Beamline Review

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Outline

- Quick Review of 98 Setup
- Component Updates
  - Moller polarimeter
  - Raster
  - SEM
  - Super harp
  - BCM
  - BPM
  - Upstream chicane
  - Downstream line
    - Calculations, simulations
    - 98 background count rates - impact
- Summary

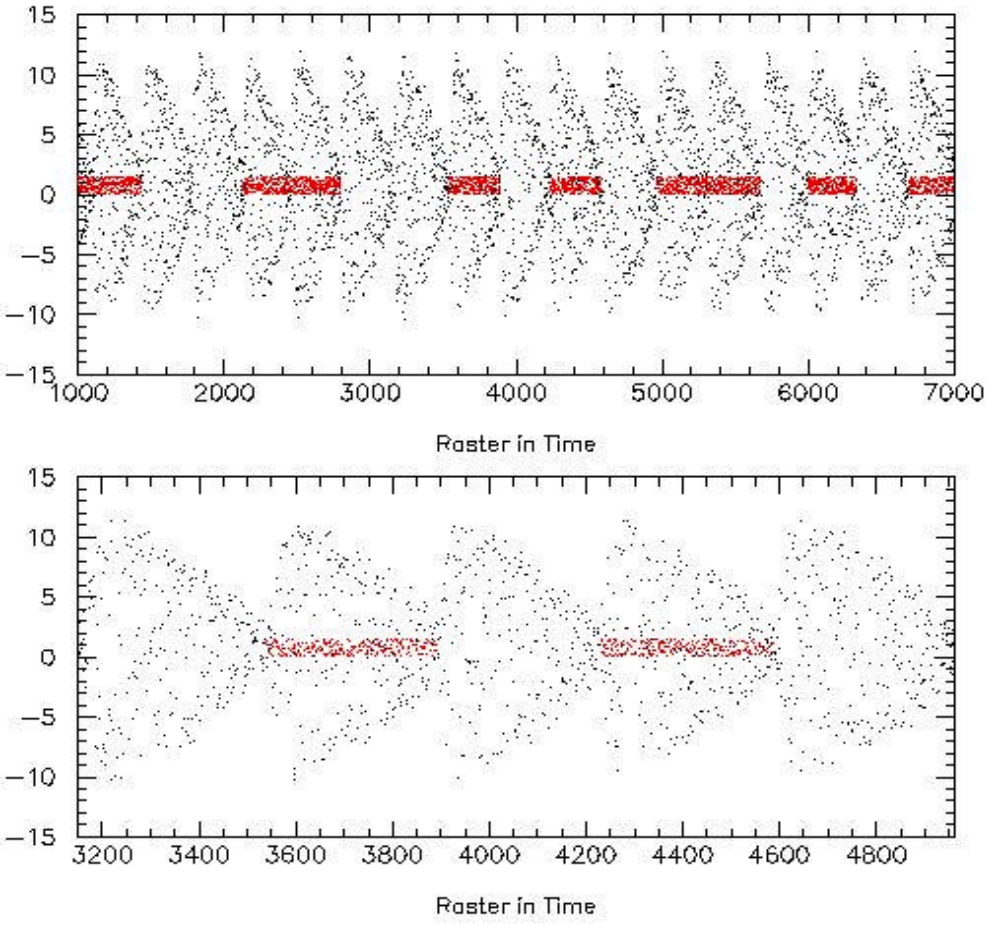
Moller Polarimeter

- Cryogenics was “disaster” in 98
  - Fix in progress
- H. Fenker, S. Danagoulian, and J. Mitchell
- Checkout during E93-038

Raster

- Fast spiral raster
  - Max amplitude 2 mm
- Slow spiral raster 98 (Chen Yan)
  - X and Y ~100 Hz
  - Amplitude modulation ~ 1 Hz
    - Synchronized to helicity flip to suppress false asymmetries
    - fxy/fmod ~ 100 : tight spiral
    - Max amplitude ~ 1cm
- Change to 30 Hz reversal
  - Amplitude modulation 30 Hz synchronized
  - fxy/fmod > 10 for uniform

Raster Sync


15
10
5
0
−5
−10
−15
1000
2000
3000
4000
5000
6000
7000
Raster in Time
15
10
5
0
−5
−10
−15
3200
3400
3600
3800
4000
4200
4400
4600
4800
Raster in Time

Basel SEM

- Primary means of centering rastered beam
  - Close to target, unaffected by fringe field
  - 75 nA < I < 1000 nA
- Primary calibration of raster
  - X required for HMS optics
- Issues:
  - 30 Hz reversal
  - I max - BCM calibrations
    - Retractable ?

