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Status and perspectives of multi-terawatt long-wave infrared lasers for particle acceleration research

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Recent years have seen growing interest within the laser particle acceleration community in laser sources operating at wavelengths substantially longer than the ˜1 μm typical of present-day facilities. This renewed focus is fueled by recent advancements in powerful mid- and long-wave infrared (M/LWIR) laser sources. While fundamental advantages, such as the λ2-scaling of ponderomotive potential and the 1/λ2-scaling of critical plasma density, have long been recognized, the emergence of improved laser technologies has made their practical exploitation more accessible and compelling.
The backbone of a 5-TW 9.2-μm laser system at BNL ATF is a series of high-pressure CO2 amplifiers, where we have pioneered several novel techniques. These include the use of mixed-isotope active media, a solid-state frequency-conversion-based seed source, and the implementation of chirped-pulse amplification in a gas laser system for the first time. A recent breakthrough in this effort is the development of a reliable bulk-material post-compression scheme, which is now being prepared for full-scale deployment.
We report on the current status of our work and discuss the prospects for this field.

Footnotes

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