Q39a Three-dimensional gas density distribution using [Ne V] fine-structure lines in the colliding wind binary WR140

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WR140 is a colliding wind binary system composed of a carbon-rich Wolf-Rayet (WC) star and an O-type star companion, notable for its periodic dust formation. The dust structure adopts a three-dimensional shape, with varying velocities across different components, suggesting spatial variations in velocity. Fine-structure lines in the colliding wind region, such as [S IV] and [Ne III], occur in highly excited environments. This study uses the James Webb Space Telescope (JWST) Mid-Infrared Instrument (MIRI) Medium-Resolution Spectrometer under the Early Release Science program DustERS (led by Ryan M. Lau) to investigate the physical conditions of the dust region in WR140. This instrument provides unprecedented sensitivity and spatial resolution, allowing separate studies of the dust shell and the WR star. We report the detection of spatially resolved [Ne V] lines at 14.3 and 24.3 μm and derive the three-dimensional electron density distribution from the [Ne V] line ratio. For the first time, this analysis reveals an increase in electron density in the region where the newly formed dust arc is located. Comparison to hydrodynamic simulations (Russel, C.M.P., et al. in prep.) further indicates that the electron density is highly clumpy, suggesting a high, clumpy density distribution being crucial for dust formation.