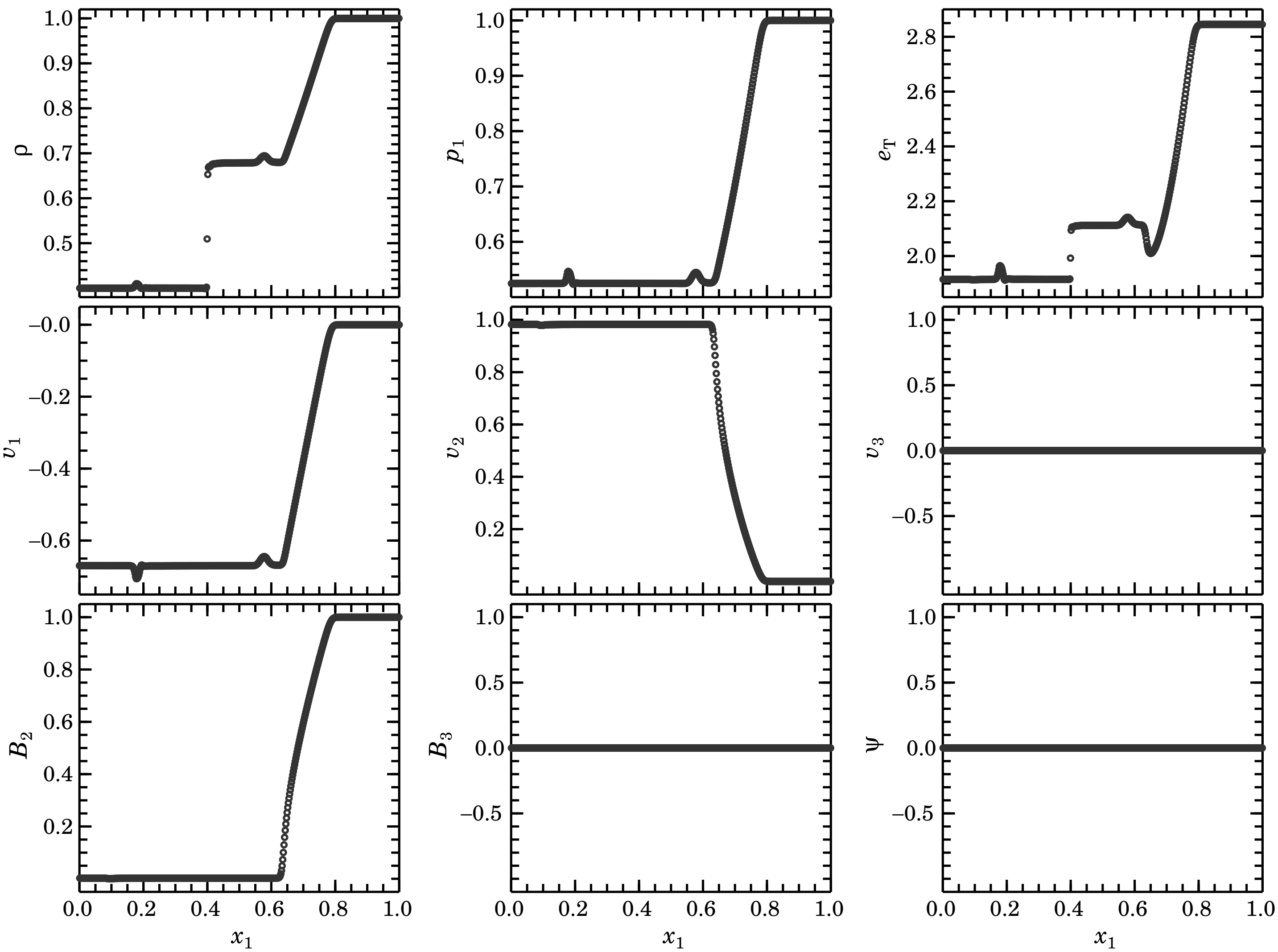
ZEUS-3D 1-D Gallery #16: "Switch-off" rarefaction



This is Fig. 4*b* from Ryu & Jones (1995, ApJ, 442, 228), showing the solution of the MHD shock tube problem with the left state $(\rho, v_1, v_2, v_3, B_2, B_3, p_1) = [0.4, -0.66991, 0.98263, 0, 0.0025293, 0, 0.52467]$ and the right state $[1, 0, 0, 0, 1, 0, 1]$ with $B_1 = 1.3$ 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) contact discontinuity (at $x_1 \sim 0.4$), and (2) "switch-off" fast-rarefaction (at $0.63 < x_1 < 0.78$). See Problem 15 in the 1-D Gallery for a definition of a "switch-off" wave.

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=0.2`. Analytical solutions from the non-linear Riemann solver described in Ryu & Jones are unavailable for this problem.

There are no significant differences between the `dzeus36` and `dzeus35` solutions. The apparent "undershoot" at the base of the rarefaction in e_T is real. The two "glitches" at $x_1 \sim 0.18$ and $x_1 \sim 0.58$ are numerical in origin and appear in fully upwinded schemes too. They are slow "transient waves" launched by the hyper-resolved (one zone) discontinuity in the initial conditions.