HRS Preparations for the Upcoming Experiments

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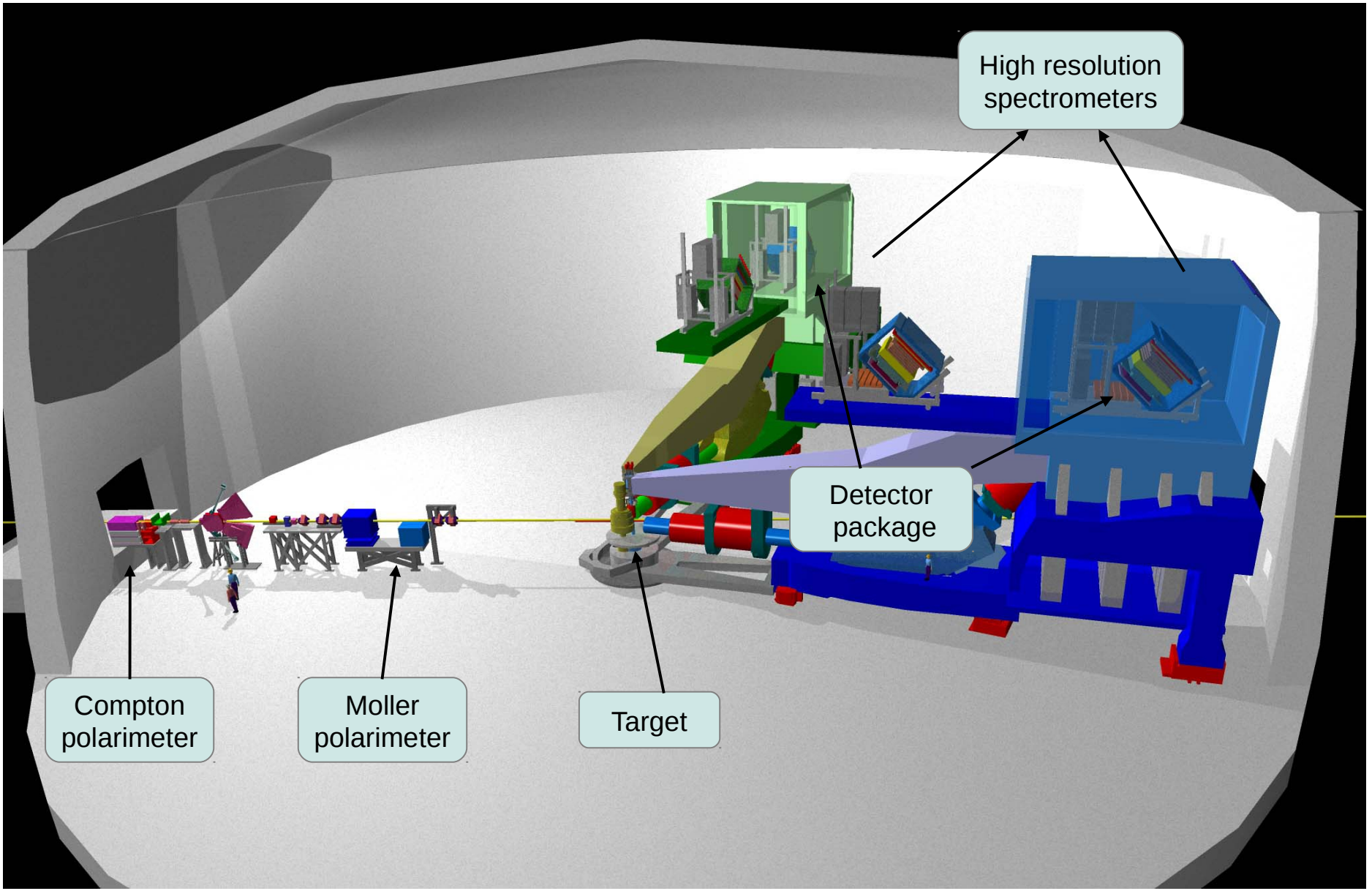
APEX Collaboration Meeting, Jefferson Lab
22nd April 2014

Outline

- Recent activities on the HRS detectors
- Beam commissioning and detector checkout in March-April 2014
- Future plans and to-do list for Fall 2014 run

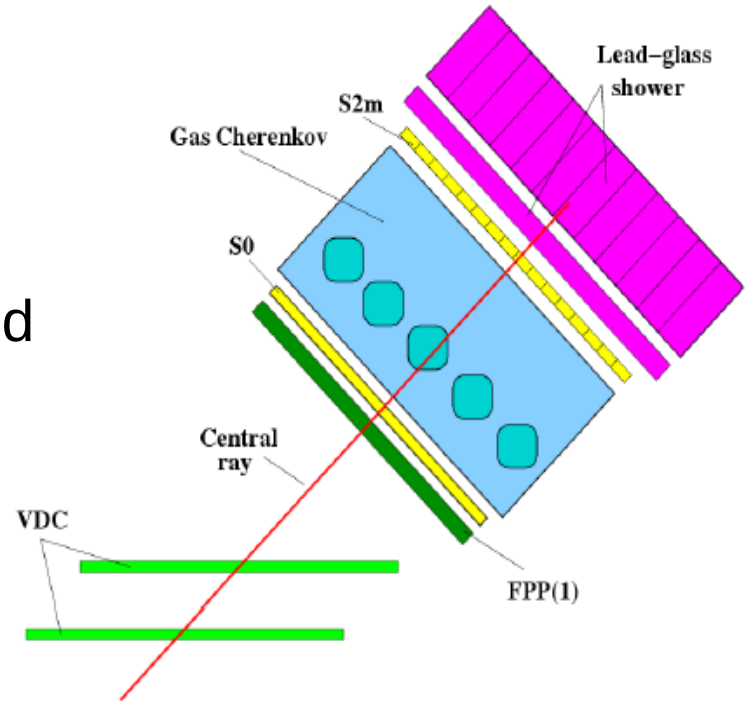
Hall A Experimental Equipment



HRS Detector Stack

Recent Activities on the HRS Detectors

- New front-end electronics for Vertical Drift Chambers
- Addition of a straw tube chamber in HRS
- Gas Cherenkov mirror reflectivity study and mirror re-alignment
- New PMTs for gas Cherenkov and wavelength shifter
- Completely redone trigger setup



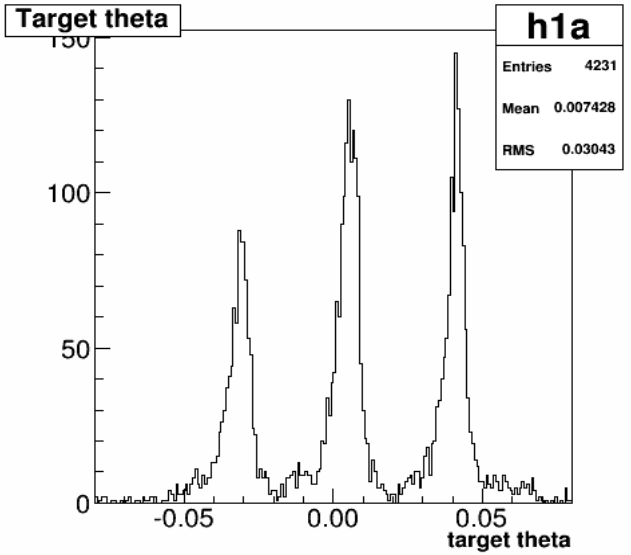
Vertical Drift Chambers

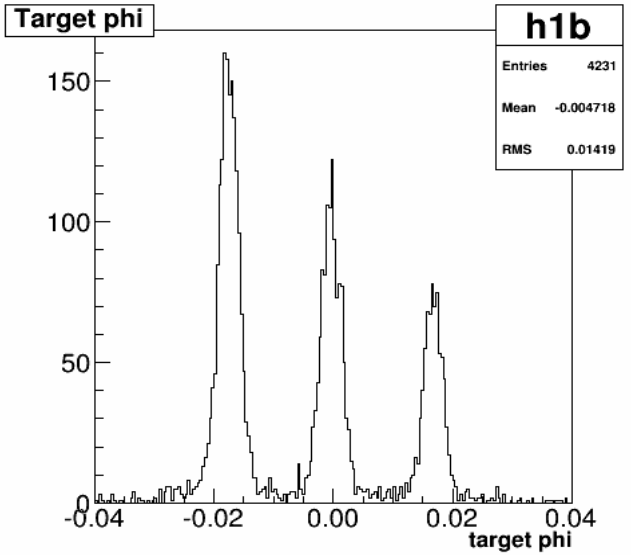
- LeCroy discriminator cards replaced with MAD cards
  (operate at smaller gain, better control of noise)
- Level translators and power supplies installed on both spectrometers
- Power supplies for threshold are replaced

