

# Recent results on Lambda - AntiLambda mass reconstruction with PANDA GEM-Tracker

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# Motivation

- To investigate the invariant mass reconstruction for the  $\text{anti}p + p \rightarrow \Lambda^0 + \text{anti}\Lambda^0$  as an important hyperonic channel using PANDA GEM-Tracker.
- This channel has been chosen since Lambda is the lightest hyperon, which is easiest to produce and all final state particles are charged and most of them are flighted in the forward directions.

Benchmark channel including :  $\text{anti}p + p \rightarrow \Lambda^0 + \text{anti}\Lambda^0$

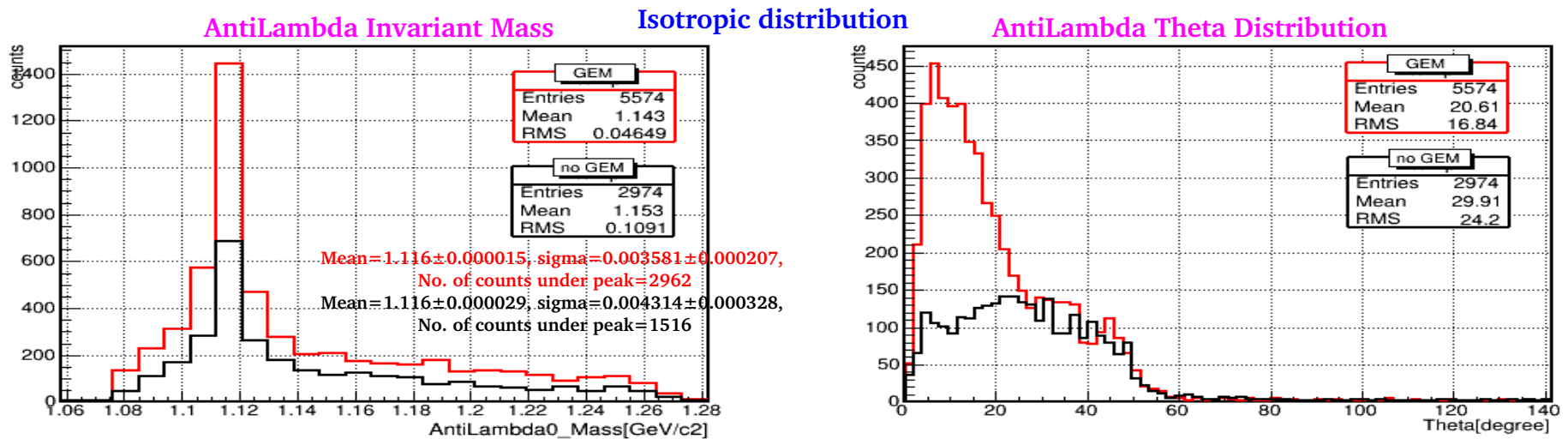
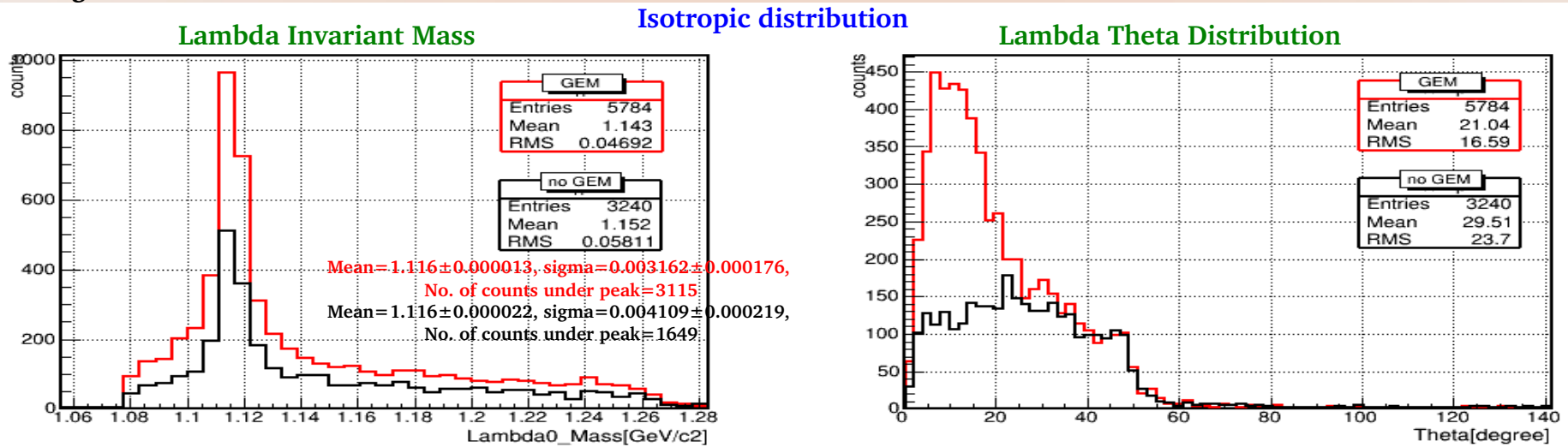
$\Lambda^0 \rightarrow p^+ \ \& \ \pi^-$

