Update on LTCC Simulation and Reconstruction Software From the Temple University Group

Burcu Duran

Sylvester Joosten

Michael Paolone

Fall CLAS12 Collaboration Workshop, November 1 2016

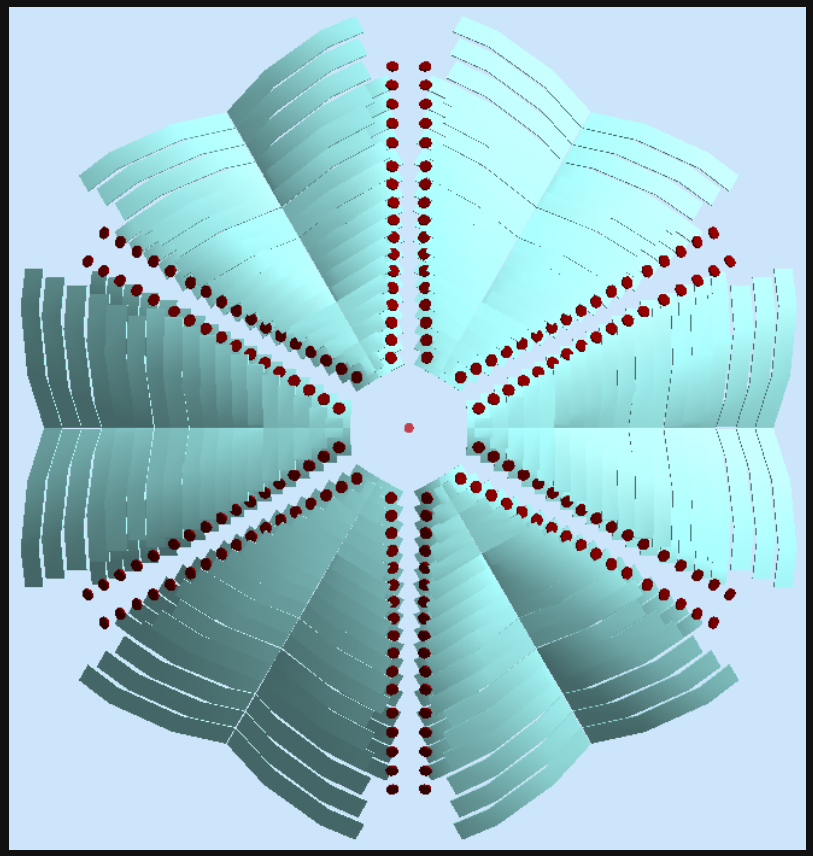
Temple Group's Goals

- **LTCC Simulation**
  - Construction and placement of Winston Cones ✔
  - PMT Shields (affect optics especially at small angles) ✔
  - LTCC Box (material in active areas) (in progress)
  - Refurbish and update existing geometry ✔
- **LTCC Reconstruction Software within CLAS12 framework (in progress)**
- **Digitization and response function (in progress)**

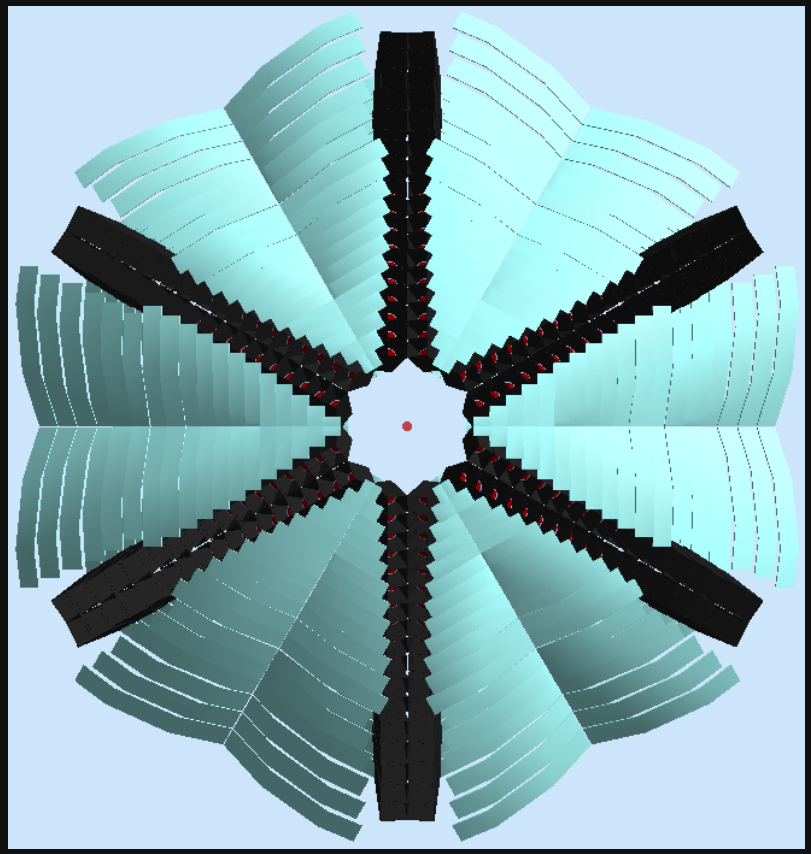
LTCC geometry before and after WCs and Shields

