

# Semi-parametric Monte Carlo of Photons in GlueX

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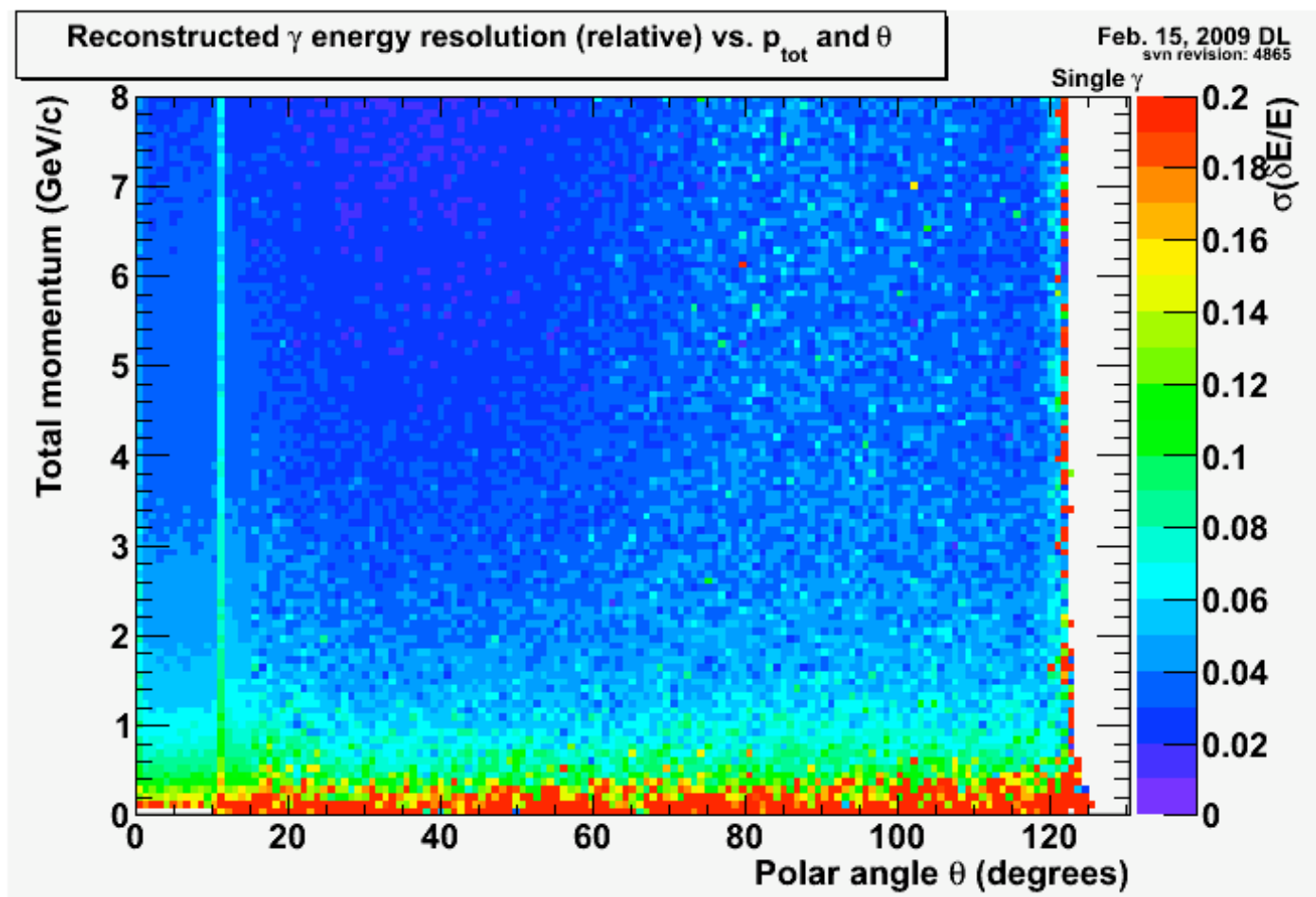
# Motivation

- New collaborators are interested in doing simulations of the GlueX detector to test new physics possibilities in Hall-D
- Tracking code is simply not yet capable of doing full reconstruction of multi-track events with backgrounds, multiple scattering etc. ...
- Estimates can be made of the detector response for multi-track events using single track efficiencies and resolutions
- If charged particle tracking is done semi-parametrically, then it makes sense to do photon reconstruction that way as well

