GlueX/Hall-D Solenoid Current Studies

Interim Report

17-September, 2014

Curtis Meyer

Studies Performed

- Two final states chosen for the study:

$$\gamma p \to p\eta\pi^+\pi^- \quad (\eta \to \gamma\gamma)$$

$$\gamma p \to p\omega\pi^+\pi^- \quad (\omega \to \pi^+\pi^-\pi^0)$$

Actually need to examine

$$\gamma p \to p\pi^+\pi^-\pi^+\pi^-\pi^0$$

- Reactions examined with detected and missing proton.

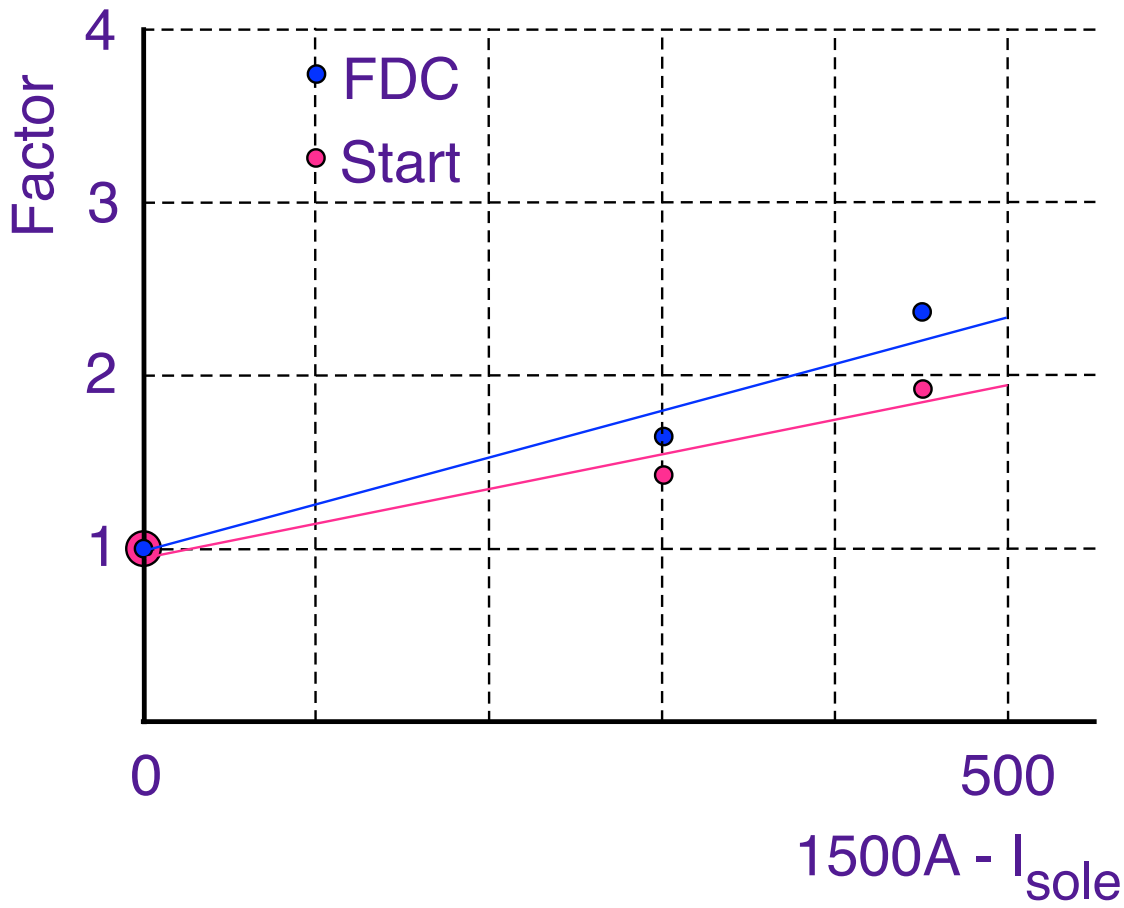
Studies Performed

- Three solenoid currents were chosen:
  - 1500 A (Design current)
  - 1350 A
  - 1200 A
- Two electromagnetic background rates were examined:
  - 1 (10^7) γ/s in coherent peak (Phase III Running).
  - 5 (10^7) γ/s in coherent peak (Phase IV Running).
- Results taken from earlier study on electromagnetic rates in detector elements.

Quantities Examined

- Electromagnetic background rates in the detector.
- Momentum resolution of charged particles.
- Angular resolution of charged particles.
  - In the lab frames.
  - In the Gottfried-Jackson frame.
- Invariant mass resolution.
- Reconstruction efficiency at 90% and 99% purity.

