# Simulations of the laser–target interaction under the non-local energy transport conditions with high-order numerical methods

Jan Nikl[1,2], M. Kucharík[2], M. Holec[3], and S. Weber[1]

[1]*ELI-Beamlines, Institute of Physics, Academy of Sciences of the Czech Republic, 18221 Prague, Czech Republic*

[2]*Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University, 11519 Prague, Czech Republic*

[3]*Centre Lasers Intenses et Applications, Université de Bordeaux-CNRS-CEA, UMR 5107, F-33405 Talence, France*

The laser–target interaction for intensities $\lesssim 10^{15}$ W/cm$^2$ takes place under the non-local energy transport conditions in many cases [1]. The mean free paths of the transported species are longer than the characteristic lengths in the plasma given by the temperature gradients. Classical hydrodynamic codes do not cover this important phenomenon or only low order numerical methods are used for the macroscopic description, having insufficient numerical accuracy. These conditions of the interaction have crucial relevance for the PW class laser systems, where such intensities are reached by the main pulse in the context of ICF [2] or they appear in the prepulses of the ultra-high intensity pulses [3]. A combination of high-order numerical methods, including fully non-local description of the heat and radiation transport, is used here to treat properly these conditions. The simulations under typical physical scenarios for the laser facilities are performed and important effects are emphasized.

## References

[1] A. V. Brantov and V. Yu. Bychenkov. Nonlocal transport in hot plasma. Part I. *Plasma Physics Reports*, 39(9):698–744, 2013.

[2] D. Batani, L. Antonelli, G. Folpini, Y. Maheut, L. Giuffrida, G. Malka, Ph. Nicolai, X. Ribeyre, M. Richetta, T. Levato, F. Baffigi, P. Koester, L. Labate, L.A. Gizzi, J. Nejdl, M. Sawicka, D. Margarone, A. Velyhan, M. Krus, O. Renner, M. Smid, E. Krousky, J. Skala, J. Ullschmied R. Dudzak, Ch. Spindloe, T. O'Dell, R.de Angelis, F. Consoliand T. Vinci, M. Rosinski, J. Badziak an T. Pisarczyk, Z. Kalinowska, T. Chodukowski, Y.J. Rhee, A. Marocchino, A. Schiavi, and S. Atzeni. Generation of high pressure shocks relevant to the shock-ignition intensity regime. *Phys. Plasmas*, 21:032710, 2014.

[3] T. Zh. Esirkepov, J. Koga, A. Sunahara, T. Morita, M. Nishikino, K. Kageyama, H. Nagatomo, K. Nishihara, A. Sagisaka, H. Kotaki, T. Nakamura, Y. Fukuda, H. Okada, A. S. Pirozhkov, A. Yogo, M. Nishiuchi, H. Kiriyama, K. Kondo, M. Kando, and S. V. Bulanov. Prepulse and amplified spontaneous emission effects on the interaction of a petawatt class laser with thin solid targets. *Nucl. Instrum. Meth.*, 745:150, 2014.