SIDIS Cherenkov Detectors for SoLID

Simona Malace
Duke U.

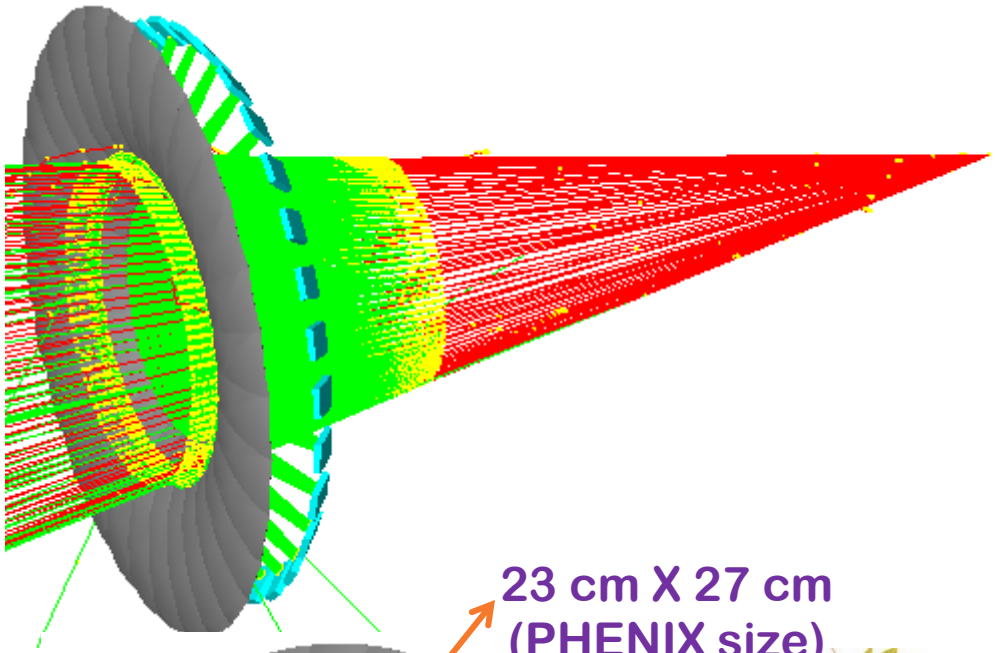
Collaborators: Zein-Eddine Meziani, Eric Fuchey

The Electron Cherenkov: GEMs + CsI

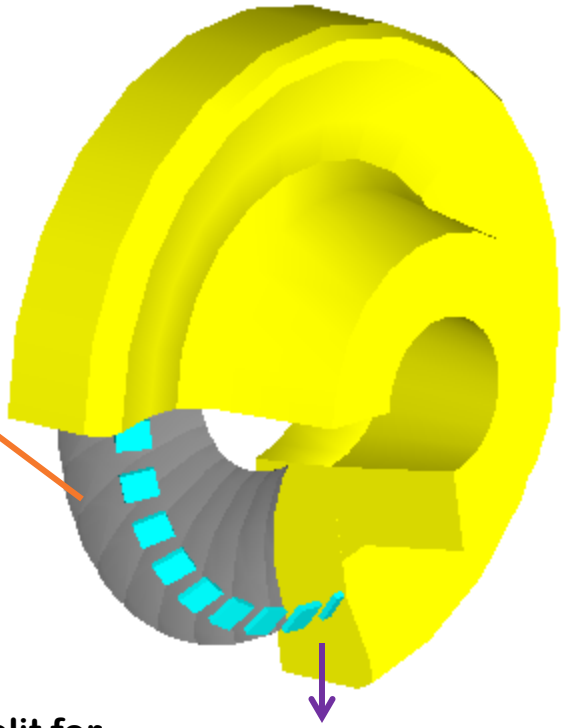
New since June 2011:

→ reduced size of GEMs + CsI to 23 cm X 27 cm (same for PVDIS)