# The *hdparsim* Project

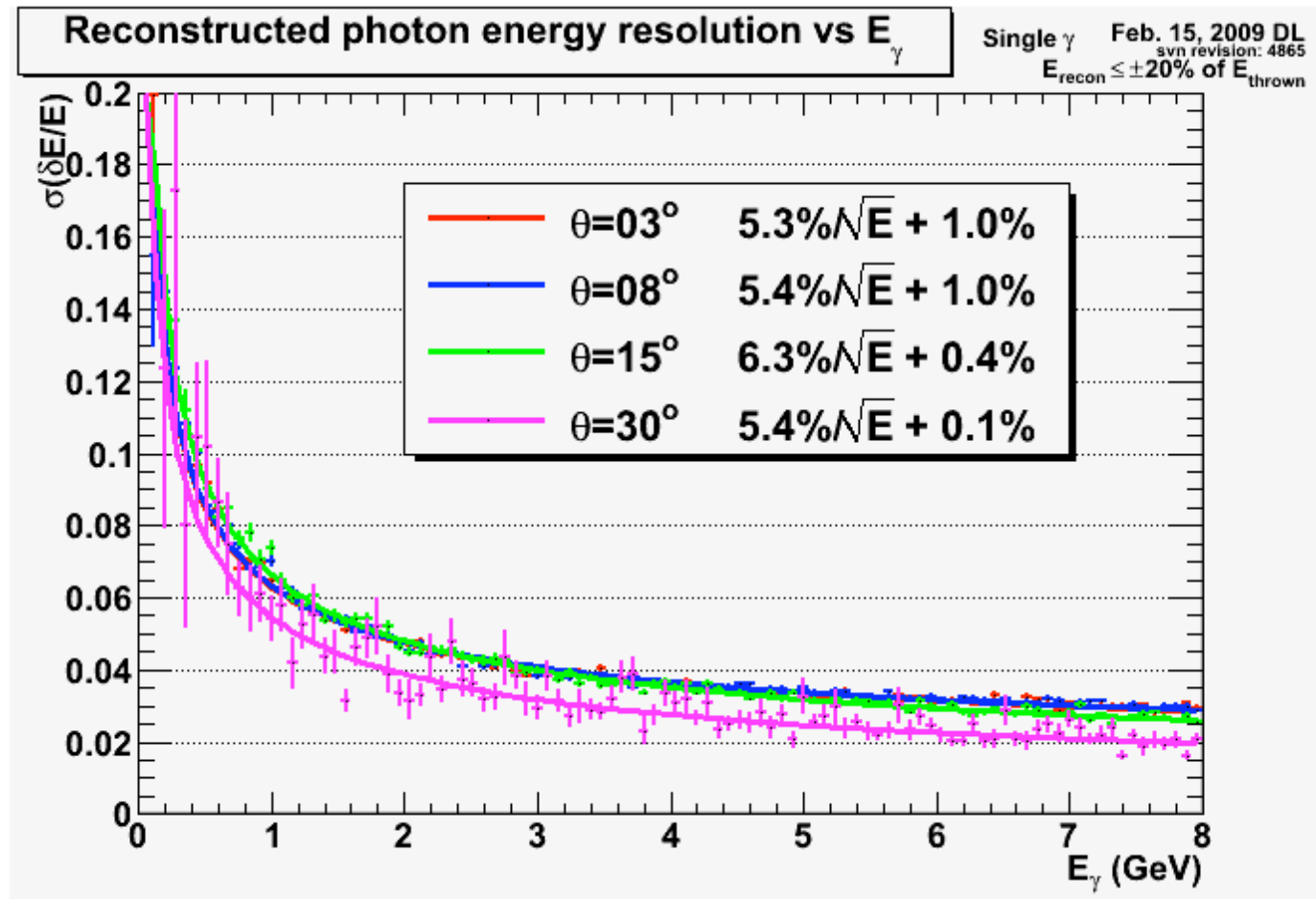
- The *hdparsim* plugin takes tables of energy resolution, angular resolutions, and efficiencies that are stored in ROOT files and uses them to smear generated values
- Source code is kept here:  
<https://halldsvn.jlab.org/repos/trunk/src/programs/Simulation/plugins/hdparsim>
- Resolution tables are available on the web, and automatically downloaded when the plugin is used.

