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Bound-Free Transitions to GeV Energy via Optical Tunneling
DANIEL GORDON, Naval Research Laboratory — Many laser plasmas are created through the mechanism of tunneling ionization. For weakly to moderately relativistic laser amplitudes ($a = eA/mc \approx 1$), the photoelectron spectrum can extend to the MeV range, with the electron gaining approximately the ponderomotive potential at the position where the bound-free transition occurred. When $a \approx 100$, a new regime of acceleration appears, in which ultrarelativistic energy is obtained in a fraction of an optical cycle. We compute photoelectron characteristics based on relativistic tunneling ionization rates, and advanced particle tracking simulations, utilizing state-of-the art computer hardware. It is found that using near-term multi-petawatt lasers, free space acceleration from rest to GeV energy is possible. The effect of radiation reaction is also examined.

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