The Hybrid Photon Library of Chris Backhouse

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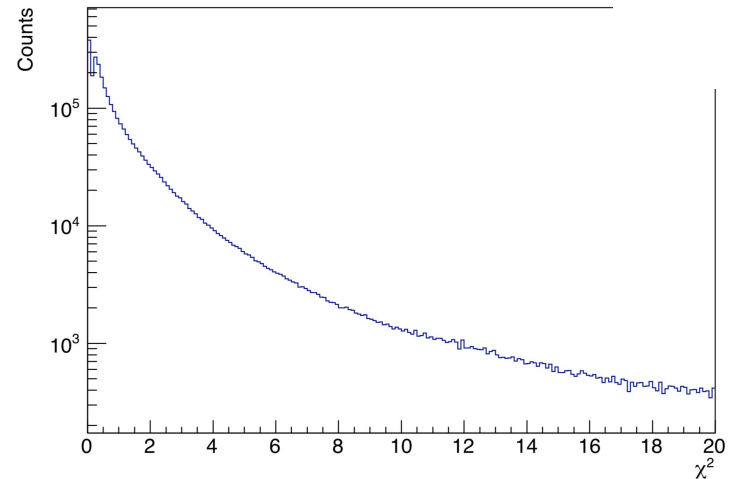
07/03/2018

Motivation

- **The Photon Library for dune10kt_1x2x6 geometry:**
  - Number of voxels per optical detector bar:
    100 in x-direction, 100 in y-direction, 300 in z-direction = $3*10^6$
  - Total in memory: $3*10^6$ * 120 * 4 bytes = 1.34 GB
- **New approach: $V(r) = A*exp(-B*r)/r^2$**
  - Parametrize the visibility of each optical detector bar assuming a $1/r^2$ relation and a decaying exponential (which is fitted to the standard library's visibility*r^2 of all voxels for each opdet).
- **Hybrid:**
  - Only uses the parametrization when the calculated visibility and the one extracted from the standard library agree within 3σ .