# Reconstructed Photon Energy Resolution from *hdgeant* and *DPhoton*



3.2M single photon events were simulated with energies from 0 to 8 GeV and polar angles from  $0^\circ$  to  $140^\circ$

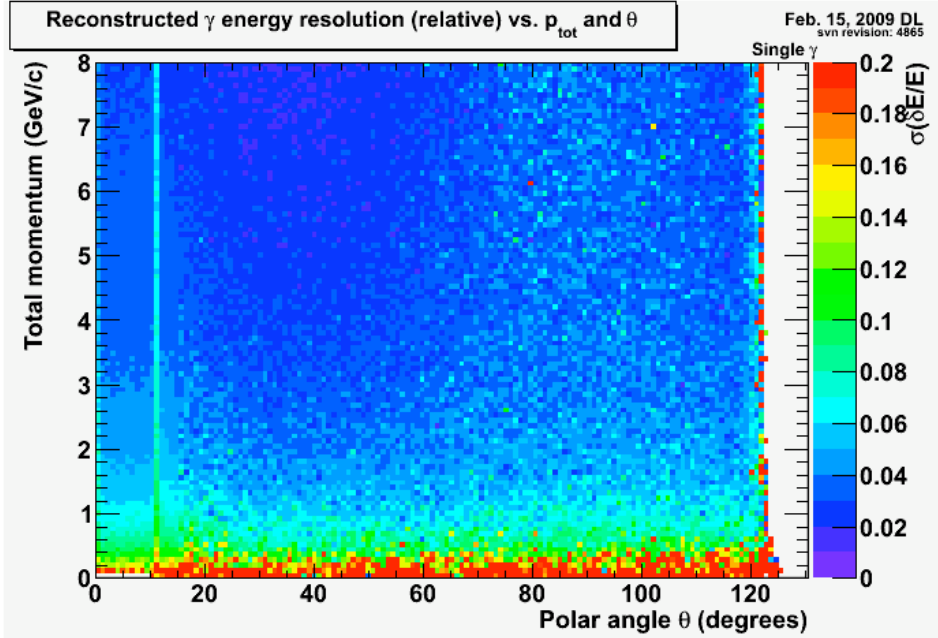
# Energy resolution for few theta bins



# Energy Resolution

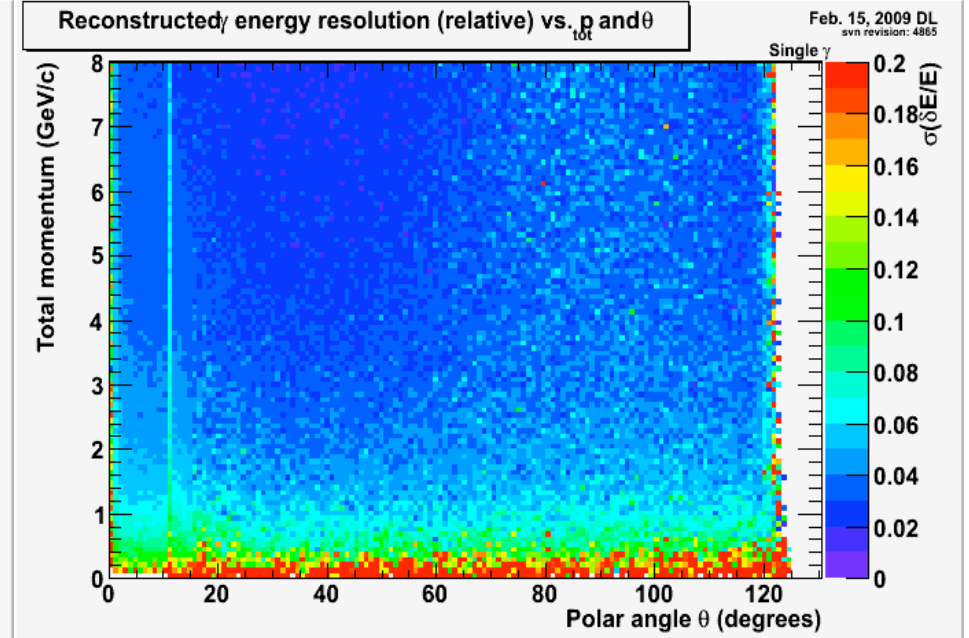
3.2M photons simulated  
and reconstructed

