Section 4
NATIONAL LASER USERS FACILITY NEWS

This report covers the activities of the National Laser Users Facility during the quarter 1 October to 31 December 1984. Scientists from six different user experiments visited LLE during this period; three continued experiments on the facility. **Humberto Figueroa** (UCLA); **Alan Hauer** (Los Alamos); **Burton Henke** (University of Hawaii); **C. F. Hooper, Jr.** (University of Florida); **John Seely**, **Charles M. Brown**, and **W. E. Behring** (Naval Research Laboratory); and **George Miley** (University of Illinois) visited LLE to discuss past or current user experiments.

The following investigators continued current experiments. **Uri Feldman** (Naval Research Laboratory) and co-investigators **John Seeley**, **Charles M. Brown**, and **W. E. Behring** have been examining the XUV spectra of various high-Z elements that are relevant to x-ray laser research. **C.F. Hooper, Jr.** (University of Florida) has begun to study the implosion dynamics of the fuel by examining the x-ray spectra of gas-filled targets. **Burton Henke** (University of Hawaii) and co-investigator **Paul Jaanimagi** have utilized a time-resolving x-ray spectrograph to study thermal transport. **Burton Henke** is the originator of the diagnostic; **Paul Jaanimagi** is the principal researcher on the experiment.

This experiment by the University of Hawaii provides a very powerful research tool for diagnosing the transient nature of laser-produced plasmas. This diagnostic has been implemented on the OMEGA laser system and is currently in use at LLE.

The diagnostic, the SPEAXS (streak-photographic-elliptic-analyzer x-ray spectrograph) system[1] (see Fig. 21.28), consists of two identical x-ray crystal spectrographs. A time-integrating channel (recorded on photographic film) provides absolutely calibrated x-ray spectra. The spectra from the second channel is time resolved with an x-ray streak camera. The spectral range from 100 to 10,000 eV can be diagnosed by using different 2-D-spacing analyzer crystals. The instrument has been calibrated and tested at the University of Hawaii and has been an on-line diagnostic on the OMEGA facility. A summary of their recent experimental data is presented below.

