§5. Development of ECE Diagnostics in the Second Cycle Experiment on LHD

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In the second cycle experiment on LHD, the electron cyclotron emission (ECE) was measured by the 32 channels heterodyne radiometer, the fast scanning Michelson interferometer and the 14 channels grating polychromator (GPC). These measurement devices were installed in the diagnostics room No.2, and the ECE is divided to these devices by the use of the grid beam splitters. The ECE collected by a 40 cm copper concave mirror traveled 80 m until the diagnostics room 2 via the 63.5 mm corrugated waveguide. The transition loss was 50%.

The signal of the Michelson system was disturbed by the noise from the driving motor in the first cycle experiment. This noise problem was solved as a plastic ring between the detector vessel and the pre-amplifier box was replaced by a aluminum ring. The small leak of the electron cyclotron resonance heating (ECH) disturbed ECE. In the second cycle experiment, the fast mechanical shutter was installed in front of the InSb detector, and the ECE could be measured 10 ms after the ECH turned off. The Fourier analysis program to analyze the Michelson data was developed. In the program, the peak of the interferogram data was searched and the Fourier cosine transform was done for the one side of the interferogram. Typical example of interferogram and spectrum of the Michelson during NBI heating is shown in Figs.1-2, respectively.

The GPC started to operate in the middle of the second cycle experiment. The output of the GPC is separately transferred to 14 InSb detectors by 14 rectangular waveguides. The optical alignment is critical and was done using the HeNe laser beam and the 168 GHz microwave. The frequency is tuned by rotating the grating. The relation between output frequency and the grating angle was calculated and was calibrated using microwave and the calculation results.

The data of each devices were taken by the own Camac systems and the own Windows NT computers. The Camac digitizers taken the data of the radiometer and the GPC with the common clock generated by the VME system. The data were compressed with the zip format and were saved both in the 3.5 inch magneto-optical disk (MO) and in the hard disk of the UNIX computer (DEC Alpha 600 MHz). It was found in the first cycle that the Windows NT computer was too busy to show the data, but in the second cycle, the UNIX showed the data between shots.

The ECE diagnostics worked well during the whole period of the second cycle experiment. The radiometer data was reduced and served in the text format to public users with the UNIX computer. The result was presented in the APS diagnostics conference.[1]

Reference

1) Y. Nagayama, et al., Rev. Sci. Instrum. 70, 1021 (1999).

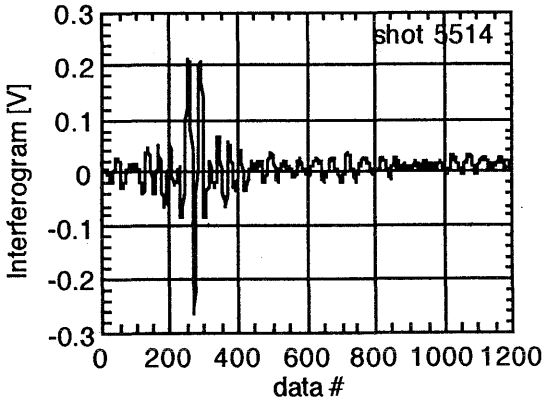

Fig. 1 An interferogram of the Michelson.

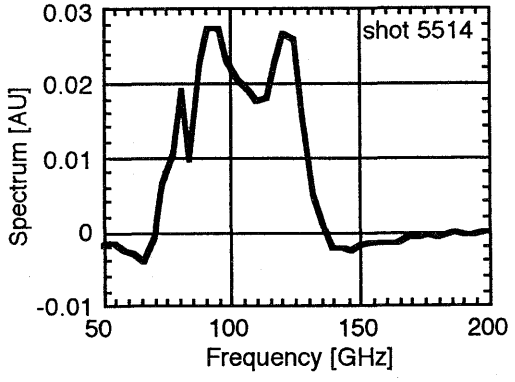

Fig. 2 Cosine Fourier transform of the Michelson interferogram.