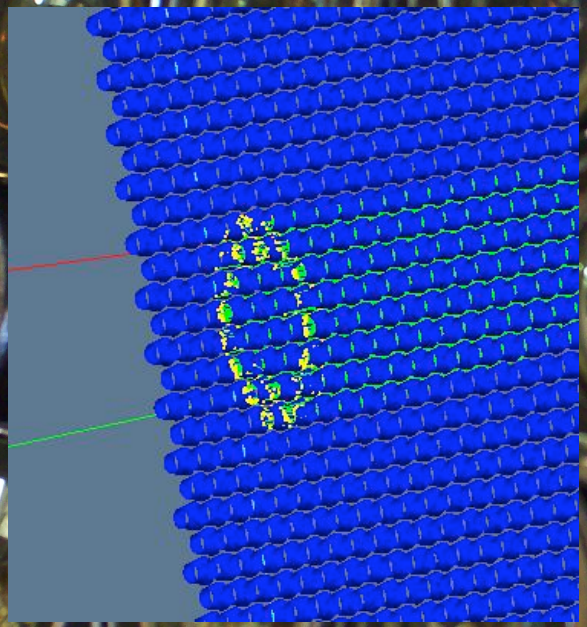
THE GRINCH

Gas Ring Imaging Cherenkov Detector



T. Averett, M. Cummings, Bo Zhao, Valerie Gray William and Mary
B. Wojtsekhowski, Jefferson Lab

BigBite Gas Cherenkov for A_1^n at 12 GeV

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- 12 GeV A_1^n will run with BB at 30 deg. Need good PID in noisy Environment. Commissioning expt for Hall A at 6.6, 8.8 GeV.

- W&M responsibility—design, simulation, prototype, detector construction
- Glasgow—Electronics, BB detector package coordination

- Previous Concept—2,000 tube array of 0.75" diameter PMT's from HERMES RICH
- New Concept—Narrow array of 550 29 mm diameter PMT's
  - Low threshold, high singles rates
  - Find timing clusters of ~10 PMT's using TDC spectrum
  - Timing cut ~10 ns

- Expect to be able to handle 2 MHz or higher background rate per tube.

BigBite Spectrometer with Cherenkov at 30 deg

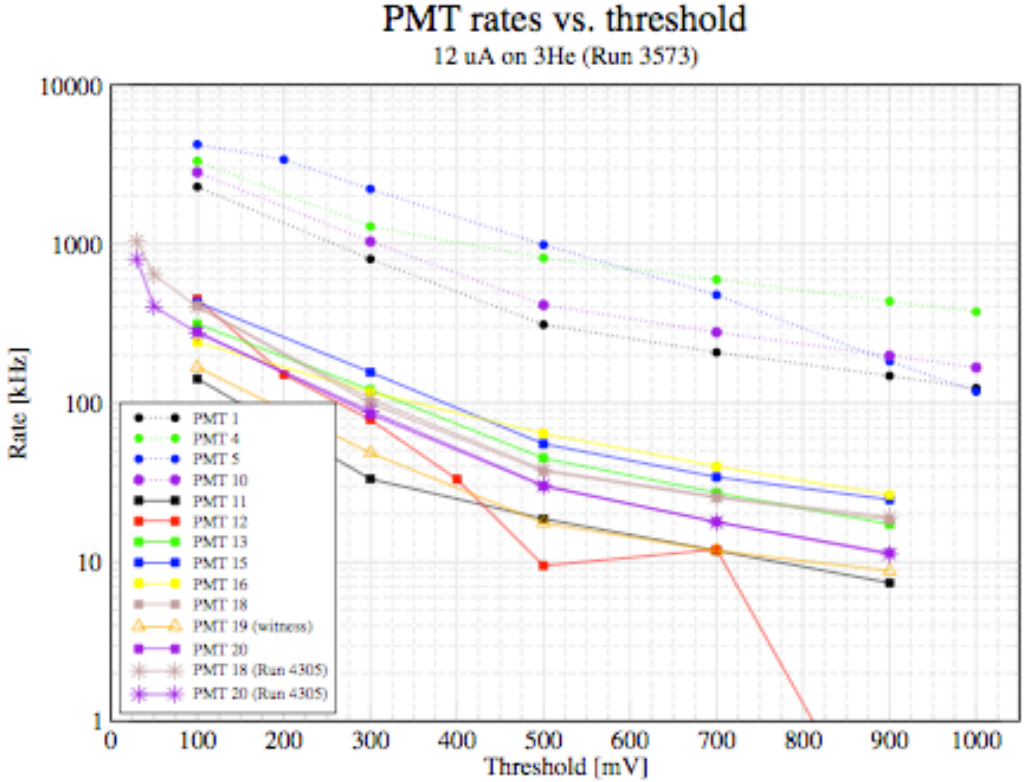
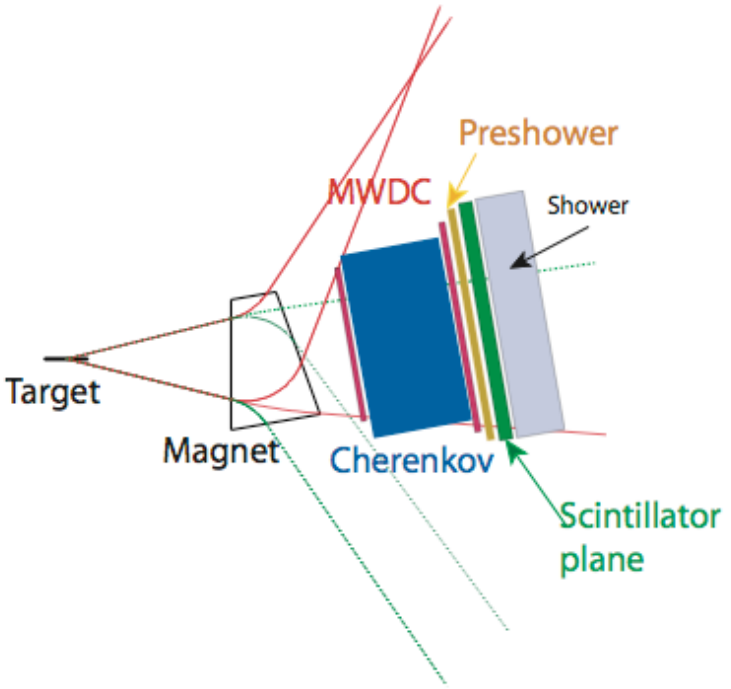


Figure 15: Background rates *vs.* discriminator threshold in the Cerenkov PMTs for 12 μA on the ^{3}He target during Transversity (BigBite at 30°). Gains were matched so that the 1 p.e. signal had an amplitude of roughly 50 mV PMTs 1–10 run from top to bottom nearest the beamline. PMTs 11–20 run from top to bottom on the far (RHRS) side of the BigBite stack.