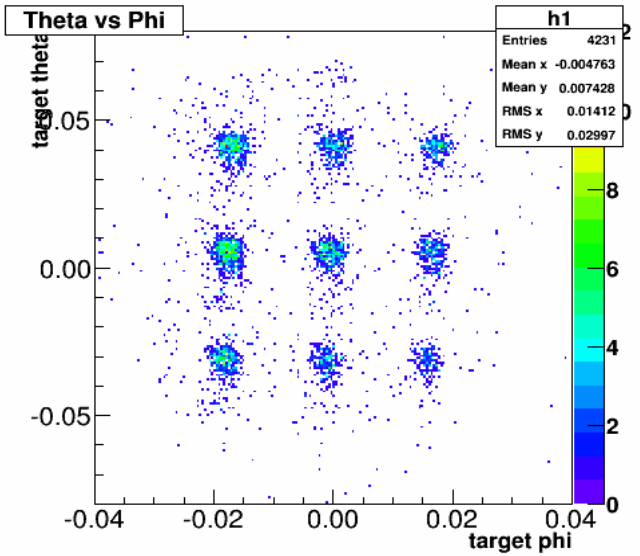
Level translator

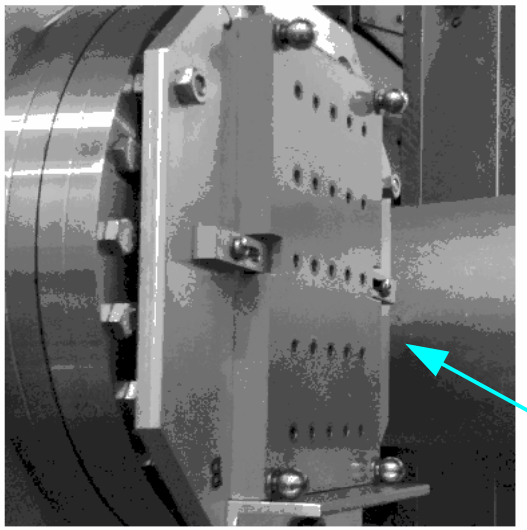
MAD cards

VDC Checkout with Beam







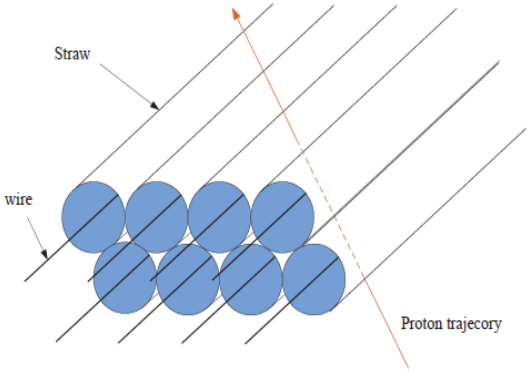


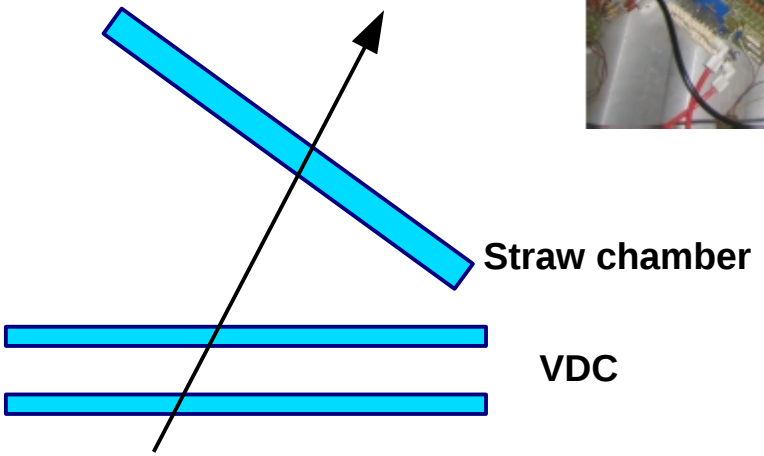
Sieve plate
(2” thick Pb)

Straw Chambers

- One Straw Chamber installed in each HRS
- 3 U and 3 V planes
- U-V angle: 45^{o} to horizontal
- 170 straws per plane
- Wire spacing: 1.095 cm

- Help resolve ambiguous tracks from VDC
- Improve tracking
- Useful for high rates experiments (APEX)



