AAPPS-DPP 2018 Plenary speaker Name: Prof. Xian-Tu He
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Rationale: Even though tremendous new progresses have been made on NIF, SGIII and other large laser facilities, realization of inertial confined fusion (ICF) ignition remains a significant challenge for the whole community. With the most well-studied central hotspot ignition scheme driven by indirect-drive (ID) approach, the peak ablation pressure is confined to ~100Mbar as shown in NIF experiments, which limits the implosion velocity to a low level, and therefore, the hotspot has to perform ignition in the stagnation stage. In this case, a high convergent ratio of over 40 (outer radius to hotspot radius) is requested, thus leading to severe hotspot deformation and hydrodynamic instabilities from any minor target asymmetry practically unavoidable during implosion dynamics. This is the main reason why the hotspot ignition scheme does not succeed so far even after several decades' efforts worldwide. Obviously, new ignition schemes are highly desired currently to push this area forward.

Recently, Prof. X. T. He's team have proposed a new hotspot-ignition scheme by hybrid-drive (HD) approach that combines both indirect-drive (ID) and direct-drive (DD) in two stages. This scheme, in two phases, first produces a long-scale ID corona plasma, so that the nonuniformity of the supersonic-electronic-thermal wave generated by DD lasers at critical surface is significantly smoothed. The resulting HD plasma pressure is far higher than the ID radiation ablation pressure. This HD plasma pressure drives an implosion velocity as high as over 400km/s, such that severe hotspot deformation and hydrodynamic instabilities can be greatly suppressed, resulting in non-stagnation hotspot ignition in a convergent ratio less than 25 (more details are illustrated in abstract). Recently, they have carried out a few experiments, which have verified the effects of boosted HD plasma pressure and supersonic-electronic-thermal wave smoothing in long-scale ID corona plasma on the SG-III laser facility, which pave a way for full demonstration of the HD approach in the future. We strongly believe that this is a significant and original contribution to the ICF research and it will attract broad interest to plasma physics community. Therefore, the proposed talk by Prof. He and his colleagues is well deserved for a plenary talk.

Talk Title: Design and experimental progress of hybrid- drive ICF ignition on SG-III laser facility

Short abstract: The hotspot-ignition scheme for ICF by hybrid-drive (HD) approach combines both laser indirect drive (ID) and direct drive (DD) stages [1-3]. Firstly a layered capsule is ablated by lower ID radiation temperature, which results in the pre-compression of fusion fuel and also the formation of a long-scale corona plasma. Later, the DD lasers are incident upon, which are absorbed near the critical surface and meanwhile generate a supersonic electronic-thermal wave (ETW). This ETW is significantly smoothed during propagating in the long-scale ID corona plasma, which slows down later to a sonic ETW and behaves like a "snowplow" that piles up the low corona plasma density into high density platform between sonic wave front and the ID ablation front. The resulting HD plasma pressure is far higher than the ID ablation pressure found in the well-studied ID scheme. The HD plasma pressure provides PdV work large enough to the hotspot, resulting in non-stagnation ignition. In this talk, we will present the 2D design with the convergent ratio less than 25. Related experimental demonstration of the boosted HD plasma pressure and the smoothing effect of the supersonic ETW carried out recently on SG-III laser facility will be reported.

List of related published papers

1. X. T. He, J. W. Li et al., A hybrid-drive nonisobaric-ignition scheme for inertial confinement fusion, Phys. Plasmas 23, 082706 (2016).
2. X.T. He, "The updated advancement of progress in China", J. Phys.: Conf. Series 688, 012029 (2016).
3. Ke Lan, X.T. He, et al., Octahedral spherical hohlraum and its laser arrangement for inertial fusion, Phys. Plasmas 21, 052704 (2014).