UCRL-JC-120783 Abs

Electron temperature scalings of gasbag targets*

C. A. Back, S. H. Glenzer, K. Estabrook, B. J. MacGowan, D. S. Montgomery, D. H. Munro, T. D. Shepard, and G. F. Stone

Lawrence Livermore National Laboratory,
P.O. Box 808,
Livermore, California 94551

Gas-filled targets can be laser-irradiated to create mm-size uniform plasmas. They are unique laser-produced plasmas because variations in the gas fill or laser parameters allow a controlled variation of the plasma conditions. To enable these plasmas to serve as testbeds to study physical processes, it is important to characterize them by measuring the range of temperature and density variations for different target types. In particular, temperature variations may be affecting the SRS data obtained on some shots.

Experiments in the past year at Nova have used gasbags to produce plasmas that attain electron temperatures of up to 3 keV for laser-plasma interaction studies relevant to laser fusion studies. Thin gasbags are formed by inflating two 3500 Å polyimide membranes and irradiated by 10 laser beams that deliver a total of ~ 2500 J of energy in 1 ns. In these experiments, the laser conditions were varied to create plasmas having electron temperatures in a range of ~ 1.5 - 5 keV, and electron densities of 5×10^{20} to 1×10^{21} cm^{-3}.

In this paper, we present measurements that characterize these large-scale plasmas by spectroscopy. X-ray spectroscopic diagnostics of high temperature underdense plasmas have been developed using spectra from gas dopants and coated fibers. Mid-Z elements from Cl to Cr have been used to diagnose electron temperature by line intensity ratio measurements. Here we report on recent refinements that have enabled us to obtain higher spectral resolution and reduce source size. Higher spectral resolution is obtained by using a different Bragg crystal configuration. Broadening due to source size is reduced by mounting a space-resolving slit between the gasbag and the spectrometer. Coupled together, these allow us to eliminate overlaps between spectral lines and examine the intercombination line and satellites to the Ar He-like n=2-1 resonance line as a function of time and space.

*This work was performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under contract No. W-7405-ENG-48.