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Nonlinear Theory for Relativistic Plasma Wakefields in the Blowout Regime WEI LU, CHENGKUN HUANG, MIAOMIAO ZHOU, MICHAIL TZOUFRAS, FRANK TSUNG, UCLA, TOM KATSOULEAS, USC, WARREN B. MORI, UCLA, UCLA TEAM — We present a theory for nonlinear, multidimensional plasma waves with phase velocities near the speed of light. It is appropriate for describing plasma waves excited when all electrons are expelled out from a finite region by either the space charge of a short electron beam or the radiation pressure of a short intense laser. It works very well for the first bucket before phase mixing occurs. We separate the plasma response into a cavity or blowout region void of all electrons and a sheath of electrons just beyond the cavity. This simple model permits the derivation of a single equation for the boundary of the cavity. It works particularly well for narrow electron bunches and for short lasers with spot sizes matched to the radius of the cavity. It is also used to describe the structure of both the accelerating and focusing fields in the wake. Beam loading is also considered with this model.

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