§11. Development of a Measurement System of COTETRA, a Fast Neutron Spectrometer, for TFTR DT Experiments

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A neutron spectrometer called COTETRA, ΔE-E type proton recoil telescope, has been developed and applied to TFTR DT fusion experiments. Two types of COTETRA are prepared for the experiment. One for high energy resolution measurements uses a Si diode as an E-detector (Set-A) and another uses a plastic scintillator (Set-B) to attain high count-rate capability. A calibration experiment for both sets was performed using the DT neutron generator at Osaka University (OKTAVIAN). The energy resolution of Set-A is 4% for 14.8MeV neutron, and that of Set-B is 9.5%[1].

In 1993, these two sets were installed on TFTR under collimated flight tubes of the multichannel neutron collimator. The Set-A is placed under the flight tube #6, and Set-B under the #5. These two channels correspond to the lines of sight at the major radii of 247cm and 268cm, respectively.

In the experiments on TFTR, three different markers are provided by the electronic system surrounded by the dashed line in Fig.1. One is a time scale marker which is produced during a TFTR discharge by a clock generator and is synchronized to the TFTR clock cycle, typically with a 2msec period to provide the time information.

The other two markers, called a foreground marker and a background marker, are used to aid in discriminating against accidental and true events. The foreground marker is obtained by the coincidence between ΔE and E-detectors after careful timing adjustments and contains both accidental and true coincidences events. The background marker is generated by intentionally sliding the timing of the coincidence between ΔE and E-detectors. The effect of the accidental coincidence events in foreground events can be determined by background events. The Pulse Height Spectra (PHS) for foreground events and that for background events are shown in Fig. 2(a). These are obtained from a neutral beam heated plasma. In this figure, the spectrum of the foreground between channels 400 and 900 agrees with that of the background and, therefore, is considered to be due to accidental coincidence events. The low energy counts below 400ch. are mainly considered to be due to background γ-rays. The evaluation of the accidental coincident events obtained by the sliding timing technique turns to be successful. The energy broadening of the peak around channel 1300 is much greater than the energy resolution of Set-B. This broadening of the peak can be due to the energy spread of the beam-heated plasma neutron source.

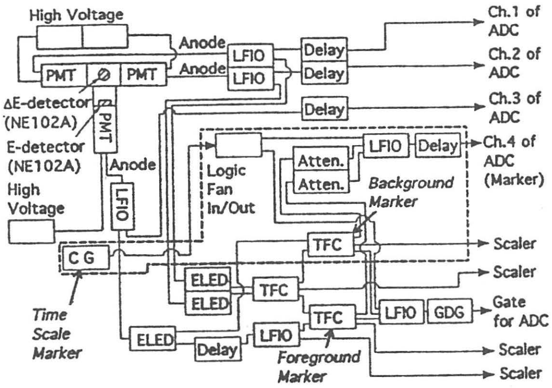


Fig. 1 Schematic drawing of the electronic modules of Set-B for TFTR DT experiments.

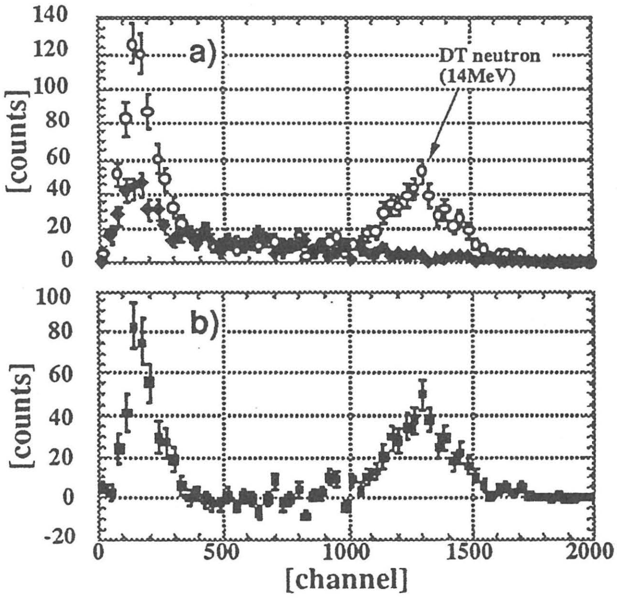


Fig. 2 Pulse height spectra of Set-B for neutral beam heated plasma. (a) Open circles and closed diamonds show PHS's for foreground events and background events, respectively. (b) The pulse height spectrum obtained by a subtraction of the background from the foreground.

*Reference*

[1] M.Osakabe et al., 10th Topical Conference on High Temp. Plasma Diag.(1994, Rochester), 7.19