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Space charge solitary waves in warm charged particle beams in resistive wall transport channels

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Abstract

In this article, a one-dimensional kinetic model is used to obtain space charge solitary waves in a beam of hot charged particles into a transmission channel with a resistance wall of radius r_w. The axial electric field is obtained as $\langle E_z^s \rangle = -\frac{g_0 e_b \partial \lambda_b}{\partial z} - \frac{g_2 e_b r_w^2 \partial^3 \lambda_b}{\partial z^3}$, where g_0 and g_2 are geometric constants. In addition, due to the resistance of the wall, an electric field E_w appears. The moments of the Vlasov equation for the water bag distribution function are converted into fluid equations and these fluid equations are reduced to the kdv equation using the reduced perturbation method. The shape of the fast and slow space charge solitary waves caused by the beam of hot charged particles in the presence of wall resistance is obtained by numerically examining the KdV equation at different times. Finally, it is revealed that with the increase of the wall resistance, the growth(attenuation) rate of the relative amplitude of the slow (fast) space charge soliton waves caused by the beams of charged particles increases.

Keywords: particle beam, space-charge, solitary wave, reductive perturbation, stability, instability, fluid model

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