Development of Compton Radiography Targets using ARC on the NIF

Authors: ¹Jeremy Kroll, ²Elias Piceno, ¹Riccardo Tommasini, ³Scott Vonhof

**Target fabrication has been assisting in the development of a platform to obtain Compton-scattering produced radiographs on the NIF**

- Compton radiography experiments, on the NIF, are now using ARC and AXIS. These experiments are aimed at obtaining Compton-scattering produced radiographs from the cold, dense fuel surrounding the hot spot.
- The Advanced Radiographic Capability, ARC, is a petawatt-class laser used to produce brighter, more penetrating, higher energy x-rays.
- The ARC X-ray Imaging System, AXIS, is an x-ray camera capable of recording two Compton radiographs during a single NIF shot.
- This requires a unique target platform to produce Compton radiographs of indirect drive ignition implosions. We will explain the details of shielding and backlighter design which made this platform possible.

**Advanced Radiographic Capability, ARC**

*Image from https://lasers.llnl.gov*

**Room Temperature Targets used to Facilitate Experimental Proof of Concept**

**Backlight targets**

- Backlight targets are used to confirm ARC pointing and x-ray image spatial resolution. Two 25 micron diameter gold micro-wires, on the left, which are driven with ARC beams. The 200 micron diameter tungsten-carbide ball, on the right, is the subject of the backlit x-ray image.

**Tungsten-carbide sphere in integrated cryo-target thermal mechanical package**

- These targets integrated the backlighter with the thermal mechanical structure of a cryogenic target. This facilitated testing of backlighter unconverted light shielding and diagnostic shielding.

**Results from tungsten sphere target shows acceptable shielding and target geometry**

**Warm TMP-based target for integrated platform backlighter shield test**

- Experimental radiograph of a 200um diameter WC spheres, produced by Au micro-wire backlighter, recorded on Image Plate, a), and on one of the two AXIS framing cameras, b). Credit: Riccardo Tommasini

**Room Temperature HDC bead target for driven hohlraum backlight imaging validation**

**HDC Bead target from top**

- This target contained a Compton radiography hohlraum with a CH coated HDC bead, which facilitates the first imaging of an implosion capsule with an ARC driven backlighter.

**Backlighter Shield and ARC Alignment Fiducial**

- Aluminum coated additive manufactured shield protects the backlighter from unconverted light. The fiducial used to confirm alignment of ARC beams to the backlighter. A gold witness plate was added for confirmation of ARC beams if they missed the backlighter wires.

**Target looking from the diagnostic**

- Hanging shields provide additional reduction of hohlraum background X-ray into the diagnostics' view.

**Cryogenic target development**

**Cryogenic W-sphere target design**

- Cryogenic compatibility requires the target to support an ice layer, which requires target positioner cryogenic shrouds and unperturbed thermal mechanical package. Since the backlighter fiducial cannot fit or be seen in the shrouds, it must be removed. This requires target and ARC alignment changes. This also requires the backlighter shielding to be modified to be attached to the target base and not the thermal mechanical package.

**Cryogenic W-sphere target design**

- This also requires the backlighter shielding to be modified to be attached to the target base and not the thermal mechanical package. Carbon fiber rod used to attach backlighter shield to the target base. 300 micron gap between shield and TMP.

**Cryogenic platform for layered implosion with ARC backlight imaging**

- Using lessons learned from the backlighter development and integrated diagnostic and backlighter shielding, we are developing the DT layering capable platform. Target fabrication is expected to build the first target for a late 2017 shot.