Construction and Testing of Multiwire Drift Chamber for SHMS in HALL C

Debaditya Biswas
Graduate Student
Hampton University, VA, USA

30th Annual Hampton University Graduate Studies Program
Jefferson Lab, Newport News, Virginia
June 1-19, 2015
outline

- SHMS of HALL C
- Construction of single wire plane
- Electric field inside the chamber
- Basic working principle of drift chamber
- Left right ambiguity
- Drift Velocity vs drift field
- Drift Chamber Gases
- Response of the chamber with cosmic ray and with external sources
- Method of drift chamber efficiency testing
- acknowledgements
Super High Momentum Spectrometer
3 Dimensional diagram of drift chamber block of SHMS
Basic construction of single wire plane

- Signal wire: diameter: 20 micrometer; material: gold plated tungstane
- Field wire: diameter: 100 micrometer; material: copper plated berillium
- Distance between two consecutive signal wires (or between two consecutive field wires) is 1 cm

- ~220 wires
- Angled

- ~160 wires
- Horizontal
Field wires are used in between two signal wires to make the electric field more uniform inside.
Basic working principle of drift chamber

- Particle track
- Gas ionization
- Signal wires (cross section)
- Amplifier cards
- ECL signal (emitter coupled logic)
- ECL to NIM converter (part of the NIM crate)
- NIM (nuclear instrumentation module) signal
- Logic pulse
Left right ambiguity

Particle track at the left of the $x_3$ signal wire

Particle track on the right of the $x_3$ signal wire

$X_3'$ and $x_3$ give signal when the particle track at the left of the $X_3$ Signal wire

$X_4'$ and $X_3$ give signal when the particle track at the right of the $X_3$ signal wire
Drift velocity vs drift field for Ar and isobuten mixture

- With high enough drift field the drift velocity is fairly constant. Which ensures the less dependence of the drift velocity on local gradient of the electric field.
- The gas mixture should also be chosen like that this graph holds true.
Drift Chamber Gases

- Gases which are used in drift chambers must have these qualities
  - low working voltage
  - High Gain
  - Good Proportionality
  - High Rate capacity
- Argon and Ethen Mixture is used in Hall C drift chambers
- For primary testing we are using Argon and Carbon dioxide mixture as ethen in flamable
- Incoming charged particles ionize the Argon Gas
- Carbon dioxide and ethen are used as quenching gases
Response of a block (16 wires) of one X plane with cosmic rays with different HV
Response of a block (16 wires) of one X plane with Cs and Sr sources (cosmic ray as background) with different HV
Testing of chambers for the efficiency measurement
Testing of chambers for the efficiency measurement

Efficiency = \frac{\text{Triple coincidence}}{\text{Double coincidence}}

Diagram:
- Scintillator 1
- Scintillator 2
- Drift chamber
- Particle track
Acknowledgements

- Dr. M Eric Christy, Associate Professor, Hampton University

- Dr. Narbe Kalantarians, Post Doctoral Fellow, Hampton University
Thank You!