Relativistic current driven nonlinear Langmuir structure in plasmas

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The nonlinear stationary states of a relativistic electron beam moving in a homogeneous positive background are calculated for the full range of amplitudes of a longitudinal self-induced electric field in the collision less limit. The parameter that controls the system is the ratio of the electrostatic energy of the fluctuations over the kinetic energy of the beam (k). In the collision less limit it might be that the number density of electrons and velocity of the beam in the stationary case are constant. If $k > 2$ it is shown that no wave breaking occurs. Instead, the electric field becomes discontinuous at certain points and the electrons delay there forming periodic electrostatic (Langmuir) structures centered around negatively charged planes. The size and charge of the above structures as well as their wavelength, which now depends on the ratio of the electrostatic energy of the fluctuations over the kinetic energy of the beam, are derived.

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