E08-005 Quasi-Elastic $^3He^{\uparrow}(e,e'n)$ Single Spin Asymmetry

Elena Long

Hall A Collaboration Meeting

December 9th, 2010

KENT STATE UNIVERSITY

Jefferson Lab

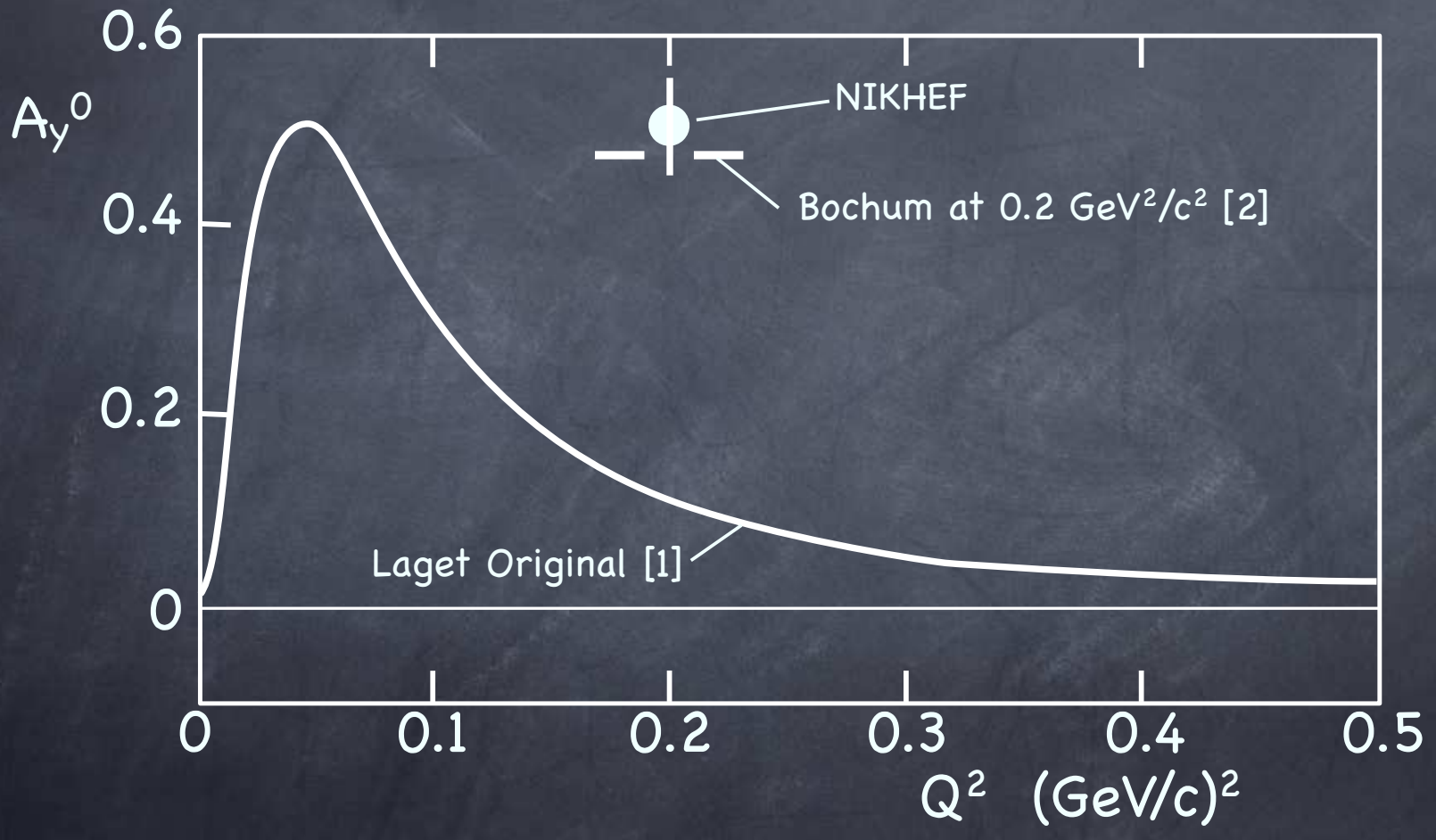
Outline

- What are we doing?
  - Details of what we're looking for from E08-005
- What's been done?
  - Experiment set-up and analysis so far
- Where are we going?
  - Analysis that has yet to be done

What are we doing?

- In PWIA, A_y in Quasi-Elastic $^3He^{\uparrow}(e,e'n)$ is exactly zero
- Previous to this experiment, no measurements of Ay have been done at large Q^2
- We will analyze high precision data points taken at 0.1 $[GeV/c]^2$, 0.5 $[GeV/c]^2$, and 1.0 $[GeV/c]^2$
- Previous experiment at NIKHEF measured A_y at 0.2 $[GeV/c]^2$
- Faddeev calculations by Bochum group correctly predicted FSI result where other groups expected a much lower value

What are we doing?



[1] J. M. Laget, Phys. Lett. B273, 367 (1991).
[2] W. Gloeckle, H. Witala, D. Huber, H. Kamada, and J. Golak, Phys. Rept. 274, 107 (1996).

What are we doing?

- Data will test state of the art calculations at high Q^2
  - Neutron form factor extractions must correctly predict this asymmetry
  - In calculating G_E^n from $^3\vec{H}\vec{e}(\vec{e},e'n)$, A_y from $^3He^{\uparrow}(e,e'n)$ will also be calculated
- At high Q^2, any non-zero result is indicative of effects beyond impulse approximation

What's been done?

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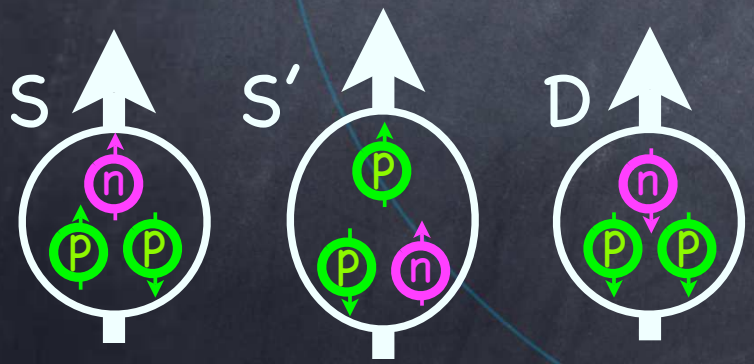
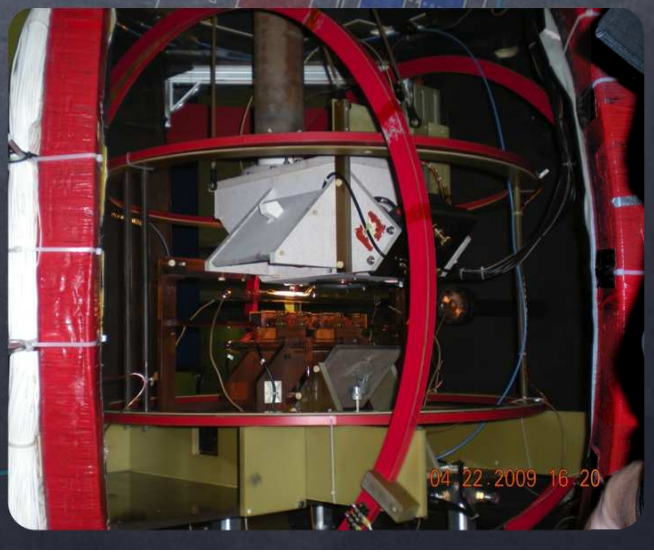
Polarized ^{3}He Target

- Optically Pumped Rubidium Vapor used with Potassium to Polarize ^{3}He via Spin Exchange
- NMR and EPR Measure Polarization
- Polarization was in Vertical Direction
- Can Polarize up to 60%
- Luminosity ~10^{36} $cm^{-2}s^{-1}$

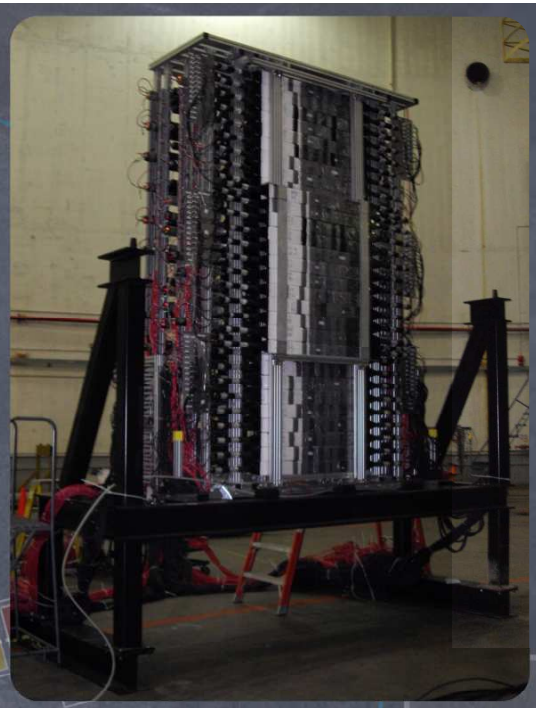


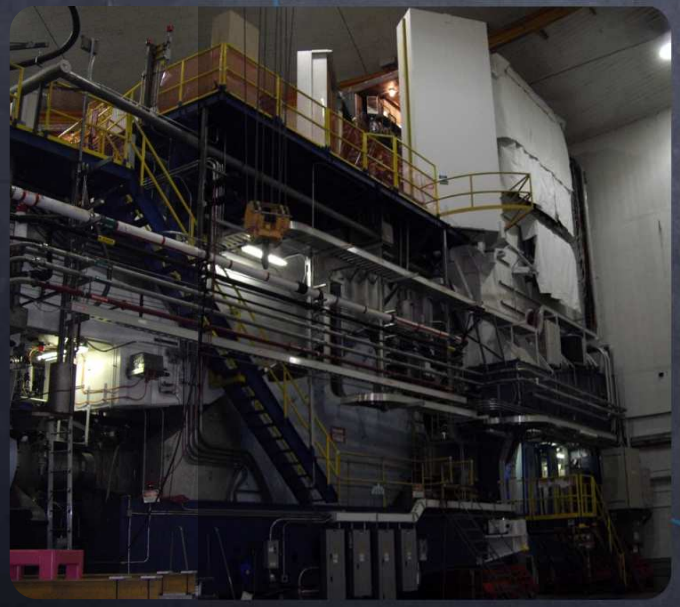


What's been done?

Hall A Neutron Detector

- Detects neutrons from ^{3}He(e,e'n)
- Along with RHRS allows G_E^n and A_y measurements to be made





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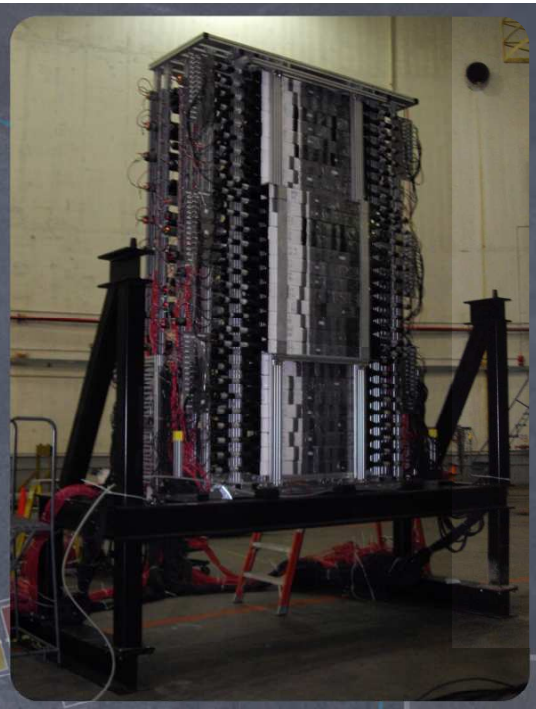

