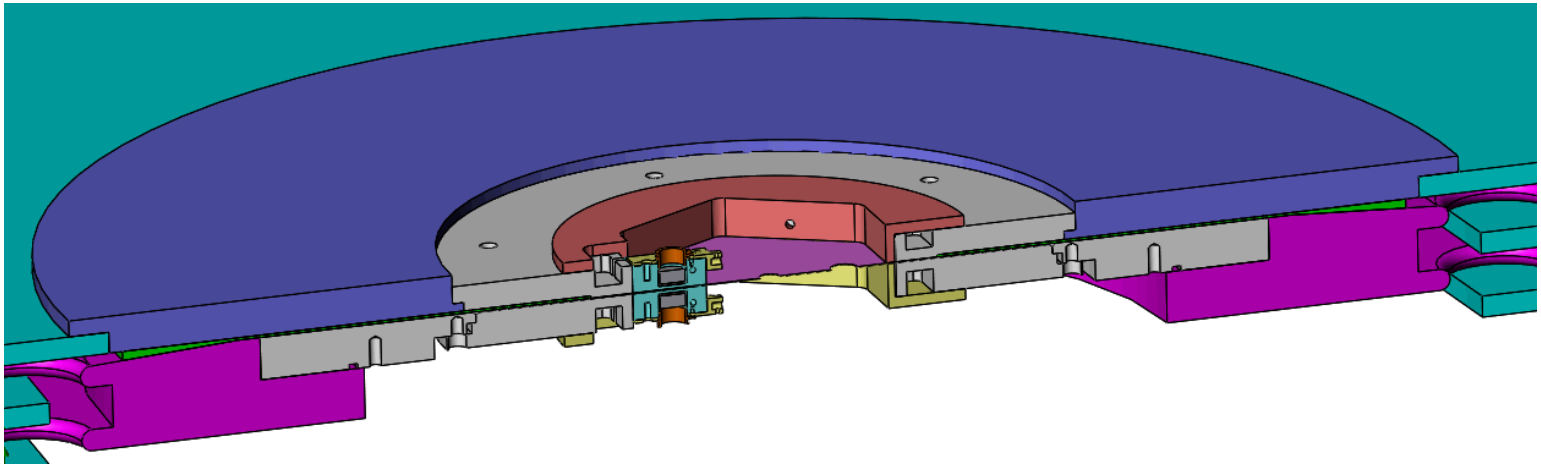
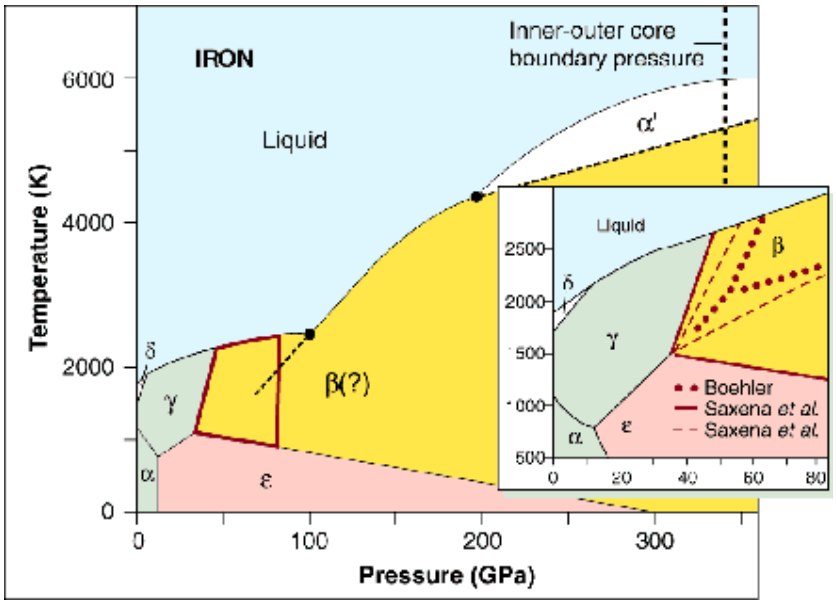
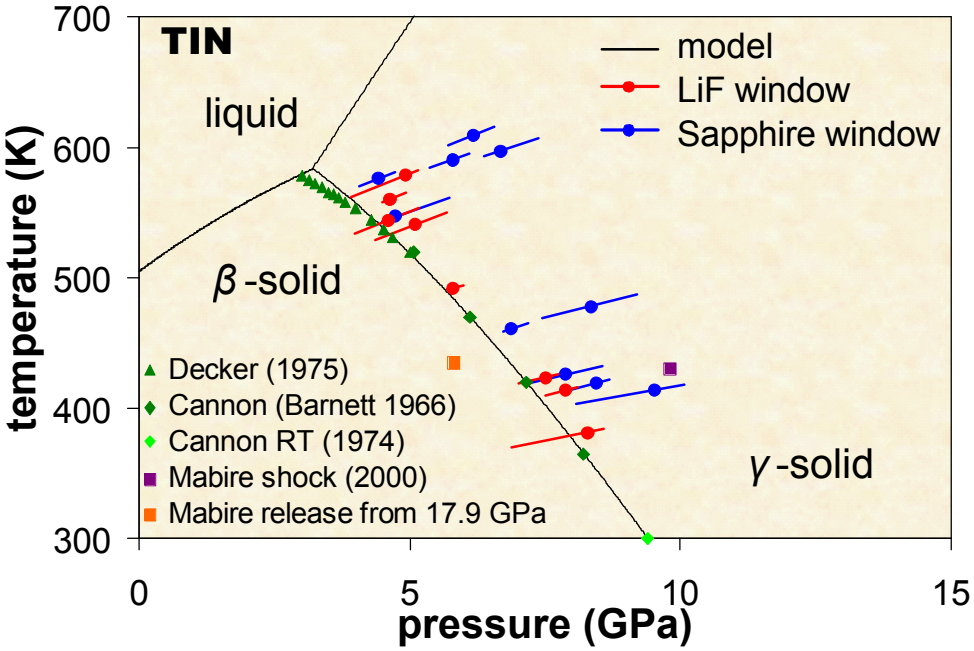
Materials Breakout: Using Thor