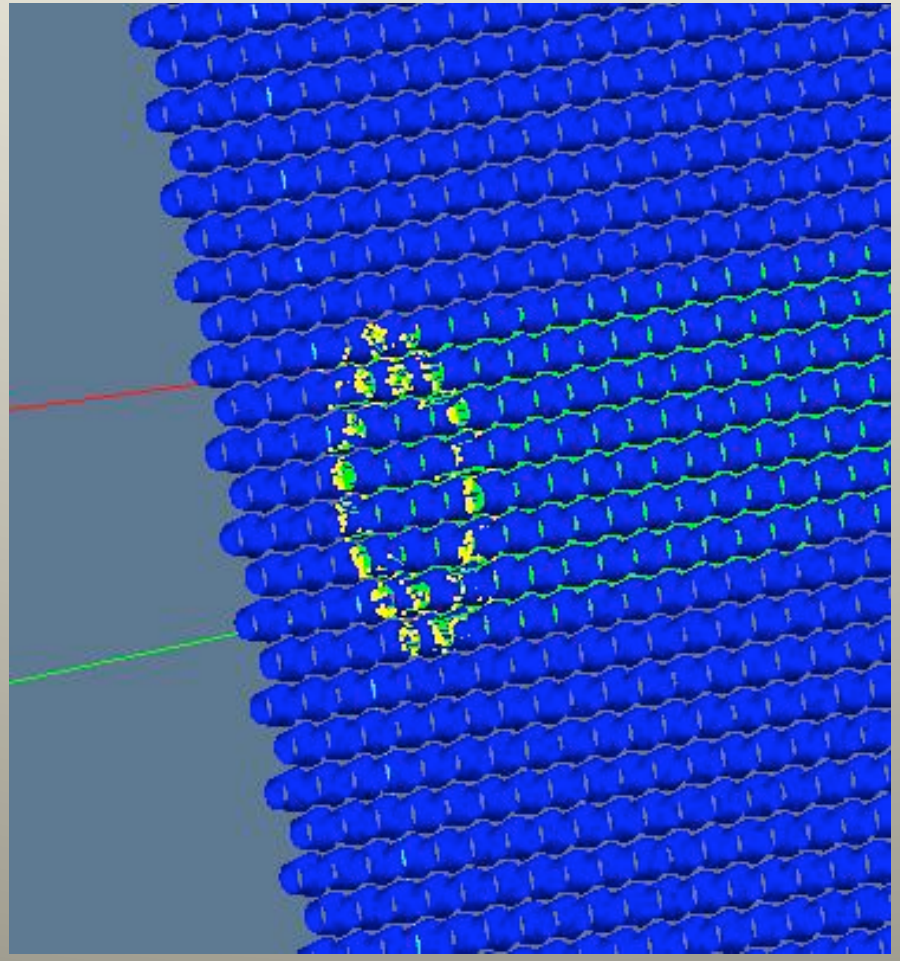


Update on Simulation

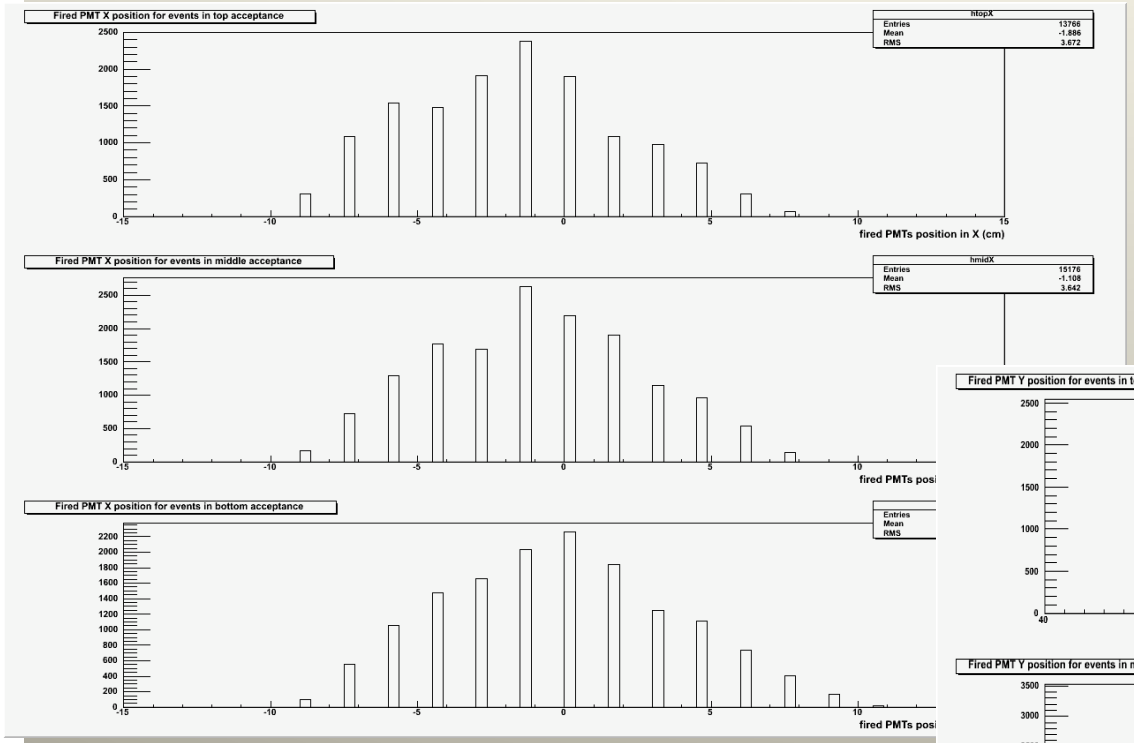
- GEANT4 simulation-Bo Zhao
  - Basic detector and mirror concept complete
  - Results showed narrow stripe of PMT's are sufficient.
  - Basic Design Determined

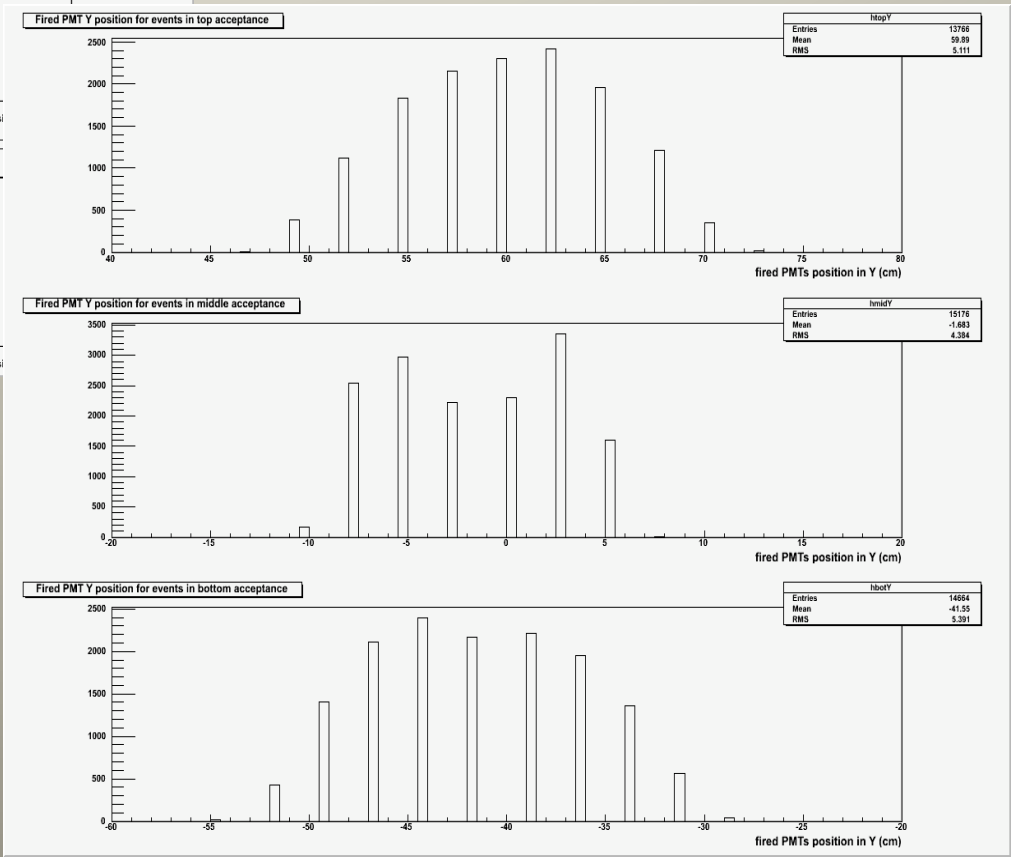
- Design specs:
  - 1.5 atm C_4F_8O (1.0 atm, prev BB Cherenkov)
  - Path length=60-80 cm (40cm)
  - 4 cylindrical mirrors, height=60cm, width=70cm, radii=130cm (40 mirrors)
  - 29mm PMT array on large angle side,
    - Total PMT's needed=550
    - Previous BB Cherenkov—20, 5"PMTs

