

DPP11-2011-000771

Abstract for an Invited Paper
for the DPP11 Meeting of
the American Physical Society

Anomalous DD and TT yields relative to the DT yield in inertial-confinement-fusion implosions¹

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Measurements of the $D(d,p)T$ (DD), $T(t,2n)^4He$ (TT) and $D(t,n)^4He$ (DT) reactions have been conducted using deuterium-tritium gas-filled inertial confinement fusion (ICF) implosions. In these experiments, which were carried out at the OMEGA laser facility, absolute spectral measurements of the DD protons and TT neutrons were conducted and compared to neutron-time-of-flight measured DT-neutron yields. From these measurements, it is concluded that the DD yield is anomalously low and the TT yield is anomalously high relative to the DT yield, an effect that is enhanced with increasing ion temperature. These results can be explained by an enrichment of tritium in the core of an ICF implosion, which may be present in ignition experiments planned on the National Ignition Facility. In addition, the spectral measurements of the TT-neutron spectrum were conducted for the first time at reactant central-mass energies in the range of 15-30 keV. The results from these measurements indicate that the TT reaction proceeds primarily through the direct three-body reaction channel, producing a continuous TT-neutron spectrum in the range 0 – 9.5 MeV. This work was conducted in collaboration with J. A. Frenje, M. Gatu Johnson, M. J.-E. Manuel, H. G. Rinderknecht, N. Sinenian, F. H. Seguin, C. K. Li, R. D. Petrasso, P. B. Radha, J. A. Delettrez, V. Yu Glebov, D. D. Meyerhofer, T. C. Sangster, D. P. McNabb, P. A. Amendt, R. N. Boyd, J. R. Rygg, H. W. Herrmann, Y. H. Kim, G. P. Grim and A. D. Bacher.

¹This work was supported in part by the U.S. Department of Energy (Grant No. DE-FG03-03SF22691), LLE (subcontract Grant No. 412160-001G), LLNL (subcontract Grant No. B504974).