SAND2014-17599PE

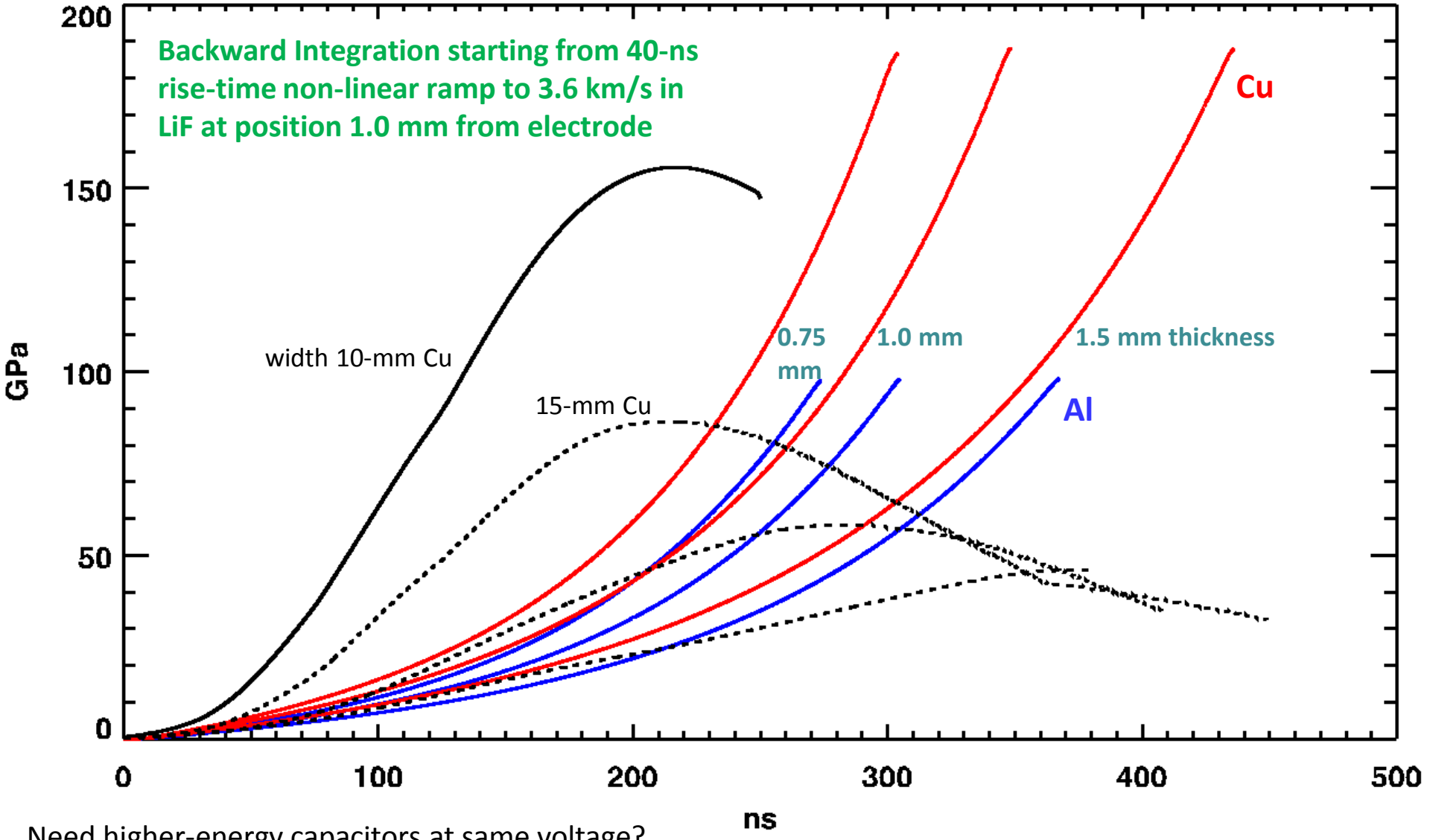


Only halfway through 1st iteration between machine & experiment designers, Thor design can still be changed!



