Assignment # 2 :

26th March 2024 :   **Submission by 9th April 2024**

1. A drift chamber of length 10 cm is filled with $80\%\,\text{Ar}$ and $10\%\,CO_2$ at one atm pressure. Applied voltage on cathode plane is $-10\,\text{kV}$, anode wire is $5\,\text{KV}$ and grid planes are grounded. Calculate position resolution of this chamber as a function of position with and without ignoring the diffusion and assume the timing resolution of TDC is 1ns.   6

2. A given voltage sensitive preamplifier requires a minimum input pulse amplitude of $8\,\text{mV}$ for good signal/noise performance. What the minimum gas multiplication factor is required in an argon-filled proportional counter with $150\,\text{pF}$ capacitance if $40\,\text{KeV}$ X-ray are to be measured ?   5

3. A cylindrical gas chamber of length, ℓ=10cm, radius, b=10 mm and wire diameter, a=10 μm is filled with pure argon at $3\,\text{atm}$ pressure and applied voltage on anode wire is $2\,\text{kV}$. Assume a charge particle deposited energy only at a distance $3\mu m$ away from anode surface, estimate the signal strength (both voltage and current) after 2, 5 and $50\mu s$.   8

4. A 1m long wire with resistivity $60\,\Omega/\text{cm}$ has readout circuits with input impedance $100\,\Omega$ at each end. Find the position along the wire of a passing particle if the peak signal is in channel 36 on one side and in channel 20 on the other. Assume the ADC pedestals are in channel 5.   2

5. Calculate the induced signal of the CMS RPC detector, for the normal incident of the following particles on the RPC chamber (assume constant Townsend co-efficient during the avalanche and w=$30\,\text{eV}$ for this gas).   8

   (a) $10\,\text{MeV}$ alpha particle
   (b) $1\,\text{GeV}$ muon
   (c) $10\,\text{GeV}$ neutron
   (d) $100\,\text{GeV}$ pion

6. A proportional chamber of radius $1\,\text{cm}$ and anode wire diameter 30μm is filled with Ar gas. The chamber is operated with $2\,\text{KV}$. Estimate the relative fraction of gain for particle flux $1\,\text{kHz}$, $10\,\text{kHz}$, $100\,\text{kHz}$ and $1\,\text{MHz}$.   6