- 6 sectors. each is filled with C4F10 gas with refraction index as a function of wavelength
- Each sector has
  - 108 mirrors
  - 36 PMTs
  - 36 WCs
  - 36 Shields

Front view of LTCC



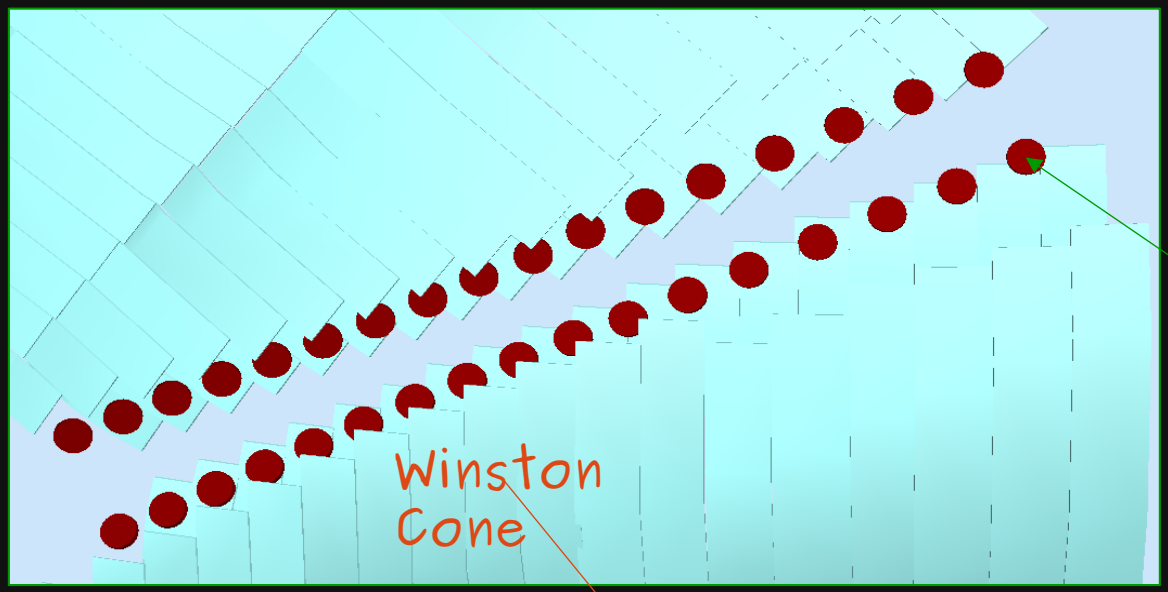
6 sectors with mirrors and PMTs

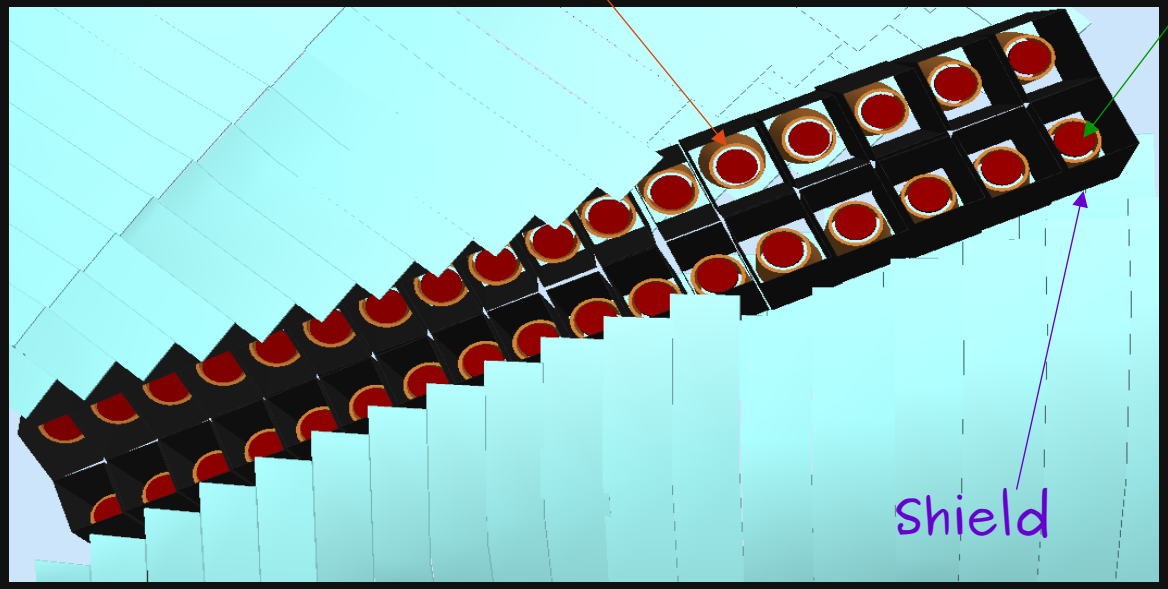


6 sectors with mirrors, PMTs, WCs and shields

Zoom in picture of LTCC before and after WCs and Shields

- **WC dimensions**
  - **Small**
  - PMT side diameter: 5”
  - other side: 8.5” diameter
  - Length: 8.5”
  - **Medium**
  - PMT side diameter: 5”
  - other side: 9.5” diameter
  - Length: 9.5”
  - **Large**
  - PMT side diameter: 5”
  - other side: 11” diameter
  - Length: 11”





- **PMTs**
  - Cylinders
  - 5.5 cm in radius
  - 1 cm in length
- **Shield dimensions**
  - Shield length is double the length of WCs’
  - Pick the sides as shield covers the outer face of WCs