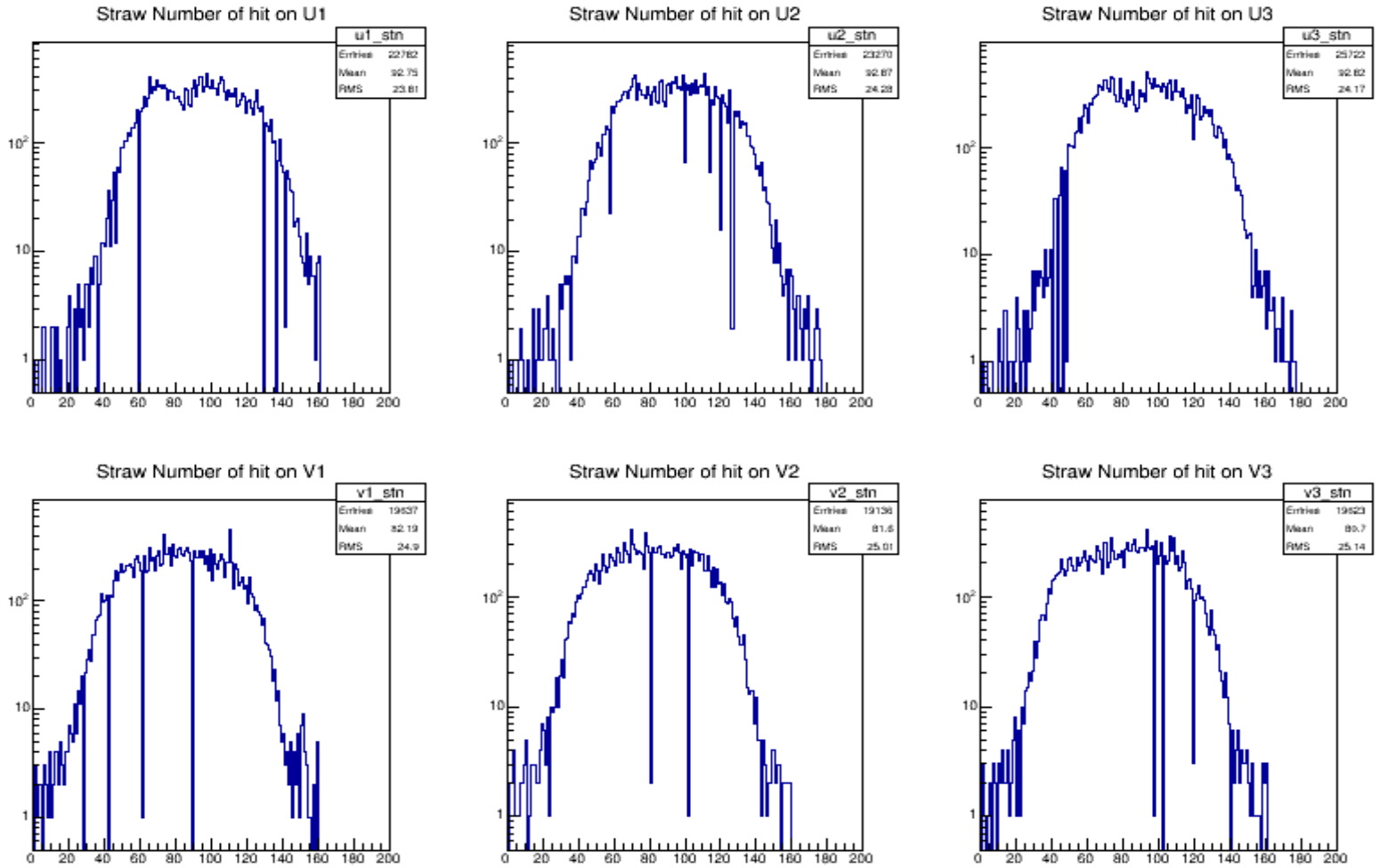


Straw Chamber Checkout with Beam

- Online software for detector diagnosis
- Need some more work to fix inefficient channels

Run #20269

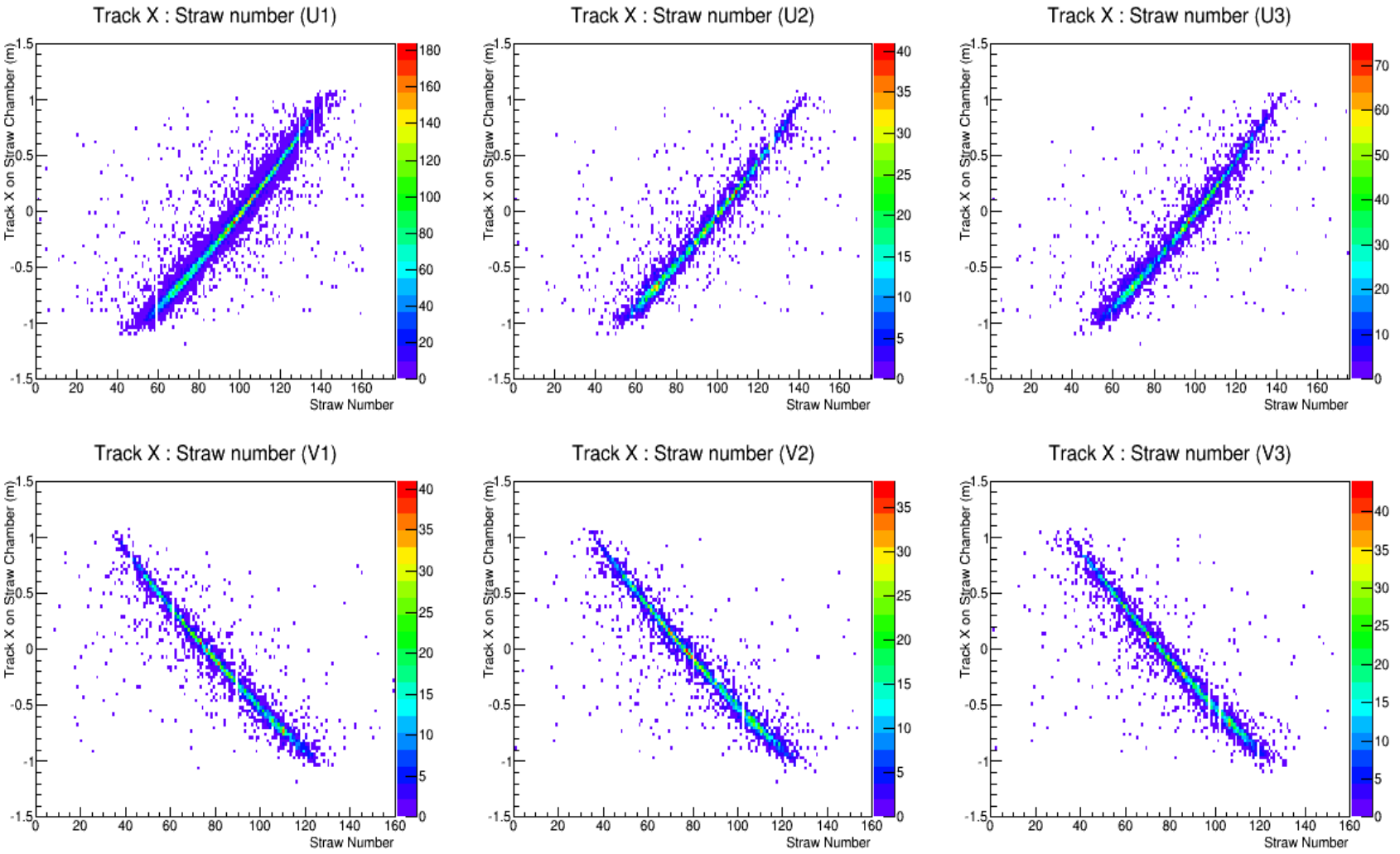
Right HRS



Straw Chamber Checkout

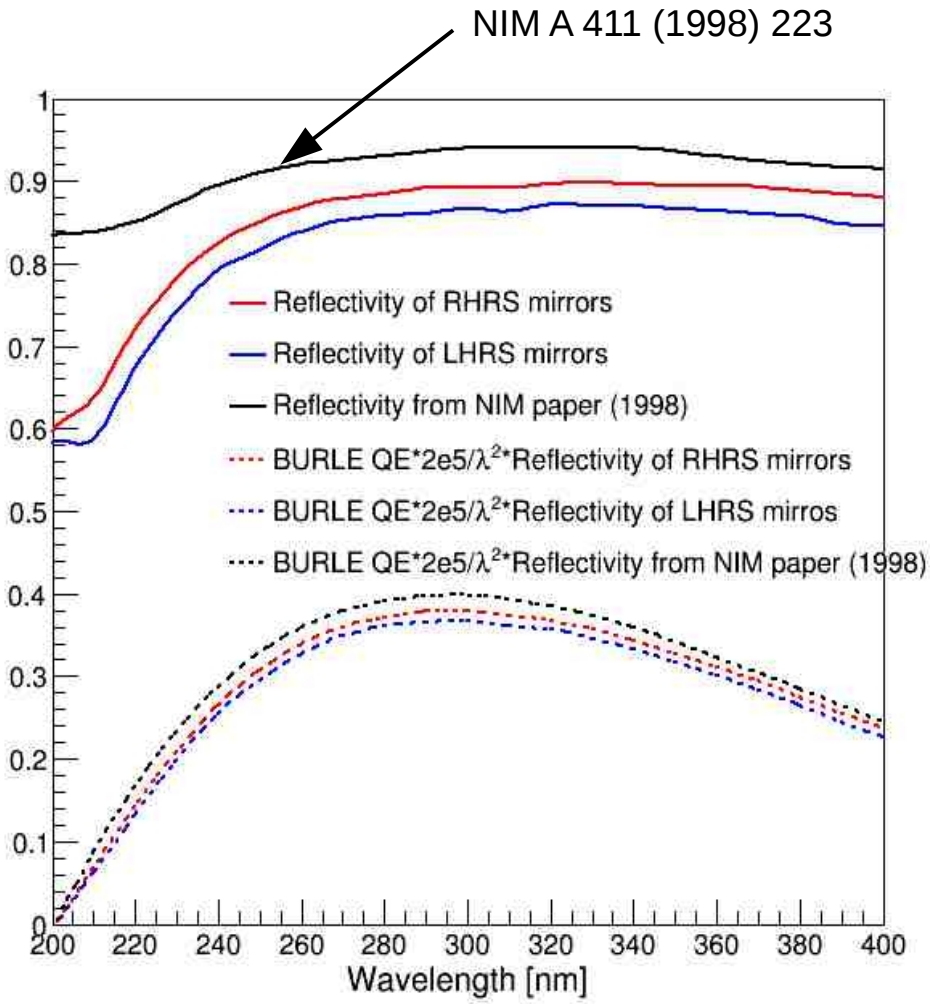
- Track projection (vertical) vs straw number

