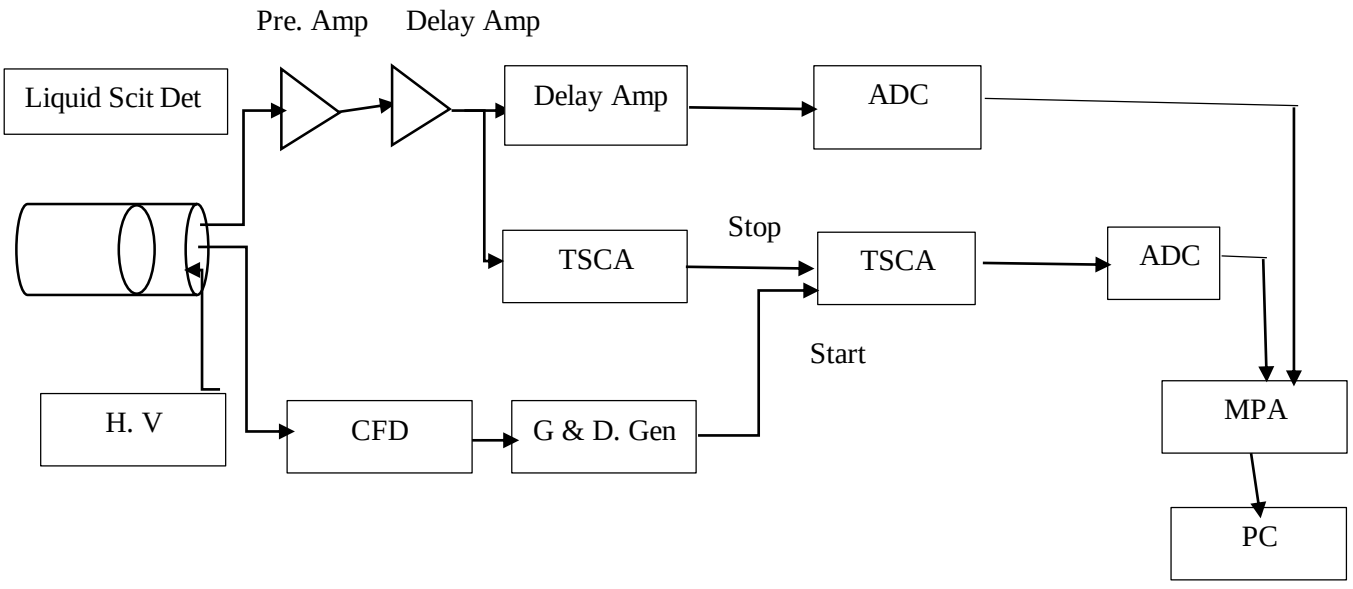
# The neutron separation, timing and spectroscopy system

**Required Equipment**

- Liquid Scintillator NE-213 Detector
- PMT Bias
- Preamplifier Model 3001
- Bin Power Supply Model 8000
- High Voltage Power Supply Model 8100
- Preamplifier Model 3001
- Delay Line Amplifier (DLA)
- Timing Single Channel Analyzer(TSCA)-2575
- Analog-to-Digital Converter Model 4010 (ADC)
- Gate & Delay Generator
- Constant Fraction Discriminator(CFD)
- Multi-Parameter Analyzer
- BNC and SHV Cables

This set is described in the following figure.



All products are provided by Iman Gostar Raman Kish company.

## Instruments Used in This Set

### 1. Liquid Scintillator NE-213

The NE-213 is an organic liquid scintillator detector with excellent efficiency and quality for neutron-gamma separation and is well known and used in neutron-gamma separation experiments. This detector is currently being manufactured at different sizes and with suitable PMTs for the bias.

### 2. PMT Base

A photomultiplier tube (PMT) consists of a photosensitive cathode, several dynodes and a collection anode. The dynodes are responsible for the increase in signal by electron multiplication. Detection signals and also the feeding of PMT require a base. At present, it is possible to produce various types of bases for different applications at Iman Gostar Ramman Kish Company.