Cherenkov Ring



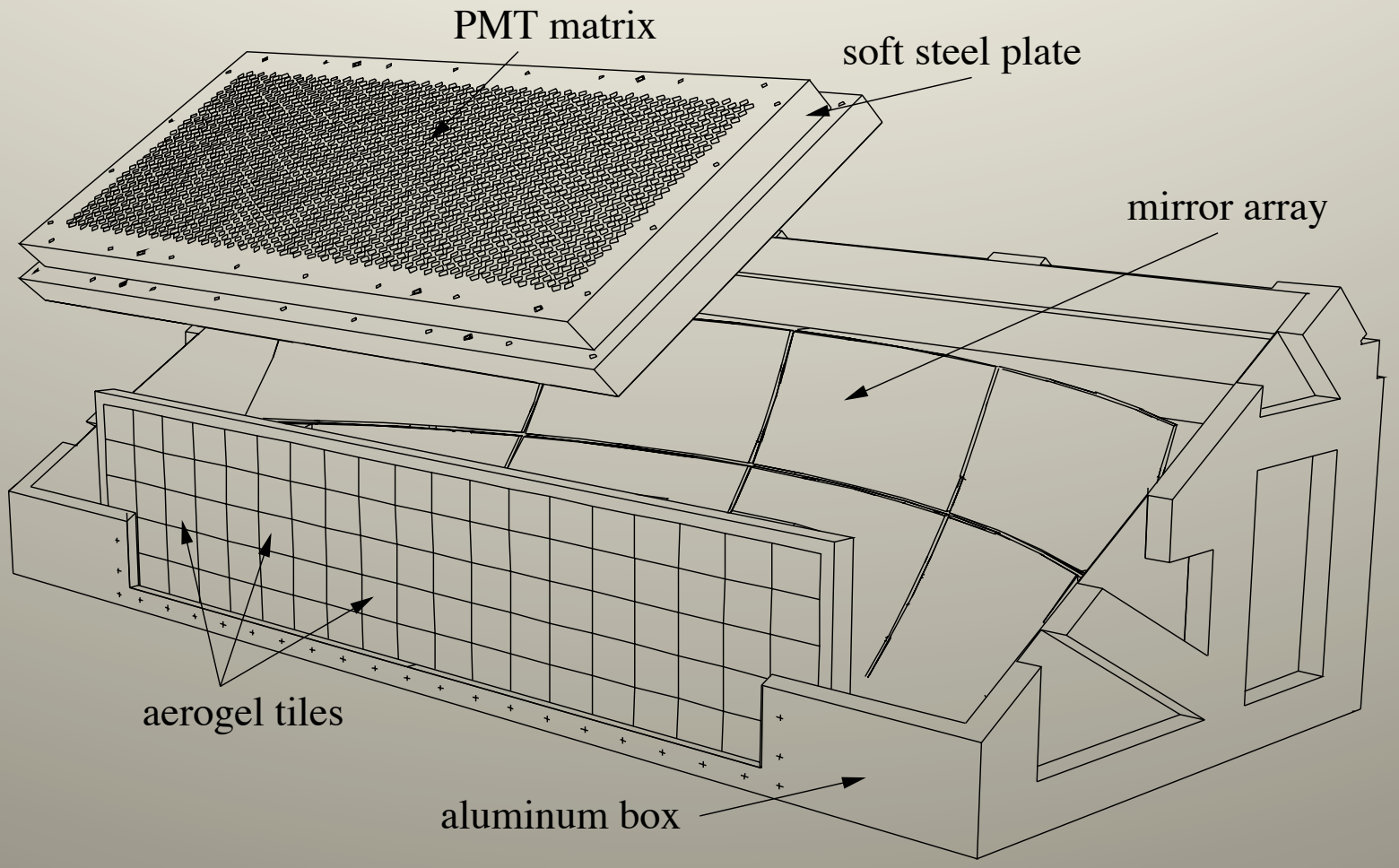
X and Y hit positions at PMTs





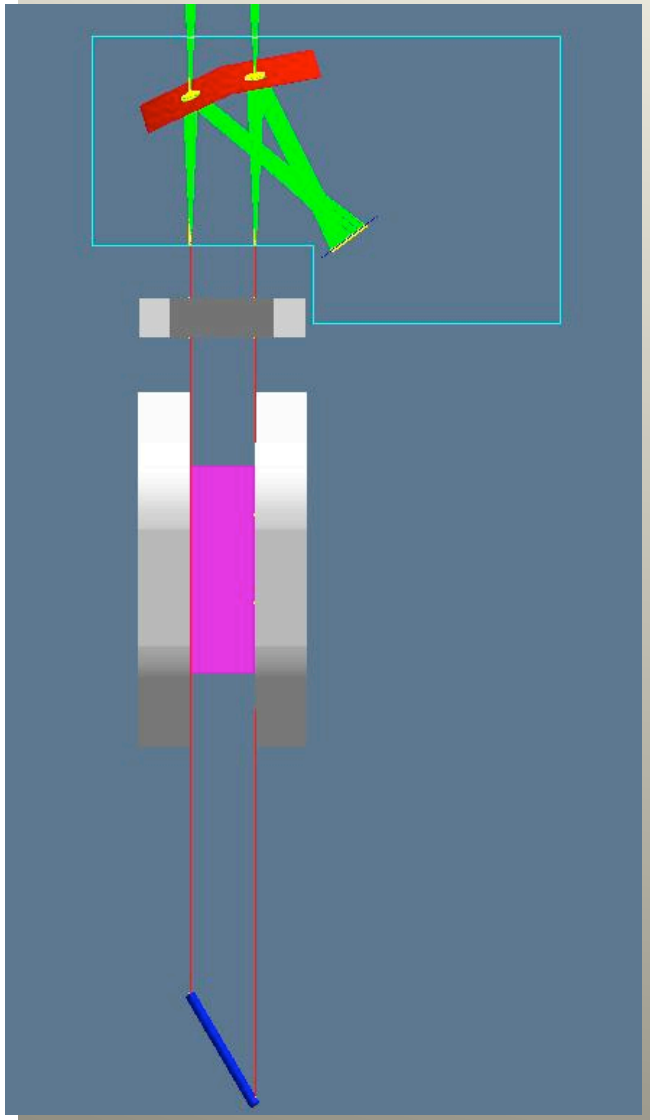
Horizontal width ΔX=20 cm
Vertical height ΔY=140 cm