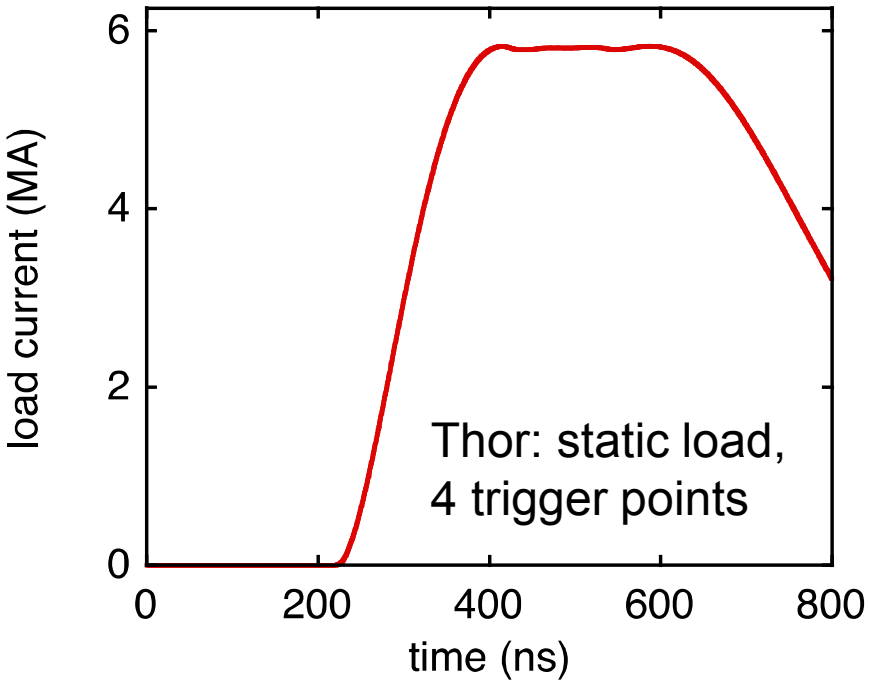


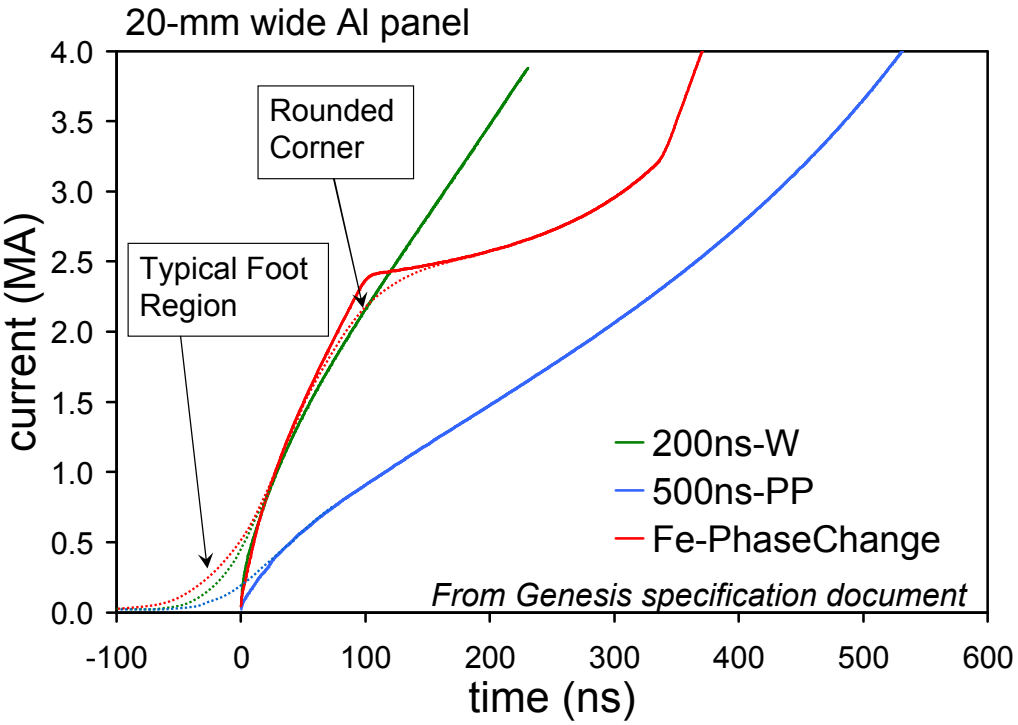
1-Mbar shockless ramp in LiF window without sample



Need higher-energy capacitors at same voltage?

Need quite flexible pulse shaping capability





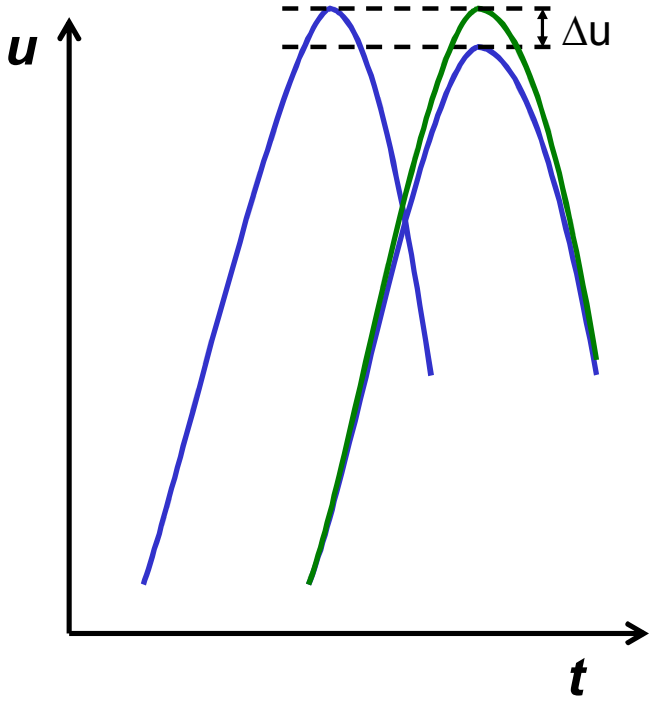
- Flat-top to hold state, avoid attenuation due to elastic release
- Plateau-like shape for some phase transitions, shock-ramp experiments
- Control local ramp curvature from negative to positive
- Possibility to control unloading rate?