→ optimized design so that SIDIS can use same mirrors as PVDIS

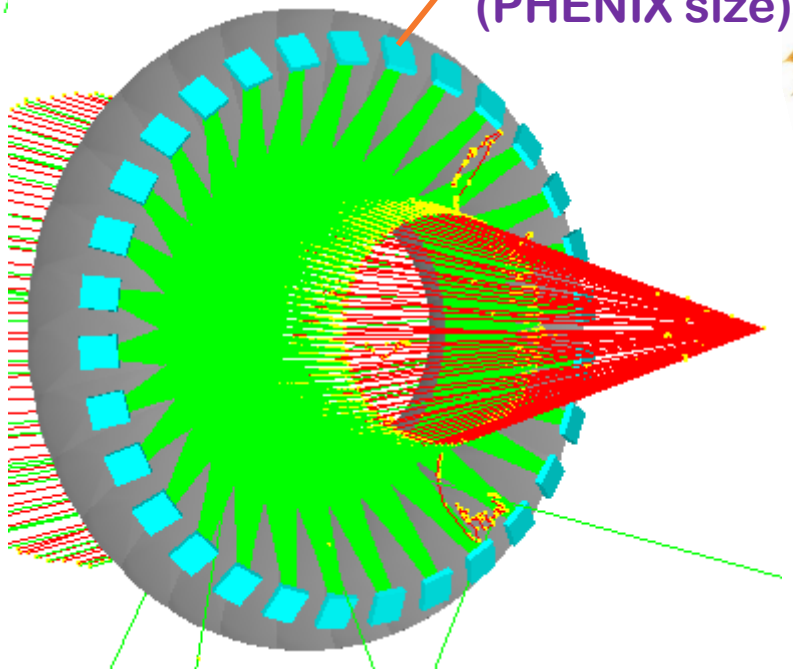


23 cm X 27 cm (PHENIX size)



same mirror as PVDIS

tank radius can be smaller



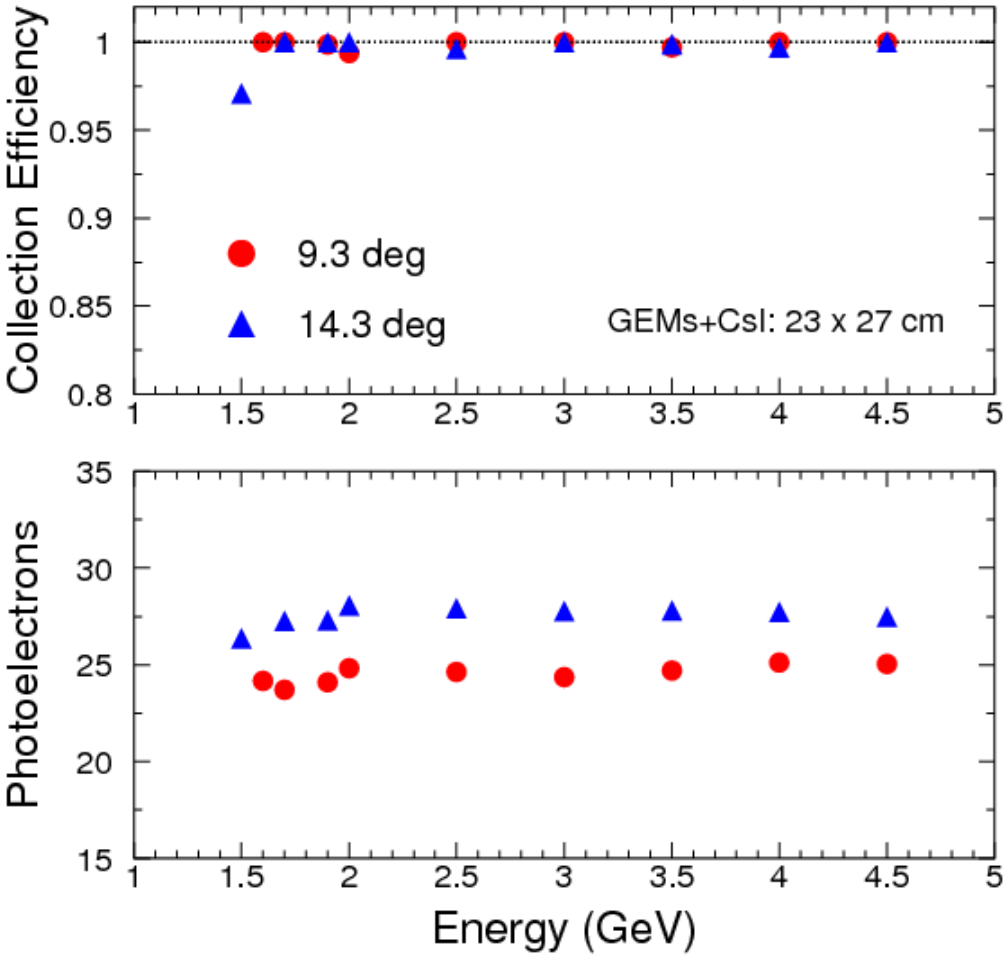
Mirrors will be split for manufacturing purposes but will have same curvature

