Plasma optics for ultra-intense lasers, special targets and structures

Abstract: The maximum achievable intensity of current lasers is limited by the damage threshold to expensive focusing optics. Other components used to influence the temporal and spatial profile of the laser beam, its spectrum or even, for example, the angular momentum are largely limited by the high intensity of laser radiation too. Plasma-based optics offer a way to push this barrier by almost an order of magnitude and maintain the compactness of the entire optical system, as plasma is able to withstand much higher radiation intensities. In this research, we will work with various optical elements based on the use of plasma – e.g. slits, lens, focusing mirror with different relief, foams, etc. The research will be carried out using computationally intensive particle simulations on powerful computational clusters using Particle-in-Cell code EPOCH or Smilei. This research is related to current and future experiments on laser facilities in the Czech Republic and abroad, and the research is carried out in cooperation with ELI Beamlines. The topic is very promising, as evidenced by a number of important and interesting recent publications, e.g. [1-4].

[1] https://doi.org/10.1063/5.0038023

[2] https://doi.org/10.1038/nphoton.2012.284

[3] https://doi.org/10.1063/PT.3.4234

[4] https://doi.org/10.1038/srep23256

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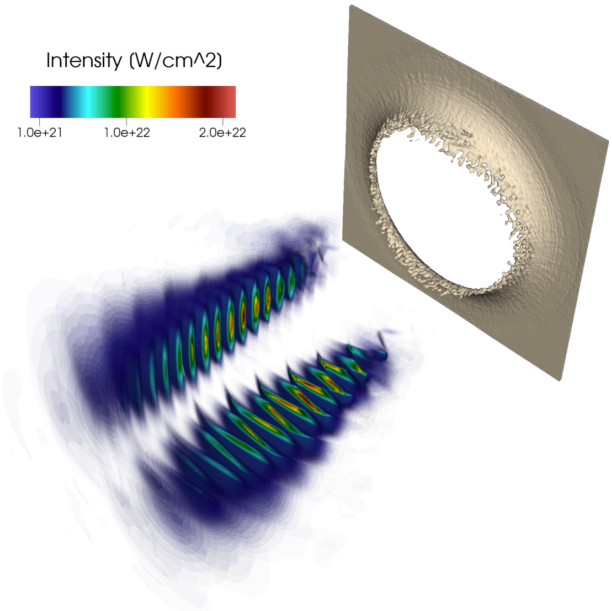

Figure 1: The distribution of laser intensity in the horizontal and vertical slice of the laser pulse after interaction with a very thin film, which works similarly to a narrow slit - 3D simulation (courtesy of Ing.M. Jirka, Ph.D.)