Focal Plane Scanner

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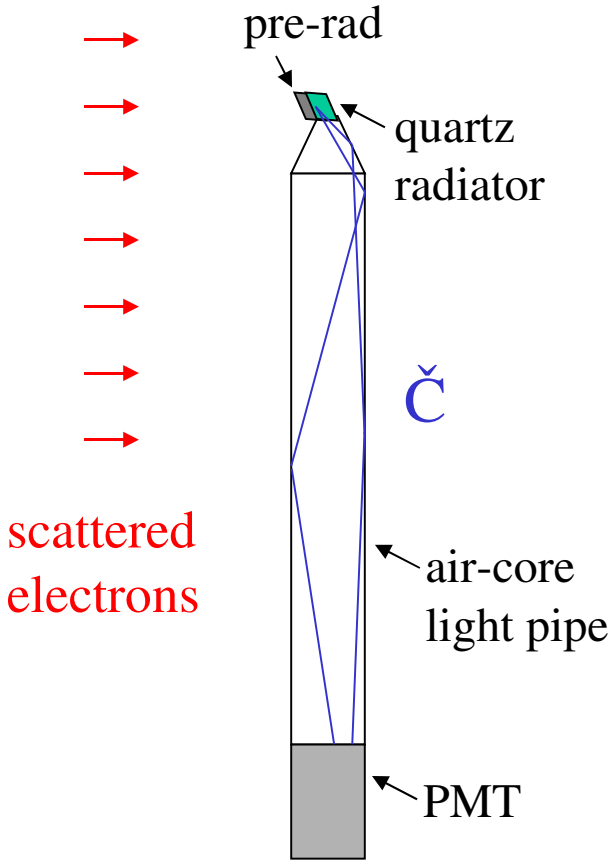
Motivation

- Q^2 determination, background studies, all done at 10 nA using tracking system.
- Region III operable up to 100 nA.
- Qweak production running 180 μA.
- Need a way to extrapolate over 3 orders of magnitude.

Qweak Focal Plane Scanner

- A scanning detector with small active area to sense high-energy electrons, operable at any beam current.
- Similar technique used in E158 and HAPPEx.
- For E158, it was used to determine optics parameters, confirm Monte Carlo predictions of rates.

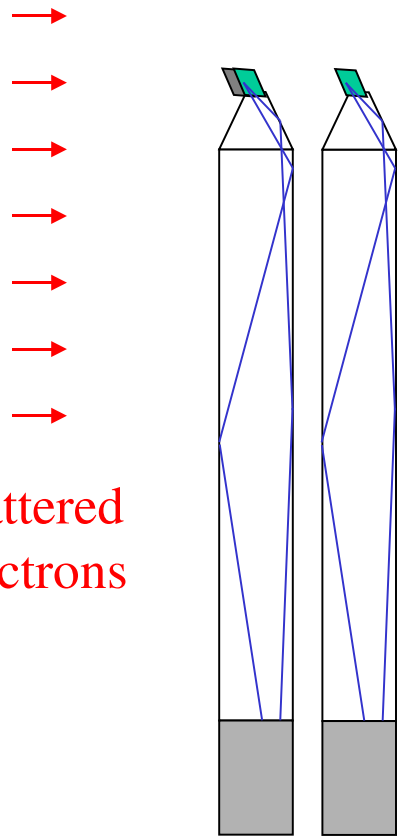
Scanner Principle



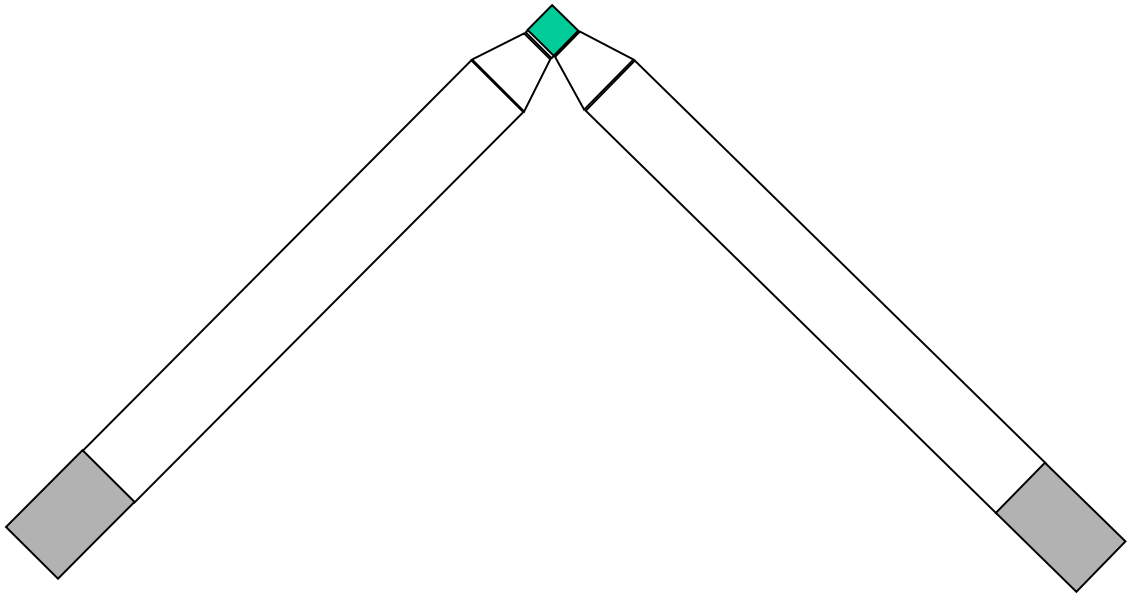
Design criteria:

- 1 cm^2 active area.
- 1 MHz max rate allows operation in counting mode with two PMT's.
- operable at both high and low current.

Scanner Concept

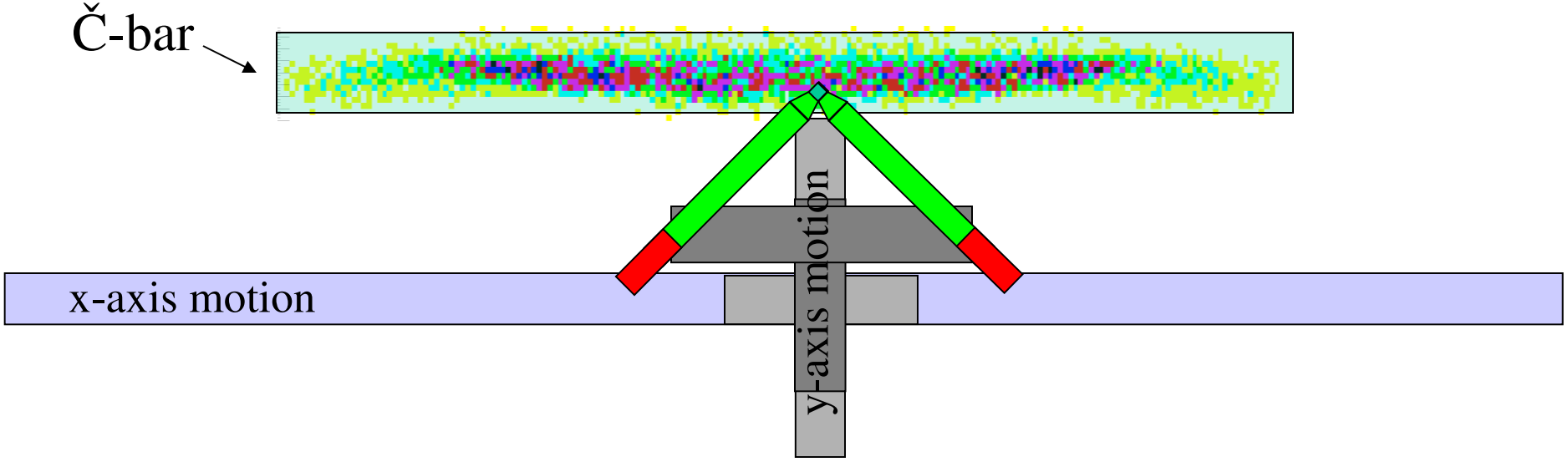


side view



beam view

Implementation in Qweak

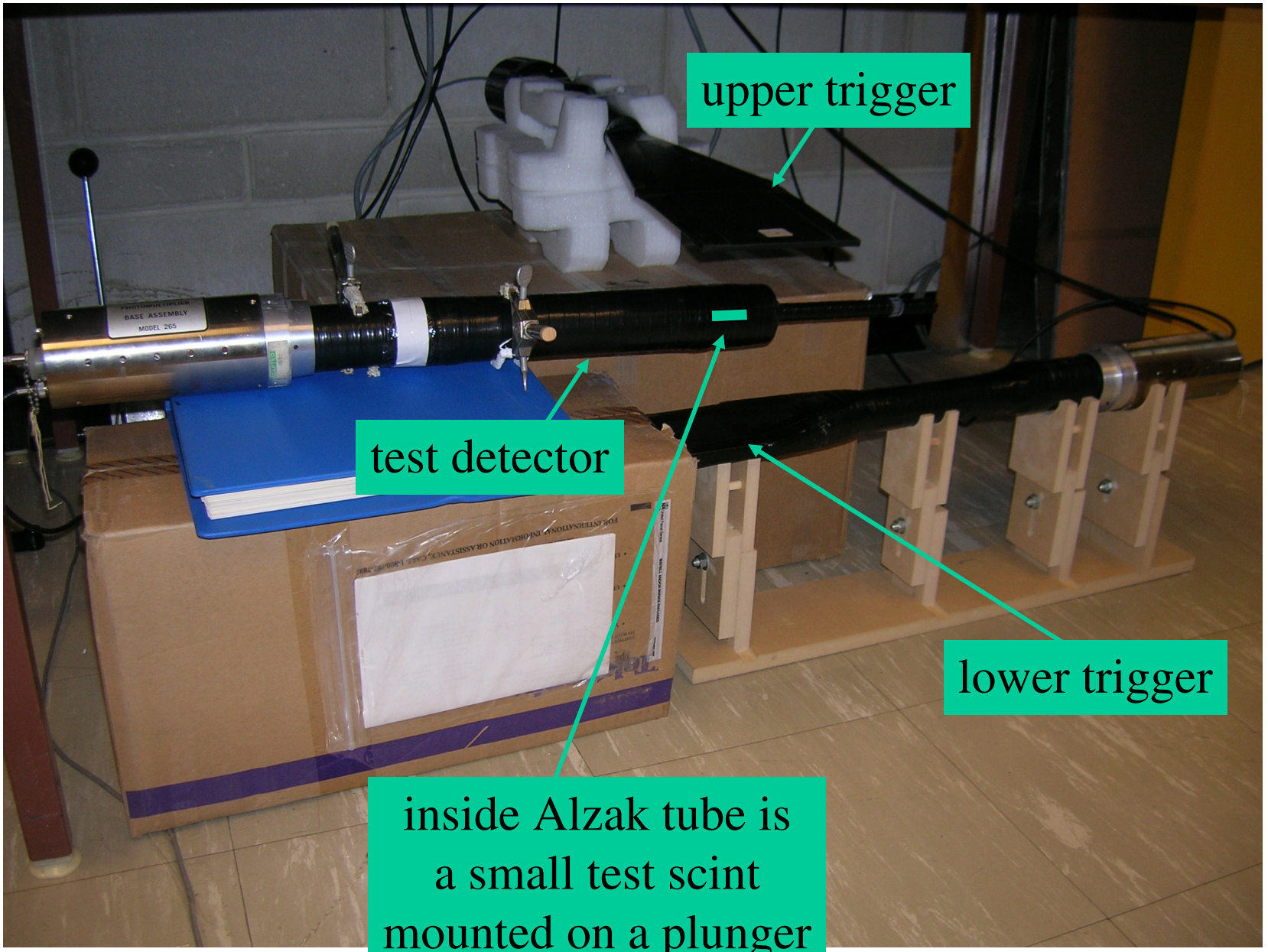


- 2D motion assy scans behind Č-bar
- Mount in any one octant at a time
- Attach to fixed support structure
- Motion assy mounted “inside” Č-bars