Right HRS



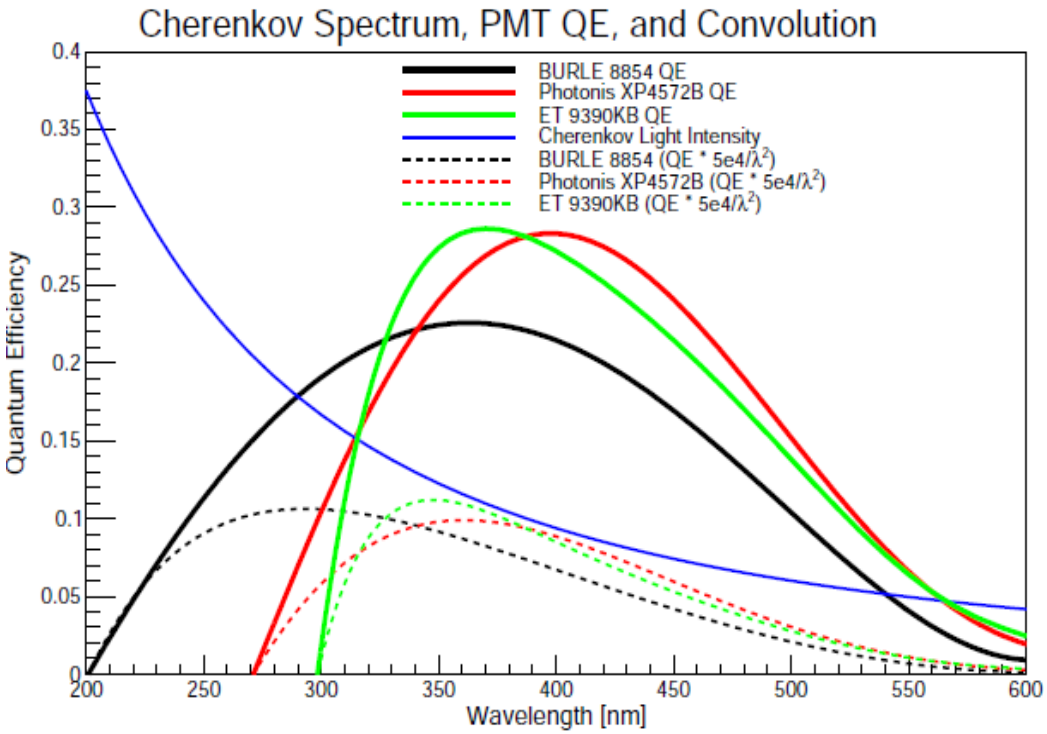
Gas Cherenkov: Mirror reflectivity tests

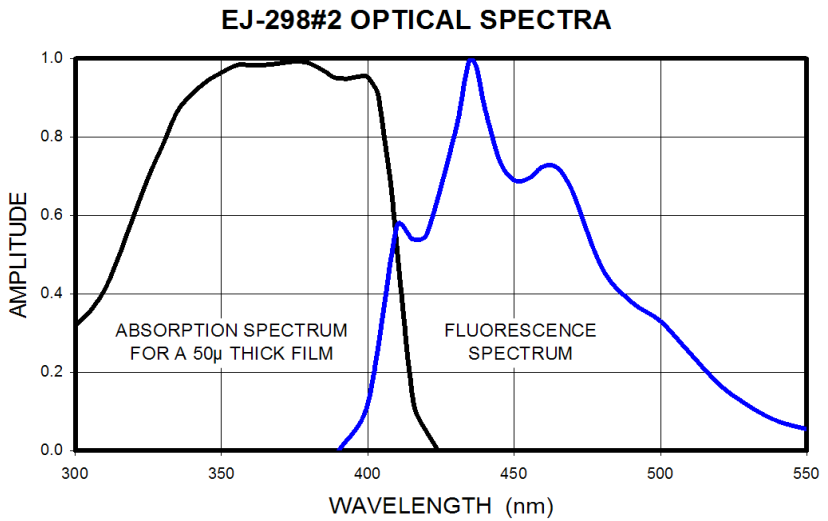
- Mirror Reflectivity tests were performed
- Deterioration in reflectivity was observed for all tested mirrors
  - ~ 30% near 200 nm
  - ~ 6% around 300 nm
- Reduction of combined efficiency due to drop in reflectivity:
  - BURLE : ~ 8 %
  - ET Tubes : ~ 7%
- Alignment of mirrors was done
- Added new windows for the gas Cherenkov



Improvements to Gas Cherenkov PMTs

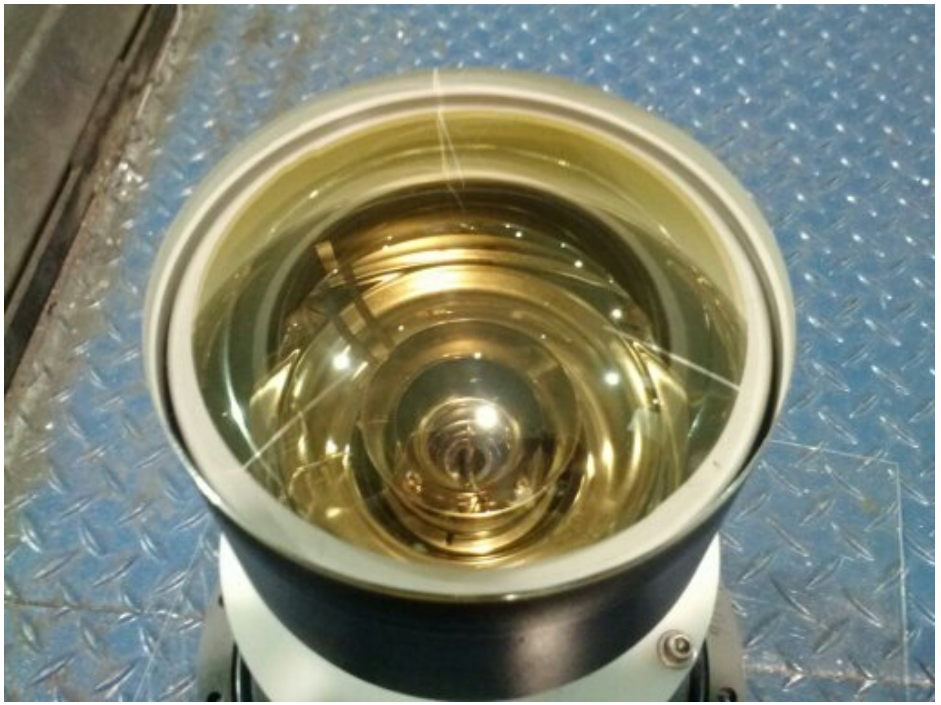
- Goal is to improve the # of P.E.
  (was < 10 for old Burle/Photonis tubes)
- Replaced gas Cherenkov with new 5” PMTs
  - ET tubes for Left HRS
  - Photonis for Right HRS
- Use of wavelength shifter (WLS)
- Tested four different WLS on a bench setup
- Selected best WLS:
  - Eljen Technologies paint EJ-299-31E
- Beam tests performed recently



