High Spatial Resolution Upgrade of the Electron Cyclotron Emission Radiometer for the DIII-D Tokamak[a)]

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The 40-channel DIII-D electron cyclotron emission (ECE) radiometer provides measurements of $T_e(r,t)$ at the tokamak midplane from optically thick, second harmonic X-mode emission over a frequency range of 83-130 GHz. Heterodyning divides this frequency range into three 2-18 GHz intermediate frequency (IF) bands. The frequency spacing of the radiometer's channels results in a spatial resolution of ~1-3 cm, depending on local magnetic field and electron temperature. A new high resolution subsystem has been added to the DIII-D ECE radiometer to make sub-centimeter (0.6-0.8 cm) resolution T_e measurements. The high resolution subsystem branches off from the regular channels' IF bands and consists of a microwave switch to toggle between IF bands, a switched filter bank for frequency selectivity, an adjustable local oscillator and mixer for further frequency down-conversion, and a set of eight microwave filters in the 2-4 GHz range. Higher spatial resolution is achieved through the use of a narrower (200 MHz) filter bandwidth and closer spacing between the filters' center frequencies (250 MHz). This configuration allows for full coverage of the 83-130 GHz frequency range in 2 GHz bands. Depending on the local magnetic field, this translates into a "zoomed-in" analysis of a ~2-4 cm radial region. These high resolution channels will be most useful in the low-field side edge region where modest T_e values (1-2 keV) result in a minimum of relativistic broadening. Expected uses of these channels include mapping the spatial dependence of Alfven eigenmodes, geodesic acoustic modes, and externally applied magnetic perturbations. Initial T_e measurements, which demonstrate that the desired resolution is achieved, is presented