Cherenkov counter for SANE

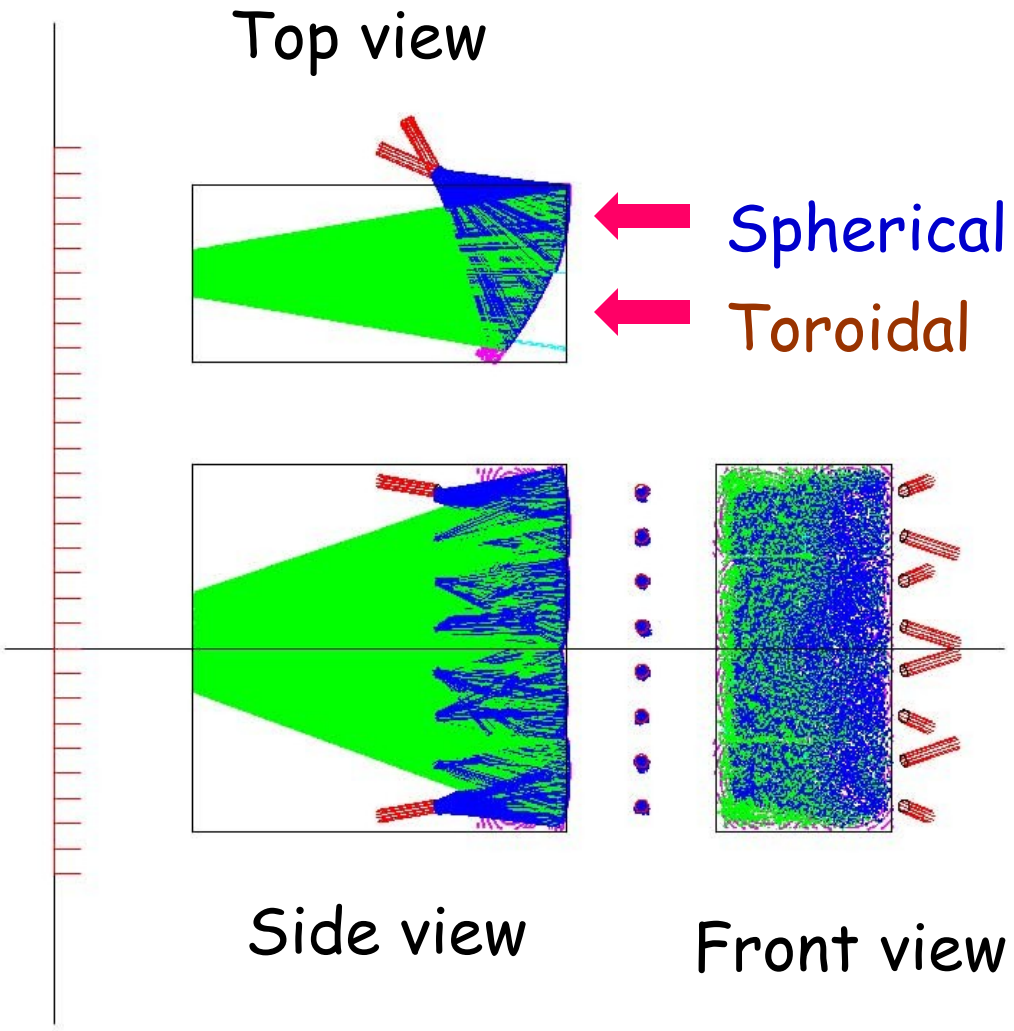
Readiness Review

- Goal:
  - High electron detection efficiency
  - Pion rejection of at least 1000:1
- Reference design
  - Operation slightly above atmospheric pressure
  - Radiator: dry nitrogen at 20°C, n=1.000279
  - Pion momentum threshold: 5.9 GeV.
  - Electron momentum threshold: 21.6 MeV
  - Windows: Tedlar/Aluminum
  - Mirrors cover an area 71 cm (H)x 150cm (V) (8 mirrors)
  - Point-to-point focusing of the mirrors for electrons > 0.7 GeV from target cell to phototube

