Hall A VDCs

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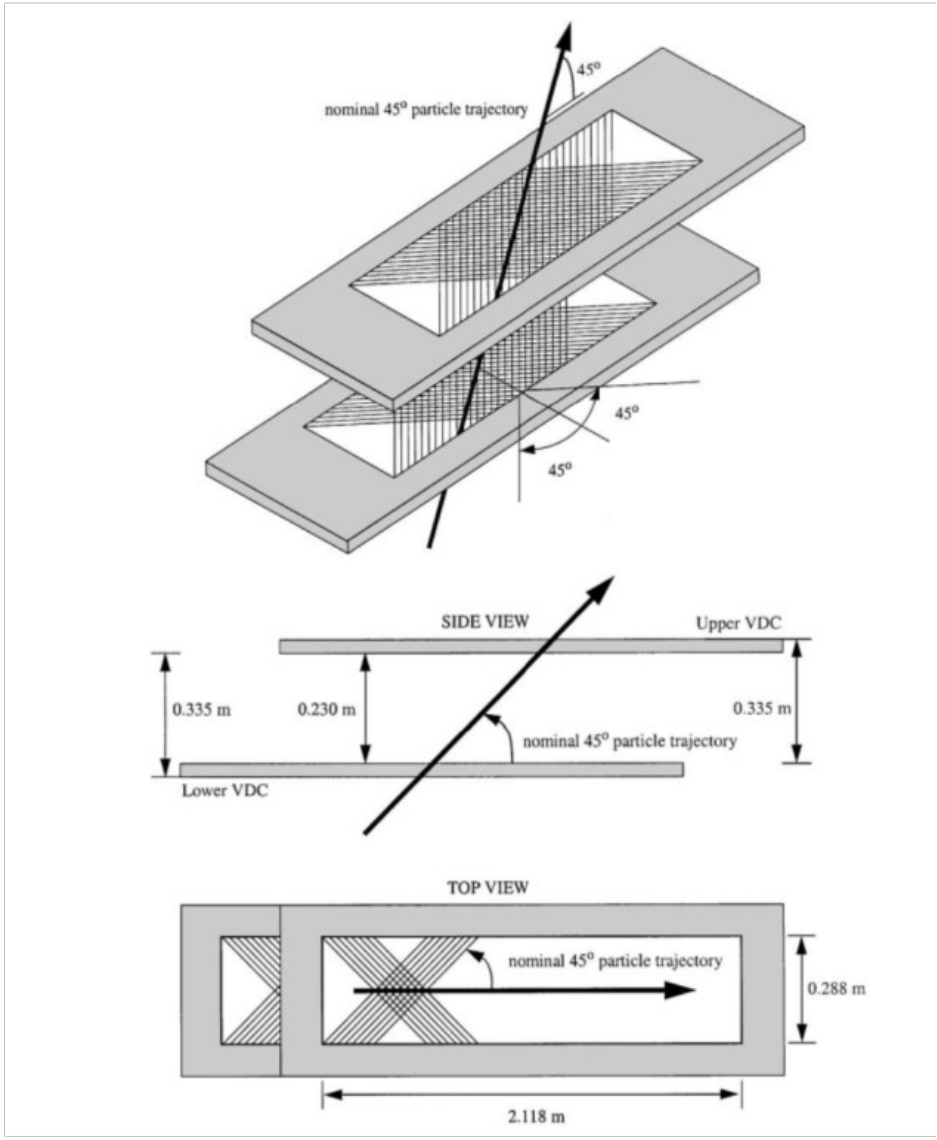
- Overview of VDCs.
- Wire Efficiency
- TDC Plots
  - How to read them.
  - Reference time.
  - Drift time to drift distance conversion.
- Geometric Trajectory Reconstruction

