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# Novel high-power and high-efficiency OEC laser-based high-gain shock ignition IFE reactor

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Blue Laser Fusion (BLF) aims to realize a laser fusion power reactor in the 2030s. We are focusing on three areas of innovation: high-pulse energy laser systems capable of delivering up to 10 MJ at high repetition rates of 1-10 Hz, high energy gain target designs, and reactor system design and implementation. We are developing a modular pulsed laser system with energy storage in an optical enhancement cavity (OEC) injected with a coherent beam combining (CBC) fiber-amplified laser system. The OEC is a Fabry-Perot cavity designed to store a large amount of energy in a two-mirror cavity by carefully synchronizing the round-trip time of the intracavity laser pulse with the next injected laser, achieving phase matching and stacking of the laser pulses. In collaboration with the California Institute of Technology and Osaka University, we have successfully demonstrated a 1.5m operating OEC. A 15 m OEC is currently under construction. Pulsed operation and CBC-OEC integration are being implemented to further scale the pulse energy towards 10kJ, and plans are underway to build a 150 m cavity. By combining multiple OECs and input lasers, this architecture can achieve effectively broader spectral width, engineered polarization, high spatial beam quality, and precise pulse timing optimized for direct-drive IFE target implosion and fusion ignition with the high-gain shock ignition (SI) scheme, where the spike pulse intensities larger than 1015 W/cm2 exceed the threshold intensity of laser-plasma instabilities (LPIs), such as stimulated Raman scattering (SRS) and two-plasmon decay (TPD), generating many hot electrons. However, hot electrons below 100 keV strengthen the shock wave. Crossbeam energy transfer (CBET) driven by stimulated Brillouin Scattering (SBS) can also be minimized, improving laser absorption. In collaboration with UCSD, we are investigating how to control LPIs of overlapped multiple laser beams regarding wavelength dependence, including adequate bandwidth and polarization dependence. We are proceeding with our IFE reactor design utilizing our new technologies above.

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