Ray trace simulation

- Shielding
- Radiation
- Accessibility

All the tubes on the large angle side of the counter



> 99 % efficiency

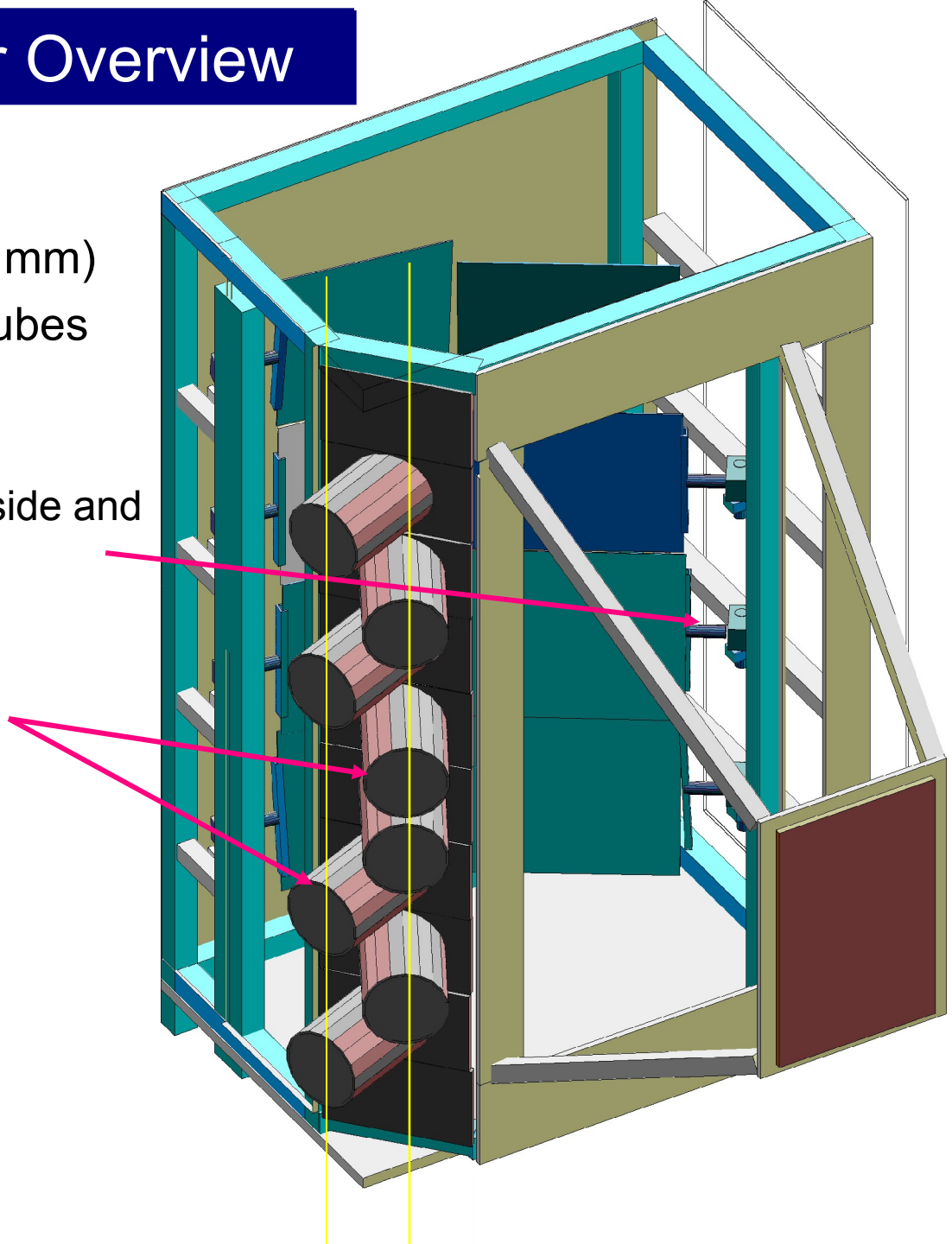
Cherenkov Counter Overview

- 4 -spherical mirrors
- 4 -toroidal mirrors (365x430 mm)
- 8 -3” quartz photonis phototubes (XP3468)

Mirrors (3mm thick) held on one side and can rotate in the horizontal and vertical planes

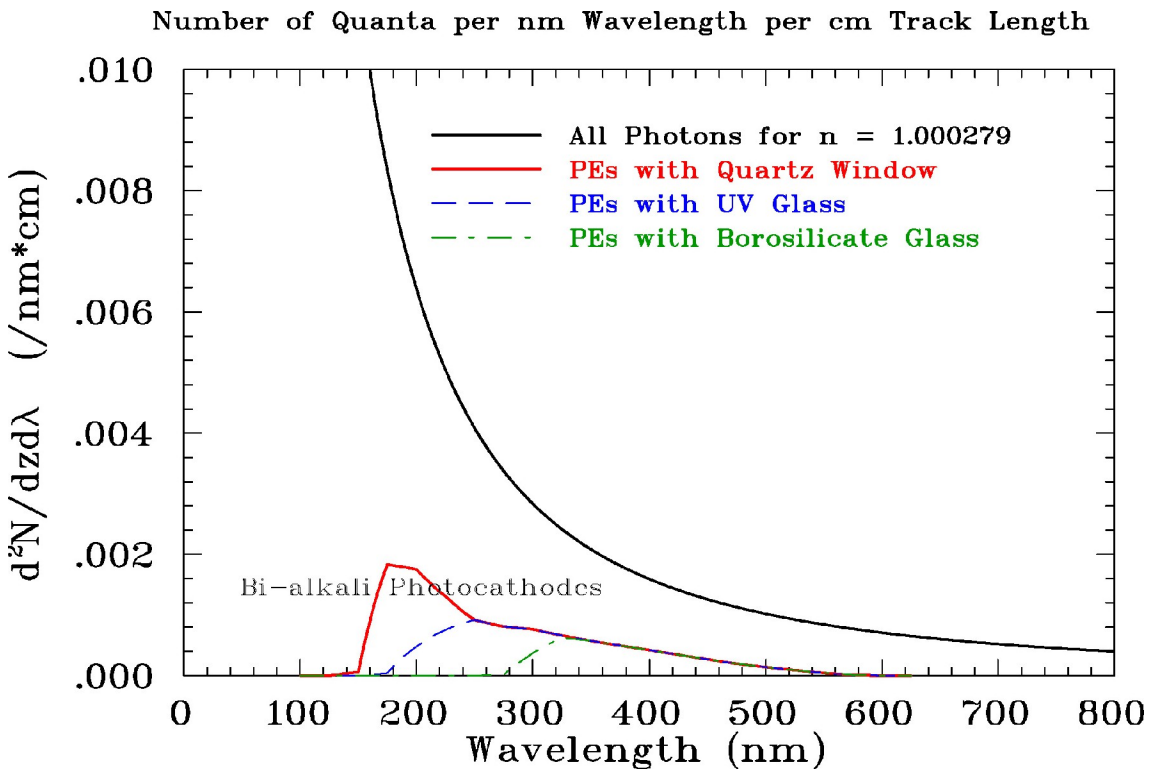
Two orientations of tubes pointing to

- ➥Near mirror (spherical)
- ➥Far mirror (toroidal)



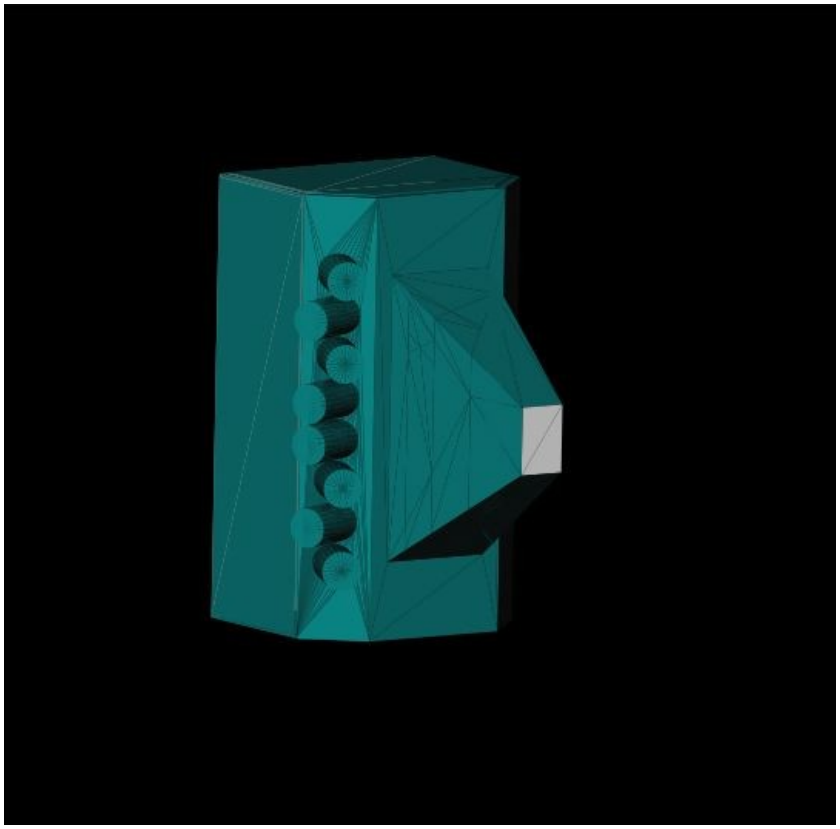
Electron detection efficiency and pion rejection