$\text{Anti}\Lambda^0 \rightarrow p^- \ \& \ \pi^+$

The exact mass value of the  $\Lambda^0$  and  $\text{anti}\Lambda^0$  :  
 $1115.683 \pm 0.006 \text{MeV}/c^2$

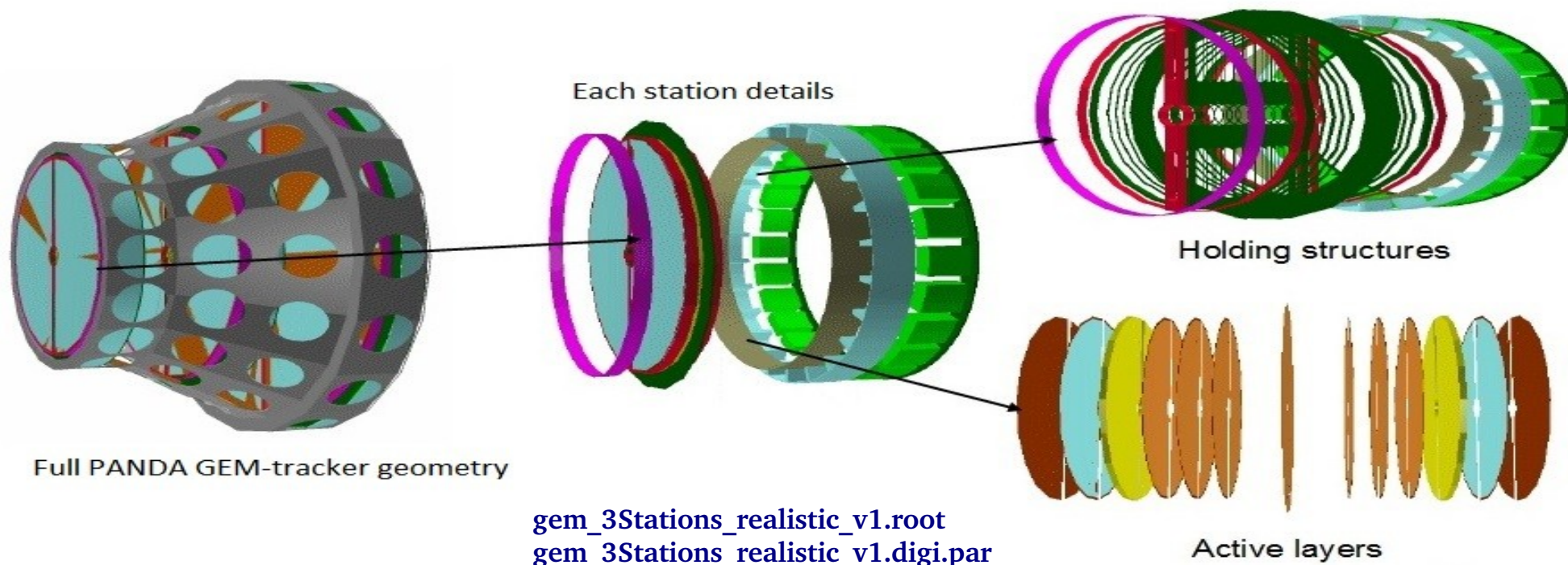
# Reminder: Investigation of Lambda – Anti Lambda Invariant Mass Reconstruction

- The simulation condition:
- No. of Events=10000, SimEngine =TGeant4, Event generator=EvtGen,
- Beam Momentum= 5 [GeV/c]
- without and with GEM full geometry
- Using PndBarrelTrackFinder class (realistic pattern recognition) and using PIDAlgoMVD,STT,DRC
- Using Revision: 29377 of PandaRoot



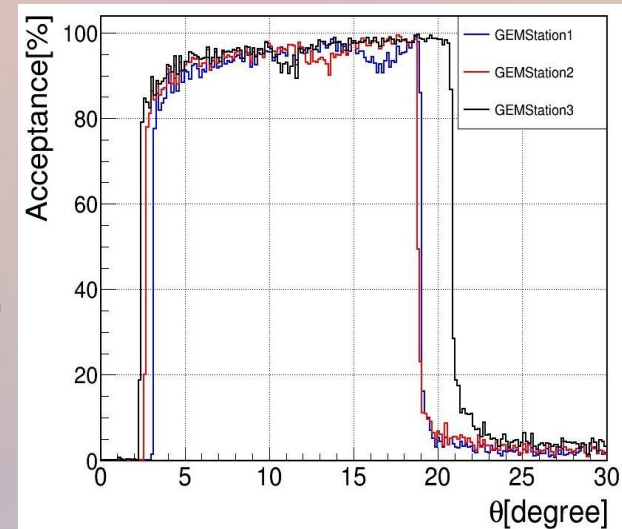
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# PANDA GEM-Tracking Detector