Super Harps

- Two harps on last girder
  - Low current operation via PMT
    - did not function in 98
    - PMT gain in field
    - Minimum angle with respect to beam
- S. Danagoulian
  - 200 micron wire
  - diodes ?
- Not crucial but a nice cross check

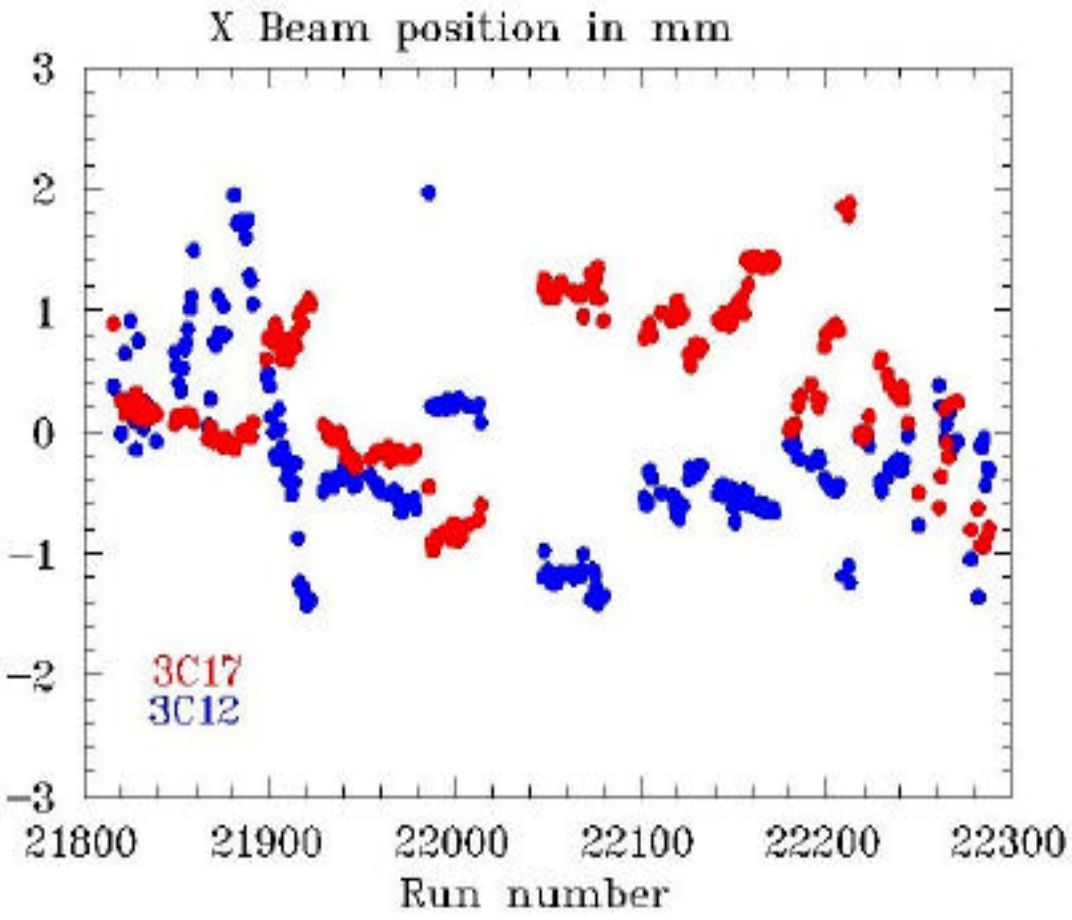
Beam Current

- Hall C BCM1 and BCM2
  - BCM3 was used to limit current
- SEM current restriction made calibrations difficult
  - relative (I^+ vs I^-)
    - suppress current asymmetry at source
  - absolute ~ 5 %
    - Basel BCI ~ 1%
      - Requires special beam
- 30 Hz Reversal
  - 4 times over-sampling