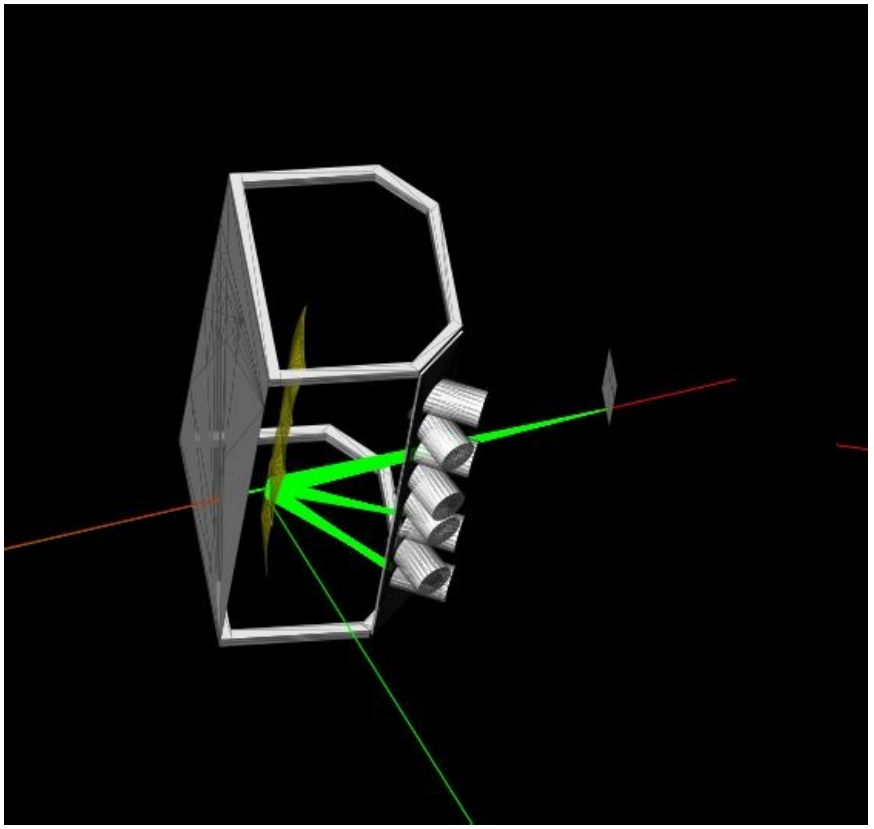
- Radiator Nitrogen
- Radiator length 125 cm
- Quartz window phototube:



~20 pe including gas transparency, mirror reflectivity (90%), Fresnel reflection at the phototube window

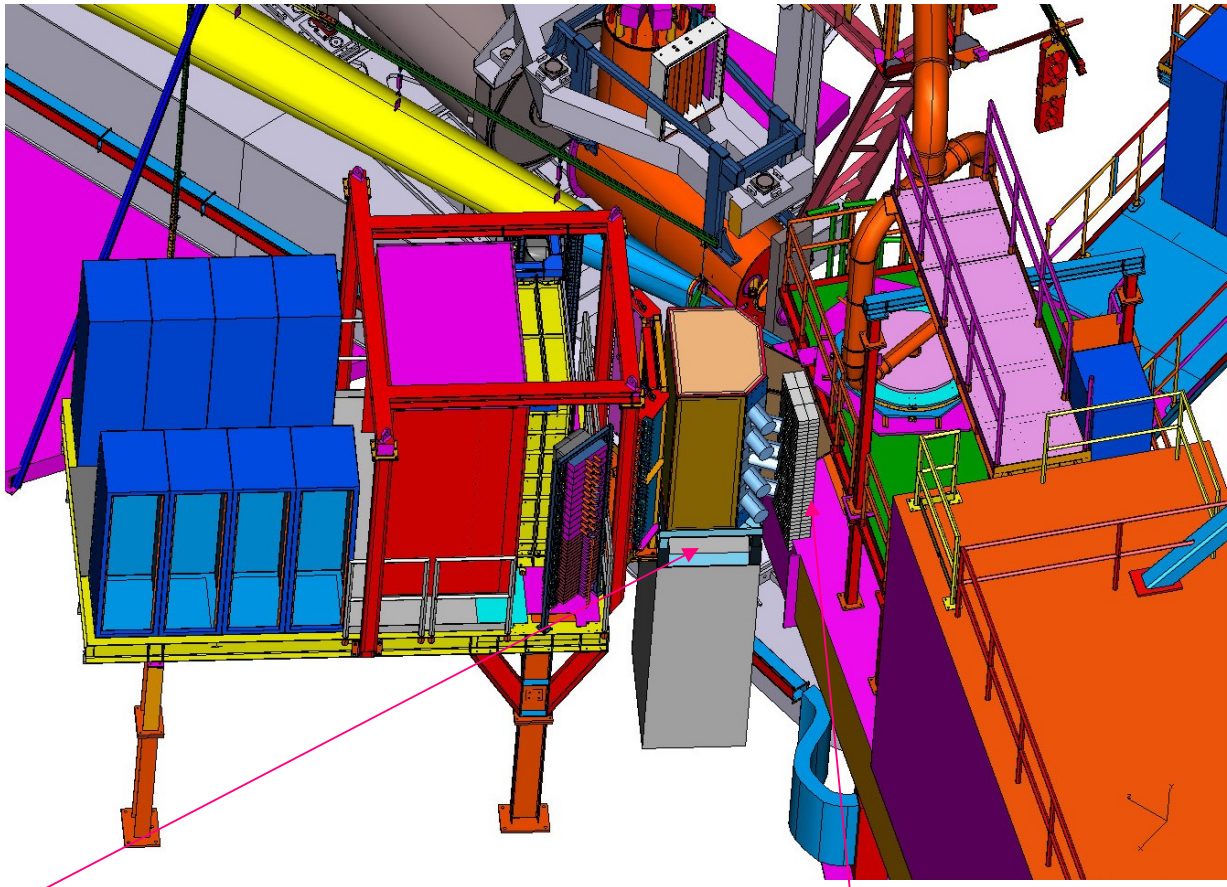
Geant Simulation (whitney Armstrong)





Setup in the Hall

- Distance of front window to the target: 50 cm
- Length of box: 155 cm
- Horizontal/vertical aspect ratio 2:1
- 71 cm (H) x 150cm (V) back window area.



Stand with height adjustment

8” of lead shielding
36 radiation lengths

Status of Cherenkov construction

- Mechanical construction
  - ✓ Phototubes holders with μ-metal shield fabricated and received
  - ✓ Mirrors mounts + side holders received
  - ✓ Full tank structure received
  - ✓ Tedlar and mylar front and back windows received (under tests)
- Mirrors manufacturing
  - ✓ Glass substrate from Eagle Glass Co.
    - Spherical and Toroidal mirrors received and shipped to CERN
  - ✓ Reflective coating performed at CERN reflectivity measured and found to be better than 80% at 160nm.
  - ✓ We expect them shipped back to Temple by Late July.

