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Plasma Instabilities Driven by Electron and Proton Ring Distributions

Peter H. Yoon[1], Sang-Yun Lee[2], Sunjung Kim[3]
[1] University of Maryland College Park, USA, [2] NASA GSFC, USA, [3] Kyung Hee University, Korea
e-mail: yoonp@umd.edu

The charged particles trapped in the planetary magnetospheres are characterized by a loss-cone feature. The perpendicular ring velocity distribution function is an ideal form of loss-cone distribution. The electrons and ions featuring the ring velocity distribution functions are unstable to a number of plasma instabilities, including the quasi-parallel cyclotron instabilities and quasi-perpendicular or obliquely-propagating multiple-harmonic cyclotron instabilities. For the electron instabilities, the multiple-harmonic, or Bernstein mode instabilities with typically peak wave intensities in the vicinity of the upper-hybrid frequency, are well known [e.g., 1], and excitation of such instabilities are observed by artificial satellites. For the protons featuring a perpendicular ring distribution, it is also well known that these are associated with the excitation of multiple-harmonic magnetosonic modes [e.g., 2]. The present paper overviews the linear and quasilinear theories of these ring-driven instabilities, and validation of the quasilinear analysis by particle-in-cell or hybrid-code simulation will be discussed. Applications to planetary magnetospheric observations such as those measured via Juno satellite in the Jovian magnetosphere [3] will be mentioned as well.

References

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