Nuclear Seminar

Measuring the t+t neutron spectrum at inertial confinement fusion facilities

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The t+t reaction is an interesting one to study because it is a mirror for the astrophysically relevant 3He+3He reaction and because the spectrum of emitted neutrons is sensitive to final state interactions. The low mass of the nuclei involved make it suitable for ab initio theoretical comparisons. There are two possible reaction branches leading to distinct final states: 5He+n and 4He+2n, populating the ground and excited state in the 5He nucleus. The three-body final state gives rise to a broad energy spectrum of neutrons whereas the two body final states give rise to un-bound resonances that appear as peaks in the neutron energy spectrum. For several years, the Wong and Anderson (Nucl. Phys. 71, 106 (1965)) reactions have served as the standard data for the neutron energy spectrum. There has been limited experimental evidence suggesting that the shape of the spectrum changes depending on Ecm. In particular, there is some evidence that the 5He[g.s.]+n channel changes strength, despite the S-factor being relatively flat over that energy range. Most recently, low Ecm measurements with low-resolution spectrometers indicate no presence of this ground state peak in the spectrum. The goal of our measurement was to carry out a much higher resolution experiment such that the ground state was easily visible if it was populated. Through experiments at OMEGA/U.Rochester and the National Ignition Facility at LLNL, both inertial confinement fusion facilities, we have been able to extract energy spectra for En>~1 MeV, and temperatures of 3.5, 7, and 13 keV, including clear evidence for the ground state peak at all temperatures. The data have been fit using an R-Matrix framework. The facilities will be described briefly and preliminary results will be presented, including a description of how to extract a meaningful neutron spectrum from a measurement in which all of the reactions take place in 100ps.

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