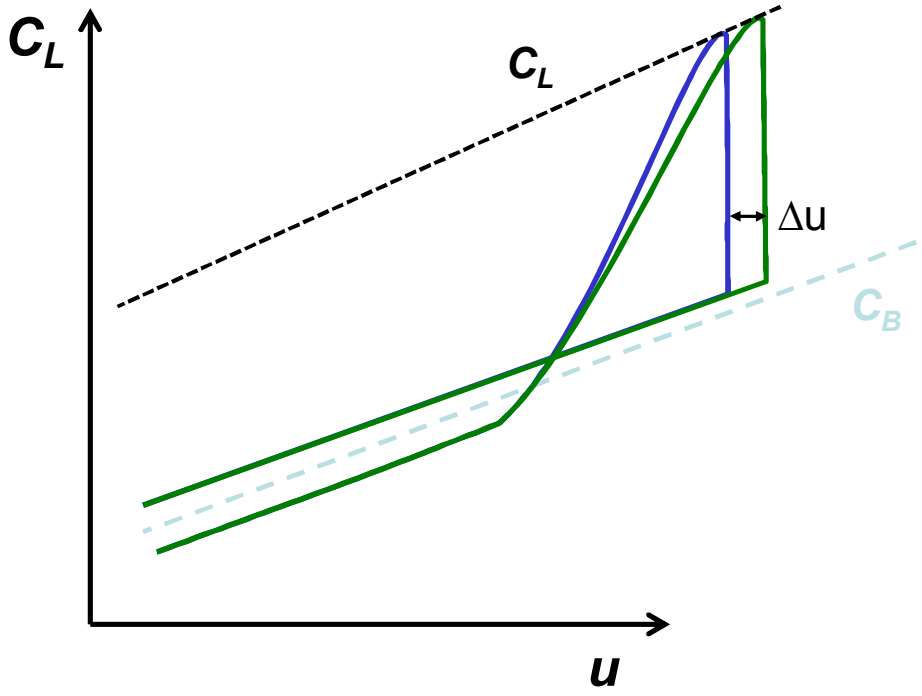
Measuring change in shear stress unloading from peak

Flat-top pulse can eliminate attenuation issue (if it's flat enough!)

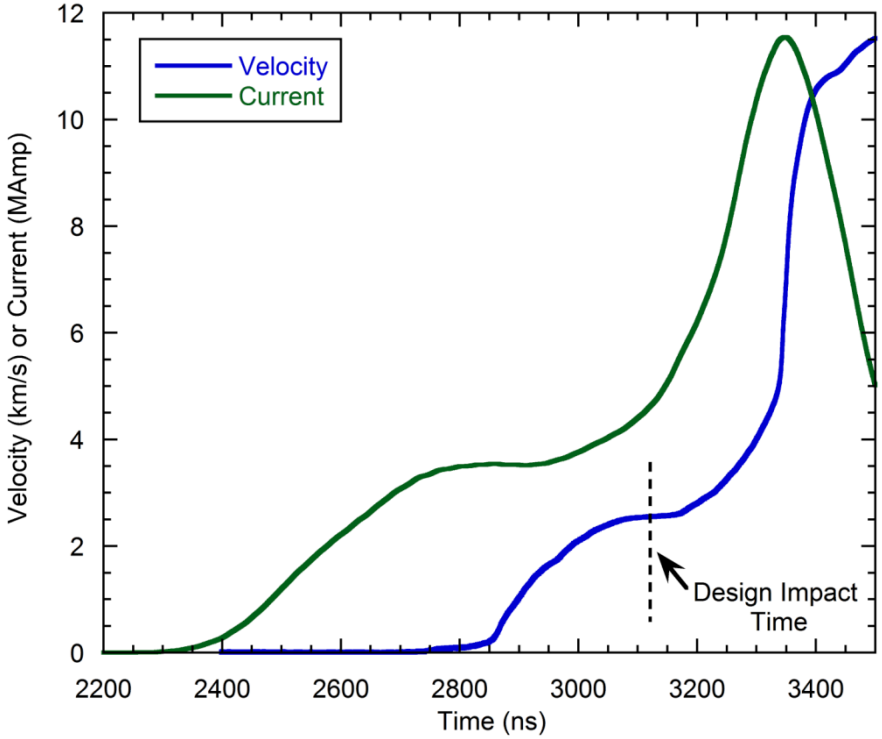
Need sample free of reverberation until after transition to bulk response