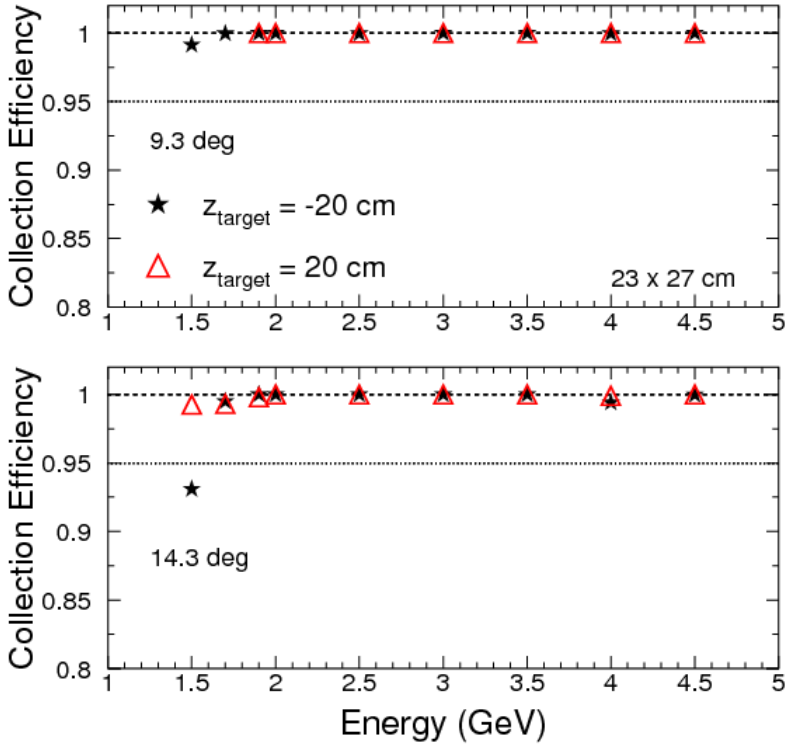
The Electron Cherenkov: GEMs + CsI

With the new setup:

→ good collection efficiency

→ reasonable number of photoelectrons





SIDIS and PVDIS could have:

→ same tank except for the additional piece that will go under the coil for SIDIS

→ same mirrors, mounted at the same location

→ same GEMs + CsI, mounted at different locations

The Electron Cherenkov: PMT

New since June 2011:

→ mirrors will be split for manufacturing purposes (see next talk)

→ take advantage: make them of different curvatures to reduce the size of the photon detector

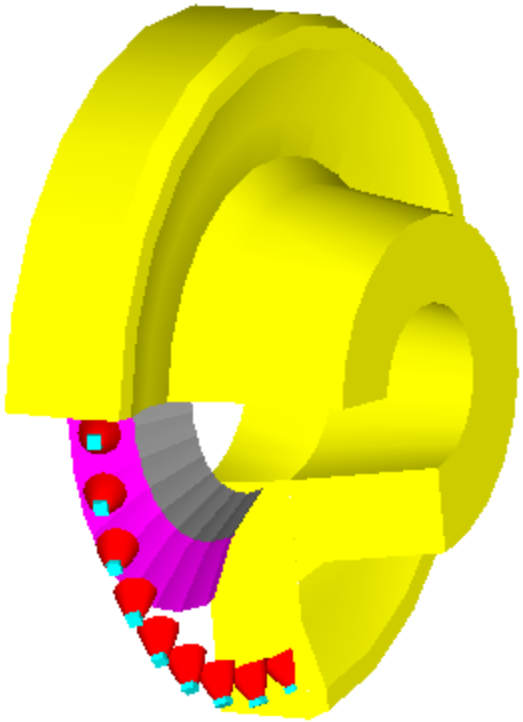
great idea from Zein-Eddine!!

