Targets for Heavy Ion Inertial Fusion Energy*

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In the past few years, the emphasis for heavy ion targets has moved from the "distributed radiator" target [1,2] to the "hybrid" target [3] because the hybrid target allows a large beam spot. Since focusing the ion beam to a small spot is difficult, the hybrid target should ease the constraints on the accelerator and make the accelerator less expensive. Since the cost of the accelerator is the largest item in a heavy ion inertial fusion power plant, reducing the cost of the accelerator should reduce the cost of the plant and the ultimate cost of electricity.

The hybrid target introduces some new target physics issues, however. In particular, the symmetry required by the capsule is controlled using internal shields inside the hohlraum, as opposed to using proper placement of the beams. The latter technique is used in the heavy ion distributed radiator and the National Ignition Facility point design. In the hybrid target, we use a shine shield to prevent the capsule from "seeing" the spot where the ions beams deposit their energy. Without the shine shield, the capsule would see a large P_2 (second Legendre polynomial) asymmetry. Radiation flows around this shine shield onto the capsule. This results in a significant P_4 asymmetry. Our solution has been to correct this P_4 by using a shim—a thin layer of material placed on or near the capsule surface to remove the small amount of excess radiation.

The double-ended Z-pinch target [4,5] has many similarities to the heavy ion hybrid target. It also uses a shine shield to block radiation from the radiating z-pinch. Again, radiation flows around this shine shield and can result in a large P_4 asymmetry. The similarities between these targets has led to a collaboration on exploring shims to control symmetry.

Our first set of experiments used a shimmed capsule to remove a P_2 asymmetry in a double-ended Z-pinch. A layer of gold, with thickness that varied as a function of polar angle, was deposited on the capsules by GA. The first set of experiments were successful in reversing the sign of the P_2 asymmetry and shows that we can control the asymmetry by using this technique.

In this talk, we will discuss the hybrid target, its impact on the heavy ion fusion power plant, as well as the design, target fabrication, and experiments to test shims for symmetry control.

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*Work performed under the auspices of the U. S. DOE by the University of California, Lawrence Livermore National Laboratory under contract W-7405-ENG-48.