Beamline improvement during g2p experiment

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$q^2 \ 0.02-0.20 \text{ GeV}^2$

6° forward angle detection
Review for g2p

Polarized NH3 target

- 1K Refrigerator
- 2.5/5T Transverse target field

Polarization influencing factors:
- Temperature
- Radiation damage
- ...

Low Current ~ 50nA
g2p Beamline

New for g2p:
- Slow Raster
- Chicane
- New BPM, BCM Receiver
- Super Harp
- Local Beam Dump

Used before, added back:
- Tungsten Calorimeter
- Septum
Raster System

- Fast Raster: ~2mm
- Slow Raster: ~2cm

- minimize depolarization
- reduce radiation damage
- less systematic error for target polarization measurement
Beam Position Monitor

Space limit: <1m from FZ2 chicane magnet to target,
Can not use cavity beam position monitor
2 M15 Antenna BPM and 1 superharp installed between target and FZ2
New BPM Receiver

Analog Part

- LNA
- Multiply Mixer
- Local Oscillator
- 1497MHz

Digital Part

- ADC
- CIC Filter
- IIR Filter
- CORDIC
- Div n
- DAC
- Epics
- DAQ
- 0~10V

Harmonic sampling
Sample Rate: 36MSPS

\[ |R| = \sqrt{I^2 + Q^2} \]
\[ \phi = \tan^{-1}\left(\frac{Q}{I}\right) \]

Cascaded integrator-comb filter

Noise limit
exclude out-of-band signal

Calculate |R| and \( \phi \)

\[ \sin \theta \sin \phi = \frac{1}{2} \cos(\theta - \phi) - \frac{1}{2} \cos(\theta + \phi) \]

Infinite impulse response filter

BW = 175Hz

We can not see fast raster signal

Thanks John Musson, Trent Allison, Keith Cole
BPMA is always good
BPMB is worse than BPMA, more noise
Using fake signal to test, the problem is not from BPM receiver
Radiation damage and Magnet field (400gaus in BPMB, and 200gaus in BPMA) will affect it.

Resolution: ~0.18mm in 50nA
Super Harp  -------------> Calibrate 2 BPMs

Did the harp scan in ~5uA pulser beam
At the same position took run in 100~50nA CW beam

Calibrate in Straight Through Configuration

50um wires
Works in pulser beam mode

Signal length

Wire position (mm)
Super Harp problem during experiment

Noise from wire motion

- Low wire speed 0.5~1 mm/s
- High wire speed 1~6 mm/s
New BCM Receiver

Calibration:
Low current ~50nA
Faraday Cup and Unser not working
Use Tungsten Calorimeter
Tungsten Calorimeter    ------->     Calibrate BCM

Use Temperature To Calibrate Charge

calculated charge with scaler count,
Current using 25,50,75,100nA
Chicane Magnet

2.5/5T Transverse Target Magnet Field
Used for banding beam to hall A dump
Or minimize out of plane angle
Local beam dump

Used for dumping the unscattered beam during 5T run

Works good, The radiation is not very huge.
Summary

- New BPM and BCM receiver for low current
- Added slow raster, chicane, local beam dump, super harp etc for g2p
- BCM and tungsten calorimeter works stable
- Need to fix the harp noise
- BPMA works good, but BPMB is more noisy
Thanks!

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