Ultrahigh-speed plasma sources and liner compression of high-temperature plasma

P.J. TURCHI, Los Alamos National Laboratory — The Open Fire series of multi-megampere experiments\(^1\) on the Shiva Star capacitor bank achieved a megajoule of aluminum and (separately) tungsten ions at flow speeds in excess of 2000 km/s, corresponding to ion energies of 0.54 and 3.7 MeV, respectively. For the same kinematics, and pulser operation, the total flow energy would remain a MJ and the average ion energy for a DT plasma (at 2.5 AMU) would be 50 keV. These values suggest the possibility of “isothermal” compression by liner implosion to interesting particle densities at fusion-level temperatures. Based on the Open Fire experiments, the initial plasma density would be \(10^{17} \text{ cm}^{-3}\) in a volume of 1500 cm\(^3\) at a temperature of 16 keV (after sharing energy with electrons). A 3-D liner implosion of about 5 MJ could isothermally compress this plasma to \(10^{20} \text{ cm}^{-3}\), with a dwell time at high density of about a microsecond, providing an \(n\tau\)-product of \(10^{14} \text{ s/cm}^3\). Such experiments, in which heat-loss actually helps, are within range of present systems, e.g., Shiva Star and Atlas.