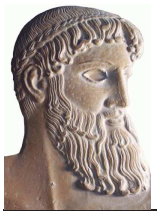
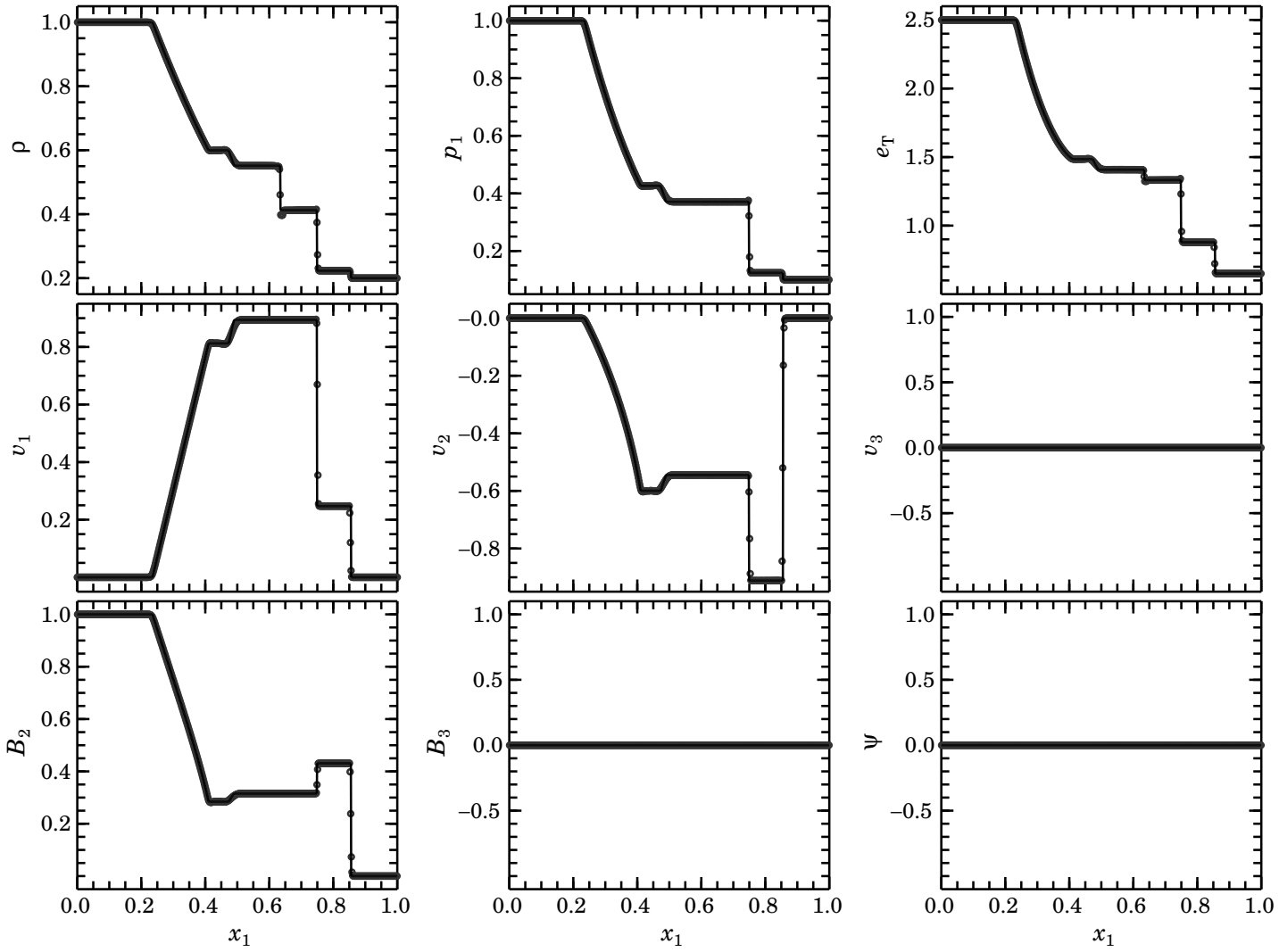


ZEUS-3D 1-D Gallery #15: "Switch-on" shock



This is Fig. 4*a* 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 $[0.2, 0, 0, 0, 0, 0, 0.1]$ with $B_1 = 1$ and $\gamma = 5/3$ at time $t = 0.15$. At $t = 0$, the discontinuity is at $x_1 = 0.5$. Plots show from left to right: (1) fast rarefaction, (2) slow rarefaction (at $x_1 \sim 0.45$), (3) contact discontinuity (at $x_1 \sim 0.64$), (4) slow shock (at $x_1 \sim 0.75$), and (5) "switch-on" fast shock.

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: `courno=0.75`, `qcon=1.0`, and `qlin=0.0`. 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 slight undershoot in ρ at the base of the contact disappears when second-order interpolation is used, but this smears the contact over several zones.

Switch-on waves have the property of creating a component of $B_\perp$ where there was none before the wave's passage. Fast shocks and slow rarefactions can be *switch-on*, while slow shocks and fast rarefactions can be *switch-off* (destroying $B_\perp$ upon wave's passage).