§3. Development of Active Divider for Magnetic-Field Resistive Photo-Multiplier

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In D-T and D-D fusion experiment, the measurement of neutron detection is very important to obtain the information of fusion reactivity and fast ions. In such experiments on magnetically confined plasma devices, the effect of magnetic field on neutron detector and the saturation of the detector must be avoided.

During TFTR discharges, the degradation of PMT gain of a COTETRA neutron spectrometer was observed due to the effect of magnetic field and the saturation of PMT. To overcome this defect, a HAMAMATSU R2490-07 was applied to reduce the effect of magnetic field. An active divider[1,2] was developed for this PMT to avoid the saturation.

Figure 1 shows the electronic circuit. The divider current was driven by seven pairs of inverted darlington transistors at the last seven stage, and each dynode voltage was kept by reference resistors (R3). When -2kV of high voltage was applied to the divider without any light source, the current of 3.63mA was supplied.

Using OKTAVIAN D-T neutron generator at Osaka University, the performance of this active divider was tested and compared with the normal (passive) resistive chain divider, which is available from HAMAMATSU Photonics. Fig. 2(a) shows the pulse height spectrum (PHS) of NE102A plastic scintillator for D-T neutrons obtained by a passive divider, and Fig.2(b) shows that obtained by an active divider. The counting rate of the detector was measured for the case of passive divider at 1.5×10^5 cps, and those for other cases were obtained by comparing the D-beam current at T-target of OKTAVIAN. As shown on Fig.2(a), the edge position of the PHS is decreasing from ~1500 channel to ~300 channel as the counting rate of the detector is increasing for the passive divider. On the other hand, those of the active divider stay at ~1000 channel up to 6×10^5 cps and the deterioration of edge position is small even for the case of 2.4×10^5 cps. This shows the effectiveness of the active divider for the use of high counting rate environment.

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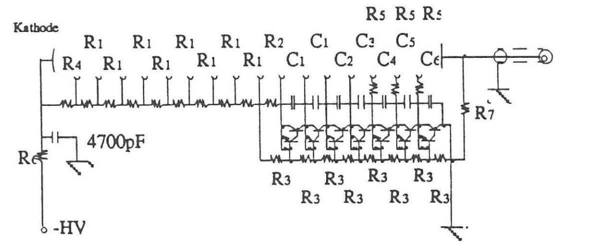

Fig.1 Schematic drawing of the electronic circuit for the active divider. The character R and C express resistors and capacitors, respectively. The value of each resistors and capacitors are; R1 (33kW), R2 (34kW), R3 (1MW), R4 (84kW), R5 (50W), R6 (3.9kW), R7 (10kW), C1 (0.01mF), C2 (0.022mF), C3 (0.047mF), C4 (0.1mF), C5 (0.22mF), and C6 (0.47mF).

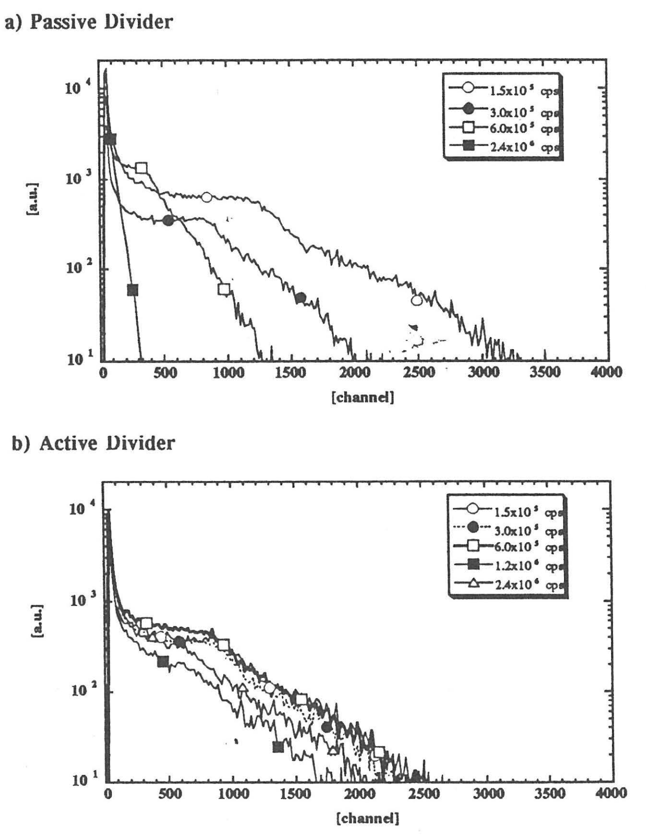

Fig.2 Pulse height spectra of NE102A for D-T neutrons. (a)Spectra obtained by passive divider. (b) Spectra obtained by active divider.

References
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