REFERENCE

[1] Sa Jun et al., A multi–detector fast neutron TOF spectrometer at the HI–13 tandem accelerator, to be published.

THE STUDY OF PROMPT NEUTRON SPECTRA OF ^{238}U FISSION INDUCED BY FAST NEUTRON

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The preliminary measurements of prompt neutron time–of–flight spectra of U fission induced by 11 MeV neutrons were carried out at HI–13 Tandem Van de Graaff Accelerator Laboratory in 1989. The exprimental set up is shown in Fig.1.

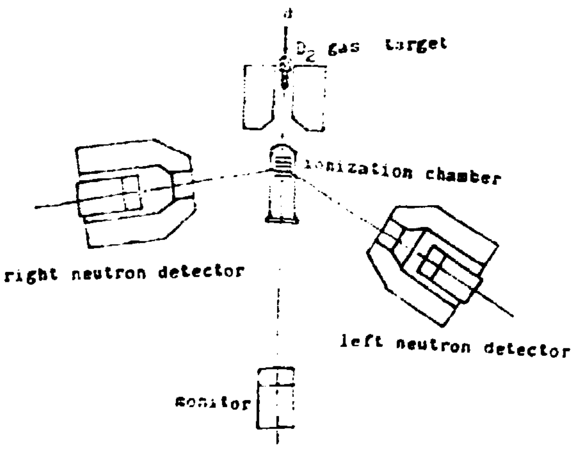

Fig. 1 The experimental set up

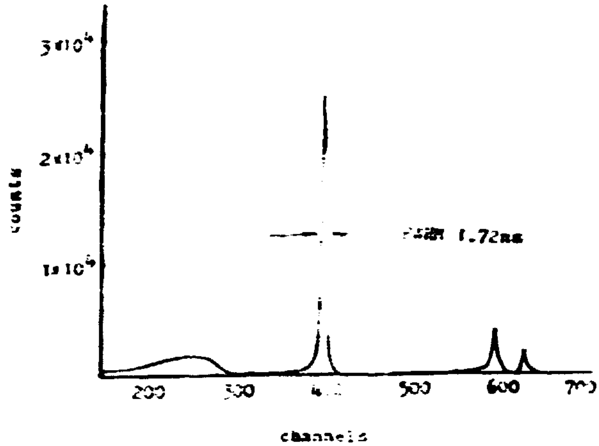

Fig. 2 Primary neutron TOF spectrum measured by 0° monitor detector

A 9.4 MeV pulsed deuteron beam with repetition rate of 4 MHz hit a deuterium gas cell of 4.3 atm. and 11 MeV pulsed primary neutron beam was produced at 0 degree direction via D(d,n) reaction. A multi–section fission chamber containing 103 parallel plates on both–sides coated with natural uranium is placed at this direction. The distance between the centers of gas cell and the chamber is 64 cm. Two heavy shielded liquid scintillators with 25 cm diameter by 5 cm thickness are placed on both sides as fission neutron detectors, one is the left detector located at 60 degree in respect to the beam direction, the other is the right one at 80 degree. The flight path is 2.5 m for both neutron detectors. A smaller liquid scintillator detector is placed at 0 degree and 3.1 m distance from the gas cell as a monitor of the time–of–flight spectrum of the primary neutrons. The measured TOF spectrum of the primary neutrons is shown in Fig. 2. The 11 MeV monoenergy peak is separated quite well from the break–up neutrons. A gate covering the monoenergy peak was set and the integral counts in this gate were recorded as a normalization standard of the primary neutrons for each run instead of beam current integral during the data acquisition.

In order to distinguish fission neutrons from the other secondary neutrons, the fission fragment signals of the fission chamber must be used to coincide with the associated fission neutron signals of the neutron detectors. the 103 fission plates were divided into 8 sections to decrease capacities among the plates and rise–time of the fission signals. The fission fragment signals of each section and pick–off signals were used as start and stop of a TAC respectively. A primary neutron TOF spectrum was measured for each section and a gate was set for 11 MeV monoenergy peak in the spectrum. The signals in this gate were in coincidence with those of neutron detectors to select fission events induced by 11 MeV neutrons and to eliminate those induced by break–up neutrons.

Two biases were used for each neutron detector, one was electronics bias set at 1 / 3 Cs energy (about 0.5 MeV proton energy), so that the available minimum energy of the fission neutron spectra was below 1 MeV, the other was higher bias set at 1 Cs energy by computer to upgrade effect–to–background ratio in higher energy region of fission neutron spectra, and a neutron–gamma rays discriminator was used to eliminate gamma rays background.

