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2.5 Microscope requirements to diagnose high-spatial-frequency bright spots in inertial confinement fusion implosions at the national ignition facility

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Inertial confinement fusion self-emission imaging provides a challenging environment for two-dimensional time resolved x-ray imaging. The short lived (˜200 ps) spherical implosion dynamically evolves throughout the deuterium-tritium (DT) compression. Current microscopes with ˜10 μm spatial resolution and 20-100 ps time resolution provide sufficient information to infer hot spot volume and emissivity under certain physical constraints. The introduction of high-atomic number materials as shell dopants, in conjunction with the susceptibility of the implosion to seeded hydrodynamic growth, has led to continued observations of high-spatial-frequency x-ray bright spots that evolve internally to the hot DT core. We wish to determine the origin and nature of these features through the application of higher resolution x-ray microscopes. This goal requires addressing both the image forming system and the detector resolution and statistics, in addition to the physics we hope to infer. With new reflective x-ray optics and coded aperture imaging being considered alongside the next generation of fast x-ray detectors, this paper addresses the instrument design requirement to measure 'bright spot' features at the NIF. Prepared by LLNL under Contract DE-AC52-07NA27344. LLNL-ABS-744014.

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