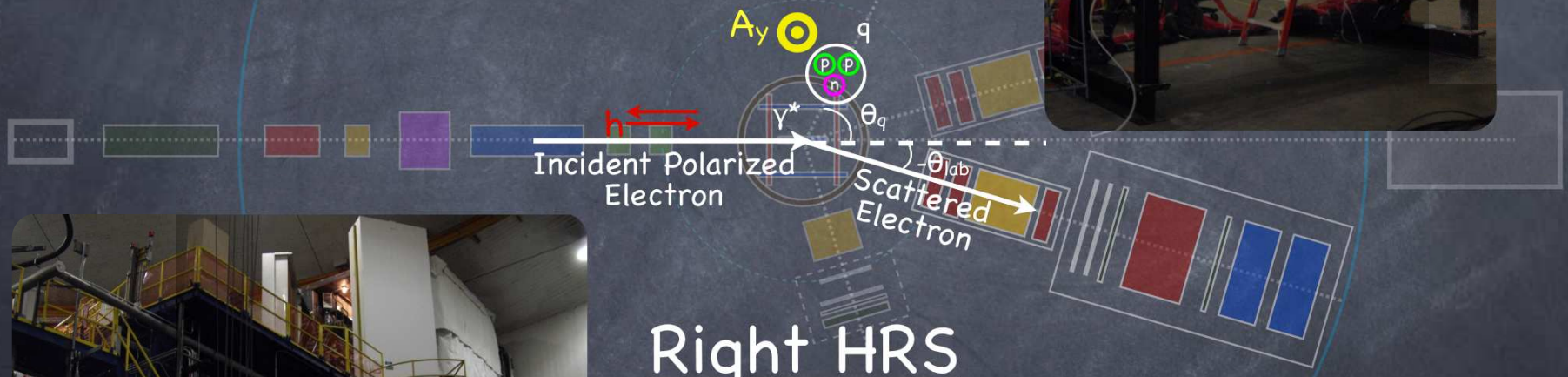

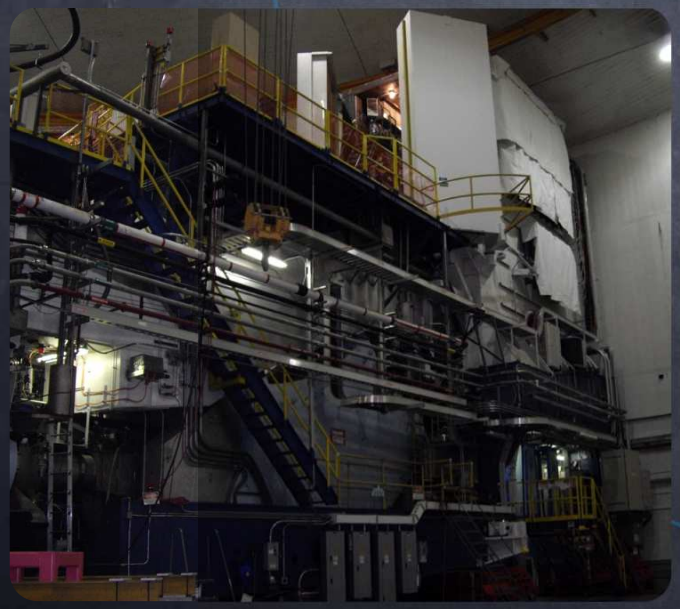

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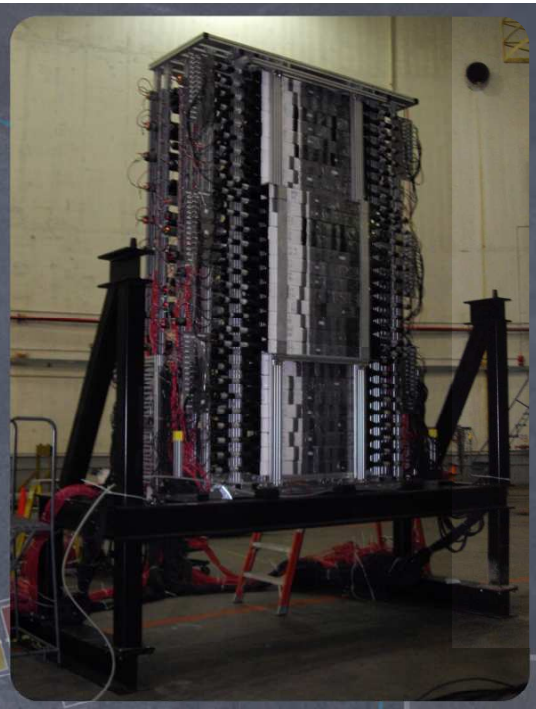

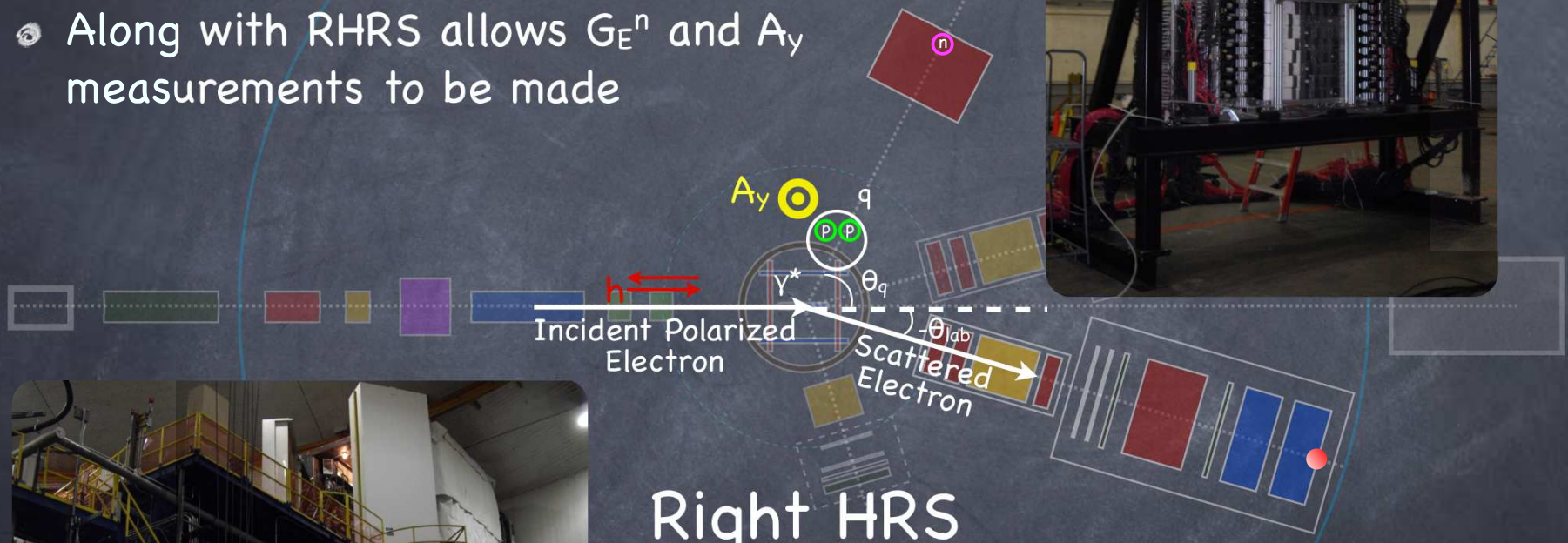

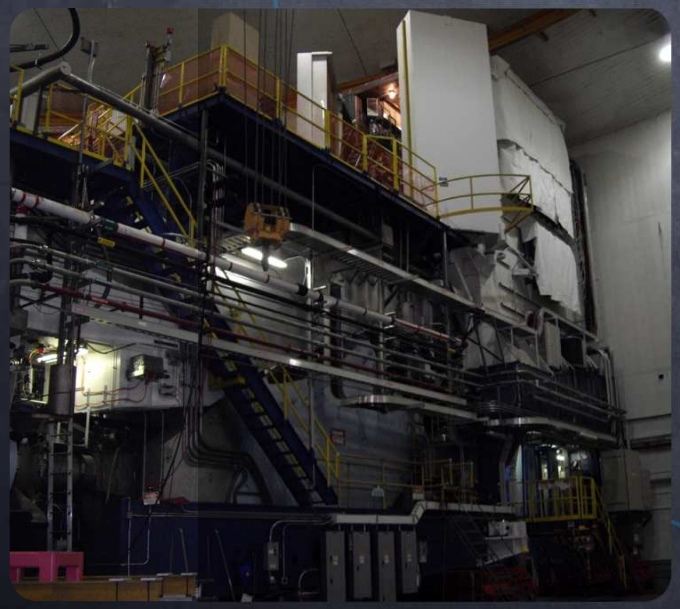

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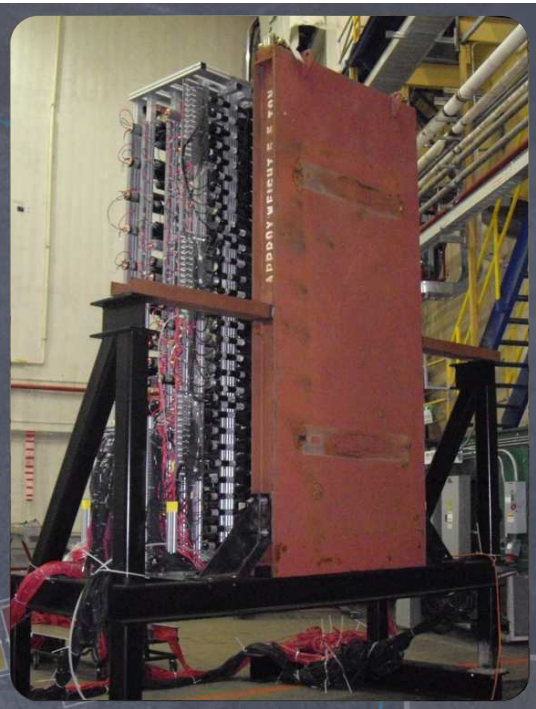

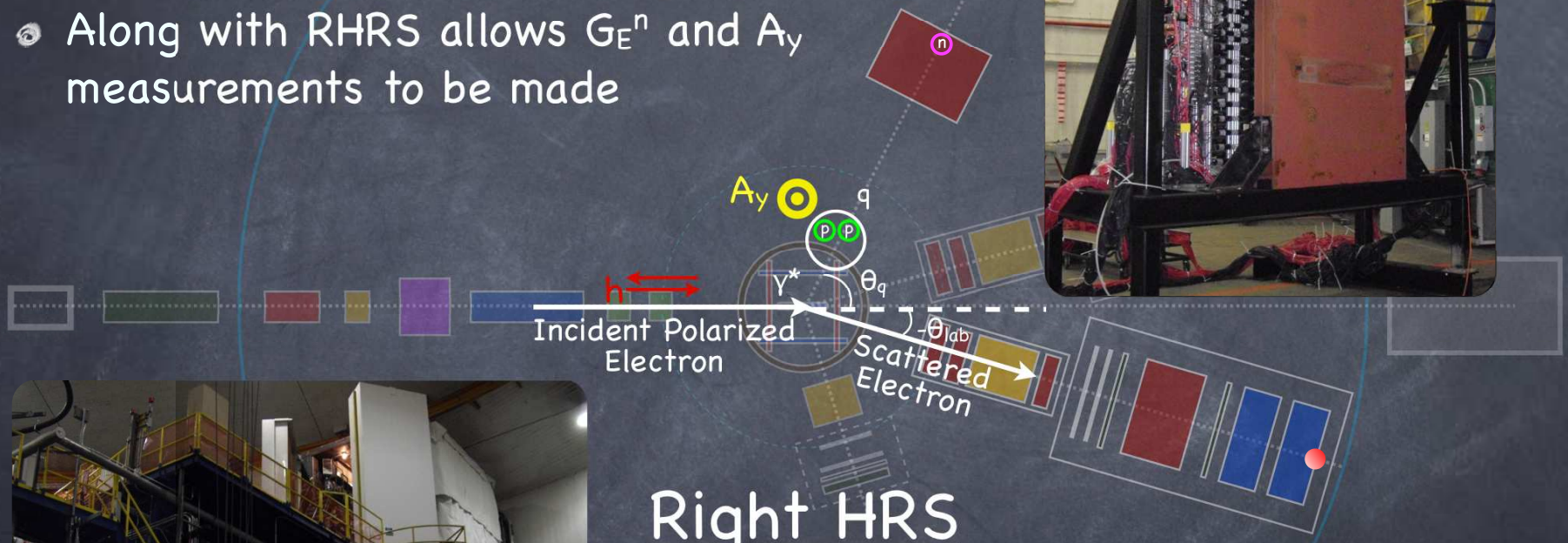

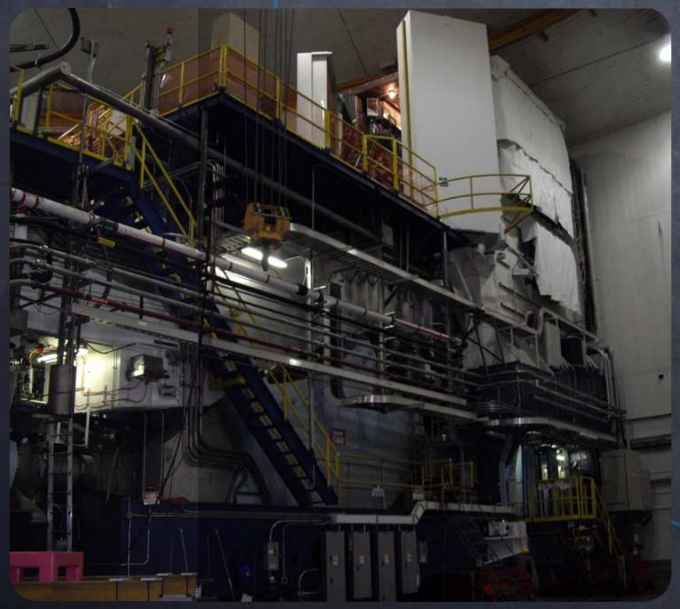

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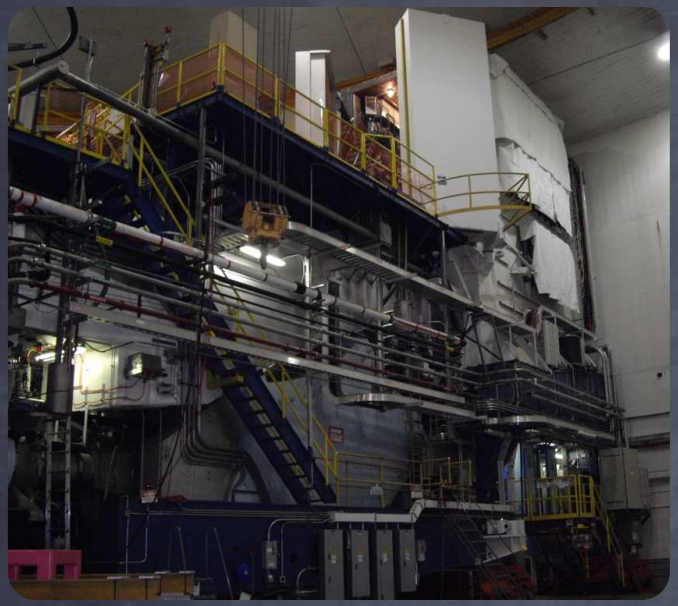
What's been done?

