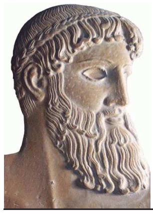
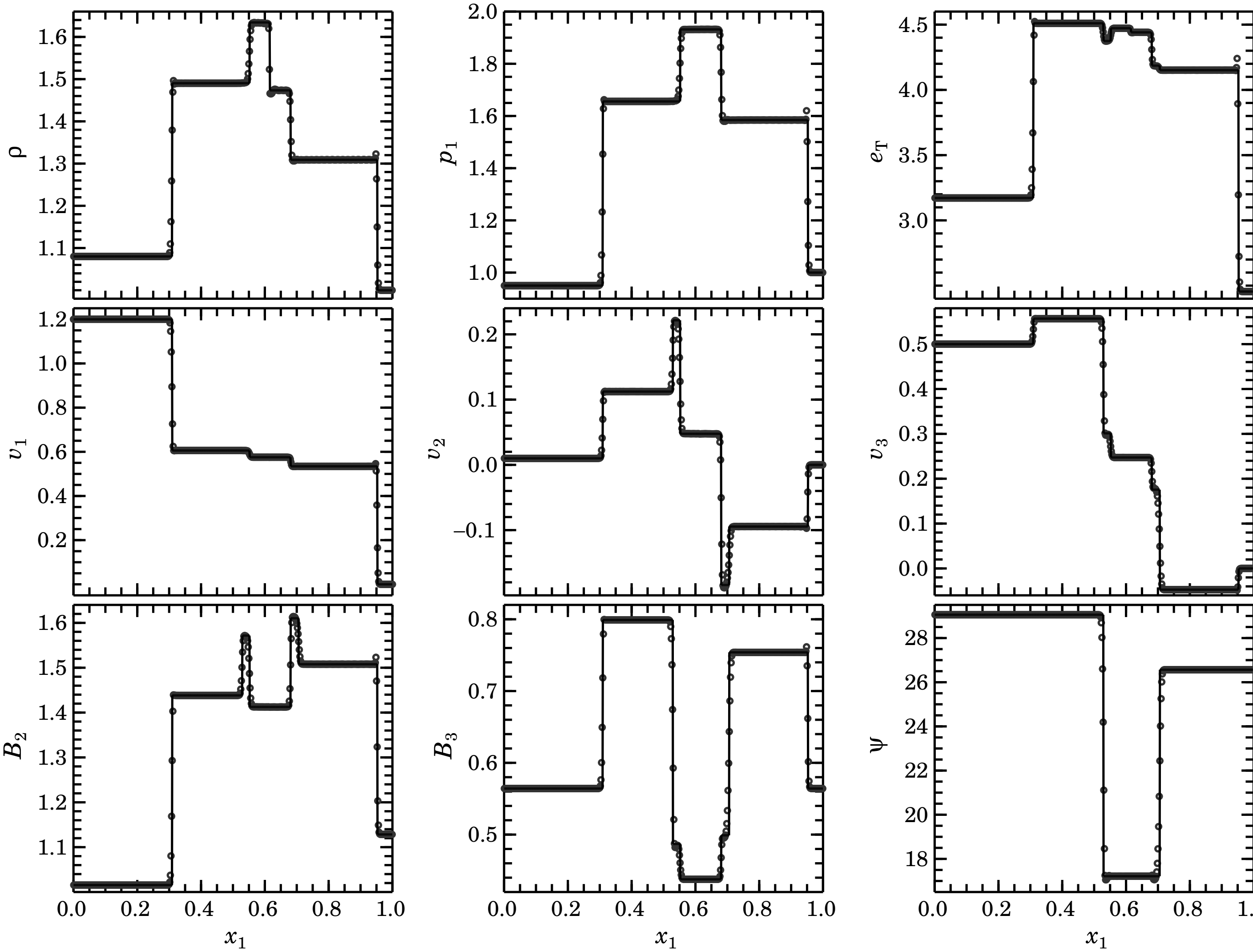


ZEUS-3D 1-D Gallery #11: “3-D field”



This is Fig. 2*a* from Ryu & Jones (1995, ApJ, 442, 228), showing the solution of the MHD shock tube problem with the left state $(\rho, v_1, v_2, v_3, B_2, B_3, p_1) = [1.08, 1.2, 0.01, 0.5, 3.6/(4\pi)^{1/2}, 2/(4\pi)^{1/2}, 0.95]$ and the right state $[1, 0, 0, 0, 4/(4\pi)^{1/2}, 2/(4\pi)^{1/2}, 1]$ with $B_1 = 2/(4\pi)^{1/2}$ and $\gamma = 5/3$ at time $t = 0.2$. At $t = 0$, the discontinuity is at $x_1 = 0.5$. Plots show from left to right: (1) fast shock, (2) rotational discontinuity (at $x_1 \sim 0.53$), (3) slow shock (at $x_1 \sim 0.55$), (4) contact discontinuity (at $x_1 \sim 0.61$), (5) slow shock (at $x_1 \sim 0.68$), (6) rotational discontinuity (at $x_1 \sim 0.71$), and (7) 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=0.2`. 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 slight undershoot of density at the base of the contact disappears with second order interpolation and the contact steepener disengaged, smearing the contact over 8–10 zones. The slight overshoot of some variables at the top of the right-moving fast shock is a result of the incomplete upwinding of the scheme. One needs to increase `qcon` dramatically to eliminate this feature, at the expense of smearing the shock over several more zones.