Electron temperature from x-ray continuum measurements on the NIF

L. C. JARROTT, B. BACHMANN, L. R. BENEDETTI, N. IZUMI, S. F. KHAN, O. L. LANDEN, T. MA, S. R. NAGEL, A. PAK, P. K. PATEL, M. B. SCHNEIDER, P. T. SPRINGER

1) Lawrence Livermore National Laboratory, USA
Email: jarrott1@llnl.gov

We report on direct measurements of the electron temperature within the hot spot of inertially confined, layered implosions on the National Ignition Facility using a titanium differential filtering x-ray diagnostic [1]. The electron temperature from continuum x-ray emission measurements is insensitive to non-thermal velocity flows as is the case with ion temperature measurements based on Doppler broadening [2] and is thus a critical parameter in interpreting stagnated hot spot conditions. Here we discuss electron temperature measurements using titanium filters ranging from 10μm to 1mm in thickness with a spectral sensitivity band of 10-30keV coupled with imaging and penumbral sized pinholes to limit the field of view specifically to continuum emission originating from the hotspot. The use of larger pinhole diameters was done to increase x-ray fluence allowing for greater sensitivity of photon energies with minimal attenuation from the compressed fuel/shell. This results in measurements less susceptible to systematic uncertainties associated with spatial variance in fuel/shell areal densities, effectively deconvolving x-ray attenuation and temperature in the analysis of data. This diagnostic has been fielded on a series of cryogenic shots with DT 'Brysk' ion temperatures ranging from 2.5-5.0keV. A detailed analysis of the measurement accuracy will be presented along with a comparison and validation against simulated electron temperatures and x-ray spectra as well as a discussion of the implications of electron temperature deviations from DT and DD neutron time-of-flight ion temperature measurements.

This work was performed under the auspices of U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344.

References

[1] Jarrott, L.C., et al. (2016). *Review of Scientific Instruments*, *87*(11), 11E534. http://doi.org/ 10.1063/1.4961074
[2] Kritcher, A. L., et al. (2014). *Physics of Plasmas*, *21*(4), 042708–11. http://doi.org/10.1063/1.4871718