## The simulation condition:

- No. of Events= 10000
- SimEngine = TGeant4
- Event generator= EvtGen
- Beam Momentum= 2, 3, 5 [GeV/c]
- Isotropic distribution and boosted distribution (forward peaking)
- PANDA setup without and with full geometry of the GEM
- Using `PndBarrelTrackFinder` class (realistic pattern recognition)
- Using PIDAlgoMVD, STT, DRC, DISC, EMC, MDT, TOF
- Using Revision: 29629 of PandaRoot



# Decay File for Forward Peaking

noPhotos

Decay pbarpSystem

1.0 Lambda0 anti-Lambda0 LambdaLambdaBar (beam momentum);  
Enddecay

Decay Lambda0

1.0 p+ pi- PHSP;

Enddecay

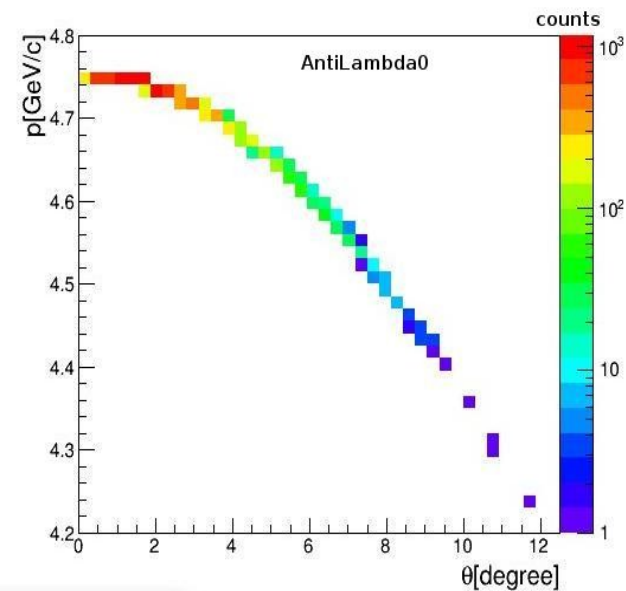
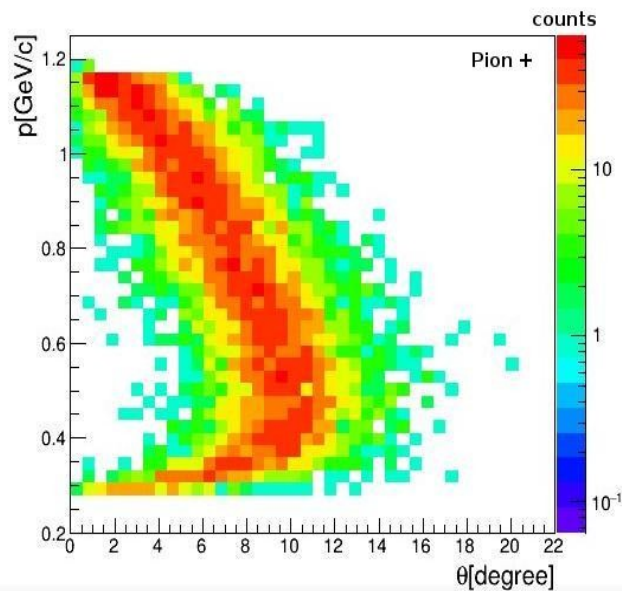
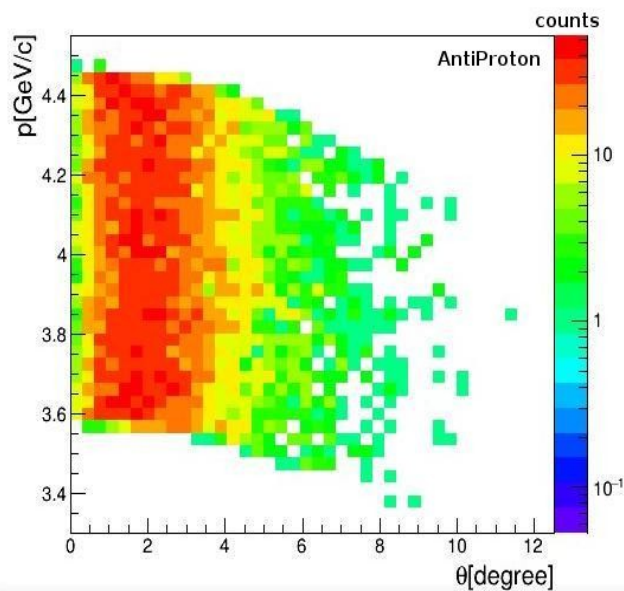
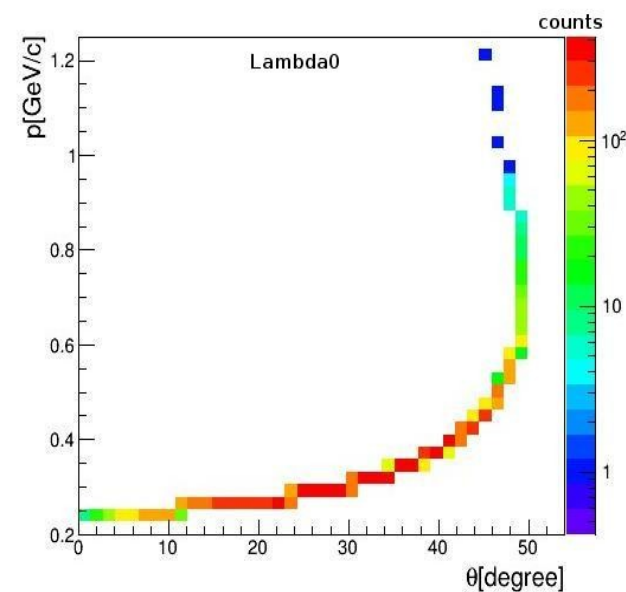
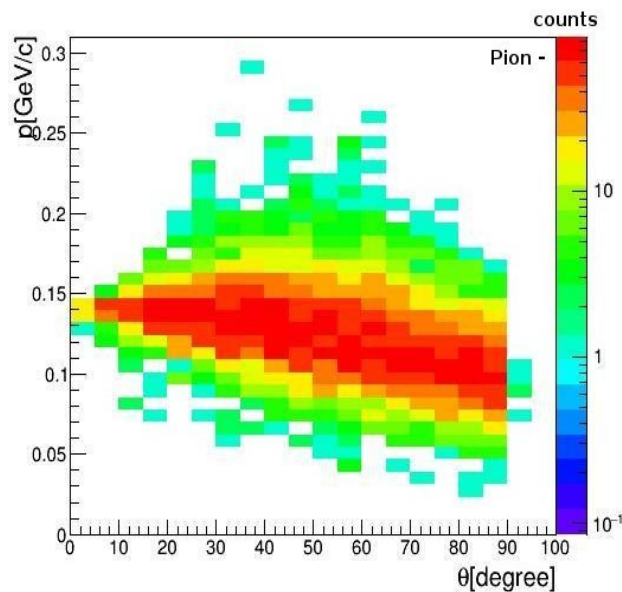
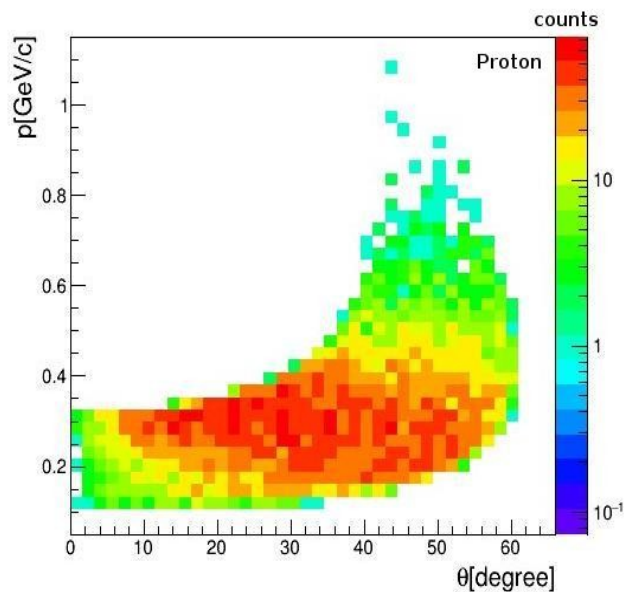
Decay anti-Lambda0