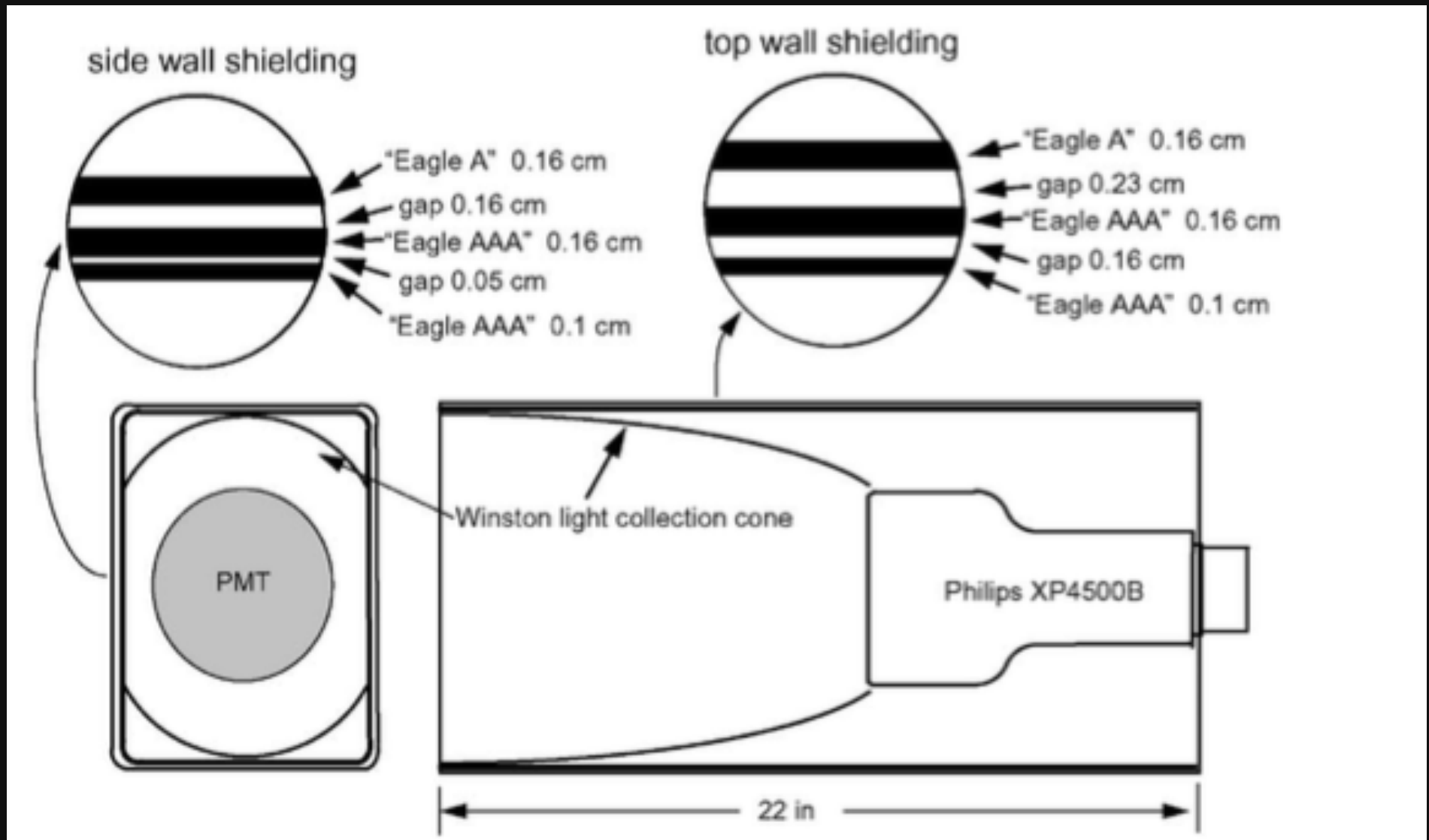
