CYCLOTRON RADIOMETER BASED ON LOW-COST, SUCCESSIVE DETECTION LOGARITHMIC AMPLIFIER ELECTRON

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A new electron cyclotron emission (ECE) radiometer has been designed, constructed and tested on the Maryland Centrifugal Experiment (MCX) [1]. The receiver was based on the Analog Devices AD8310, which is a successive detection logarithmic amplifier capable of direct RF down-conversion with >95 dB of dynamic range. This integrated circuit was chosen because of its low noise floor, excellent logarithmic accuracy (+/- 0.4 dB) and fast video response (15 ns rise time). The capabilities of this integrated circuit made it possible to design a very low cost ECE radiometer using a minimal number of components but with exceptional performance characteristics. The design, construction and initial testing of the ECE radiometer was performed over the summer of 2009 as an REU research project at the University of Maryland. These instruments have been employed for many years to measure the intensity of blackbody radiation from fusion plasmas, from which the electron temperature can be calculated. Typically, such measurements are made using ECE receivers where the video signal is intentionally filtered to time-average high-frequency, large amplitude fluctuation in the emission due to plasma instabilities. In our case, we utilized the wideband characteristic of the receiver to measure edge modes in the MCX plasma, which rotates at Mach >1. We will present the details about the design of the ECE radiometer and show the results of the measurements. The data show that rapid fluctuations in ECE intensity were well correlated with the optical and magnetic diagnostics on MCX. The results demonstrate that a large array of these receivers could be economically constructed and utilized to perform correlation radiometry on the MCX plasma.

[1] R.F. Ellis, A. Case, R. Elton, J. Ghosh, H. Griem, A. Hassam, R. Lunsford, S. Messer, and C. Teodorescu, Phys. Plasmas **12**, (2005)