Fitting procedure

For each opdet:
points represent the standard library's
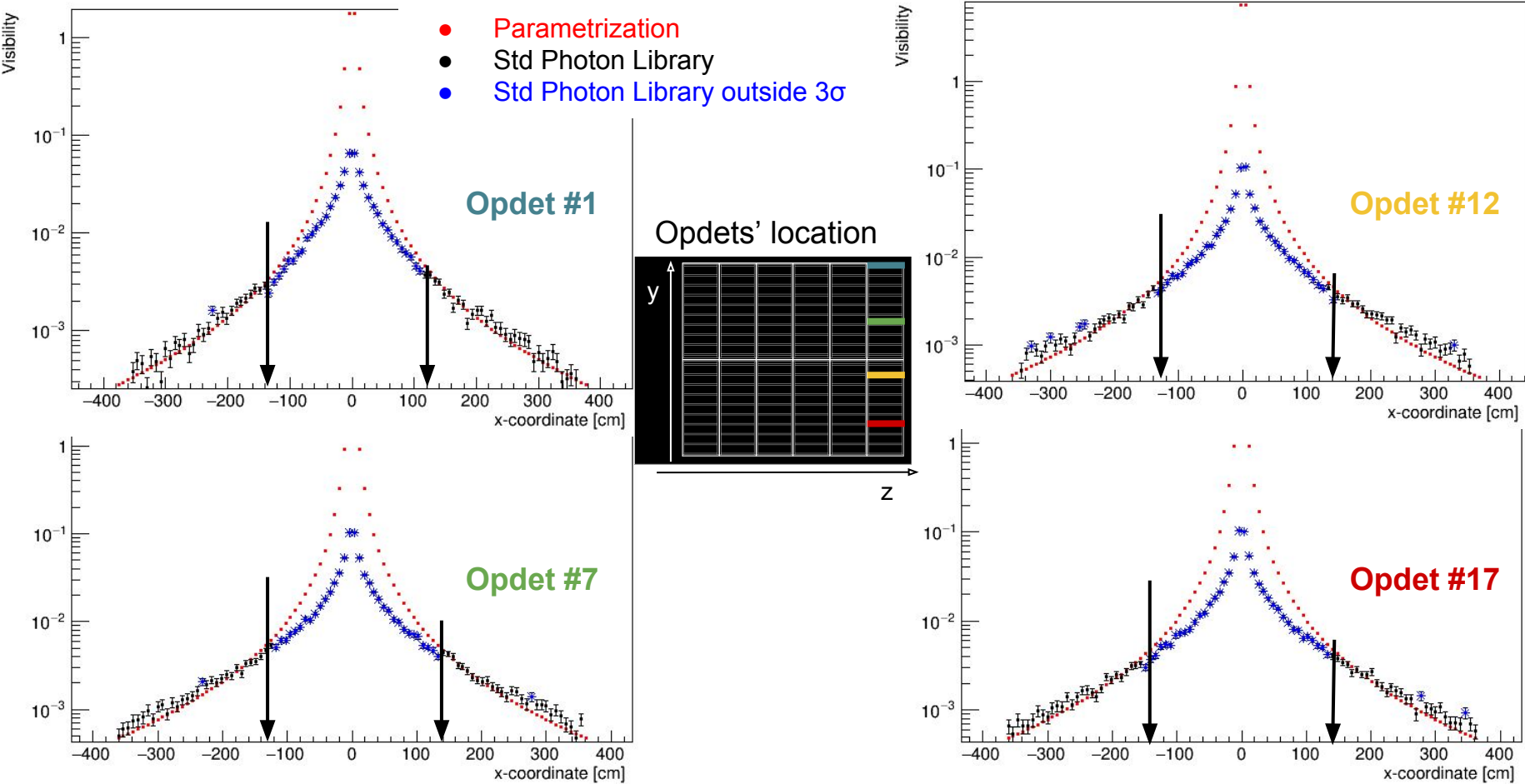visibility*r^2 of one opdet for a given voxel.
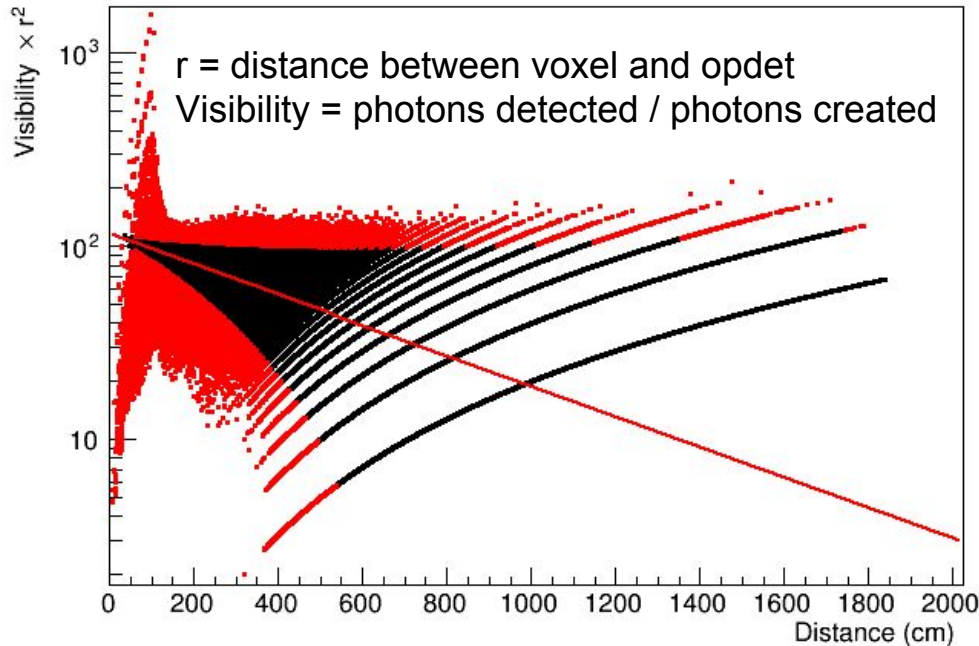
Red points (~3% of total)
are outside 3σ of fit line.
Black points are within 3σ of
the predicted visibility using
parametrization.

