# IMPACT OF BACKGROUND PLASMA ON CYCLOTRON RADIATION EMISSION PROCESSES

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In the polar regions of the Earth's magnetosphere, particles descend into an increasing magnetic field. Conservation of magnetic moment leads to the formation of a horseshoe shaped velocity distribution through magnetic compression. A cyclotron maser instability driven by the horseshoe distribution is thought to be the generation mechanism of Auroral Kilometric Radiation (AKR). A laboratory simulation of this process (scaled to the microwave range by increasing the cyclotron frequency) was created at Strathclyde. Measurements of the radiation conversion efficiency, mode and spectral content from the experiment were in close agreement with numerical predictions and satellite observations in the magnetosphere. Experiments were carried out at a cyclotron frequency of 4.42GHz using a 12A electron beam of energy 75keV, [1]. Measurements of the output antenna pattern determined the total output power and mode content. The peak microwave output power obtained experimentally was 19kW corresponding to an emission efficiency of 2%. This result compared well with those predicted numerically using the 2D PiC code KARAT [2], with an output power of 20kW and RF conversion efficiency of 2% for the same interaction parameters.

Recently a Penning trap was constructed and inserted into the interaction region of the experiment to generate a background plasma. This arrangement allows better comparisons to be made with the astrophysical conditions. Measurements will be presented of plasma electron temperature, density and plasma frequency using an electrostatic and RF probe. Due to the reduced radial dimensions of the Penning trap, the $TE_{01}$ resonant cyclotron frequency has been increased to ~5.21GHz. To date, initial measurements have yielded electron temperatures of $\sim 10^4$K, number densities of $\sim 10^{14}m^{-3}$ and a plasma frequency of ~150MHz to 250MHz. Preparations are currently underway for the injection of an electron beam into the Penning trap to obtain cyclotron resonant energy transfer.

1. S. L. McConville et al, "Demonstration of auroral radio emission mechanisms by laboratory experiment", PPCF, 2008, **50**, 074010.
2. D. C. Speirs et al, "Numerical simulation of auroral cyclotron maser processes", PPCF, 2008, **50**, 074011.