The block diagram of the electronics is shown in Fig. 3. 8 ADC were used, two of them were used to record primary neutron TOF spectra for the fission chamber and the monitor detector, the others were used to record fission neutron TOF spectra, pulse height spectra and neutron–gamma rays discrimination spectra for two neutron detectors, respectively. In addition, a 12 bits input register was used: bit 2 to bit 9 were connected with 8 timing output from 8 section of fission plates respectively to determined which section the fission event belongs to; bit 11 was used to determine whether right or left neutron detector the event comes from; bit 12 for judging random coincidence between the outputs of the fission chamber and the neutron detectors.

A fission neutron TOF spectrum for the sixth section of the fission plates and the left detector at low bias is shown in Fig. 4. the data accumulation time is 60 h. Two small peaks on the right of the bit fission gamma rays peak are attributed to the gamma rays emitted from two diaphragms hit by pulsed deuteron beam.

The data were stored event by event on tapes during the experiment. The data analyses and necessary corrections are being done.

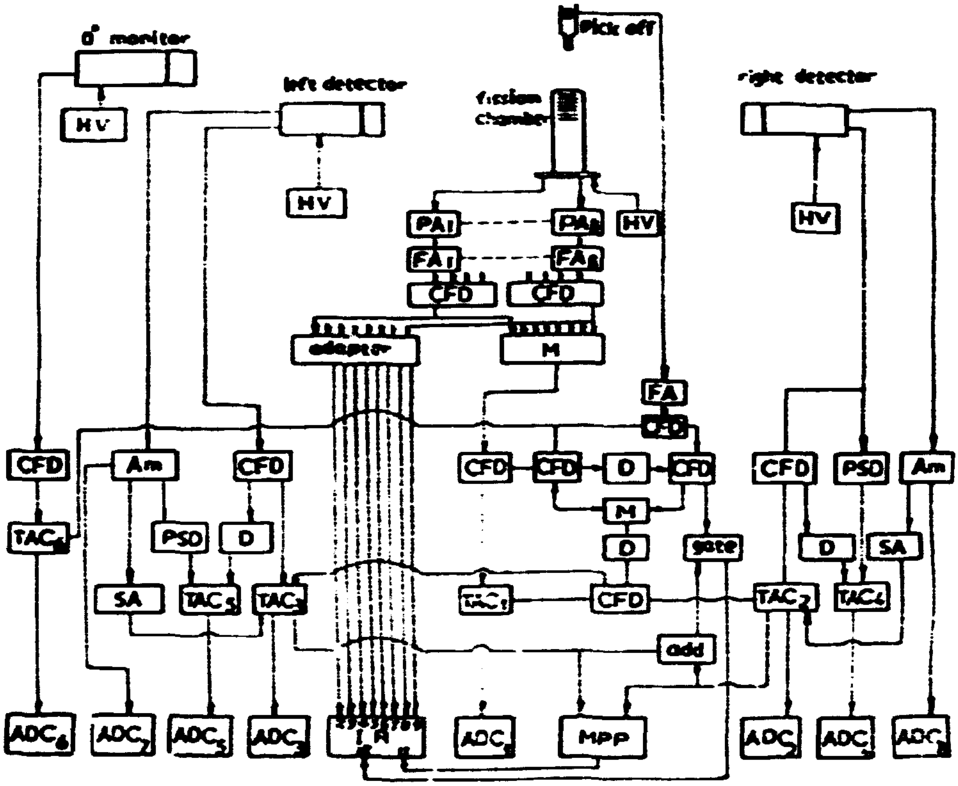

Fig. 3 Block diagram of the electronics

HV— high voltage power supply; Am— amplifier; PA— preamplifier; D— delay; FA— fast amplifier; CFD—constant fraction discriminator; SA—single channelanalyzer; MPP—multi parameter plate; PSD—pulse shape discriminator; M—mixer; IR—input register.

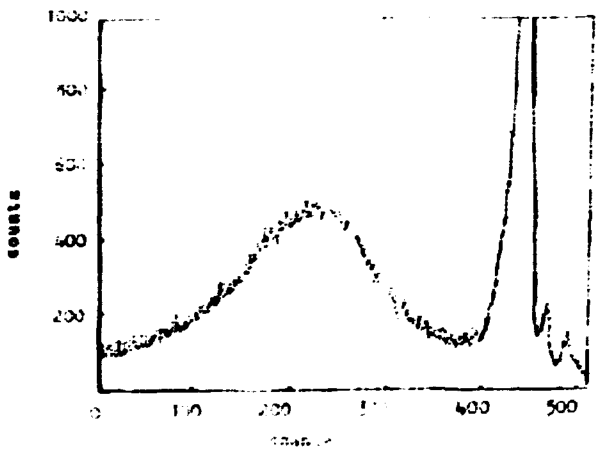

Fig.4 Fission neutron TOF spectrum at low bias