SAHS (Statistical Analysis of Hot Spots)

Study of the statistical properties of a smoothed laser focal spot in the context of Inertial Confinement Fusion

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Funding: CEA/CESTA

Ideally, the focal spot of high power nanosecond lasers, like the laser MégaJoule (LMJ), should be perfectly homogeneous. In practice, this isn't possible. The focal spot is thus a pattern of speckles with many hot and cold spots. To get a kind of homogeneity, it is possible to move slightly but very rapidly the focal spot. This technique, named smoothing, consists in broadening the pulse spectrum with phase modulation and in focusing different spectral components at different positions using a dispersive element like grating.

In order to evaluate the quality of such a smoothing, the most used criterion until now,was the asymptotical contrast. i.e. the residual spatial contrast of the focal spot after a relatively long time (several tens picoseconds). It turns out that this criterion is not sufficient to compare the efficiency of different smoothing techniques. It is therefore difficult to choose between them for a given type of experiments. Then, in order to better characterize the quality of the smoothing, new observables for the optical field have therefore been defined and more could be obtained. The goal of this project is to calculate these observables (hot spots size and duration, spatial distribution, velocity, fluences histogram,…) for different smoothing methods that could be achieved on the LMJ.

A code allowing calculating the optical fields in the focal plane exists but it will be necessary to develop computing tools for characterizing the statistical properties of the focal spot. This is this project goal. The results obtained in this framework will constitute a major stake of the studies to achieve ignition with the LMJ as they are directly linked to energy exchanges between beams and therefore to the laser irradiation symmetry of the fusion target.

References

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