Progress Report for TG-AST140008

During our 2021-2022 allocation we have primarily worked on analysis of results and writing papers. Four papers from the *cores* project are in preparation. One paper on *supernovae* has been published as (Hristov et al. 2021). Three papers from the *turbulence* project have been produced, one of those has been submitted to Monthly Notices of the Royal Astronomical Society.

The first paper in the *cores* project examines the initial conditions of star forming clouds. We find an abundance of fractal structures, mixing between different cores early on, and we find a novel prediction of the star formation rate. This will be submitted by August 2022 as Collins, Le, and Jimenez (2022).

The second paper in the *cores* project examines the rate of collapse and gravitational binding energy during collapse. We find that the cores do not always have a phase where the velocity is subsonic, as was originally expected; and the collapse is slower than free-fall in all but the largest objects, which are substantially faster. This will be submitted as Le, Collins and Jimenez (2022).

The third paper, to be submitted by Summer 2022, examines the behavior of magnetic fields during the collapse. It is found that the ratio of magnetic field strength to density decreases as a function of time by the act of turbulence alone. This will be submitted as Jimenez, Collins and Le (2022).

The fourth publication, to be completed by Fall 2022, is an examination of the full suite of forces acting on collapsing gas.

The *turbulence* study has netted one submitted publication and two more being finalized. The first is a study of the PDF of density in isothermal turbulence, and has been submitted to Montly Noticess of the Royal Astronomical Society as Rabatin and Collins (2022). The second is a study of the joint distribution of the density and velocity and their correlation. The thrid is the preliminary suite that inspires the current proposal, a prediction of the joint distribution of Kinetic and Internal energy in isothermal turbulence.

We concluded the Supernova project this year, with the results published in (Hristov et al. 2021). We find the surprising result that many Type Ia spernovae require very large (10^6G), magnetic fields to reproduce the late-time light curves observed.

References

Hristov, B., Hoeflich, P., & Collins, D. C. 2021, ApJ, 923, 210