

Multi-molecular Line Observations of Protostellar Outflows

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Abstract. We present the results of a multi-molecular line survey of the gaseous surroundings around protostars at different evolutionary stages. The high angular and velocity resolution observations, taken with the Owens Valley Radio Observatory (OVRO) millimeter interferometer array, allow a detailed study of the molecular outflow, the circumstellar envelope, and the outflow-envelope interaction. We find enhanced abundance of certain species [e.g., $\text{HCO}^+(1-0)$, $\text{CS}(2-1)$, $\text{HNC}(1-0)$] along the outflow cavity walls, independent of the outflow source age. Comparing our molecular line maps with HST and ground-based images we show that the molecular line enhancement coincide with regions where shock-induced optical or near infrared emission is detected. We see clear evidence that outflows can affect the chemical composition of circumstellar envelopes through the shock enhancement of different molecular species in the outflow-envelope interface, consistent with recent chemical models (e.g., Rawlings et al. 2004; Viti et al. 2002). Our results also indicate that the outflow's efficiency of producing shock-induced molecules decreases with outflow age.

Keywords. ISM: jets and outflows, stars: formation, stars: circumstellar matter, stars: pre-main-sequence, ISM: molecules

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References

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