

Imaging Techniques for Microwave Diagnostics

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Advances in microwave technology have made it possible to develop a new generation of microwave imaging diagnostics for measuring the parameters of magnetic fusion devices.

The most prominent of these diagnostics is electron cyclotron emission imaging (ECE-I). After the first generation of ECE-I diagnostics utilized at the TEXT-U, RTP and TEXTOR tokamaks and the LHD stellarator, new systems have recently come into operation on ASDEX-UG and DIII-D, soon to be followed by a system on KSTAR. The DIII-D and KSTAR systems feature dual imaging arrays that observe different parts of the plasma. The ECE-I diagnostic yields two-dimensional movies of the electron temperature in the plasma and has given already new insights into the physics of sawtooth oscillations, tearing modes and edge localized modes.

Microwave Imaging Reflectometry (MIR) is used on LHD to measure electron density fluctuations. A pilot MIR system has been tested at TEXTOR and, based on the promising results, a new system is now under design for KSTAR. The system at TEXTOR was used to measure the plasma rotation velocity. The system at KSTAR and also the one on LHD will be/are used for measuring the profile of the electron density fluctuations in the plasma.

The emphasis in this paper will be largely focused on ECE-I. First an overview of the advances in microwave technology are discussed, followed by a description of a typical ECE-I system along with some typical experimental results.