DOE/SF/21020--T1

Final Report for DE-AI03-96SF21020

**High-Resolution Imaging of Early-Time Imprinting
using Normal-Incidence Multilayer Mirrors**

Dr. John F. Seely
Space Science Division, Naval Research Laboratory

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible electronic image products. Images are produced from the best available original document.

High-Resolution Imaging of Early-Time Imprinting using Normal-Incidence Multilayer Mirrors

Dr. John F. Seely

Space Science Division, Naval Research Laboratory

Code 7674, Washington DC 20375-5352

Tel. 202-767-3529, john.seely@nrl.navy.mil

Contents:

1. Experiments at the Laboratory for Laser Energetics
2. Reporting of results to the Scientific community
3. Attachment: Scientific paper published in Applied Optics on March 1, 1998

1. Experiments at the Laboratory for Laser Energetics

A normal-incidence multilayer mirror telescope was designed, fabricated, and tested. The telescope consisted of a primary mirror and a secondary mirror in a Cassegrain optical configuration. The mirrors had multilayer coatings that efficiently reflected the soft x-ray radiation in a narrow bandpass centered at a wavelength of 48 Å.

The reflectance of the multilayer mirrors was measured at the Brookhaven synchrotron using the NRL monochromator and reflectometer. The measured reflectance was compared to detailed computer calculations.

The mirror mounts and the telescope structure were designed and fabricated at NRL. The telescope was aligned and focused using visible light. Thin metal filters were designed and procured to filter out unwanted radiation.

The telescope was taken to LLE on October 28, 1996. The telescope was mounted in a TIM instrument module on the OMEGA target chamber. The focusing and alignment of the mirrors were checked and optimized. Images were recorded on x-ray film on October 30. Images were recorded on a gated framing camera on October 31 and November 1. On each laser shot, hard x-ray images were recorded by a pinhole camera and a gated framing camera.

The soft and hard x-ray images were returned to NRL for analysis. The images were digitized and compared. As discussed in the attached scientific paper, it was found that the soft x-ray images were uniform on a spatial scale of 10 µm, while the hard x-ray images were non-uniform with many emission features of 150 µm size.

The major result of the study was that the soft x-ray emission from plasmas generated by 6 to 8 overlapping OMEGA beams is quite uniform, even for the case when beam smoothing techniques were not implemented. This implies that the soft x-ray emission can be used for backlighter applications and for the study of absorption by CH foils in the 48 Å wavelength region, at slightly longer wavelengths than the carbon K

absorption edge where carbon is relatively transmissive. These backlighter techniques are now being implemented at LLE.

2. Reporting of results to the Scientific community

The experimental results were presented in a scientific paper that was published in the March 1, 1998 issue of *Applied Optics*, Vol. 37, p. 1140-1145.

The results were also reported at the SPIE conference on "Applications of X-Rays Generated from Lasers and Other Bright Sources" that was held on July 31-August 1, 1997. A paper was published in SPIE proceedings, volume 3157.

3. Attachment: Scientific paper published in Applied Optics on March 1, 1998

The paper entitled "Uniformity of the Soft X-Ray Emissions from Gold Foils Irradiated by OMEGA Laser Beams Determined by a Two-Mirror Normal Incidence Microscope with Multilayer Coatings" is attached. This paper was published in the March 1, 1998, issue of *Applied Optics*.

~~Q13~~ Paper removed for separate handling.