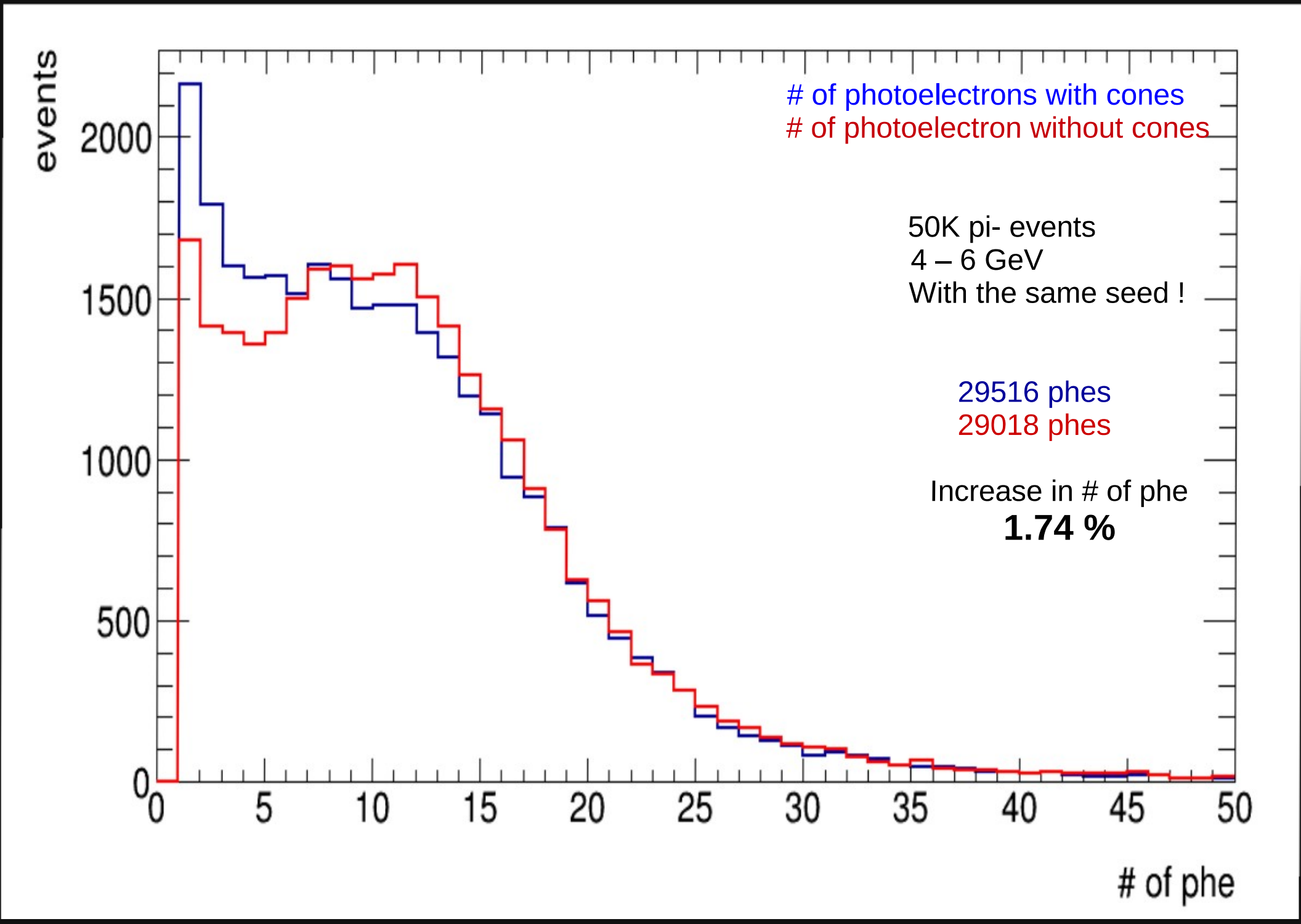
