Contribution ID: **183** Type: **Invited Abstract**

Ab initio description of nuclear reactions with applications to astrophysics

Thursday, 16 June 2022 11:00 (30 minutes)

Thermonuclear reactions between light nuclei play an important role in explaining the origin and evolution of our universe, but are generally very difficult or even impossible to measure at the astrophysically relevant energies of tens to hundreds of keVs due to the hindering effect of Coulomb repulsion. As a result, they are almost always estimated by extrapolation from higher-energy measurements, a process that leads to significant uncertainty. Along with high-precision experimental data, first-principle (or ab initio) calculations with quantified uncertainties based on validated chiral nucleon-nucleon and three-nucleon forces can set a new standard for the evaluation of thermonuclear reaction rates that will lead to more robust predictive capabilities for astrophysical models. In this talk, I will present ab initio predictions of thermonuclear reactions obtained within the framework of the no-core shell model with continuum, including the recent ab initio informed evaluation of the ^{7}Be(p,γ)^{8}B solar fusion reaction and discuss initial results and prospects on bridging ab initio calculations and three-body reaction models.

Prepared by LLNL under Contract No. DE-AC52-07NA27344.

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Session Classification: NS2022 Plenary

Track Classification: Oral Presentations