

ALMA PROBES REFRACTORY CHEMISTRY AND RELATED MASS-LOSS EVENTS IN VY CMa

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The hypergiant star VY Canis Majoris, or VY CMa provides an excellent opportunity to study the evolution of massive stars, which undergo significant mass-loss and are characterized by asymmetric outflows. The arcs, knots, and clumps formed in these processes contain dust and molecules. Using the ALMA, images of PO, PN, NaCl, and Na³⁷Cl have been obtained in Band 6 at 0.25 and 1 arcsec resolution and combined with single-dish data from the ARO Submillimeter Telescope (SMT). While PO emission is confined to the spherical outflow directly on the star, that of PN is more extended, forming a bridge between the star and the SW Clump seen in HST data. NaCl and Na³⁷Cl, on the other hand, trace two distinct sources: the spherical outflow and the SW Clump. NaCl is known to condense out of the gas-phase rapidly in circumstellar material. The survival of NaCl in the SW Clump supports the idea that this material was ejected directly from the photosphere. PN and PO are not observed in the more extended structures seen in SO₂ and HCN, indicating likely grain condensation as well.