Chemistry 988

Spring, 2oo9 Exam # 2 Practice

Distributed: Tues., 28 Apr. o9 Due: ?

1. During a recent search for new isotopes [PRL **102** (2009) 142501] the elemental (Z) resolution of the detector system was quoted as $\sigma_Z = 0.098$ What is the probability that a given event would fall half-way between two elements? For example, such a misidentification who lead to a Z=18.50 for a particle between Ar and K.

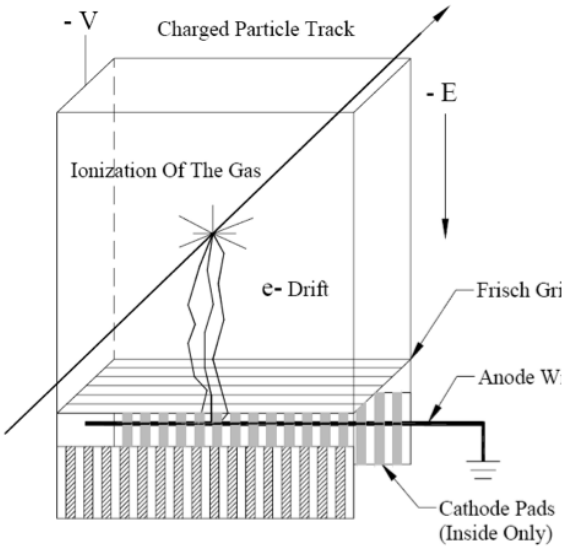
2. Bipolar pulses have two significant differences with respect to unipolar pulses in analogue circuits, one with respect to charge measurement and one with respect to time measurement. Describe these two differences.

3. Scientists that use PMT's often prefer to use negative high voltage (HV) for pulse processing but scintillation manufacturers prefer to use positive high voltages. What is the advantage of using negative as opposed to positive HV for pulse processing? What is the advantage of using positive as opposed to negative HV for detector manufacture?

4. CRDC (cathode-readout drift-chamber) detectors are used in two spectrometers at the NSCL to measure the position (in two dimensions) of fast moving nuclear fragments. A cartoon of a CRDC is shown below. A voltage of -900 V is applied to the top of the drift region and the Frisch grid is held at ground (in contrast to what is indicated in the figure) creating a linear electric field in the 25 cm drift region. The anode wire is 25μm and is usually run at +1000 V. The region surrounding the anode can be considered to be a cylinder approximately 1 cm across.

   (a) The drift velocity for ions in gas is given by the expression: $v = \mu\mathcal{E}$ where $\mathcal{E}$ is the electric field and μ is the ion mobility. For electrons in the fill gas $\mu = 2x10^4 \frac{cm^2}{V\ s} * \frac{760}{p}$ where p is the pressure in torr. Estimate the drift time for electrons created at the vertical midplane of the detector when operated at 200 torr.

   (b) What is the required uncertainty in the time measurement if the required uncertainty in the position is 300 μm?



(c) What is the required noise level on the anode wire if the typical signal is 1.00 V with a rise time of 100 ns? The time is measured against the start signal from a scintillator attached to a PMT with a σ_t=0.25 ns.

(d) What is the typical gain of the anode wire if the filling gas is P-10?

(e) What is the expected resolution of a pulse created by depositing 15 MeV into the gas if the Fano factor for P-10 gas is 0.21?

(f) Describe how the horizontal position signal is created.