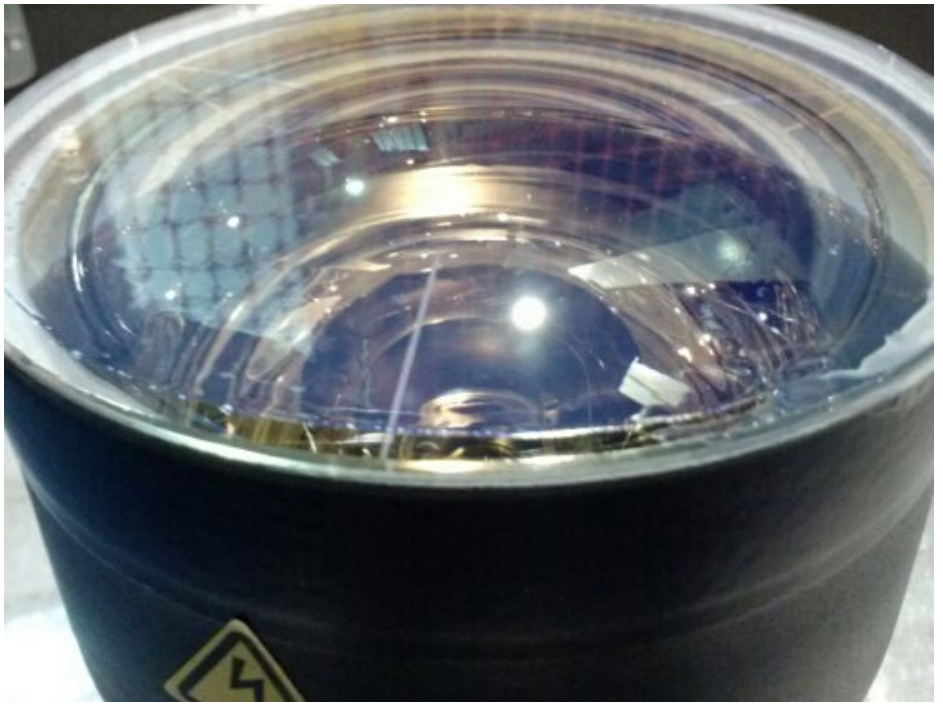


Application of Paint: Before & After

Before WLS Applied



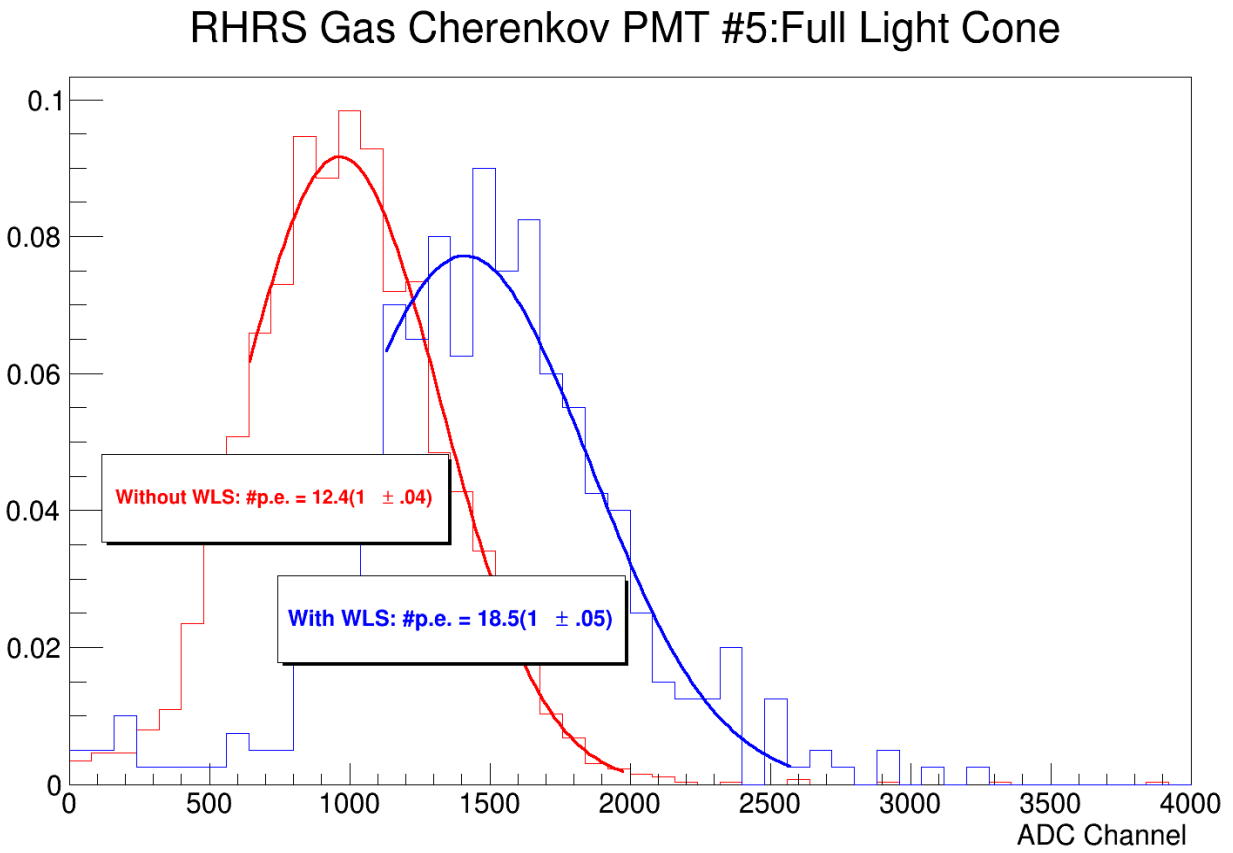
After WLS Applied



Thickness of paint: 50 -100 micron

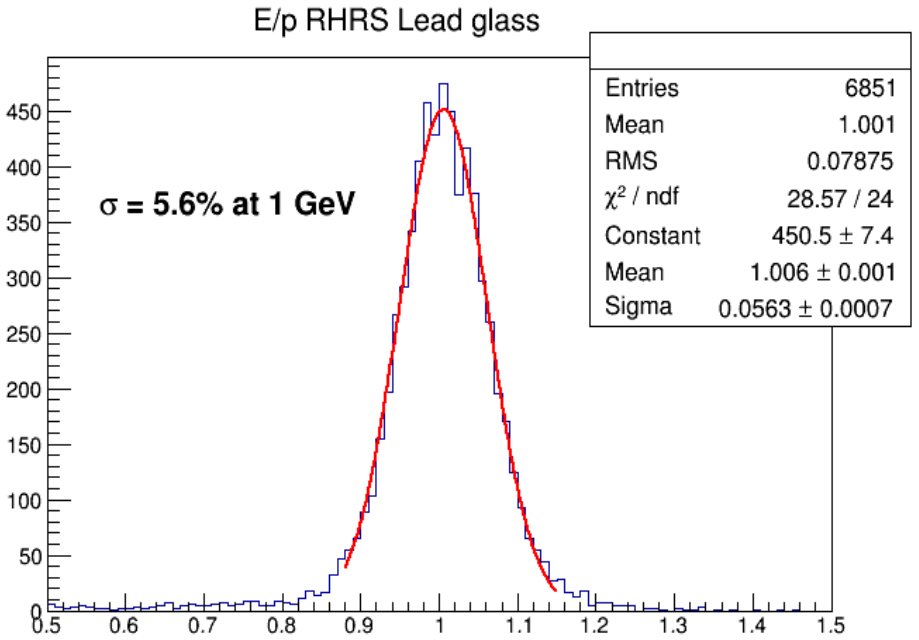
Beam Tests of WLS

- Results from Photonis PMT on Right HRS
- Tested 2 PMTs on each HRS
- Gain improved by 50 – 60%