Recent Progress on Scanner

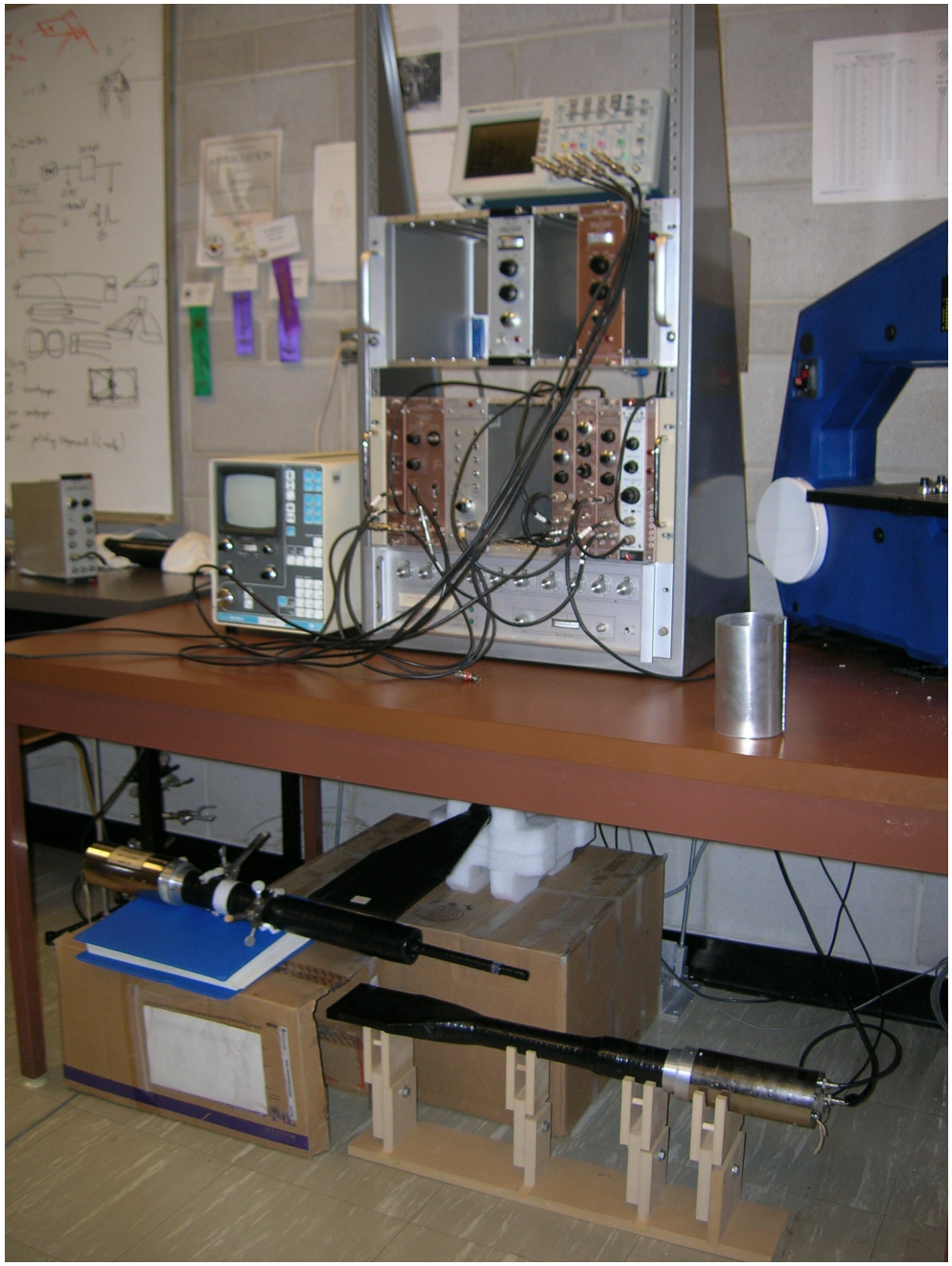
- Ongoing prototyping tests related to detector performance.
- Simulation of detector performance.
- Mechanical design
  - Mounting and 2D motion assy.
  - Detector assy.