r = distance between voxel and opdet
Visibility = photons detected / photons created
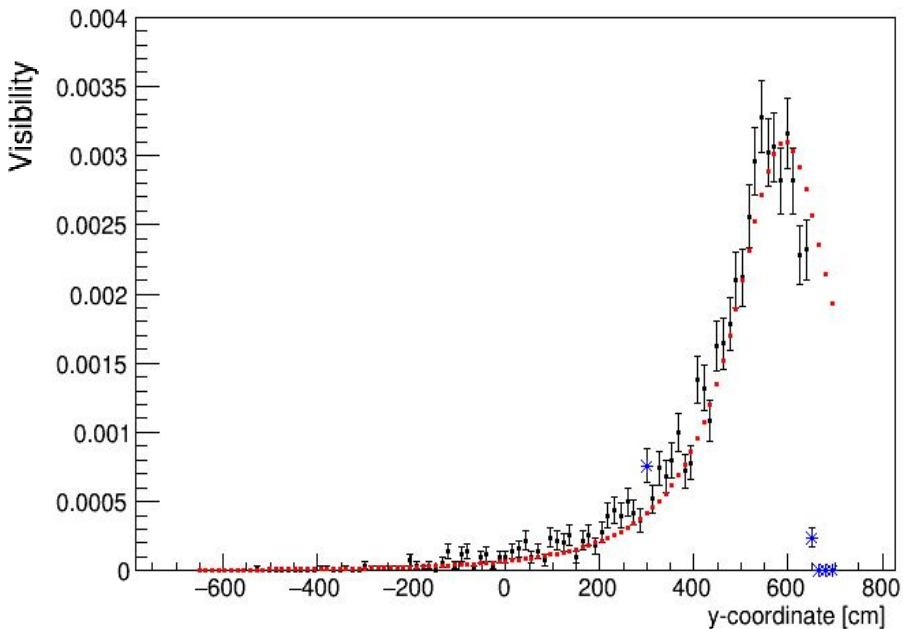

Histogram representing the amount
of X^2 values.

3
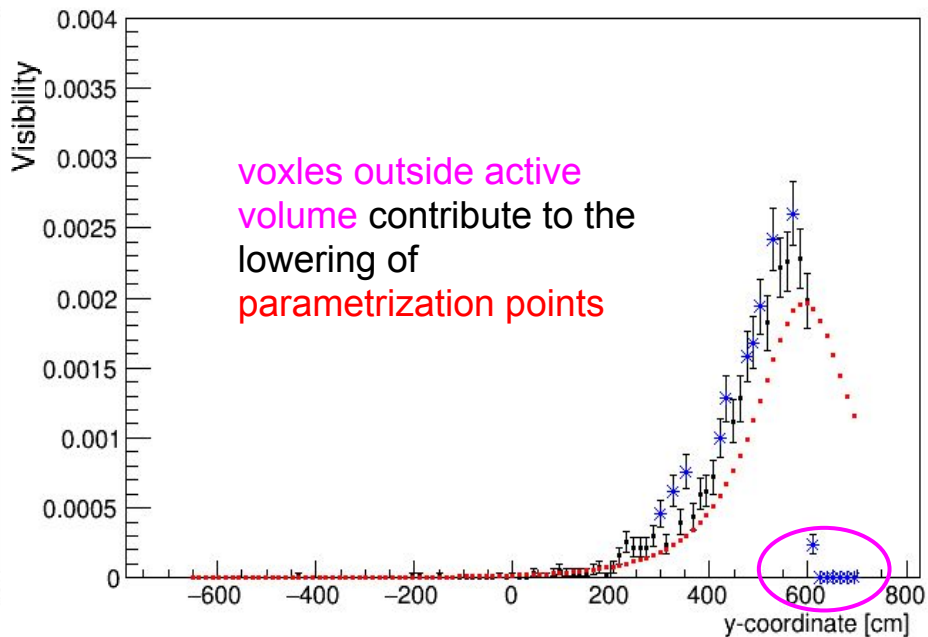
Parametrization's validity depending on the distance