HERMES RICH. 2,000 PMT array

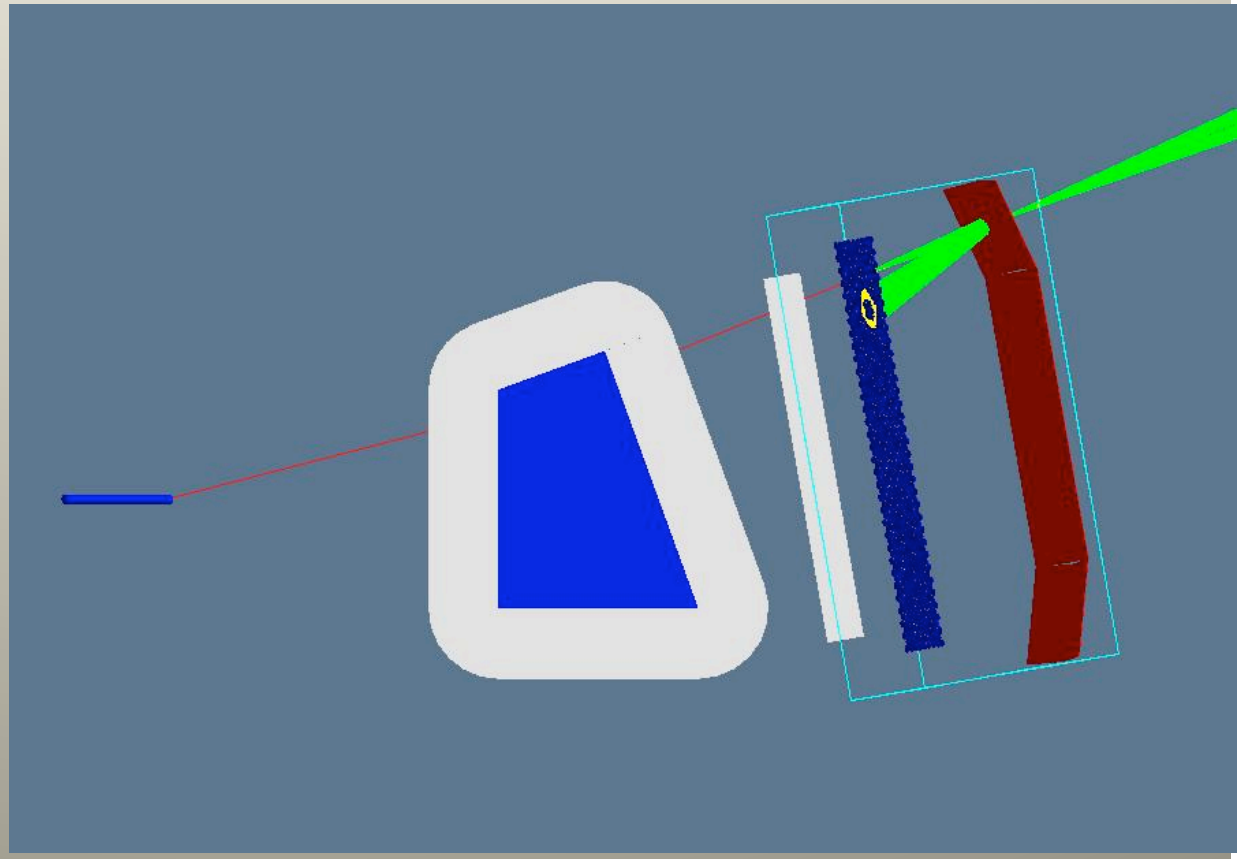


PMT's

Proposed detector

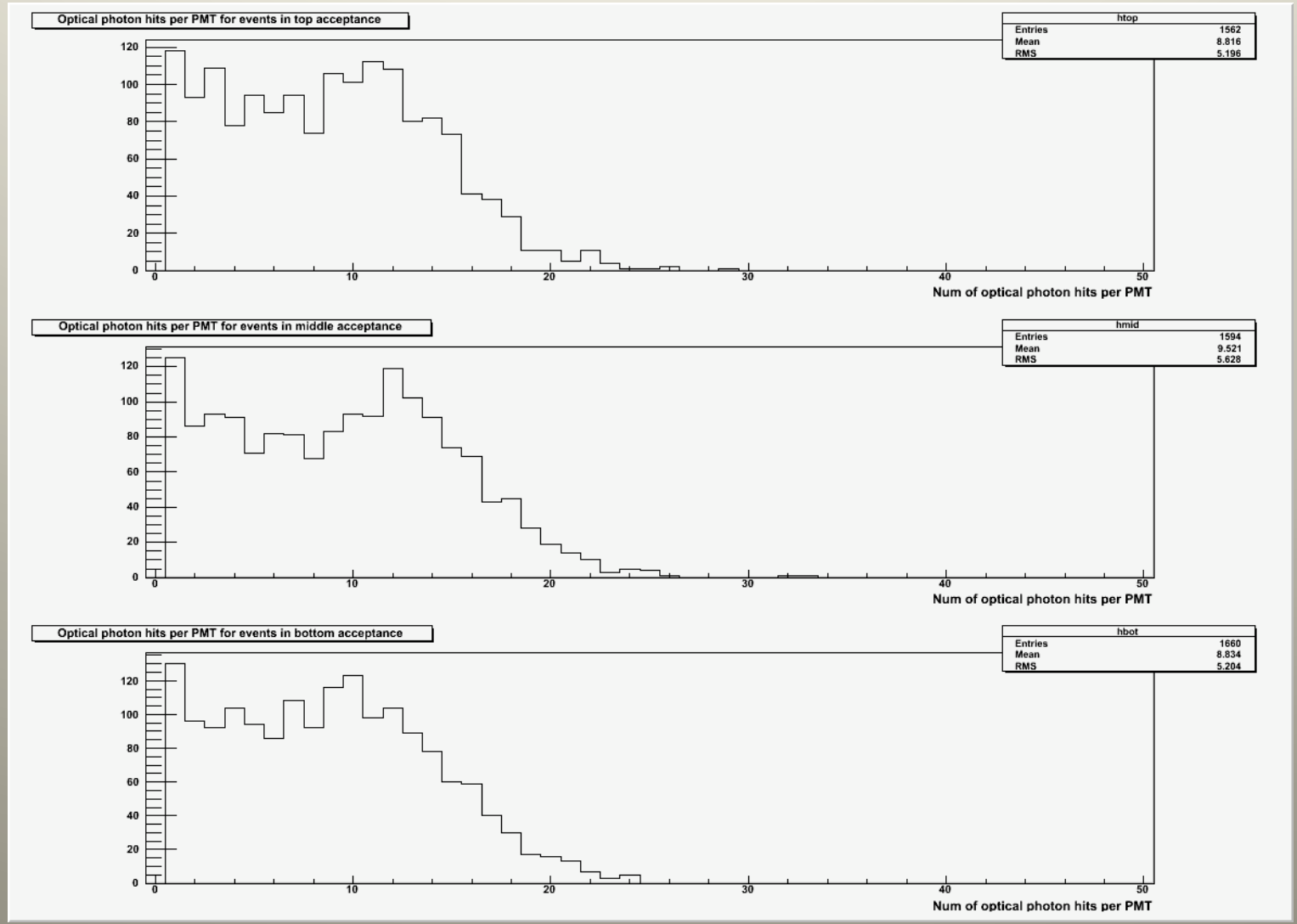


Top View

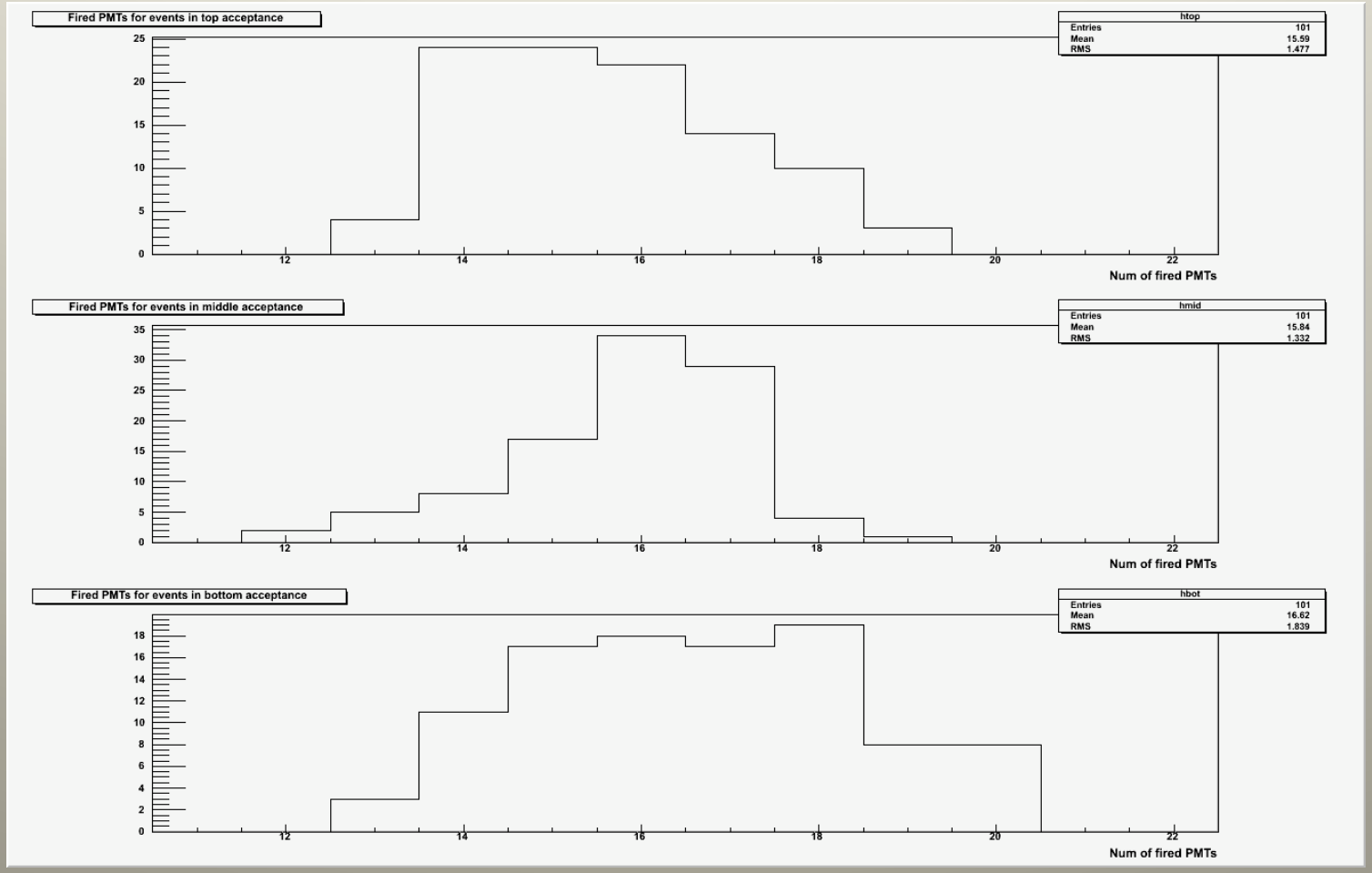


Side View

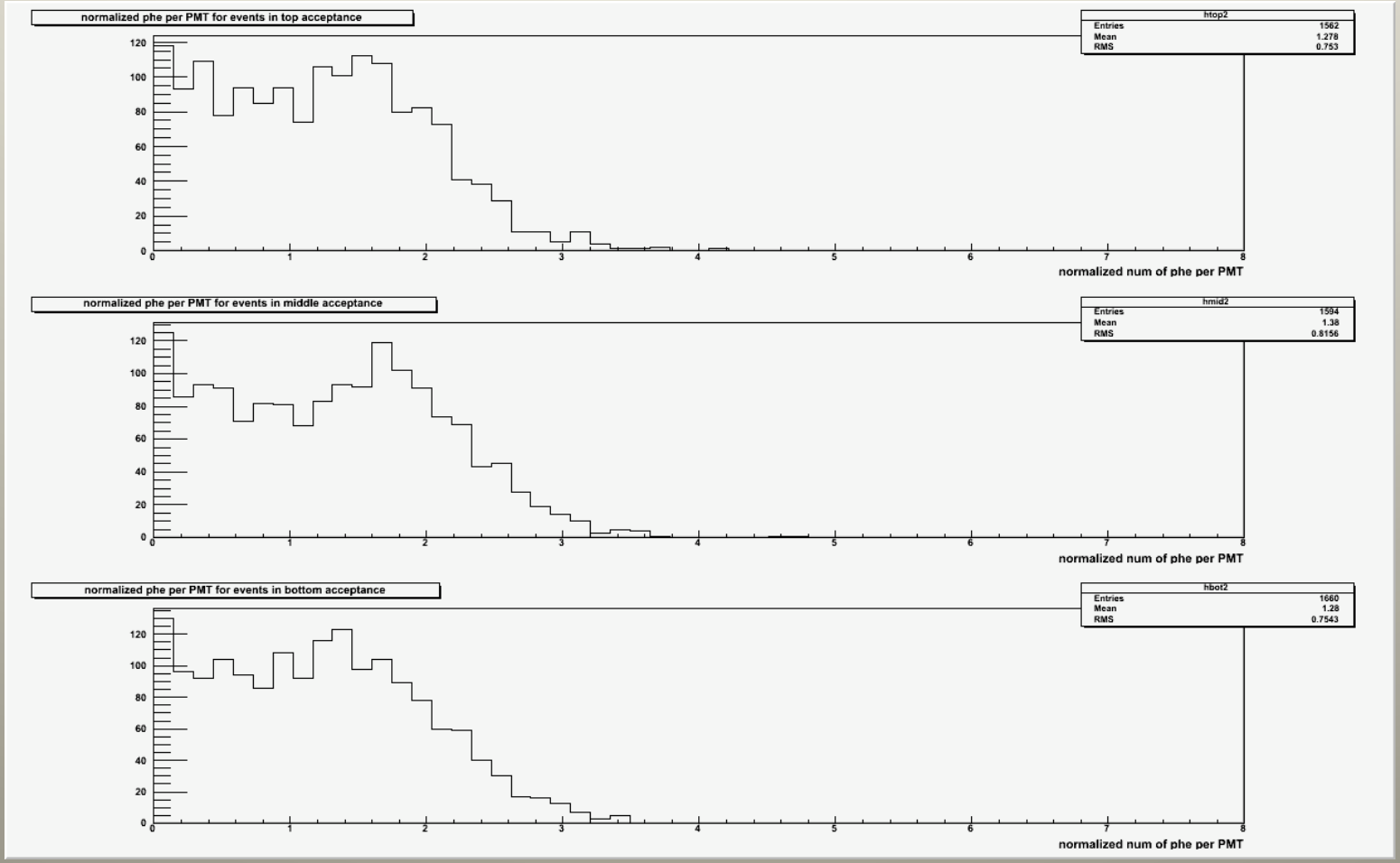
Number of photon hits per PMT



PMT's fired per event
➔about 15-16



