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Shock generated vorticity in the interstellar medium and the origin of the stellar initial mass function NICHOLAS KEVLAHAN, RALPH PUDRITZ, McMaster University — Observations of the interstellar medium (ISM) and molecular clouds suggest these astrophysical flows are strongly turbulent. The main observational evidence for turbulence is the power-law energy spectrum for velocity fluctuations, $E(k) \propto k^{\alpha}$, with $\alpha \in [-1.5, -2.6]$. The Kolmogorov scaling exponent, $\alpha = -5/3$, is typical. At the same time, the observed probability distribution function (PDF) of gas densities in both the ISM as well as in molecular clouds is a log-normal distribution. In this paper we examine the density and velocity structure of interstellar gas traversed by curved shock waves in the kinematic limit. We demonstrate mathematically that just a few passages of curved shock waves generically produces a log-normal density PDF. This explains the ubiquity of the log-normal PDF in many different numerical simulations. We also show that subsequent interaction with a spherical blast wave generates a power-law density distribution at high densities, qualitatively similar to the Salpeter power-law for the IMF. Finally, we show that a focused shock produces a *downstream* flow with energy spectrum exponent $\alpha = -2$. Subsequent shock passages reduce this slope, achieving $\alpha \approx -5/3$ after a few passages. These results suggest that fully-developed turbulence may *not* be required to explain the observed energy spectrum and density PDF.

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