*hdgeant*



100M photons parametrically  
simulated using *hdgeant*  
derived resolutions

*hdparsim*

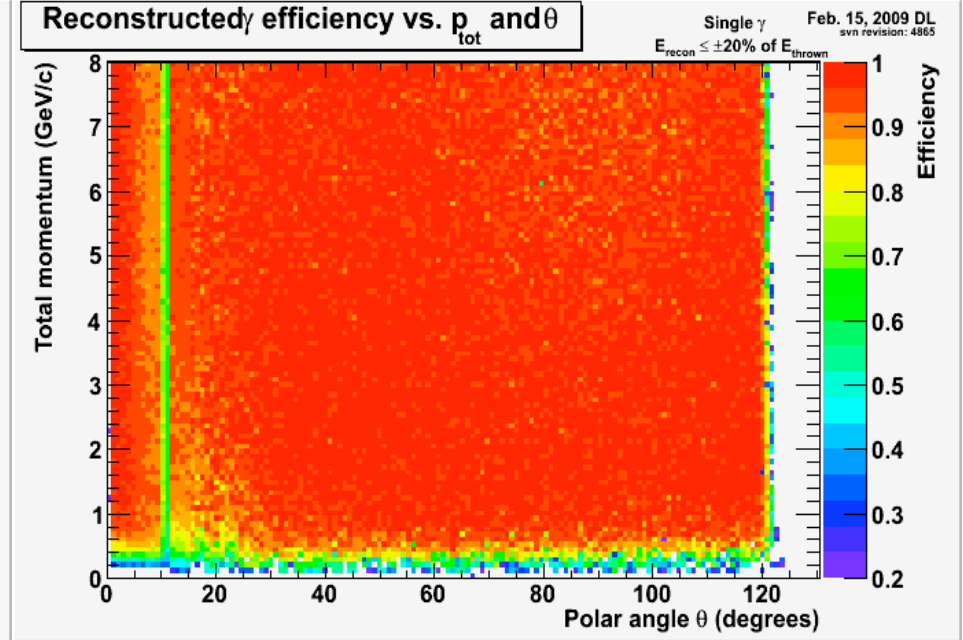
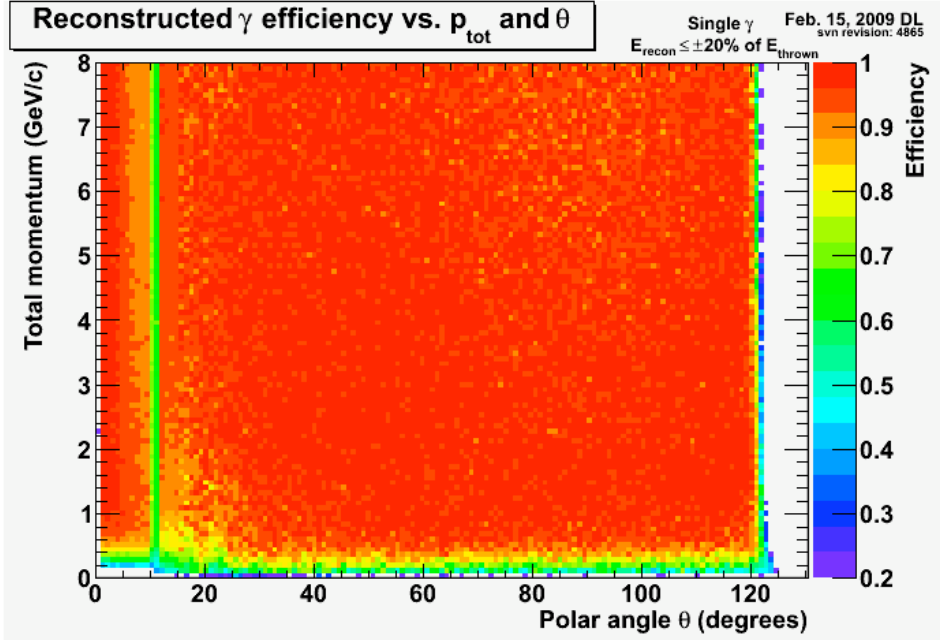