BPM's

- Hall C Beamline instrumented with "hand picked" SEE for low current operations
  - most pretty good at 100 nA
  - discussed possibility of improvement with H. Areti
- Lots of beam motion in 98
  - should be better now
- Last girder used two BPM's with oversized cans to accommodate raster
  - girder stored after 98

Beam Motion
3C12 and 3C17



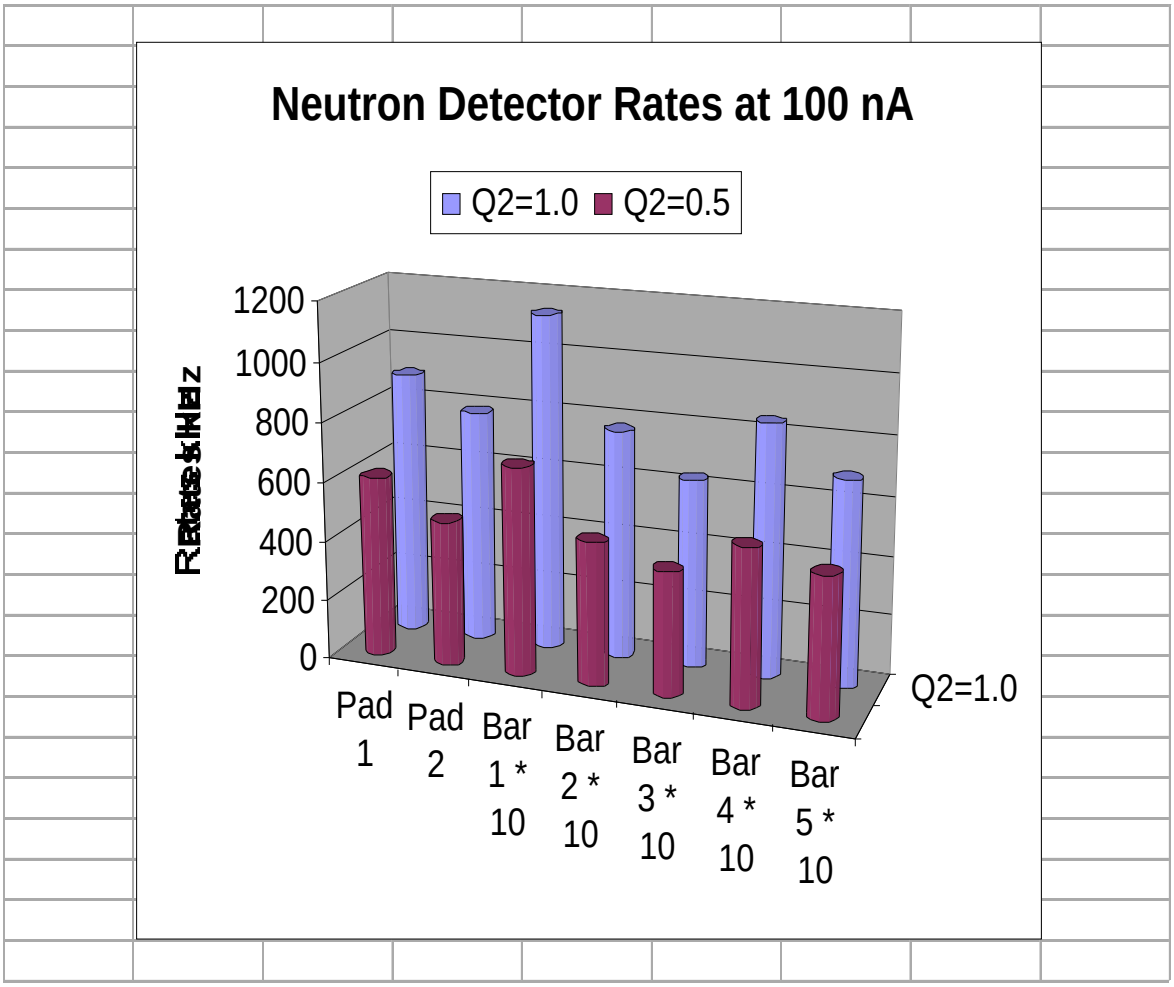
Upstream Chicane

- BE in alcove + BZ on adjustable stand
  - pre-compensate for target field
  - typical deflection ~ 2 degrees
  - BZ ~ 15 cm low
  - Manual adjustment
- Settings
  - Collaboration calculates match point from target field map
  - Accelerator optics (A. Bogacz) calculates chicane fields and magnet positions
  - surveyors position ~ 1 shift