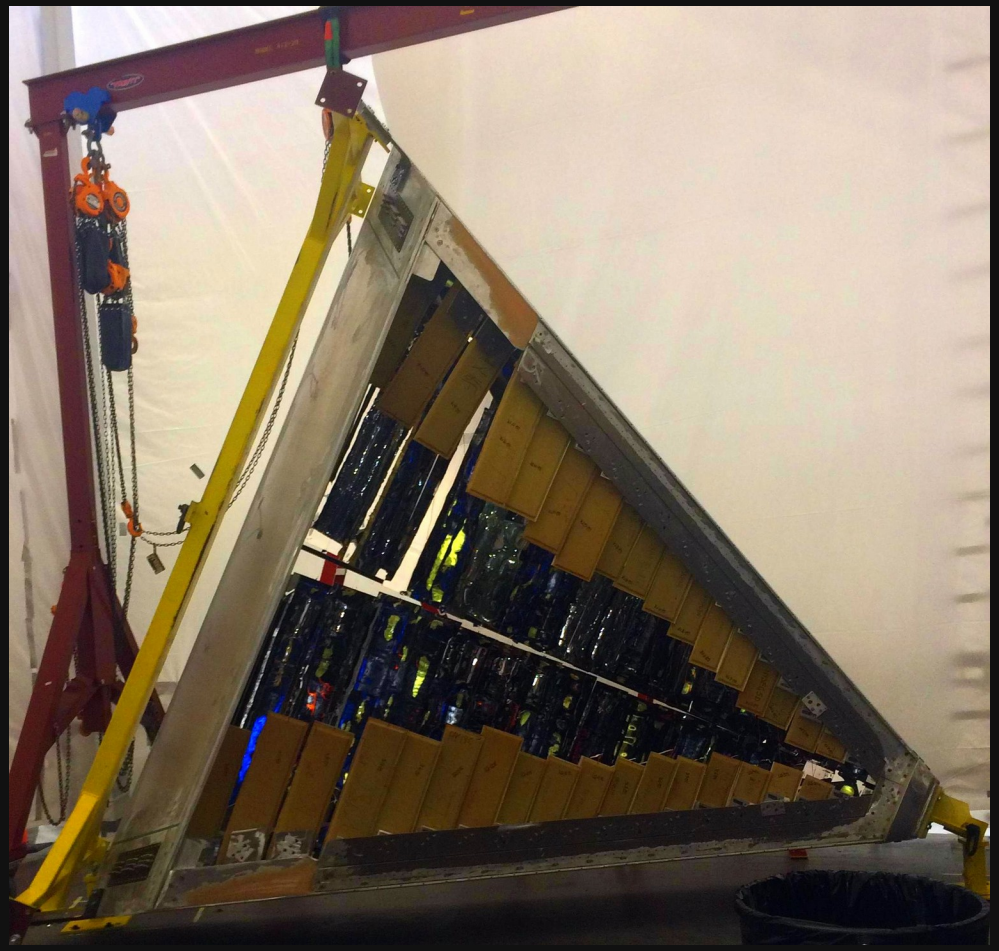