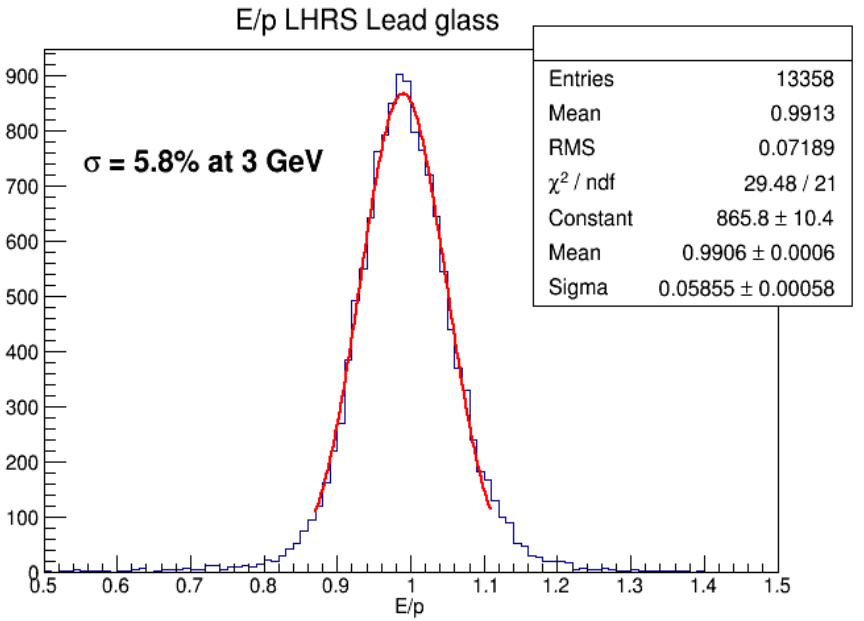


Preshower and Shower

- Shower + preshower sum constructed for trigger
- Gain matching of all ADC channels
- Commissioning with electron beam



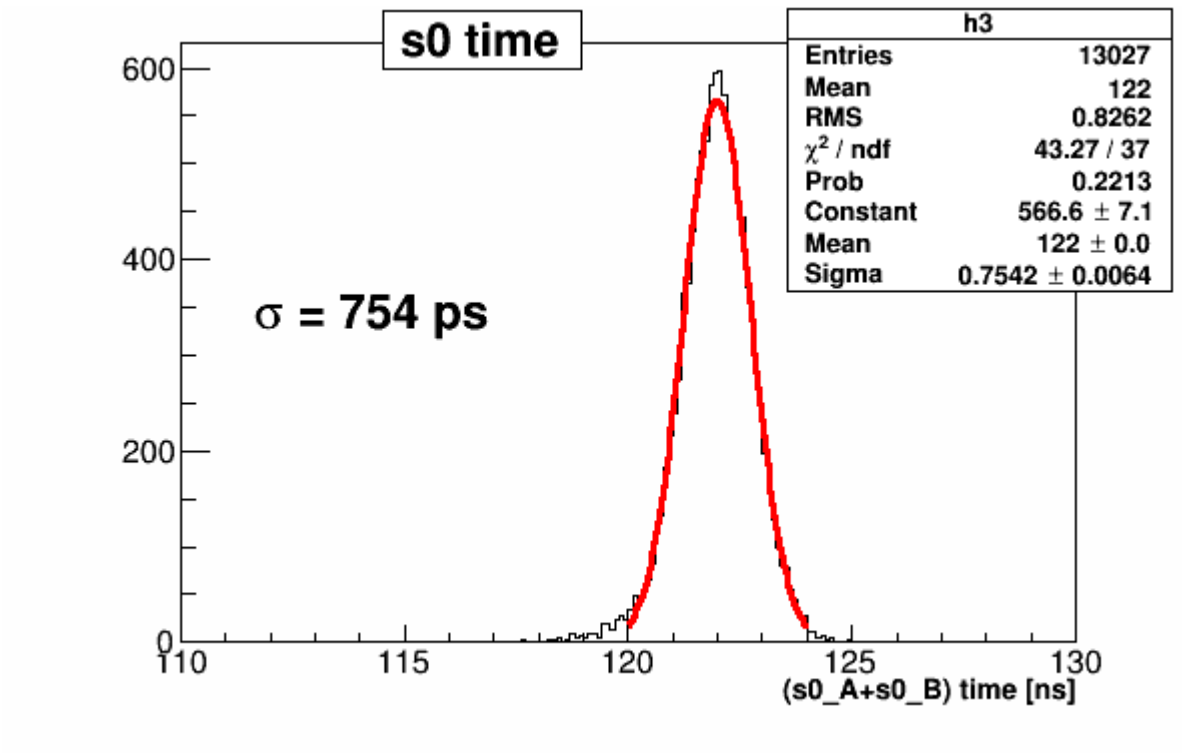
Right HRS



Left HRS

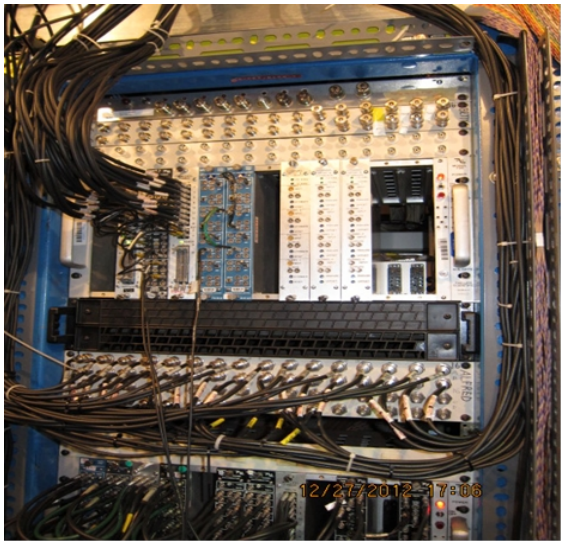
s0 Scintillator

- Single paddle of scintillator counter
- Two PMTs (A & B) in top and bottom



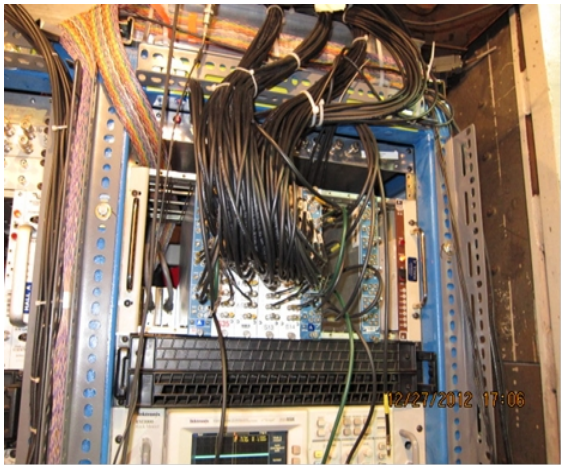
HRS Data Acquisition Status

- HRS trigger setup was completely redone after the end of 6 GeV run
  - Got rid of the old CAMAC electronics
  - Only NIM and VME based electronics



- Trigger are available through programmable module (MLU)

  T1 = s0 && S2m
  T2 = s0 && GC
  T3 = s2 && GC
  T4 = s0 && Shower
  T5 = s2m && Shower
  T6 = GC && Shower