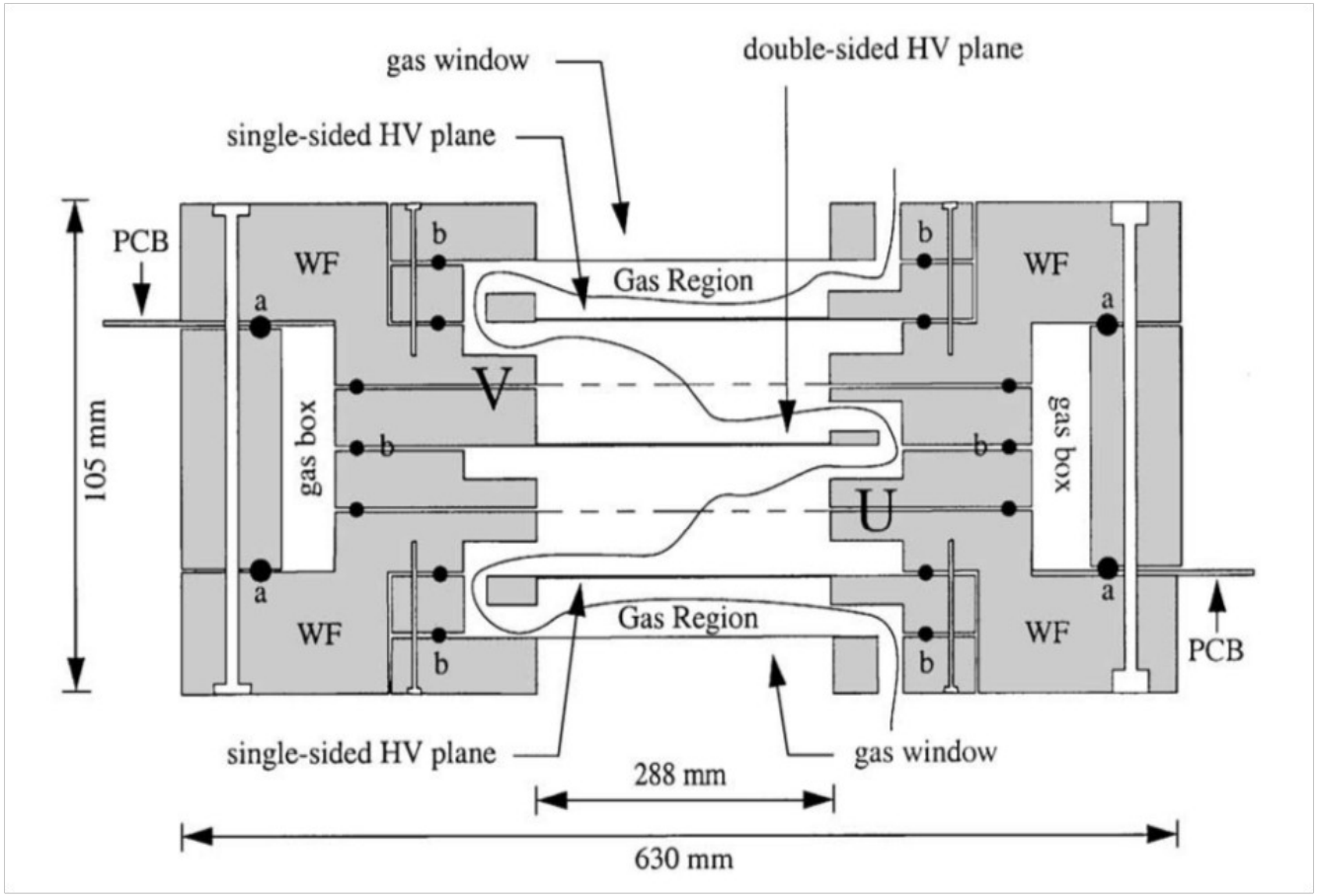
VDC Configuration

- Two planes each with two sets of wires at 45 degree angles. U1, V1, U2, V2.
- Two planes separated by 0.335 m.
- Lower VDC lies in spectrometer focal plane and upper VDC allows for angular reconstruction of particle trajectories.



