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Broadband Characterization of High Temperature Black Body Source with Fourier Transform Michelson Interferometer for ECE Measurements

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In a tokamak electron cyclotron emission (ECE) is measured to determine electron temperature profile and its evolution. Michelson interferometer (MI) diagnostic is capable of measuring the spectrum of the ECE in a wide spectral range (70-500 GHz). Usually MI is calibrated with hot-cold technique. The lab calibration of the MI diagnostics is carried out locally with room temperature and cold source. The absolute calibration of the diagnostics is done with transmission lines, bends, mode converters etc. During absolute calibration signal is below noise level and very long integration time is required to improve S/N ratio. Hence a high temperature calibration source is required to reduce the integration time. This paper deals with the design, development and characterization of a high temperature black body source. This source has been developed by precise machining of cones on a metallic surface and then coating it with silicon carbide paste and electrically heating to a temperature of 873 K. The broadband characterization of this high temperature source has been done with hot - cold technique. Initially, the calibration factor of the system is determined by periodic switching between the room temperature source (RAM material) and the cold source (LN2 at 77 K). The calibration factor obtained from two sources at known temperatures is used to determine the radiation temperature of the unknown high temperature / hot black body source by Fourier transform MI over a wide frequency range of 70 - 1000 GHz. The characterization process will be described in the paper in detail. The radiation temperature of the hot source measured during characterization was found to be in the range 737 - 755 K in entire band. The radiation temperature was about 125 K below the physical temperature of the hot source due to radiation losses. Dips were observed at frequencies 557 GHz and 753 GHz indicating the presence of water absorption lines as expected. The broadband characterization of high temperature / hot black body source with MI has been carried out successfully and results have been presented.

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