Estimated Background Rates for d_2^n

- MC simulation by Degtyarenko et al. (tested in Halls A and C)
- Online cuts include:
  - BB magnet sweeps particles with p < 200 MeV/c
  - GEN BB trigger: shower+pre-shower+scint
    - provide ~10:1 online hadron rejection (or better)
  - ~550—600 MeV threshold on shower
  - 4—5 p.e. threshold on Cherenkov
    - heavily suppress random background
    - negl. pion contamination (~100 Hz knock-ons)
- Total estimated trigger rate (GEN trig + Cherenkov): 2—5 kHz

Online triggers

e-	2-5 kHz
e+	<1 kHz

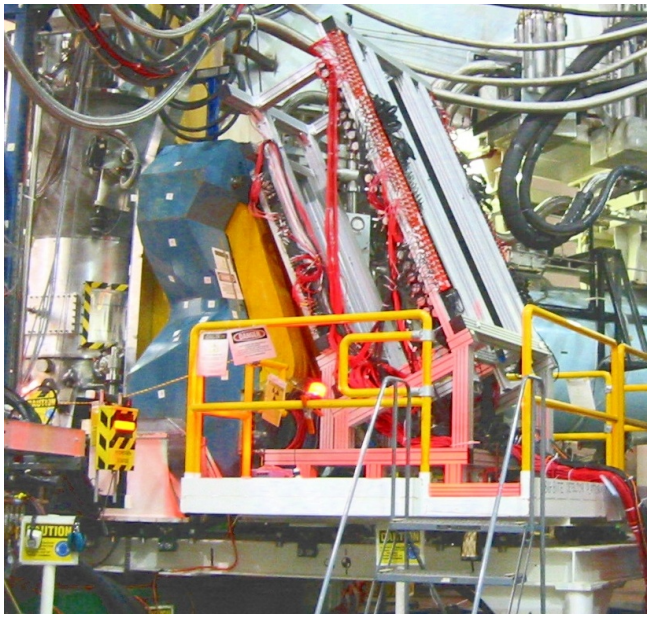
π-	90 kHz
π+	90 kHz
p	50 kHz
n	50 kHz

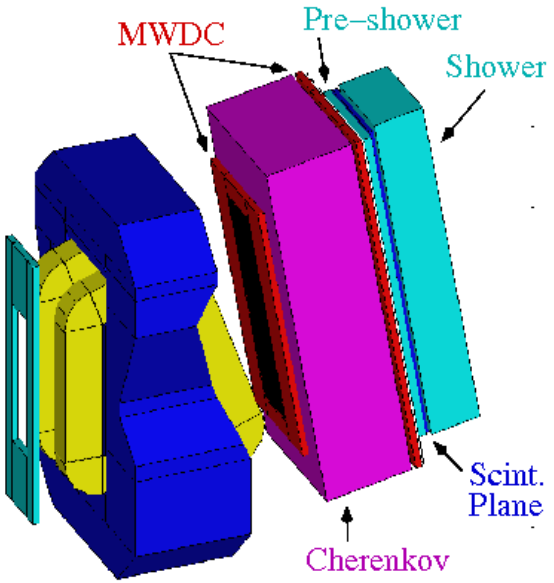
Removed via online cuts

Cherenkov Design Parameters

- Dimensions: 200cm x 60cm x 60cm
  - ➡ located in gap between first and second wire chamber with minimal modifications to BigBite frame
- Radiator gas: C_4F_{10} (or Freon12)
  - ➡ n = 1.0015 (1.0011)
  - ➡ π threshold: 2.51 GeV/c (2.98 GeV/c)
  - ➡ ~25 (16) photo-electrons / 40 cm electron track
    - ↳ Quartz PMT (5" Photonis XP4508)
    - ↳ mirror reflectivity: ~90%, 10% loss at PMT-gas interface (2 mirror reflections)
  - ➡ >99% efficient with 4-5 p.e. threshold
    - ↳ negl. pion contamination
      minimum π/e rejection ratio 1000:1 online

