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Beam loading in the blowout regime of laser/plasma wakefield acceleration.[1] MICHAIL TZOUFRAS, WEI LU, CHENGKUN HUANG, FRANK TSUNG, WARREN MORI, UCLA, JORGE VIEIRA, RICARDO FONSECA, LUIS SILVA, IST (Portugal) — The amount of charge, the final energy, and the quality of the charged particle beam that is generated from a plasma-based accelerator depends on how the charge is loaded into the wake. In recent experiments the wakes are created by either the radiation pressure of the laser or the space-charge force of the electron beam expelling the plasma electrons outward. We present a theory for beam loading valid for such nonlinear multi-dimensional wakes. We start from the equation for the blowout radius derived by Lu et al. [1]. Analytical solutions are found for this equation when the wake is loaded by flat-top or trapezoidal electron beams. As a result expressions for the accelerating field, the shape of the bubble and the amount of charge are obtained. These are compared to those predicted by the linear theory of Katsouleas et al. [2]. We also discuss the optimum current profile to minimize the final energy spread while maximizing the mean energy and the number of particles. [1] W. Lu et al, Phys. Rev. Lett. 96, 165002 (2006). [2] T. Katsouleas et al, Particle Accelerators, 1987, Vol. 22, pp. 81-99.

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