Optimisation of Polar Direct Drive Illumination for Mega-Joule Laser Facilities

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Laser inertial confinement fusion (ICF) now enters the burning plasma regime, the next step is higher energy yield which requires coupling more energy to the target. Laser direct drive achieves improved coupling as there is no hohlraum acting as an intermediary. However, the Mega-joule laser facilities (National Ignition Facility and Laser Mégajoule) are configured with beams entering at the poles for indirect drive, and so require beam re-pointing to recover a direct-drive compatible illumination. A polar direct drive scheme has already been tested on the NIF [1], however the irradiation configuration may not be optimal. The National Ignition Facility features: 8 cones of quads with independent wavelength tuning; 48 quads entering from different ports with independent pointing, power balance and defocusing; and the quads may be split to 192 beams with individual pointing offsets. There is a large parameter space which likely features different optimal setups for solid target illumination, conventional hotpot ignition, and shock ignition. Neural networks are a useful tool for the optimization of parameter space and have been used to more efficiently model ICF experiments [2].

This talk presents an efficient search of the design space using a neural network [3] to optimize beam parameters reducing global RMS deviations from uniform illumination and to tune specific modes. The algorithm is trained using the 3D ray tracing package Ifriit [4]. The project will be extended to couple 3D hydrodynamics and off-line CBET analysis for a selection of ICF targets.

References

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