- This experiment, E08-005, ran from April 26th through May 10th in Jefferson Lab's Hall A
- The kinematics taken were:

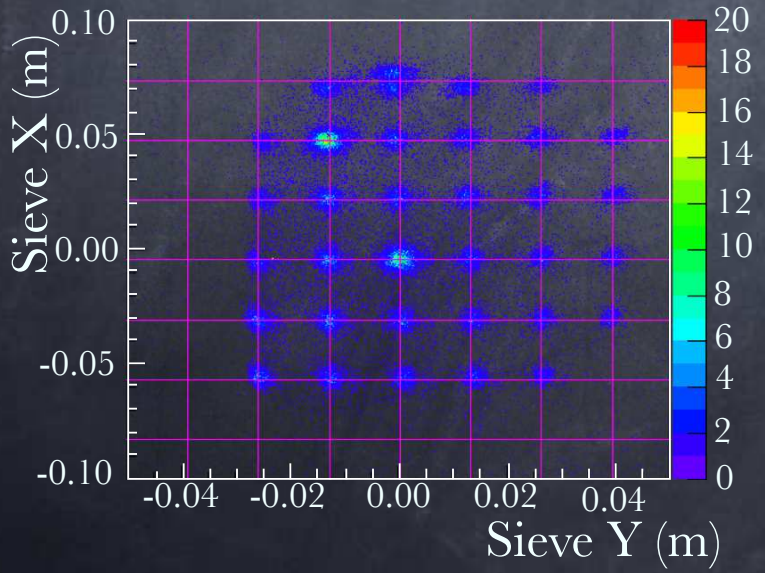
E_0 [GeV]	E' [GeV]	θ_{lab} [°]	Q^2 $[GeV/c]^2$	$\|q\|$ [GeV/c]	θ_q [°]
1.25	1.22	17.0	0.13	0.359	71.0
2.43	2.18	17.0	0.46	0.681	62.5
3.61	3.09	17.0	0.98	0.988	54.0

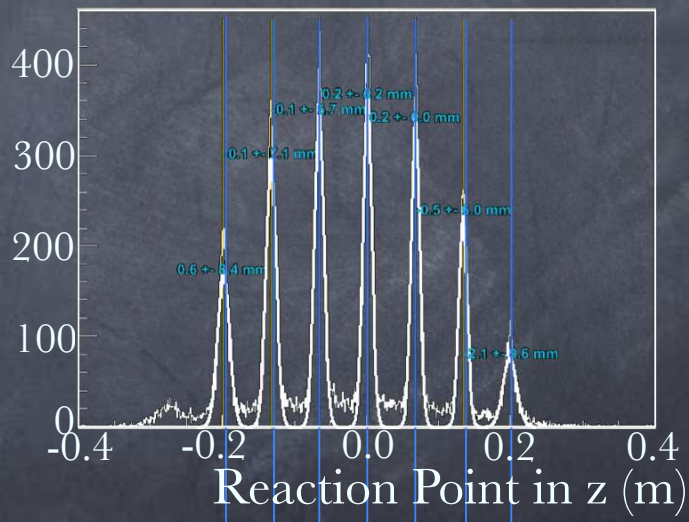
Date	E_0 (GeV)	RHRS (°)	RHRS P_0 (GeV)	LHRS (°)	LHRS P_0 (GeV)	HAND (°)	BigBite (°)
4/26	1.245	-17	1.2205	17	1.2205	71	-74
4/27	1.245	-17	1.1759	17	1.1759	71	-74
4/29	3.605	-17	3.0855	17	3.0855	54	-74
5/6	3.605	-17	3.0855	17	3.0855	62.5	-74
5/8	2.425	-17	2.1813	17	2.1813	62.5	-74

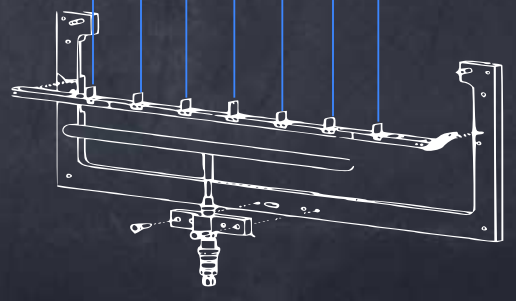
What's been done?



- RHRS optics calibration finished
- See Ge Jin's talk from the 2010 Summer Collaboration meeting (http://bit.ly/faDudd)







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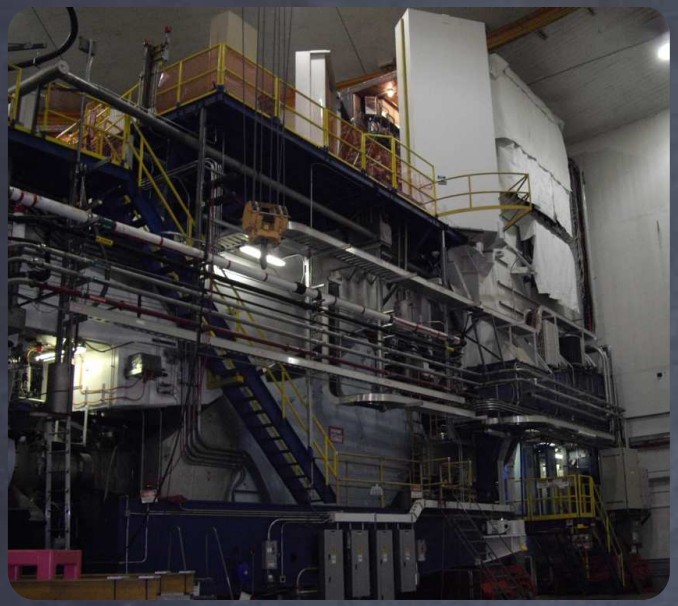

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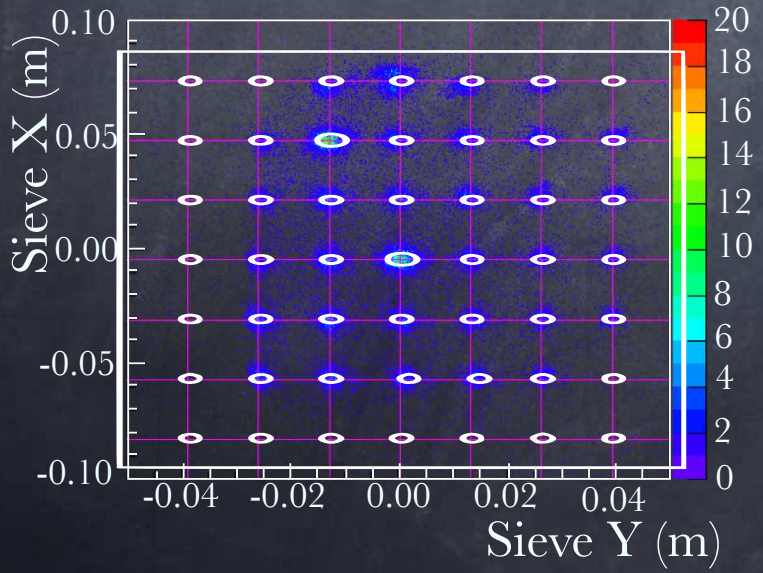

