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Versatile Joule-class OPA as front-end laser for inertial fusion research

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The strategy to achieve high gain in Inertial Confinement Fusion (ICF) necessitates flexible laser beamlines capable of delivering diverse temporal characteristics at the kJ energy level. While direct drive target compression demands broad-bandwidth nanosecond pulses, specific ignition schemes require short pulses to generate penetrating particles. Consequently, advanced spectral management is critical in both regimes.
In this work, we present a versatile, multi-Joule front-end solution based on Optical Parametric Amplification (OPA). This system leverages two proprietary pump lasers specifically optimized for OPA applications: a high-repetition-rate unit (3J at 5–10Hz, 532nm) and a high-energy unit (>30J at 1 shot/min, 527nm). Both lasers deliver top-hat beam profiles with a high Strehl ratio, ensuring ideal conditions for OPA pumping. Furthermore, they feature adjustable temporal shaping (3–20ns) and are available in circular or square beam formats. We will demonstrate how this modular OPA architecture offers the necessary parameter flexibility for both short- and long-pulse operations in next-generation research facilities

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