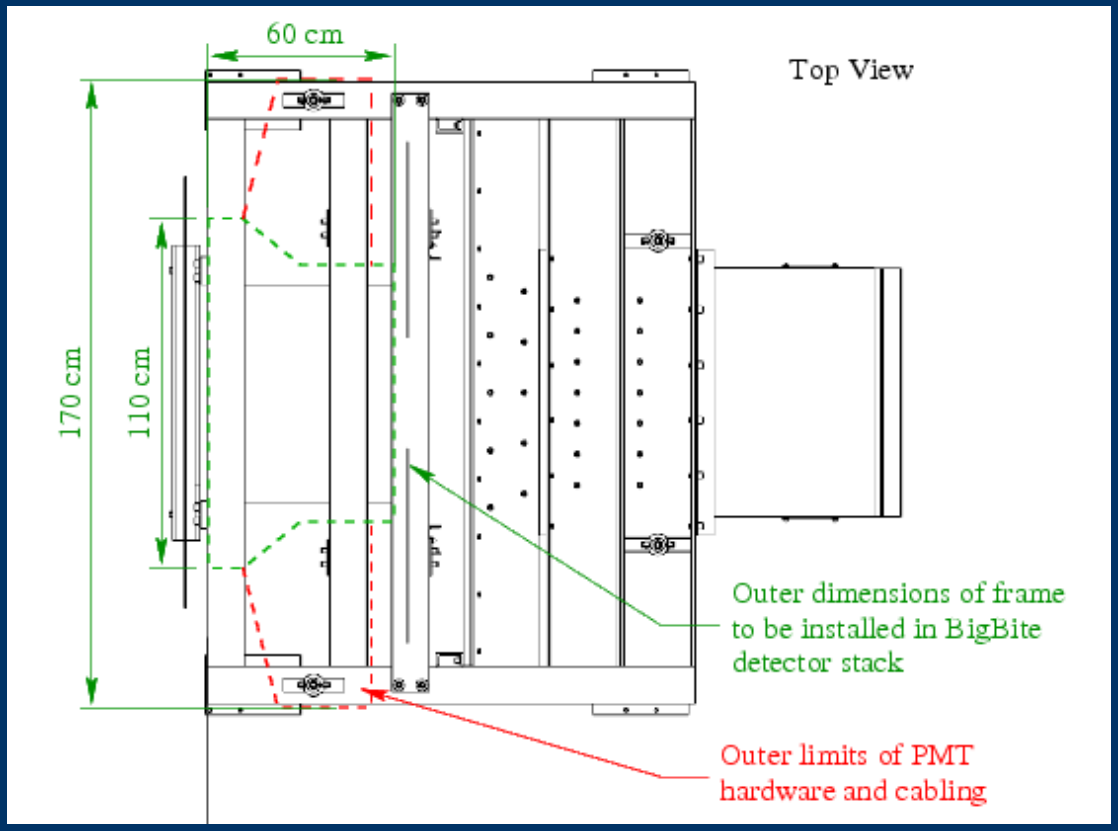
BigBite with the Gas Cherenkov

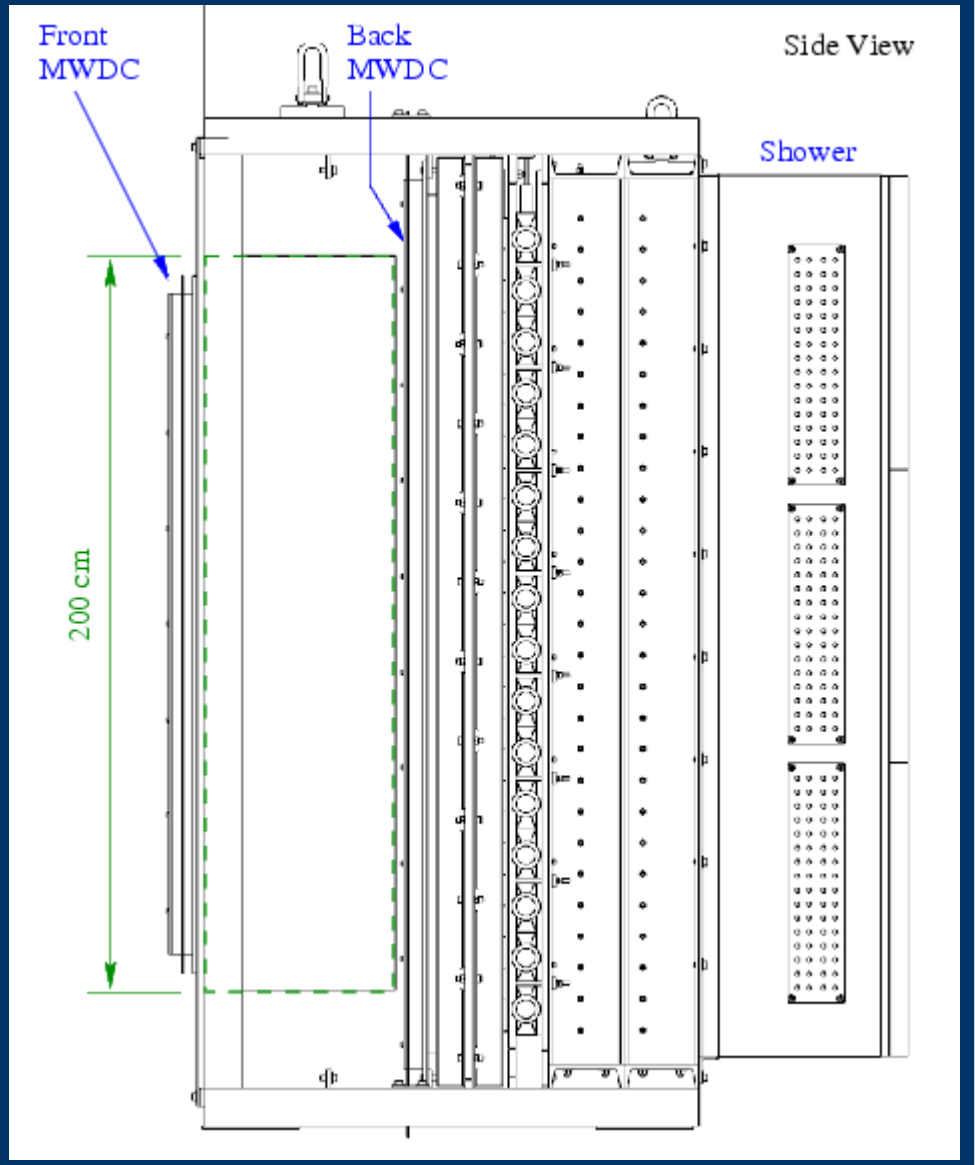




- non-focusing, large acceptance, open geometry
- $\Delta p/p$ = 1 – 1.5% (@ 1.2 T) σ(W) = 50 MeV
- angular resolution 1.5 mr, extended target resolution 6 mm
- large solid angle: 64 msr
- detector package
  - ➡ 2 MWDCs, segmented trigger, Pb-glass shower
  - ➡ Gas Cherenkov (new)

