# Astrophysical Fluid Dynamics

## Assignment #8: due December 18th

### 1. Flow parallel to an MHD shock

Derive an expression for the change in the parallel component of the gas velocity, $v_\parallel$, through an MHD shock. Show that if the parallel and perpendicular components of the magnetic field are both non-zero ($B_\parallel \neq 0$, $B_\perp \neq 0$) then $v_\parallel$ remains unchanged only in the trivial case where there is no change in the velocity, density or magnetic field strength through the shock.

### 2. Rotational discontinuities

Consider an MHD shock in which $v_{1,\perp} = v_{2,\perp}$. Derive expressions for $\rho_2/\rho_1$ and $P_2/P_1$ in this case, and show that a non-trivial shock solution exists only if $v_{1,\perp}$ satisfies:

$$v_{1,\perp} = \frac{B_{1,\perp}}{\sqrt{4\pi\rho_1}}. \tag{1}$$

Draw a sketch of what happens to the magnetic field structure as we pass through such a shock. [**Note**: you may assume that the shock is isentropic].