# Development of a NIF Platform for Activation Studies with a Prompt Source of Fast Neutrons

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Implosion of targets at the National Ignition Facility (NIF) allows access to previously inaccessible regions of high density and high temperature phase space coupled with high neutron fluences. These novel regimes provide a wealth of information on high energy density physics and the neutron activation of atomic species. In particular, the high-fluence neutron spectrum produced by deuterium-tritium filled targets provides an opportunity to measure the activation of materials by fast-spectrum neutrons with a sharp time structure.

We have coupled the Indirect Drive Exploding Pusher (IDEP) platform [1] with a newly deployed large volume, gas-cell diagnostic [2]. The IDEP platform is a single-shock, indirectly-driven target which utilizes low laser energy (<1 MJ). Shots reproducibly produce symmetric implosions with high neutron yields in short burn widths and minimal neutron energy down-scatter (approximately, $5x10^{14}$ neutrons in 300 ps and down-scatter ratios 0.25% ± 0.25%). The new, gas-cell diagnostic consists of reusable, sealed cells mounted in chamber, ~50 cm from the target. Postshot, the cells are retracted and recovered; the contents are evacuated and undergo gamma-coincidence counting at the Livermore Nuclear Counting Facility. The IDEP coupled with gas-cell diagnostic, therefore, provides a unique vehicle to study neutron activation of gaseous substances.

We have fielded this target-diagnostic combination on a series of shots and have measured cross-sections of xenon radioisotopes with uncertainties reduced by factors of 2-3 relative to current literature values. We are also utilizing this target-diagnostic combination to attempt to measure nuclear-plasma interaction effects taking place on xenon loaded inside the capsule gas-fill [3]. Design and capabilities of this target-diagnostic combination will be discussed as well as preliminary results from our initial series of shots.

**References**

[1] S. Le Pape, et al., Phys. Rev. Lett. **112**, 225002 (2014).

[2] A. Ratkiewicz, et al., Review of Scientific Instruments **87**, 11D825 (2016).

[3] D.L. Bleuel, et al., Plasma Fusion Res. **11**, 3401075 (2016).

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