Construction of Drift Chambers for Drell-Yan Measurement at FNAL SeaQuest

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Drift Chambers

SeaQuest Japanese group constructs & operates two drift chambers at Station 3 (St. 3+ & St. 3–)

Performance Requirements

- Position resolution: 400 micron in horizon direction
- Muons are bent in horizontal plane
- Rate tolerance: ≤ 1 kHz in wire length of 1 mm
- Backgrounds due to muons from J/ψ decay

Drift Property

- HV: –2.4 kV (cathode & field), –1.4 kV (guard)
- Gas: Argon (86%) + Methane (10%) + CF4 (4%)
- Position resolution: 400 micron

Operation

- Gas: Argon (98%) + Methane (10%) + CF4 (4%)
- HV: –2.4 kV (cathode & field), –1.4 kV (guard)

Position & direction of sense wires

- 8 planes
- 14° tilt in U & V

Detection Efficiency

- Measurement with test chamber & Ar:CO2 (80% : 20%)
- Definition: efficiency of detecting one track by one plane
- Tension of wires

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Summary & Plan

- SeaQuest measures Drell-Yan process, q + q → γ∗ → μ+ + μ–, in proton-proton reaction with 120 GeV proton beam at FNAL
- SeaQuest Japanese group constructs & operates two drift chambers at Station 3 (St. 3+, St. 3–)
- The detail of the chamber characteristics are shown above
- St. 3+ chamber has been tested with the commissioning beam and with cosmic rays and 120 GeV hadron absorber, D-Y near J/ψ, D-Y w/ high mass, etc.
- To be compared with measurement
- Drell-Yan process in proton-proton reaction

Experiments Schedule

- Beam experiment for commissioning ... March & April of 2012
- Spectrometer upgrade ... Now
- Beam experiment for physics ... Spring of 2013

For Details & Commissioning Status ... Poster by F. Sanft

Construction of New St. 3– Chamber

New St. 3– chamber is being constructed at FNAL toward the physics run.

Procedures

2012

02 Constructed the frame parts @ Japan
03 Transported the frame parts to Fermilab
06 Assembled the frame
07-10 Stratched all wires
11-12 Build & attach the Mylar windows / Start gas flow

2013

1-2 Build & attach the electronics for readout & HV / Start HV training
6 Test
4 Start the physics run

Strengthening Wires

- 5,154 wires ... 768 of sense wires & 4386 of other wires
- Optimized procedure
- 2 minutes/wire
- 4 hours/day ... 2 shifts/day x 2 months
- Tension of wires
- Adjusted by a metal block hanged
- 75 g for sense wires & 130 g for other wires
- Accuracy: 90% required & 95% (± 3σ) achieved!

Measuring Wire Tensions

- Measure the eigen frequency (f) of wire free oscillation
- External pulse w/ fex, initiates the oscillation
- Oscillation is detected as induced voltage
- Amplitude gets maximum & f = frex
- Derive tension (f) from f by

Q = \frac{4πL^2f^2}{T}

- Accuracy: 6.5%