DOE/ER/20719-1

SPECTROSCOPIC DIAGNOSTICS on HIGH-DENSITY, STRONGLY-COUPLED ICF PLASMAS

Semi-Annual Report
February 1, 1995 - July 31, 1995

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February 1996

Prepared for the U.S. Department of Energy
Under Grant Number DE-FG03-95SF20719

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SPECTROSCOPIC DIAGNOSTICS on HIGH-DENSITY, STRONGLY-COUPLED ICF PLASMAS

In our research for the period of February 1, 1995 through July 31, 1995, we have upgraded our equipment in anticipation of the restart of the Omega-Upgrade laser at the University of Rochester Laboratory for Laser Energetics/National Laser User Facility (LLE/NLUF). During this period we also have carried out some exploratory experiments on aluminum targets related to both continuum and line emissions near series limits where lines blend into the continuum. This work was performed using the Trident glass laser at Los Alamos National Laboratory. The layout of this experiment showing the diagnostics deployed is shown in Fig. 1. We had almost 60 shots at full power [175 J at 2ω in 1 ns pulses (Fig. 2) focused to a 0.5-mm diameter spot for an irradiance per beam of 8×10^{13} W/cm^2]. The targets (see also Fig. 1) were mainly 1 mm x 1 mm square aluminum foils of thickness varying from 2.5 to 25 μm. Most were coated with 1 μm of CH on both sides as a tamper to increase the compressed plasma density prior to expansion. Also, most targets were illuminated from both sides.

As highlighted in Fig. 1, we successfully fielded a gated imaging spectrgraph (GIS) consisting of a KAP crystal followed by a 4-frame gated x-ray imager. This data is expected to yeild valuable information on K-shell spectra, including innershell satellite lines.

We also fielded a McPig grazing incidence spectrograph covering 25-1400 Å (oriented as shown in Fig. 1). From the McPig data we were able to determine already that target burn-through from the rear beam became apparent at a thickness of $\leq$2.5 μm. This is important for optimizing target vaporization during the laser pulse for the proposed early-time experiments. McPig spectra obtained at long wavelengths (>1000 Å) in these experiments are being examined for evidence of anomalies near the plasma frequency, a subject of a previous proposal.

We also utilized a transmitting-grating spectrograph coupled with a Kentek streak camera for the 0-70 Å spectral region (again, as indicated in Fig. 1). The spectral intensity obtained on this series was quite low. Hopefully future experiments with increased sensitivity will yield time-resolved data on any transparency window at the end of the Li-like series limit, as well as useful information on early-time satellite-line features as proposed here.

The data obtained from these experiments are currently being analyzed in anticipation of presentation at the forthcoming APS Division of Plasma Physics Conference to be held in Louisville, KY in November 1995 and for future experiments at LANL on TRIDENT and elsewhere [e.g., at LLNL (NOVA) and LLE (OMEGA-UPGRADE)].