Prototyping Tests – Cosmics Testing



Prototyping Tests

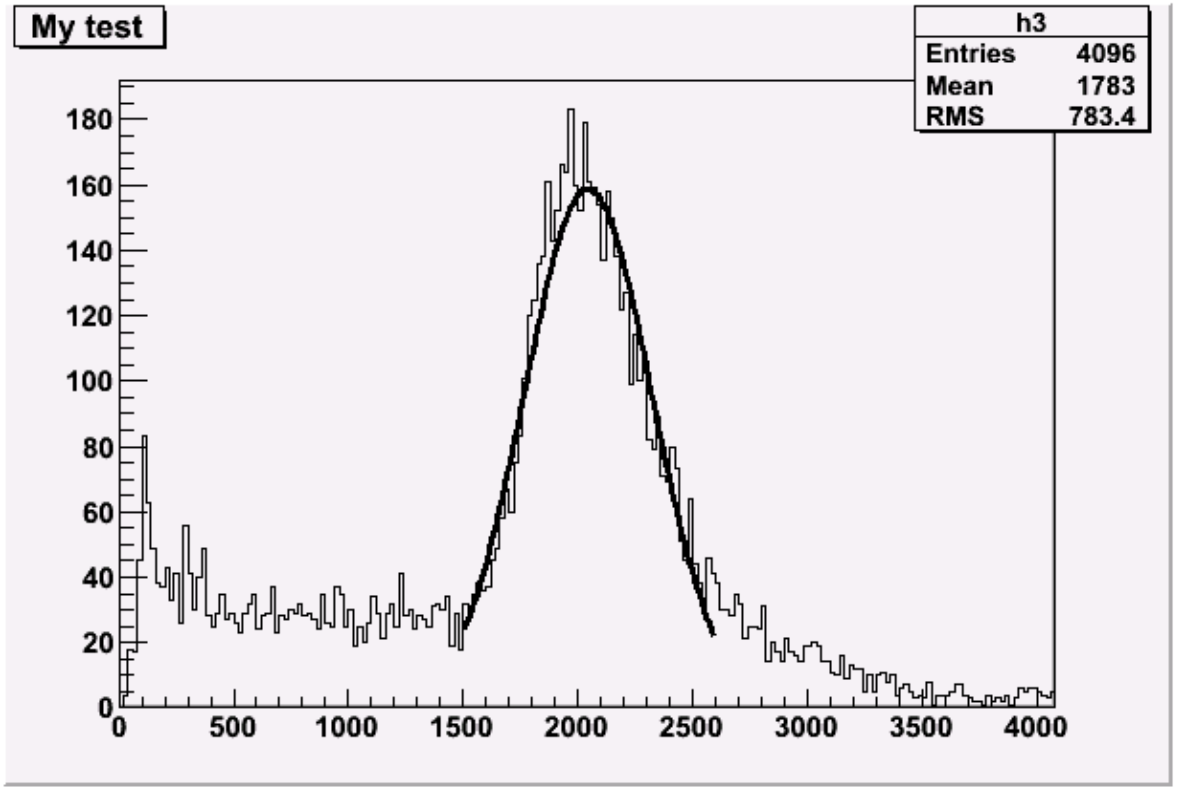
- MCA reads out shaped pulse height.
- Begun work with small scintillator samples. (Plan to transition to quartz)
- Begun work with high reflectivity light pipes.