Tank fabrication finished and tank at Temple

Mirrors holders fabricated and received

Phototube mount

support ring pointing ring

- The pointing of the face of the tube can be adjusted from outside

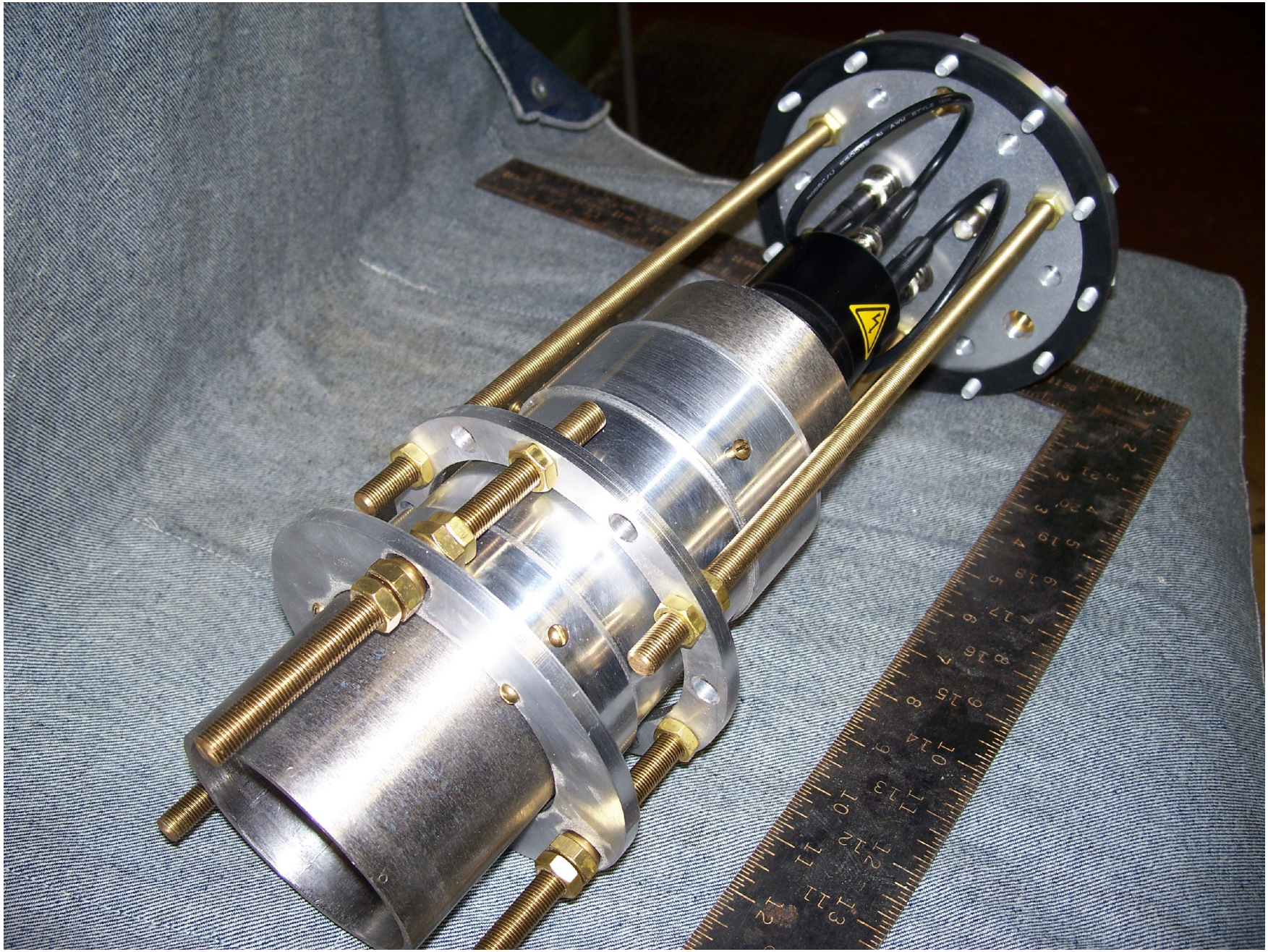
Magnetic Shielding

- Based on a 3" diameter cylinder and a maximum 300G DC field,
- Amumetal (80% Nickel) 0.125” thick provides better than 50:1 reduction

Tests done at Temple consistent with these predictions.

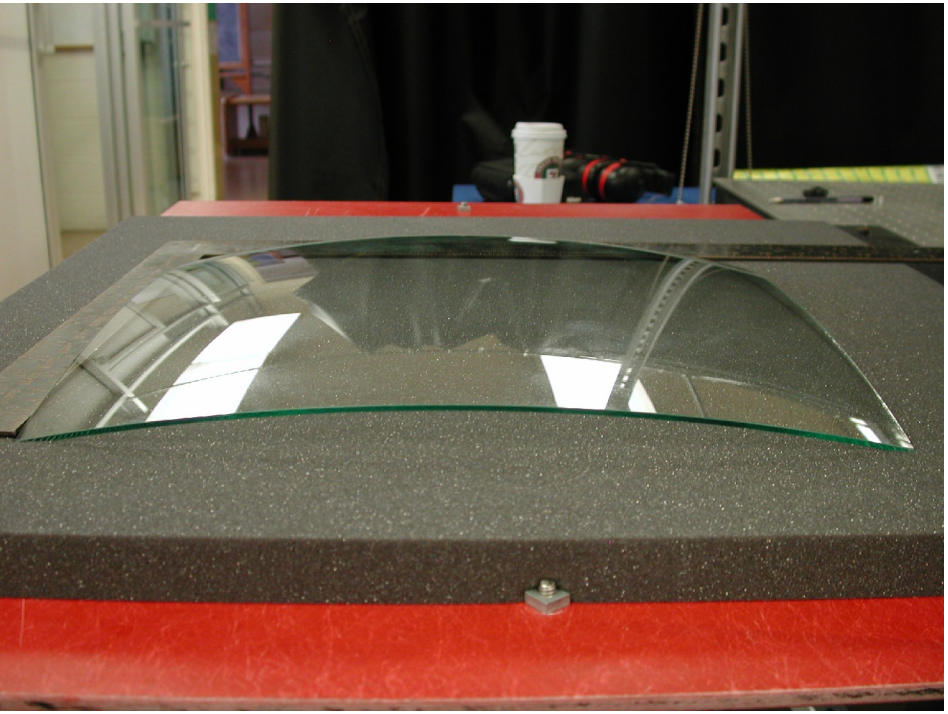
J. Hoburg, IEEE Transactions on Electromagnetic Compatibility Vol. 37, No 4, November 1995