Downstream Beamline

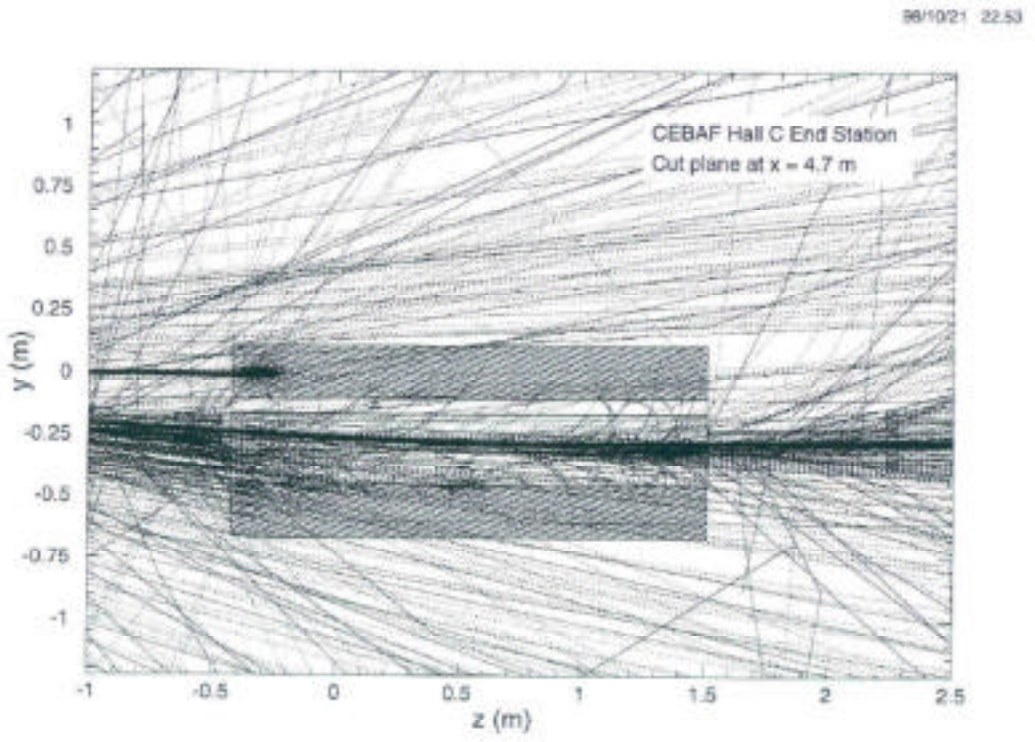
- 98 Downstream chicane
  - Aluminum vacuum line with telescoping diameter from target to several meters past BZ
  - Helium “can” to dump
- Background rates in neutron detector dramatically increased
  - ~ 10 times I_{anode} from 30 μA to 330 μA (hclog 6728 and 6959)
  - rates scale with L_{rad} of target
- Based on “back of envelope” Bremstralung in target blamed
  - later confirmed by Geant (Cole Smith, Pavel Degtiarenko, R. Carlini)

