FAST IGNITION STUDIES AT OSAKA UNIVERSITY

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ABSTRACT

After the invention of the chirped pulse amplification technique [1], the extreme conditions of matters have become available in laboratory spaces and can be studied with the use of ultra-intense laser pulse (UILP) with a high energy. One such example is the fast ignition [2] where UILP is used to heat a highly compressed fusion fuel core within 1-10 pico-seconds before the core disassembles. It is predicted possible with use of 50-100 kJ lasers for both imploding the fuel and heating [2] to attain a large fusion gain. Fast ignition was shown to be a promising new scheme for laser fusion [3] with a PW (= 10^{15} W) UILP and GEKKO XII laser systems at Osaka. Many new physics have been found with use of UILP in a relativistic parameter regime during the process of the fast ignition studies. UILP can penetrate into over-dense plasma for a couple hundred microns distance with a self-focusing and relativistic transparency effects. Hot electrons of 1-100 MeV can be easily created and are under studies for its spectral and emission angle controls. Strong magnetic fields of 10's of MGauss are created to guide these hot electrons along the target surface [4]. Based on these results, a new and largest UILP laser machine of 10 kJ energy at PW UILP peak power is under construction to test if we can achieve the sub-ignition fusion condition at Osaka University. The machine requires challenging optical technologies such as large size (0.9 m) gratings, tiling these gratings for UILP compression; segmenting four large UILP beams to obtain diffraction limited focal spot. We would like to over-view all of these activities.

References

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