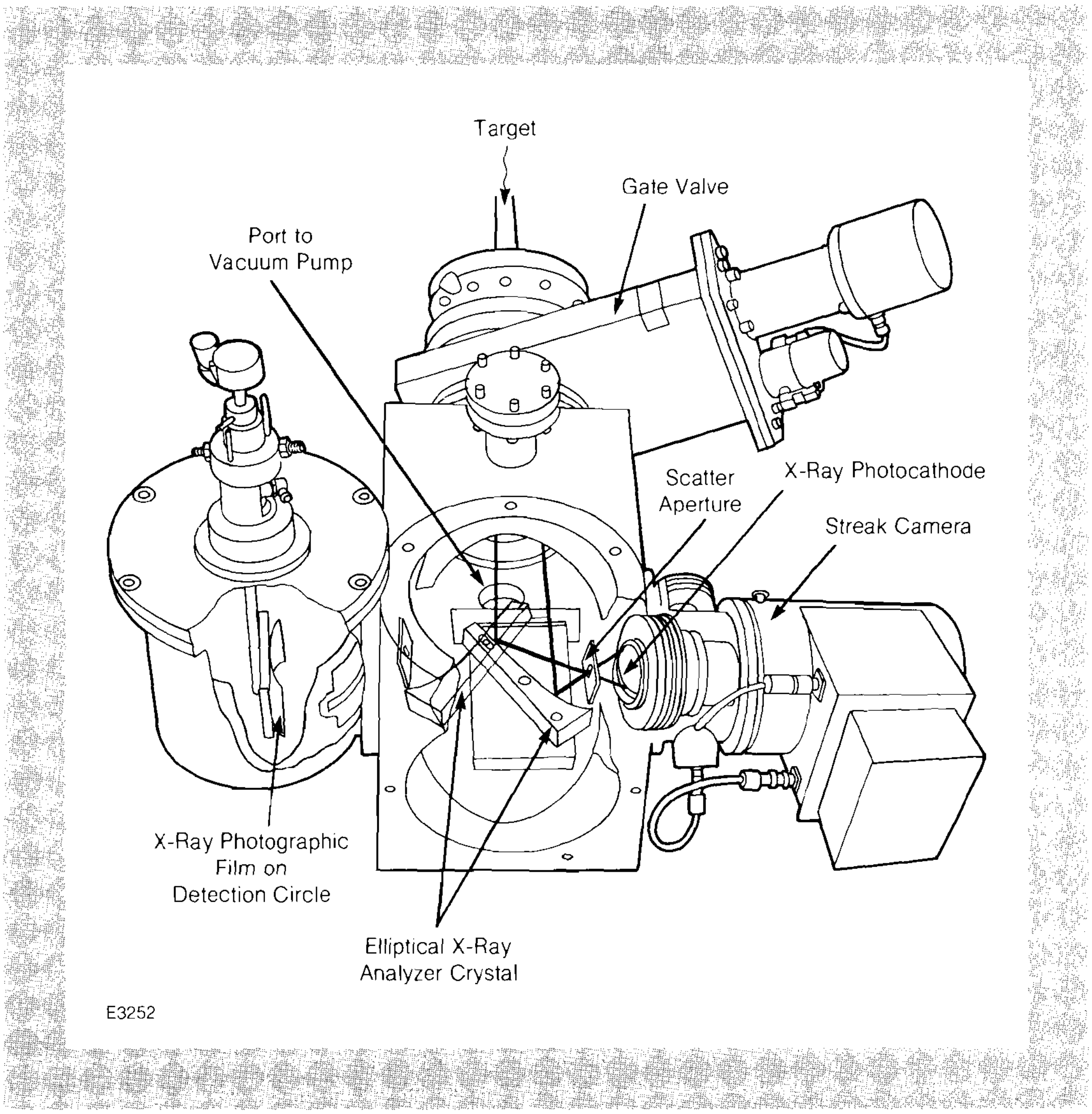

Fig. 21.28
Schematic of the twin-channel, streak-photographic-elliptic-analyzer x-ray spectrograph (SPEAXS system).

The SPEAXS system has been used extensively in the 6- and 12-beam UV-laser campaigns on OMEGA. The main experimental program for this diagnostic has been to study thermal transport. The SPEAXS system has contributed valuable time-resolved data to the high-Z, Au experiments in cooperation with LANL and also to LLE's x-ray laser program.

The thermal transport experiments were performed predominantly with six UV beams. Time-resolved x-ray spectroscopic measurements were made of the progress of the ablation surface through thin layers of material on the surface of the targets. Aluminum layers of various thicknesses on thin- and thick-wall, glass-shell targets were used. Also, the burn-through of CH layers on thin-wall, glass-shell targets was studied. These latter targets were overcoated with a 150-Å Au layer in order to provide a timing fiducial. An example of the time-resolved data is shown in Fig. 21.29. Data on the mass ablated from the Au/CH/glass