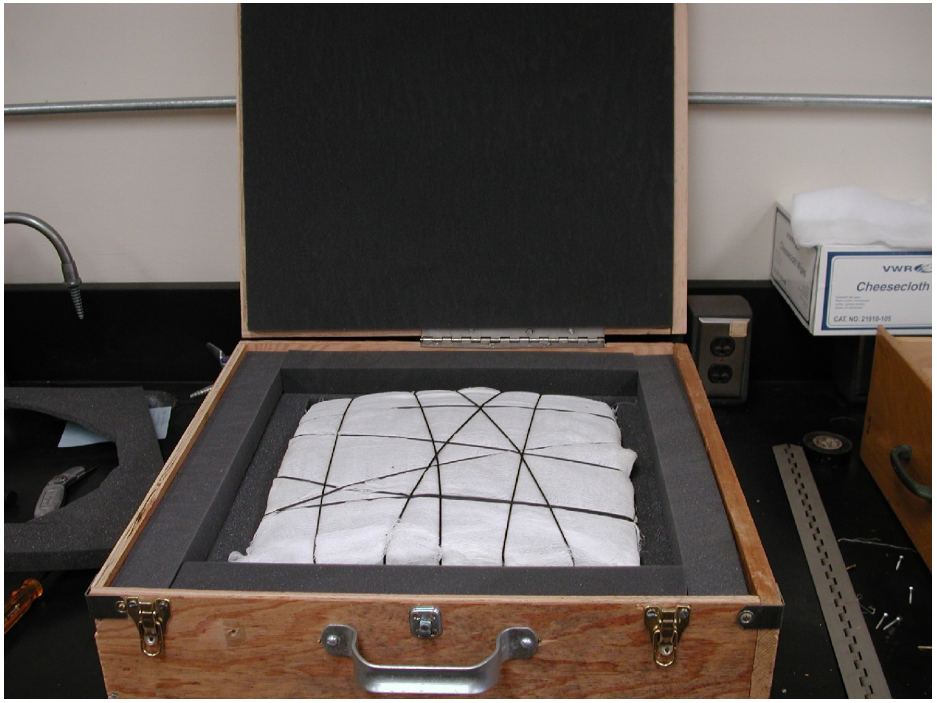
μ-metal shield
Extends from the face of the tube by 2inches




μ metal
Shields

Spherical mirrors as well as toroidal mirrors received from Eagle Glass Inc. (West Virginia) and shipped to CERN.



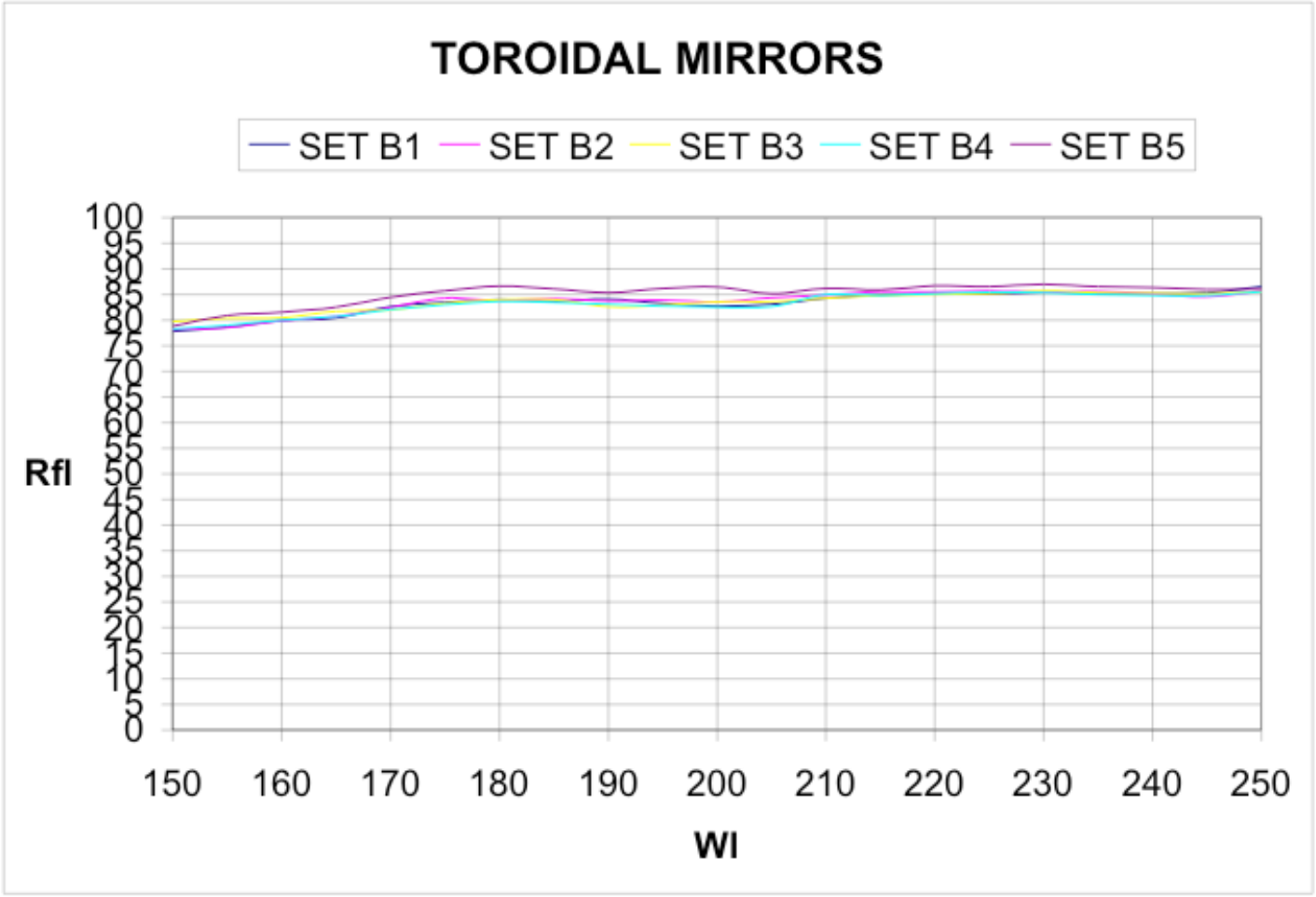


Aluminization finished at CERN with the following performance: Reflectivity greater than 80% at 160 nm

