A New Cyclotron Maser Mechanism Observations and Theory

This paper is part of the following report:
TITLE: International Conference on Phenomena in Ionized Gases [26th]
Held in Greifswald, Germany on 15-20 July 2003. Proceedings, Volume 4

To order the complete compilation report, use: ADA421147

The component part is provided here to allow users access to individually authored sections
of proceedings, annals, symposia, etc. However, the component should be considered within
the context of the overall compilation report and not as a stand-alone technical report.

The following component part numbers comprise the compilation report:
ADP014936 thru ADP015049
We present a new cyclotron maser type instability driven by a crescent or horseshaped electron distribution function. Such distribution functions are easily created by an electron beam moving into a stronger magnetic field region, where conservation of the first adiabatic invariant causes an increase in their pitch angle. This produces a broad region on the distribution function where there is a +ve slope in the perpendicular component of the velocity space distribution function. Planetary dipole magnetic fields are examples of where these types of distributions can be found, giving rise for example to the earth's auroral kilometric radiation and Jupiter's decametric radiation signatures.

We examine the stability of these electron horseshoe distribution functions for right-hand extraordinary mode (R – X mode) radiation close to the electron cyclotron frequency propagating perpendicular to the magnetic field using both non-relativistic and relativistic beams. A quasi-linear theory is developed which is used to analyze the saturation process. Saturation occurs when the perpendicular slope in velocity space forms a plateau. This provides an estimate of the efficiency of such a process. Calculations suggest that efficiencies as high as 20% can be achieved. Finally, a laboratory experiment to investigate this new type of instability will be discussed.