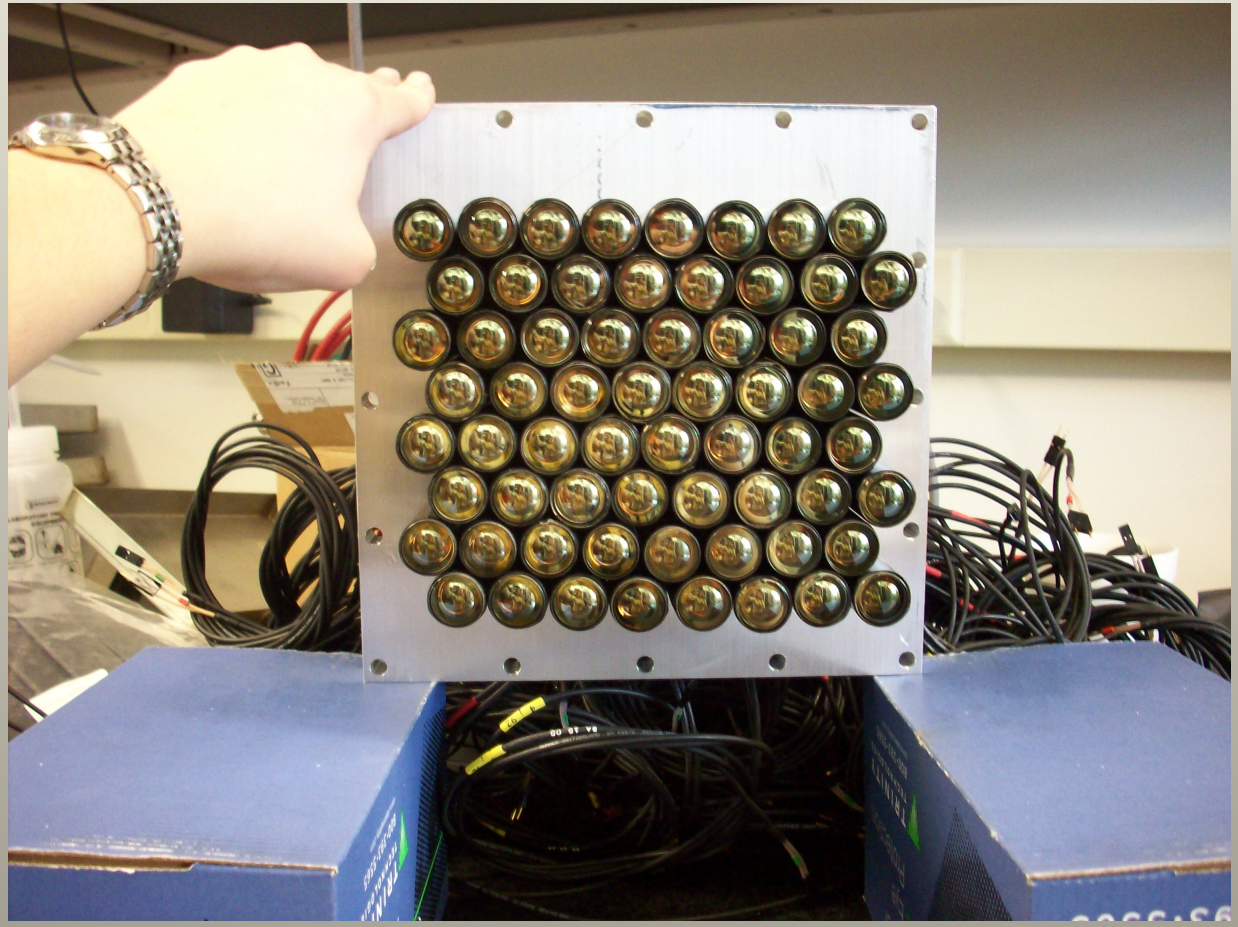
Expected number of p.e.’s per tube



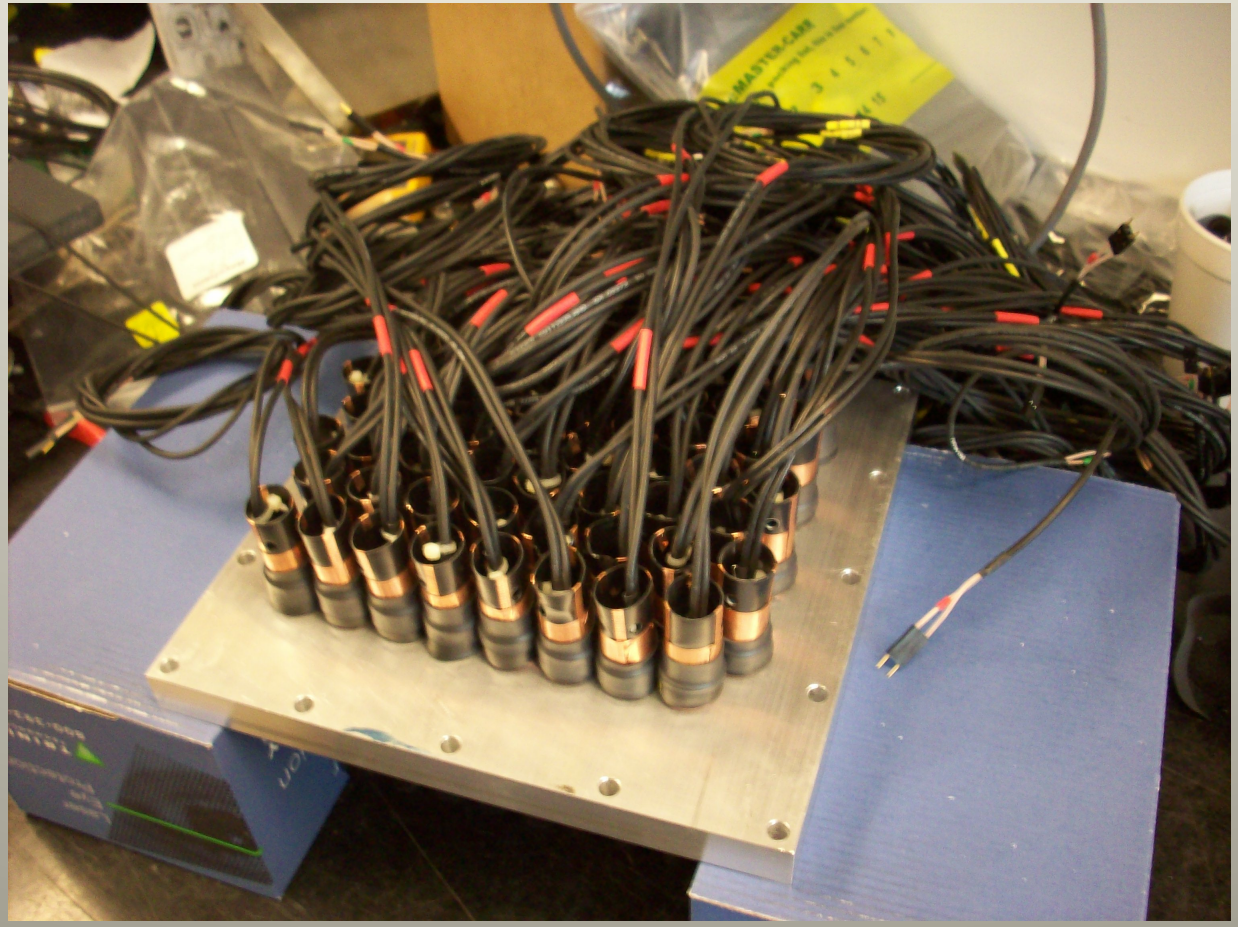
Update on Prototype Detector

- Fall 2010—Received 70 PMT's on loan from Dirk Ryckbosch at Univ. of Gent, Belgium. Thanks!
- Prototype array and housing complete--M. Cummings, W&M
- HV distribution complete--M. Cummings, W&M
- All DAQ components acquired
- Prototype detector and electronics—Recently moved to Jefferson Lab
- DAQ running in Hall A—B. Zhao
  - Assembled array of 8x8=64 PMT's
  - Begin testing with aerogel, acrylic, gas
  - VME QDC, TDC ready.
  - Cabling finished on PMT's
- Test run during g2p in Fall