Cherenkov Frame



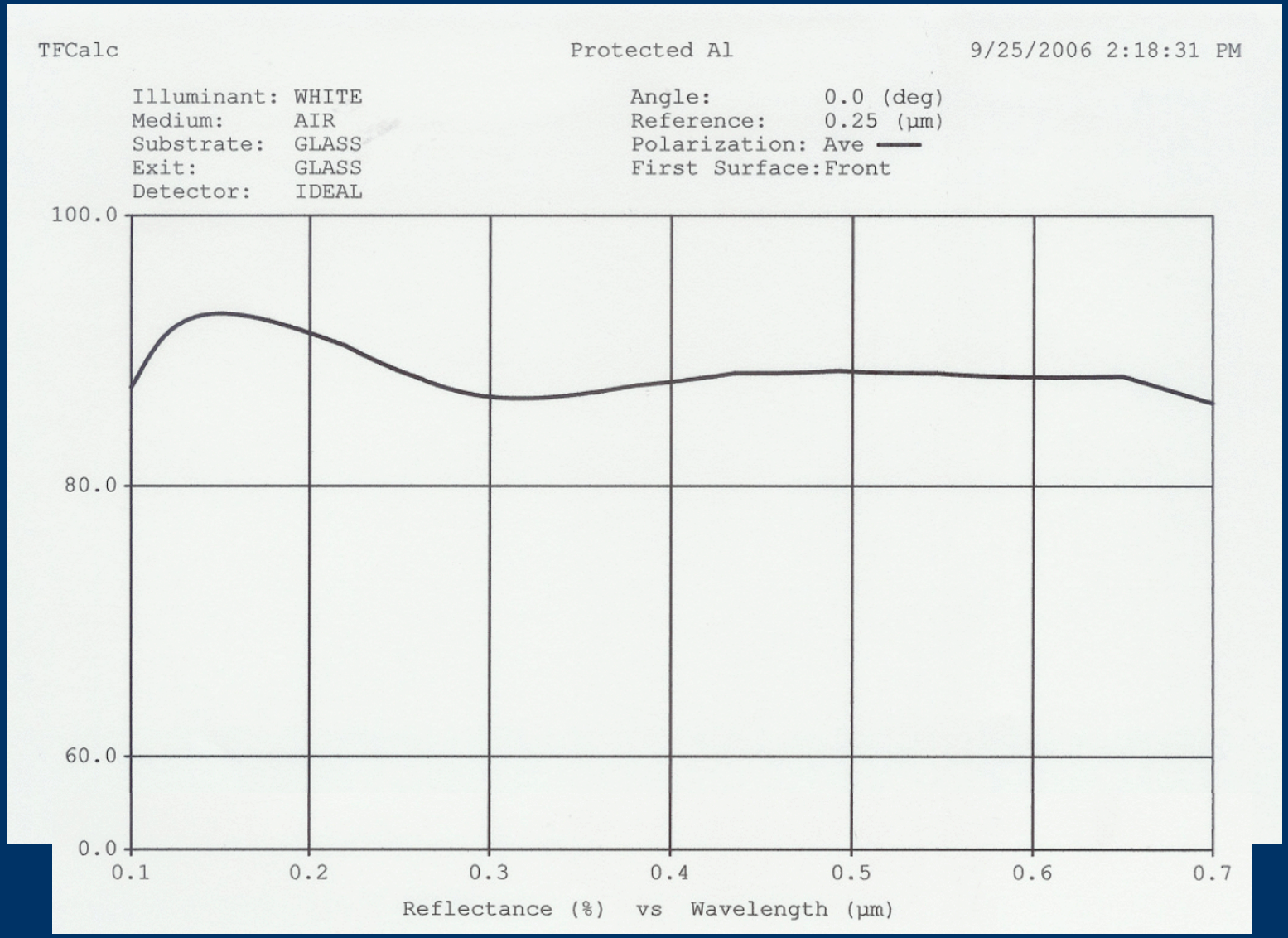


Engineer at Temple (Ed K.) is currently working on real CAD drawings – will work with Al Gavalya, etc to integrate Cherenkov into BigBite frame

