Establishing Extreme Dynamic Range with JWST: Decoding Smoke Signals in the Glare of a Wolf-Rayet Binary

Scientific Category:	Stellar Physics
Scientific Keywords:	Circumstellar Matter, Dust, Hot Stars, Interstellar Medium, Massive Stars
Alternate Category:	Galaxies and the IGM
Instruments:	MIRI, NIRISS
Proprietary Period:	0 months
Allocation Information (in hours):	
Science Time:	6.5
Charged Time:	15.2

Abstract

Dust is a key ingredient in the formation of stars and planets. However, the dominant channels of dust production throughout cosmic time are still unclear. With its unprecedented sensitivity and spatial resolution in the mid-IR, the James Webb Space Telescope (JWST) is the ideal platform to address this issue by investigating the dust abundance, composition, and production rates of various dusty sources. In particular, colliding-wind Wolf-Rayet (WR) binaries are efficient dust producers in the local Universe, and likely existed in the earliest galaxies. To study these interesting objects, we propose JWST observations of the archetypal colliding-wind binary WR 140 to study its dust composition, abundance, and formation mechanisms. We will utilize two key JWST observing modes with the medium-resolution spectrometer (MRS) on the Mid-Infrared Instrument (MIRI) and the Aperture Masking Interferometry (AMI) mode with the Near Infrared Imager and Slitless Spectrograph (NIRISS).

Our proposed observations will yield high impact scientific results on the dust forming properties WR binaries, and establish a benchmark for key observing modes for imaging bright sources with faint extended emission. This will be valuable in various astrophysical contexts including mass-loss from evolved stars, dusty tori around active galactic nuclei, and protoplanetary disks. We are committed to designing and delivering science-enabling products for the JWST community that address technical issues such as bright source artifacts that will limit the maximum achievable image contrast.

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