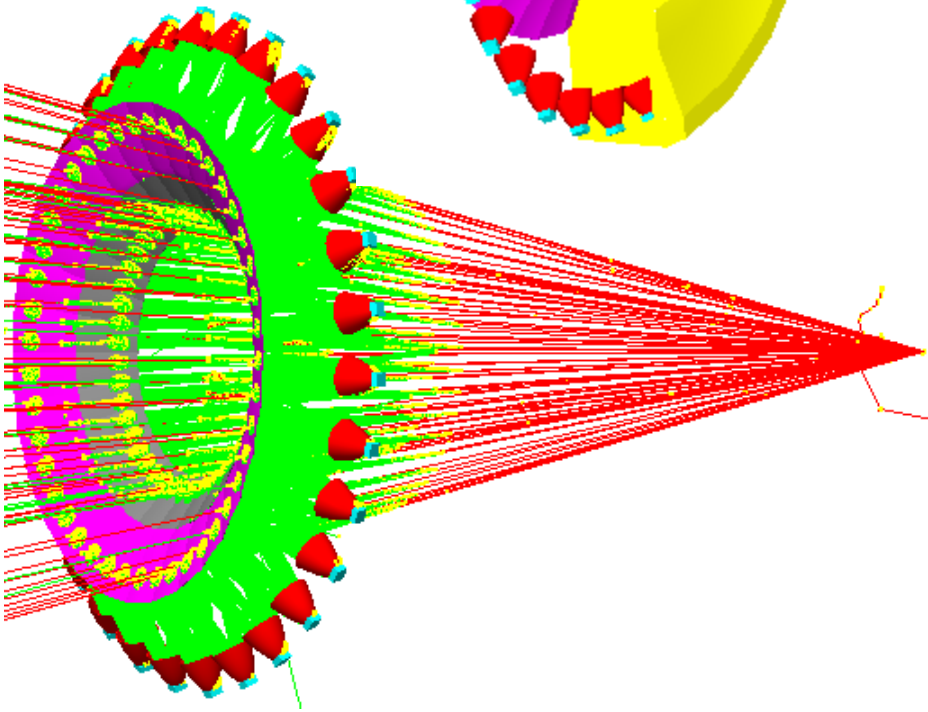
PMTs are expensive:
$3000 per PMT if one buys many

went from 9 PMTs to 4 PMTs per sector: ***saves a LOT of money***

→ more work to: find a way to hold mirrors to avoid loss of physics phase space

→ look into making mirrors from a light, rigid material to minimize the need for support