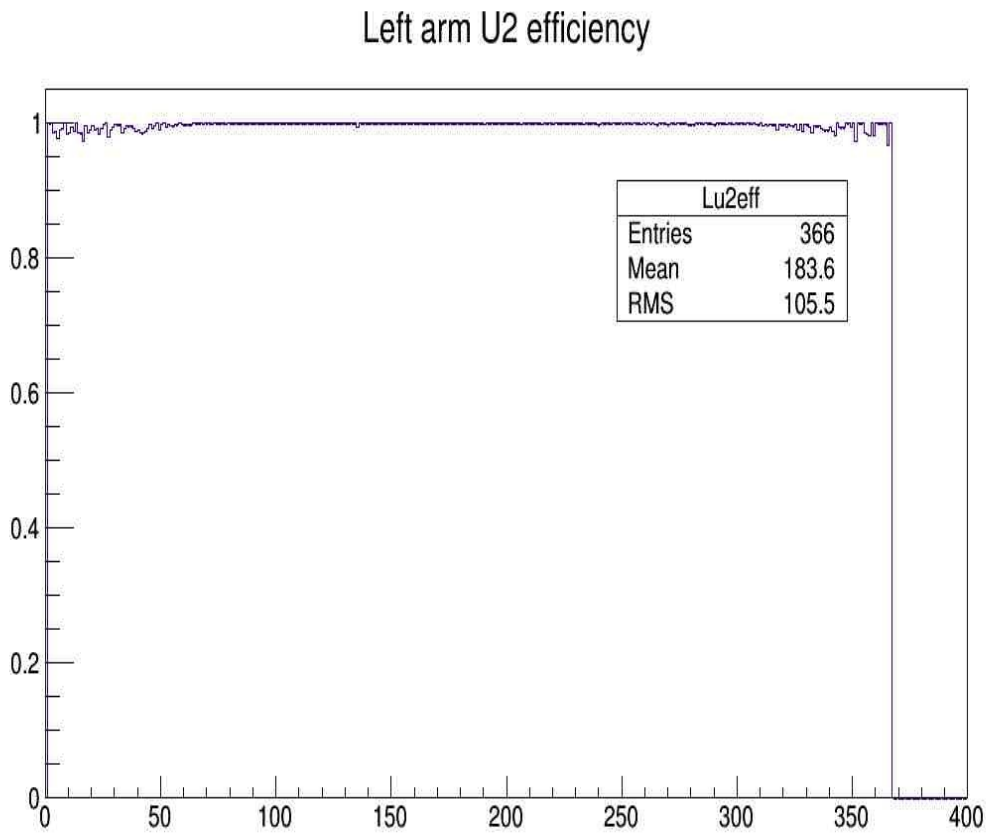
Internal View

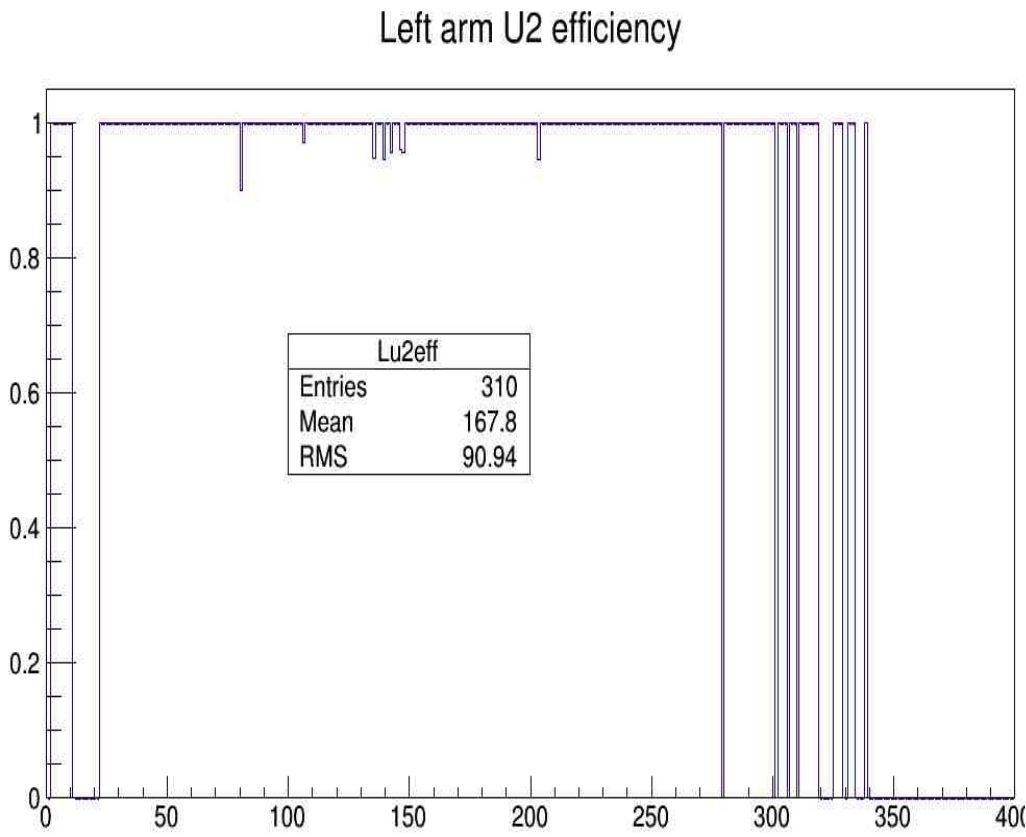
- 368 sense wires per plane. Gold plated tungsten 20 μm diameter.
- Gas: argon and ethane (50-50 by volume).
- Mylar windows.