### 3. BIN Power Supply Model 8000

The 8000 power supply is a 19 inch rack with a power supply of 160 watts, and all of its connectors have the standard voltage of a NIM bin.

**Specifications**

- Input: 220 or 115 Vac,
- Output impedance: $\langle 0.3\Omega$ at any frequency up to 100 KHZ for the dc output.
- Temperature coefficient: $\langle 0.02\%/^{\circ}C$, 0 to $60^{\circ}C$.
- Output ripple: < 3 mV
- Voltage adjustment: $\pm 2\%$ minimum range

### 4. High Voltage Power Supply Model 8100

The IAP 8100 high voltage power supply is used for biasing various detectors.

**Specifications**

- Output polarity: positive or negative

- Output voltage: 0 to 3 KV
- Output current: 0- 10 mA
- Output ripple: $\langle 10mV$
- Power: 220 Vac

### 5. Preamplifier Model 3001

The IAP 3001 scintillation preamplifier is an all-transistor preamplifier designed for use with photomultiplier tubes. It is non inverting preamplifier with no provisions for pulse shaping excepts the variation of fall time. A diode network prevents destruction of the input transistor if a sudden positive or negative high voltage is applied to the input.

**Specification**

- Rise time: $\langle 60n\text{sec}.$
- Fall time: fall time constant is designed for $50\mu\text{sec}$, assuming a signal source impedance of $1M\Omega$
- Internal nonlinearity: $\leq 0.02\%$.
- Power required: $+24V$ dc, 17mA; -24Vdc, 17mA; supplied from any IAP transistor main amplifier or an IAP preamplifier power supply through 10-ft captive cable.
- Input: BNC connector; isolated for 1000 V; positive or negative polarity, $1M\Omega$ impedance shunted by 45 pF plus the capacity selected by jumper S1 (0,100, 200, 500, or 1000 pF).
- Test pulse: BNC connector; accepts a pulse generator output with fast rise and slow decay to check operation of the electronics; input impedance

### 6. Delay Line Amplifier (DLA)

DLA is intended for energy and time spectroscopy with scintillation detectors. Its delay-line shaped output signal is particularly suitable for timing and high-counting rate applications. This output signal offers a more rapid baseline recovery than is possible with Semi-Gaussian shaping amplifiers.

**Specifications**

- Gain range: from 10 to 1000.
- Shaping filter: front-panel switch permits selection of integration time constant with 0.04, 0.1 or 0.25 μs

- Integral nonlinear: less than ± 0.05%
- Temperature ability: gain ≤ ± 0.01% / ° C, 0 to 50 ° C and DC level ≤ ± 0.1 mV / ° C, 0 to 50 ° C

7. **Timing Single Channel Analyzer: TSCA**

The TSCA device is used as a single-channel analyzer (SCA) or a discriminator. Its main output is a fast negative signal and a slow positive pulse. Two separate outputs are considered for low and high level analyzers in this device.

**Specifications**

- Dynamic range: 1-200
- Pulse pair resolving time: minimum pulse-pair resolving time for negative and positive output is 200 ns.
- Temperature instability: less than ± 0.01 % / ° C
- Discriminator nonlinear: less than ± 0.25%
- Delay temperature instability: less than ± 0.03 %/°C
- Delay nonlinear: less than ±2 %

8. **Analog-to-Digital Converter Model 4010 (ADC)**

The IAP model 4010 ADC is a high resolution Wilkinson type analog to digital converter with 13 bit conversion range.

**Specification**

- Accepts signal: positive or bipolar pulses (positive portion leading).
- Input range: 25 mV to 10 V.
- Input impedance: 1000 Ω.
- Rise time: 100 ns to 100 µs.
- Fall time: 200 ns to 100 µs.
- Width: 0.5 µs minimum.

9. A constant fraction discriminator (CFD) allows good time resolution to be obtained from all detectors.

**Specifications**

- Count rate: 100 MHz
- Dynamic range: 1- 1000
- Five modes of operation
- Two negative outputs and two positive outputs, simultaneously
- Multi-color counting rate display
- Dc collapse

## 10. Cables

- SHV and BNC