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Self-aligning concave relativistic plasma mirror with ultrafast adjustable focus HAI-EN TSAI, Univ of Texas, Austin, ALEXEY AREFIEV, Institute for Fusion Studies, Univ of Texas, Austin, JOSEPH SHAW, Univ of Texas, Austin, DAVID STARK, Institute for Fusion Studies, Univ of Texas, Austin, XIAOMING WANG, RAFAL ZGADZAJ, MICHAEL DOWNER, Univ of Texas, Austin, UNIV OF TEXAS, AUSTIN TEAM, INSTITUTE FOR FUSION STUDIES, UNIV OF TEXAS, AUSTIN TEAM — Plasma mirrors (PMs) excited at sub-relativistic intensity ($<10^{18}$W/cm^2) are widely used to improve the temporal contrast of ultrashort laser pulses that are subsequently focused to ultra-relativistic intensity. However, new applications demand PMs that reflects efficiently with high beam quality when excited directly at relativistic intensity. We report a quantitative laboratory study of space-/time-integrated and space-/time- resolved reflectivity of PMs excited by high-contrast, 30 fs, 800 nm relativistically intense laser pulses. We observe high reflectivity (>0.8) for intensities up to 5x10^{18}W/cm^2, provided laser contrast exceeds 10^4 at 1 ps and angle of incidence is less than 5°. Particle-in-cell simulations suggest that sharp drops observed outside these limits are caused by refocusing of reflected light outside the collection optics due to depression of the reflecting surface by light pressure (deformation, usually a concave curvature) and self-induced relativistic transparency. Furthermore, the reflected relativistic intensity can be enhanced multiple times and the second focus position can be adjusted in the range of few tens of micron away from PM surface by controlling the contrast at 1 ps.

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