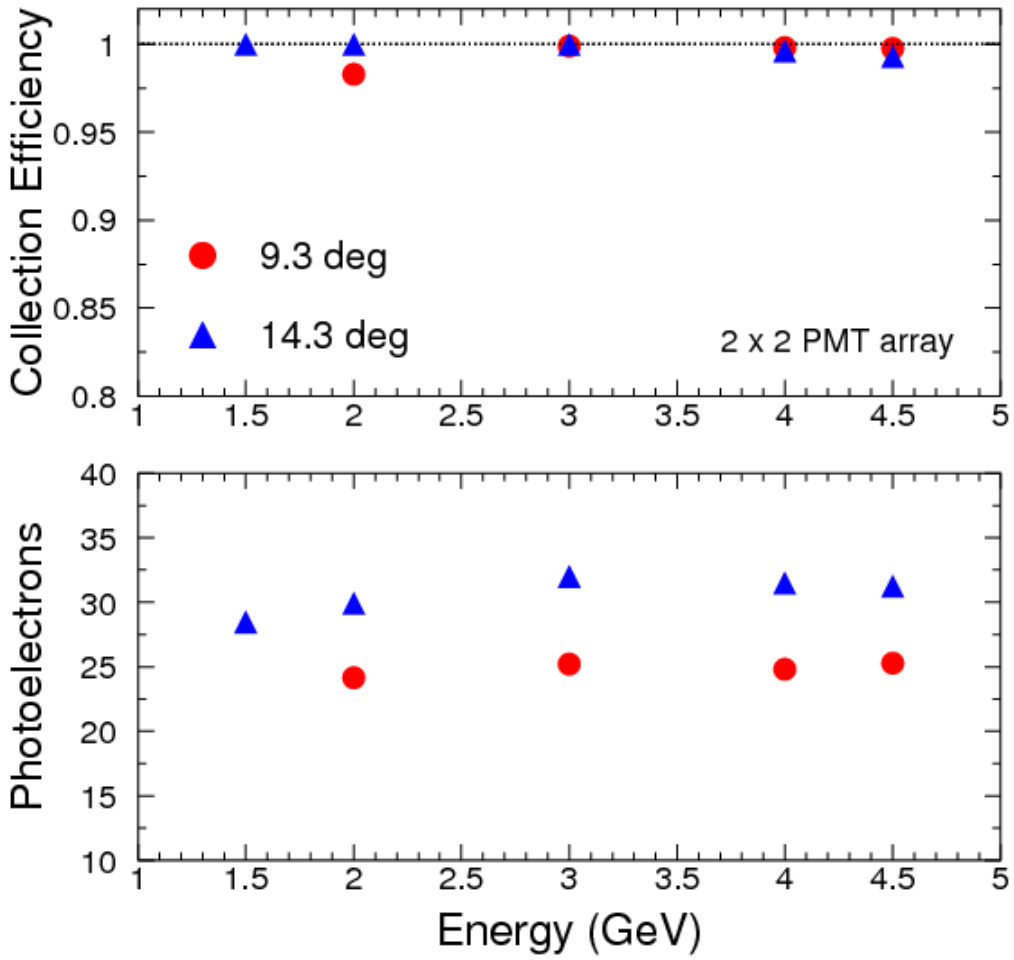


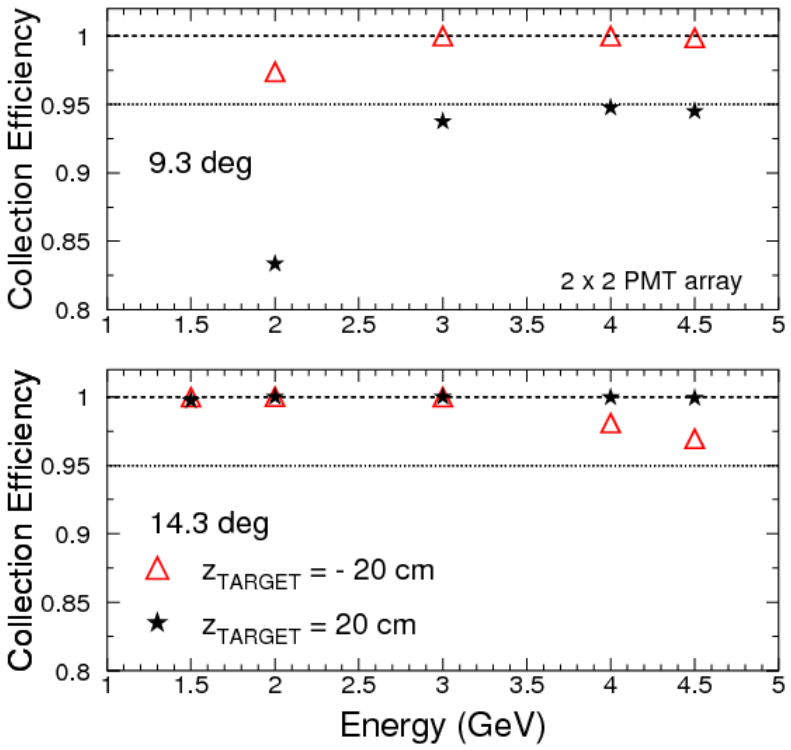
The Electron Cherenkov: PMT

With the new setup:

