

High-Power MIR Lasers for Strong Field Experiments

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While most strong-field experiments have traditionally been restricted to the near-infrared (NIR) regime (0.8–1 μm), theoretical models suggest that many physical processes scale more favorably at longer wavelengths [1]. Driven by this potential, high-power short-wave and mid-infrared (MIR) lasers have recently emerged as indispensable tools for investigating wavelength-scaling laws across strong-field atomic, molecular, and plasma physics. We have demonstrated a femtosecond chirped-pulse amplifier (CPA) leveraging Cr:ZnSe and Fe:ZnSe gain media [2]. To achieve few-cycle pulses, the CPA output was spectrally broadened in a gas-filled hollow-core fiber (HCF) and subsequently compressed using bulk materials for dispersion compensation [3]. Furthermore, we developed a compact, high-repetition-rate optical parametric chirped-pulse amplifier (OPCPA) based on ZGP crystals, pumped by a 2- μm CPA system [4]. Given current developmental trajectories, the peak power of MIR femtosecond lasers is projected to reach the terawatt (TW) level in the near future, opening new frontiers for relativistic plasma experiments.

References

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