# Reconstruction Efficiency

Photon considered found if reconstructed energy was within +/- 20% of thrown

*hdgeant*

*hdparsim*

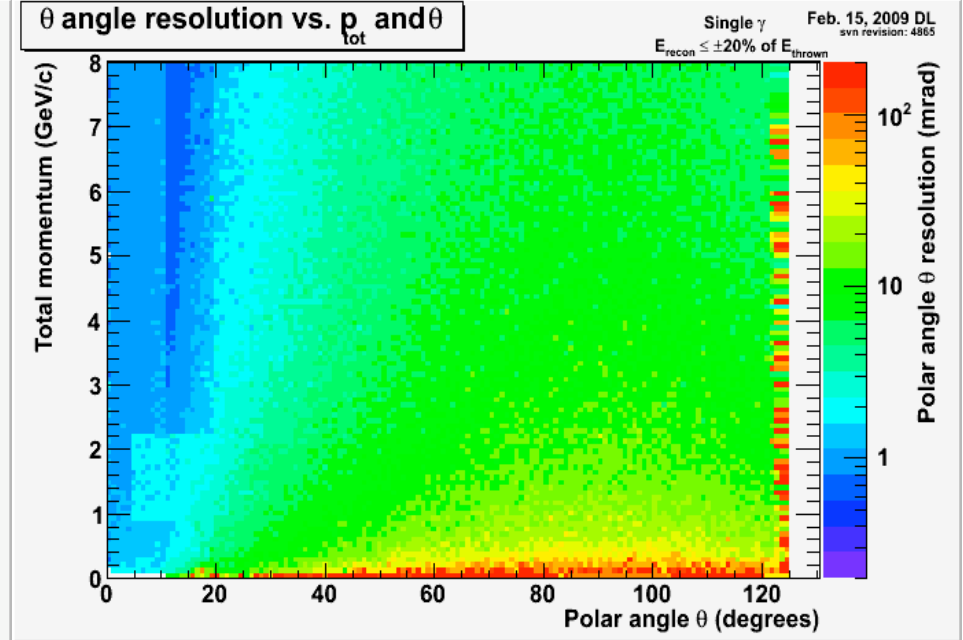
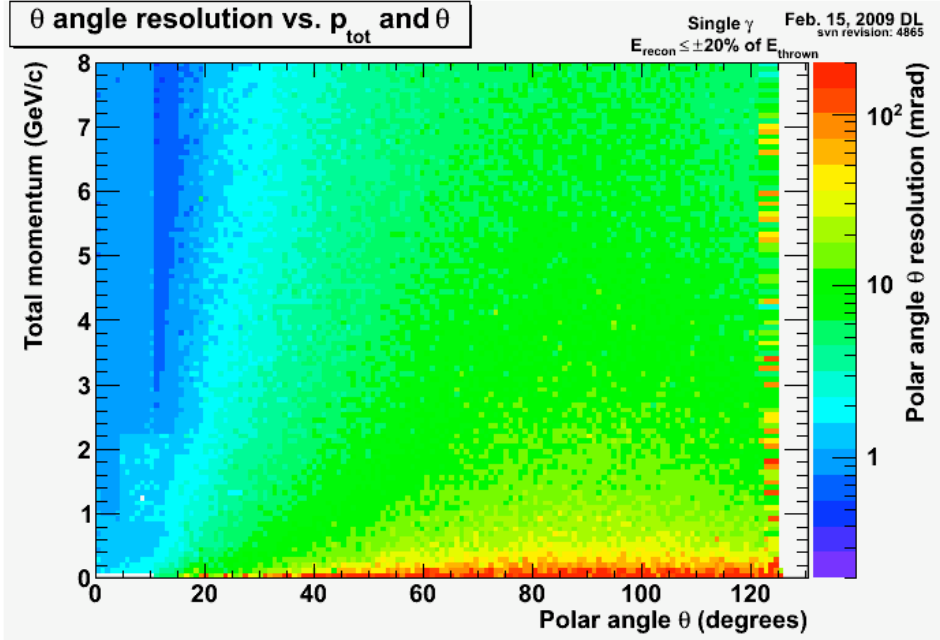