→ **good collection efficiency**

→ **reasonable number of photoelectrons**





→ **Next iteration: will try to improve collection efficiency for 9.3 deg, extended target**

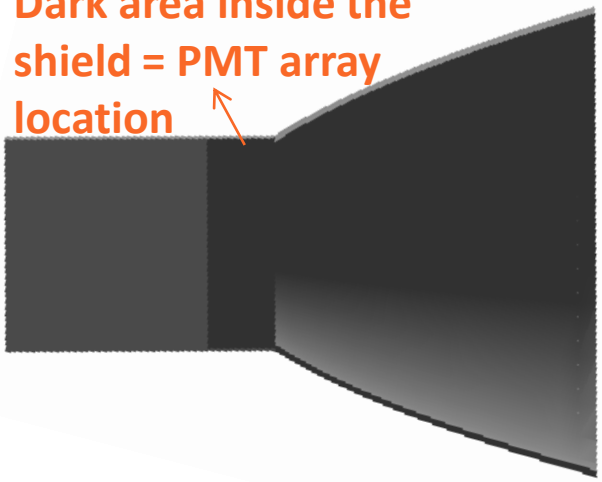
The Cherenkov: PMT

From H8500C field tests at Temple U.

→ at 20 G (longitudinal field): < 10% signal loss
→ at 70 G: 30%

Request sent to Amuneal for "ideal" shield

- longitudinal component of the magnetic field from 150 G to < 20 G
- transverse component of the magnetic field from 70 G to 0 G



Estimates based on BaBar v4 field map

Ideal *could be higher* though (< 50 G)

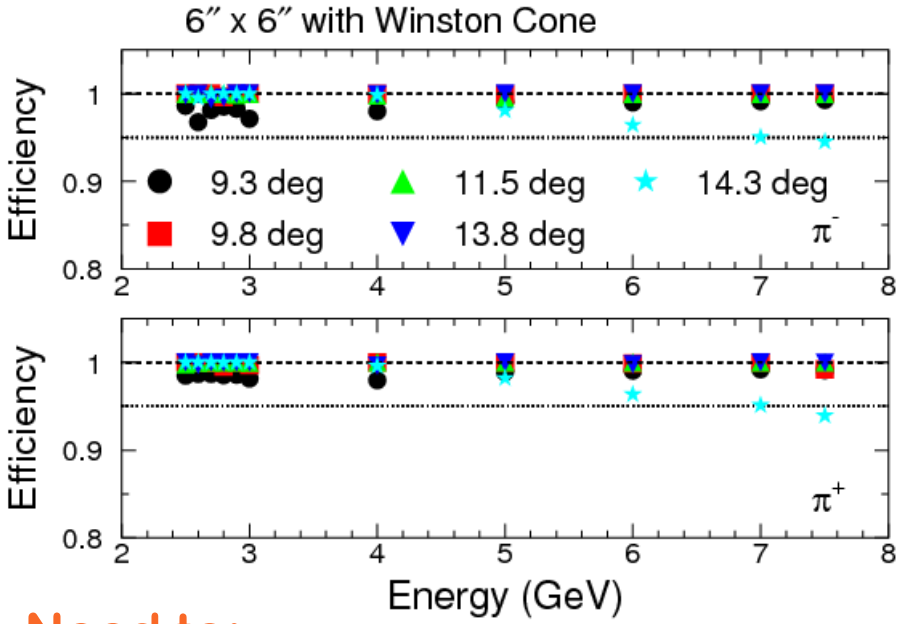
Amuneal says it's possible with a 2 layer shield:
→ inner: Amumetal 0.04"
→ outer: 1008 carbon steel 1/8"
→ mylar in between 0.062"