Electromagnetic Rates



1300A current leads to rates that are 50% higher than 1500A current.

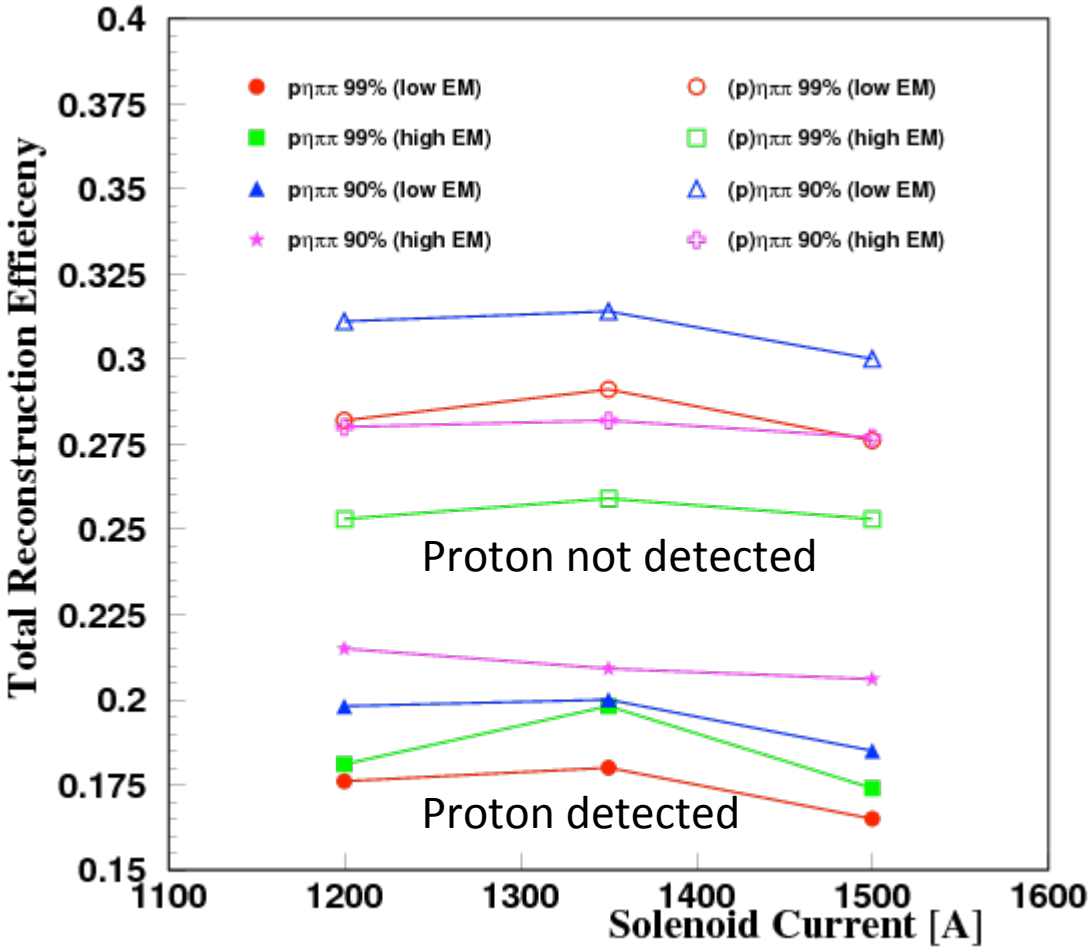
Worst case is 50% longer running for the same result. Our high-intensity proposal assumes a factor of 2 below design rates.

- Rates increase by 20% to 30% for each drop of 100A in solenoid current.
- Absolute rates will not be known until we have data.

Momentum and Angular Resolutions

- Momentum resolution decreases linearly with the magnetic field strength. Running at 1300A decreases the momentum resolution by 13% (as expected).
- Angular resolution in both the lab and GJ frame appear independent of the magnetic field (as expected).
- Invariant mass resolution decreases less rapidly than momentum resolution. A 20% drop in momentum resolution led to a 10% increase in the width of an invariant mass.

Reconstruction Efficiency: ηππ



Dependence is not strong.

Reported errors are too small.

It would not be surprising for higher-multiplicity final states to have their efficiency improve as the number of low-momentum pions is larger.

Results from the ωππ channel hinted that there is an efficiency improvement at lower fields. Work is being repeated due to a problem.

We are on track to having the ωππ channel done soon.

Summary

- From what we see now, we do not feel that our initial program will be significantly impacted if we run at 1300A-1350A current.

- The high-intensity running may be limited due to EM backgrounds in detector elements and solenoid currents higher than 1350A may ultimately be needed. The answer to this will require actual running with photon beams.