

## Front end electronics for fission detectors

Venkataramanan.S, Arti Gupta, Akhil Jhingan, Sugathan.P

<sup>3</sup>Inter University Accelerator Centre, Aruna Asaf Ali Marg, New Delhi - 110067, INDIA

\* email: venkat@iuac.res.in

### Introduction

The primary motive behind National Array of Neutron Detector (NAND) at IUAC [1] is to study the reaction dynamics in fusion fission reactions in the low/medium energy region. The detection of neutron emitting sources is essential in these types of studies. The large area position sensitive Multi Wire Proportional Counters (MWPC) developed at our center [1] have been proved to be excellent for fission fragment mass and angular distribution studies [2]. The front end electronics such as shaping amplifier, numerous constant fraction discriminators required to process signals from a five electrode geometry MWPC detectors are developed and incorporated in a single width NIM module.

### MWPC Detector

The MWPC [2] developed at IUAC for this purpose has an active area of 8" x 4" and has a 5 electrode geometry. X and Y position signals are readout using standard delay line technique having end to end delay of 160ns and 80ns respectively. Timing signal is extracted from the anode and energy loss signal from the cathode. In all electrodes, wires are separated by 1.27mm. For position readout, two wires each are shorted and connected to one tap of delay line chips (TZB-12-5) having delay of 2ns per tap. The detector is housed in a circular aluminium

chamber. Gold plated Tungsten wires soldered on 1.6mm thick PCBs are used as electrodes.

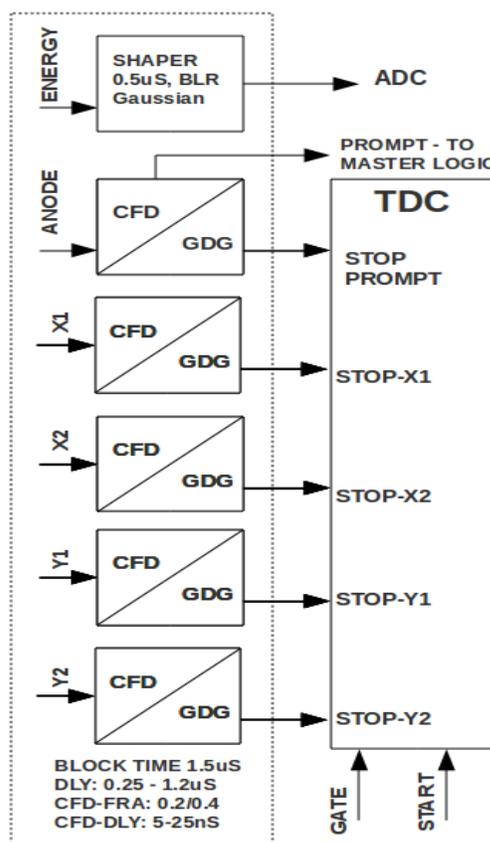


Fig:1 Fission detector electronics module

## Fission detector electronics module

The fission detector electronics [3] for 5 electrode geometry requires various front end functional blocks such as shaping amplifier for energy spectroscopy, fast pre-amplifier (FPA), timing filter amplifier (TFA), constant fraction discriminators (CFD), gate and delay generators (GDG), logic units. We have developed a single width NIM module, that contains the functional blocks as shown in Fig.1. The single width NIM module contains a mother board, on which the daughter cards like shaping amplifier, constant fraction networks are inserted. The additional circuits on mother board are ultra stable control voltage regulator, ECL termination voltage (M2V) regulator, LED blinkers to indicate the presence of signals. All these circuits are assembled with SMT devices in a daughter card format for easy maintenance.

## Shaping Amplifier

The shaping amplifier for energy spectroscopy is a semi-gaussian type amplifier realised with ultra-low noise operational amplifiers. The shaping stage is a 4 pole Sallen-Key low pass filter, and base-line corrected with a Robinson twin diode restorer. The final buffer amplifier is capable of driving 50 ohm cable across its dynamic range of 0-8V.

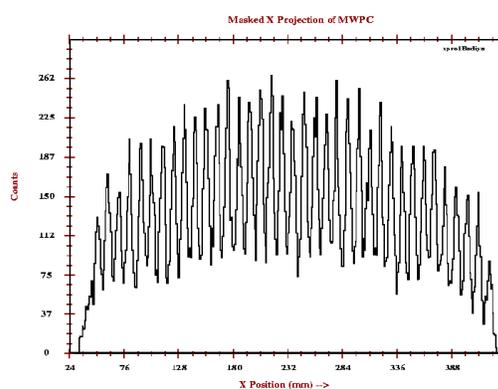
## CFD & GDG

Constant Fraction Discriminator and Gate and Delay Generator (CFD + GDG) circuits are combined in a single daughter card. The CFD fraction and DELAY are selectable on multi-tap

delay line on PCB as per experimental requirement. The CFD circuit has built-in DEAD TIME of 1.5 $\mu$ S to reduce false triggering. The LLTH, WALK Adj., WALK Monitoring and DELAY adjustments are possible from front panel.

## Test results

The 5 electrode geometry MWPC fission detector was tested with a mask and alpha source. The mask has 1mm diameter holes at 5mm separation. The position resolutions observed are identical with commercially available CFD.



## References

- [1] DST, Govt. of India approval reference no: IR/S2/PF-02/2007 dated 04.01.2010
- [2] Compact multi wire proportional counters for the detection of fission fragments, Review of Scientific Instruments 80, 123502 (2009) Akhil Jhingan, et al.
- [3] Technical report on Fission detector electronics for NAND array IUAC/TR/SV/2009-10/13