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Laboratory investigation of cyclotron emission processes for Auroral Radiation

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When a beam of electrons encounters an increasing magnetic field along its vector of motion, conservation of the magnetic moment results in the formation of a crescent or horseshoe shaped velocity distribution. A scenario analogous to this occurs in the terrestrial auroral zone where particles are accelerated into the polar regions of the Earth's magnetic dipole and expand adiabatically in velocity space. The resultant horseshoe shaped velocity distribution has been shown to be unstable with respect to a cyclotron-maser type instability. This instability has been postulated as the mechanism responsible for auroral kilometric radiation and thermal radiation from other astrophysical bodies. In this paper we present the results of recent numerical simulations and laboratory investigations of radiation emissions from electron beam which have been subject to magnetic compression. Electron beam diagnostics demonstrated the formation of the desired velocity distribution. Radiation was generated at both 11.7GHz and 4.45GHz by an electron beam of current 5-25A and energy 75kV subject to magnetic compression ration of up to 30. Conversion efficiencies between beam and radiation power were achieved of up to 2.5% and strong agreement was achieved between the numerical investigations and the experimental measurements.