25. Fast wave, fast shock, perpendicular shock, entropy, jump relation.

Consider the fast perpendicular shock.

(a) Determine the positive root of the solution for the compression ratio. How does the compression ratio behave for very large and very small upstream plasma β?

(b) An important quantity for space plasma processes is entropy. A measure of entropy is $s = p/n^\gamma$. Determine the downstream to upstream ratio of s as a function of upstream Machnumber and plasma β. Plot this ratio and the compression ratio as a function of plasma β for a fixed upstream Machnumber of 20. What is the value of the minimum upstream plasma β to sustain a shock? Why?

26. Simulation of a hydrodynamic shock.

The initial condition 8 in the simulation code is an example for a hydrodynamic shock. Note, in order to run this stable and without large oscillation you need to increase the viscosity parameters significantly.

(a) For what values of the viscosities do you get a reasonably stable solution?

(b) Run the code for two different upstream Machnumbers and use methods 0, 1, and 2 for the treatment of the energy equation (parameter intu). Describe any differences in the results. Compare the analytic jump conditions for a hydrodynamic shock with your results for the two Machnumbers. Discuss these results. (Note, that for larger Machnumbers you will need higher viscosity and possibly also a wider transition region parameterized with $l0$ in the program.

27. Project

Decide a project topic, collect the material, and make a first attempt to understand the basic motivation, methodology, and impact of the results of the article.

In case you choose a simulation topic, outline your goals for this topic and formulate an approach how to achieve those.

Please turn in the solutions to the homework on Friday, 4/4/08