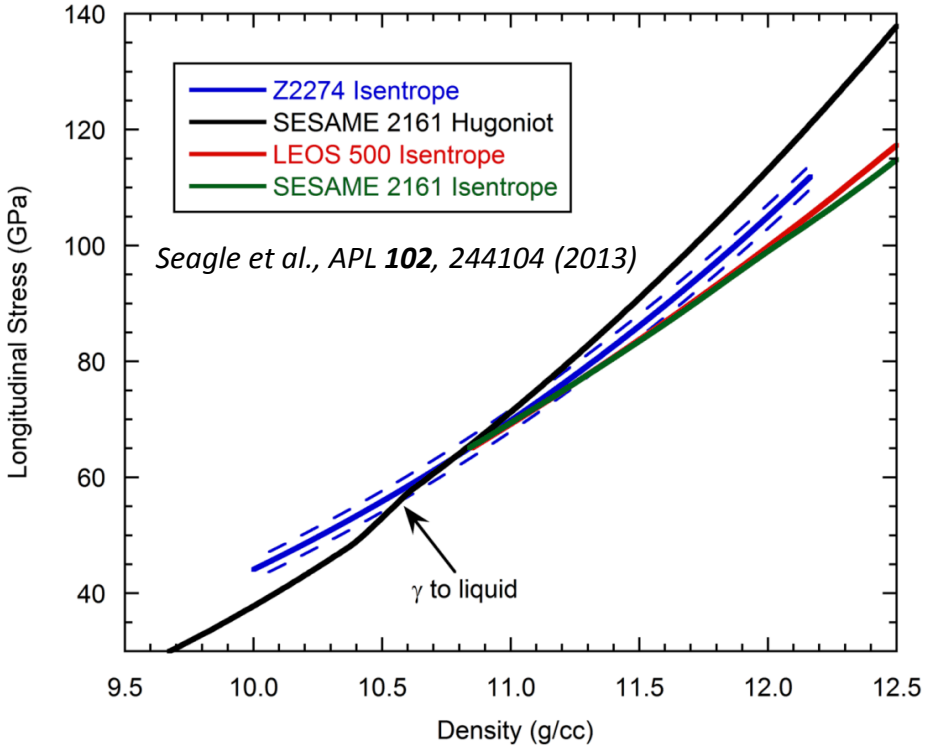
Thicker sample → longer pulse shape → wider sample