Wire Efficiency

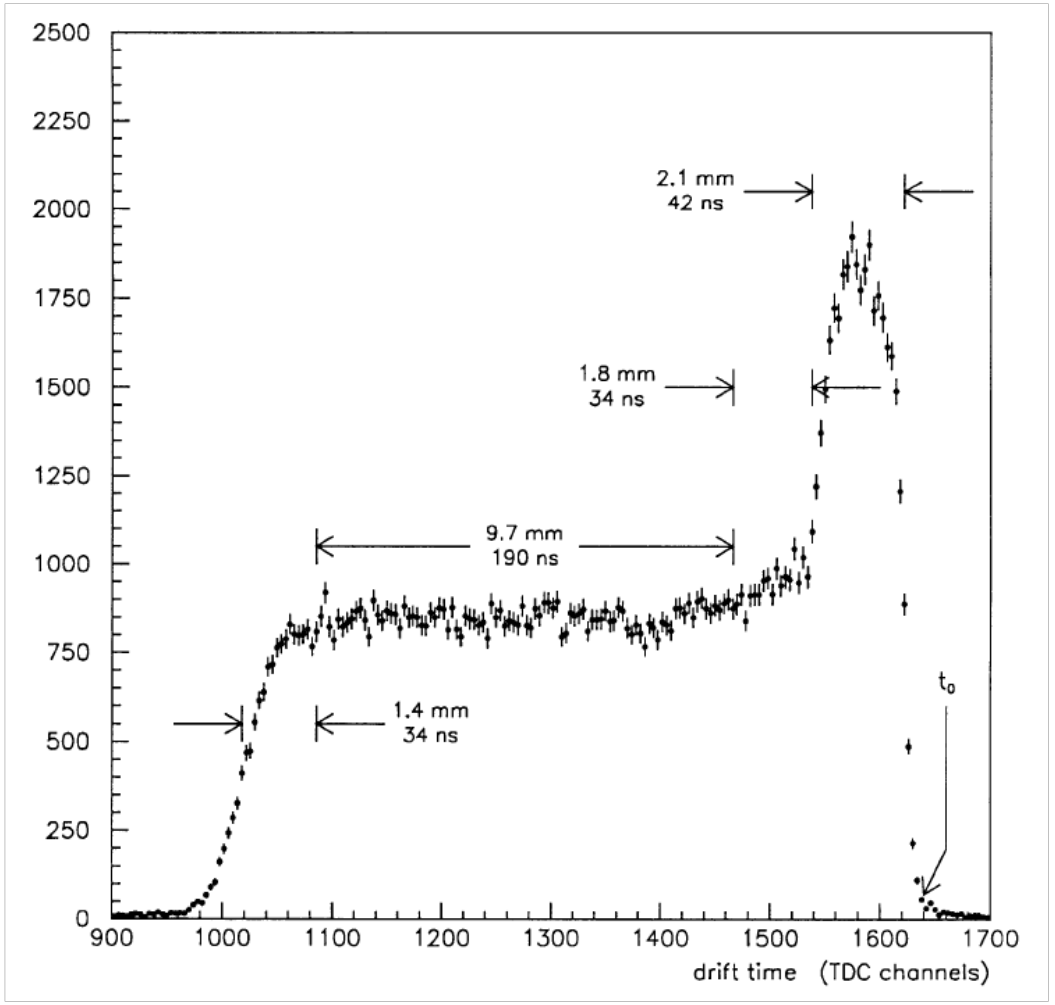
- An event is defined as two sense wires firing with a third between them. If the third also fired the event is efficient for the third wire.
- A wire's efficiency is given by: $\epsilon = \frac{\kappa}{\kappa + \lambda}$