Muon peak in 1x1x2 cm^3 scintillator

- In this trial, scint is 20 cm from PMT entrance window
- Using MIRO2 coating ("the best")
- ~180 p.e.
- time to try quartz

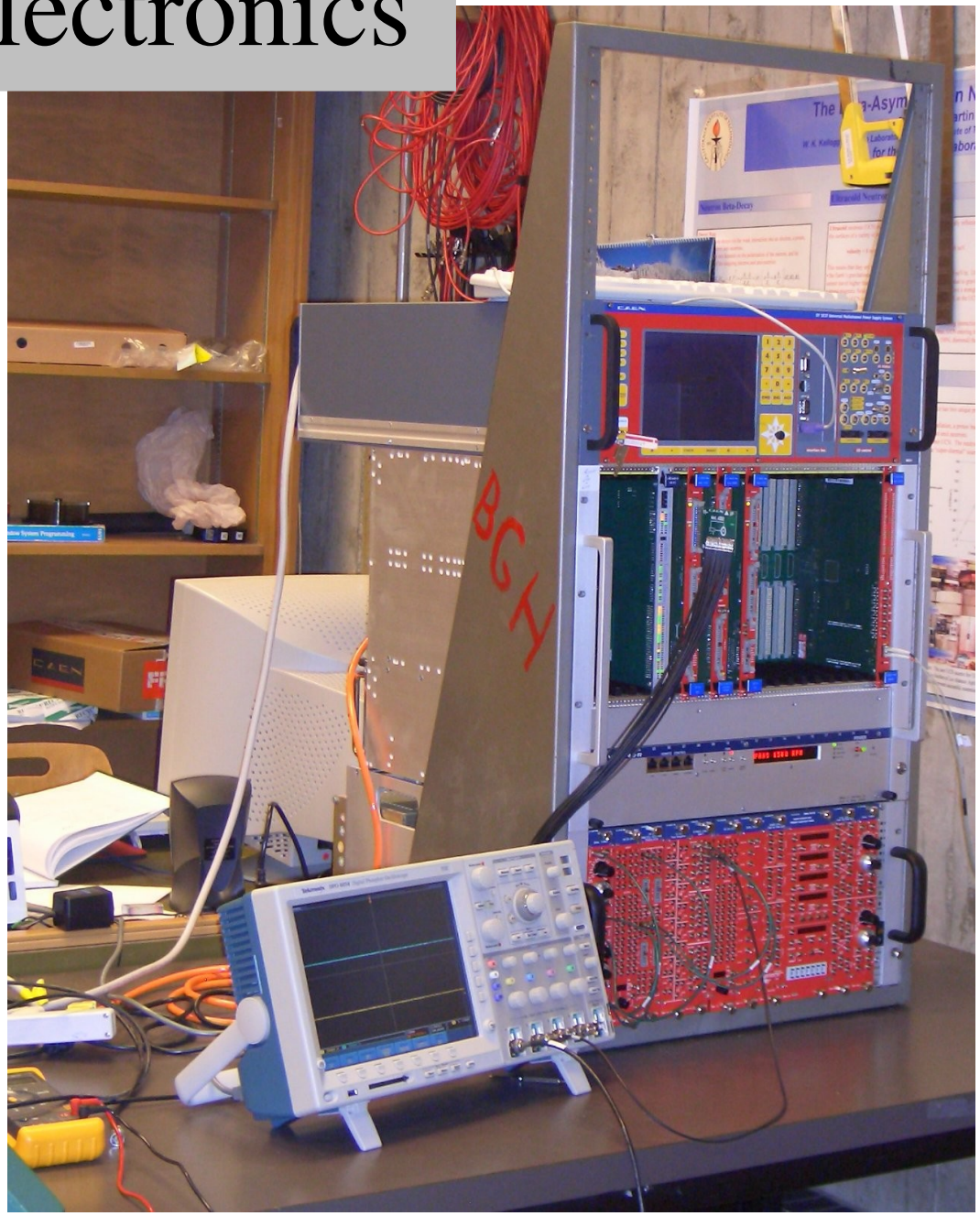
3. distance = 20 cm



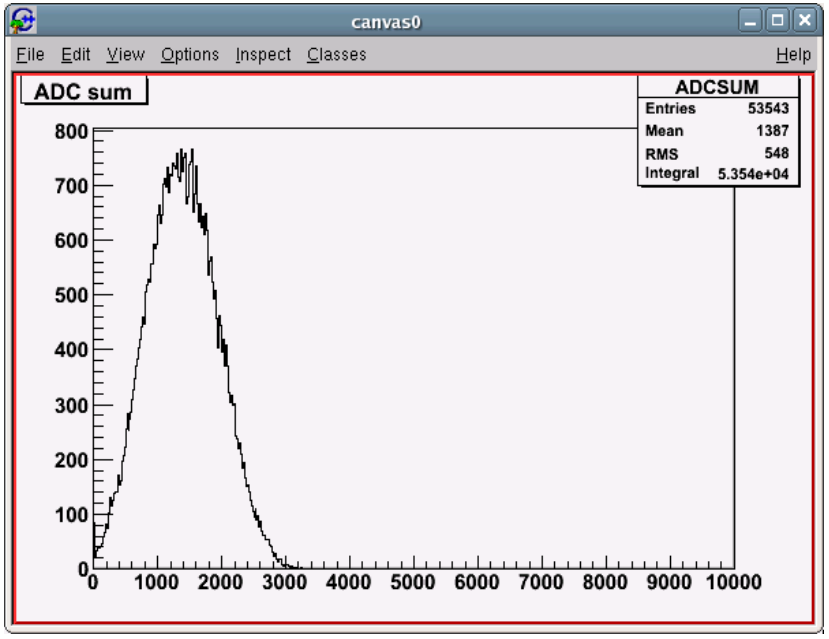
EXT NO.	PARAMETER NAME	VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	1.58796e+02	2.98423e+00	1.03659e-02	-2.79243e-05
