§4. 2ch Pulsed Radar Reflectometer System in the 4th Cycle

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In order to measure the edge density profile and 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 and reflected microwave may have a complicated behavior. 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 measures the delay time of the reflected wave, it is possible to distinguish between X-mode and O-mode polarized waves even if the mode conversion and/or the polarization rotation is occurred.

We constructed V-band and R-band pulsed radar reflectometer systems. The schematic of V-band 2ch pulsed radar reflectometer system is shown in Fig. 1. 60GHz and 65GHz Gunn oscillators are used as sources. The output powers of both sources are 100 mW. PIN switches are used as a pulse modulator using the tuned signal of the generated impulse output. The microwave pulses pass through the oversized waveguide in order to avoid the deformation. The separate, transmitter and receiver horns are used in order to avoid the mixture of spurious reflecting components in the waveguides, vacuum window, etc. The antenna is a conical horn with a Teflon lens for focusing the microwave beam and can be moved horizontally and rotated using a remote controller. In a mixer the reflected wave picked up by the receiver horn is mixed with the local microwave, of which frequency is 78 GHz. The intermediate frequency signal is divided, and each signal is filtered by a band-pass-filter with the bandwidth of ±1.0 GHz then detected and converted from the envelope of the reflected wave to the pulse. The reference pulse for the TOF measurement is measured using a V-band detector, which is located at just after the PIN switch to avoid the jitter of the pulse generator and the PIN switch. Figure 2 shows these three detected pulses which are amplified by each inverse amplifiers. The pulse width is around 2 ns and the repetition rate is 100 kHz in the standard operations. The detected pulses are fed to a diagnostics room using the electro-optical converters and the optical cables. Then time-of-flight (TOF) measurement is carried. A constant fraction discriminator (CFD) is used to obtain the start and the stop pulse for the time-to-amplitude converter (TAC), because the pulse amplitude is changed during the plasma discharge. The obtained data are acquired by CAMAC (Aurora 14 with 12 bits 1 Mword memory) and stored by a windows-NT based personal computer.

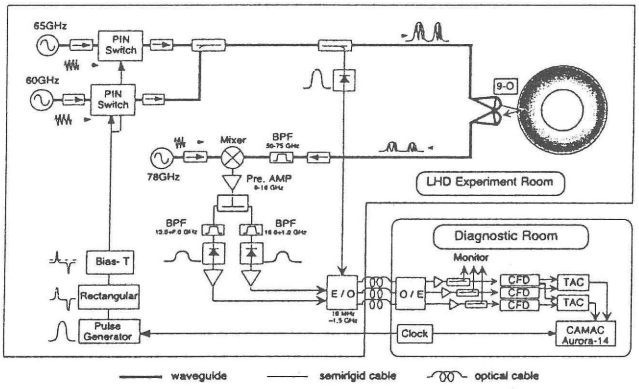

Fig. 1. Schematic of 2ch V-band pulsed radar reflectometer system. The R-band system is similar; the probe frequencies are 33 and 39 GHz, and the local frequency is 51GHz.

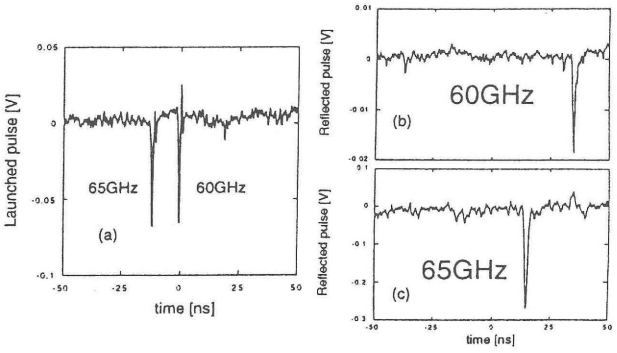

Fig. 2. The launched pulse and the reflected pulses. (a) Launched and (b,c) Reflected pulses.