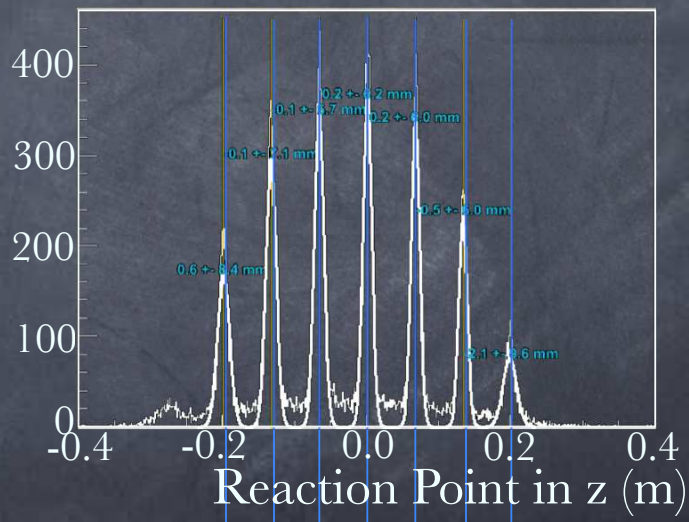

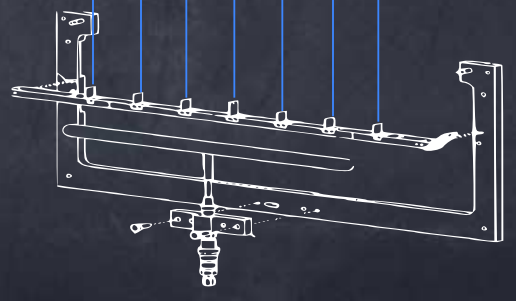

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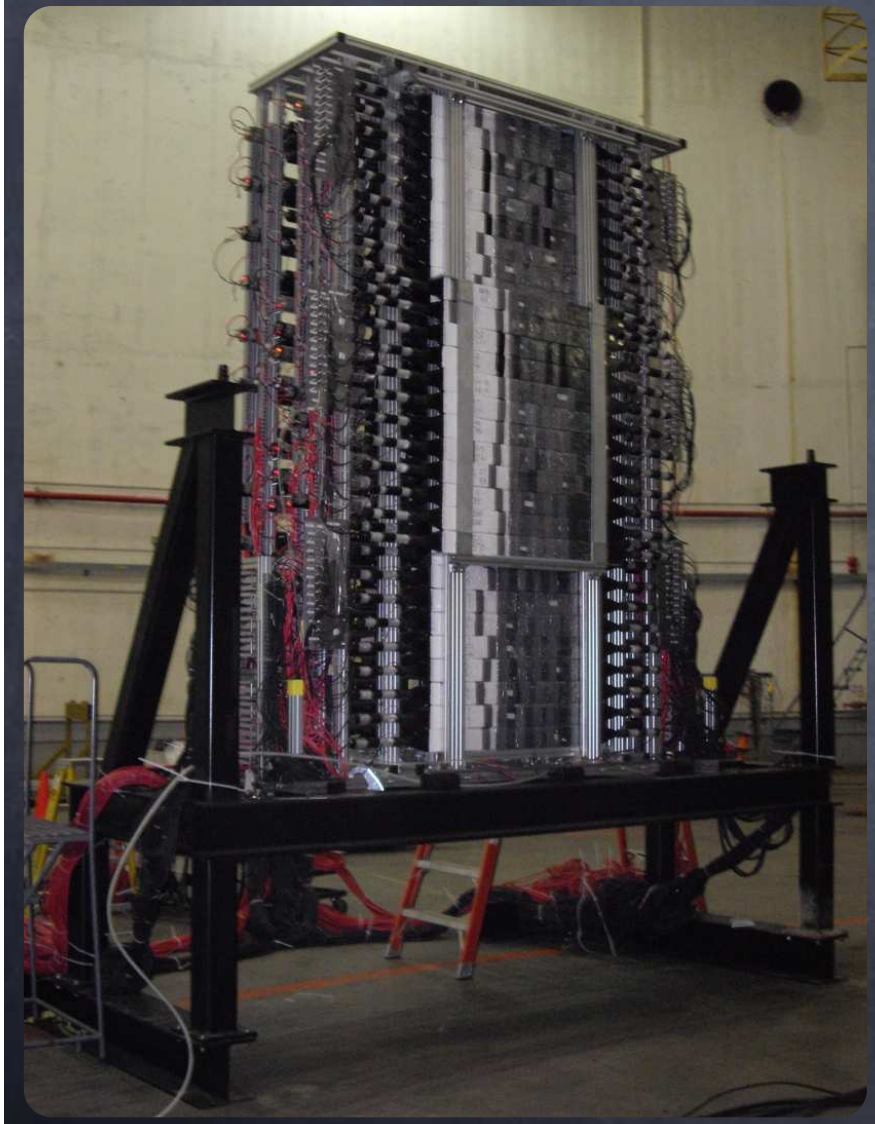
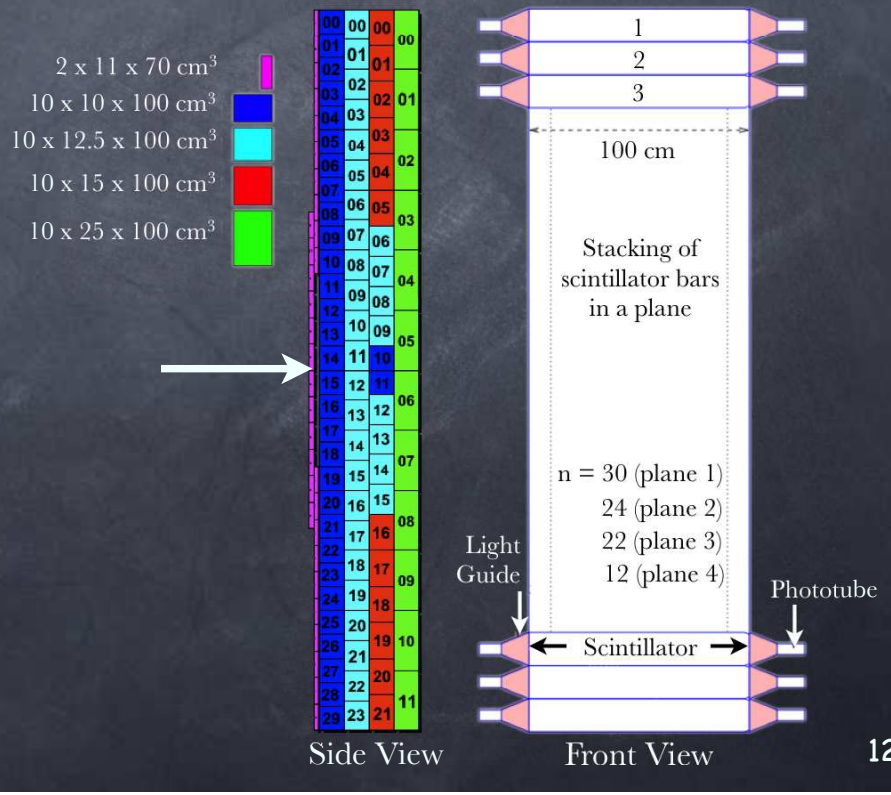
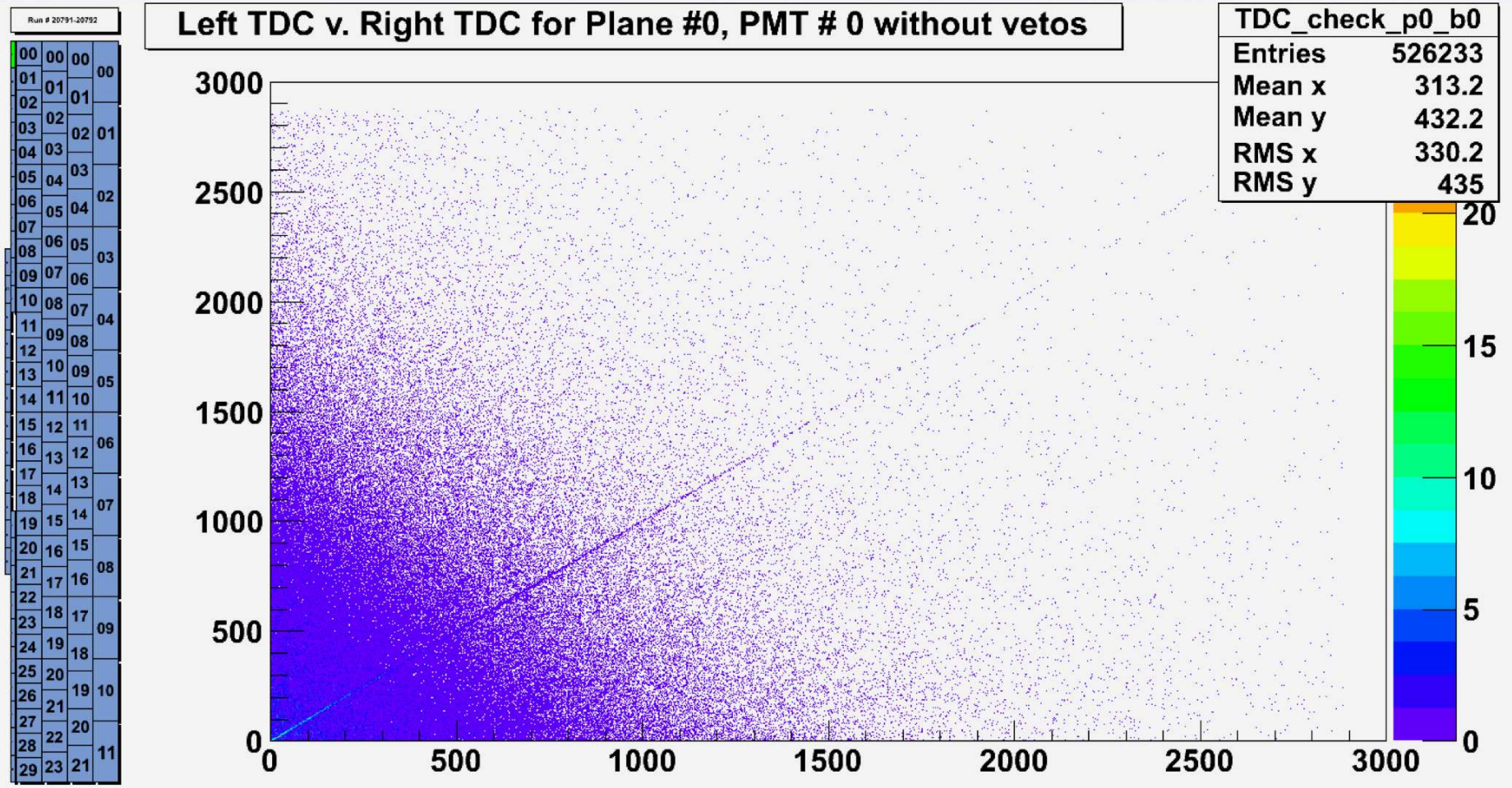


- HAND calibration started
- 88 Scintillator + 64 Veto Bars
- ADC and TDC channels recorded for each of 240 PMTs



What's been done?

Q^2=1 Proton TDC Correlations without Lead Wall



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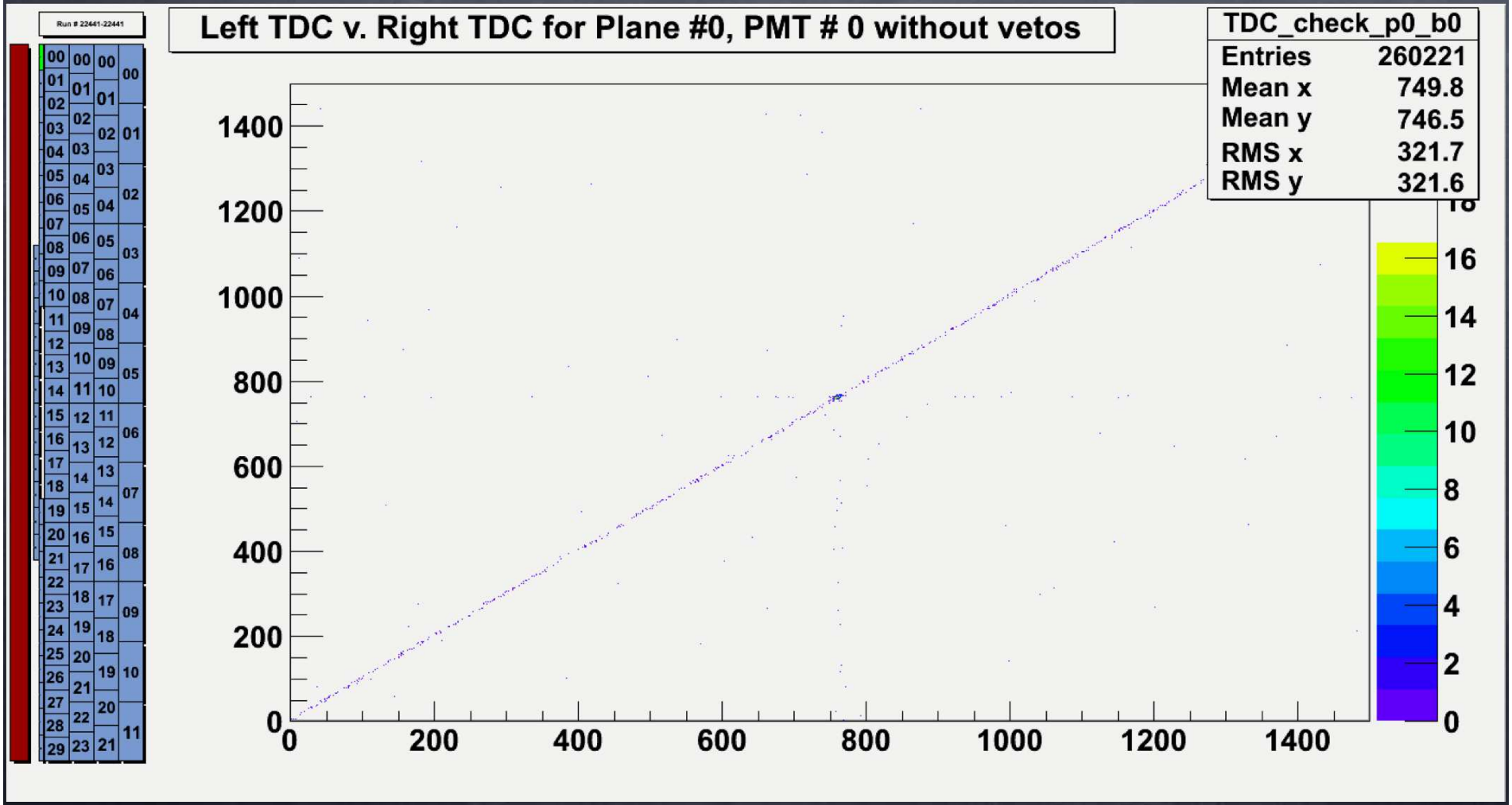

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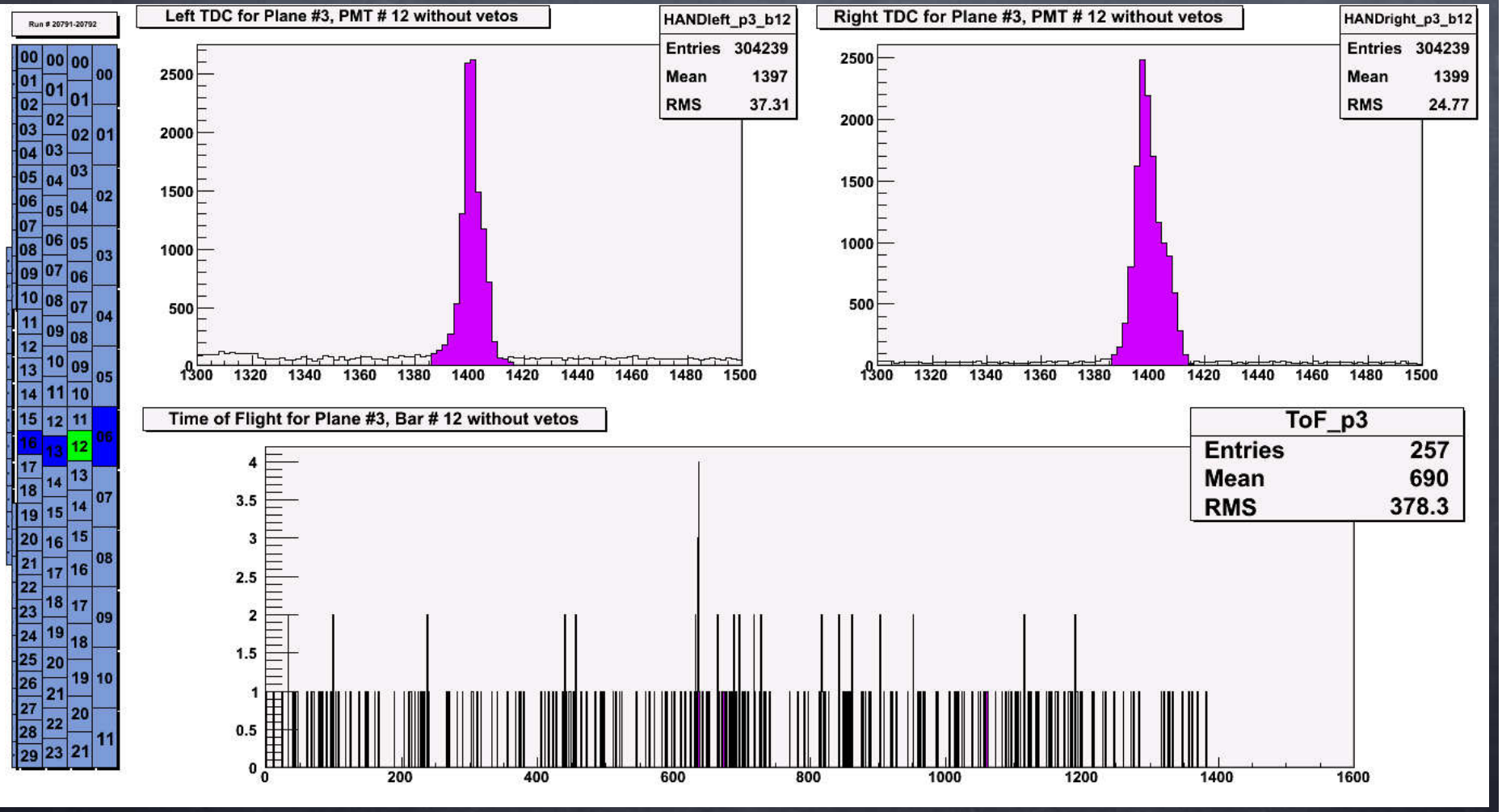
Proton tracking