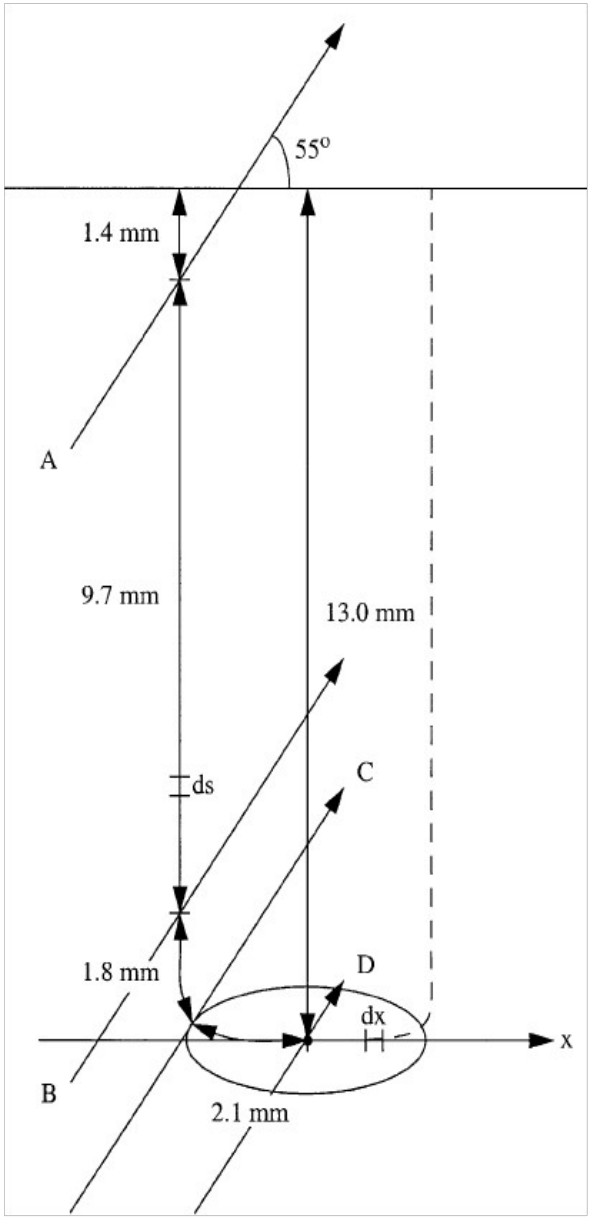




Drift Time

- Common stop TDCs → Large TDC values indicate short drift times.





TDC Explanation

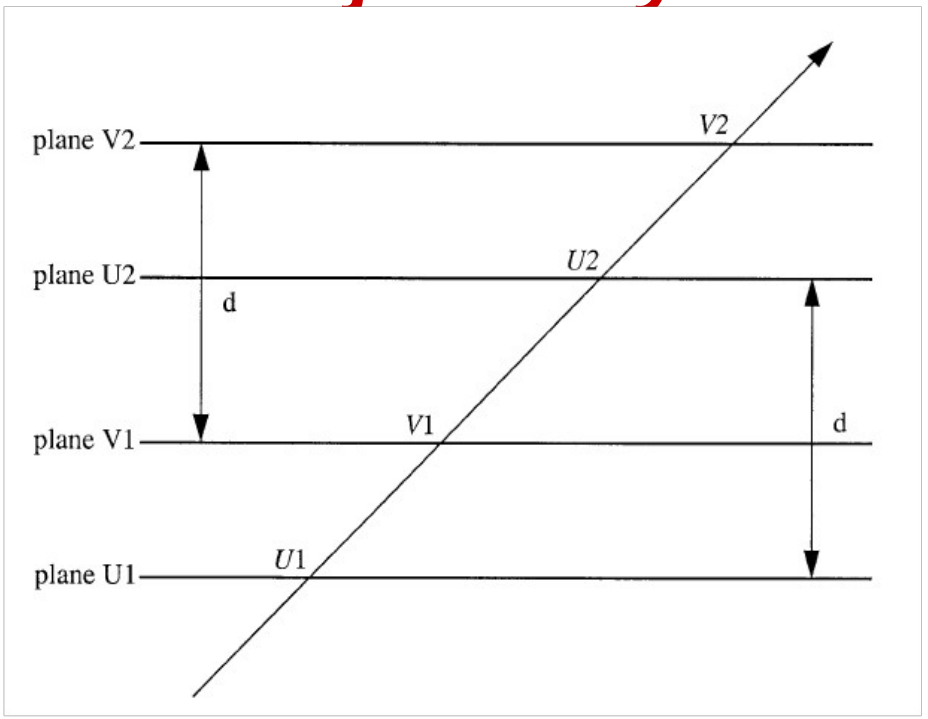
- Region A 1020-1080: Large trajectory angles. Intersect less of the cell → lower detection probability.
- Region B 1080-1460: Bulk of the cell. Flat parallel field lines → constant drift velocity.
- Region C 1460-1540: Field lines become quasiradial. Drift velocity is roughly constant but the track density increases.
- Region D 1540-1620: Close to the sense wires we reach a maximal track density and a dramatic increase in drift velocity.

