Astronomy 304, STARS

Homework # 10 Due Monday, April 7, 2003

Show All Your Work

1. Derive the Initial Mass Function (IMF) for non-magnetic, supersonic turbulent interstellar clouds. The shock jump conditions for strong, non-magnetic, isothermal shocks are

$$\begin{aligned} \rho_1 u_1 &= \rho_0 u_0 & (1) \\ \rho_1 u_1^2 + P_1 &= \rho_0 u_0^2 & (2) \end{aligned}$$

   where for an isothermal fluid, $P = c_{s0}^2 \rho$, where c_s is the sound speed, which is constant. Highly supersonic means $u_0 >> c_0$.

   What power law exponent β of the turbulent energy spectrum $E(k) = v_k^2/k \propto k^{-\beta}$ is needed to produce the observed IMF

$$N(m) d\log m \propto m^{-1.35} d\log m = m^{-1.35} dm/m$$

   as found orignially by Salpeter, ApJ, **121**, 161, 1955.

   Search the web for simulation results for the turbulence spectrum of COMPRESSIBLE, SUPERSONIC, turbulence and compare.