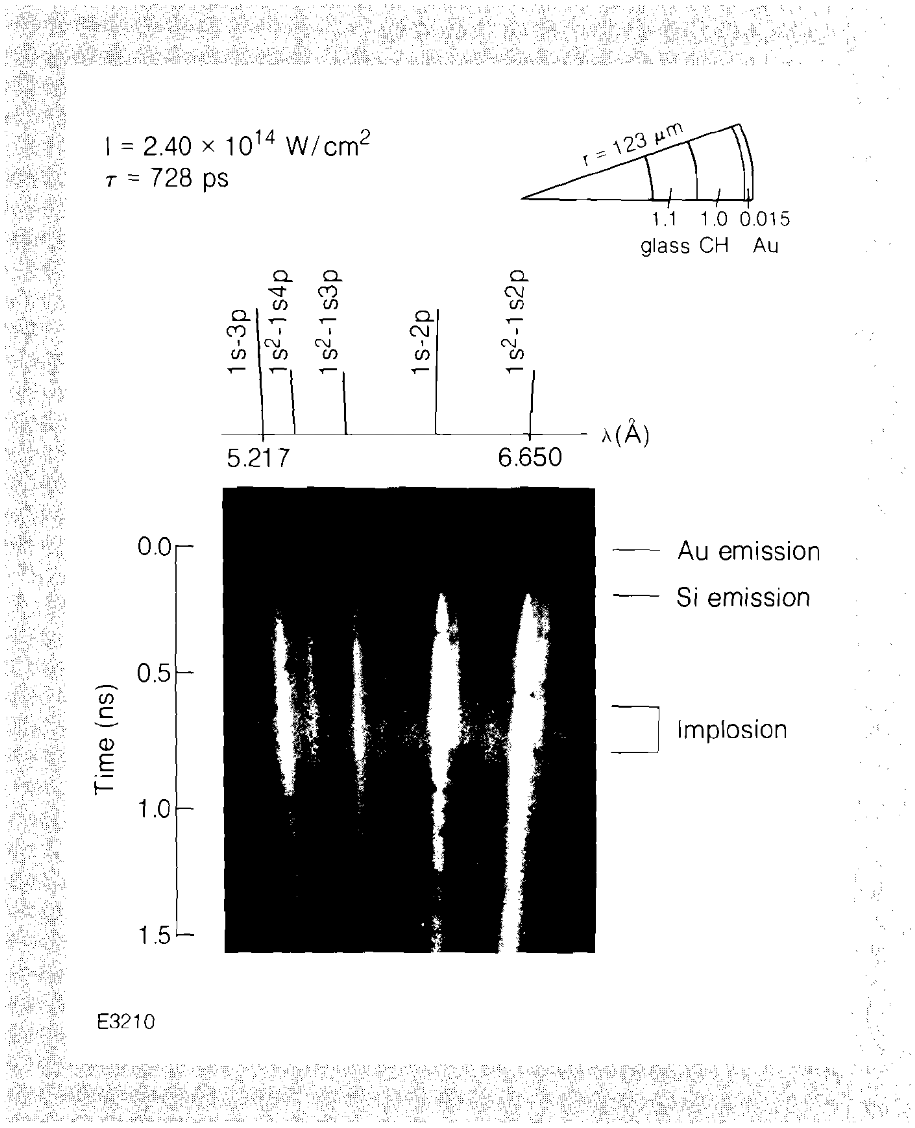

Fig. 21.29
Time-resolved x-ray spectrum from an Au/CH/glass target using a PET analyzer crystal.

targets are presented in Fig. 21.30. The experimental points on this plot use the mass of Au layer (~ 45 ng) or the mass of the Au + CH layers (200–800 ng) of the targets. The gold layer is assumed to have been ablated by the time we observe its x-ray emission. Similarly, the onset of the silicon line emission denotes the burn-through time for the CH layer. The absorbed energy is derived from the time-dependent absorption as predicted by *LILAC* simulations. Since we are observing x-ray emission in the 1.7- to 2.5-keV range, we consider the 500-eV isotherm