Visibility V(y) for x = 140cm for opdet #1

- ● Parametrization
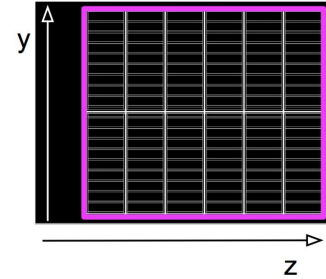- ● Std Photon Library
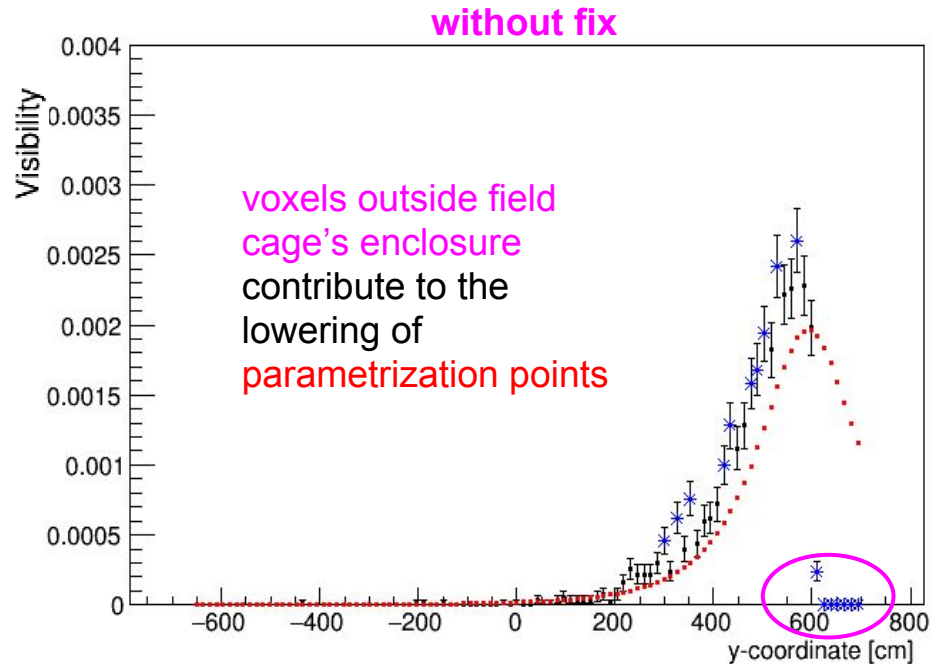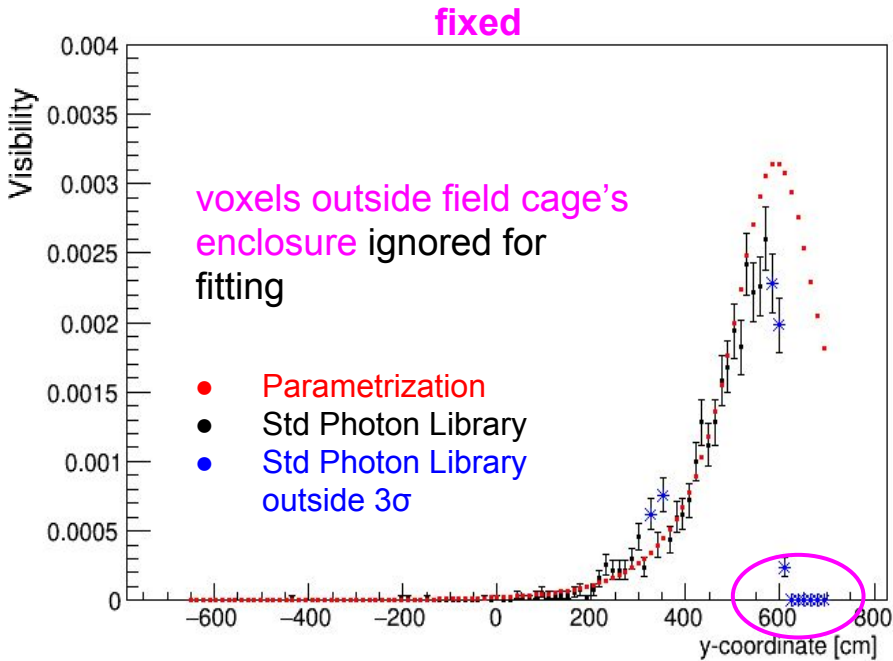- ● Std Photon Library outside 3σ

without field cage

with field cage

voxles outside active volume contribute to the lowering of parametrization points

Field Cage Fix

Visibilities V(y) for x = 140 cm
for OpDet #1 with field cage

fixed

voxels outside field cage's
enclosure ignored for
fitting

● Parametrization
● Std Photon Library
● Std Photon Library
   outside 3σ

without fix

voxels outside field
cage's enclosure
contribute to the
lowering of
parametrization points

3% of Std Photon Library needed for voxels inside FC

6% of Std Photon Library needed in total

Hybrid Photon Library vs Standard Photon Library **without** field cage

Video with **Xprojection slices**: starts far away(#2) from the APAs and gets closer(#48).

