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Trapping, dark current, and wavebreaking in nonlinear plasma waves

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Authors
Schroeder, Carl
Esarey, Eric
Shadwick, Brad
et al.

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Trapping, dark current, and wavebreaking in nonlinear plasma waves\textsuperscript{1} CARL SCHROEDER, ERIC ESAREY, BRAD SHADWICK, WIM LEEMANS, Lawrence Berkeley National Laboratory — The trapping of thermal electrons in a nonlinear plasma wave of arbitrary phase velocity is investigated. The threshold plasma wave amplitude for trapping plasma electrons is calculated, thereby determining the fraction trapped and the expected dark current in a plasma-based accelerator. It is shown that the presence of a laser field (e.g., trapping in the self-modulated regime of the laser wakefield accelerator) increases the trapping threshold. The maximum amplitude of the nonlinear plasma wave (i.e., the wavebreaking field) is calculated for arbitrary phase velocity and initial plasma temperature, and the relation between trapping and wavebreaking is discussed. Implications for experimental and numerical laser-plasma studies of trapping in plasma waves are presented.

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