Rates: Basic Facts

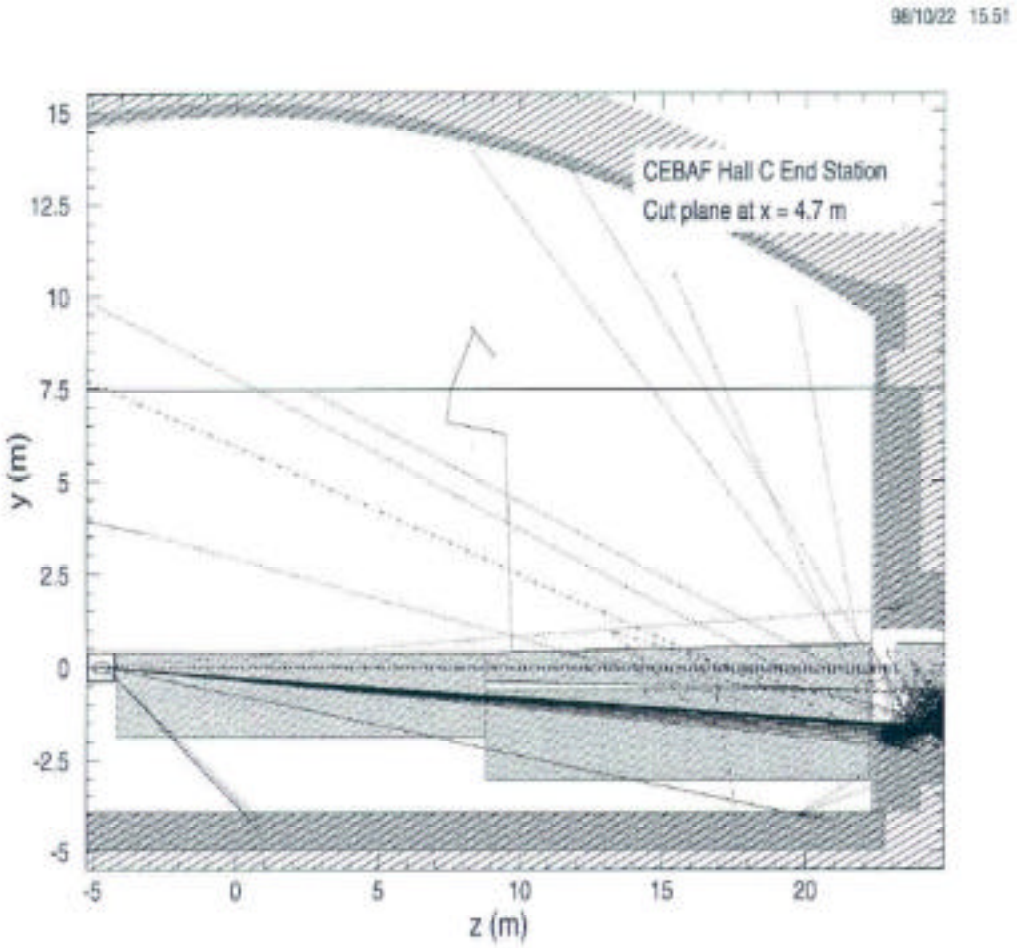


- Paddles count ~ 0.5 to 1.0 MHz
- Bars count ~ 50 to 100 kHz
- Rate Ratio $Q^2=1/Q^2=0.5$ ~ 1.5
  - ~ 4.23/2.72 = 1.55