# Polar Angle Resolution

*hdgeant*

Note the z-axis is a  
log scale in mrad

*hdparsim*



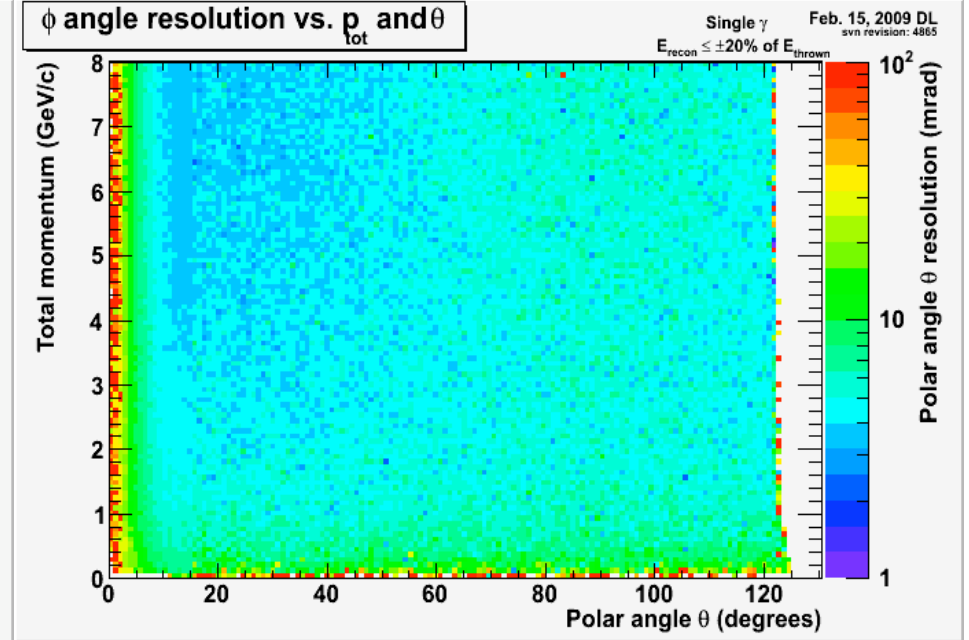
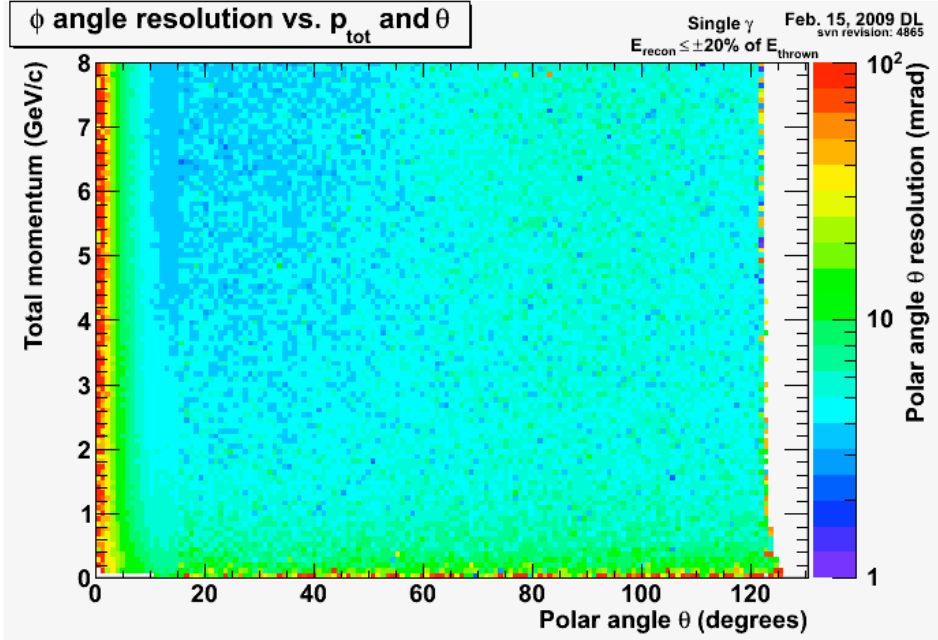


