

ICF Target Support Highlights

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General Atomics, with our partner Schafer Corporation, serves as the ICF Target Support Contractor, providing target development and fabrication and target system engineering development to support the ICF program at five ICF Labs — LLNL, LANL, NRL, SNL, and UR/LLE. This informal newsletter contains highlights of that support for March 1999.

GA/Schafer onsite staff at LLNL, LANL, and SNL fabricated, machined, assembled and characterized more than 110 targets of various kinds for experiments on Nova, Omega, Trident, and Z. We fabricated, characterized, and delivered about 400 targets and target components, including micromachined hohlraums, witness plates, and foams to LLNL, LANL, and SNL for shots on Nova, Omega, and Z, plastic and glass microballoon capsules to LLNL, LANL, and UR/LLE for shots on Nova and Omega, and flat foil targets of various materials and configurations to NRL and UR/LLE for experiments on Nike and Omega

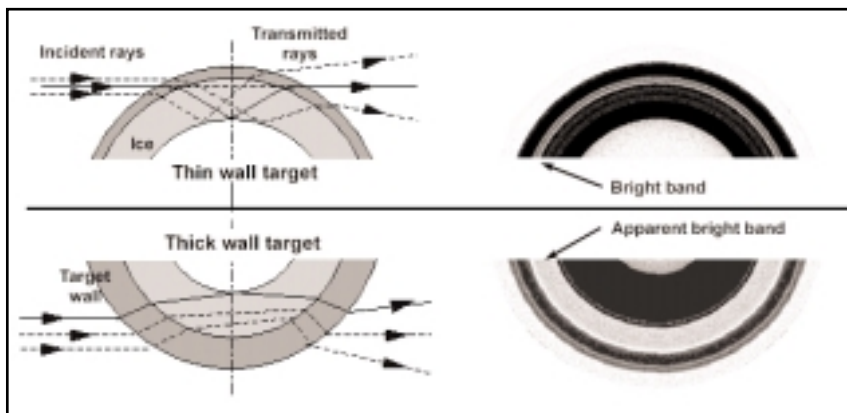


Fig. 1. Computer model and computer generated image of ICF capsules containing DT ice.

High gain cryogenic targets for ICF are spherical shells, which contain a layer of DT ice surrounding a volume of DT gas in thermal equilibrium with the solid. The roughness of the inner surface of the cryogenic fuel layer inside of these targets is one of the sources of imperfections, which cause implosions to deviate from perfect one-dimensional performance. Shadowgraphy (backlighting) is used to measure the surface roughness of the ice layer in current cryogenic experiments. A bright band is formed in the shadowed region of the target by rays experiencing total internal reflection at the ice solid/vapor interface. The apparent

ice thickness is the distance from the outer edge of the target image to the bright band center. An analytical relation is developed between the actual ice thickness formed inside a target and the apparent ice thickness measured on the target image.

To better understand the details of the bright band image, Monte-Carlo ray-tracing methods are used to model the experiment. From observation of computer generated images (Fig. 1), targets are grouped into two categories: thin wall targets and thick wall targets. For thin wall targets (i.e. 1 mm diameter, wall thickness $<75 \mu\text{m}$), the width of the bright band is independent of the target wall thickness. However, for thick wall targets (1 mm diameter, wall thickness $>75 \mu\text{m}$), the width of the bright band is a function of the wall thickness and the ice. The band is formed by rays penetrating through the ice layers as well as undergoing total internal reflection on the solid/vapor interface. Current experiments use thin wall targets and our modeling efforts have emphasized this type. Indirect drive NIF targets will be thick walled.

We have studied the effect of a single spherical defect in the ice surface on our computer-generated images (Fig. 2). The type of defect (bump or hole), height, base diameter, target wall thickness, and ice layer thickness are input parameters. As expected, bump defects move the bright band towards the image center while holes move the bright band away from image center. However, the displacement is not directly proportional to the size of the defect. We have modeled the transfer function between defect size and bright band displacement. The ice layer thickness (75-200 micron) and the target wall thickness (10-50 μm) have little or no significant impact on the bright band position for a given size surface defect.

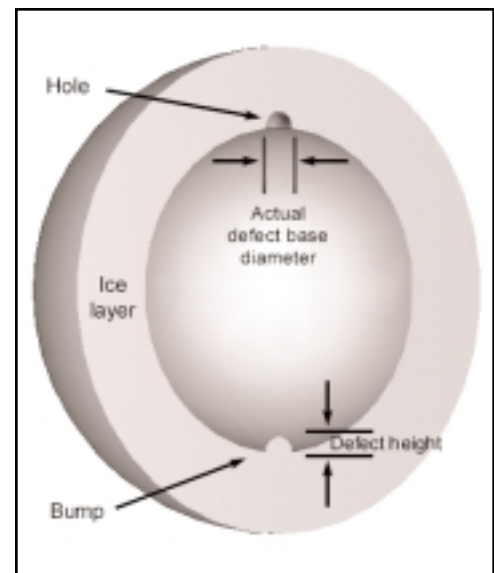


Fig. 2. Schematic of DT ice defects being modeled.

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