Q^2=1.0, no lead wall



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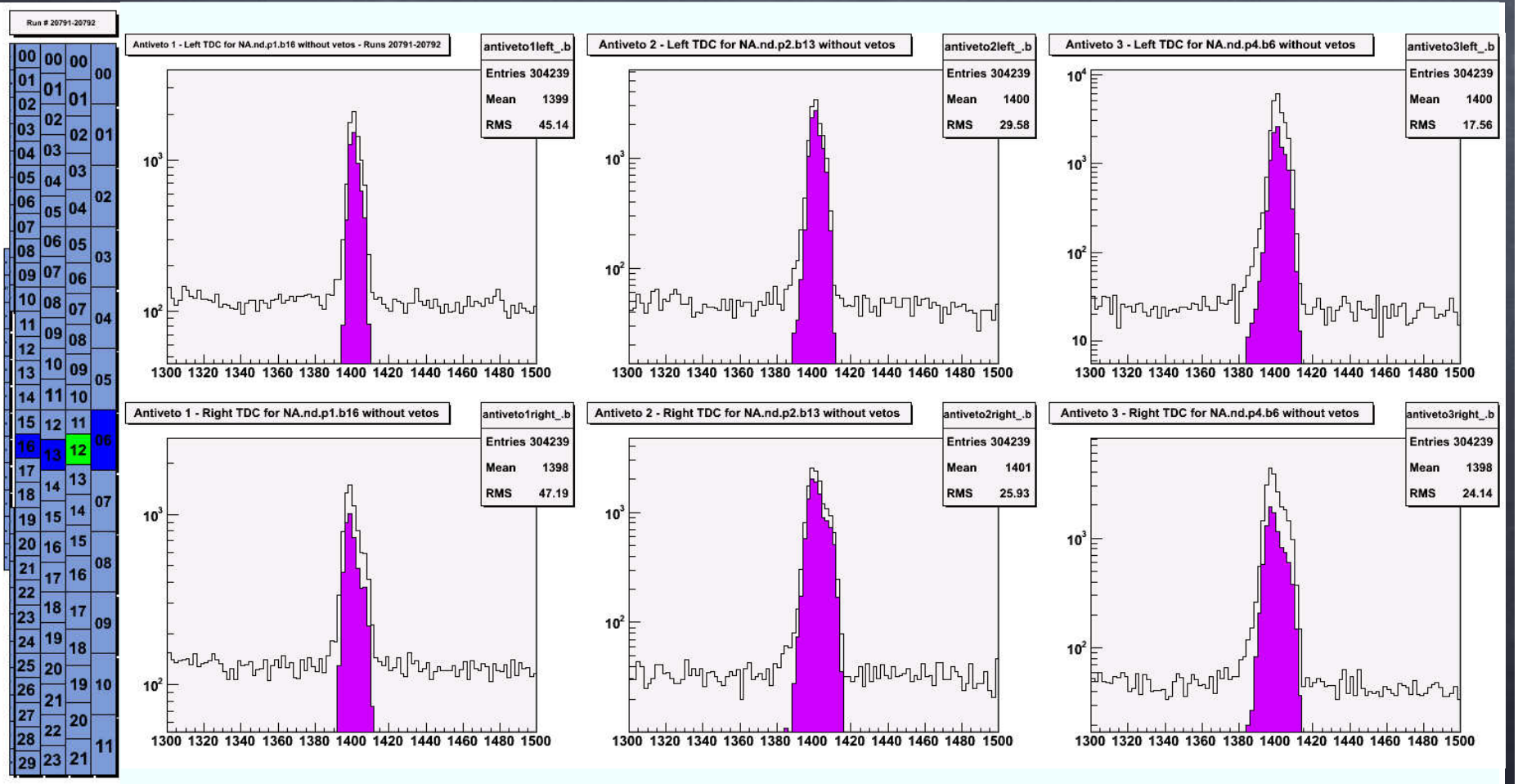

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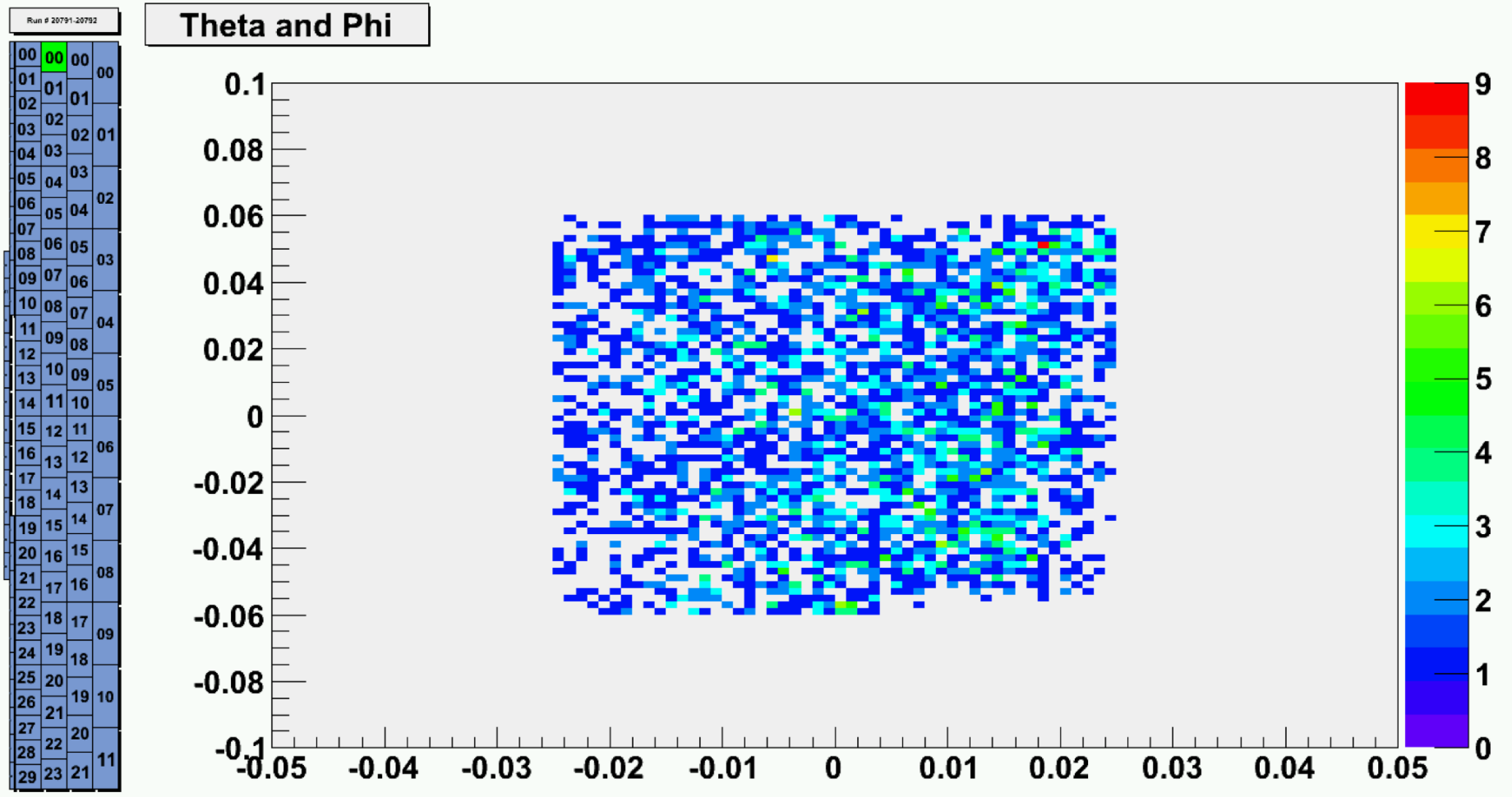
Theta Correlates to Bar



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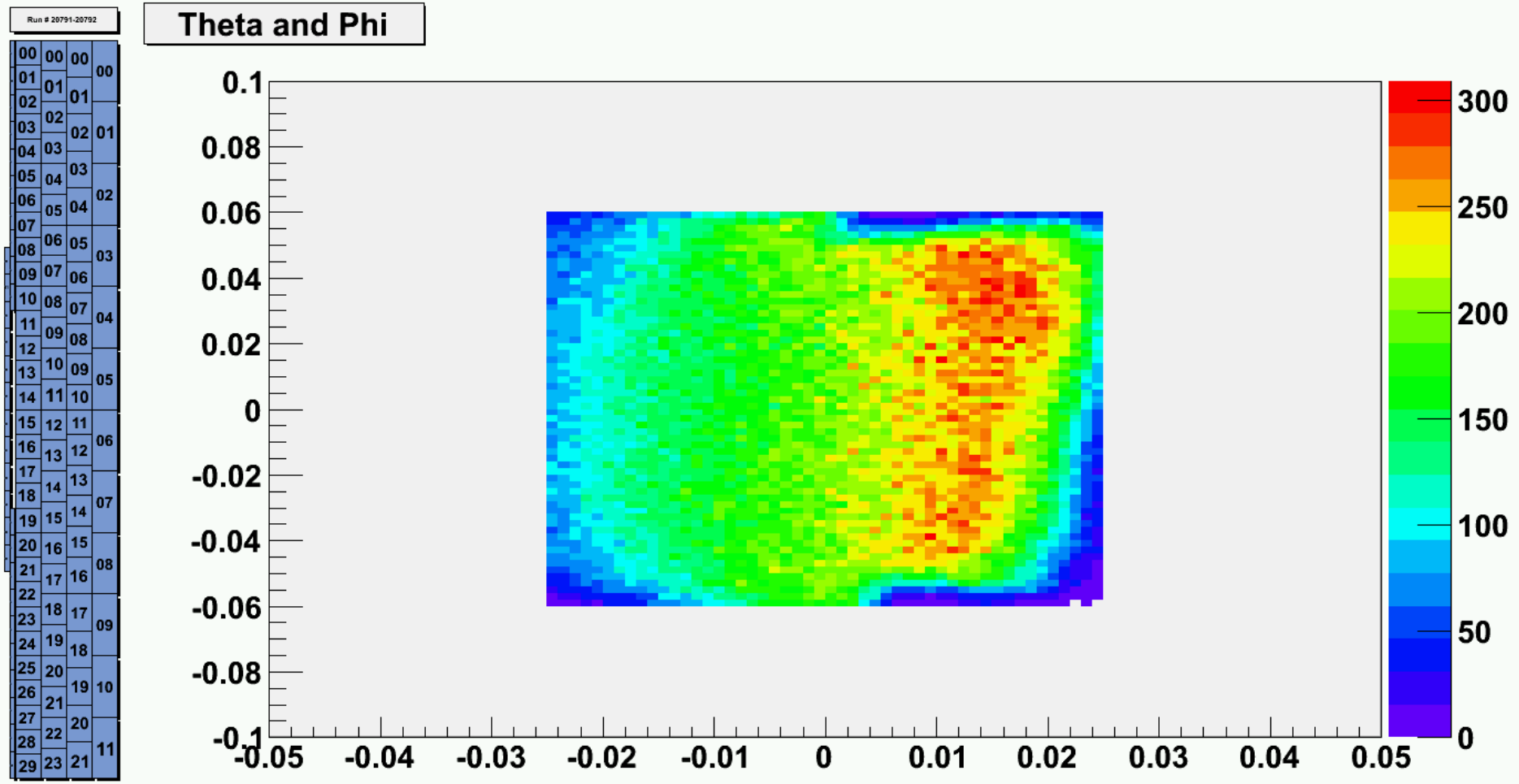

