EXPLORING LIGHT ANTI-QUARK ASYMMETRY WITH THE SEAQUEST EXPERIMENT

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DRELL-YAN FIXED TARGET EXPERIMENT AT FERMILAB

- What is the structure of the nucleon?
  - What is \( \bar{d}/\bar{u} \)?
  - What is the origin of the sea quarks?
- What is the structure of nucleonic matter?
  - What is \( \bar{d}/\bar{u} \) in Fe, C, and W?
- SeaQuest: 2012 – 2015
  - Significant increase in physics reach
- Beyond SeaQuest
  - High-luminosity Drell-Yan program: complementary to spin programs at RHIC and JLAB
  - Polarized beam at Fermilab Main Injector (see C. Aidala’s talk, JC 00003)
  - Polarized target at Main Injector (see K. Lee’s talk, JC 00006)
**SEAQUEST STATUS**

- Commissioning Run: Late Feb. 2012 – April 30th 2012
- First beam on March 8th 2012
- Main Injector shut down began on May 1st 2012 (for 12 months)
- Extensive beam tuning by the Fermilab accelerator group
  - $1 \times 10^{12}$ protons/s (5s spill/min)
  - 120GeV
- Cryogenic target systems ($LH_2$ and $LD_2$) worked smoothly
- All the detector subsystems worked
  - Improvements underway
- Reconstructed di-muon events seen
- Analysis underway

**Successful Run**
TARGET SETUP

- Hydrogen Cryostat
- Deuterium Cryostat
- Hydrogen Flask
- Empty Flask
- Deuterium Flask
TARGET IN THE ENCLOSORE

5 Targets
- $LH_2$
- Empty Flask
- $LD_2$
- “No Target”
- Fe
- C
- W

Motion Table
PLC controlled
H2 Pumpcart Outside the Enclosure

- **PI-05-N**: Pneumatic pressure at electro-pneumatic valves
- **PI-07-H**: H2 supply line pressure
- **Pneumatic output from EV-H2VV to safety relief valve (PV-H2VV)**
- **MV-02-N**: Pneumatic (air) input to electro-pneumatic valves
- **RV-02-H**: H2 supply line regulator
- **Exhaust lines for pumps. Attaches to vent pipe to go outside of building.**
- **H2 supply**
- **MV-08-N**: Pneumatic input to EV-H2VV
- **Rough Pump**
The cooldown takes less than an hour. But the actual fill during the experiment took 16h for $H_2$ and 12h for $D_2$. 

$H_2$ COOLDOWN CURVE

H2 Cooldown 3-14-2012

H2 20.28K
D2 23.66K
Detectors’ Hits

Hodoscopes – provide triggers

Wire Chambers & Proportional Tubes

- Detectors showed hits consistent with their orientation/geometry
- Final check of their calibration on-going
- New Station 1 and Station 3 chambers for the next run!
WHAT IS THE HOUGH TRANSFORMATION?

For a given point $P_0(x_0, y_0)$, any straight line passing it can be written out with two parameters $(r, \varphi)$:

$$x \cos \varphi + y \sin \varphi = r,$$

where

$$r(\varphi) = x_0 \cos \varphi + y_0 \sin \varphi$$

is a sinusoidal curve in the $(r, \varphi)$ space, or the Hough Space.
50 S I G N A L + 1 0 B A C K G R O U N D

Euclidean Space

Hough Space

Approximate Intersection Point
Peak(s) in the Hough Space

Counts

\( r \)

\( \varphi \)
Hough transformation “thinks” the red squares should form a line. The red line is from least square fit.
TWO TRACKS
TWO TRACKS
TRACKING

- Generalize to 3D
  - Straight lines in 3D space can be projected onto $x - z$ and $y - z$ plane to get two separated, though interrelated 2D straight lines.
  - As long as we do well with 2D tracking, we do well for 3D tracks.

- A new approach for E906
  - More efficient/robust for many hits with noise
  - Very promising approach to tracking