Hohlraum Electron Temperature Floating Dot and Wall Motion Experiments on The National Ignition Facility (NIF)

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The Hohlraum Campaign experiments seek to understand the effects of hohlraum plasma dynamics on radiation drive and increase energy delivery to the capsule. Physicists use X-ray spectroscopy and observe the dynamic extraction of Mn-Co samples to measure hohlraum plasma density and electron temperatures in various regions of the hohlraum interior. These plasma conditions greatly affect the laser-plasma interactions within the hohlraum. Therefore, mapping the plasma conditions throughout the hohlraum allows physicists to map the laser-plasma interactions.

Floating Dot Target Design

To measure the plasma conditions in the hohlraum between the capsule and LEH, the target needed to have the following unique features:

- Two part tooling for construction with parting line at the mid-plane between top of capsule and LEH
- Mn-Co dot deposited on thin film and bonded to lower hohlraum
- Curved HDC windows used in upper hohlraum for visibility from sample to LEH
- Capsule stalk assembled to Thermo-Mechanical Package (TMP)

Hohlraum T_e Target Design

Development was necessary to fabricate the Mn-Co dot films and curved HDC windows. New tooling was required to securely hold the films, accurately cut the films, and precisely deposit the dot. To cut the curved HDC windows, we developed laser ablation techniques that allowed for more complex shape designs to be realized.

The target assembly required new tooling for nearly every operation, but assembling the capsule to the TMP required the most new tooling. Many of the assembly procedures required:

- We used an articulating stereo microscope to view the curved HDC window's outer ellipse plane that was difficult to see under an OCMM
- The vacuum chuck used to hold the upper hohlraum during HDC install could be revised to improve visibility

Hohlraum Wall Motion Target Design

In addition to measuring the hohlraum plasma density and electron temperature, physicists use X-ray cameras to study the plasma effects on laser energy transport within the hohlraum. The latest evolution of Waldos target feature large thin-wall hohlraum sections to:

- The design featured, and are large enough to visualize NIF's inner cone beam spots on the hohlraum.

The thin-wall patches were fabricated by using similar processes as used for hohlraum fabrication. This gave the inner gold wall a pristine surface quality that is essential for high laser energy transport through the target. The patches held their shape well, but there were some spring-back observed after parts were released. Future fabrication of thin-wall patches will compensate for this spring back.

Capsule installation required the most new tooling at any assembly operation. The DE windows were so large that new vacuum chucks were required to manipulate the DE during capsule installation and target closing. Installing the thin-wall patches without glue wicking onto the internal wall surface was the most significant assembly challenge. Gluing the patches successfully relied on innovation UV curing and minimal glue application.

Hohlraum Wall Motion Target Assembly

The experiment was successful in visualizing laser energy through the thin-wall patches. An obscuration of laser energy between 5.5 ns and 6.2 ns is shown by the patch emission dimming in the last frame.