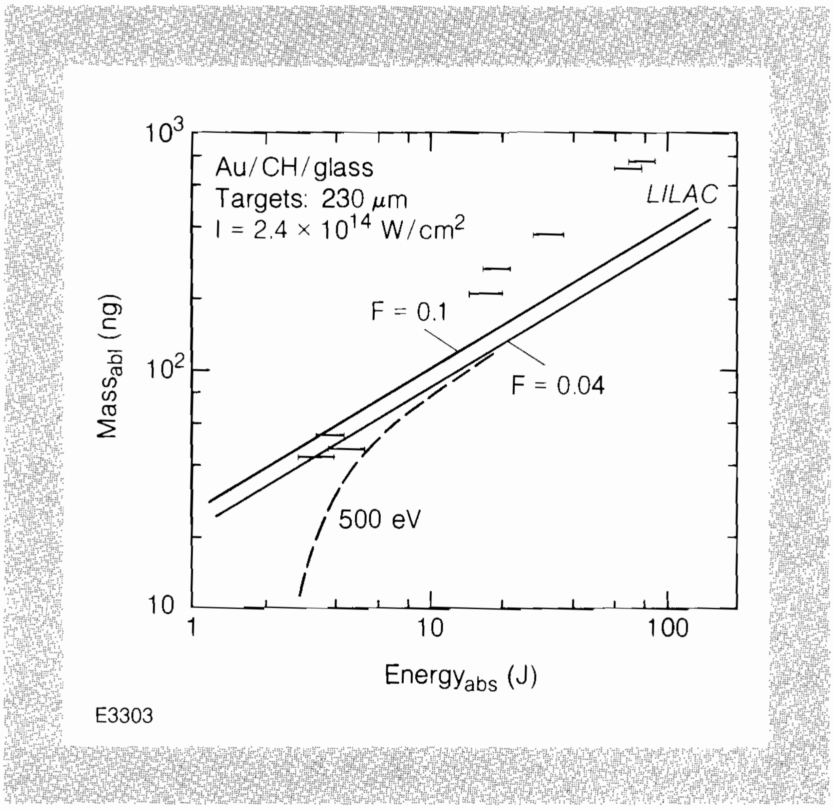

Fig. 21.30
Mass-ablated versus absorbed energy during a target shot for Au/CH/glass-shell targets, ~230 μm in diameter at $I = 2.4 \times 10^{14}$ W/cm^2. Comparison with LILAC *code simulations with flux limiters of F=0.04 and 0.1.*

as the mass-ablation surface for comparisons with code predictions. The qualitative agreement of the absorbed energy dependence for the ablated mass is good but quantitative agreement is poor.

The mass-ablation rate for CH burn-through, as derived from the time-resolved data, is in good agreement with time-integrated data,[2] as presented in Fig. 21.31. The discrepancy in the mass-ablation rate between experiments and *LILAC* code simulations is ascribed to nonuniform irradiation with only six UV beams.[3] The presence of hot spots in any of the incident laser beams will dominate the burn-through of the CH layer and result in too large a value for the mass-ablation rate.

Preliminary results (two target shots) with 12 UV beams support the nonuniformity argument. The experimentally measured, mass-ablation rate with 12-beam irradiation is in much closer agreement with *LILAC* code simulations.

During FY84 (1 October 1983 to 30 September 1984), the user program accumulated a total of 259 target shots on both the GDL and the OMEGA facilities. Table 21.III summarizes the total number of target shots by users. Additional information on these experiments can be obtained from the appropriate investigators.

On 4 March 1985, the National Laser Users Facility Steering Committee will hold its sixth meeting. The committee meets to review and approve proposals and to recommend funding of approved proposals in inertial fusion to the U. S. Department of Energy. This funding allocation is separate from LLE's operation agreement and is

