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Laser induced pellet fusion based on ultrarelativistic heavy ion physics

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Inertial Confinement Fusion is a promising option to provide massive, clean, and affordable energy for humanity in the future. The present status of research and development is hindered by hydrodynamic instabilities occurring at the intense compression of the target fuel by energetic laser beams. A recent proposal Csernai et al. (2018) combines advances in two fields: detonations in relativistic fluid dynamics and radiative energy deposition by plasmonic nano-shells. The initial compression of the target pellet can be eliminated or decreased, not to reach instabilities. A final and more energetic laser pulse can achieve rapid volume ignition, which should be as short as the penetration time of the light across the target. In the present study, we discuss a flat fuel target irradiated from both sides simultaneously. Here we propose an ignition energy with smaller compression, largely increased entropy and temperature increase, and instead of external indirect heating and huge energy loss, a maximized internal heating in the target with the help of recent advances in nanotechnology. The reflectivity of the target can be made negligible, and the absorptivity can be increased by one or two orders of magnitude by plasmonic nano-shells embedded in the target fuel. Thus, higher ignition temperature and radiation dominated dynamics can be achieved. Here most of the interior will reach the ignition temperature simultaneously based on the results of relativistic fluid dynamics. This makes the development of any kind of instability impossible, which up to now prevented the complete ignition of the target.

Primary authors: Prof. CSERNAI, Laszlo Pal (University of Bergen); STOCKER, H (Frankfurt Institute for Advanced Studies, Frankfurt/Main, Germany); SATAROV, L.M. (National Research Center "Kurchatov Institute" Moscow, Russia)

Co-authors: MISHUSTIN, Igor (Goethe University); Mr MOTORNENKO, Anton (Frankfurt Institute for Advanced Studies); PAPP, Istvan (University of Babeş-Bolyai); CSETE, M (Dept. of Optics and Quantum Electronics, Univ. of Szeged, Hungary); KROO, N (Hungarian Academy of Sciences, Budapest, Hungary)

Presenter: Prof. CSERNAI, Laszlo Pal (University of Bergen)

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