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QED-driven laser absorption MATTHEW LEVY, Univ. of Oxford, T BLACKBURN, Chalmers Univ. of Technology, N RATAN, J SADLER, Univ. of Oxford, C RIDGERS, Univ. of York, M KASIM, L CEURVORST, J HOLLOWAY, Univ. of Oxford, M BARING, Rice Univ., A BELL, Univ. of Oxford, S GLENZER, SLAC National Accelerator Laboratory, G GREGORI, Univ. of Oxford, A ILDERTON, M MARKLUND, Chalmers Univ. of Technology, M TABAK, S WILKS, Lawrence Livermore National Lab., P NORREYS, University of Oxford
— Absorption covers the physical processes which convert intense photon flux into energetic particles when a high-power laser (I $>10^{18}$ W cm^{-2} where I is intensity at 1μm wavelength) illuminates optically-thick matter. It underpins important applications of petawatt laser systems today, e.g., in isochoric heating of materials. Next-generation lasers such as ELI are anticipated to produce quantum electrodynamical (QED) bursts of γ-rays and anti-matter via the multiphoton Breit-Wheeler process which could enable scaled laboratory probes, e.g., of black hole winds. Here, applying strong-field QED to advances in plasma kinematic theory, we present a model elucidating absorption limited only by an avalanche of self-created electron-positron pairs at ultra-high-field. The model, confirmed by multidimensional QED-PIC simulations, works over six orders of magnitude in optical intensity and reveals this cascade is initiated at 1.8 x 10^{25} W cm^{-2} using a realistic linearly-polarized laser pulse. Here the laser couples its energy into highly-collimated electrons, ions, γ-rays, and positrons at 12%, 6%, 58% and 13% efficiency, respectively. We remark on attributes of the QED plasma state and possible applications.

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