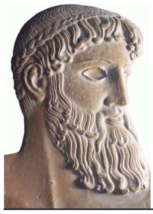
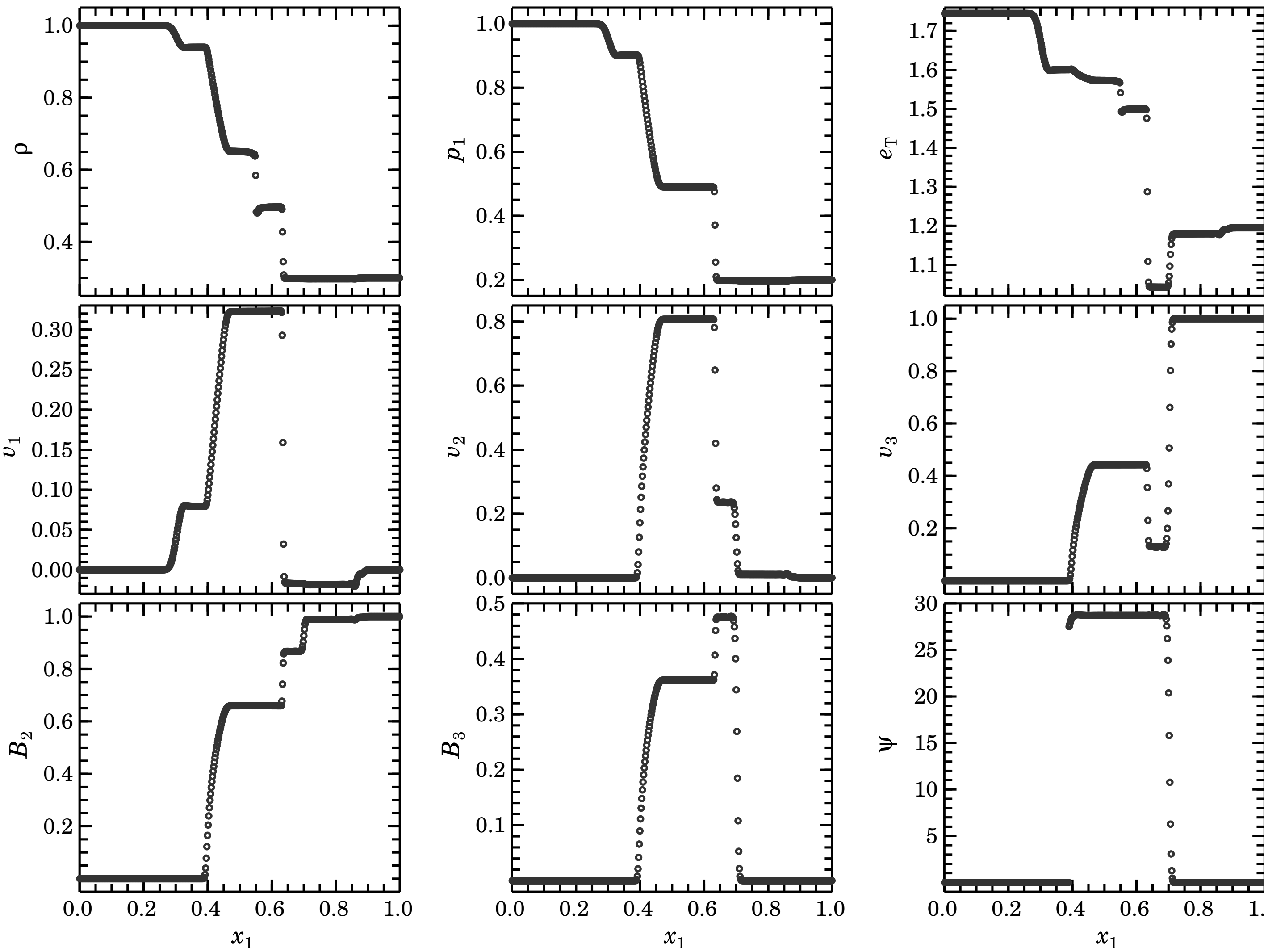


ZEUS-3D 1-D Gallery #18: "Switch-on" rarefaction



This is Fig. 4d from Ryu & Jones (1995, ApJ, 442, 228), showing the solution of the MHD shock tube problem with the left state $(\rho, v_1, v_2, v_3, B_2, B_3, p_1) = [1, 0, 0, 0, 0, 0, 1]$ 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 $x_1 = 0.5$. Plots show from left to right: (1) Euler (*i.e.*, HD since $B_\perp = 0$ 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. See Problem 15 in the 1-D Gallery for a definition of a "switch-on" 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.

Despite the introduction of the new *Finely Interleaved Transport* algorithm, `FIT`, `dzeus36` still seems to be trying to insert a "rarefaction shock" into the fast rarefaction wave. As done for the `dzeus35` solution, this can be prevented by increasing `qlin` to 0.4. See problem 21 in the 1-D Gallery for further discussion.