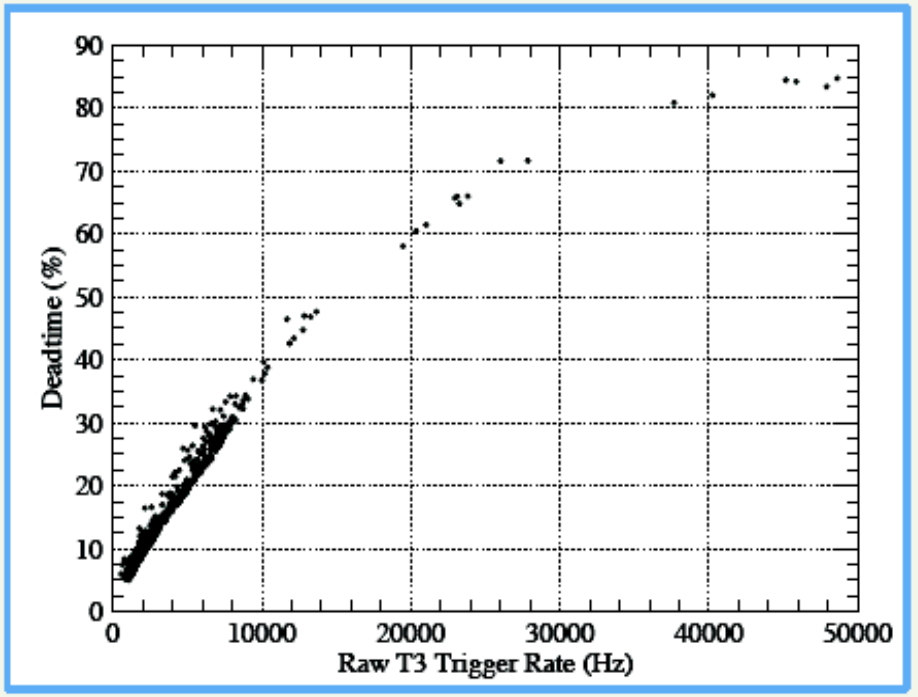
- Singles trigger can be selected from software
- Added noise canceling filters for ADCs
- Added refurbished high voltage crates
- Added one additional fastbus crate (total 3 crates in each HRS)

DAQ Performance for g2p Experiment (2012)

LHRS RESULTS

Production running **6.5 kHz** with **~25% deadtime** with PS3 = 1!

Production Running



T3 (kHz)	PS3	DT (%)
6.5	1	25
15	2	20
22	3	20
30	4	20

Ryan Zielinski (UNH)

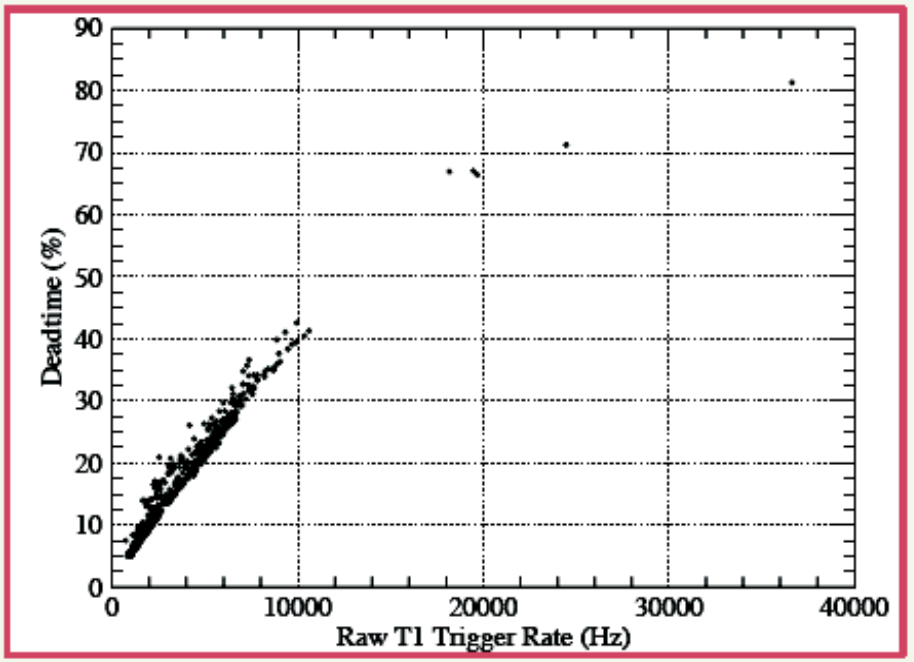
Hall A Collaboration Meeting June 7, 2012

DAQ Performance for g2p Experiment (2012)

RHRS RESULTS

Production running **6.1 kHz** with **~25% deadtime** with PS1 = 1!

Production Running



T1 (kHz)	PS1	DT (%)
6.1	1	25
15	2	25
22	3	20
30	4	21

Ryan Zielinski (UNH)

Hall A Collaboration Meeting June 7, 2012

Future Plans

- Vertical Drift Chamber
  - Implement sparcification for TDC readout (smaller gate window)
  - Work on improving tracking using straw chamber
- Straw Chamber
  - Fix inefficient/bad channels
  - Work on calibration software
- Gas Cherenkov
  - Apply WLS to all PMTs on both spectrometers (mostly done)
- Trigger/DAQ
  - Implement EDTM
  - Study trigger efficiency
- Install SciFi detector and establish readout for APEX experiment

Acknowledgments

HRS detectors/DAQ work:

- Yang Wang (W&M)
- Igor Rachek (Budker)
- Vincent Sulkosky (Longwood Univ)
- Longwu Ou, Barak Schmookler, Kalyan Allada (MIT)
- Sergey Abrahamyan, Albert Shahinyan,Karen Ohanyan, Galust Sargsyan, (YerPhi)
- Robert Michaels, Alexandre Camsonne, Ole Hansen, Bogdan Wojtsekhowski, Jack Segal, Chirs Cuevas (JLab)

Summary

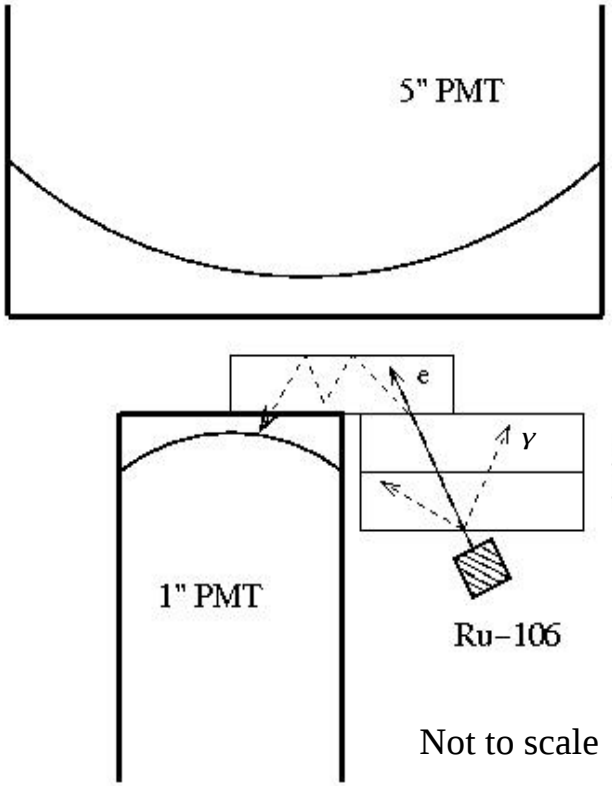
- Several improvements were made to the HRS detectors/DAQ after the end of 6 GeV run:
  - addition of straw chamber
  - new PMTs with WLS for gas Cherenkov
  - new discriminator cards for VDCs
  - new trigger setup
  - improved DAQ rate with the addition of a fastbus crate
- Successfully checked out all detectors with 4 – 6 GeV beam
- Some of these improvements will benefit APEX experiment

