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Recent Measurements of DT Gamma to Neutron Branching Ratio at ICF Conditions[1]

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The total T(d,g)5He/T(d,n)4He branching ratio of (4.5 +/- 0.5)E-5 has been measured on Inertial Confinement Fusion (ICF) implosions at the OMEGA laser facility. Recent measurements have shown that the DT branching ratio at ICF is 2 - 3 times less than that of previously measured at particle accelerator facilities. Measurements were done at ion temperatures of (5 +/- 2) keV, which is quite low compared to previous measurements. Implication of the recent founding is that nuclear properties such as DT branching ratio might be reconsidered at low temperature ICF and stellar conditions. In practical sense, precise measurements of the branching ratio T(d,g)5He relative to T(d,n)4He are important in order to diagnose target areal density and resultant fusion yield of cryogenically-layered implosions at the National Ignition Facility (NIF). In this work, we have used LANL's Gas Cherenkov Detector (GCD), which provides a high bandwidth, energy thresholding capability for gamma-ray detection using gamma/electron/Cherenkov conversion. High-bandwidth aids the detection of D-T fusion gamma rays before the arrival of associated 14.1 MeV neutron-induced gammas; energy thresholding gives further protection against such undesirable backgrounds. In addition, to reduce systematic uncertainty, we have applied three independent calibration methods to characterize GCD response such as (1) D-3He gamma-rays generated at Omega laser where no absolute detector calibration was required because quite similar gamma spectrum from D3He and DT, (2) mono-energetic gamma rays generated at Duke University's High Intensity Gamma-ray Source (HIgS), and (3) 14-MeV neutron-induced inelastic gamma-rays generated at OMEGA using puck materials of known areal density placed near target center. In conjunction with an independent neutron yield measurements and ACCEPT and GEANT4 simulation codes, the resultant DT branching ratio was inferred.

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