GEANT of Beam at Downstream BZ



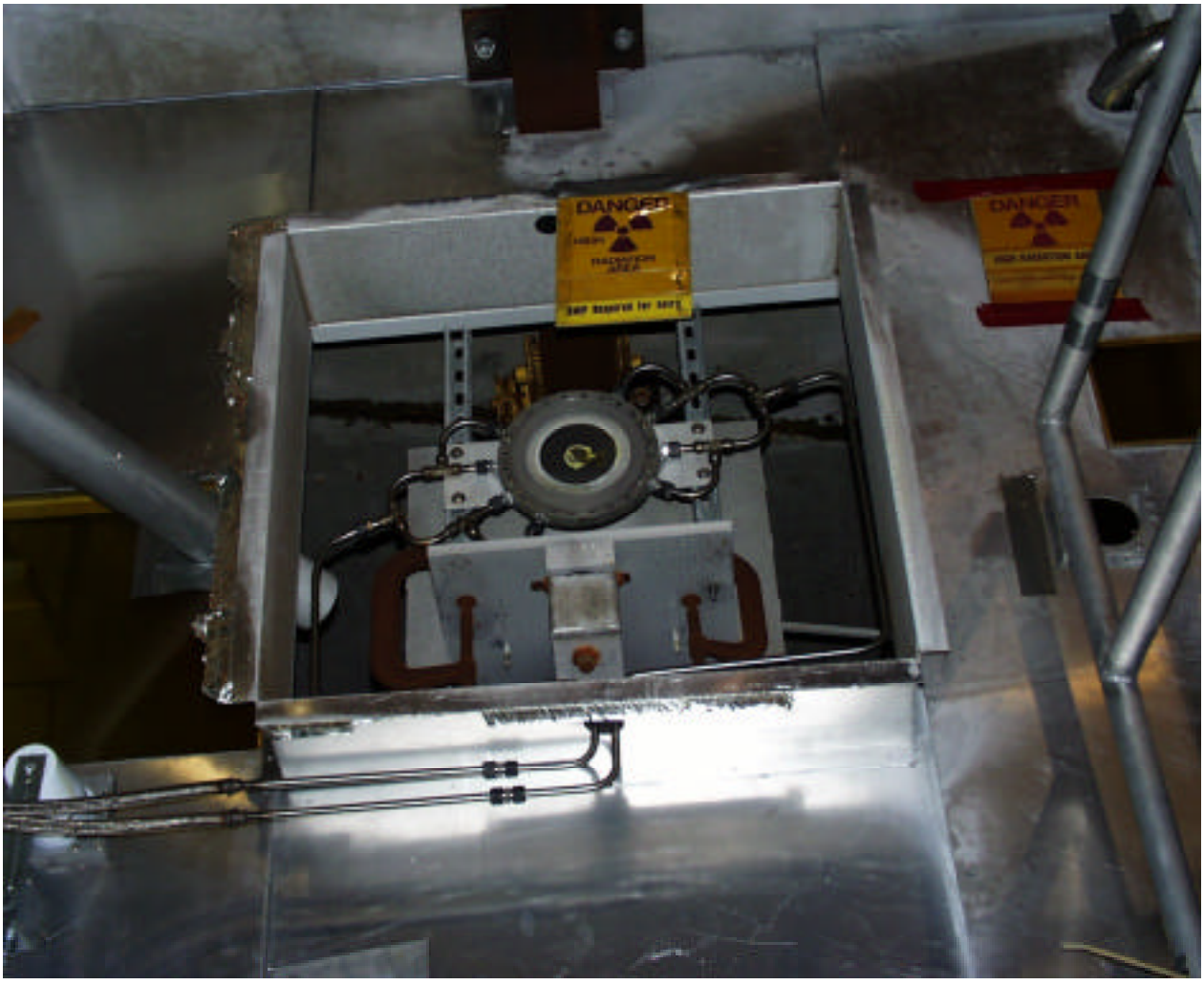
GEANT of Beam to Dump



Observations and Simulations

- Total radiative energy loss scales with beam energy
- Monte Carlo photo-neutron rates
  - $T_N > 50$ MeV 50 ds-bl/1 tgt
  - $T_N > 20$ MeV 100 ds-bl/1 tgt
  - photo-neutron rates 1 to 10 MHz/m^2 at 100 nA ($\varepsilon \sim 0.5$)
- Monte Carlo gamma rates
  - $E_\gamma > 10$ MeV 10 ds-bl/ 1 tgt
- Helium bag to dump
  - leak tight for PMT's !!

