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Heat-induced deformation of compressor gratings and resulting spatio-temporal couplings

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Today's laser-plasma accelerators are driven by terawatt-class laser systems at a few-Hz repetition rates and few-Joule pulse energies. Typically, the architecture of these systems includes a compressor based on in-vacuum gold-coated gratings, which absorb a percent-level fraction of the incident laser energy. However, as laser technology pushes the limit towards higher repetition rates and operation at higher average power, the energy absorbed in the compressor becomes a severe issue: the heat-induced deformation of the gratings changes the spatial and temporal properties of the laser beam during high-power operation, which can in turn drastically decrease the peak intensity on target, as well as degrade the quality of the accelerated electron beams. Here, we present experimental studies on the impact of heat-induced grating deformation and report on the wavefront and pulse degradation on target.

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