Geophysical Research Abstracts
Vol. 13, EGU2011-5344, 2011
EGU General Assembly 2011

Fundamental aspects of beam-generated plasma radiation

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Studies on the generation of plasma radiation by electron beams are of current interest since the beginning of the spacecraft era in the sixties. The observed emission in the form of auroral hiss, AKR and Type III bursts, for example, are related to whistler and free-space modes. There still remains a sufficiently unresolved problem concerning the mechanism which converts the primary excited electrostatic modes at relatively large wave numbers into a phase velocity regime where the electromagnetic waves may propagate without significant damping over large distances. This question is considered using the example of auroral hiss for which an enormous amount of measurements have been made on Earth and other planets; at least at Saturn by Cassini. Starting from fluid and kinetic dispersion analysis of beam-excited whistler and Langmuir waves, kinetic (PIC) simulations have been done for auroral conditions. It has clearly been demonstrated that a nonlinear shift from large to small wave numbers takes place which, at last, is associated with an accumulation of magnetic energy at the point where phase and group velocity coincide. This so-called GSS point plays a crucial role in the interpretation of the hiss time-frequency spectrum which often appears as a characteristic funnel shaped envelope.