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Free boundary ion temperature gradient mode theory and the nonneutral effects

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Abstract

It has been known that the free boundary condition can lead the electromagnetic interchange modes to become the peeling modes. However, the free boundary theory for electrostatic modes remains to be developed. Especially, as is known, due to the finite ion orbit size effects there are excess electrons at tokamak edge. It is also interesting to know how these nonneutralized edge electrons affect the free boundary electrostatic modes. In this work we present the free boundary ion temperature gradient mode theory with the nonneutral effects included. Both the "slab" and "toroidal" branches in the toroidal geometry are investigated. The multiple region matching and asymptotic analyses are performed to derive the dispersion relation. The nonneutral effects are included to extend the electrostatic drift wave theory beyond the usual quasi-neutrality condition. The detailed theoretical framework will be described and the results will be discussed.