

Utilizing N_2H^+ to Probe Protostellar Envelopes: the Case of L1157

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We present observations of the Class 0 young stellar object L1157 using the Combined Array for Research in Millimeter-wave Astronomy (CARMA) in the 3 mm dust continuum and N_2H^+ line emission. For the first time, we detect a large-scale N_2H^+ flattened envelope that is extended with a linear size of $\sim 20,000\text{AU}$. This N_2H^+ feature is extended perpendicular to the CO outflow of the young stellar object, and coincides with the $8\ \mu\text{m}$ extinction feature against the background PAH emission. By comparing the N_2H^+ feature with the $8\ \mu\text{m}$ extinction, we examine the N_2H^+ abundance along the flattened envelope; enhancement of the N_2H^+ abundance toward the central protostar and depletion in the innermost region is suggested. Moreover, this highly flattened envelope shows dynamical signatures consistent with a slow, solid-body rotation at large scales and gravitational infall in the inner region; though the structure is not rotationally supported. We construct a simple model to interpret both the dust continuum and N_2H^+ emission, providing a possible dynamical scenario for the overall properties of the envelope.