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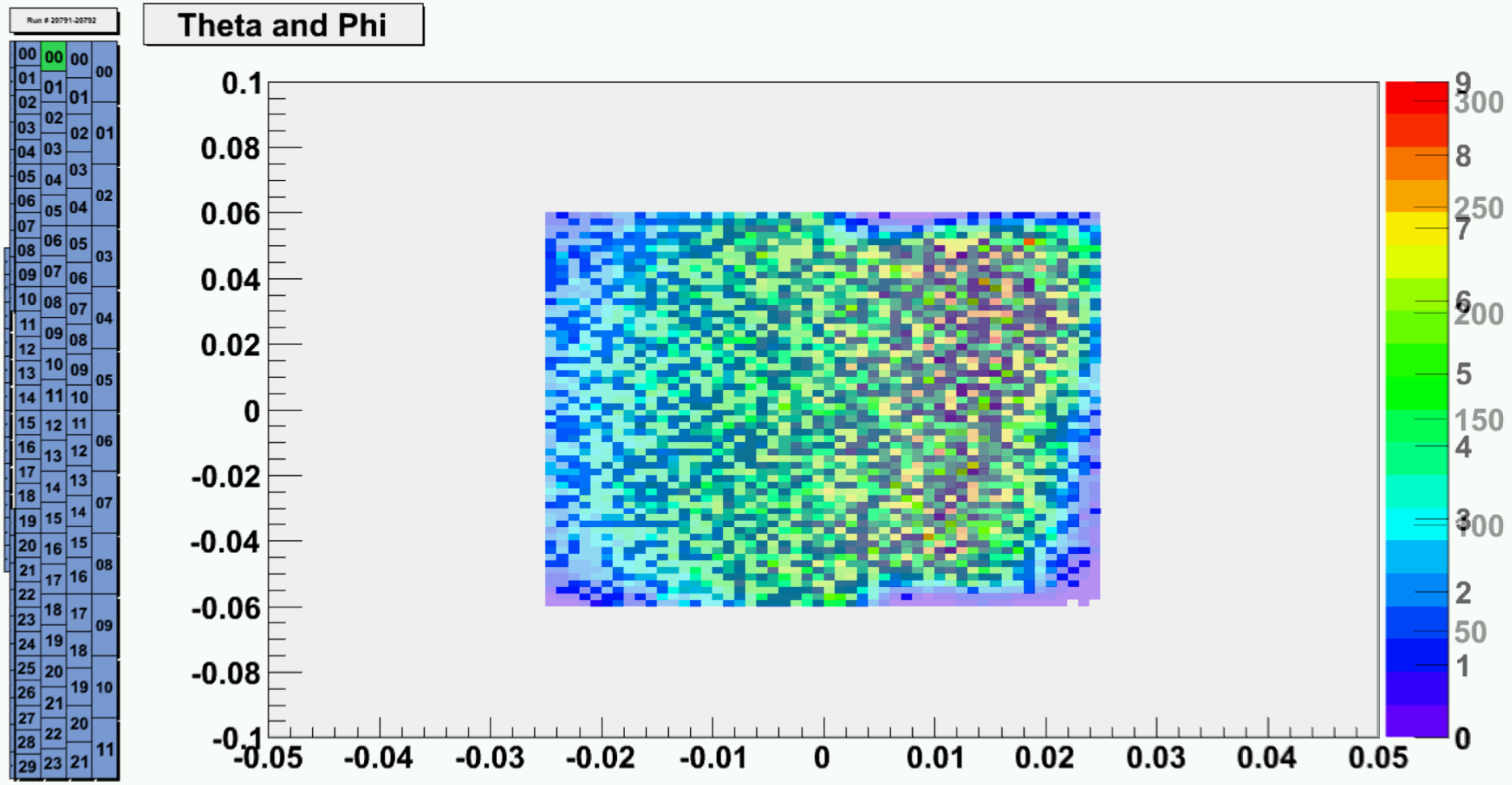

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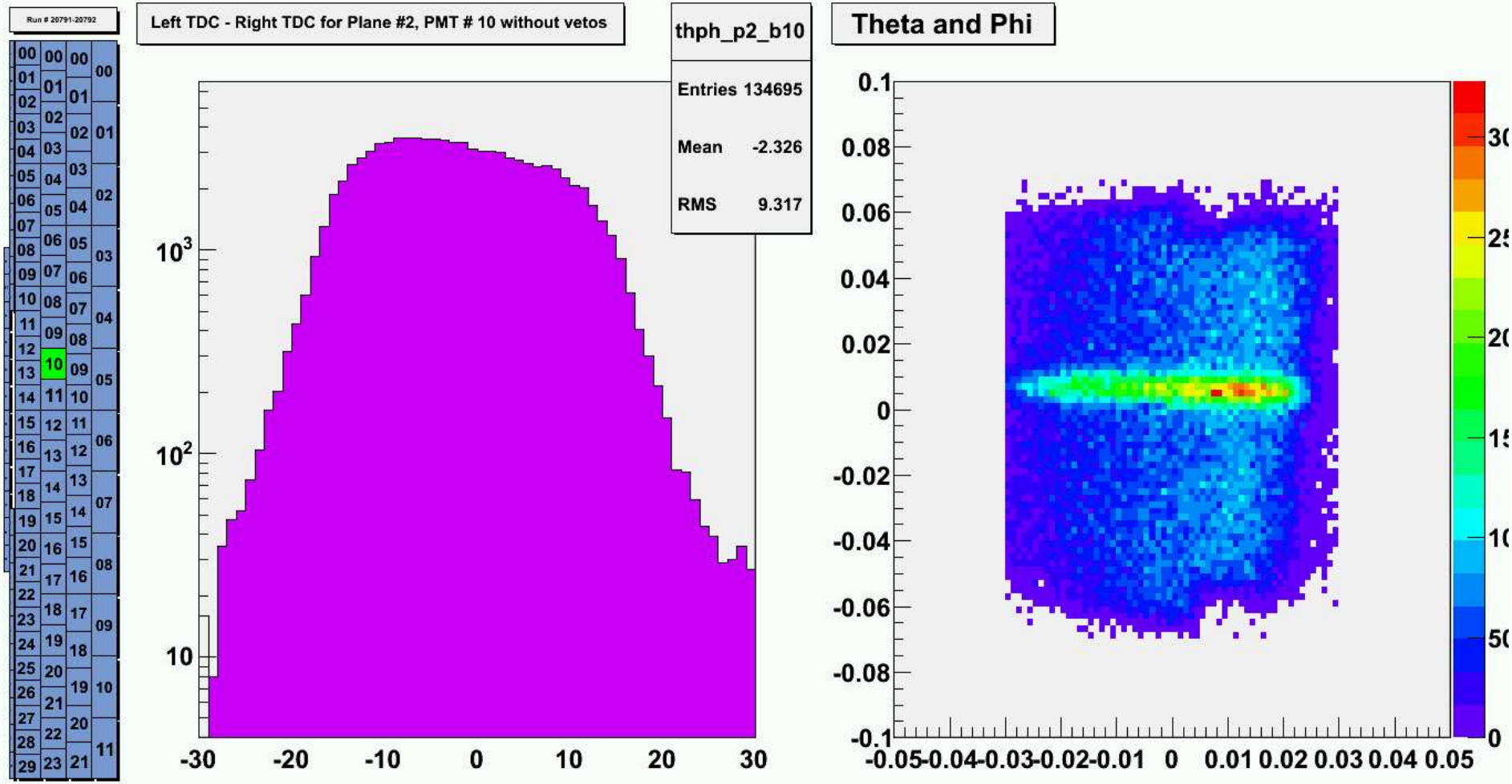
Phi Correlates to Left-Right Position



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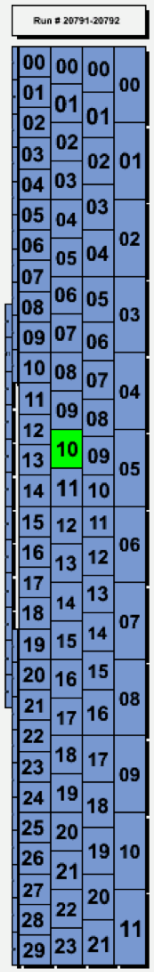
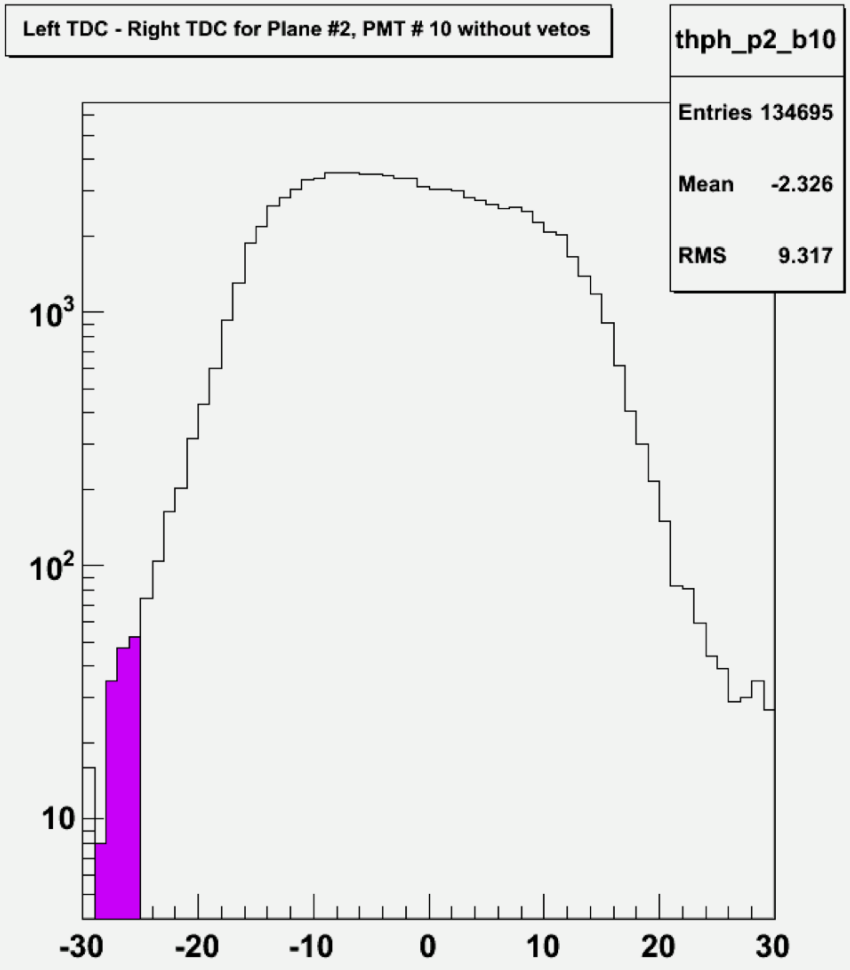
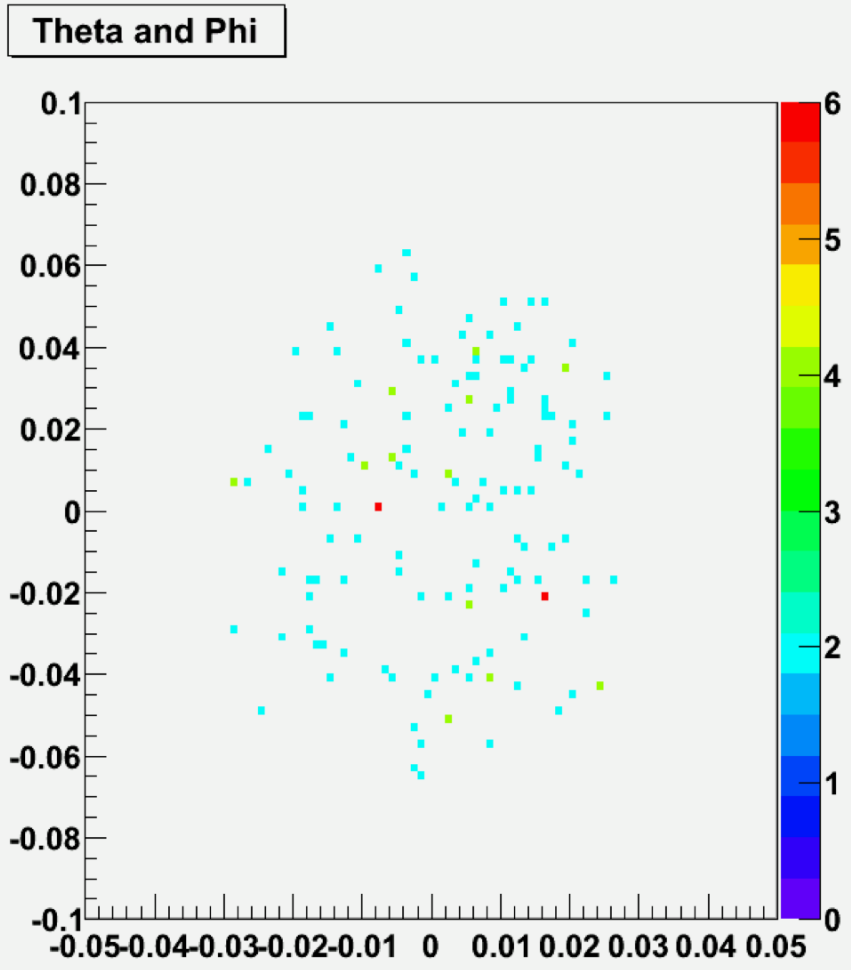
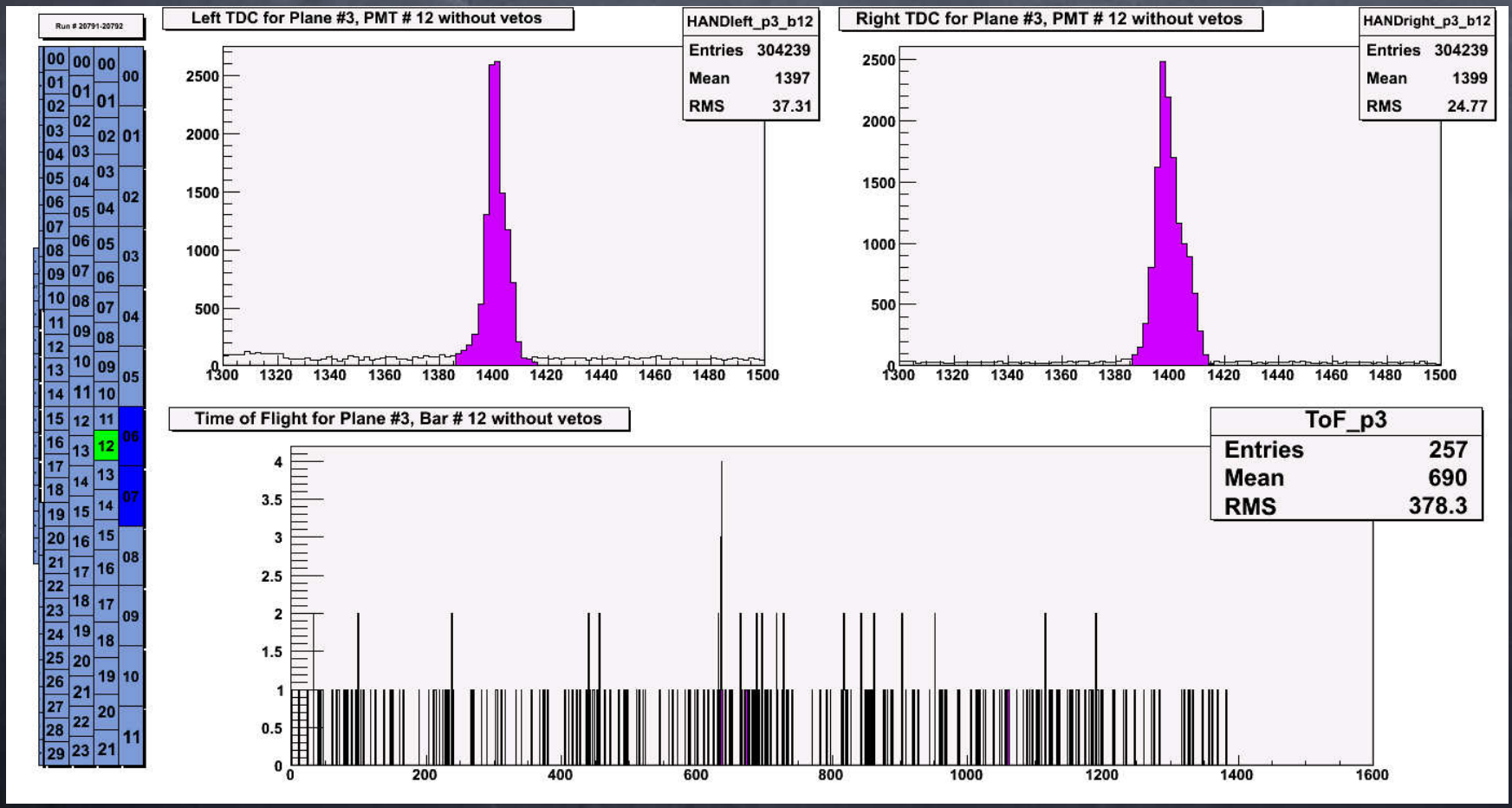






