THE ROD-PINCH DIODE AS A POSSIBLE WARM DENSE MATTER ENVIRONMENT*

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The rod-pinch diode[1] is a co-axial relativistic electron-beam-driven diode, where the cathode is a hollow disk and the anode a rod protruding through the cathode. The diode operates at currents in excess of the critical current such that electrons emitted from the cathode are magnetically insulated from crossing the A-K gap and are forced to attach at the tip of the anode rod, where magnetic insulation is lost[2]. Fielded on the RITS-6 accelerator at Sandia in negative polarity geometries [3], it has been operated at high electrical powers in excess 0.75 TW with voltages greater than 6 MV and currents of 120 kA. Pulse lengths are typically ~ 45 ns. For high atomic number anode/rod materials like Gold or Tungsten, specific energy deposition of order 1 MJ/g is achieved at the tip.

Optical imaging of the thermodynamic expansion of the rod tip, for times after the electric pulse, suggest expansion speeds of the bulk material of order a few cm/□s. Referring such velocities back to initial conditions for the material suggest near solid density at a couple eV temperatures. Particle-in-cell (PIC) simulations of electron beam energy deposition into the rod tip also suggest high average temperature of the bulk material. In addition, because the rod diameter is not a full electron range at these energies, the electrons reflex through the anode, producing. relatively uniform (radial) heating.

A discussion of the possibility of using the rod-pinch as a warm dense matter environment and the planned measurements to verify its utility will be presented.

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