Back-reflection protection in high-power laser experiments using single plasma mirror

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In high-intensity laser interactions with solid targets, the radiation pressure can push inwards the plasma produced by the intense laser light and form a density hole with transverse dimensions comparable to the incident light [1], or can modulate the target surface [2, 3]. Recent measurements with PW class lasers demonstrated that energies of up to 3% of the incident laser energy can be back-reflected in the laser system [2]. Given the foreseen intensities in the ELI-NP experiments in the range of 10^{22}-10^{23} W/cm^2, back-reflections of the main laser pulse can occur from the distorted plasma, leading to damages of the beam transport system optics or even to the laser amplification chain. Due to the large beam diameters of the ELI-NP high-power laser, conventional optical insulators cannot be used [4]. We are therefore investigating the solution of using a single plasma mirror as a back-reflection suppressor. Using the simulated and measured laser temporal contrast profile of the ELI-NP laser, we are presenting the first simulation results in the evaluation of the target behavior and its optimum characteristics necessary to mitigate a back-reflected pulse. A design for the implementation of the plasma mirror setup is also discussed.

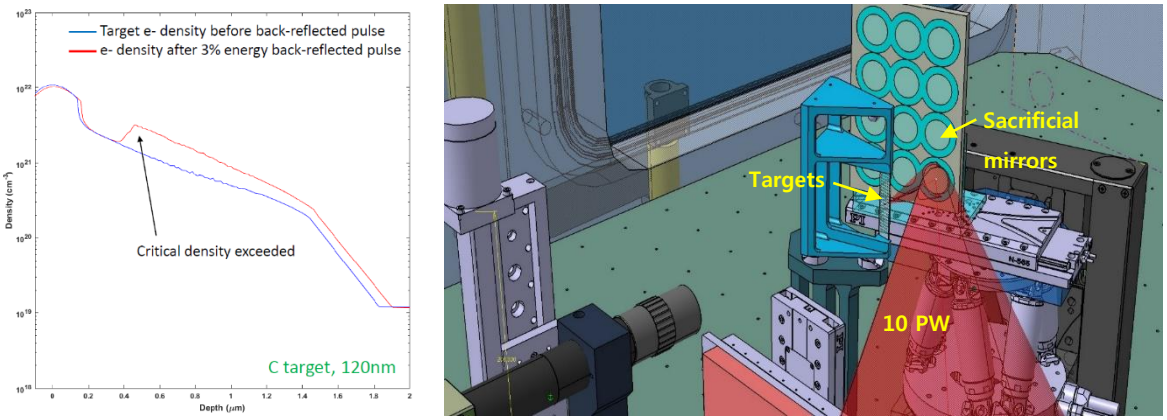

Figure 1. Left: Hydrodynamic simulation of 3% back-reflected 10 PW laser pulse on a thin-film C plasma mirror target. **Right:** Conceptual setup for 10 PW sacrificial mirror solution.

References

[1] W. B. Atwood, et al., Phys. Rev. Lett. **40**, 184 (1978)