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**Using Secondary Nuclear Reaction Products to Infer the Fuel Areal Density, Convergence, and Electron Temperatures of Imploding $D_2$ and $D^3He$ Filled Capsules on the NIF** B. LAHMANN, J.A. FRENJE, M. GATU JOHNSON, F.H. SEGUIN, C.K. LI, R.D. PETRASSO, MIT, E.P. HARTOUNI, C.B. YEAMANS, H.G. RINDERKNECHT, D.B. SAYRE, G. GRIM, K. BAKER, D.T. CASEY, E. DEWALD, C. GOYON, L.C. JARROTT, S. KHAN, S. LEPAPE, T. MA, L. PICKWORTH, R. SHAH, LLNL, J.L. KLINE, T. PERRY, A. ZYLSTRA, S.A. YI, LANL — In deuterium-filled inertial confinement fusion implosions, 0.82 MeV $^3$He and 1.01 MeV T (generated by the primary DD reaction branches) can undergo fusion reactions with the thermal deuterium plasma to create secondary $D^3He$ protons and DT neutrons, respectively. In regimes of moderate fuel areal density ($\rho$R $\sim$ 5 - 100 mg/cm$^2$) the ratio of both of these secondary yields to the primary yield can be used to infer the fuel $\rho$R, convergence ratio (CR), and an electron temperature ($T_e$). This technique has been used on a myriad of deuterium filled capsule implosion experiments on the NIF using the neutron time of flight (nTOF) diagnostics to measure the yield of secondary DT neutrons and CR-39 based wedge range filters (WRFs) to measure the yield of secondary $D^3He$ protons. This work is supported in part by the U.S. DoE and LLNL.

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