

§6.1. Reflectometric Measurements in the 3rd Cycle: Pulsed Radar Reflectometer

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In order to measure the edge density profile and to obtain fluctuation information with high temporal and spatial resolution, we try to apply microwave reflectometer on LHD. Because LHD has a complex structure of the magnetic field configuration and also has a large magnetic shear, the launched microwave may behave in a complicated fashion. In order to study the effect of the strong magnetic shear on polarization of microwave, the pulsed radar reflectometer is a suitable reflectometric technique. Because the pulsed radar reflectometry measure the delay time of the reflected wave not the phase, it is possible to distinguish between X-mode and O-mode polarized waves even if the mode conversion and/or polarization rotation is occurred.

U-band pulsed radar reflectometer system is shown in Fig. 1 and it uses 51GHz 50 mW Gunn oscillator as a source. PIN switch is used as a pulse modulator. The separate, transmitter and receiver horns are used in order to avoid the mixture of spurious reflecting components in the waveguides, vacuum windows, etc. The antenna is a conical horn with teflon lens for focusing the microwave beam and can be moved horizontally using a remote controller. The reflected wave picked up by the receiver horn is mixed with reference 39 GHz microwave in a mixer. The IF signal is filtered by band-pass-filter and then detected of the envelope of the reflected wave. The detected pulses are fed to diagnostics room using electro-optical converter, and then time-of-flight (TOF) measurement is carried. The launched pulse is measured just after PIN switch to avoid the jitter of the pulse generator and PIN switch, and we measure the time difference between the launched pulse and the reflected one. The pulse width of the launched microwave is around 2ns. The repetition rate is 250 kHz in the standard

condition because the TOF measurement system is required the condition that the repetition rate is less than 400 kHz.

In the standard operational mode in the 3rd cycle, the magnetic field strength is 2.75T and the magnetic axis position is 3.6m. When we use the X-mode right-hand cutoff with 51GHz, the measurable range is between $R=4.5$ and 4.55m. LHD plasma is usually initiated by ECH and then neutral beam is injected. It is found that the ergodic region and the edge surface layer are constructed steadily during NBI heating phase in Fig. 2. The fluctuation amplitude of the ergodic region is 20 times larger than that of the inner plasma region and a coherent mode is sometimes appeared and its frequency is about 1-3kHz.

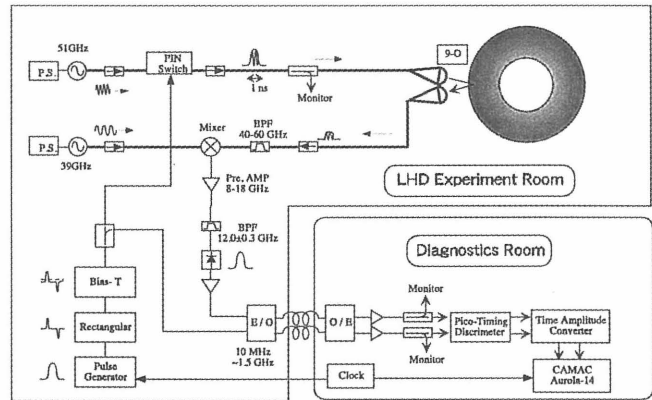


Fig. 1. The schematic of U-band pulsed radar reflectometer system

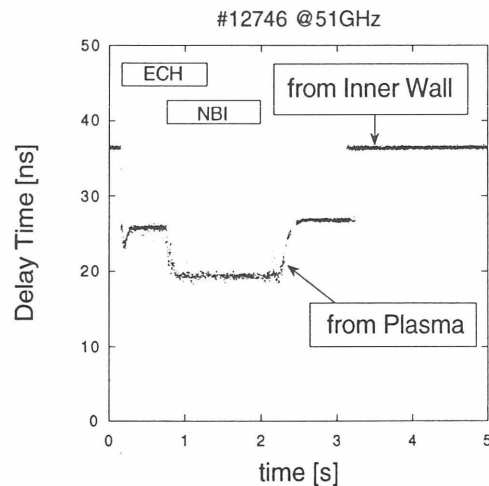


Fig. 2. The time evolution of the pulsed radar reflectometer signal at a typical NBI shot.