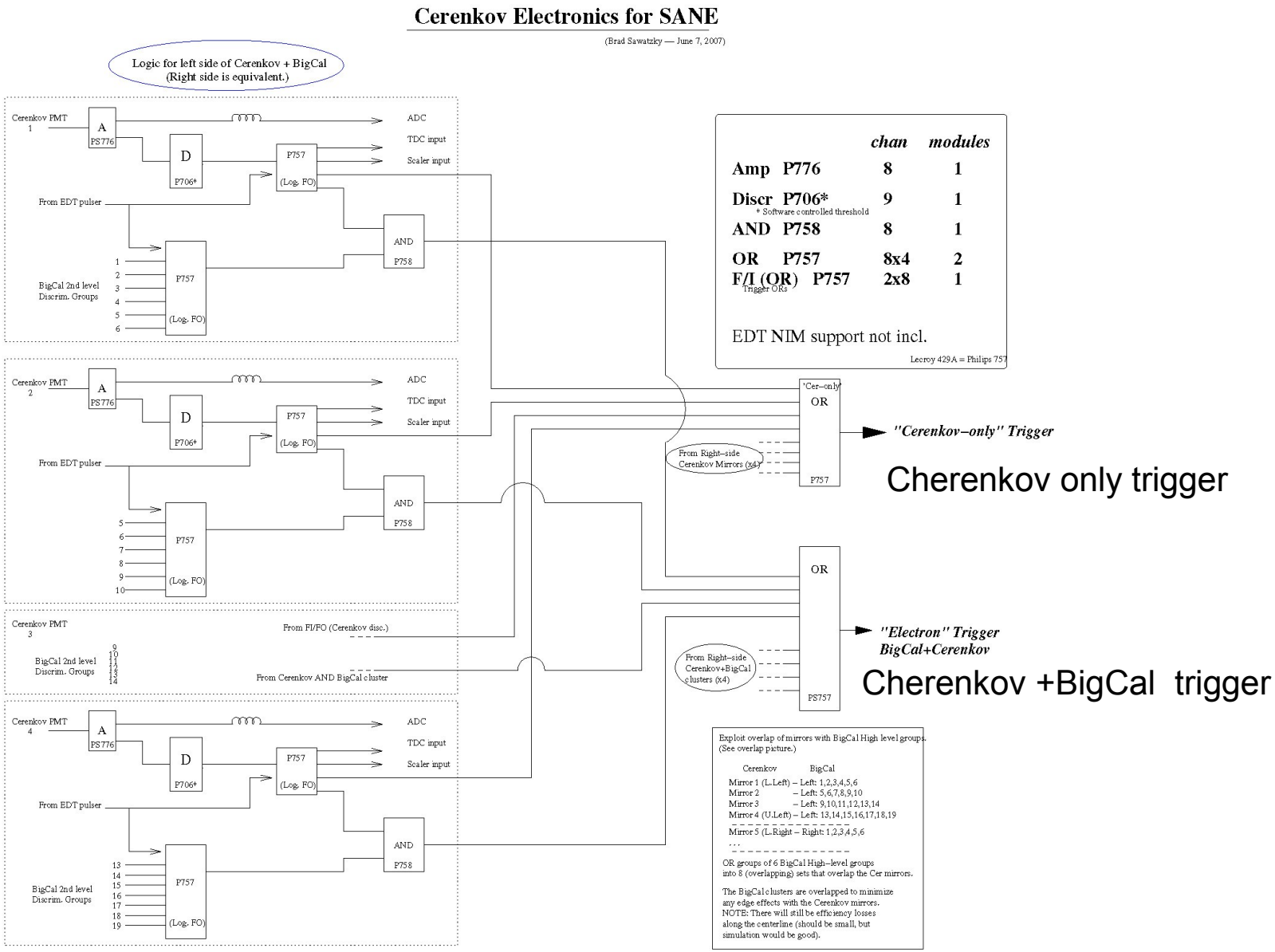
(4+1 spare)x2 Mirrors awaiting shipment back to Temple

Reflectivity (spherical mirrors)

Reflectivity (toridal mirrors)

