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Development of High Peak and Average Power Tm:YLF Lasers

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Lasers capable of generating petawatt-class peak powers at kHz repetition rates are needed for future laser wakefield accelerators (LWFAs) and could have far reaching impacts in industry, medicine and national security. We present the development of Tm:YLF laser technology including joule-level short pulse amplification and gas-cooling at high average power in two separate experiments. We show chirped pulse amplification (CPA) producing stretched broadband pulses up to 1.59J pulse energy centered at 1.88 μ m and subsequent compression to sub-300fs pulses which demonstrates Tm:YLF's short pulse amplification capability. Shorter, sub-150fs, pulse compression may be possible by addressing gain narrowing. We also show heat removal surpassing 20 W/cm² from a diode-pumped, gas-cooled slab which demonstrates Tm:YLF's average power capability. These results represent an order of magnitude higher heat extraction than any laser material currently employed in petawatt-class systems to-date, showing that a gas-cooled amplifier head geometry supports multi-kW operation. These results along show the potential suitability of Tm:YLF based lasers for drivers of future laser plasma acceleration, including specifically for LWFA drivers.

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Working group

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