

PHYS 432 Assignment 4, Problem 2

Yuliya Shpunarska

24 March 2022

1 Problem 1

I didn't manage to get a working simulation but here is a discussion of how it should behave.

1.1 What is the ratio of densities pre- and post-shock? Does what you get agree with the shock jump conditions derived in class? Include a snapshot to support your answer.

For an adiabatic strong shock, we derived in class that the ratio of densities should be:

$$\frac{\rho_1}{\rho_2} = \frac{\gamma - 1}{\gamma + 1}$$

where ρ_1 is the pre-shock density and ρ_2 is the post-shock density. Hence for a monoatomic gas with $\gamma = \frac{5}{3}$, we expect the ratio to be $\frac{1}{4}$.

1.2 What is the width of your shock? What sets this width? Explain and verify by varying the relevant parameters. Include snapshots to support your answer.

The width of the shock is determined by the viscosity and the advection. In this simulation we did not specifically examine the viscous diffusion, but in this case, since the Mach number is very high for a strong shock, it should dominate over viscous effects. Hence the width of the shock $\Delta x = \lambda_{mfp}/M$ should be very small.