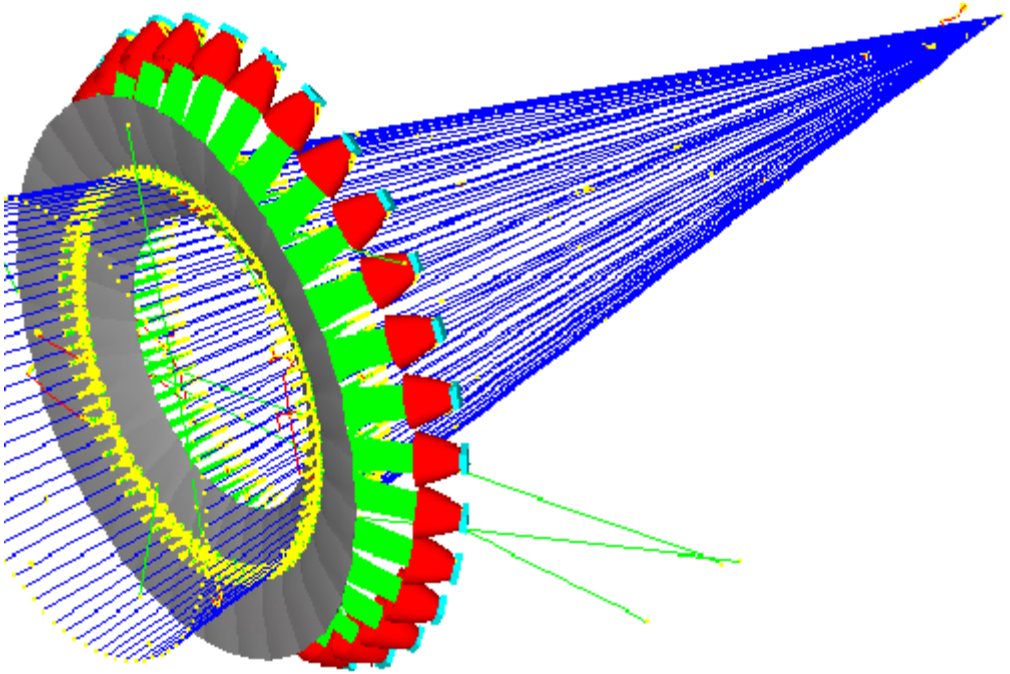
No official quote yet but:
→ straight-cone shape shield would be substantially cheaper than Winston cone shape
→ "very rough estimate" for straight-cone: $1350 per unit for a quantity of 31

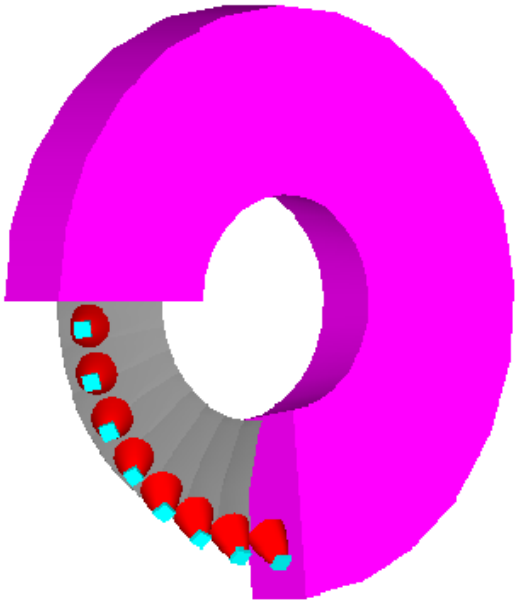
The Hadron Cherenkov: PMT

New since June 2011:

→ good collection efficiency when using spherical mirrors, Winston cones and 3 X 3 arrays of 2” PMTs (for both positive and negative pions)