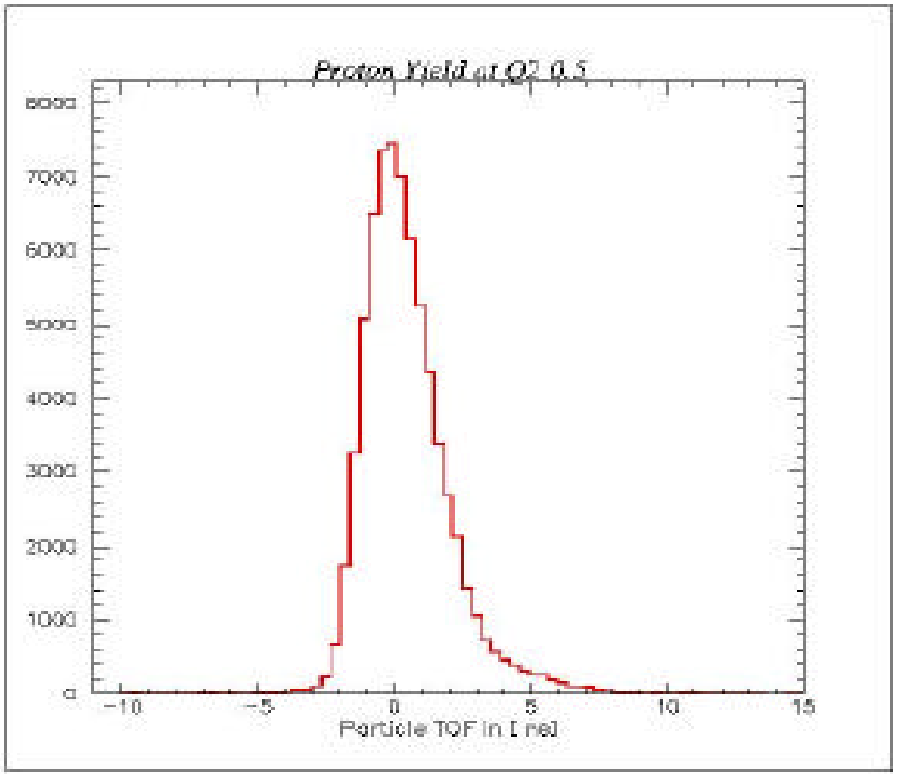
Dump Entrance with Diffuser



Impact of Background Count Rates

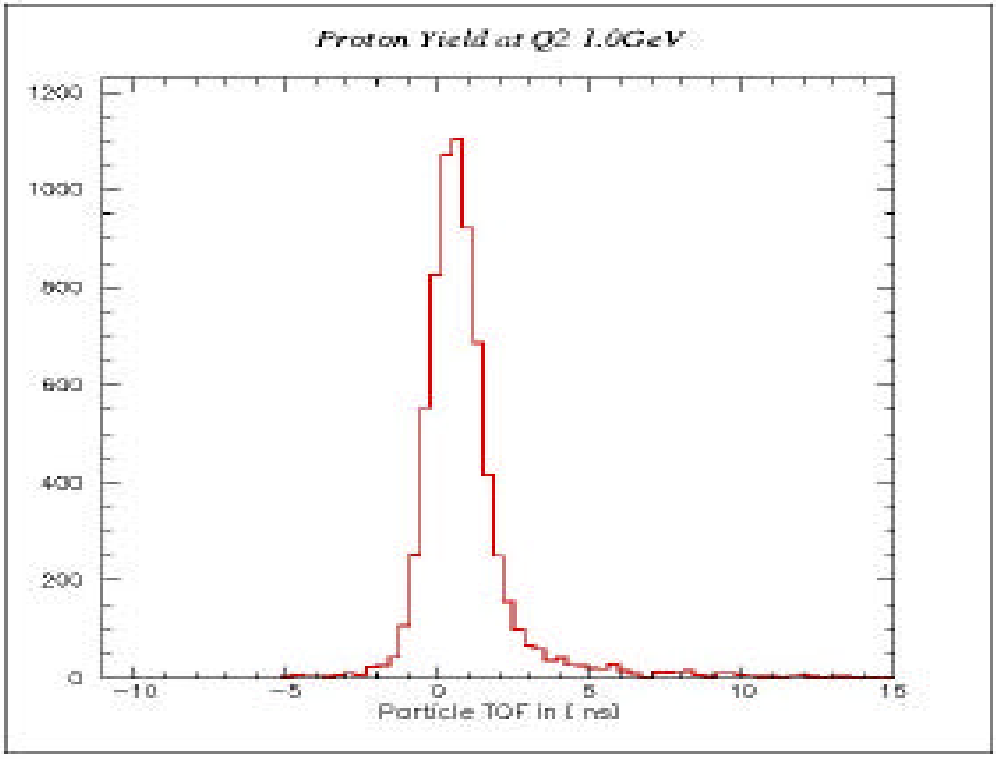
- Lower is better but ?
- Real to random ratio
  - Randoms act as dilution
  - Increased data rate to tape
    - Increased analysis time
- Electronics deadtime
  - Potentially a systematic error
- PMT photo cathode lifetime
  - Gain shift
- Veto efficiency ~ 95 % per plane in 98

