The 3D Morphology of VY Canis Majoris II: Polarimetry and the Line-of-Sight Distribution of the Ejecta

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We use imaging polarimetry taken with the HST/ACS/HRC to explore the three dimensional structure of the circumstellar dust distribution around the red supergiant VY Canis Majoris. The polarization vectors of the nebulosity surrounding VY CMa show a strong centro-symmetric pattern in all directions except directly East and range from 10% - 80% in fractional polarization. In regions that are optically thin, and therefore likely have only single scattering, we use the fractional polarization and photometric color to locate the physical position of the dust along the line-of-sight. Most of the individual arc-like features and clumps seen in the intensity image are also features in the fractioanl polarization map. These features must be distinct geometric objects. If they were just local density enhancements, the fractional polarization would not change so abruptly at the edge of the feature. The location of these features in the ejecta of VY CMa using polarimetry provides a determination of their 3D geometry independent of, but in close agreement with, the results from our study of their kinematics (Paper I).

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