Hybrid Library Xprojection_48 without FC
Hybrid

Standard Library Xprojection_48 without FC
Standard
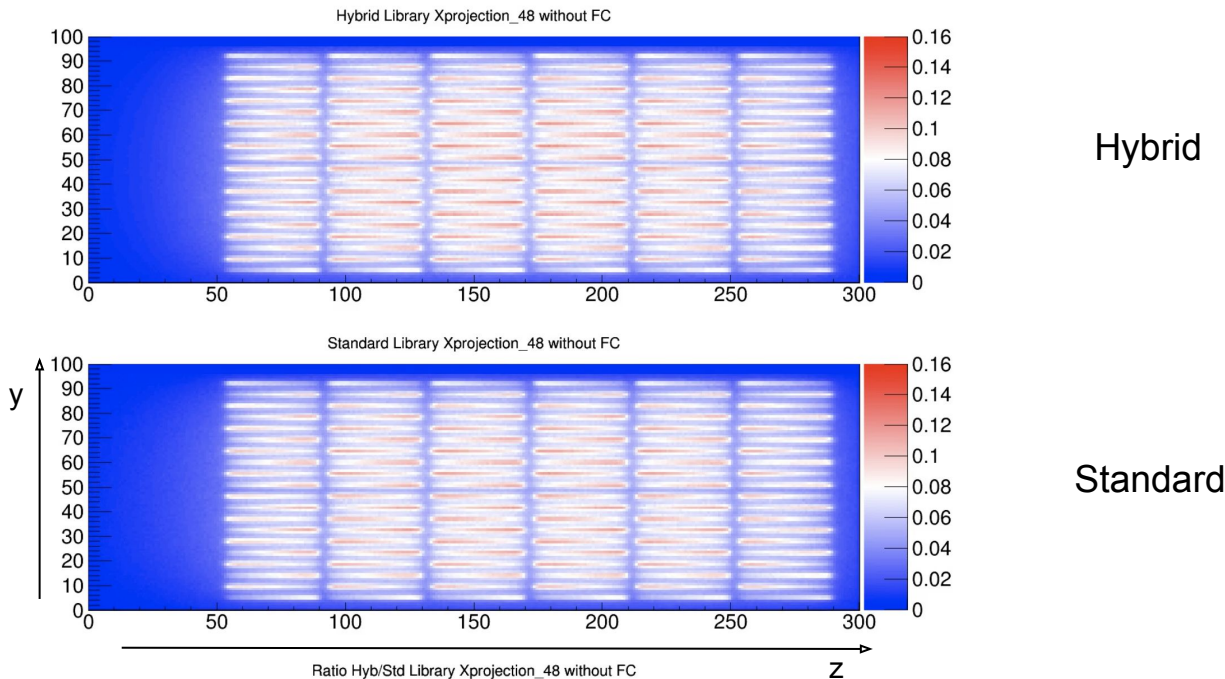
Note: the jump from Xprojection #30 - #31 is only due to a change in the scaling of the visibility.

Ratio Hyb/Std Library Xprojection_48 without FC
Hybrid/Standard
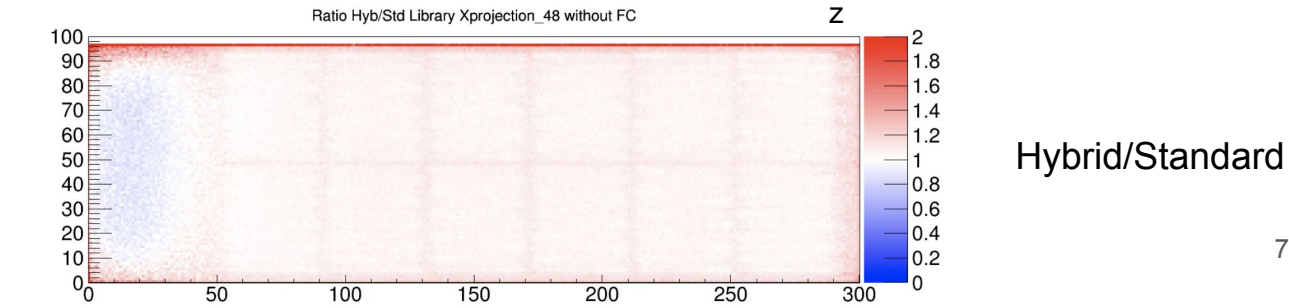
Summary

- ❖ Branch of larsim: origin/feature/btapia_hybridlibraryCB
- ❖ Working on LArSoft version v06_82_00
- ❖ The use of the Hybrid Photon Library eliminates 97% of needed memory in the dune10kt_1x2x6 geometry.
- ❖ Other parametrizations can be tested this way.
- ❖ Can be used for the Dual Phase Far Detector as well.

