Shocked Clumps in a Stellar Jet: Astrophysical Simulations with Laboratory Analogs

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Herbig-Haro objects, the shocked outflows of young stars observed via their emission lines, are ideal for comparisons with laboratory laser experiments. We have done experiments on the Omega laser of shocks over-running multiple clumps, the results of which have motivated the numerical simulation of the Herbig-Haro object HH 29. Observations of HH 29 clearly reveal clumps that have been shocked by the outflow; these observations provide emission line maps (Hα and [SII]) [1] as well as radial velocities [2] and proper motions [3]. The internal dynamics shown in these simulations of HH 29 can be used to further our understanding of the laboratory laser experiment results.

We are using AstroBEAR, a 3-D MHD code, to model HH 29. For a given number of clumps, we have varied the positions, densities, and sizes of the clumps. AstroBEAR can track number densities of HI, HII, and electrons, and has a well-tested cooling routine, allowing us to obtain valid emission line maps of Hα and [SII]. The simulations also provide velocities from which we determine radial and proper motions. Currently we are running these simulations without magnetic fields, but it would be possible in the future to add in magnetic fields for more complete models. We report the results of the simulations as we explore the parameter space, and discuss how they compare with observations.

References

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