Charles A Beichman¹, Graça M Rocha¹, Joseph J Green¹, Jewell Jeffrey B¹, Gael M Roudier¹, Alexandra Greenbaum², Jarron Leisenring³, Julien Girard⁴, Laurent Pueyo⁴, Marshall Perrin⁴, Michael Meyer⁵, Matthew De Furio⁵, and Taichi Uyama⁶

¹Jet Propulsion Laboratory, California Institute of Technology

²Draper Laboratory

³University of Arizona

⁴Space Telescope Science Institute

⁵University of Michigan

⁶IPAC, California Institute of Technology

The James Webb Space Telescope (JWST) will probe circumstellar environments at an unprecedented sensitivity. However, the performance of high-contrast imaging instruments is limited by the residual light from the star at close separations ($<2\text{-}3''$), where the incidence of exoplanets increases rapidly. There is currently no solution to get rid of the residual light down to the photon noise level at those separations, which may prevent some crucial discoveries.

We are further developing and implementing a potentially game-changing technique of post-processing that does not require the systematic observation of a reference star, but instead directly uses data from the science target by taking advantage of the technique called "phase retrieval". This technique is built on a Bayesian framework that provides a more robust determination of faint astrophysical structures around a bright source.

This approach uses a model of instrument that takes advantage of prior information, such as data from wavefront sensing operations on JWST, to estimate instrumental aberrations and further push the limits of high-contrast imaging. With this approach, our goal is to improve the contrast that can be achieved with JWST instruments.

We were awarded a JWST GO-Calibration proposal to implement, test and validate this approach on NIRCcam imaging and coronagraphic imaging. This work will pave the way for the future space-based high-contrast imaging instruments such as the Nancy Grace Roman Space Telescope Coronagraph Instrument (Roman CGI). This technique will be crucial to make the best use of the telemetry data that will be collected during the CGI operations.

"© 2021 California Institute of Technology. Government sponsorship acknowledged. The research was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. This document has been reviewed

and determined not to contain export controlled data.”