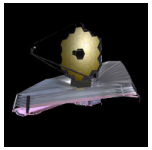

7942 - From data-driven to physics-based: improving exoplanet imaging with differentiable coronagraph models

Cycle: 4, Proposal Category: AR

INVESTIGATORS

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OBSERVATIONS

ABSTRACT

We propose the use of a new GPU-accelerated, physics-based image processing method to improve the sensitivity of all NIRCam coronagraphic data of known directly-imaged exoplanets. Currently, our ability to directly detect faint planets is limited by our ability to model and supress the glare of the star. This work will use a post-processing method based on using a NIRCam coronagraph model to jointly fit the glare of the star and instrumental aberrations in the optical system. This is an extremely high-dimensional problem, which only recently has become computationally tractable thanks to the innovation of auto-differentiation from the machine learning community. By making our coronagraph model differentiable, this method efficiently optimizes more than one million free parameters and acheives a detection performance up to 7 times deeper than traditional methods. The proposed analysis will: 1) demonstrate the effectiveness of this new method leveraging the extraordinary stability of JWST, 2) obtain higher precision astrometry and photometry of known companions thanks to higher signal-to-noise detections, 3) search for undetected companions

in archival data with improved sensitivity, and 4) characterize unknown defects in the NIRCam optical system, which will result in higher fidelity JWST simulations for the broader astronomical community through software such as webbPSF.

OBSERVING DESCRIPTION