

§55. Broadband Electron Cyclotron Emission Radiometry for the LHD

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A 32-channel heterodyne radiometer for the purpose of measuring the Electron Cyclotron Emission (ECE) spectrum has been developed, and installed on the LHD. Two double-sideband mixers with image rejection filters (high pass and low pass) are used to cover almost the full spectral range of the second harmonic LHD ECE. Figure 1 shows a block diagram of the 32-channel broadband heterodyne radiometer. The radiation transmitted through the waveguide is introduced to the radiometer and then split into two branches by a 3dB power divider. The waveguide bandpass filters are used at the input of the mixers to reject the heterodyne image frequencies for each branch. The RF power of each branch is fed to a double-balanced mixer, and down converted to an IF range of 1 – 28 GHz. A Gunn oscillator at 132 GHz is used as a local oscillator. The conversion loss of the Mixer is less than 13.5 dB for the RF frequency of 104 – 160 GHz. In this system, the frequency band-stop characteristics of the filters are important for image rejection. The upper sideband filter has frequency passband of 133 – 160 GHz with the insertion loss of less than 3.5 dB and an attenuation of 30 dB at the frequencies of 128 and 169 GHz. The lower sideband filter allows the radiation in the frequency range of 110 – 131 GHz

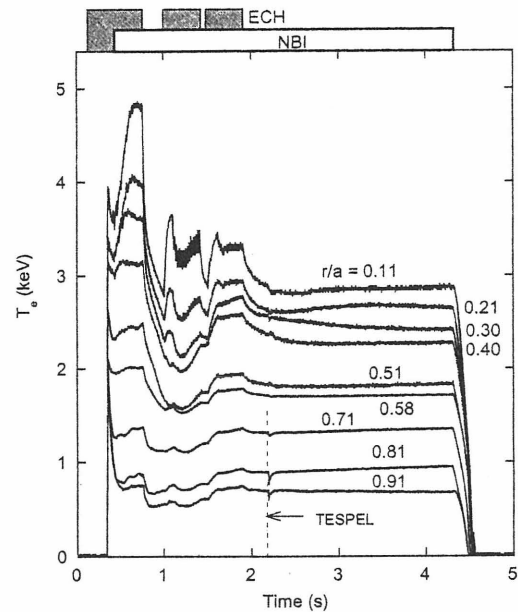


Fig.2 Time evolution of 9 ECE channels.

with the attenuation of less than 2.5 dB. The IF output of the Mixer is connected to a low-noise wideband amplifier and then split into two parts, low frequency IF-band of 2 – 18 GHz and high frequency IF-band of 18-26.5 GHz. Each of them is divided into 8-channels after passing through two stage IF amplifiers and followed by a multi-cavity bandpass filter having a different centre frequency with the 3 dB bandwidth of 1.2 GHz and a Schottky barrier diode as a video detector.

Figure 2 shows an example of the ECE signals emitted from the different radial positions of the LHD plasma. The effective noise level (V_{rms}) corresponds to ~ 5 eV with the band width of 100 kHz.

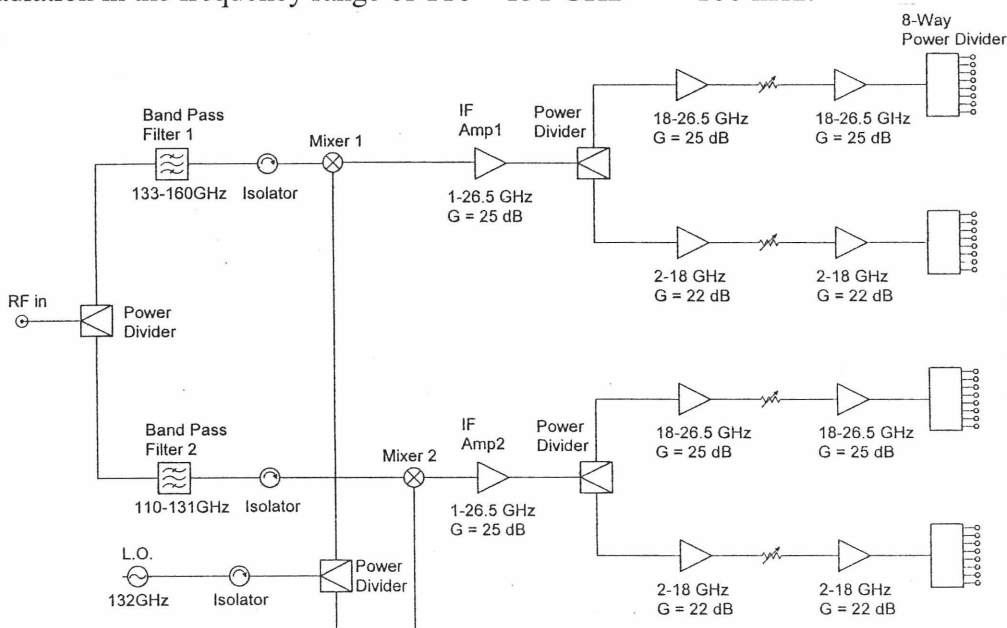


Fig.1 Block diagram of the 32-channel heterodyne radiometer installed in the LHD. Filter 1: upper sideband bandpass filter, Filter 2: lower sideband bandpass filter.