CRYOGENIC TARGET RESEARCH FOR IGNITION EXPERIMENTS AT THE NATIONAL IGNITION FACILITY

D.R. Harding, M.D. Wittman, N.P. Redden
Laboratory for Laser Energetics, University of Rochester, Rochester, NY, USA
dhar@lle.rochester.edu

Providing targets for cryogenic ignition experiments at the National Ignition Facility (NIF) presents many technical challenges that make the task more complex than scaling-up the existing OMEGA cryogenic system. Foremost is the need to fill the target through a tube; second is the target design; and third is the infrastructural constraints imposed by the need to interface the target and its cryogenic environment with the NIF target chamber and the existing ignition target inserter cryostat (ITIC). These challenges and the plan to resolve them are addressed separately.

The need to fill the target with DT through a tube is the most fundamental change from the OMEGA cryogenic system and presents the biggest challenge: the fill tube must be robust and sufficiently stable to support the target, small enough to not perturb the implosion, provide a precise amount of fuel to the target, and not perturb the ice layer. A design for a fill tube target and layering cryostat was developed and tested using deuterium: the fuel content was precisely controlled and an ice layer was formed. The quality of the ice layer was compromised by the fill tube absorbing the infrared illumination that was needed to form the ice layer. Modifications to make the system usable with tritium, which will resolve this problem, are underway. In the meantime, tests to control the amount of fuel in the target were repeated using a mixture of H_2 and D_2 (as a surrogate for the D_2, DT, T_2 system) and limitations with the design were revealed. These limitations will be discussed.

The direct-drive NIF ignition target design contains 40× the amount of fuel of an OMEGA target; the innermost ablator is beryllium. The target will be imploded at a temperature 1.5-K lower than the OMEGA target. Each of these factors will likely cause the protocol needed to form the layer to differ from the protocol used for OMEGA targets. A description of how the ice layer forms in OMEGA targets and how this may be affected by the requirements for the NIF targets will be presented.

Interfacing the NIF drive-drive target and its cryogenic environment with the NIF target chamber and ITIC will be a complex engineering task. Any simplifications that can be made by miniaturize and simplify the cryogenic environment surrounding the target should greatly ease that engineering task. The intent is to evaluate different designs for the target and its cryogenic surroundings in the cryogenic facility at LLE with the goal of simplifying the engineering task without compromising the quality of the target.

This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0001944, the University of Rochester, and the New York State Energy Research and Development Authority. The support of DOE does not constitute an endorsement by DOE of the views expressed in this abstract.