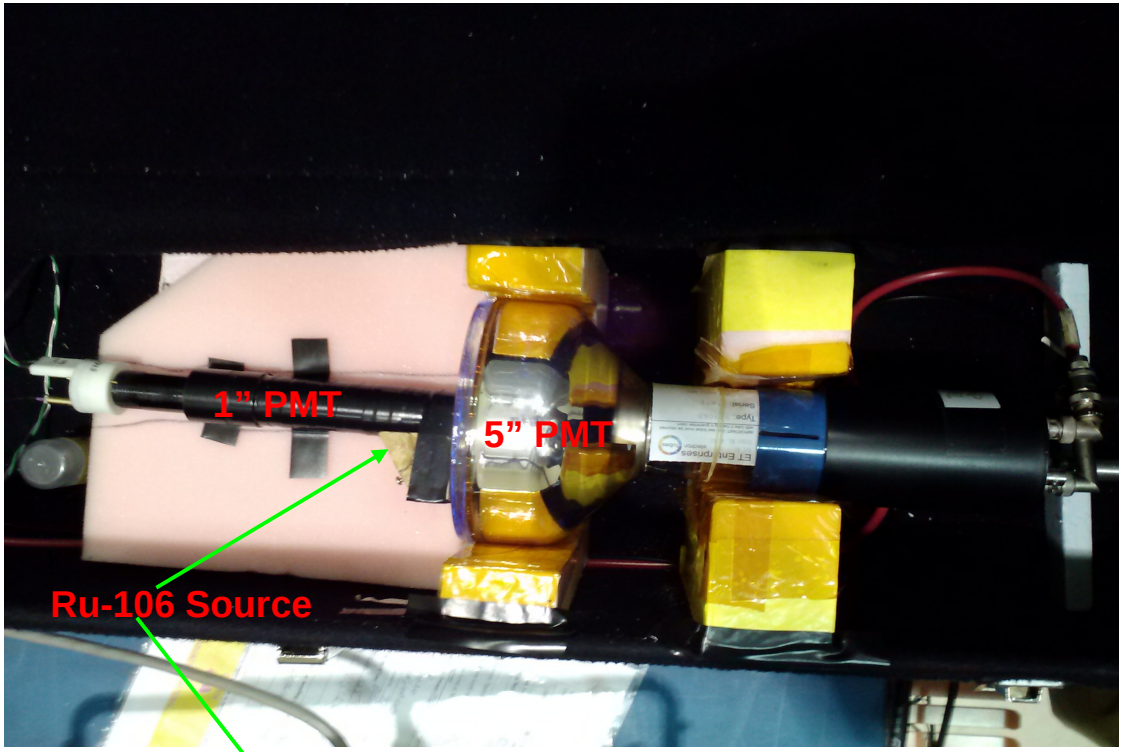
Spare Slides

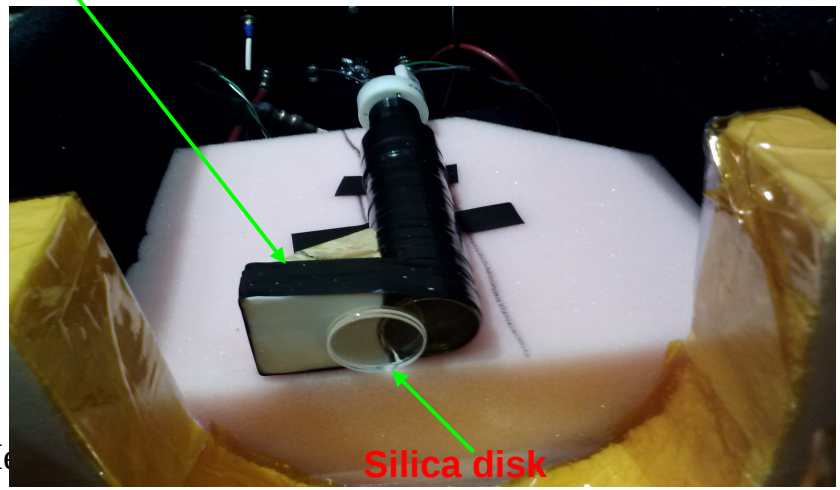
Cherenkov Test Setup

Cerenkov spectrum using beta source (Ru-106) and fused silica disks

Trigger on 1” PMT and integrate pulse from 5” tube (coincidences)



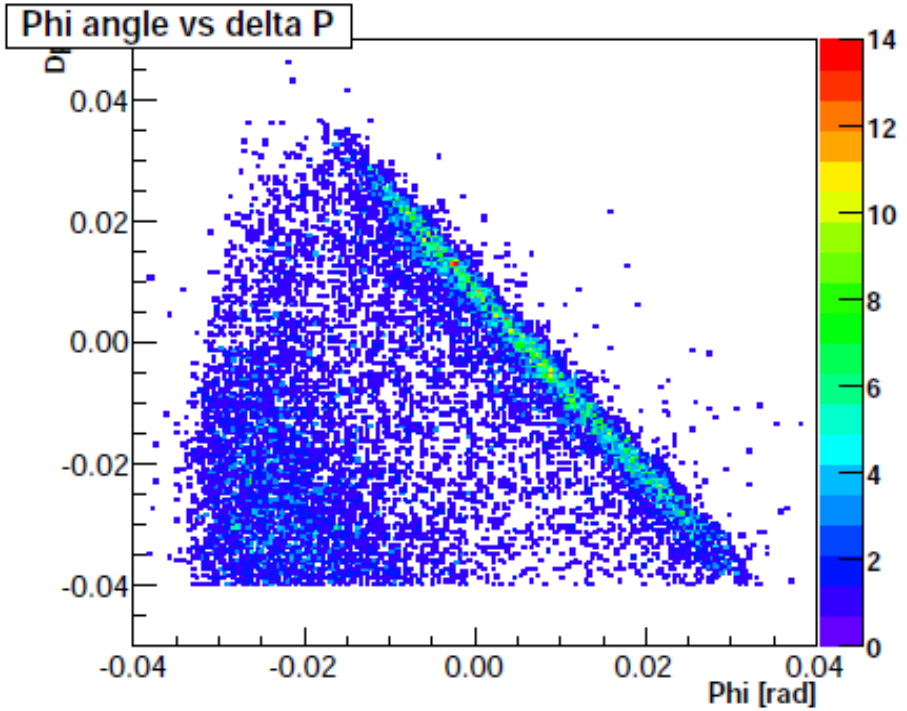


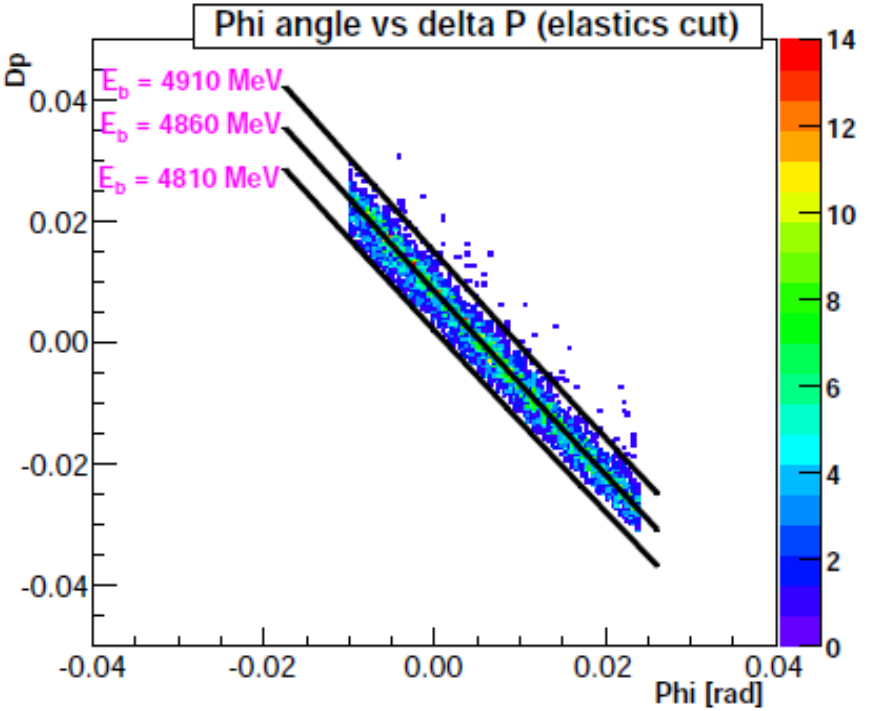


Online plot of H(e,e') elastics in Left HRS

An attempt to measure beam energy with H(e,e') elastic scattering:

Set beam energy = 4.89 GeV
HRS angle = 28 degrees
HRS momentum = 3.0 GeV/c





Without any calibrations or survey of HRS angle