LBNL Nuclear Physics Forum

Thursday, April 26, 2018 @ 11:00 am

Building 88 Lounge (2nd floor)

Cookies and coffee available from 10:45am

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*Thermonuclear reactions probed at stellar core conditions with laser-based inertial confinement fusion**

Stellar models require accurate thermonuclear reaction rates to predict the nuclear power production and dynamic evolution of these systems. Direct measurement of nuclear reaction rates in thermonuclear plasmas is challenging because these conditions are difficult to produce and diagnose. Still, there are physics issues such as plasma electron-screening or other plasma-nuclear effects that are present in stellar cores but not in terrestrial accelerator experiments.

Laser-based inertial confinement fusion (ICF) implosions produce extremely dense, hot plasmas that provide a path to study reactions in these thermonuclear conditions and to begin exploring some of these plasma-nuclear issues. However, ICF experiments have significant challenges not found in accelerator experiments. For example, the complex temporal and spatial evolution of these systems can make absolute cross-section measurements difficult and quite challenging to model. In this talk, we show that these issues can be overcome and ICF implosions can be used to make nuclear measurements in some specific circumstances.

In particular, the method of yield ratios is used to infer $^{2}H(d,n)^{3}He$ and $^{3}H(t,2n)^{4}He$ astrophysical S-factors by observing the $^{2}H(d,n)^{3}He$ and $^{3}H(t,2n)^{4}He$ yields relative to $^{3}H(d,n)^{4}He$, in gas-filled implosions, using the $^{3}H(d,n)^{4}He$ reactivity as a reference. The resulting data shows excellent agreement with evaluations and prior accelerator data bolstering confidence in this method.

This platform is now being explored as a candidate for a future plasma-electron-screening experiment to attempt to observe enhancements to reaction rates in the presence of plasma electrons.

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