Abstract Submitted
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Deep Learning Enabled Inference of Fuel Magnetization in Magnetized Liner Inertial Fusion[1] WILLIAM LEWIS, PATRICK KNAPP, MATTHEW GOMEZ, ADAM HARVEY-THOMPSON, PAUL SCHMIT, DAVID AMPLEFORD, Sandia National Laboratories — Magnetized Liner Inertial Fusion (MagLIF) is a magneto-inertial fusion concept relying on quasi-adiabatic heating of a gaseous D-D fuel and flux compression of a pre-imposed axially oriented magnetic field to reach fusion relevant plasma conditions. Calculations show that up to $\sim 1000\times$ flux compression is possible, sufficient for trapping charged fusion products and reducing electron thermal conduction. However, physical mechanisms such as resistive diffusion and the Nernst effect may cause magnetic flux to leave the fuel, potentially causing performance degradation. As a result, quantifying fuel magnetization is critical for understanding performance. Recently it was shown that yield and time-of-flight measurements of primary D-D and secondary D-T fusion neutrons are sensitive to the magnetic field-fuel radius product (BR). Yet analysis of experimental data is time consuming, requiring significant user input, and is somewhat lacking in rigorous uncertainty quantification. We present a deep-learning approach based on the aforementioned diagnostics within a Bayesian framework that provides uncertainty quantification. We analyze several MagLIF experiments, showing an indication of the importance of the Nernst effect as laser preheat of the target is increased.

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