Proton fast ignition of inertial fusion targets revisited

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Ion fast ignition (IFI) was proposed as an alternative scheme to ignite targets with lower energy and symmetry requirements [1]. Progress on ion fast ignition has been reported in [2]. Many of the ion beam requirements published so far are based on ideal assumptions on ion beam focusing and beam-plasma interaction. However, the following effects have been reported over the last years:

1. Divergence of laser-driven protons generated in hollow cones [3] and its consequences on ion energy deposition [4].

2. Anomalous energy deposition of intense ion beams in resistive plasmas [5]. 3. Improved modeling of proton stopping power. Dedicated experiments [6] have shown that the BPS stopping model [7] fits the experimental results, while the standard stopping theories show substantial differences. As the ranges predicted by the BPS model are 20- 30% higher than the standard models, the parameters typically used for the IFI scenario may change substantially.

To analyse the relevance of these effects, we have conducted integrated simulations of IFI, from ion generation to fuel ignition. We have combined PIC, hybrid, and radiation-hydrodynamic simulations to evaluate the laser energy requirements of the IFI scheme. The results obtained will be helpful to assess the potential of IFI as an alternative scheme for inertial fusion targets.

References

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