Coincidence Timing
Q^2= 0.5 GeV/c
Charged Particles



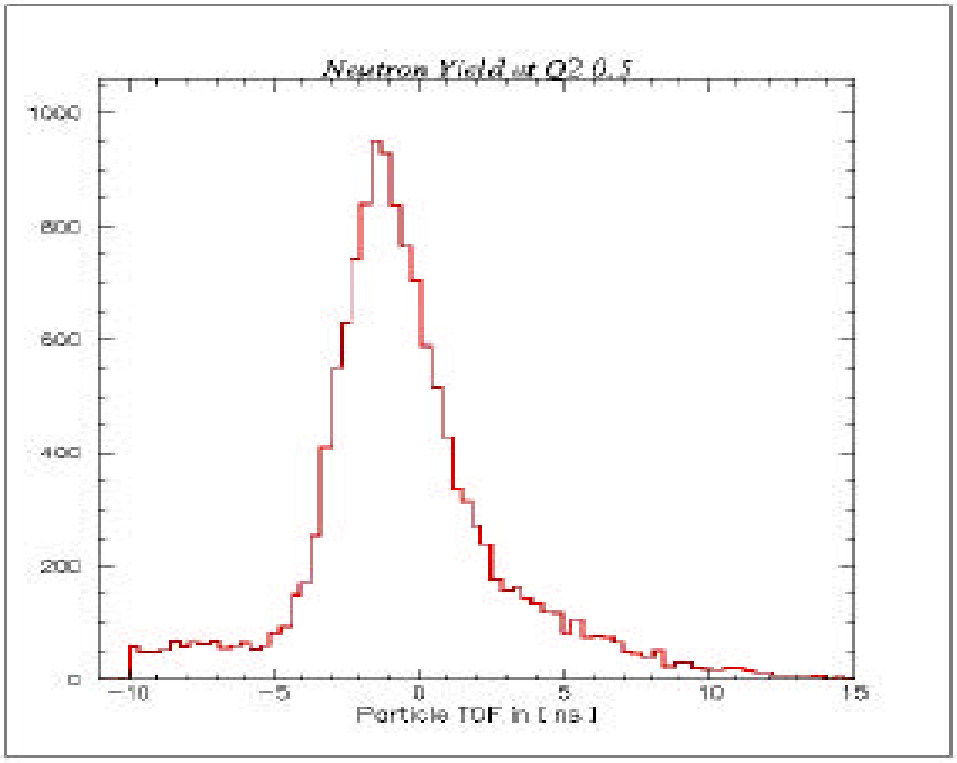
Real to Random Excellent

Coincidence Timing
Q^2= 1.0 GeV/c
Charged Particles



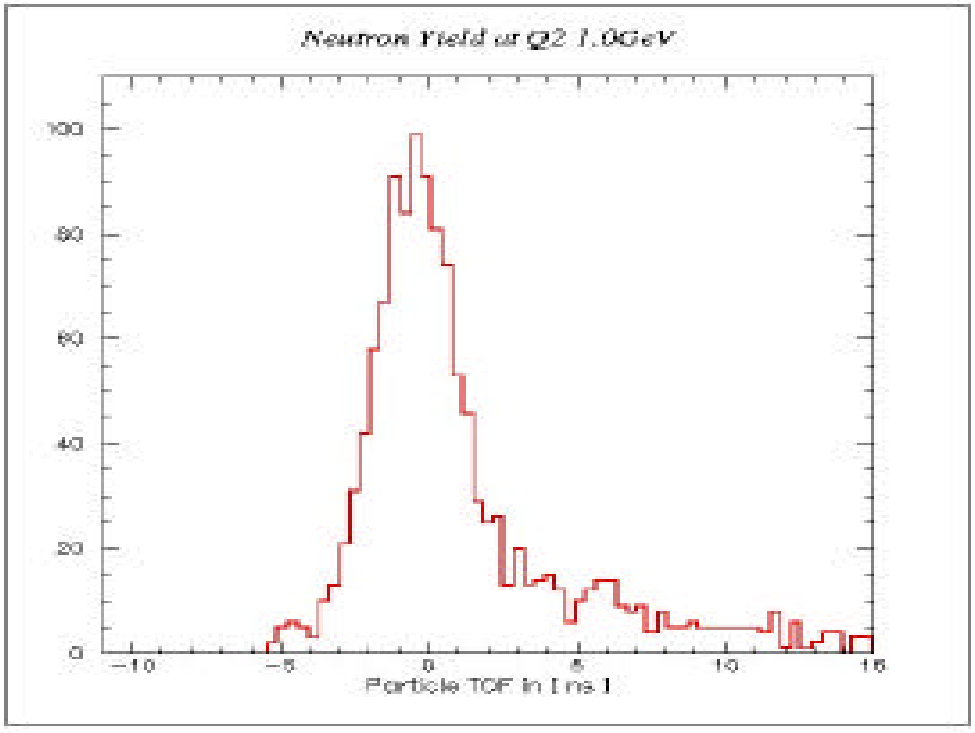
Real to Random Excellent

Coincidence Timing
Q^2= 0.5 GeV/c
Neutral Particles



Real to Random > 15

Coincidence Timing
Q^2= 1.0 GeV/c
Neutral Particles



Real to Random > 10