

Final Project Topic

For this project, I'll be working with Sarah Stangl.

At the bare minimum, this project will involve making a simple 1D (Lagrangian) hydrocode that will model velocities, temperatures, pressures, etc. within a star as a function of time. This code should also be able to introduce a (simple) shock event, which could be useful in creating models of core-collapse SNe.

To do this numerically, we will first either use a piecewise-constant or more likely a piecewise-linear method to approximate the interface states that are needed for calculation. If time permits, this method could be possibly upgraded to the more accurate piecewise-quadratic method, and the results may be compared. Initially we may likely start designing this code run in serial, but again as time permits this code may be parallelized if possible. It may even be necessary.

I've already looked at the appendix of the Arnett (1966) paper that covers a lot of steps involved in creating a basic hydrocode. It is a bit different because it is a very old paper, but I believe it uses the piecewise-linear method (averages) to get interface values.

There was also another great source that was shown to me by Michael Zingale¹ that has a lot of example code and a detailed book for astrophysics students on writing a hydrocode.

This project interests me not only because it easily relates to my research in SNe, but because there are many different ways to optimize a hydrocode. Code optimization is a skill that I am always trying to better for myself, and this is the perfect way to practice this and gain a lot of knowledge about what goes on in the background of creating models related to my field of research.

References

Arnett, W. D. 1966, Can. J. Phys., 44, 2553, doi: 10.1139/p66-210

¹<http://zingale.github.io/hydro1d/>