2	Mean	2.04335e+03	4.41338e+00	2.06854e-02	6.90530e-05
3	Sigma	2.77530e+02	4.61555e+00	2.03631e-05	-5.28391e-02

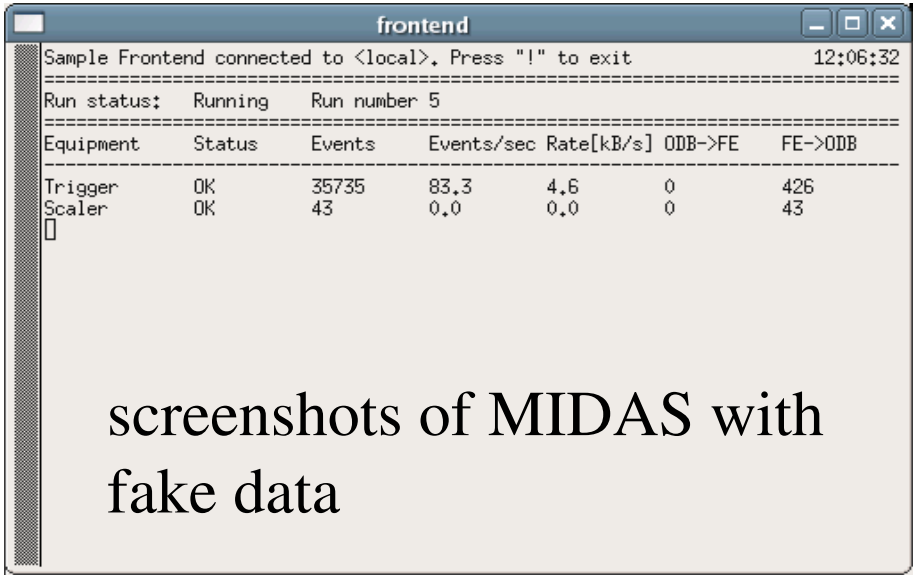
New CFI Test Electronics

- Multichannel HV system.
- Multichannel VME ADC/TDC/Scaler
- NIM bin with modules with lemo connectors on them!
- Lemo cables purchased from TRIUMF
- 500 MHz DPO oscilloscope.
- A few more modules/items to be purchased.



