§3. Improvement of the Neutron Energy Spectrometer, COTETRA (Counter Telescope with Thick Radiator)

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A new type of neutron spectrometer, named COTETRA (counter telescope with thick radiator), has been developed, and used to measure neutron energy spectra on the DT experiment of TFTR. It showed the energy resolution of about 8% on the laboratory test, but the measured peak width of the energy spectrum of a NBI heated plasma was 23%, wider than the expectation (11%).

Following problems have been pointed out as causes of the resolution degradation, a) fluctuation of the DC levels of signal lines, b) degradation of the PMT gain due to high counting rates, c) change of the PMT gain due to the stray magnetic field. The fluctuation of DC levels was monitored during the shot, and it was found to be negligibly small. By using magnetic-field resistive PMT and active dividers, the problem b), and c) were solved.

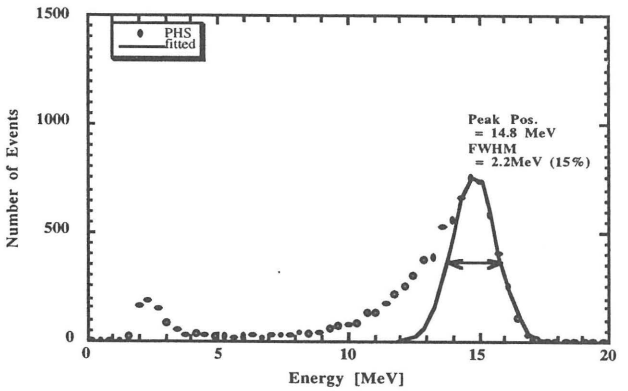

Fig.1 D-T neutron spectrum from OKTAVIAN.

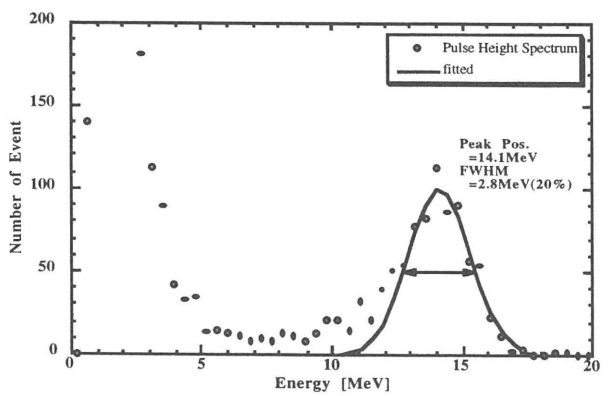

Fig.2 D-T neutron spectrum from the NBI-heated DT plasma of TFTR.

The neutron spectrum from the DT generator (OKTAVIAN), and that from the NBI-heated DT plasma measured with this improved detector are shown in Fig1, and Fig. 2 respectively. The peak in Fig. 1 showed an asymmetric shape with a tail on the low energy side, with the 15% FWHM at the high energy side. The larger value of FWHM is due to the poorer linearity of PMT. The neutron spectrum in Fig. 2 can be explained by the expected Doppler broadening of beam-plasma interaction and the peak shape in Fig. 1.

Possible causes of the tail on the low energy side are the effect of the back foil of ΔE scintillator, and the proton scattering on the side wall of the holder cylinder of ΔE detector.The effect of the foil thickness on the peak shape is small (Fig.3). The DT neutron spectrum measured with the new holder designed so as to diminish the proton scattering effect is shown in Fig. 4.

References

[1] M.Osakabe, et. al., Rev. Sci. Instrum. 66 , 920 (1995)

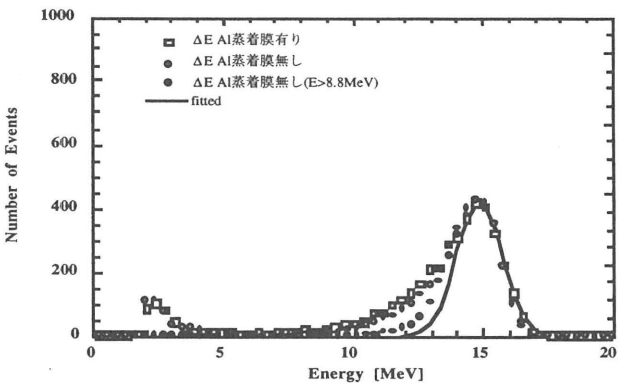

Fig.3 COTETRA neutron spectra with differnct back foil thickness, and without it measured with a DT generator.

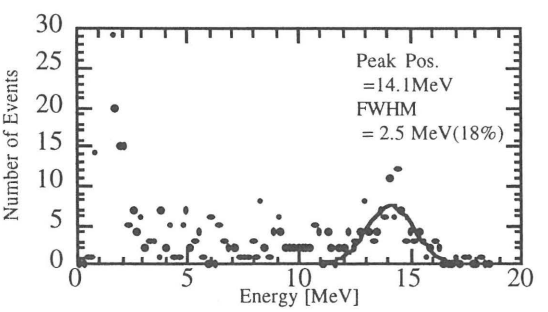

Fig.4 D-T neutron spectrum from the NBI-heated DT, with new ΔE detector holder.