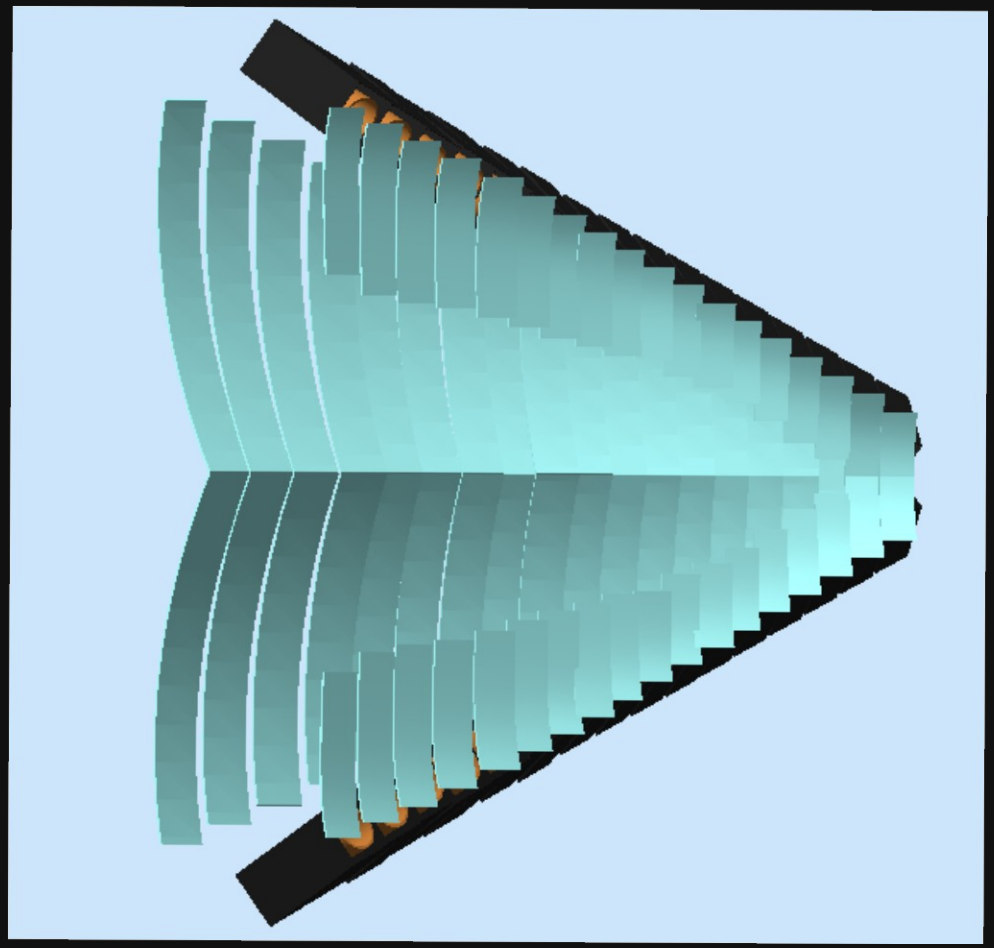
Fig. 4. PMT assembly with Winston light collection cone and magnetic shielding.