Cherenkov Mirrors

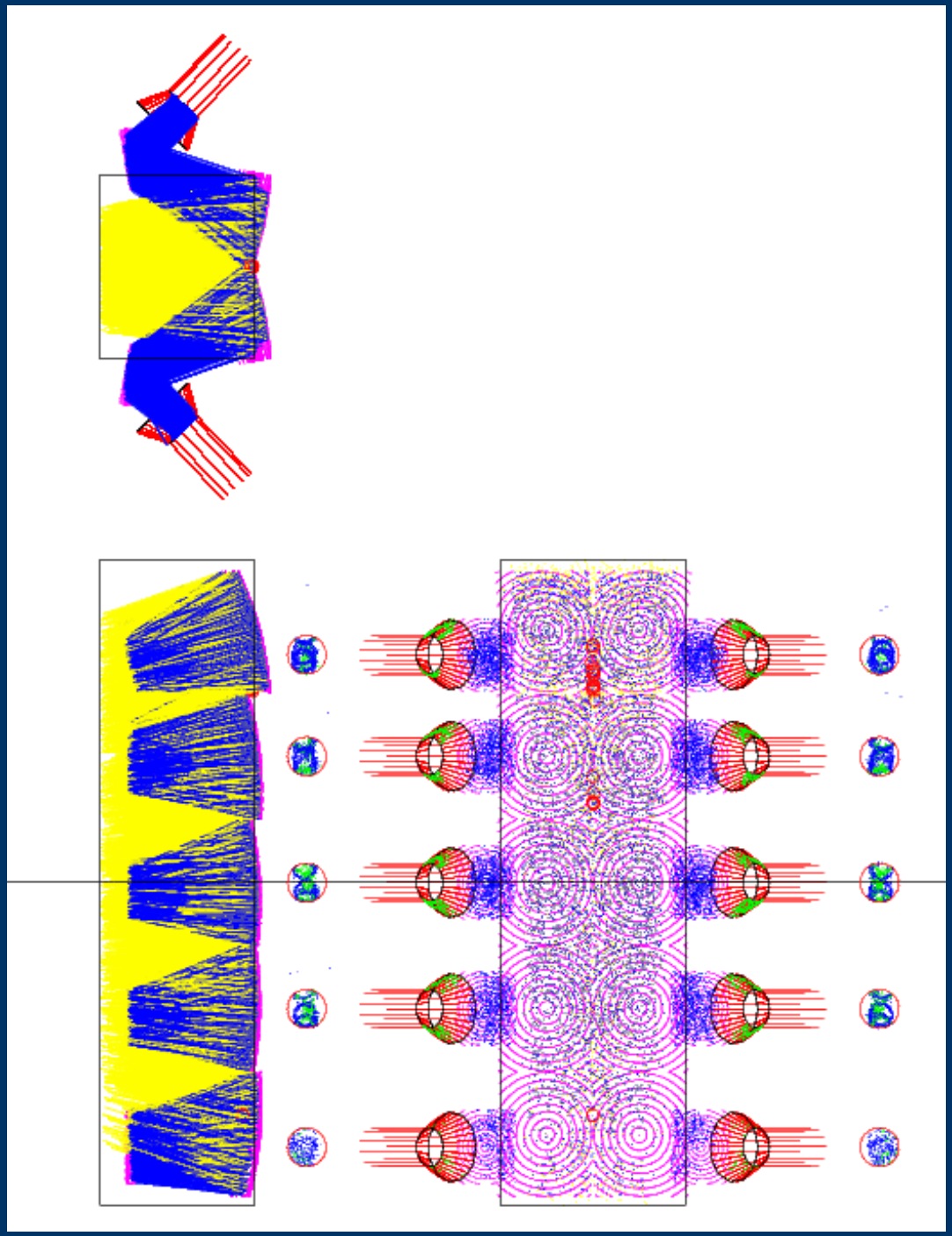
- Mirror blank vendor has been located
  - Eagle Glass Specialties, Inc.
    - ~$200/blank for spherical mirrors
- In touch with several Al coating vendors
  - Alpine Research, Esco Prod., Denton Vac.
  - no company will guarantee reflectivity below 200nm (they can't measure it)
  - three companies sending samples for our evaluation (1 here, 1 in transit, 1 pending)
    - setting up testbed in EEL building now
    - basic test involves monitoring the response of a Photonis Quartz PMT to real Cherenkov spectrum with/without mirror

