Stellar-relevant thermonuclear reactivity measurements at the National Ignition Facility*

C. Weber[1], D. Casey[1], C. Cerjan[1], M. Hohenberger[1], E. Hartouni[1], B. Remington[1], M. Gatu Johnson[2], N. Kabadi[2], B. Lahmann[2], J. Frenje[2], and A. Zylstra[3]

[1]Lawrence Livermore National Laboratory, Livermore, California 94550, USA
[2] Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
[3] Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA

The evolution of stars is governed by thermonuclear reactivities that are challenging to measure in laboratories at stellar conditions. These measurements are typically made using particle accelerators which must be corrected to remove the added physics of bound-electron screening. Stellar reactivities have the further complexity of being enhanced by screening from free electrons in the plasma.

Conditions created on the National Ignition Facility have properties similar those found in the cores of main-sequence stars. On NIF a capsule is imploded by laser-generated x-rays, resulting in core temperatures of 2-6 keV (2-7x10^7 K) and densities of 1-100 g/cm^3. These conditions have been used to measure the reactivity of DD and TT reactions by comparing the yield to a reference reaction of DT. This technique has been showed to be robust to plasma gradients and in good agreement to existing reactivity data [1].

Ongoing work is seeking generate reactions in the presence of measurable plasma screening. To achieve this, measurement techniques need improvement to reduce uncertainties and develop methods to measure other simultaneous reactions. Design work is also required to enhance the effects of plasma screening while ensuring a measurable output. This talk will review existing reactivity measurements and discuss the feasibility of a measurement in the presence of plasma screening.

**This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and was supported by the LLNL-LDRD Program under Project No. 18-FS-010.*

[1] D. T. Casey *et al.*, Nature Physics, 13, 1227 (2017)