# of photoelectrons with cones
# of photoelectron without cones
50K pi- events
4 – 6 GeV
With the same seed !
29516 phes
29018 phes
Increase in # of phe
1.74 %
events
# of phe
0
500
1000
1500
2000
0
5
10
15
20
25
30
35
40
45
50

Real LTCC vs Simulation



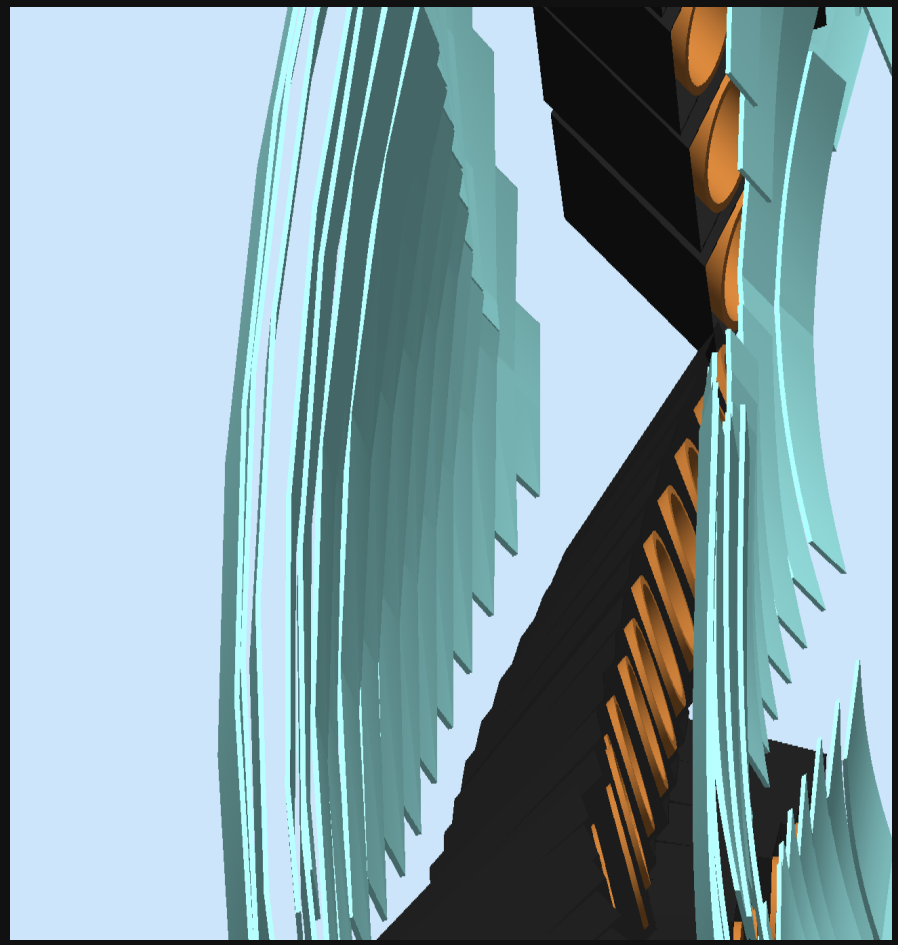
Real picture of 1 sector of LTCC



Simulation picture of 1 sector of LTCC

Real LTCC vs Simulation

elliptical mirrors and shields in a sector



LTCC Reconstruction

- **Reconstruction is being developed, inspired by existing HTCC code.**
- **Reconstruction uses CLAS12 reconstruction framework COATJAVA**

- **Procedure**
  - **Search for the highest # of photoelectron hit**
  - **Create cluster by adding adjacent hits with compatible timing**
  - **Repeat for remaining hits.**
  - **Investigate occurrence of overlapping clusters and implement a solution if needed**
  - **Track matching**

LTCC Reconstruction Status

- **Writing clustering algorithm**
  - Ready to test against simulation
  - Github link: https://github.com/sly2j/detectors
  - Final github location will be compatible with other CLAS12 reconstruction

- **LTCC track matching for PID**
  - Starting point: CC track matching
  - Reconstructed track matching with LTCC segment and time matching
  - Time matching
  - Ongoing

Response Function

- **Does simulation response match with real-world response ?**
  - **Simulation that shows some amount of photoelectrons and ADC signal is *ideal***
  - **Real system is different**
  - **Identify inefficiencies and apply to response function**

Summary & Future Work

- Burcu Duran
- Sylvester Joosten
- Michael Paolone

- ✔ **The placement of Winston cones and shields in the GEMC LTCC geometry is completed.**
- ✖ **Box that includes LTCC will be completed in December 2016.**
- ✖ **LTCC reconstruction is being written by using CLAS12 software.**
- ✖ **Simulation response will be checked.**
- ✖ **Two CLAS12 notes with the geometry and reconstruction will be created.**

THANKS !

The LTCC Group Leader

Maurizio Ungaro (Jefferson Lab)

Temple University Nuclear Research Group

Hamza Atac

Zein-Eddine Meziani

Melanie Rehfuss

Nikolaos Sparveris

This work is supported by DOE grant award DE-FG02-94ER40844