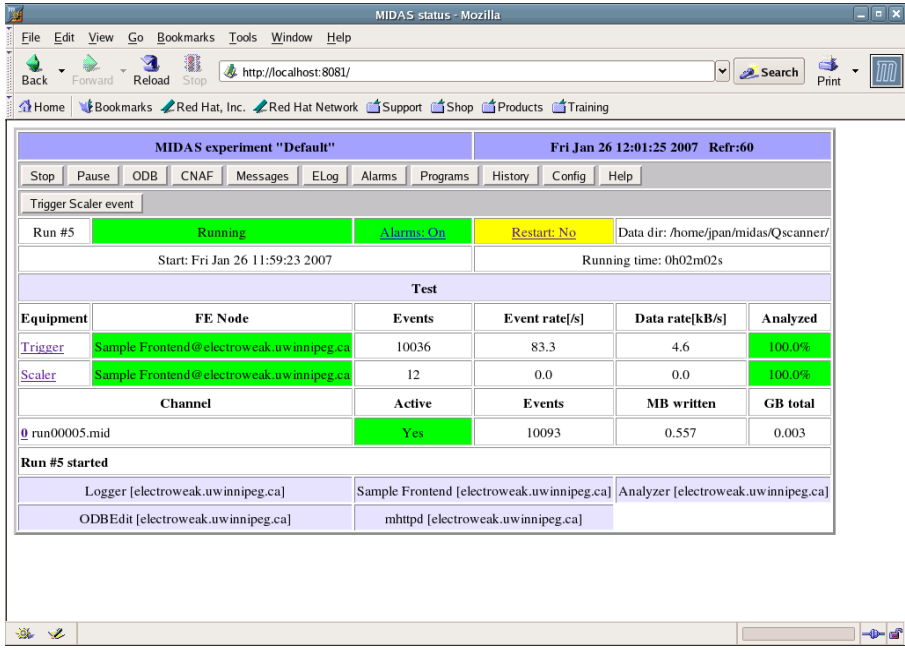
DAQ code: CAEN+MIDAS



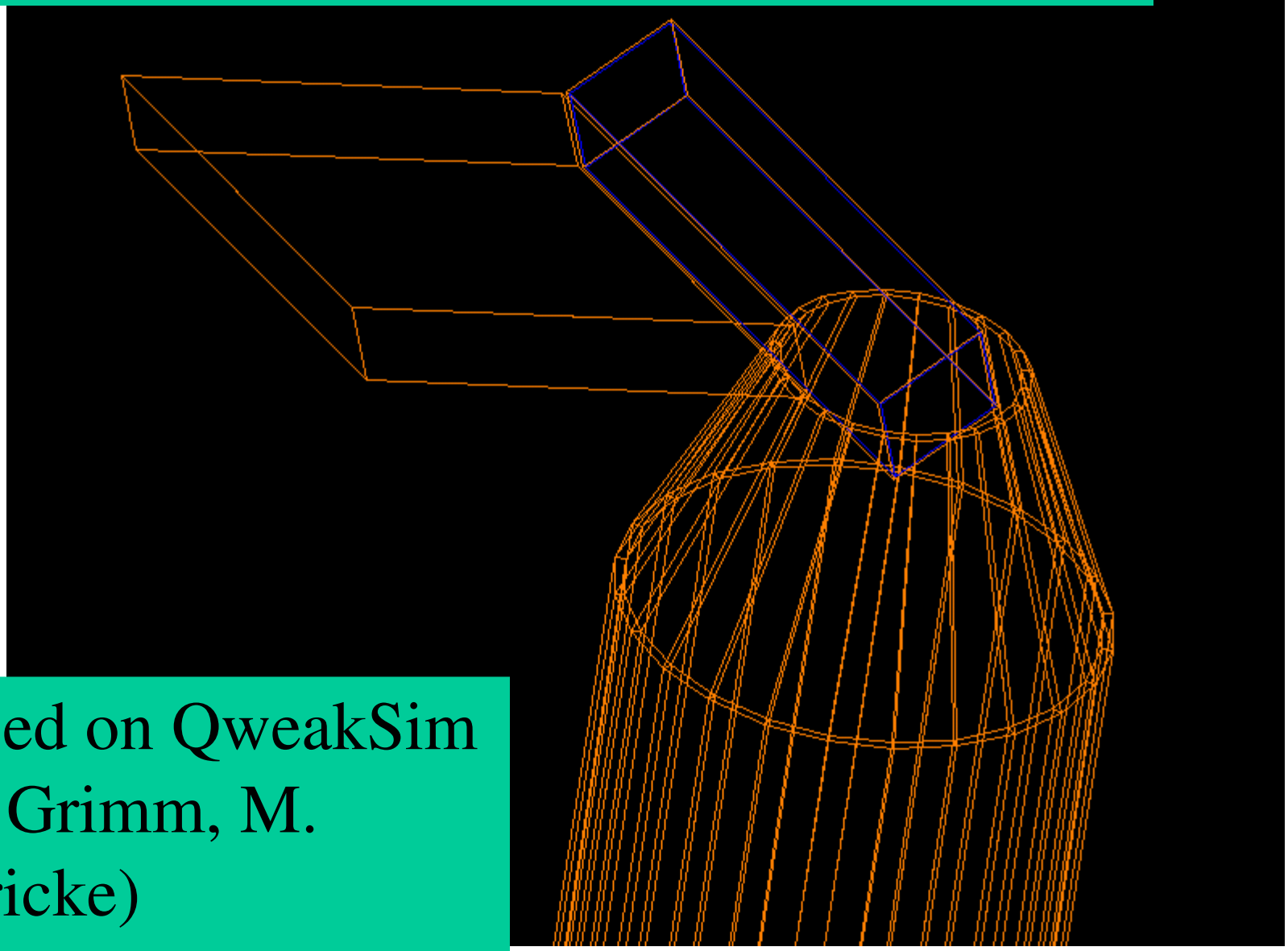


screenshots of MIDAS with fake data

- CAEN basic code working (can talk to VME modules)
- MIDAS/Roody working
- Need to implement CAEN software into MIDAS then ready to go!



Simulation



- Based on QweakSim (K. Grimm, M. Gericke)

Simulation

- Benchmarking against E158 succeeded.
  - Light yield and variation with parameters is quantitatively understood (relative to E158 simulations reported in their paper).
  - One bone of contention is effect of preradiator
    - not fully resolved, yet.
- Now beginning to use to design our scanner.
  - E.g. study in progress:
    - light yield vs tilt angle of quartz.

Mechanics

- support structure (P. Medeiros, G. Smith)
- 2D motion assy.
- detector assy. (P. Wang and G. Mollard @ UM)

- Status:
  - some work in Aug.-Sept., not much since then.
  - action item: want to buy the 2D motion robot.
  - I will be at JLab next week – can we talk about it?

Summary and to-do list

- Ongoing light guide material tests and simulations.
  - New test electronics now available and we are in the programming stage (J. Pan).
- Complete a realistic prototype rad/lightpipe/PMT assy. (J. Pan, A. Micherdzinska, J. Martin)
- Mechanics
  - purchase 2D motion robot and program it. (J. Martin, A. Micherdzinska, summer students)
  - request one more meeting at JLab to confirm this big robot doesn't conflict with anything else.

