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MEASUREMENT TECHNIQUES DEVELOPMENT

Final Report

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MEASUREMENT TECHNIQUES DEVELOPMENT—FINAL REPORT

This final report covers work done through the period of performance 16 January 1991 to 16 January 1993. The format of this final report is to give a summary of the main results and to include detailed results by incorporation in the list of references which include all relevant internal reports, published articles, conference and meeting presentations.

The work has been in support of the drive symmetry and hydrodynamic implosion experiments which LANL group P-4 is designing and fielding at the NOVA laser facility at Lawrence Livermore National Laboratory (LLNL). The work done involves experimental support in obtaining data, analysis of the data, and experimental design. New analysis techniques have been applied to spectral line radiation coming from the compressed cores of radiatively imploded targets to obtain diagnostics of core plasma conditions from the shapes of spectral lines observed with high resolution x-ray crystal spectrometers. The post-processing capabilities of the design codes have been improved by the addition of the capability of simulating realistic experimental backlighters and also by the addition of a detailed spectroscopy package which allows simulation of time resolved spectroscopy from these experiments. New techniques have been used to analyze x-ray images of imploded capsules by performing a full modal analysis which quantitatively measures the departure from sphericity of the observed image. A new diagnostic camera has been developed and successfully fielded at NOVA. This is the time-integrated multichannel pinhole camera used for x-ray imaging of imploded capsules. A detailed analysis of the effects of shell emission relative to core emission was carried out theoretically in a study of basic image formation for these laser imploded capsules. This study resulted in an experimental

campaign in which Dr. Delamater is the experimentalist and principal investigator. This experimental campaign is currently ongoing and important to the success of the drive symmetry campaign at NOVA.

Documentation on the status of work performed is given in the references listed below. These include (1) presentation at LLNL and LANL as part of cylindrical experiment design review, (2) presentation at APS Plasma Physics annual meeting at Tampa, Florida (1991) and Seattle (1992), (3) presentation at Hohlraum physics workshops (LANL, March 1992 and at LLNL, October 1992), presentations at Anomalous Absorption Conference (Lake Placid, New York, June 1992), presentation at NECDC (Nuclear Explosive Code Developer Conference, Sunnyvale, California, November 1992), and (4) several published journal articles.

PRESENTATIONS, REPORTS, AND PUBLICATIONS

1. B. Hammel, C. Keane, D. Kania, J. Kilkenny, R. Lee, R. Pasha, R. Turner, and N. Delamater, "K and L-Shell Spectroscopy of Indirectly Driven Implosions," *Rev. Sci. Instru.*, 63, 5017, 1992.
2. R. C. Mancini, C. F. Hooper, N. Delamater, A. A. Hauer, C. J. Keane, B. A. Hammel, and J. K. Nash, "Density and Temperature Diagnostic Based on the Ar He-Beta Line and Associated Satellites," *Rev. Sci. Instr.* 63, No. 10, 1992.
3. G. Charatis, N. Delamater, G. Busch, R. Bosch, G. Ganger, J. Thornburg, and D. Sullivan, "Evidence for Population Inversions in Al and Mg by Laser Irradiation at 20 ps Pulse Lengths," *JOSA-B*, Vol. 9, 1278, August 1992.
4. R. A. Bosch, R. L. Berger, B. H. Failor, N. Delamater, G. Charatis, and R. L. Kauffman, "Collision and Interpretation of Plasma Crated by Laser Illuminated Disks," *Phys. Fluids B*, Vol. 4, 979, 1992.
5. N. Delamater, A. Hauer, B. Hammel, L. Powers, C. Keane, D. Ress, and J. Nash, "Analysis of Line Radiation from Radiatively Imploded Targets with Applications to Both HLP and HEP Experiments (U)," LLNL Laser Program 1991 Annual Report, 1992 (Classified).
6. A. Hauer, D. Ress, W. Hsing, L. Suter, N. Delamater, L. Powers, D. Harris, R. Thiessen, O. Landen, P. Amendt, G. Magelssen, and R. Watt, "Review of NOVA Drive Symmetry Measurement and Control Experiments (U)," presentation to the ICF Advisory Committee, Washington, DC, December 16, 1992 (P-4 internal report) (Classified).