# Azimuthal Angle Resolution

*hdgeant*

Note the z-axis is a  
log scale in mrad

*hdparsim*



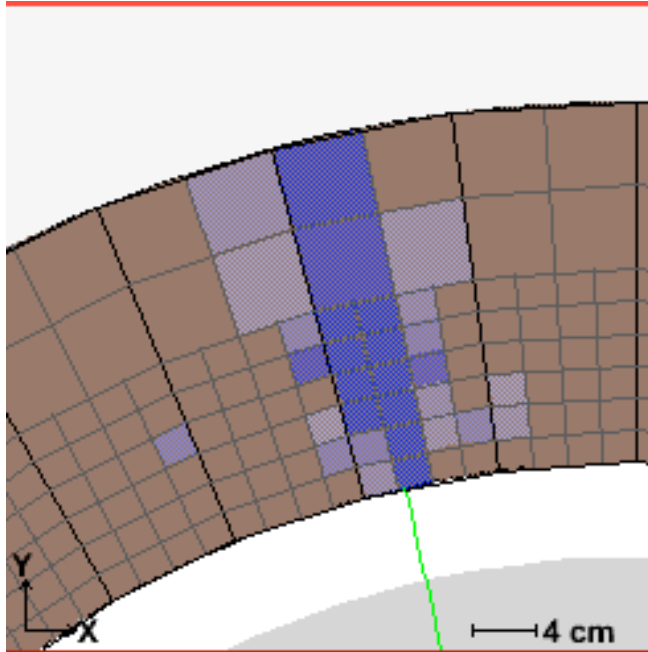
# Performance

- It took about 35 minutes to produce a file of 100M generated events with 1 photon each on my laptop
- It took about 20 minutes to process all 100M events with *hdparsim*

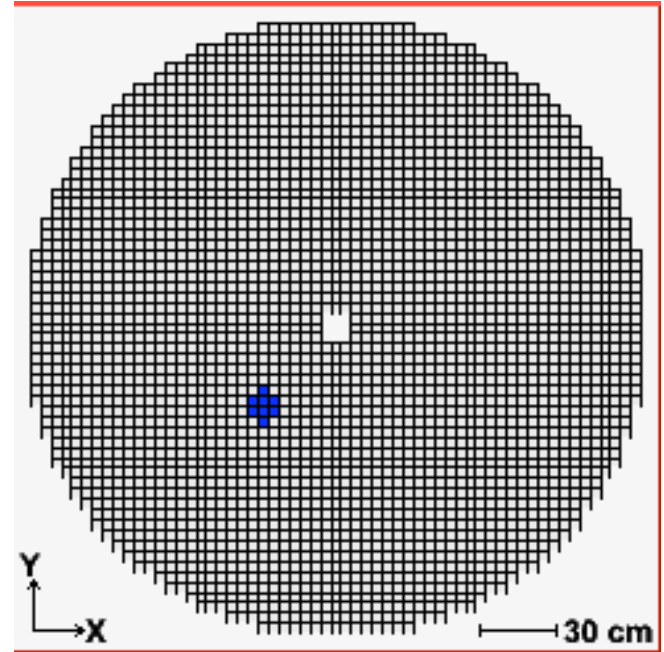
```
264 Feb 15 09:42 run_test.csh
593454704 Feb 15 09:46 genphoton.ascii
1320005967 Feb 15 10:17 output.hddm
660854 Feb 15 10:17 hd_res_photon.root ← downloaded
646808612 Feb 15 10:38 hd_root.root
```

# Calorimeters in Event Viewer

BCAL drawing in *hdview2*



FCAL drawing in *hdview2*



Track Info

Thrown						
trk:	type:	p:	theta:	phi:	z:	
1	gamma	0.8	60	5.989	65	
---	---	---	---	---	---	
---	---	---	---	---	---	
---	---	---	---	---	---	
---	---	---	---	---	---	

Reconstructed						
trk:	type:	p:	theta:	phi:	z:	DPhoton:
1	q=0	0.781	59.57	6.005	65	<input type="text" value="DPhoton"/>
---	---	---	---	---	---	
---	---	---	---	---	---	
---	---	---	---	---	---	
---	---	---	---	---	---	

*DPhoton* can now be selected at bottom of window to compare thrown to reconstructed parameters

# Summary

- The reconstructed photon resolutions have been mapped out using *hdgeant* and the *DPhoton* objects in DANA
- The resolution tables have been incorporated in the *hdparsim* plugin and can be used for fast prototyping (charged particles are forthcoming)
- Tables can be updated with design changes or more realistic simulations (dark pulses, extended target, ...)