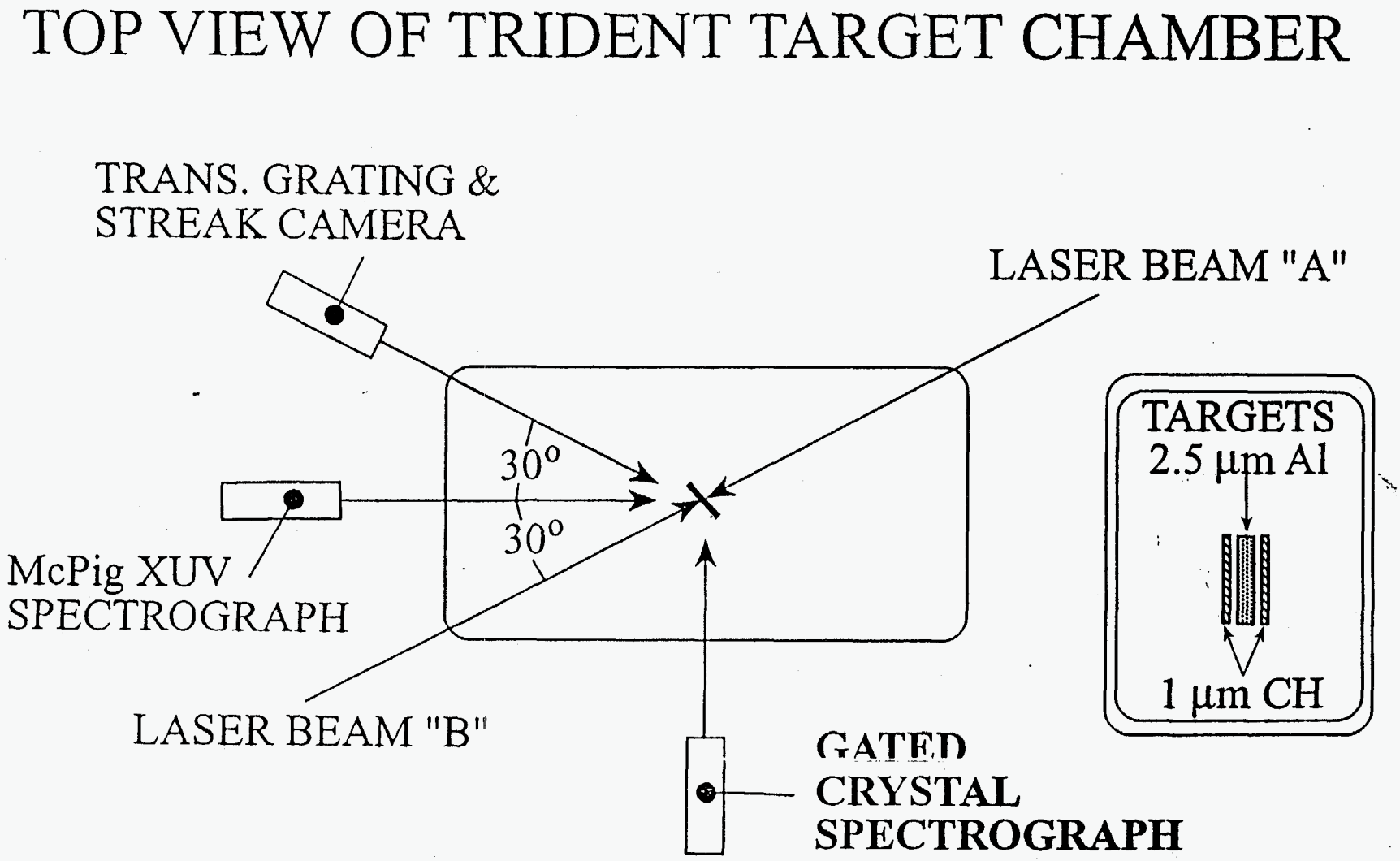

Fig. 1. Layout of the diagnostics fielded on the LANL Trident facility.

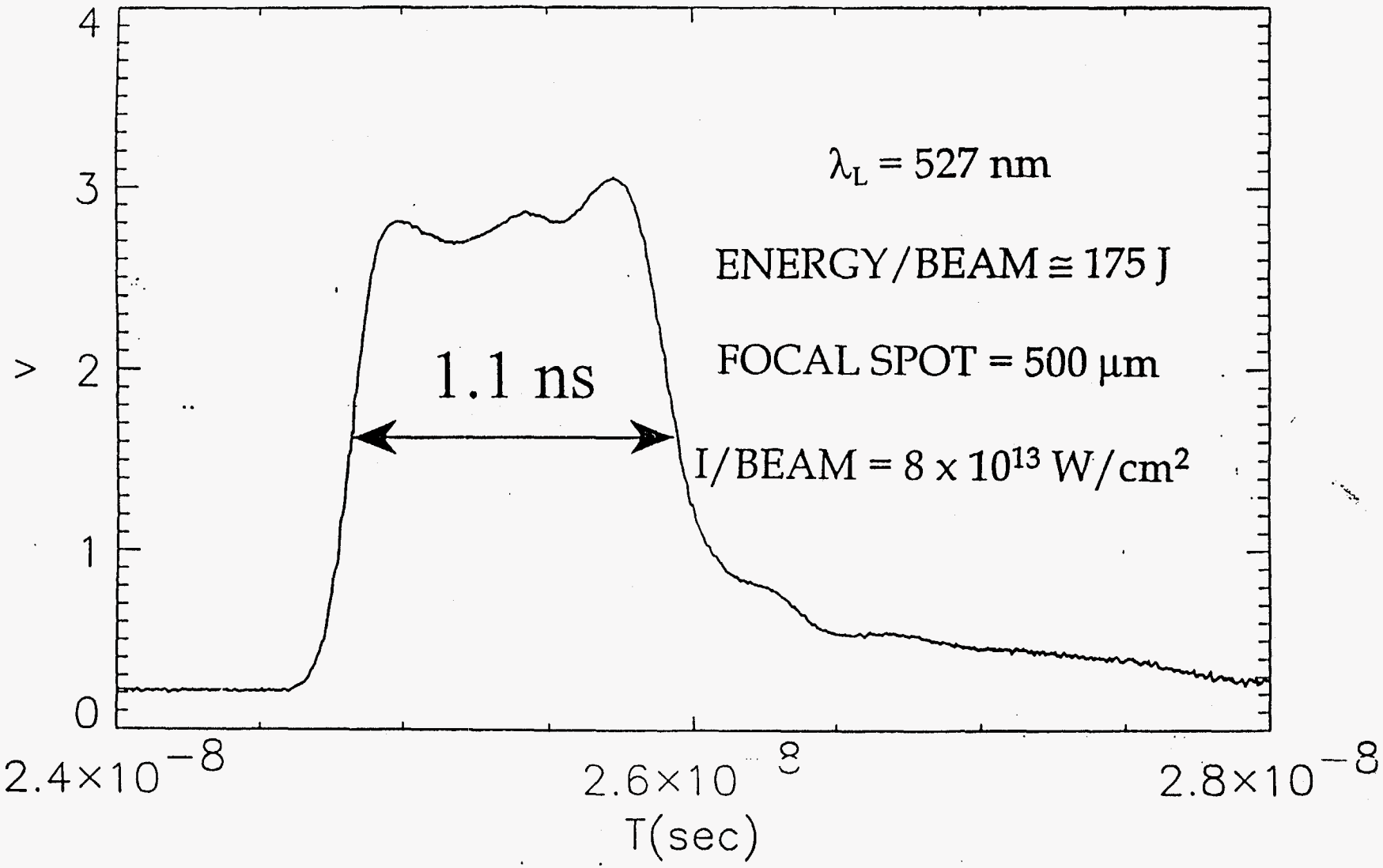

Fig. 2. Typical pulse shape and laser parameters for each of the two beams.