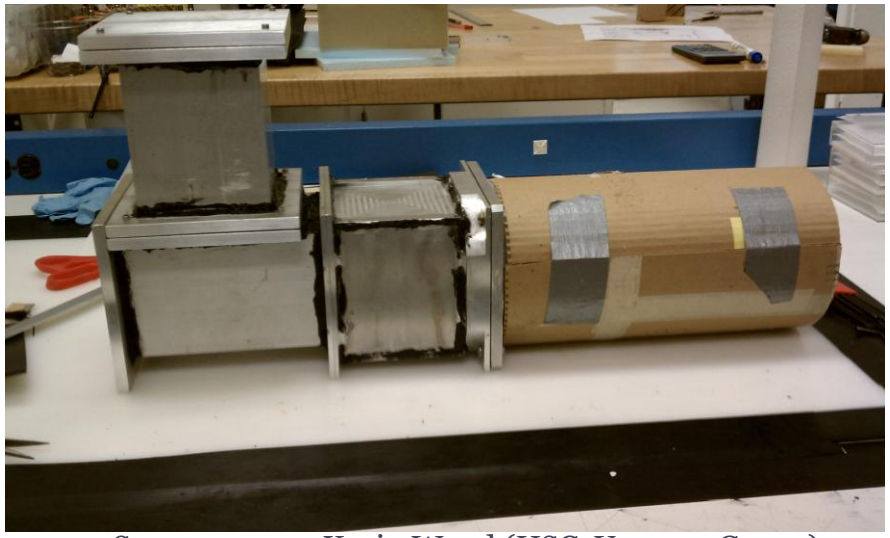
Aerogel Cherenkov Prototype Experiments

Laura Rothgeb

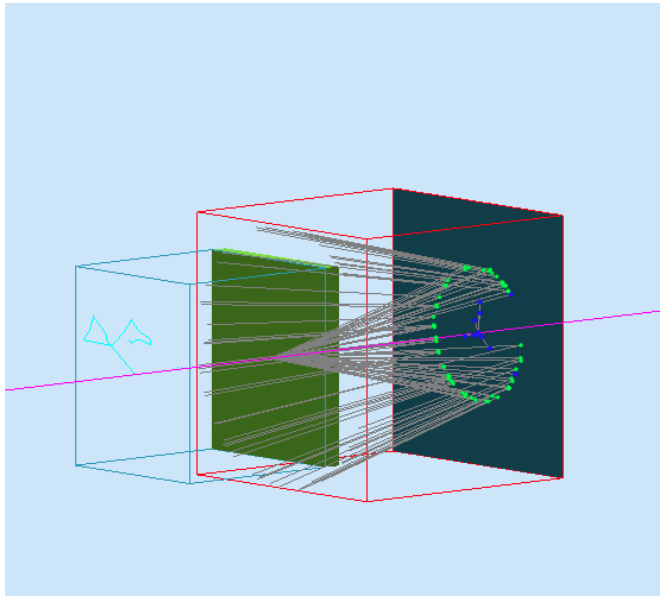
August 3, 2012

Background

- Summer 2011: first version prototype built, simulated and tested
  - Extension volume
- Fall 2011: second version built and simulated
  - No extension volume
- Yerevan Group second prototype



Summer 2011, Kevin Wood (USC, Yerevan Group)



