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Theory of Horseshoe Maser Instability I. VORGUL, A. CAIRNS, Umiversity of St Andrews, R. BINGHAM, Rutherford Appleton Laboratory, K. RONALD, A. PHELPS, A. CROSS, D. SPEIRS, S. MCCONVILLE, University of Strathclyde — When a beam of electrons with a thermal spread moves along converging magnetic field lines, the distribution function evolves into a horseshoe shape in ($p_{\|}$, $p_{\perp}$) space. In such a distribution there is a population inversion of particles in perpendicular momentum which results in the plasma being subject to a cyclotron maser instability. There is strong evidence that this type of instability is the source of auroral kilometric radiation. The theory of the instability indicates that the phenomenon can be scaled to laboratory dimensions, with centimetre rather than kilometre wavelengths, and an experiment to do this has been constructed at the University of Strathclyde (see the paper of S D.C. Speirs et al at this conference). Recently we have carried out an analysis of this horseshoe instability in cylindrical geometry and have shown that the predicted growth rate is in line with what is seen in simulations and sufficient to account for growth of the instability within the dimensions of the experiment. Here we extend the analysis in order to understand in more detail the properties of the dispersion relation and attempt to relate these properties to experimental observations in both the laboratory and space. Theory predicts high growth rate of several spatial modes propagating almost perpendicularly to the electrons motion, with quasi-TE mode structure and sharp spectrum with a resonance at the frequency just below the cyclotron frequency.

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