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Probabilistic Model of Laser Drive Asymmetries for an IFE Reactor design

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In the pursuit of the realization of an Inertial Fusion Energy (IFE) reactor, directly driving the fuel capsules with laser beams is a compelling design choice due to the more efficient energy coupling compared to indirect drive. However, the laser illumination symmetry necessary for achieving ignition and gain imposes stringent accuracy requirements on the laser system.
We present a reactor beam port configuration derived from the charged particle repulsion heuristic from [1]. Multiple beams per port are used to dynamically shift power between different beam spot sizes as the capsule implodes, reducing the laser light blowby while maintaining a uniform illumination. A probabilistic model has been developed to directly propagate the laser drive modes from stochastic system errors (target injection, beam pointing and power imbalance) without the need for Monte Carlo simulations. This model constitutes a useful tool for the broad optimization of the laser beam geometrical configuration of future facilities.
[1] M. Murakami and D. Nishi, "Optimization of laser illumination configuration for directly driven inertial confinement fusion". Matter and Radiation at Extremes **2**, 2 (2017).

Autor: Herr MATEO, Alfonso (Universidad Politécnica de Madrid, Focused Energy GmbH)

Co-Autoren: Dr. GAFFNEY, Jim (Focused Energy Inc.); Dr. SOKOL, Martin (Focused Energy GmbH); Dr. DEBAYLE, Arnaud (Focused Energy GmbH); Prof. HONRUBIA, Javier (Universidad Politécnica de Madrid, Focused Energy GmbH)

Vortragende(r): Herr MATEO, Alfonso (Universidad Politécnica de Madrid, Focused Energy GmbH)

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