Fall 2011, First GEMC simulation

The CUA Prototype

CUA Prototype, with gate PMTs

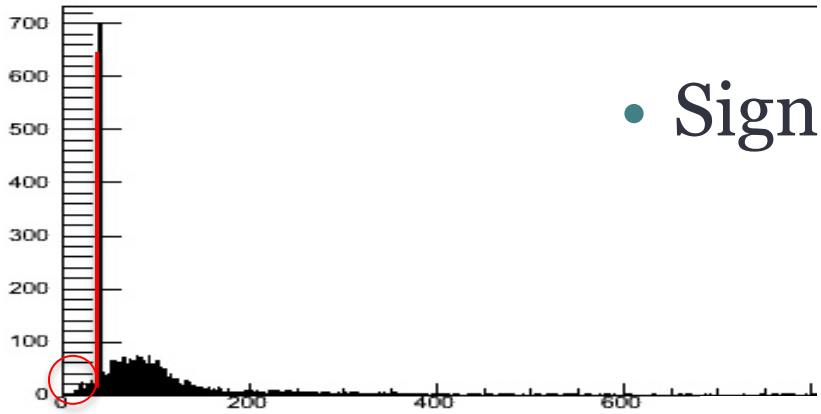
- Spring 2012: final CUA prototype designed and constructed
  - Uses one 5” diameter photomultiplier tube previously used at Bate Laboratory at MIT
    - High gain, low quantum efficiency
  - Gated by two cosmic muon detectors
  - DATA gathered using CODA and analyzed using ROOT curve-fitting software

Initial Testing

- First prototype testing performed at JLab
  - 5 cm aerogel: 5 photoelectrons
  - 8cm aerogel: 9 photoelectrons
- Early tests at CUA resulted in far fewer photoelectrons
  - New scintillators for gate PMTs constructed
  - Experimental setup changed to maximize calculation accuracy

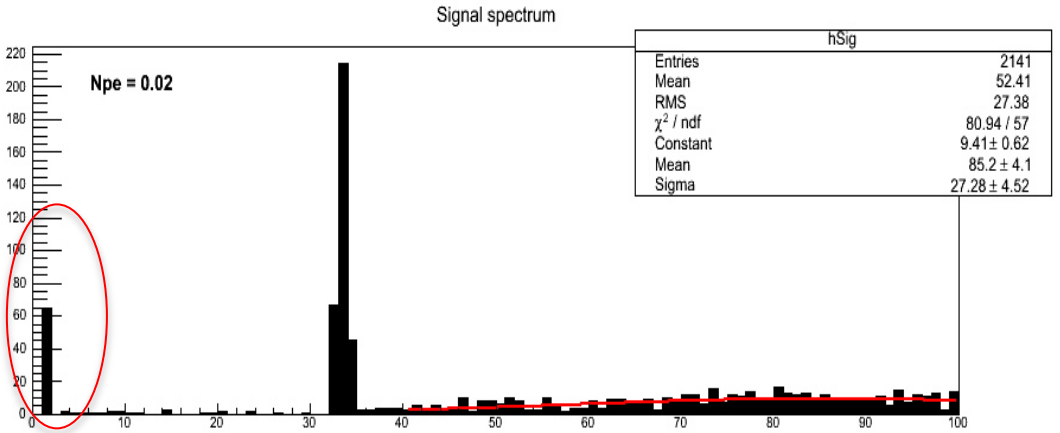
Complications

- Low number of photoelectrons
  - Half as many as Yerevan prototype and CUA JLab tests



