Contribution ID: **74** Type: **Poster**

Outflow-Outflow interactions in binary and clustered protostars

Theoretical models suggest that jet-driven bow shocks govern Class 0/I molecular outflow morphologies extending up to 10^{4-5} au, with additional modifications arising from binary motion, precession, and ambient interactions due to other outflows produced by clustered or binary protostars. Previous studies have demonstrated that outflow interactions in clustered environments are common, particularly in high-mass star-forming regions such as W43-MM1, where multiple outflows interact at scales of 5×10^3 au. Recent observational advances have enabled the detection of fine structures within these outflows, providing new constraints on theoretical models.

This study aims to investigate the interaction between molecular outflows, studying their occurrence probability and the observational signatures produced by such interaction, and analyzing how these interactions modify the structure and emission characteristics of the protostellar envelope. We use 3D hydrodynamical simulations to model these interactions under realistic physical conditions, incorporating initial conditions derived from observational studies. The simulations allow us to study the dynamic evolution of the system, revealing signatures of outflow collisions that could serve as observational markers. These findings are particularly relevant for future studies using (sub)millimeter interferometers such as ALMA and NOEMA, which can now resolve outflow interactions at scales of less than 10^3 au.

We present our results to understand better the complex dynamics governing molecular outflow interactions in binary systems. By characterizing these interactions, we can refine our models of jet evolution and provide empirical criteria for identifying similar events in other protostellar environments. The results offer valuable insights into the role of multiplicity in star formation and the broader implications of outflow collisions in shaping the interstellar medium.

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Session Classification: Session 1a