Reflectivity



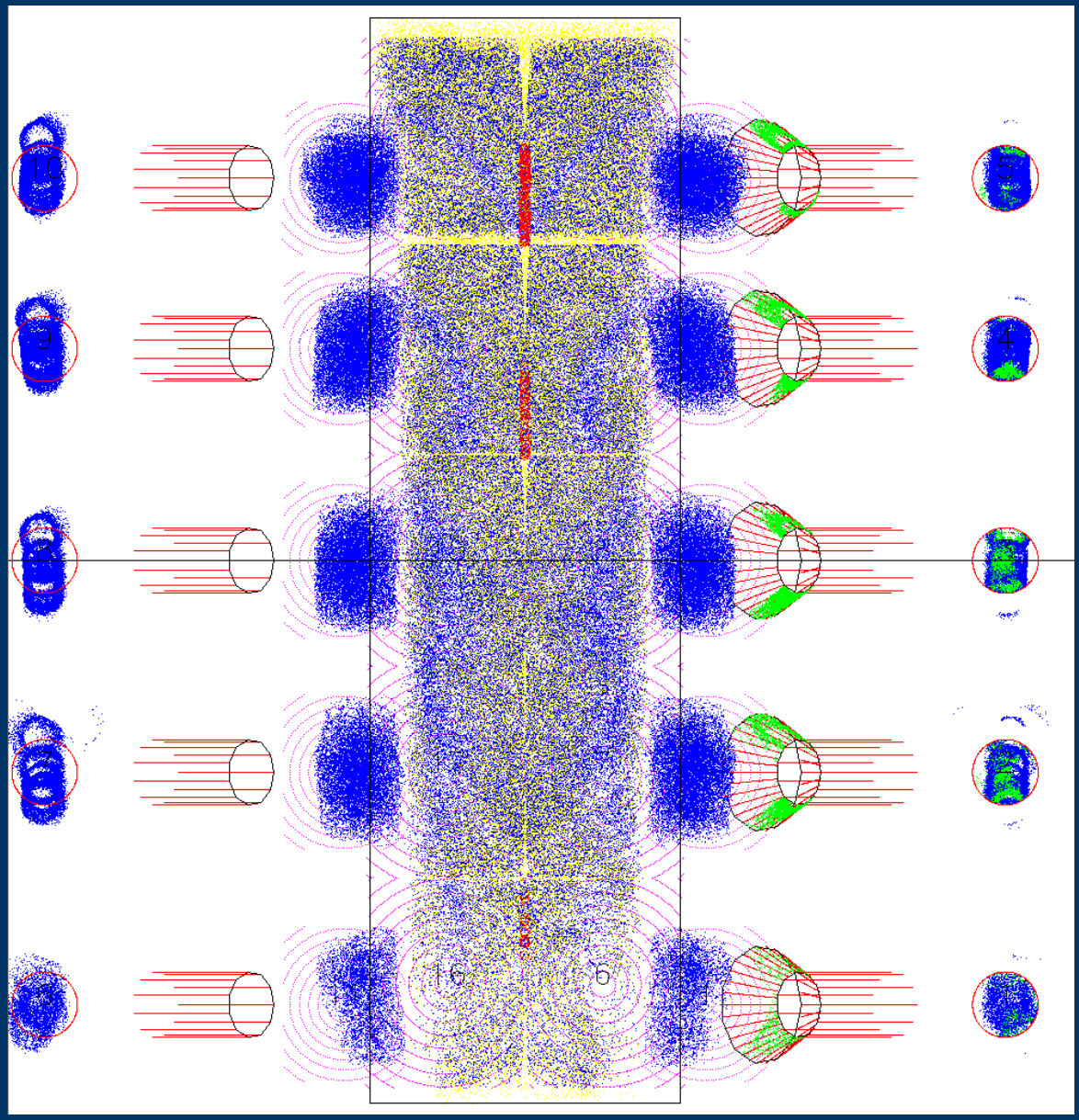
Cherenkov Optics

- Optics were tricky due to the large momentum acceptance of BigBite
  - we will be going with a 'two bounce' design
  - “pseudo”-Winston cones used to improve acceptance