- Signals below the Pedestal

- Double peak
  - Also seen at JLab and with Yerevan group prototype

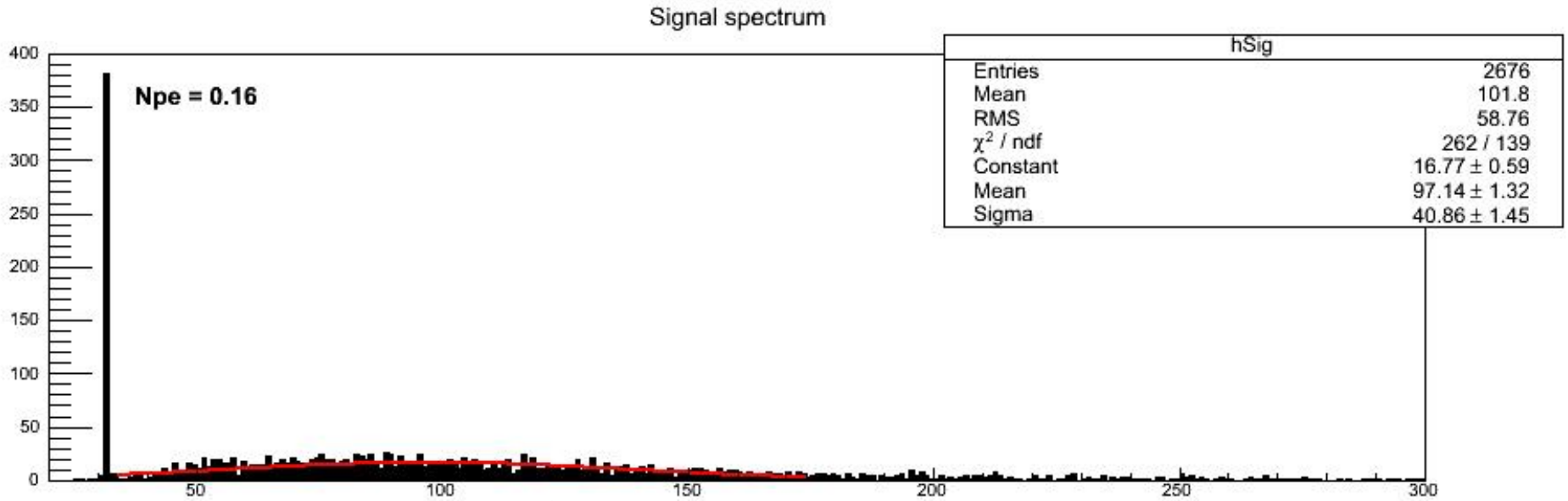


Results

- 5 centimeters of Aerogel (1800V)
  - XX Photoelectrons

Results

- 8 centimeters of Aerogel (1800V)
  - 5 Photoelectrons



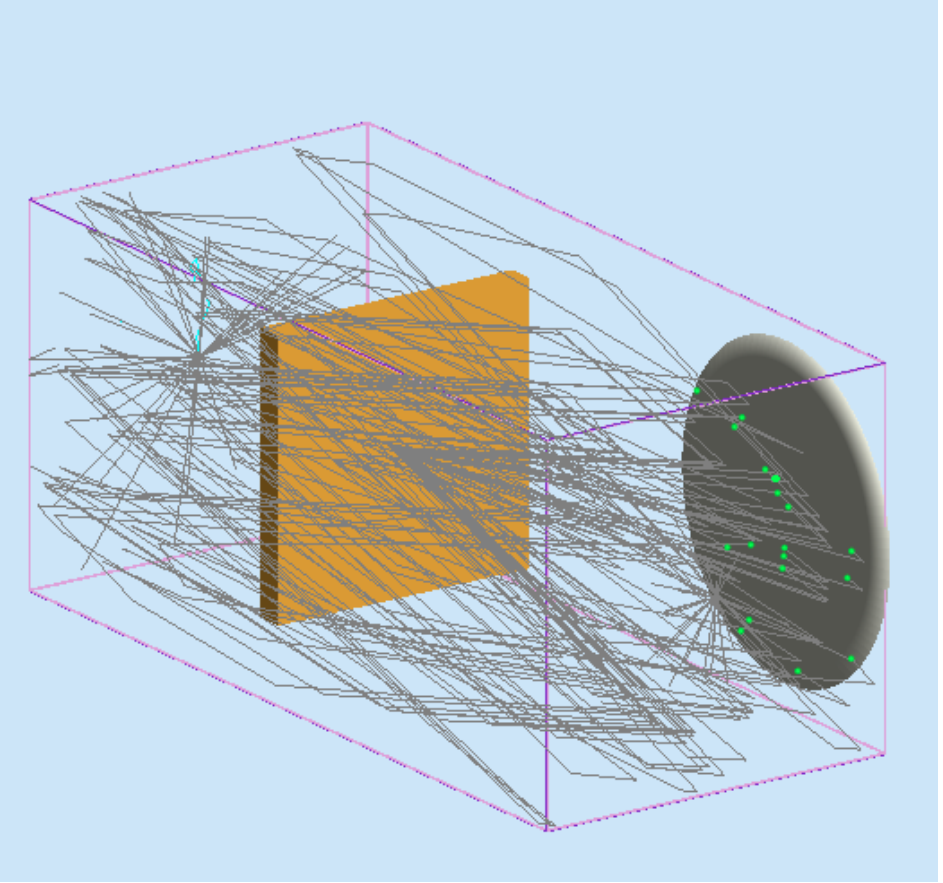
Δ ~ 66 ADC channels

Results

- 10 centimeters of Aerogel (1800V)
  - XX Photoelectrons

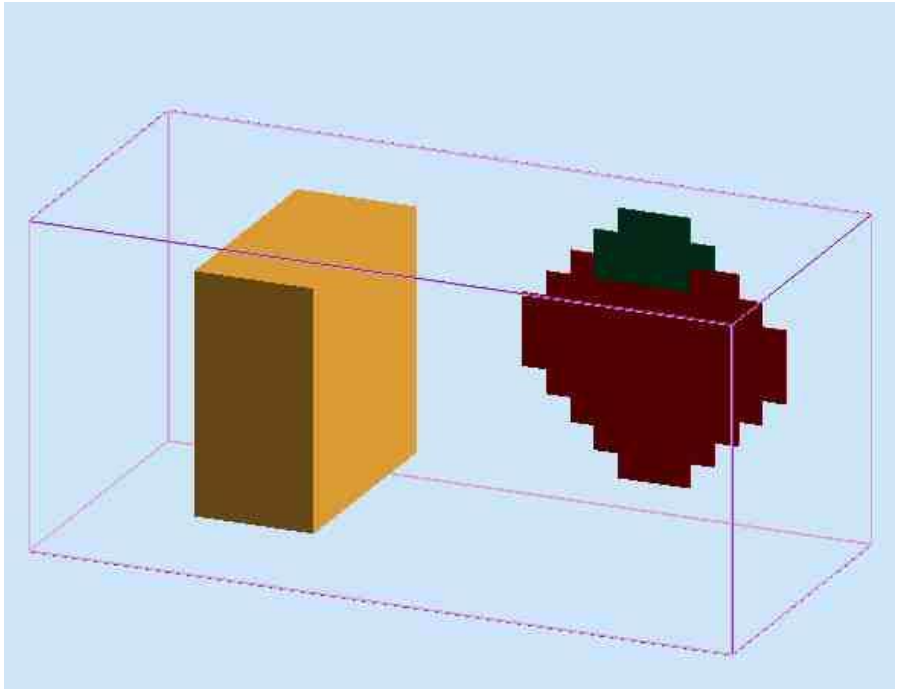
Simulations

- Uses GEANT4 platform GEMC
- First version models the geometry of the prototype, and assumes 100% efficiency
  - Separate calculation to account for 13% quantum efficiency



"Normal" window, 1 cm aerogel

Simulations



"Grid" window, 5 cm aerogel (GEMC), 13% efficient

- Second version implements a grid pattern PMT window
  - Each pane is a separately adjustable photocathode surface
  - Allows the pattern of inefficiency to be manipulated to match the PMT scanning results

The Future

- Diffusive material (Millipore) as the detector box lining
  - Corresponding change will be made in simulation
- Low gain, high quantum efficiency PMT from previous HMS aerogel detector to be tested in prototype
- Continue to investigate causes of low photoelectron production, signals below pedestal and double peak

Acknowledgements

- Dr. Horn and the CUA Nuclear Physics Group
- Marco Carmignotto, Nathaniel Hlavin, Gina Repole and fellow interns
- Dr. Mullur and the VSL for this opportunity to present

Questions?