Where are we going?

- Ratio of protons that survive veto cuts
  - Example: 100% -> 7.7% -> 1.6%



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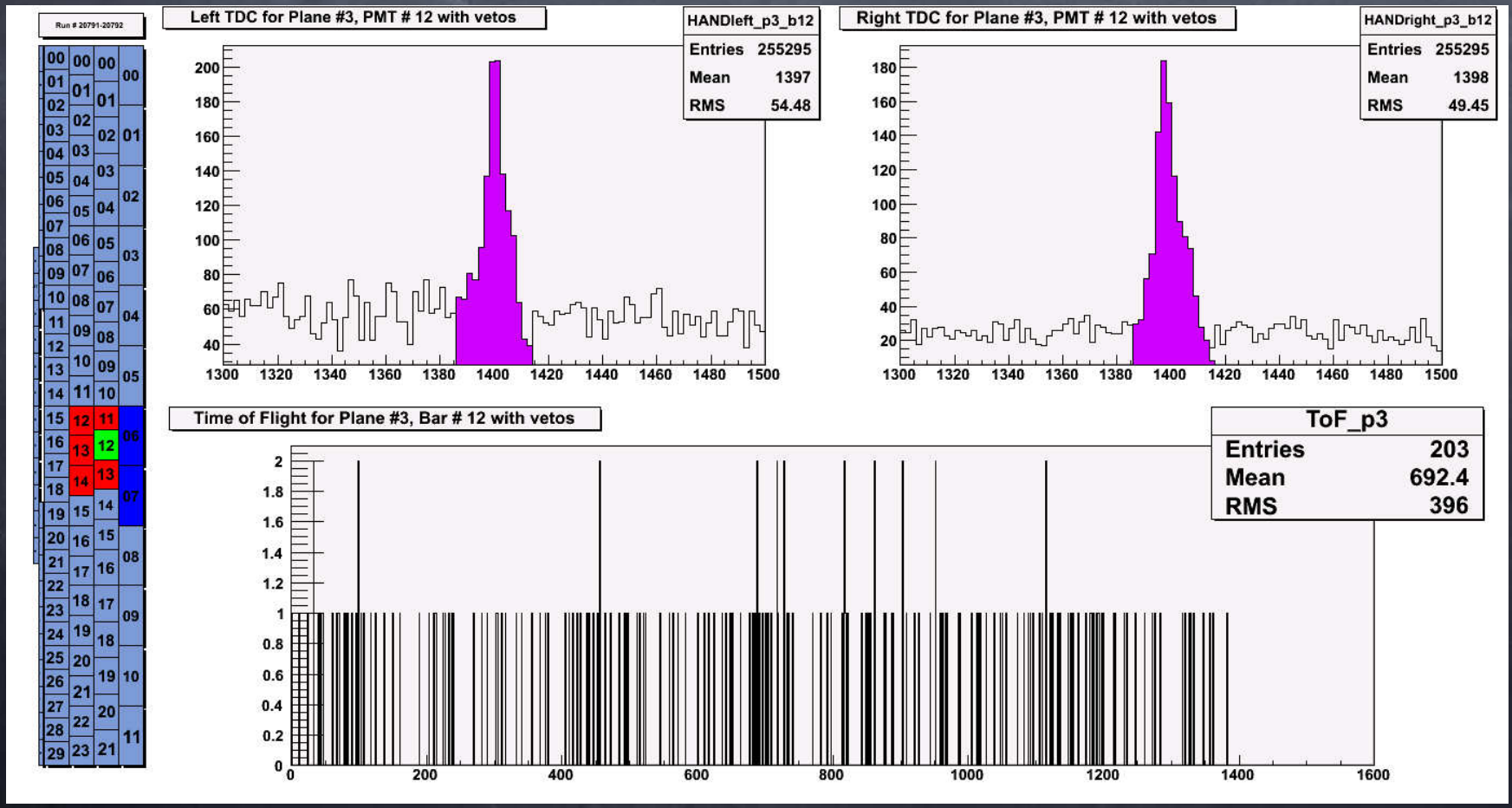

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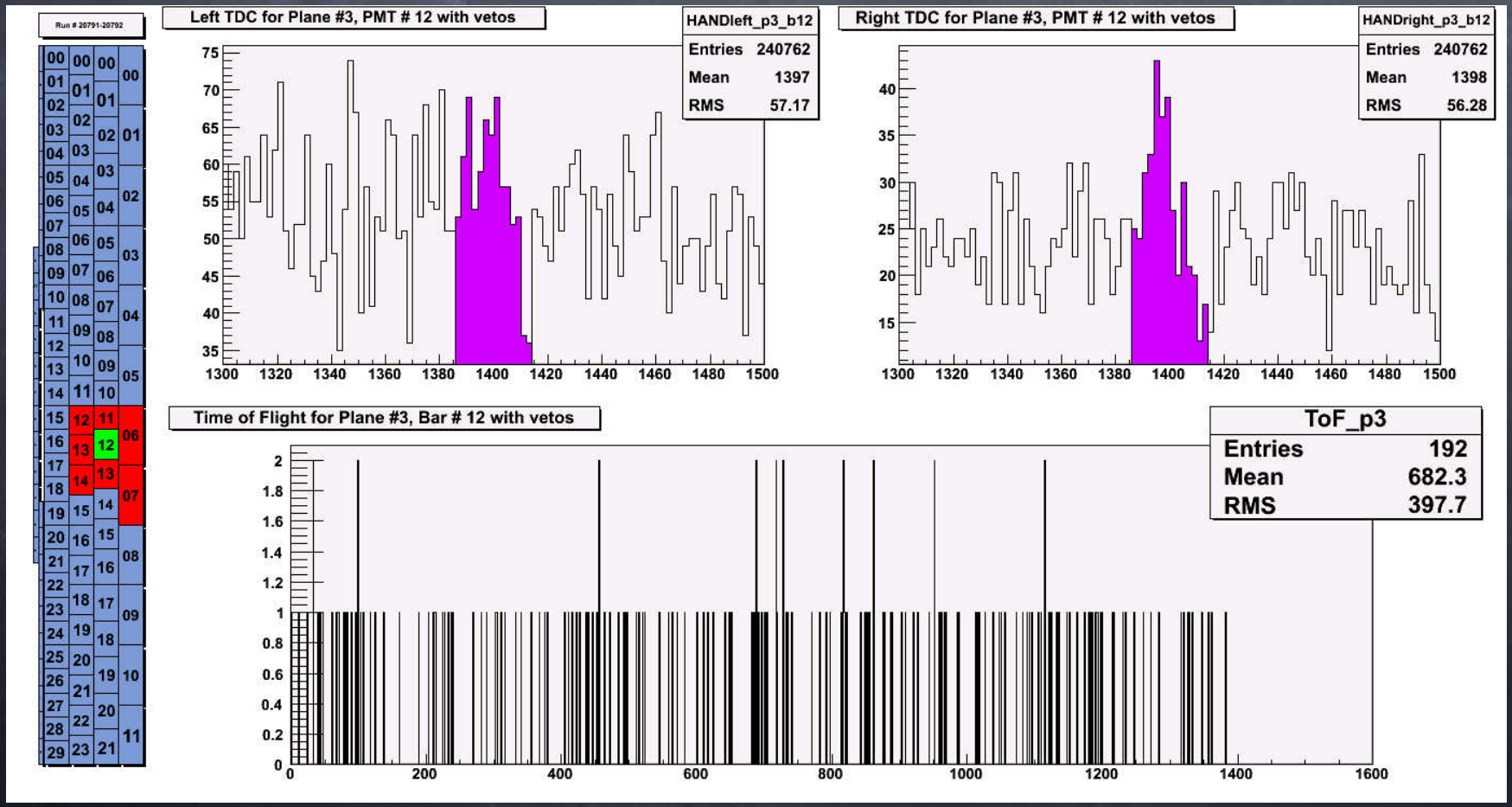

Where are we going?

