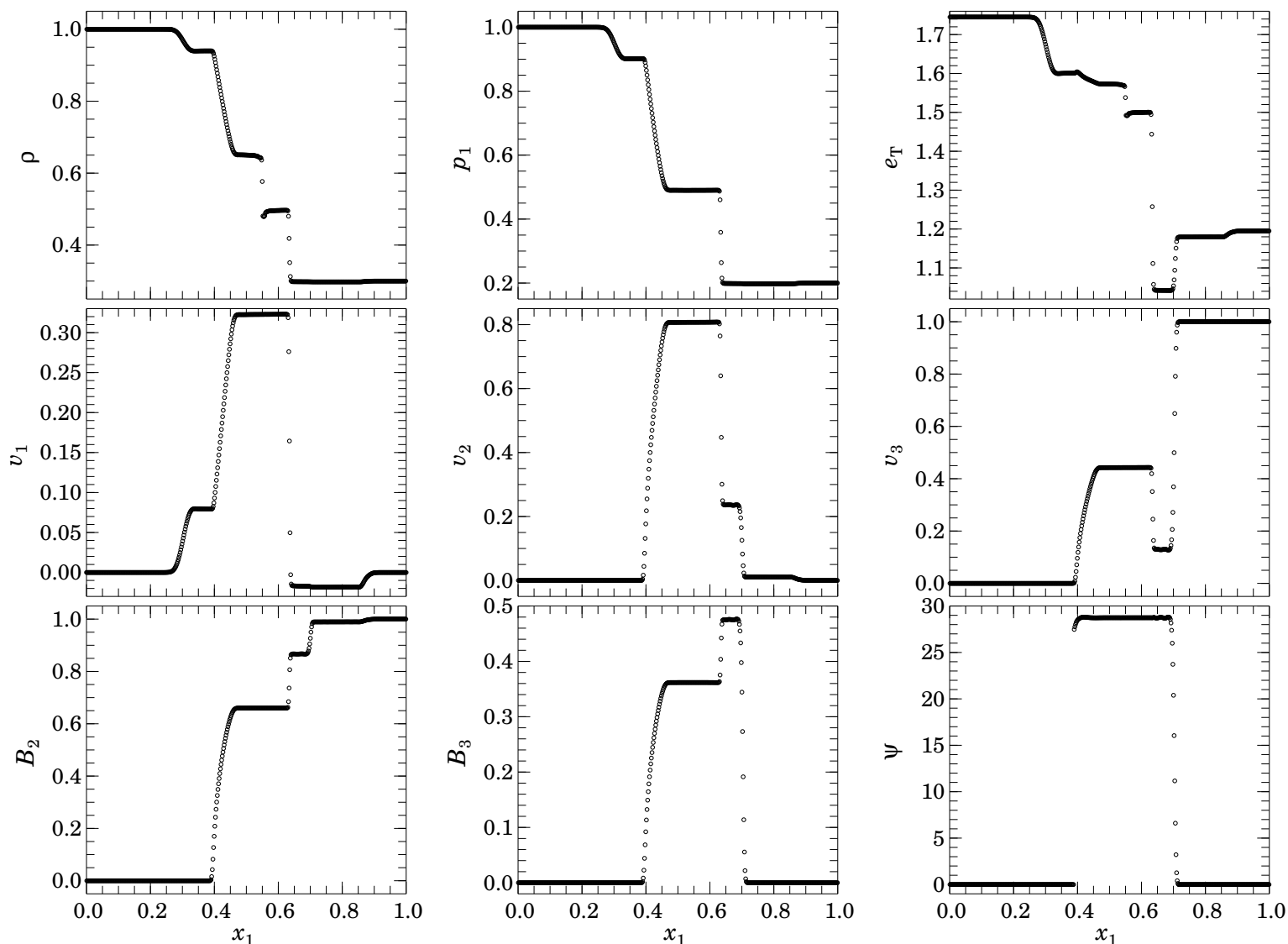


ZEUS-3D 1-D Gallery #10: “Switch-on/off” waves



This is Fig. 4d from Ryu & Jones (1995, ApJ, 442, 228), showing the solution of the MHD shock tube test with the left state $(\rho, v_1, v_2, v_3, B_2, B_3, p_1) = [1, 0, 0, 0, 0, 0, 1]$ and the right state $[0.3, 0, 0, 1, 1, 0, 0.2]$ with $B_1 = 0.7$ and $\gamma = 5/3$ at time $t = 0.16$. At $t = 0$, the discontinuity is at $x_1 = 0.5$.

Open circles are the `dzeus35` solution using 512 zones, `CMoC`, the total energy equation, and third-order interpolation with the contact steepener engaged. `dzeus35` parameters controlling the time step and artificial viscosity are: `courno=0.75`, `qcon=2.0`, and `qlin=0.4`. Analytical solutions from the non-linear Riemann solver described in Ryu & Jones are unavailable for this problem.

Plots show from left to right: (1) hydrodynamical (because the tangential magnetic field is zero on both sides) rarefaction, (2) “switch-on” slow rarefaction (at $0.4 < x_1 < 0.45$), (3) contact discontinuity (at $x_1 \sim 0.55$), (4) slow shock (at $x_1 \sim 0.64$), (5) rotational discontinuity (at $x_1 \sim 0.7$), and (6) fast rarefaction. The higher than normal artificial viscosity parameters were chosen to prevent `dzeus35` from fitting “rarefaction shocks” in the fast rarefaction wave (see problems #13–14 in the 1-D Gallery).

See Problem #7 in the 1-D Gallery for a definition of “switch-on” and “switch-off” waves.