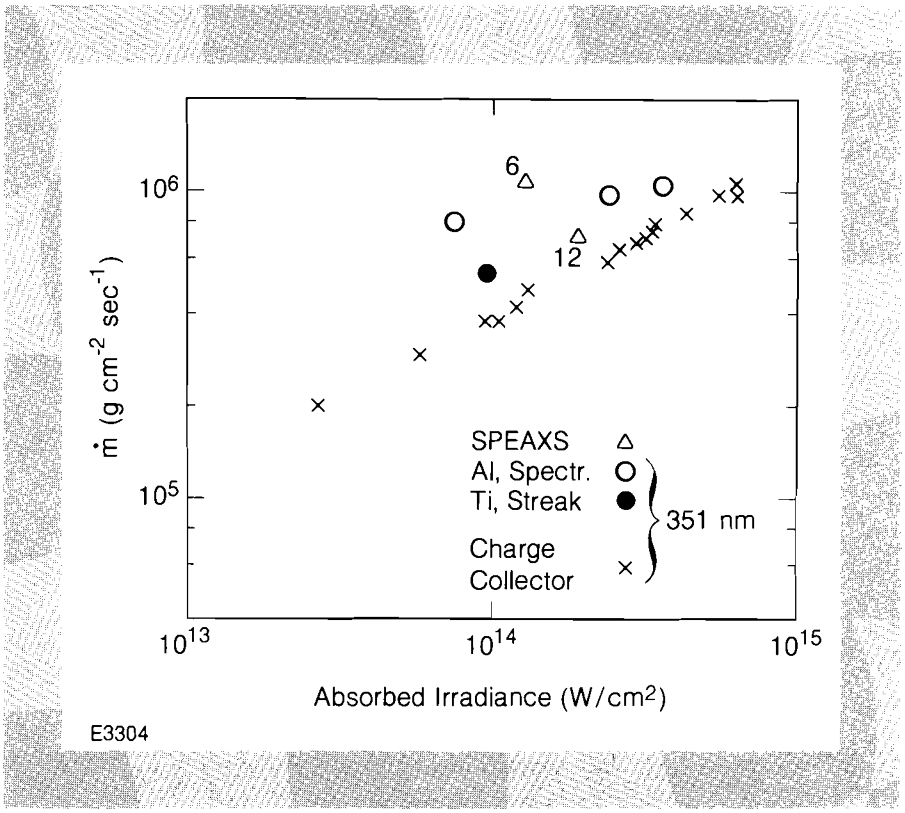

Fig. 21.31
Mass-ablation rate in spherical geometry, six-beam UV-laser irradiation; one point with 12-beam laser.

designed to provide research funds to users in the inertial fusion and related scientific areas. Users in other fields may use the facility but must provide their own research funds.

The committee consists of

Brian J. Thompson, Chairman
(Provost, University of Rochester)

Thomas C. Bristow
(non-voting, NLUF Manager)

John C. Browne
(Los Alamos National Laboratory)

Robert L. Byer
(Stanford University)

Michael Campbell
(Lawrence Livermore National Laboratory)

Peter M. Eisenberger
(Exxon Research & Engineering Co.)

Robert P. Madden
(National Bureau of Standards)

Barrett H. Ripin
(Naval Research Laboratory)

Ravindra N. Sudan
(Cornell University)

User (Affiliation)	Experiment	Number of Shots	
		GDL	OMEGA
J. Kent Blasie and Leo Herbette (U. of Pennsylvania and U. of Connecticut)	Biophysics	38	—
Phil Burkhalter (Naval Research Laboratory)	X-Ray Laser	—	33
Ray Elton (Naval Research Laboratory)	X-Ray Laser	7	—
Uri Feldman (Naval Research Laboratory)	XUV Spectroscopy	—	35
Hans Griem (U. of Maryland)	Plasma Physics	—	26
Burton Henke and Paul Jaanimagi (U. of Hawaii)	X-Ray Diagnostics	—	67
Chan Joshi and Nizar Ebrahim (UCLA and Yale University)	Plasma Physics	52	—
		98	161
		TOTAL	259

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Table 21.III
Summary of user shots for FY84.

Last year, 21 proposals were submitted; ten were approved. The next issue of the LLE Review will list the new approved proposals.

The users guide has been revised to include a description of the OMEGA and GDL experimental facilities and information for the preparation of user proposals. Copies of this revised guide and any further information on the National Laser Users Facility are available from:

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REFERENCES

1. B. L. Henke, H. T. Yamada, and T. J. Tanaka, *Rev. Sci. Instrum.* **54**, 1311 (1983); B. L. Henke and P. A. Jaanimagi, submitted to the *Review of Scientific Instruments*.
2. LLE Review **17**, 32 (1983).
3. LLE Review **20**, 150 (1983)