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Fill tube radiation hydrodynamics experiments on ignition scale capsules[1]

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Recently, experiments on the Z facility at Sandia National Laboratories examined the perturbations created on inertial confinement fusion capsules by the presence of tiny (∼10-40 micron diameter) fill tubes. Tubes similar to these will be used to fill ignition capsules with deuterium tritium fuel on the National Ignition Facility (NIF). Edwards, et. al [Phys. Plas. 12, 056318 (2005)], in calculations assessing the impact of these tubes on ignition capsules, showed that the dominant perturbation from the fill tube was not due to the hydrodynamic perturbation from the hole and tube at the capsule's surface but rather was due to the radiation shadow cast on the capsule surface by the exploding tube. This radiation shadowing leads to a scaling of the perturbation on the capsule that is linear with the tube size. It also implies that the size of the perturbation on the capsule depends on the composition of the tube. The experiments to test these predictions were designed to take advantage of Z's unique capabilities to symmetrically implode ignition scale capsules with drive temperatures near the NIF foot temperature. General Atomics produced smooth, ignition scale capsules, drilled holes in an equatorial plane and attached multiple (up to 4) tubes to each capsule for the experiments. These targets enable the cleanest comparisons of the perturbations created by fill tubes of different sizes and compositions. The capsules and perturbations resulting from the fill tubes were imaged using a 6.151 keV bent crystal imaging system with excellent spatial resolution over a field of view which covered the entire capsule. A careful comparison between calculations and experimental results will be presented and the implications of these results for NIF ignition capsules with fill tubes will be discussed.

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