1.0 anti-p- pi+ PHSP;

Enddecay

End

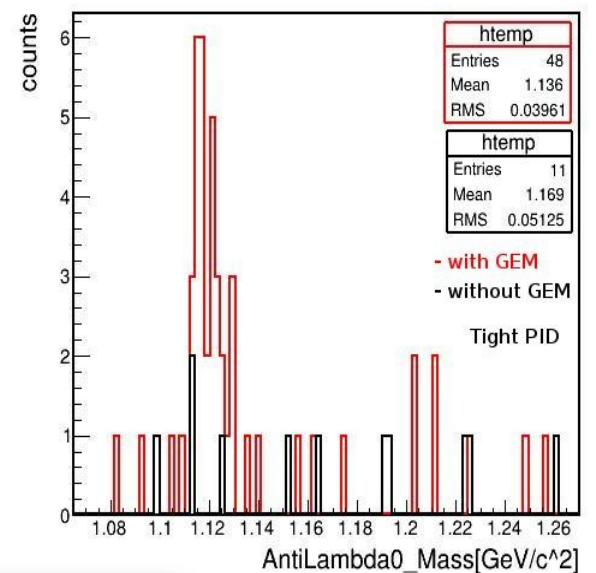
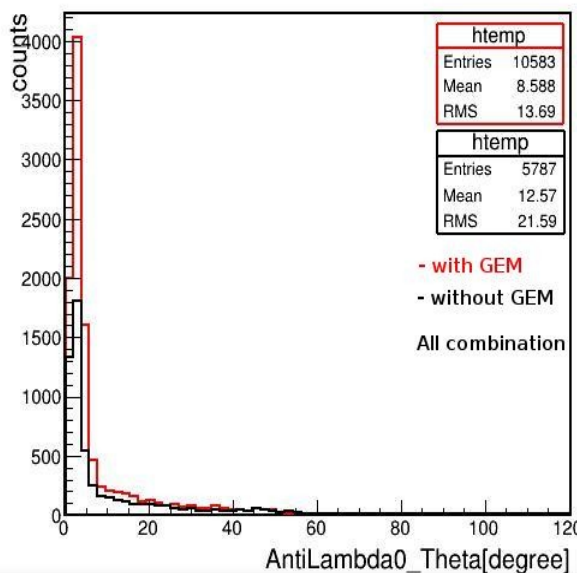
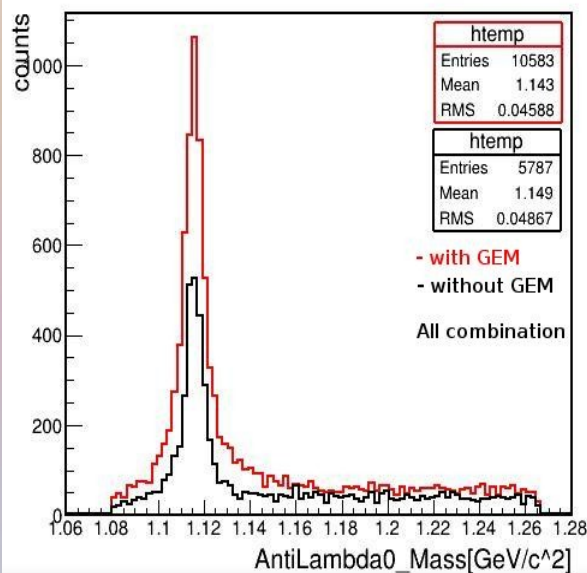
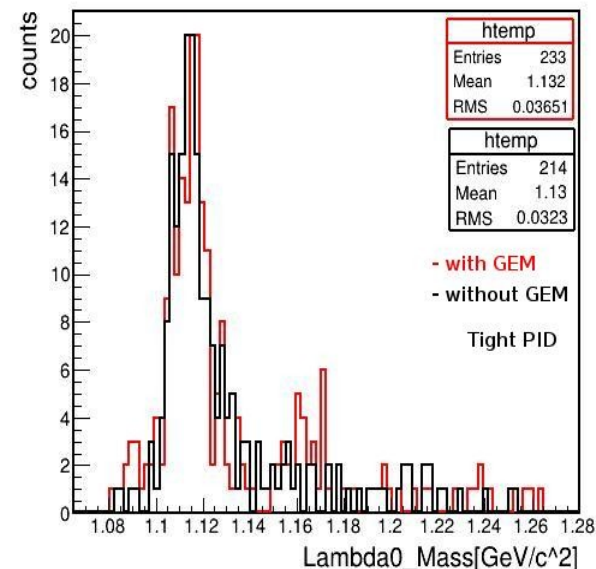
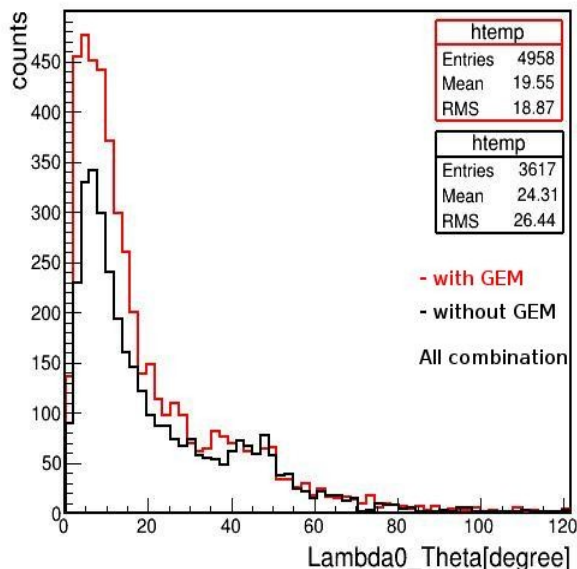
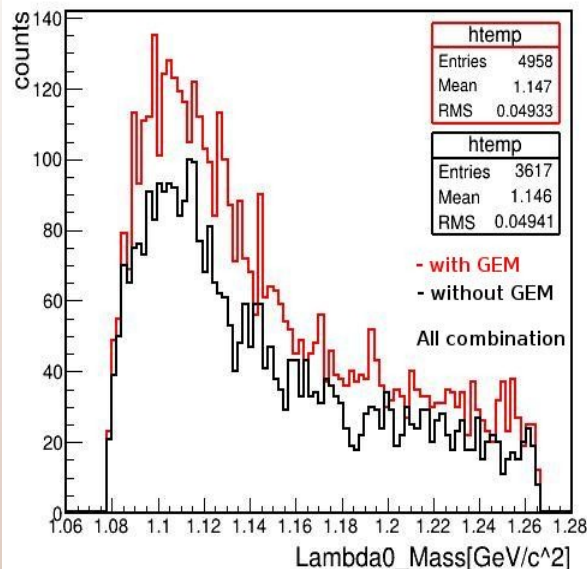
# Beam Momentum = 5 GeV/c , Boosted distribution (Forward Peaking) , p vs $\theta$



