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I5.014 The shock ignition approach to laser fusion: status and progress

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Direct-drive "Shock Ignition" is an interesting alternative to the classical approach to ICF investigated on NIF and could relax the problems met on the pathway to ignition. In the conventional approach, hot electrons (HE) are dangerous because they induce target preheating making compression more difficult. In SI, however, HE generated by the final laser spike at the end of compression, when the accumulated target <rho r> is large enough, may increase lasertarget coupling and strengthen the shock with a positive impact. Hence, their characterization is crucial for assessing SI feasibility. Within the Enabling Research EUROfusion Project "Preparation and Realization of European Shock Ignition Experiments", we are conducting experiments in Europe and the US to contribute answering these open questions.
At the PALS laboratory in Prague we characterized HE produced by high-energy laser pulses of 300 ps at 1st and 3rd harmonics of the iodine laser (wavelength = 1315/438 nm, focused to intensities 9x10^15 / 2x10^16 W/cm^2). We studied the correlation of HE and Stimulated Raman Scattering (SRS) and assessed the impact of HE on target preheating and on shock dynamics. Results were compared to advanced hydro simulations done with the code CHIC that takes into account parametric instabilities and HE in a self-consistent way. At the Omega EP facility in Rochester, we characterized HE by X-ray imaging and spectroscopy and evaluated their impact on preheating and shock dynamics by time-resolved X-ray radiography. Finally, the addition of an external magnetic field (MIFED device) affected HE trajectories affecting their capability of penetrating into the target. A significant effort was also done to optimize diagnostics, including time-resolved X-ray radiography (experiments at LULI and GEKKO), shock breakout diagnostics (LIL facility) and X-ray phase contrast imaging (Phelix laser).
This work contributed to our understanding of SI physics but also to consolidate a European research network on IS, serving as preparation for future experiments to be done on the LMJ/PETAL laser facility at the relevant energy scale.

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