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Obliquely Propagating Nonlinear Electrostatic Waves with (r, q) Distributed Electrons in Multicomponent Space Plasmas

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Electron velocity distributions (EVDs) with a flat top at low energy and/or an enhanced tail at high energies are commonly observed in Earth's magnetosphere and solar wind. Noteworthy is the fact that only (r,q) distribution with two spectral indices may fit such observed flat top distributions. At low energies, both the kappa and Maxwellian distributions are unable to fit the observed EVDs. In the limiting cases, r = 0, q → ∞ , r = 0, q = (κ+1), r > 0, q→∞ , (r,q) distribution reduces the Maxwellian, kappa and Druyvesteyn-Davydov distributions. In the current model, electrons are treated as (r,q) distributed and Sagdeev potential is derived for multicomponent plasma by considering fully nonlinear fluid equations for electrostatic waves. We analyzed the properties of solitary structures using observed plasma parameters and values of r and q indices that matched with the reported values. It becomes apparent that the propagation features of solitary structures differed evidently from those based upon Maxwellian or kappa EVDs.