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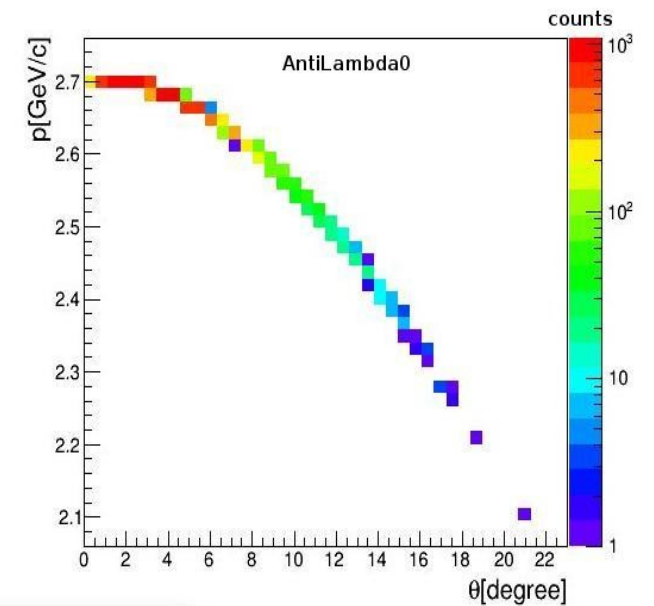
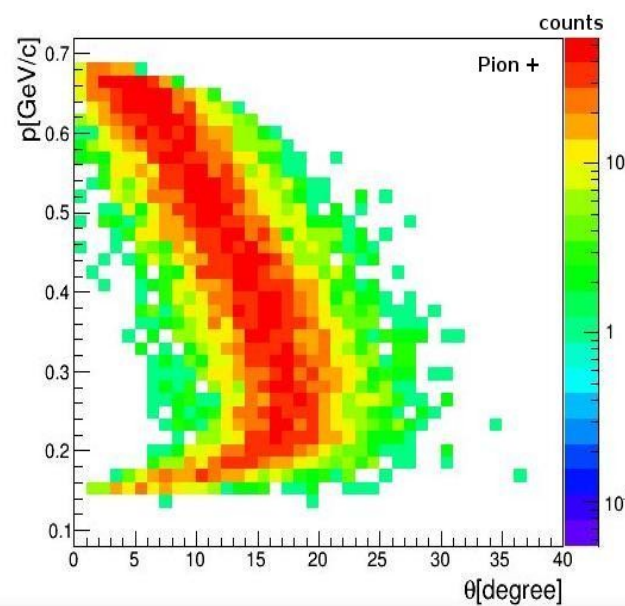
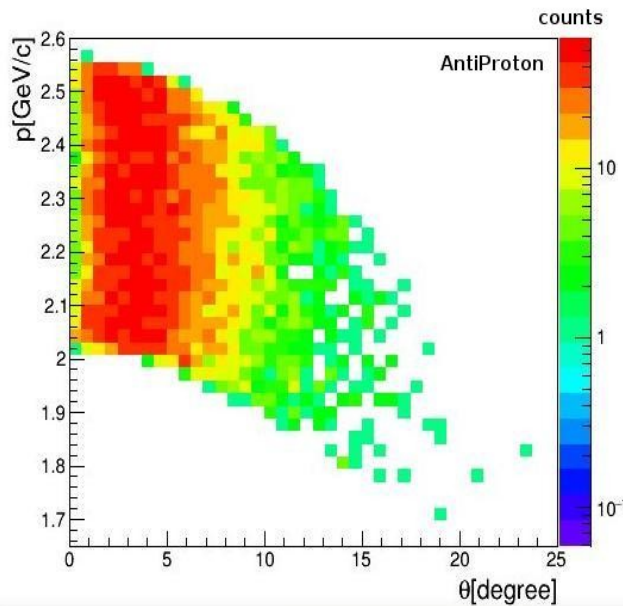
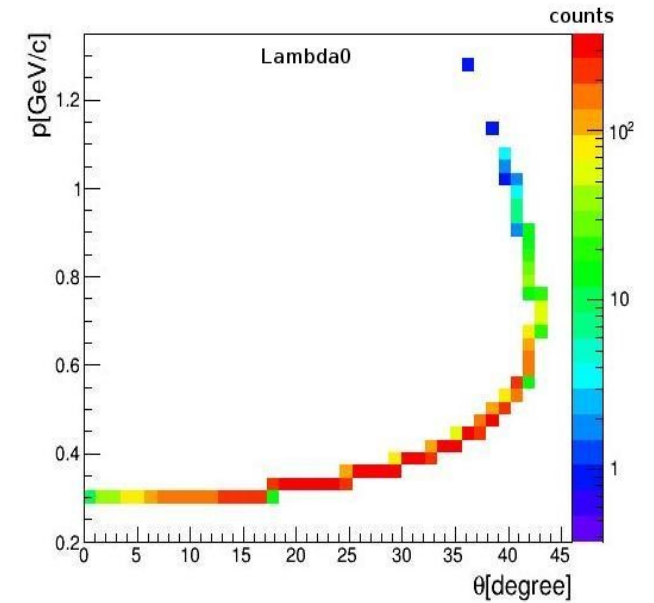
