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Radiography of magnetically-driven implosions of initially solid beryllium cylindrical shells for equation-of-state studies at the Z pulsed-power facility[1]

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The Z accelerator delivers approximately 4-MV, 26-MA electrical pulses with adjustable current rise times of 100–600 ns, as well as adjustable pulse waveforms. The magnetic pressure produced is used for various applications, including magnetically-driven implosions. The Z-Beamlet Laser (ZBL) is a pulsed (0.3–1.5 ns), multi-kJ, TW-class Nd:glass laser system that provides x-ray radiography capabilities for Z experiments. This talk focuses primarily on the radiography diagnostic used to study the magnetically-driven implosions of initially solid cylindrical shells (also referred to as "liners"). Specifically, we discuss the 6.151-keV monochromatic backlighting system and its use in obtaining radiographs of imploding beryllium (Be) liners. The high transmission efficiency of 6.151-keV photons in Be allowed us to obtain radiographs with finite transmission throughout the radial extent of the imploding liners. Abel inverting these data, we have obtained time-resolved measurements of the imploding liner's density as a function of both axial and radial location throughout the field of view. These data are allowing us to study magneto-Rayleigh-Taylor (MRT) growth for inertial-confinement-fusion applications, as well as compression-wave propagation for equation-of-state studies (see talks by R.L. Lemke and M.R. Martin). Additionally, Z's pulse-shaping capabilities have enabled us to obtain data for both shock- and quasi-isentropically-compressed Be. Example data from MRT, shock-compression, and quasi-isentropic-compression experiments will be shown. We will also discuss planned upgrades to 25-keV radiography that will allow us to study materials with opacities beyond that of beryllium. This work was done in collaboration with R.W. Lemke, M.R. Martin, J-P Davis, M.D. Knudson, D.B. Sinars, S.A. Slutz, C.A. Jennings, M.E. Cuneo, D.G. Flicker, and M.C. Herrmann.

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