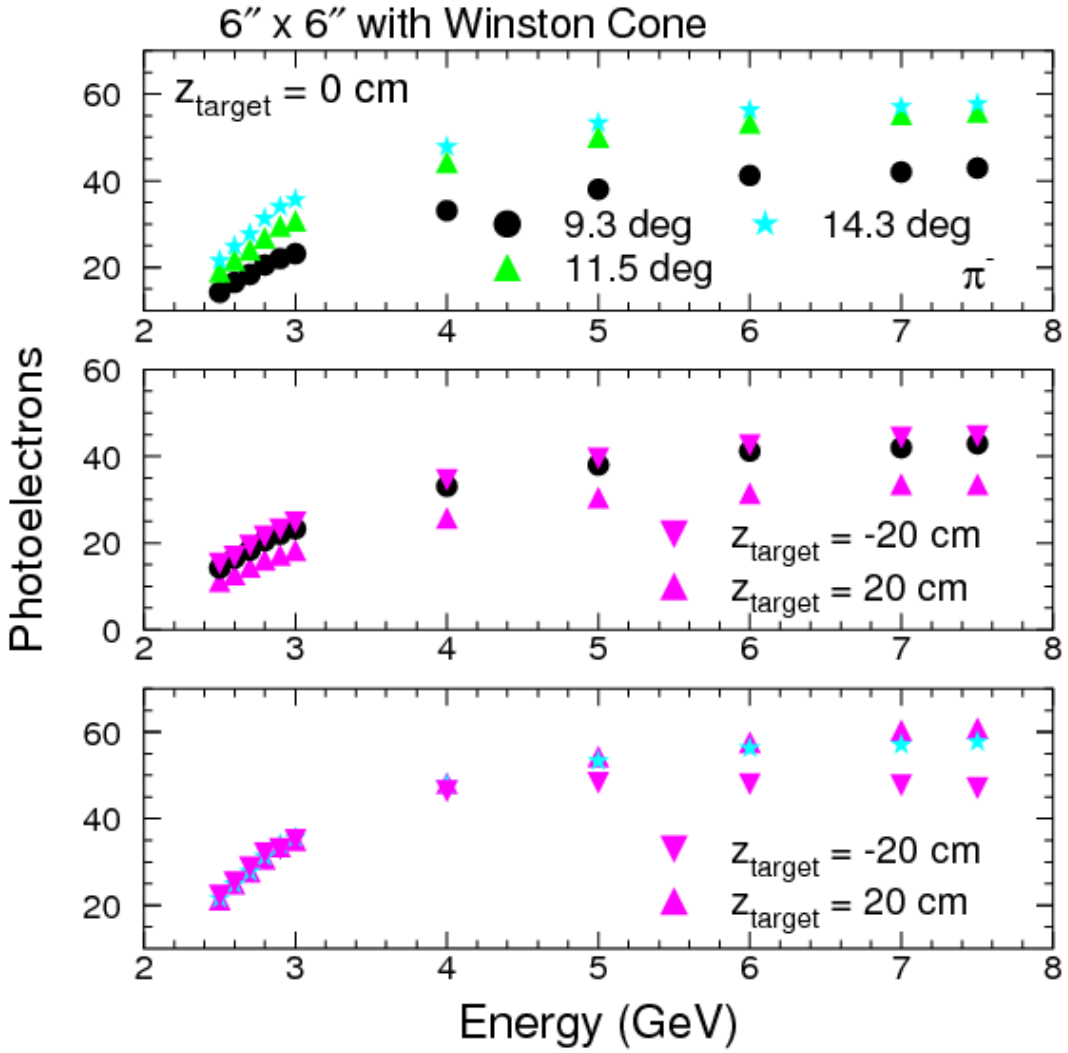


Need to:

→ split mirrors and (hopefully) reduce the PMT array size (to 2 X 2 PMTs)

The Hadron Cherenkov: PMT

New since June 2011:



Estimates based on:

→ use of C_4F_{10} (will switch to C_4F_8O)

→ tank 20 cm longer than in proposal (with BaBar v4 there would be room for this extension)

→ same assumption about mirrors, Winston cones and PMT parameters as for the electron Cherenkov

→ Tank could be shorter along z: fewer photoelectrons than 20 at the lowest momentum is probably O.K.

Need more iterations to "finalize" design

Summary

Simulation and design: iterate!

→ “finalize” the hadron Cherenkov design
→ switch to CLEO when available and re-optimize
→ migrate to GEMC
→ …

Tests:

→ test H8500C-03 during g_2^p: “simple” background test
→ test GEMs + CsI prototype during g_2^p: see next talk for details
→ …