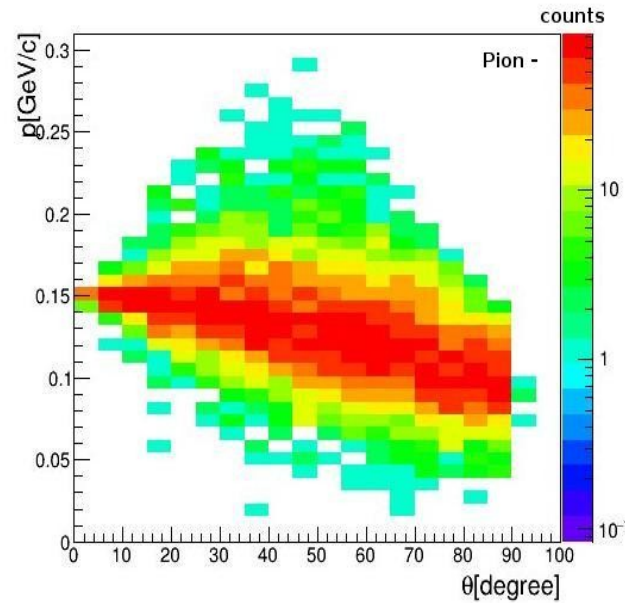
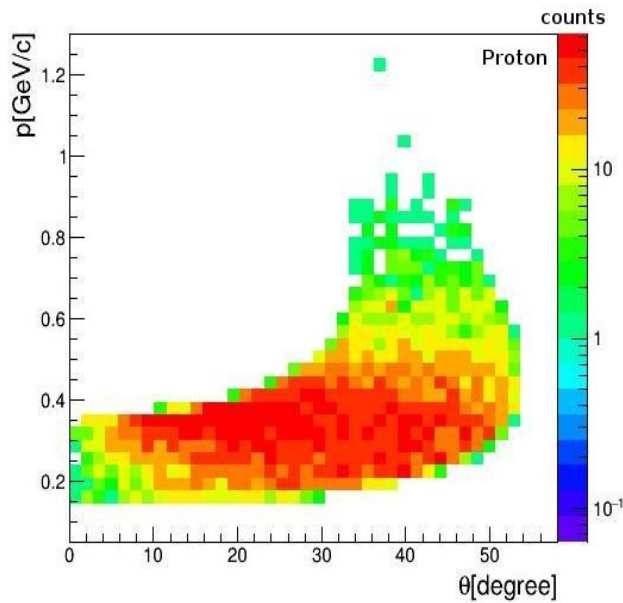
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# Beam Momentum = 5GeV/c , Boosted distribution (Forward Peaking)



