

§20. Technology Related to High Power Micro-, Millimeter- and TeraHertz-Waves and its Application to Plasma Heating and Diagnostics

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i) Objectives

In LHD experiments, a Mega-Watt millimeter wave system (77 GHz and 154 GHz) has been used for strong electron heating and current drive and, recently, is used for a diagnostic power source such as collective Thomson scattering (CTS). In the diagnostic aspects, electron temperature profiles and temperature fluctuations are measured using electron cyclotron emissions (ECE) from a plasma over a millimeter-wave range. The millimeter-wave reflectometry is also used to measure the electron density fluctuation to analyze the turbulence in the plasma.

In these days, microwave, millimeter-wave and Tera-Hertz-wave oscillators and some components have been progressively developed and applied to plasma, material and medical sciences.

The objective of this workshop is to promote the exchange of the state-of-the-art informations among the researchers of micro-, millimeter- & TeraHertz-waves for the improvement in each field and the development of collaborative research.

ii) Activities in FY2014

In this fiscal year, we intended to collect information and to make intensive discussion of the latest research results and the new research trend of the generation, detection and application of millimeter- / micro-waves and also TeraHertz-waves. Main themes in this fiscal year are as follows,

1. Present status of the research, development and manufacturing of micro-, millimeter- & TeraHertz-wave power sources and components.
2. New idea, technologies and application of high power micro-, millimeter- & TeraHertz-wave power sources and components to the fusion research and to the other research fields.

We had a workshop in February 27th, 2015 under the keywords of "Technology Related to High Power Micro-, Millimeter- and TeraHertz-Waves and Its Application to Plasma Heating and Diagnostics". The workshop mainly included one lecture by Dr. M. Shapiro (MIT) and six recent research reports by collaborators.

The participants distributed over wide area related to the micro-, millimeter- & TeraHertz-wave technology and its application. About 24 members joined the workshop. The viewgraphs of each presentation were summarized and distributed in the CD-ROM for convenience.

iii) Brief Summary of the Presentations

In the workshop, the recent research activities were reported by the following researchers. Their presentations covered the power source development, method of analysis and application of millimeter-/ Tera-Hertz waves. The topics are widely spread, for example, gyrotron development for ITER and JT-60SA, development of millimeter-wave components and so on. We hope the expansion of research field, new idea and new future collaboration through the information exchange within the researches in the various research fields related to power sources, detectors, theories about micro-, millimeter- and Tera-Hertz waves.

There were seven presentations. The presentation title and presenters are listed below.

Presentations: Lecture

- "Research of Millimeter-Wave Related Theory and Technology in MIT"
by Dr. M. Shapiro, Massachusetts Institute of Technology

Presentations: Recent Research Reports

1. "Measurement of Electron Beam Using Photoconductive Antenna"
by Dr. K. Kan, The Institute of Scientific and Industrial Research, Osaka University.
2. "Research on Radiation from Negative-Index Materials"
by Dr. D. Li, Institute for Laser Technology.
3. "Development of 300 GHz Band Pulsed Gyrotrons for Collective Thomson Scattering Diagnostics"
by Mr. K. Jun, Fukui University.
4. "High Power Tests of the JT-60SA Gyrotron at Three Frequencies"
by Dr. T. Kobayashi, Japan Atomic Energy Agency.
5. "Research and Development of Fast Switching Device for High Power Millimeter Wave"
by Dr. M. Saigusa, Ibaraki University.
6. "The Influence of the Polarization on the Mirror at a Miter-Bend"
by Mr. Y. Fujita, Nagoya University.