# §3. Workshop on Generation, Application and Measurement of High Power Millimeter Waves

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1. Objectives

In National Institute for Fusion Science, there are a lot of high power millimeter wave sources such as gyrotrons for plasma production and heating. The millimeter wave power is transmitted over long distance by using corrugated waveguides for transmisstion. On the other hand, the electron cyclotron emission from the LHD plasmas is utilized as a diagnositic method of plasma temperature. Since the millimeter wave technology, which includes power sources, detectors and components, is still developing, it is important to catch up with the leading edge of such technology for the improvement of ECH and ECE system. The objectives of this workshop are the information change between the researcher of millimeter wave and microwave technologies, the improvement of each millimeter wave systems through the workshop and development of combined research fields.

2. Activities

The activities of this fiscal year consist of three lecture talks and discussions. These lectures are related to high resolution millimeter and sub-millimeter wave diagnostics, millimenter wave scattering diagnostics and development of millimeter wave components for ECH.

Program and contents of the lectures are as follows.

(1) "Atacama Large Millimenter/Sub-millimeter Array: Challenge to THz Region" by Ryohei Kawabe (National Astronomical Observatory of Japan)

Dr. Kawabe belongs to the group of millimeter wave interferometer in Nobeyama and LMSA (Large Millimeter/Sub-millimeter Array). He presented the details of the ALMA (Atacama Large Millimeter Array) project, which is proceeded in Chilean Andes and also explained required high resolution millimente and submillimenter wave diagnostics. The ALMA project consists of the construction of 64 radio telescopes with 12m diameter. As for the millimeter wave technology, super conducting detectors upto THz and submillimeter wave photonic local oscillators are being developed.

(2) "History of application of scattering diagnostics in gyrotron heating group of GPI" by N. K. Kharchev (General Physics Institute).

Dr. Kharchev was a guest professor in NIFS from General Physics Institute in Moscow. He made a review of millimeter wave scattering experiments by using gyrotrons. He introduced the experimental method and results made in L2-M in Moscow, TJ-I, TJ-II in Spain and LHD in NIFS. The methods of signal analysis are FFT spectrum, wavelet spectrum and coherency.

(3) "My odyssey of RF plasma heating technology" by Dr. K. Ohkubo (NIFS).

He surveyed his research history of the interaction between microwaves and plasma waves in Kyoto university, Institute of Plasma Physics in Nagoya University and NIFS. For example, transverse propagation of whistler waves (KU), lower hybrid wave heating / current derive and electron cyclotron heating (IPP) and electron cyclotron heating and remote steering antenna for ITER (NIFS). He placed emphasis upon the R&D, technical know-how and experimental results during the construction of the systems, RF components and so on.

The attendances distributed over wide area related to the millimeter wave technology. About 30 members joined the workshop.

- Millimeter diagnostics: Dr. R. Kawabe (NAOJ)
- High power millimeter wave application to plasma heating: NIFS, Tsukuba Univ. Kyushu Univ. Kyoto Univ.
- Generators of high power micro and millimeter waves: Fukui Univ. Niigata Univ. Kanazawa Univ. Tohoku Univ.
- Millimeter wave technology: JAERI, Ibaragi Univ.

This work shop is useful and should be continued to keep in close touch between researchers in this area. The future plan of this work shop is to promote technological information exchange through lectures, presentations and discussions.