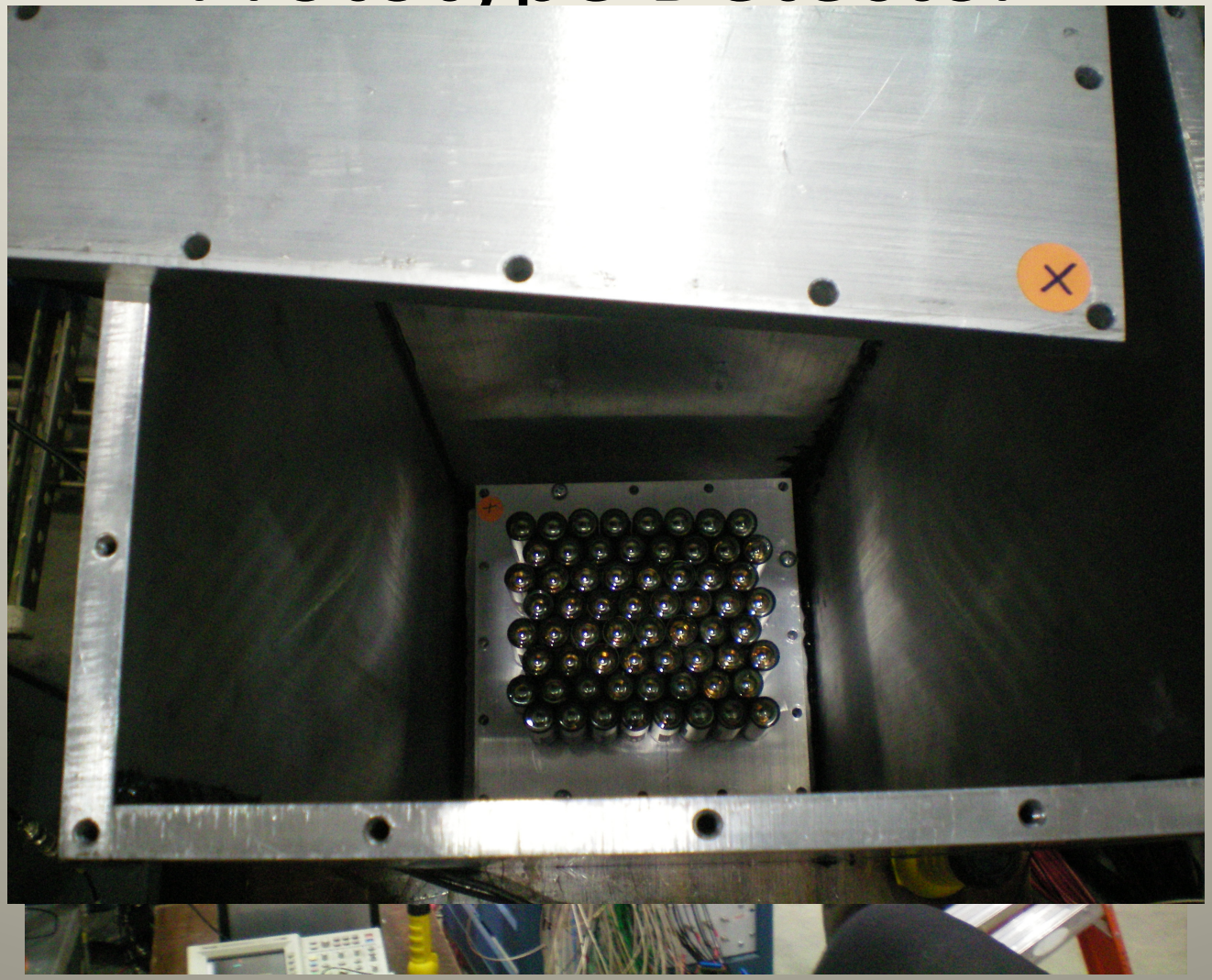
Prototype PMT array



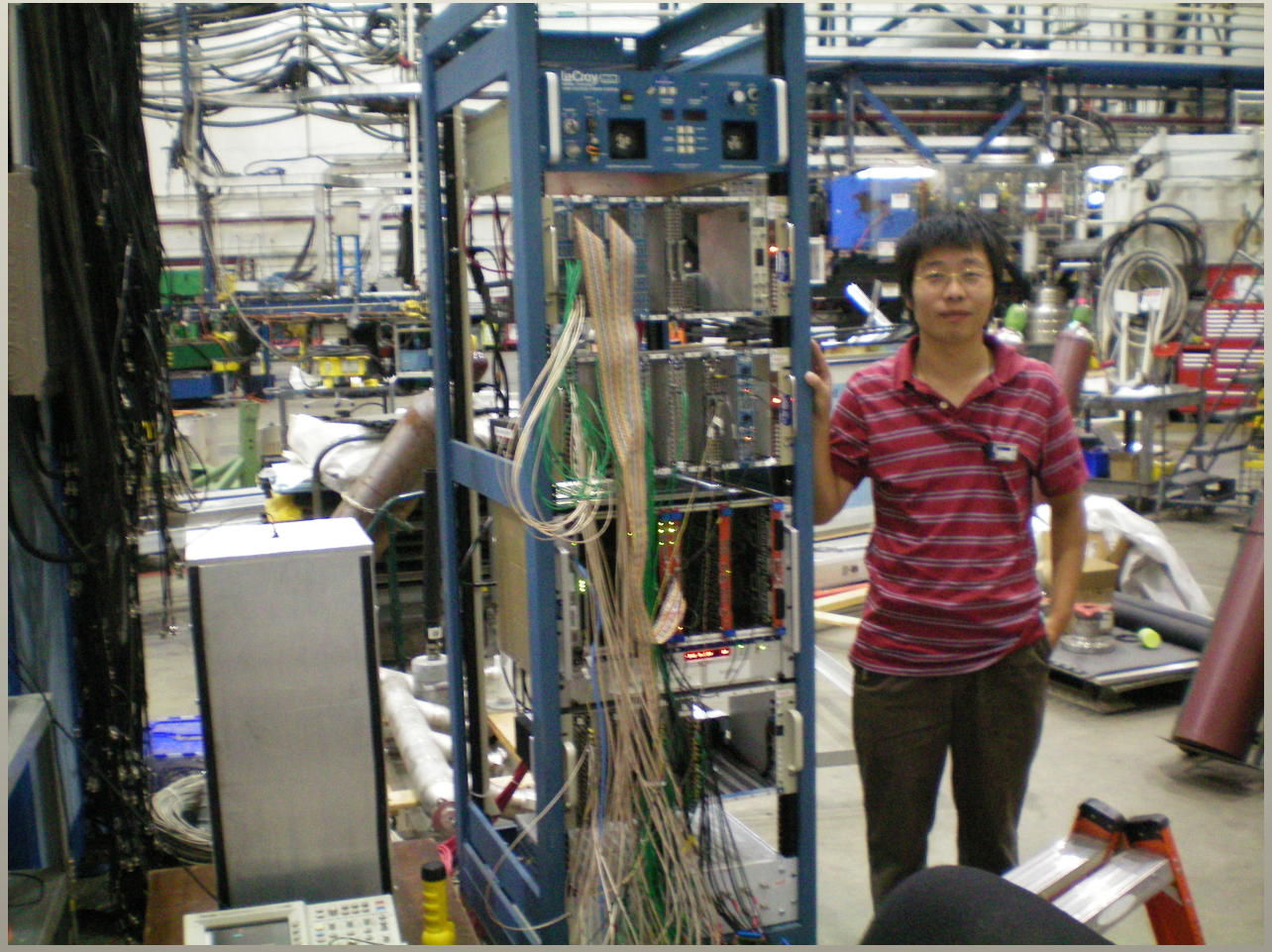
Prototype PMT array



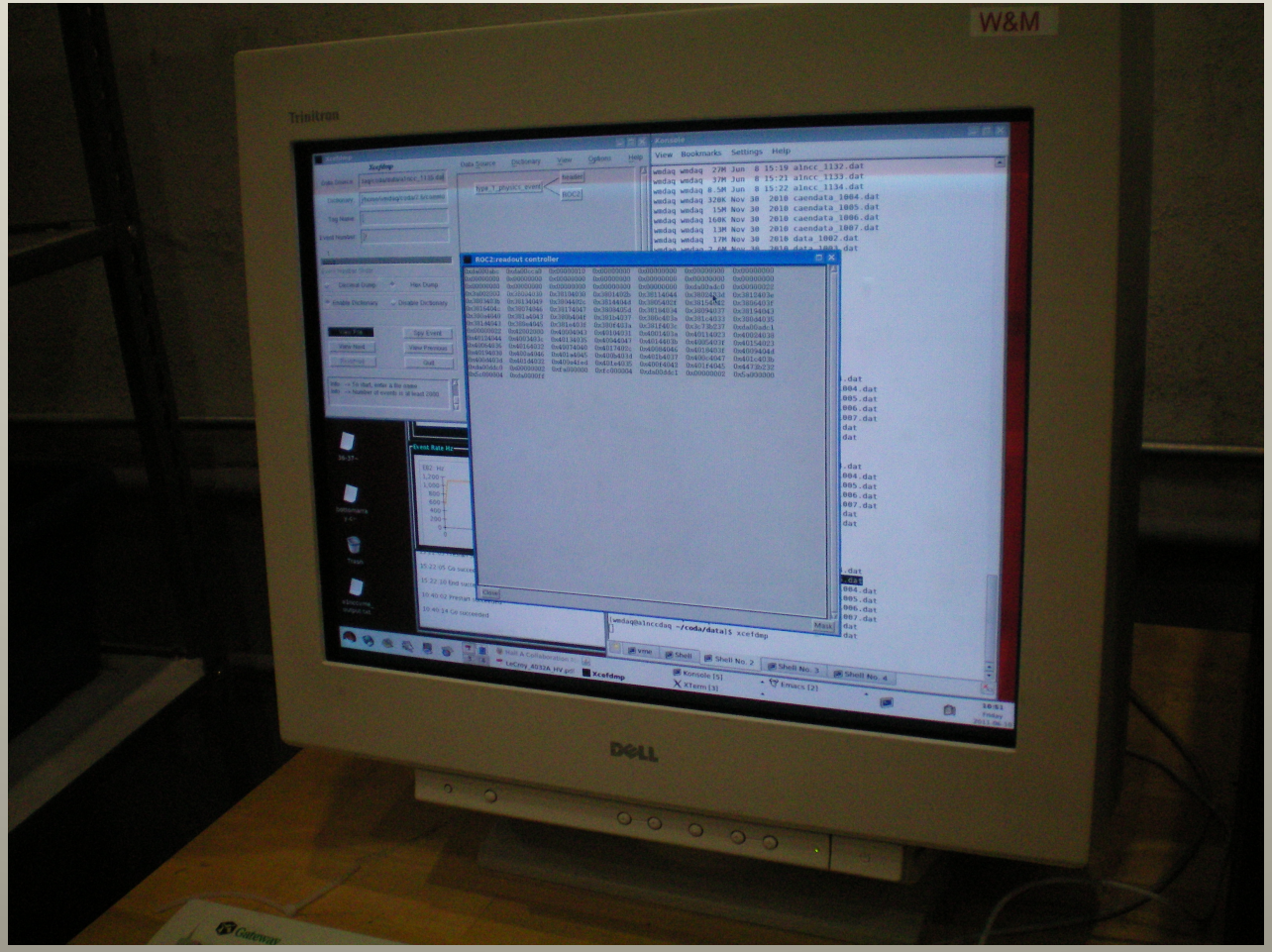
Prototype Detector



Prototype Detector and Electronics in Hall A—Bo Zhao, W&M



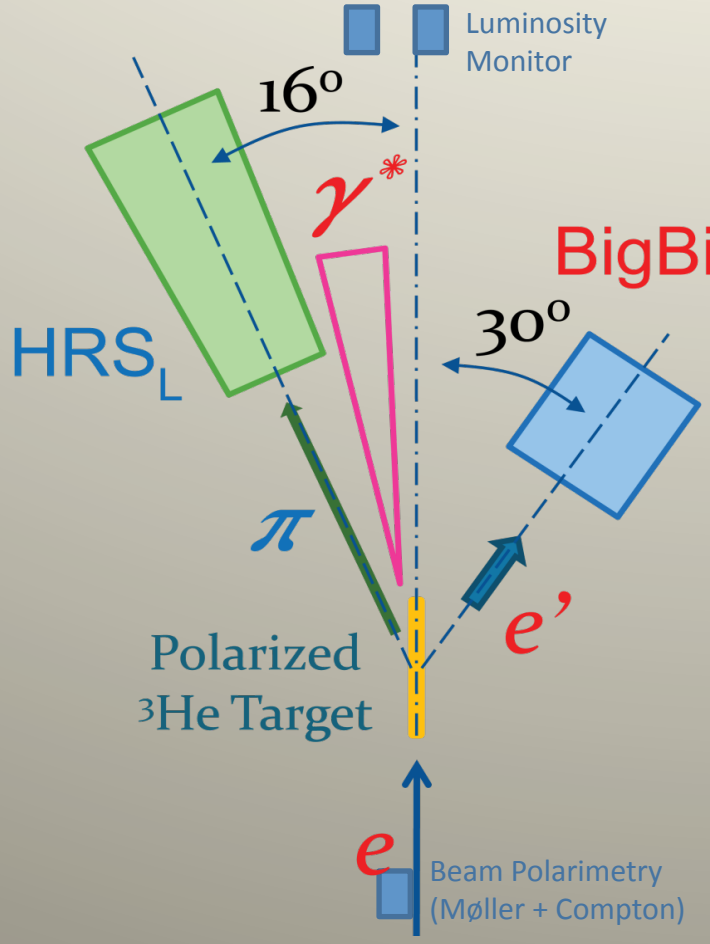
Raw Data from CODA/VME System



Update on Design

- Nothing yet really
- Simulation complete—now time to start engineering and get price quotes, etc.

Transversity kinematics



Measure ^{3}He(e,e') SSA using BB and LHRS in singles mode.

E=5.89 GeV

	LHRS	BB			
		1	2	3	4
θ (deg)	16.00	29.60	29.60	29.50	28.80
θ (rad)	0.28	0.52	0.52	0.51	0.50
E (GeV)	5.89	5.89	5.89	5.89	5.89
E' (GeV)	2.35	1.12	1.36	1.65	2.05
ν (GeV)	3.54	4.78	4.53	4.25	3.84
Q^2 (GeV^2)	1.07	1.71	2.09	2.51	2.99
W^2 (GeV^2)	6.45	8.13	7.30	6.33	5.09
X	0.16	0.19	0.25	0.32	0.42