- Finalize veto cuts
- Examine neutron penetration from deuterium target
- Examine neutron penetration from ^{3}He target
- Make neutron cuts
- Find semi-exclusive ^{3}He(e,e'n) asymmetry using neutron cuts
- Finalize scaling factors of asymmetry

Thank to the Hall A Quasi-Elastic Family of Experiments

E05-015,
E08-005,
and E05-102

Spokepersons

T. Averett, College of William and Mary (E05-015, E08-05)
J. P. Chen, Thomas Jefferson National Accelerator Facility (E05-015)
S. Gilad, Massachusetts Institute of Technology (E05-102)
D. Higinbotham, Thomas Jefferson National Accelerator Facility (E05-102, E08-005)
X. Jiang, Rutgers University (E05-015)
W. Korsch, University of Kentucky (E05-102)
B. E. Norum, University of Virginia (E05-102)
S. Širca, University of Ljubljana (E05-102)
V. Sulkosky, Thomas Jefferson National Accelerator Facility (E08-005)

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M. Mihovilovič, Jožef Stefan Institute
Y. Zhang, Lanzhou University

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S. Riordan, University of Virginia
B. Sawatzky, Temple University
R. Subedi, University of Virginia
V. Sulkosky, Massachusetts Institute of Technology
Y. Qiang, Duke University
B. Zhao, College of William and Mary

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W. Boeglin
P. Bradshaw
M. Canan
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R. De Leo
X. Deng
A. Deur
C. Dutta
L. El Fassi
D. Flay
F. Garibaldi
H. Gao
R. Gilman
S. Golge
O. Hansen
T. Holmstrom
J. Huang
H. Ibrahim
E. Jensen
M. Jones
H. Kang
J. Katich
C. W. Kees
P. King
J. LeRose
R. Lindgren
H. Lu
W. Luo
P. Markowitz
M. Meziane
R. Michaels
B. Moffit
N. Muangma
H. P. Khanal
K. Pan
D. Parno
E. Piasetzky
M. Posik
A. J. R. Puckett
X. Qian
X. Qui
A. Saha
F. Salvatore
M. Shabestari
A. Shahinyan
B. Shoenrock
J. St. John
A. Tobias
W. Tireman
G. M. Urciuoli
D. Wang
K. Wang
J. Watson
B. Wojtsekhowski
Z. Ye
X. Zhan
X. Zheng
L. Zhu

Extra Slides

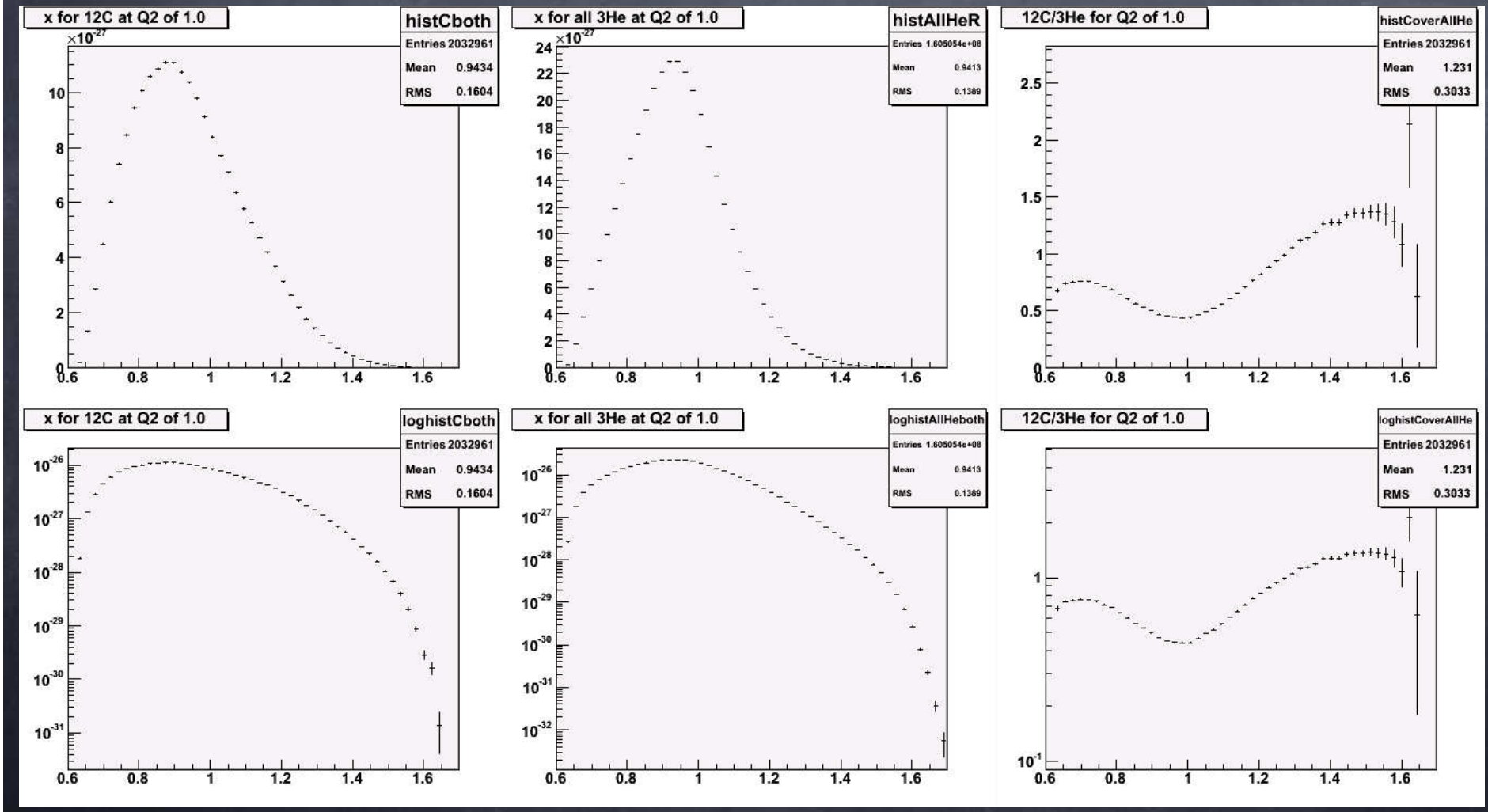
Bjorken-x Yields

$$\text{Yield} = \frac{N}{Q * LT * \rho * \Delta z} * \left(\cancel{\frac{1}{\varepsilon_{det} * \Delta\Omega * \Delta E'}} \right)$$

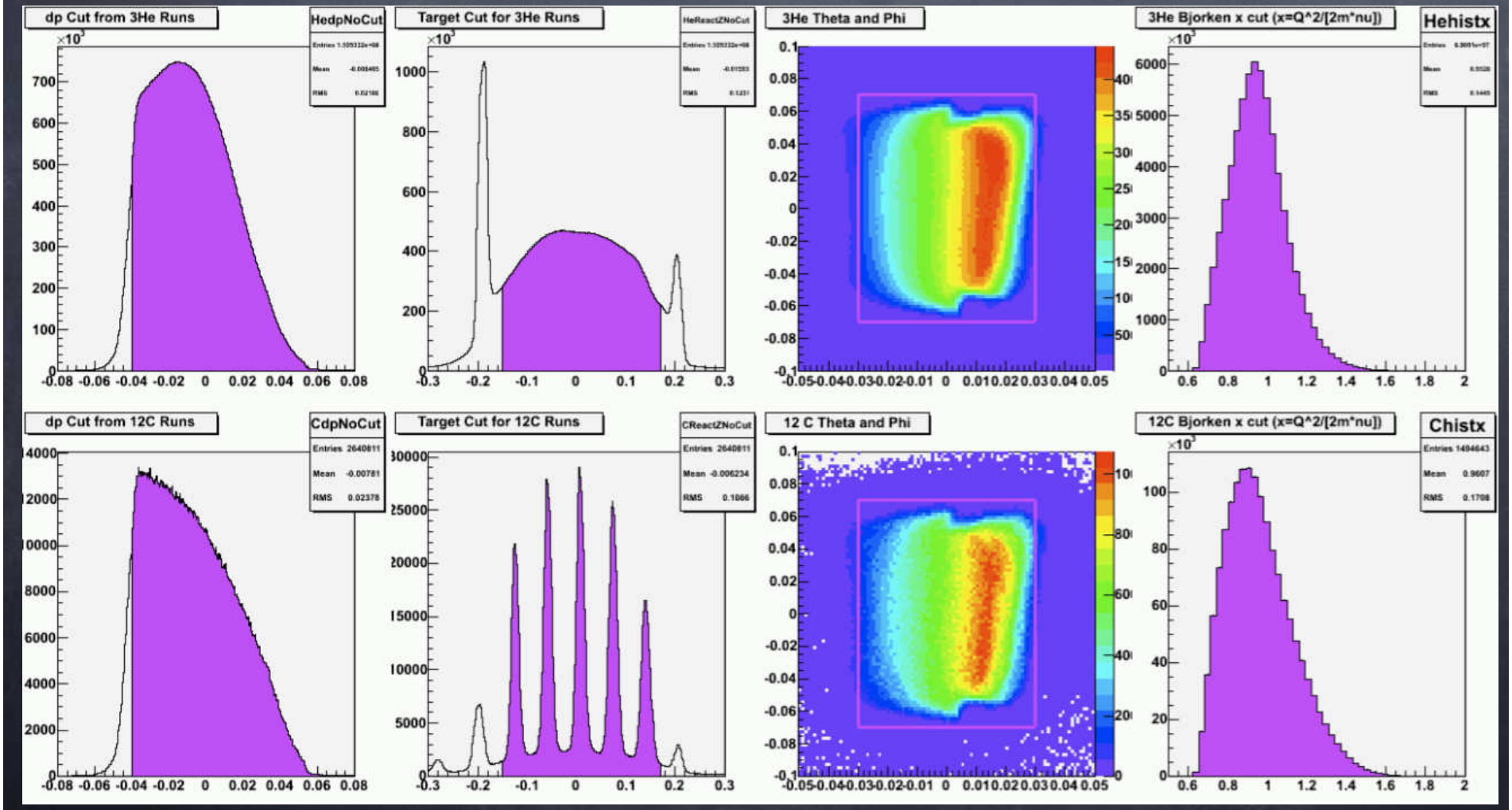
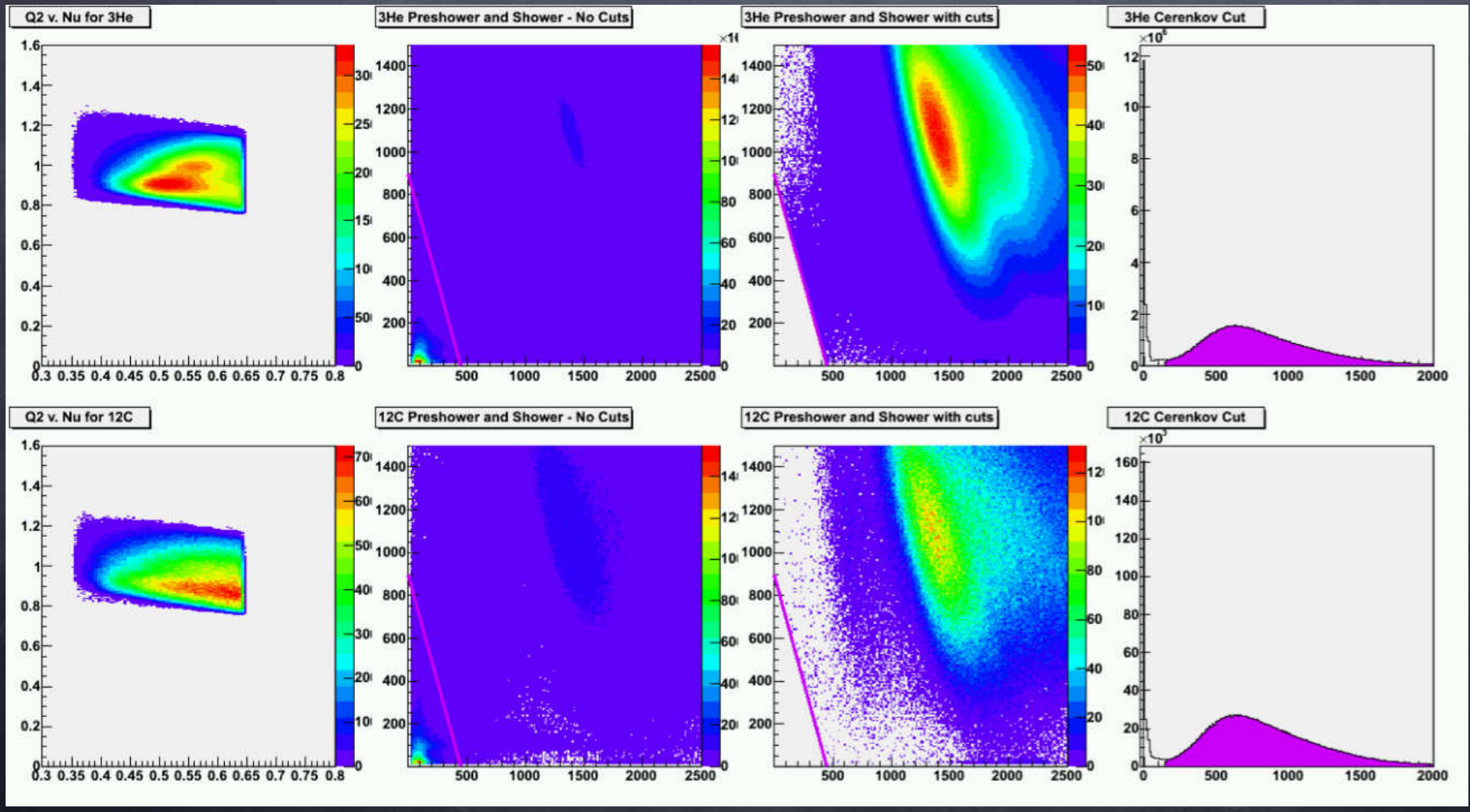
Ignore since it will cancel

$$\text{Scaling} = \frac{^{12}\text{C Yield}}{^{3}\text{He Yield}}$$

Bjorken-x Scaling at Q^2=1



Bjorken-x Cuts



Bjorken-x Cuts