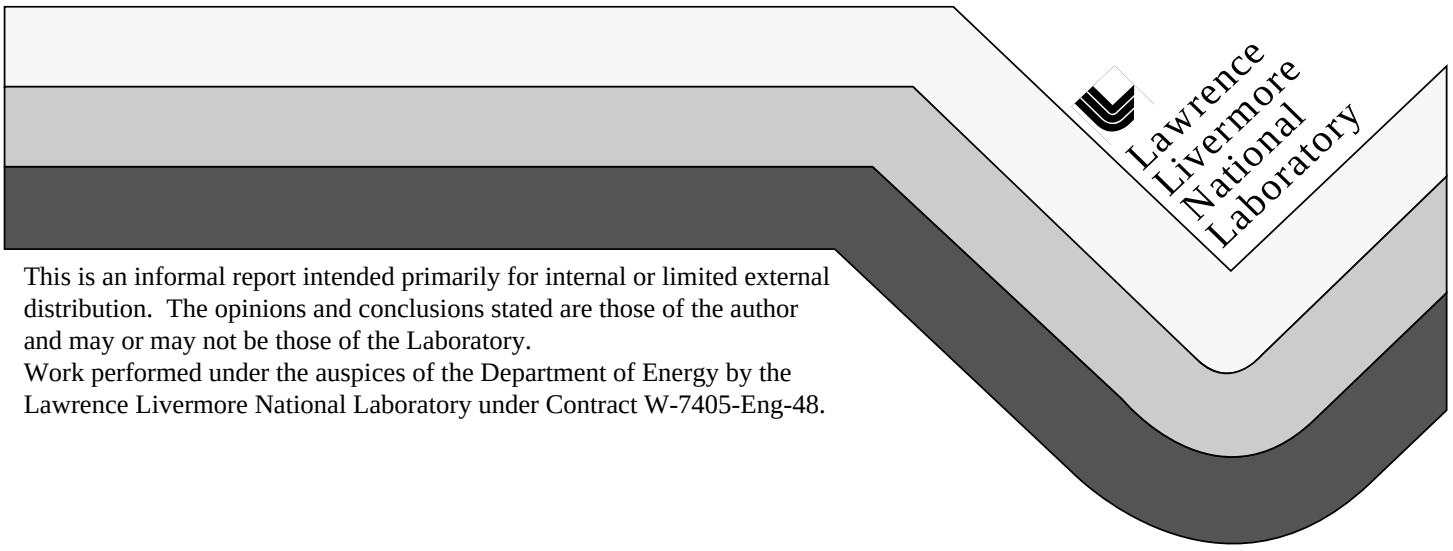
UCRL-ID-133580

Final Report: 97-ERD-022 Supernovae on Nova

Bruce A. Remington

March 11, 1999



Work performed under the auspices of the Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Final Report: 97-ERD-022
Supernovae on Nova
Bruce A. Remington, Principal Investigator

This is the final year of the 3-year LDRD-ERD involving Lasers, D&NT, Physics, and ILSA to develope astrophysics experiments on intense lasers such as the Nova and Gekko lasers. During this 3 year period, we have developed a highly successful experiment probing the hydrodynamics of the explosion phase of core-collapse supernovae, which occurs during the first ~3 hours after core collapse. This was in collaboration with the Univ. of Arizona and CEA/Saclay. We also developed a very successful experiment to probe the hydrodynamics of the later time, young remnant phase, meaning the first ~10-20 years after core collapse. This was in collaboration with the Univ. of Michigan and Univ. of Colorado. Finally, we developed during the final year an exquisite experiment to probe the dynamics of radiative, high Mach number astrophysical jets, in collaboration with the Univ. of Maryland and Osaka Univ.

Each experiment has received very high visibility, with a multitude of publications, both in the technical journals (most importantly, the astrophysical journals) and in the popular press. The attached publication list shows 25 papers published or submitted to technical journals, 5 articles appearing in the popular press (including a cover story of Sky and Telescope), and 65 conference presentations, ~10 of which were invited talks. The most important papers to come out of this effort was a comprehensive theory paper for Ap. J. establishing the rigorous scaling between laboratory laser experiments and the astrophysical subjects of interest: supernovae, supernova remnants, and jets; and a review article for Science covering this emerging subfield of Astrophysics on Intense Lasers. Since there are so many publications that have resulted from this LDRD project, only these two most important papers are attached. The rest are properly referenced, and can be found online or in the library.

In anticipation of the closing of the Nova laser, we have successfully proposed transferring the supernova hydrodynamics experiments to the Omega laser at the Univ. of Rochester under the NLUF Program and the radiative jet experiments to the Gekko laser at Osaka University, Japan.

The goal of this 3-year endeavor was to technically assess whether intense laser facilities could be used beneficially for astrophysics research. The answer to our progress is best answered by our being asked to supply input to the National Academy of Sciences Decadal Survey for Astronomy and Astrophysics, meaning that this new type of astrophysics research is to be represented in the next 10-yr. plan for astronomy and astrophysics.

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