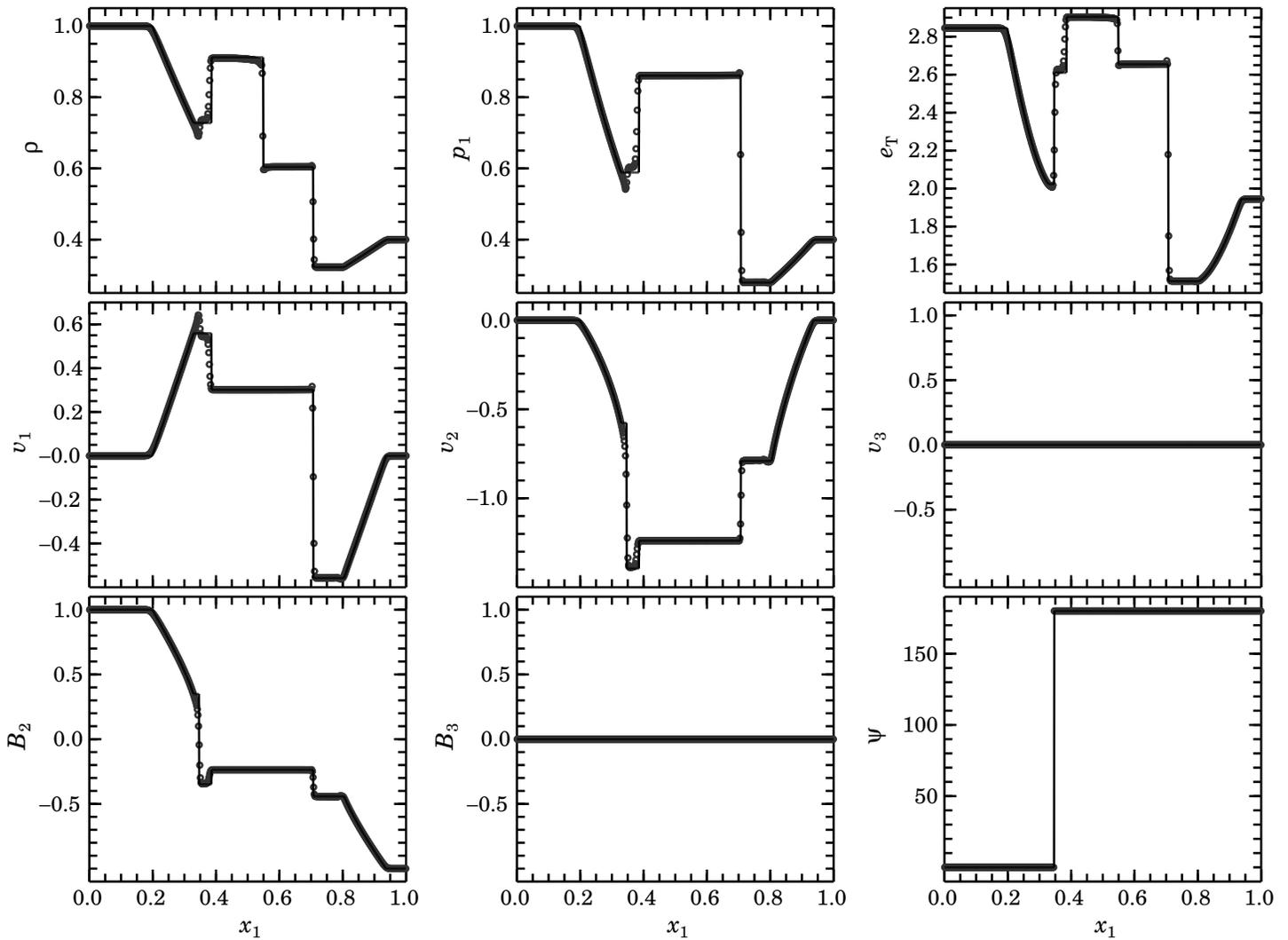


ZEUS-3D 1-D Gallery #20: “Compound” waves



This is Fig. 5b from Ryu & Jones (1995, ApJ, 442, 228), showing the solution of the MHD shock tube problem with the left state $(\rho, v_1, v_2, v_3, B_2, B_3, p_1) = [1, 0, 0, 0, 1, 0, 1]$ and the right state $[0.4, 0, 0, 0, -1, 0, 0.4]$ with $B_1 = 1.3$ and $\gamma = 5/3$ at time $t = 0.16$. At $t = 0$, the discontinuity is at $x_1 = 0.5$. Plots show from left to right: (1) fast compound wave, (2) slow shock (at $x_1 \sim 0.38$), (3) contact discontinuity (at $x_1 \sim 0.55$), (4) slow shock (at $x_1 \sim 0.7$), and (5) a fast rarefaction.

Open circles are the `dzeus36` solution using 512 zones, `CMoC`, the total energy equation, and third-order interpolation with the contact steepener engaged. `dzeus36` parameters controlling the time step and artificial viscosity are: `cournu=0.75`, `qcon=1.0`, and `qlin=0.2`. Lines are the results from the non-linear Riemann solver described in Ryu & Jones.

There are no significant differences between the `dzeus36` and `dzeus35` solutions. The fast compound wave consists of a fast rarefaction attached to an intermediate shock, and is found in virtually all numerical solutions. In a non-dissipative analytical solution, the compound wave is replaced by a shallower fast rarefaction followed closely by (but not attached to) a rotational discontinuity.