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7.3 A Quartz-based Cherenkov Radiator for High Precision Time-of-Flight Measurement of DT Fusion Gamma and Neutron Spectra

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A quartz based Cherenkov radiator has been implemented at the National Ignition Facility (NIF) to provide a new high precision measurement of the spectrum of 14.1 MeV DT fusion neutrons. This detector has two benefits over traditional scintillator-based nToFs. (1) it enables a high precision (<50ps) co-registered measurement of both a thresholded gamma spectrum and the neutron spectrum on a single record; other methods typically require gamma and neutron signals to be co-registered via other diagnostics and/or dedicated timing experiments. (2) the temporal width of the instrument response function (IRF) is reduced to < 1.0ns thereby reducing the uncertainty in the Brysk ion temperature derived from the width of the measured neutron spectrum. Analysis of co-registered gamma and neutron data from NIF DT implosions on multiple lines-of-sight indicate that the bulk vector velocity of the implosion hot-spot can be determined to within 5 km/s, while analysis of the neutron spectrum indicates the uncertainty in the ion temperature due to the IRF is reduced to approx. 0.1keV. LLNL-ABS-744335 This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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