Backups

Important Dimensions:

Voxels in the Std Photon Library:

Δx = 7.594 cm

Δy = 13.577 cm

Δz = 5.822 cm

Opdet bars:

Δx = 0.952 cm

Δy = 10.16 cm

Δz = 209.6825 cm

12 APAs with
10 Optical Detectors each
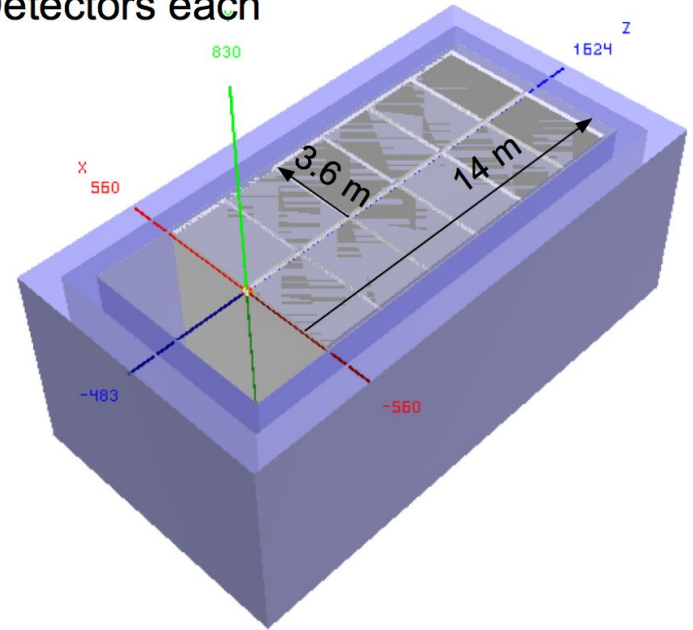
Top view for y = 0 of the
detector's lower half

