Plasma Density Measurements within Tungsten Wire-Array Z-Pinches on the COBRA Accelerator

JON DOUGLASS, RYAN MCBRIDE, KATE BELL, PATRICK KNAPP, JOHN GREENLY, SERGEI PIKUZ, TANYA SHELKOVENKO, DAVID HAMMER, Cornell University — The COBRA pulsed-power generator, with a nominal peak current of 1.1 MA and a minimum zero-to-peak rise-time of about 100ns, is being used to study the early phases of wire-array z-pinch development with a variety of diagnostics. Here we present the results of applying point-projection x-ray radiography to make accurate, high-resolution spatial and temporal measurements of the plasma density distributions in tungsten (W) wire-array z-pinch implosions. Density measurements are quantified by comparing x-ray transmission recorded on photographic films to transmission through W calibration steps of known thicknesses. Plasma density distributions as a function of time are presented for the coronal ($10^{18}$-$10^{20}$/cm$^3$), ablation ($<10^{18}$/cm$^3$) and on-axis ($<10^{19}$/cm$^3$) plasmas during the pre-stagnation phases of z-pinch dynamics (70-170 ns after the start of the current pulse). With this data set the time dependence of ablation velocity and corresponding mass ablation rate are addressed.

This research was supported by the Stewardship Sciences Academic Alliances program of the National Nuclear Security Administration under DOE Cooperative agreement DE-FC03-02NA00057.

Jon Douglass
Cornell University

Date submitted: 18 Jul 2007  Electronic form version 1.4