Physics 790 Seminar

Exploring Experimental Parameters for Pulsed, Isentropic J x B Compression of Solid Metal

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Abstract:

Material states of extremely high pressures are currently an active area of research in the field of High Energy Density Physics. Planetary interiors, material equations of state, solid-state probing, inertial confinement fusion and other applications are of interest. However, it is a challenge to bring matter to these pressures while maintaining a low temperature, solid state. Several approaches have attained isentropic compression, including laser direct drive, shocked plasma reservoirs, and pulsed power, which has reached 240 GPa in lab. These previous experiments have been performed on planar targets to take advantage of interferometry diagnostics, like VISAR. To achieve higher pressures, a cylindrical target being compressed by pulsed power J x B force, has been proposed. A solid rod can be compressed by stronger magnetic fields and with 1/r^2 geometrical compression as opposed to 1/r for the planar case. This rod geometry leaves unavailable VISAR and EUV diagnostics, requiring x-ray probes (Bremsstrahlung backlighting and x-ray diffraction).

Recent exploration of experimental parameters with a simple 1-D ideal gas compression numerical code will be described. The magnetic pressure of a 1-MA “Zebra” input was simulated. The radius, a range of changing gas and magnetic pressures, and densities were analyzed. It was apparent that lower diameter gas “rods” (< 12 mm) may not survive the current curve to reach peak. Changing magnetic and gas pressures with decreasing radius were also observed, with gas pressure ultimately overcoming magnetic at “saturation” (over 100 GPa, near peak current). There was also an order of magnitude increase in density over the course of pulse.

A more sophisticated “semi-analytical” model that is work in progress will be explained, as well as experimental goals, and possible x-ray diagnostic techniques for rod geometry will be mentioned.

Goudsmit Conference Room, LP 208
Thursday, May 5th, 2016 4:00 – 4:30 PM