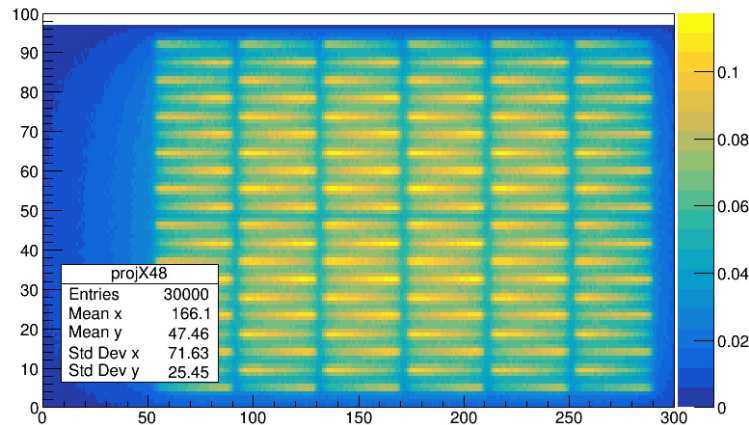# Hybrid Photon Library vs Std Photon Library
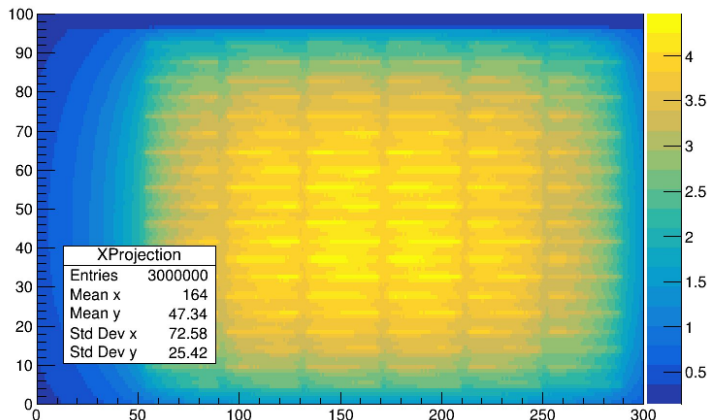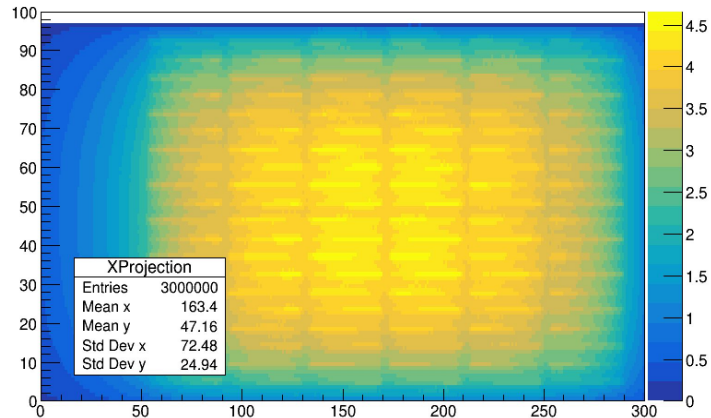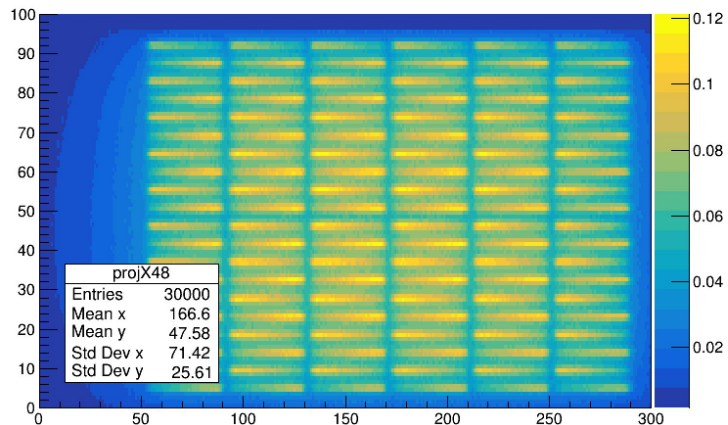
Hybrid Photon Library vs Std Photon Library Opdet #50