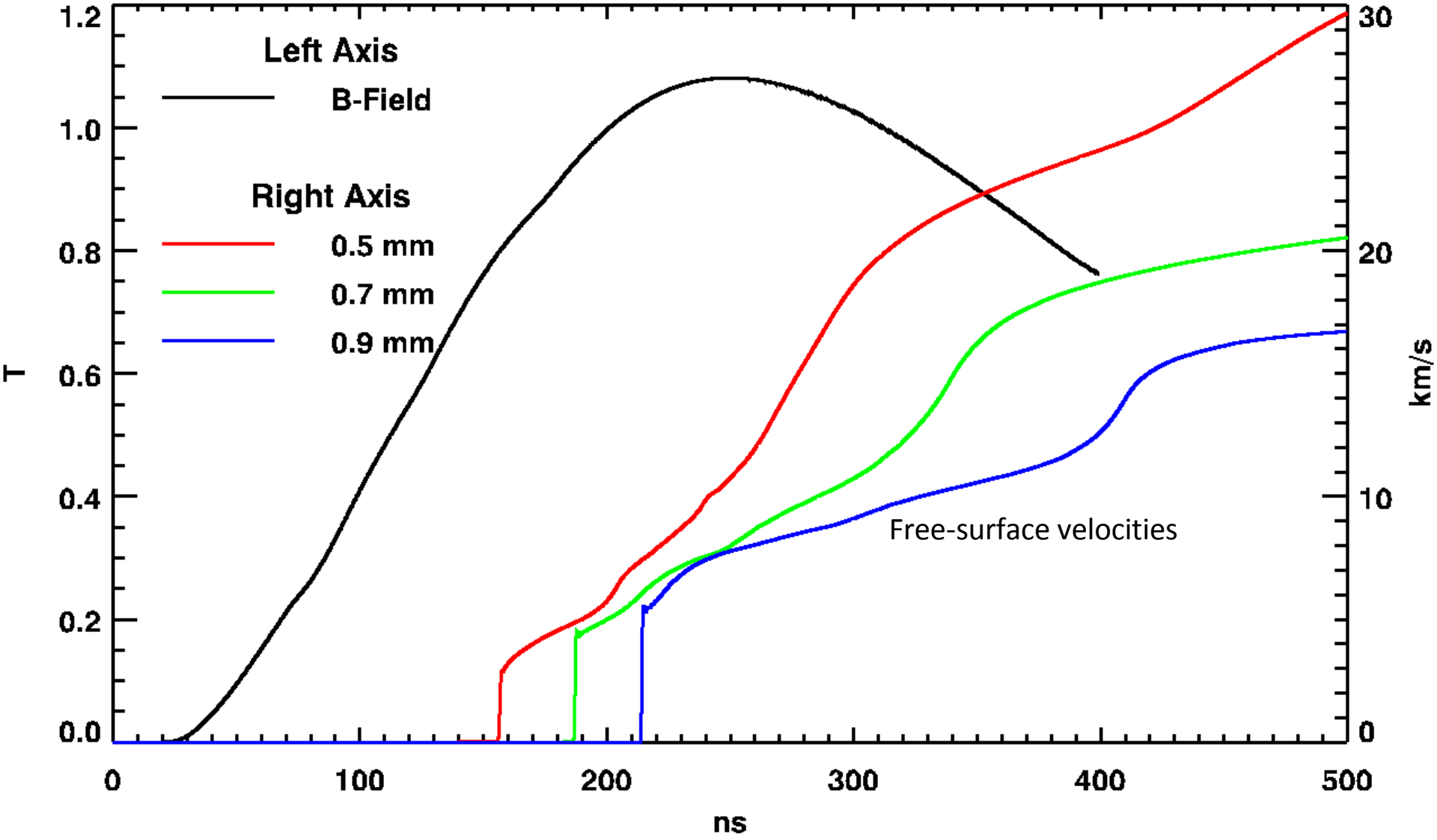
Shock-ramp has been demonstrated on Z



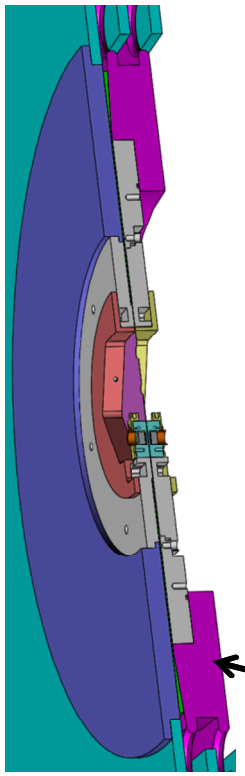


Are there experiments that could use 2-3 MA plateau with ramp to 5-6 MA?