7. N. Delamater, G. Pollak, A. Hauer, R. Mancini, C. F. Hooper, C. J. Keane, B. A. Hammel, and J. K. Nash, "Temperature and Density Diagnostic Based on the Ar He-Beta Line and Associated Li-Like Satellites," LA-UR-92-2147, *BAPS*, 37, 1431, November 1992.
8. W. Hsing, A. Hauer, N. Delamater, B. Hammel, O. Landen, B. Remington, D. Ress, and T. Weiland, "Short Pulse Backlighting on NOVA," LA-UR-92-2146, *BAPS*, 37, 1429, November 1992.
9. L. Powers, L. Suter, D. Ress, A. Hauer, and N. Delamater, "Analysis of NOVA Capsule Symmetry Experiments," *BAPS*, 37, 1519, November 1992.
10. N. Delamater, G. Pollak, and J. Nash, "Development of a Non-LTE Spectral Post Processor for Dense Plasma Simulations with Application to Spectroscopic Diagnostics in Spherical Implosions at NOVA (U)," presentation to NECDC, Sunnyvale, California, LA-UR-92-3557, November 1992 (Unclassified abstract, Classified report).
11. N. Delamater, D. Harris, A. Hauer, W. Hsing, D. Ress, and L. Powers, "Image Analysis for Symmetry (U)," presentation to Hohlraum workshop, LLNL, P-4-92:086, October 13, 1992 (Classified).
12. N. Hoffman, C. Choi, E. Lindman, N. Delamater, G. Pollak, C. Knapp, D. Harris, and J. Nash, "Calculations of X-ray Line Spectra from Asymmetrically Imploded ICF Capsules at NOVA (U)," presentation to NECDC (Nuclear Explosive Code Developer Conference), Sunnyvale, California, November 1992, X-1-92-445, October 1992 (Classified).

13. N. Delamater, G. Pollak, C. J. Keane, B. Hammel, A. Hauer, L. Powers, and D. Harris, "Development of a Non-LTE Spectral Post Processor for Dense Plasma Simulations," LA-UR-92-1800, in *Proceedings of the 22nd Annual Anomalous Absorption Conference*, Lake Placid, New York, June 1992.
14. N. Delamater, A. Hauer, R. Watt, D. Ress, L. Powers, D. Hammel, and C. Keane, "HLP-4 Data Review (U)," P-4-92:032, March 25, 1992 (Classified).
15. N. Delamater, A. Hauer, G. Pollak, B. Hammel, C. Keane, L. Powers, R. Mancini, and C. Hooper, "HLP-4 Spectroscopy: Data and Simulations (U)," presentation to Hohlraum workshop, LANL, P-4(VG)-92:17-45, March 3, 1992 (Classified).
16. A. Hauer, N. Delamater, D. Ress, L. Powers, L. Suter, B. Hammel, R. Watt, G. Magelssen, O. Landen, D. Wilson, and D. Harris, "Overview of Drive Symmetry Measurements on the NOVA Laser System (U)," P-4-91:151, December 20, 1991 (Classified).
17. N. Delamater, C. Keane, R. W. Lee, Y. Lee, and B. Hammel, *Proceedings of 1991 Topical Conference on the Physics of Radiatively Driven ICF Targets*, "Satellite Line Effects on Density Determinations from Stark Broadening Analysis of Ar Beta Lines Observed from NOVA Implosions (U)," LA-CP-91-400, November 30, 1991 (Classified).
18. R. Mancini, C. Hooper, N. Delamater, A. Hauer, and J. Nash, "Density and Temperature Sensitivity Study of the Li-Like Satellites of the Ar He-Beta Line," *BAPS*, 36, 2417, October 1991.
19. A. Hauer, N. Hoffman, N. Delamater, and G. Magelssen, "Cylindrical Experiment Design Review (U)," P-4-91:95, June 28, 1991 (Classified).