Modification of the Hugoniot adiabat due to turbulence generated in shocked deuterium-filled CH foams

A.L. VELIKOVICH, Plasma Physics Division, Naval Research Laboratory, J.G. WOUCHUK, C. HUETE RUIZ DE LIRA, UCLM, ETSII-INEI Campus s/n Ciudad Real, Spain — Direct-drive laser targets are often designed with DT-filled CH foam ablators. Accurate modeling of these targets requires understanding of shock propagation in such non-uniform media. The interaction of the shock front with the preshock random density non-uniformities generates a random motion (turbulence) in the postshock flow. The energy coupled into the postshock turbulent motion, in turn, modifies the shock adiabat. As first detected in simulations by G. Hazak et al., Phys. Plasmas 5, 4357 (1998), shock compression and shock velocity in a deuterium-filled foam would be, respectively, less and greater than those predicted for the uniform medium of the same average density. We report an exact analytical theory of this “shock under-compression” effect and present explicit formulas for the shock adiabat modification. We discuss the contributions of post-shock Reynolds stresses, acoustic energy flux emitted downstream and correlations between vortical and entropy perturbations and highlight the difference between the cases of 2D and 3D turbulence.

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Alexander Velikovich
Plasma Physics Division, Naval Research Laboratory

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