5-mm wide stripline could throw Cu flyers > 10 km/s



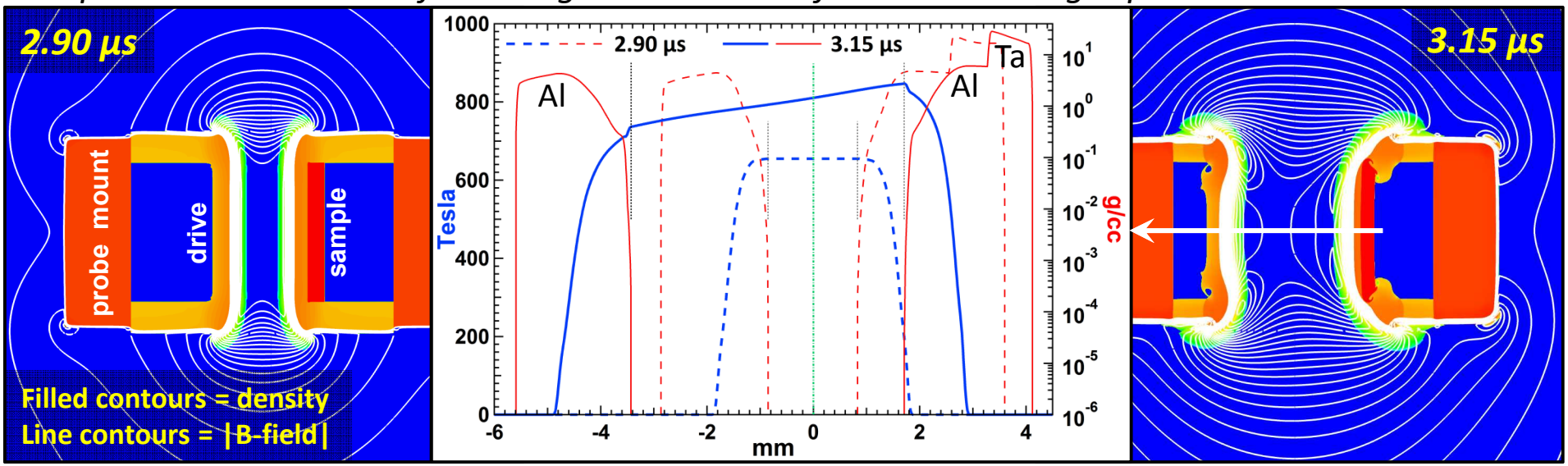
Additional experimental details

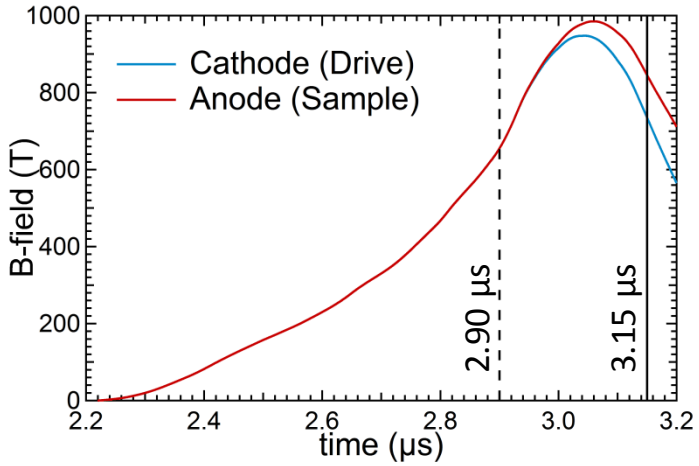


- Tight inductance budget → stripline panels limited to length/width ratio < 2
  - Only one sample or drive measurement per panel
  - Tapering/notching to improve B-field uniformity along length
- Usually need drive measurement opposite sample in order to analyze
  - Requires 2-D MHD calculations to check / account for 2-D drive effects (see next slide)
  - Use square/rectangular samples and panel features to maintain 2-D, as recently started at Z
- Kapton insulator has no wide-range EOS or conductivity models, also very limiting for pre-heating samples
  - Consider starting out with vacuum load region for Thor-II ?
- Position radial power-flow region vertically for ease of access to load

2-D MHD calculations elucidate & correct for late-time cross-gap non-uniformity of driving B-field

Snapshots with line-outs from Alegra simulation of Z2434 mid-height position





- Asymmetric wave reverberations in electrodes
  - Left (drive): reflection from free surface
  - Right (sample): reflection from high-impedance material
- Resulting 2-D effects cause asymmetric B-field topology
- Can occur prior to time of peak current
- Use 2-D B-field Sample/Drive ratio to correct 1-D B-field

Sandia National Laboratories

Diagnostics, Diagnostics, Diagnostics!