Questions and Comments Filed Away from Last Meeting

- Behind or in front of the Cherenkov bar? (multiple scattering)
  - intend to minimize impact on experiment, so behind... do we want to entertain in front? Depends on support structure.
  - Multiple scattering at 1 GeV in 1.5 cm quartz is 0.3° meaning 80 micron displacement over the 1.5 cm (in front vs behind). Likely not worth it unless mechanically easy.
- Beware of opening angle of incident electrons +/- 11 deg.
  - Yes – the two radiators would be as close as possible in z.
- Possibility of current/integrating mode for bases and electronics
  - should be straightforward.
- What is goal on linearity? What is overall goal of device?
  - to be answered in full/toy Qweak simulation

Additional Uses of a Scanner Detector

- Scan over large fiducial region, into inelastic region, over Cherenkov bar light guides, to get additional confidence in backgrounds.
- "Light map" can be compared to simulation.
- Q^2 extrapolation/determination
  - mini-torus setting during production running?
  - gas vs. liquid target extrapolation?
  - at least, complementary to region III.

Procedure

- Measure light distribution with scanner at low beam current acceptable to region III and Cherenkov bar coincidence.
- Measure light distribution with scanner at 180 uA.
- If they are the same, region III/Cherenkov light distribution believable at 180 uA to high confidence.
  - Note: scanner light map will not be the same as the region III/Cherenkov bar coincidence map.