EVOLUTION OF INSTABILITY AND ASSOCIATED PARTICLE LOSS IN THE RADIATION BELTS

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Abstract Submission Form

2004 National Radio Science Meeting

Abstract: ganguli26893

Date Received: September 24, 2004

In 1970 Brice [1] noted that it is possible to artificially enhance the energetic particle precipitation rate in the radiation belts by injecting chemicals. Ionization of the released chemicals results in the formation of an ion ring distribution perpendicular to the ambient magnetic field. Such an ion distribution is highly unstable to both electrostatic and electromagnetic instabilities. The objective of this study is to compare the possible electrostatic and electromagnetic instabilities that may be generated by such ion distributions, assess their properties, and quantify the parametric domains and conditions where particular modes dominate. The quasi-stationary instability spectra that result in enhanced loss of ions driven by a fresh supply of ring ions through ionization are analyzed for typical inner radiation belt environments. Conditions under which the electrostatic modes that correspond to the fastest growing modes of the ion ring distribution can be stabilized by by Landau damping of the ambient plasma are identified. This allows the electromagnetic modes to dominate since they are not subjected to Landau damping. The threshold density and other parameters that result in predominance of electromagnetic modes and their role in particle loss mechanisms in the radiation belts will also be discussed. * This work is supported by ONR

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2. H - Waves in Plasma
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4. C - Contributed Paper, Program chair: G. Ganguli
5. No special instructions