Lecture F20 Mud: Laval Nozzle Flows

1. **In the PRS, isn't the answer 14.14, not 45?** (1 student)
   I had a typo on the PRS — missing an extra zero for p_e and p_r, which explains the $\sqrt{10}$ discrepancy. Sorry about that. The corrected PRS will be posted along with all the others for lectures F11-F20.

2. **Is there a way to tell if a flow will be subsonic or supersonic?** (1 student)
   As a minimum, the information required to determine the type of flow is:
   — duct geometry $A(x)$, or just A_e and A_{throat}
   — reservoir p_r, h_r
   — back pressure p_e or p_B.
   From this info one can determine what type of flow is present (choked/unchoked?, and if choked: shocked/overexpanded/matched/underexpanded?).

3. **How do we know if the flow behind the throat is subsonic or supersonic?** (1 student)
   It depends on what's the imposed p_e (or p_B). You get partial or full supersonic flow if p_e is below the pressure needed to reach choking.

4. **What are the dashed lines in the $p(x)$ and $M(x)$ plots?** (1 student)
   Those are the pressure and Mach distributions for choked isentropic flow, either subsonic or supersonic. The subsonic leg occurs right at choking onset. The supersonic leg occurs if $p_B < p_*$ (no shock inside duct).

5. **Why do the waves reflect back into the jet rather than "escaping"?** (1 student)
   The waves cannot propagate outside the jet because we have assumed the flow outside the jet is still ($M = 0$), or at least subsonic ($M < 1$). Stationary shocks or waves are possible only if $M \geq 1$. However, the waves in the exhaust jet of a supersonic aircraft will indeed undergo only a partial reflection, with part of each wave "excaping" from the jet into the surrounding supersonic flow. We haven't looked at this more complicated case.

6. **No mud** (6 students)