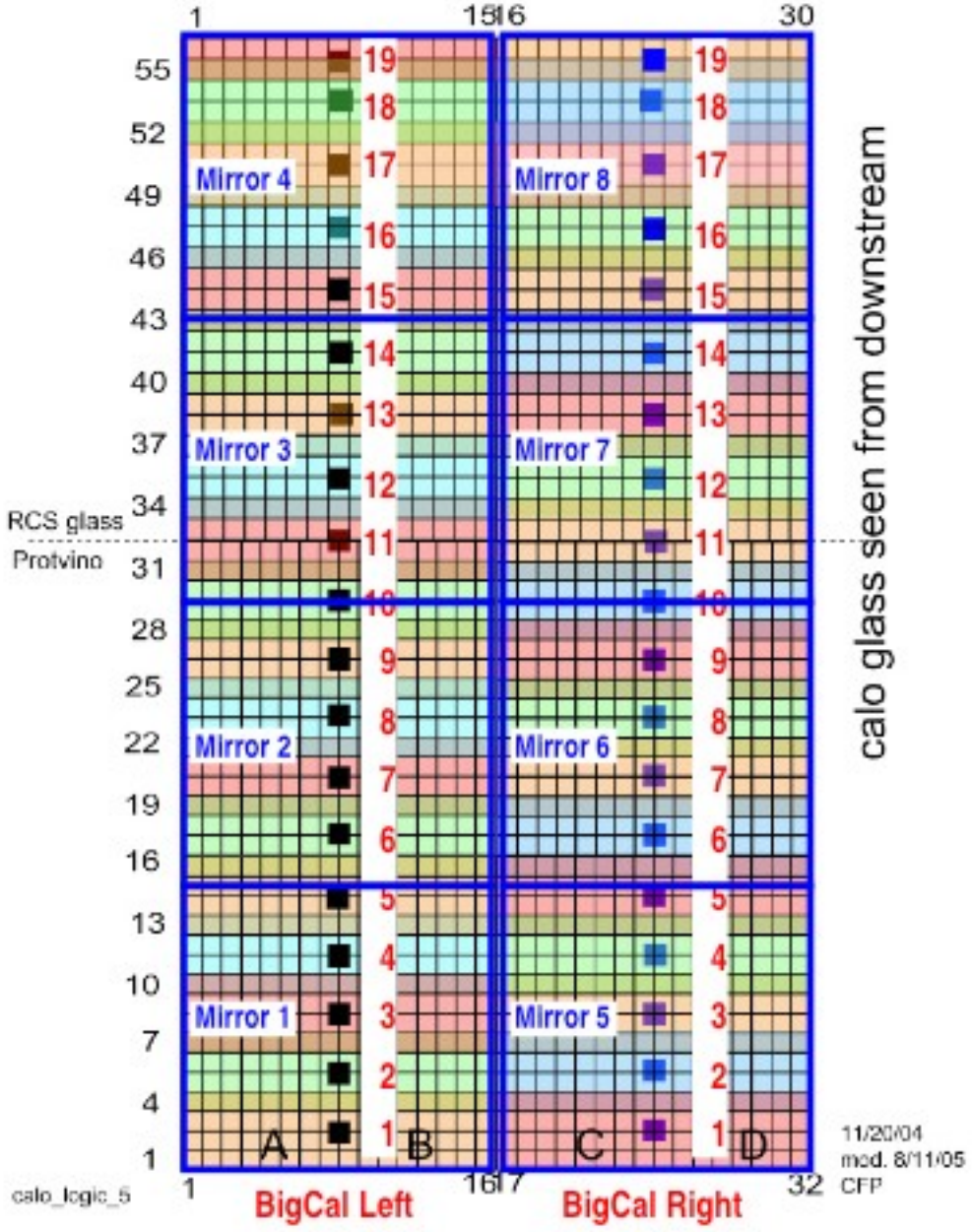


Electronics Setup



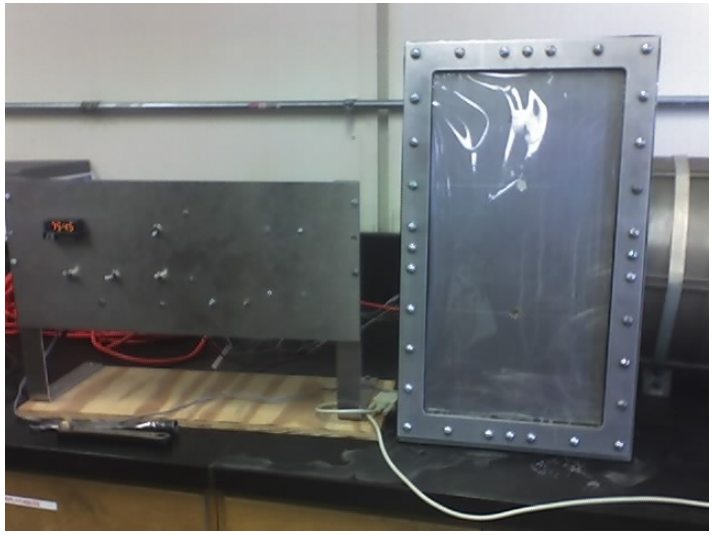
- Can use geometrical correlation of each mirror with Bigcal blocks

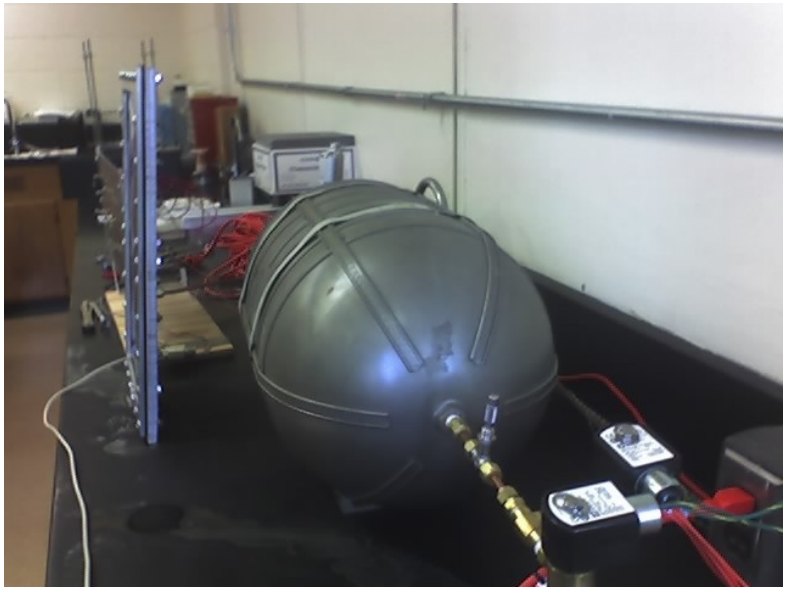
Correlation of BigCal with the Cherenkov Mirrors



Gas System

- Dry nitrogen at sligthly above atmospheric pressure (768Torr).
- About five fills per standard bottle of compressed gas (total volume of the tank 1.73m$^{3)}$.
- Constant monitoring of the pressure with feedback control using Capacitance manometer (1/10 of a Torr resolution) to maintain the pressure.
  - Overpressure will be vented into the atmosphere.
    - The safety valve will be opened at 774 Torr
    - (Jlab safety limit is 775.72 Torr = 15 psi)
  - Underpressure is dynamically corrected using an automated control valve to fill.





- We assume 1 kPa (7.5 Torr) daily fluctuation (drop) requires 15 liters of gas (0.53 ft^3)
- Worst case a drop of 8 kPa (60 Torr) in case of a storm.
- The windows are tested for these maximum variations

Manpower

- Temple group:
  - Alex Lukhanin,
  - Whitney Armstrong,
  - Brad Sawatzky
  - Z.-E.M

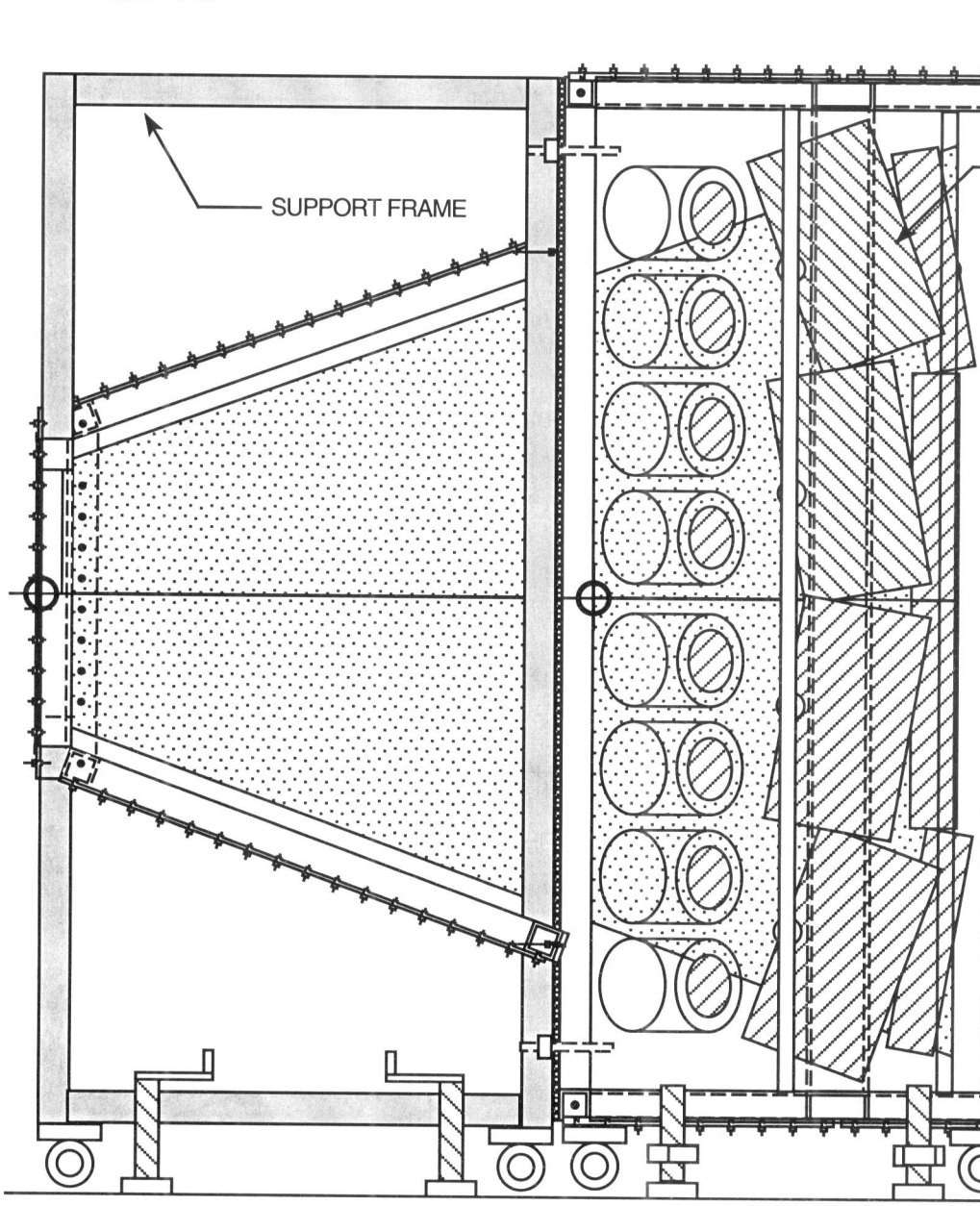
The group will provide the man power to test and setup the Cherenkov counter initially but operation should be straigthforward