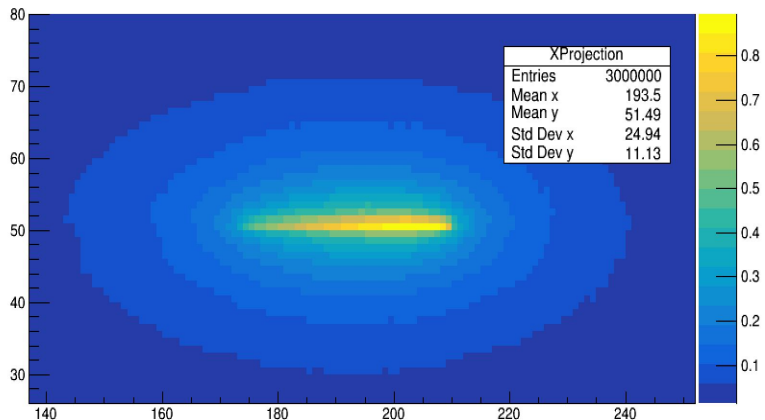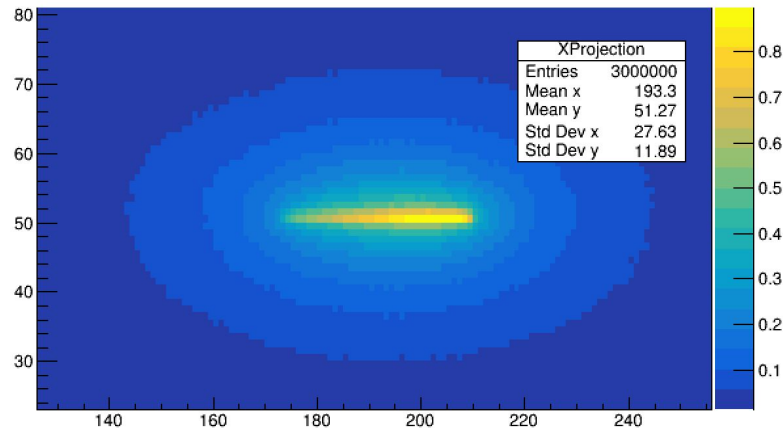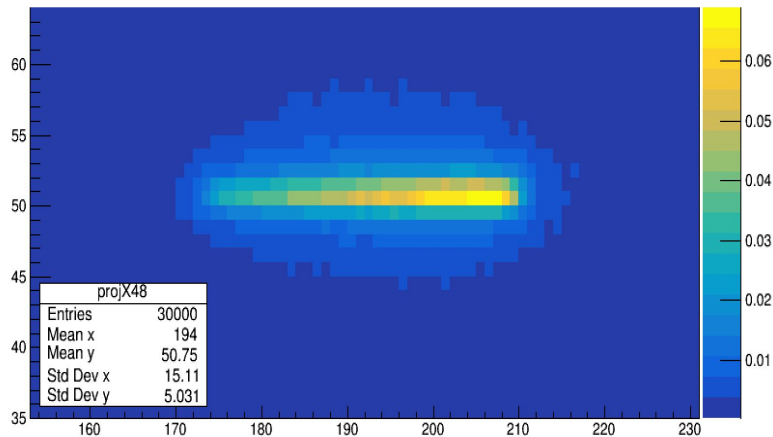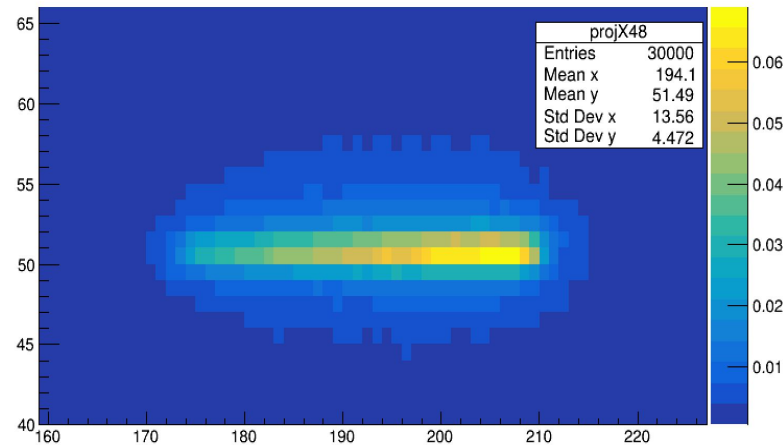
Adding the Field Cage
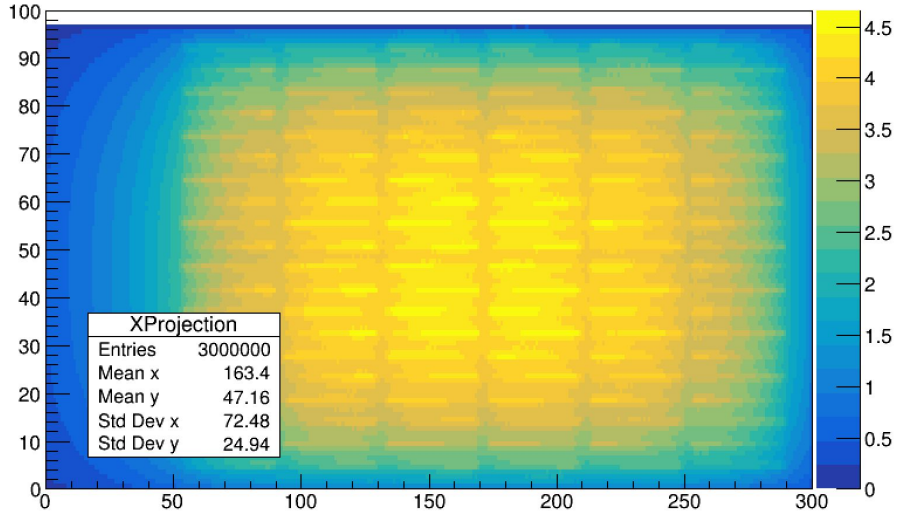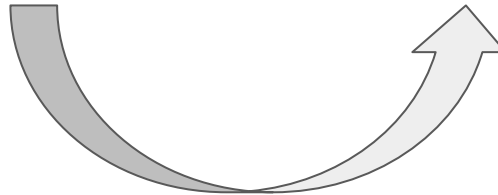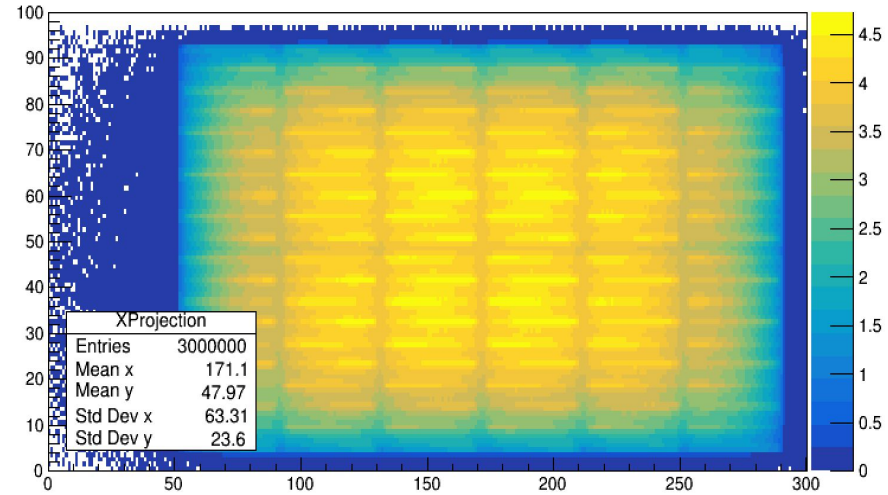
Change in the
Std Photon Library