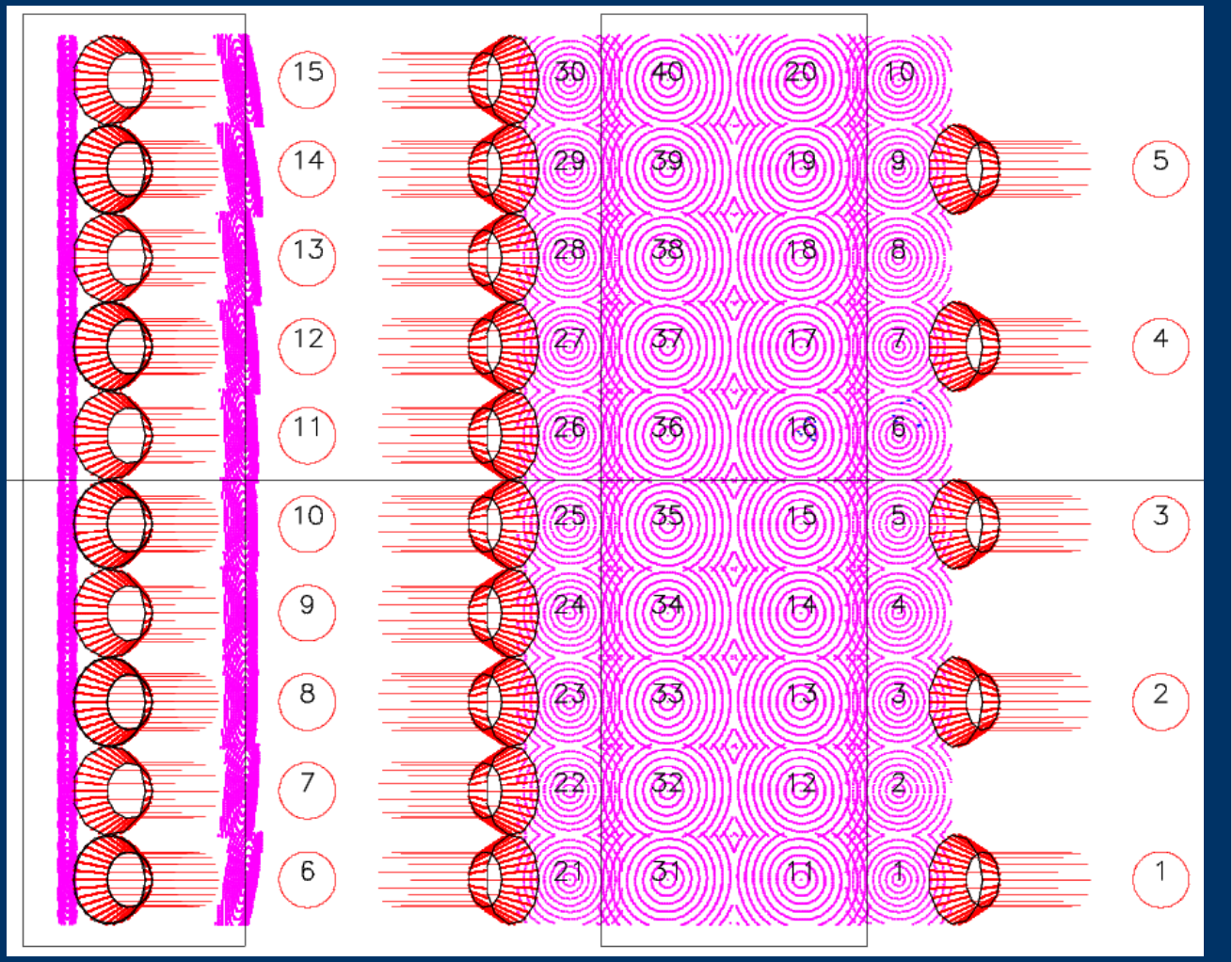
Cherenkov Optics

- No cones on left side
- Highest 'ring' associated with low-momentum particles (larger bend angle)
- Lower rings are from high momentum particles (smaller bend angle)
- (The structure in the hit distribution is an artifact of the rendering – it is *not* real)



Cherenkov Optics: 20 Mirrors?

- Size limit of common coating chambers (18” diam.) may actually make 20 mirror design more cost effective in the short term and more flexible in the long term!
- We would fill 10 PMT “slots” with planned hardware
  - 2 mirrors would focus on each PMT
  - could add more PMTs if available



“Super Size” “Original”

Cherenkov Costs

Component	Units	Cost/unit	Sub-total
Cerenkov frame/mounting hw/fittings *Currently avail. funding from Temple U.*			$20k $30k (-$10k)
Primary Mirrors (spherical)	10+2	$2000	$24k
Secondary Mirrors (flat)	10+2	$1000	$12k
Pseudo-Winston Cones†	10+2	$500	$6k
			$42k ($10k)[1]
PMT (XP4508B) w/ base (**Quartz**)‡	10+2	$2500	$30k
μ-metal shield (existing stock)	10+2	—	Purchased (JLab) —
Quartz optical windows*:	10+2	$500	$6k
C_4F_{10} gas: (cost/fill§)		$2600	—
Daily consumption (atm. press. fluctuations)		$26/day	—

†May be omitted for purposes of E06-014 at the cost of a significant loss in efficiency for the lowest energy bins.

‡Quartz-face PMTs result in almost a factor of two more detected photons versus a UV-glass PMT.

*Not required if the PMTs can be installed inside the tank (preferred option).

§A fill is estimated to be 1800 liters priced at US$145/kg (1 kg liquid = 100 liters gas at STP).

[1] NOTE: Mirror prices are dominated by worst-case coating cost (CERN @ $1000/mirror). If one of the local vendors proves OK the cost/mirror will drop by a factor of 4 or 5!