Schedule

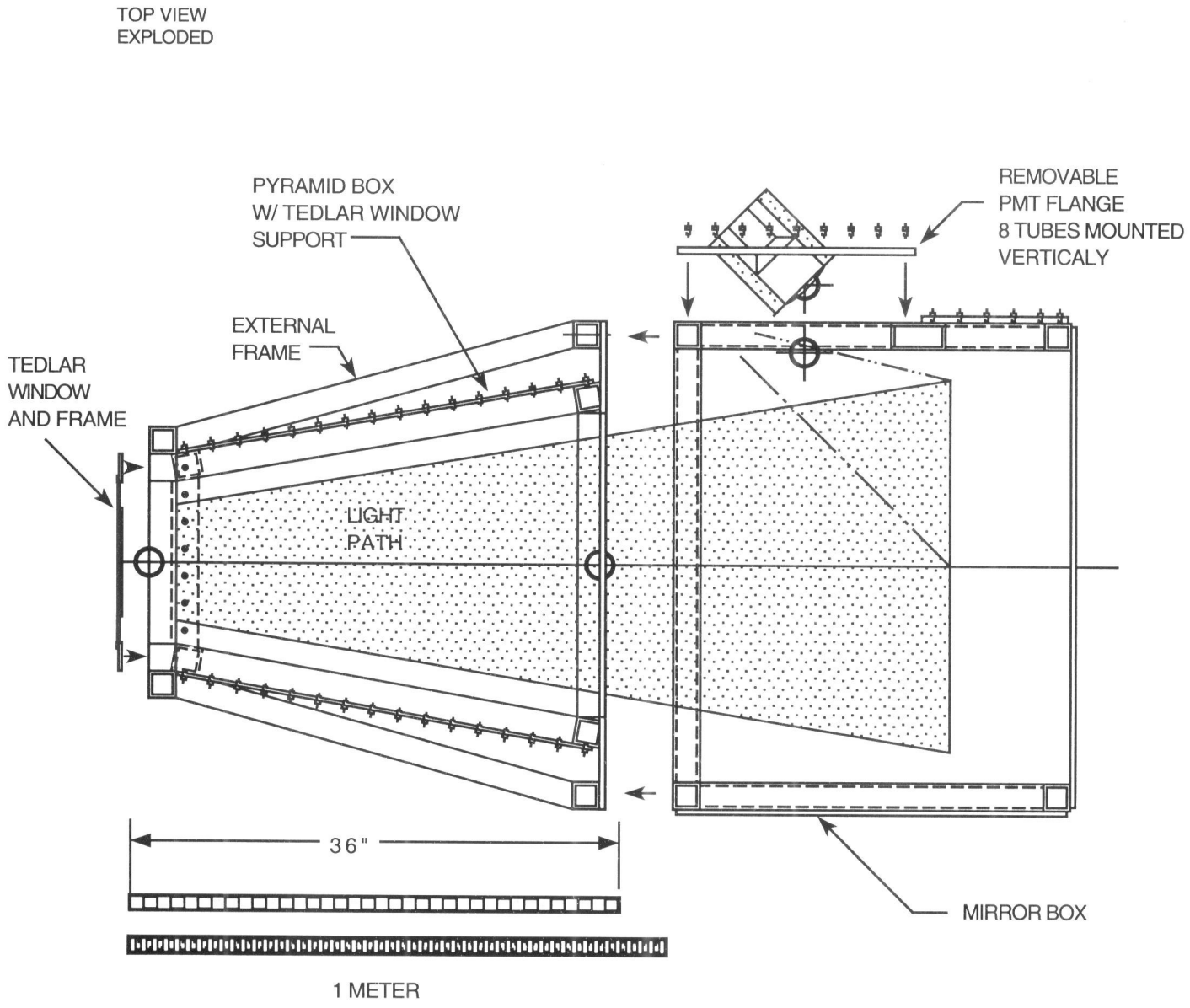
- At Temple:
  - ➥Receiving and setting up the mirrors + alignment at Temple in July
  - ➥Gas system with tank will be tested for a period of a month in August.
  - ➥Electronics + High voltages setup + data acquisition will be setup and tested in August- early September.
  - ➥Detector ready to be moved to JLab September 2007 for setup and testing on site.
- At Jlab:
  - ➥Platform design and procurement for testing this fall with GEPIII (July- August)
  - ➥Electronics + High voltages setup + data acquisition will be setup and tested in September.
  - ➥Preparation of lead shielding July-August.

Draft Design of the Counter

- Draft design with 50% efficiency on half of the detector if we use 3” tubes everywhere.
- Two type of phototubes
  - 3’’ tubes
  - 5” tubes
- Modular design
- Flexible for quick changes and alignment



Top view of the counter



Pion and proton of electron knock-on probabilities

16 mil aluminum exit window of the vacuum target chamber

5 mil window of the GC entrance window

125 cm of radiatior gas