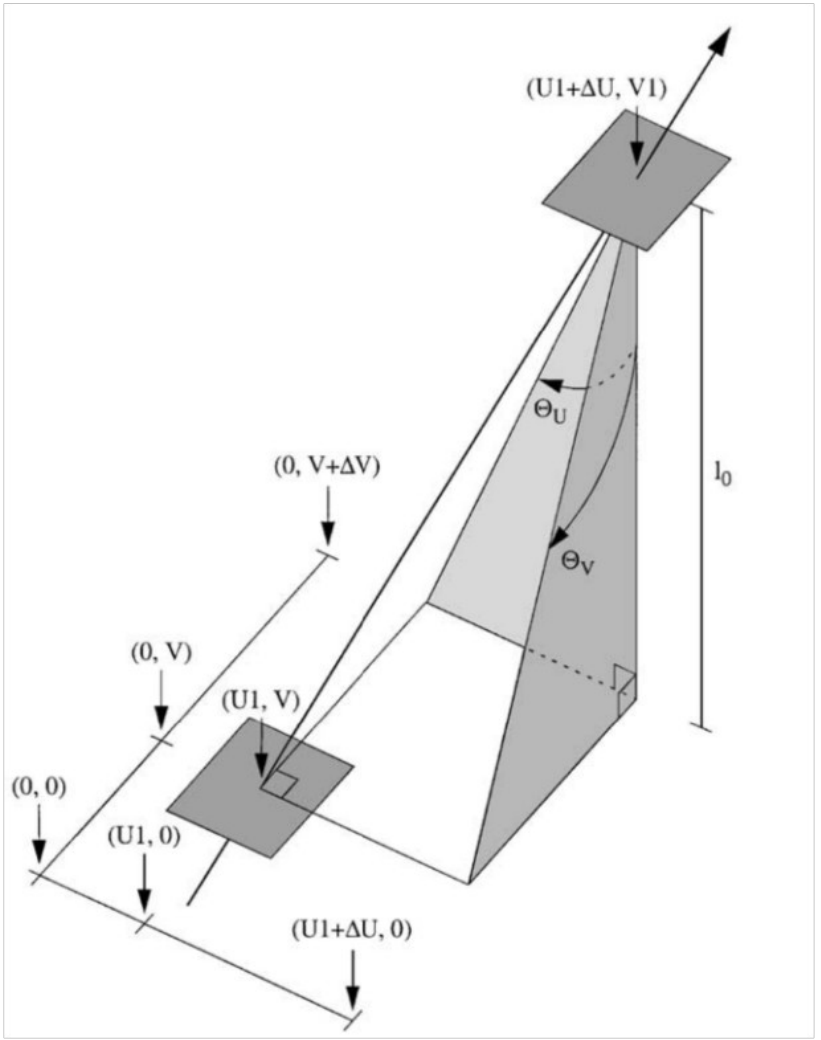
Drift Time to Drift Distance

- Reference Time (t_0): Chosen by differentiating the short drift time region (~1600) to find the maximum slope.
- Numerous algorithms to convert from time to distance.
- Integrate over the number of events per time bin with a calibration constant (k) for the drift cell size.

$$x(t') = \frac{1}{k} \int_{t_0}^{t'} \left(\frac{dN}{dt} \right) dt$$

Trajectory Reconstruction





- Trajectory defined by (U,V,θ_U,θ_V).

$$\tan\left(\theta_{(U,V)}\right)=\frac{U2-U1}{d} \qquad U=U1$$

$$V=V1-\Delta V=V1-l_0\tan\left(\theta_V\right)$$

Questions?

References:

- Fissum, K.g, W. Bertozzi, J.p Chen, D. Dale, H.c Fenker, J. Gao, A. Gavalya, S. Gilad, C.r Leathers, N. Liyanage, R.o Michaels, E.a.j.m Offermann, J. Segal, J.a Templon, R. Wechsler, B. Wojtsekhowski, and J. Zhao. "Vertical Drift Chambers for the Hall A High-resolution Spectrometers at Jefferson Lab." Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 474.2 (2001): 108-31. Web. 25 Oct. 2016.
- "Basic Instrumentation for Hall A at Jefferson Lab." Basic Instrumentation for Hall A at Jefferson Lab. Elsevier, 13 Feb. 2001. Web. 25 Oct. 2016.