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# Beam Momentum = 3GeV/c , Boosted distribution (Forward Peaking), p vs $\theta$

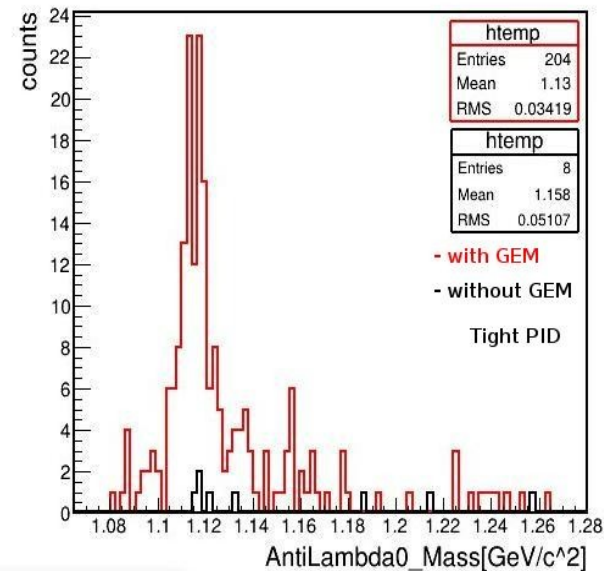
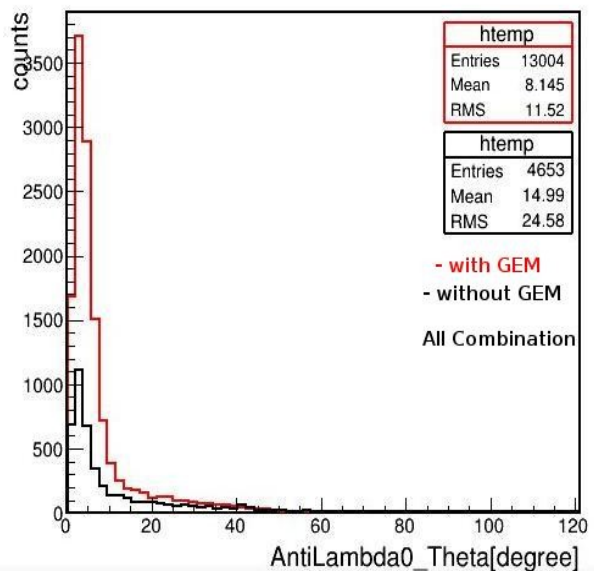
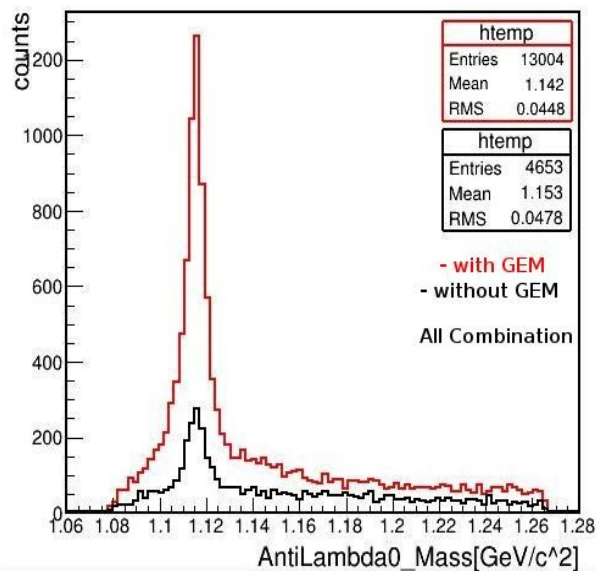
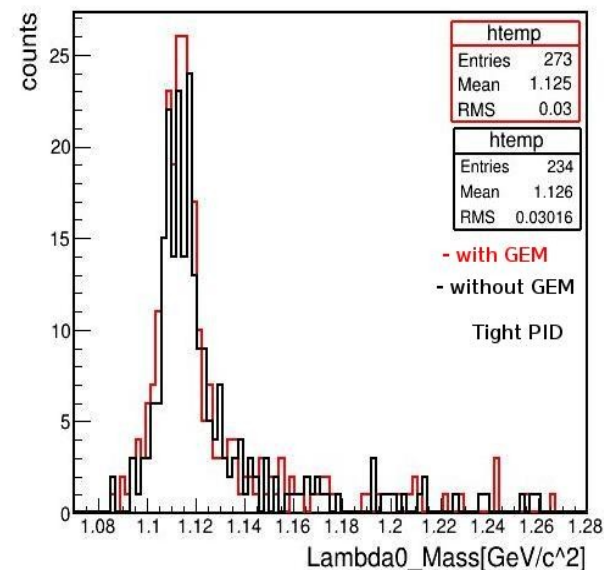
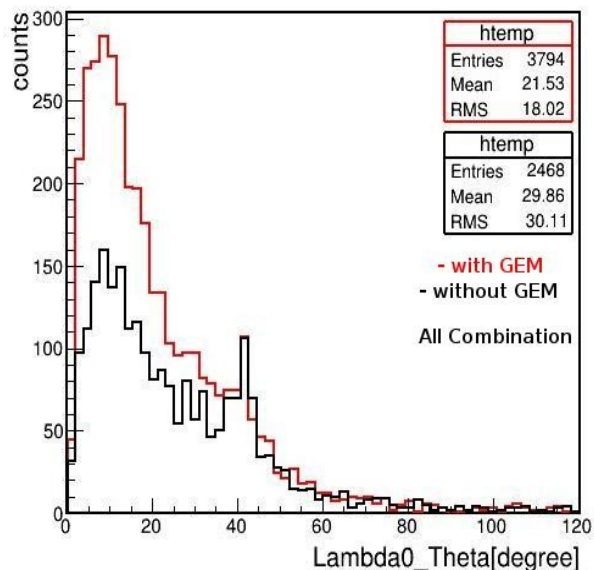
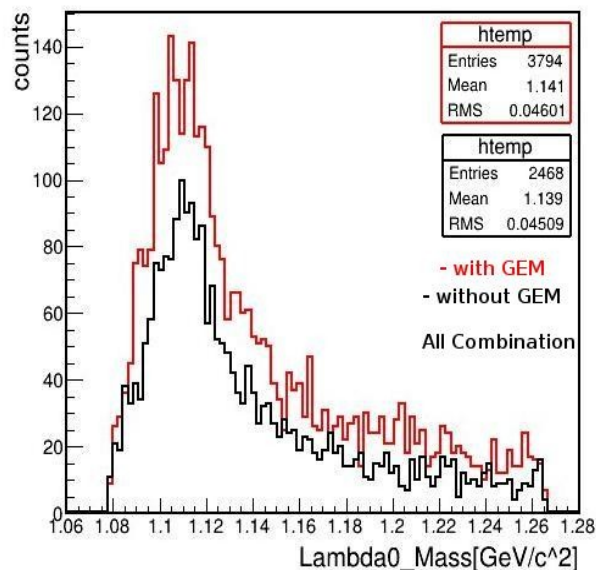


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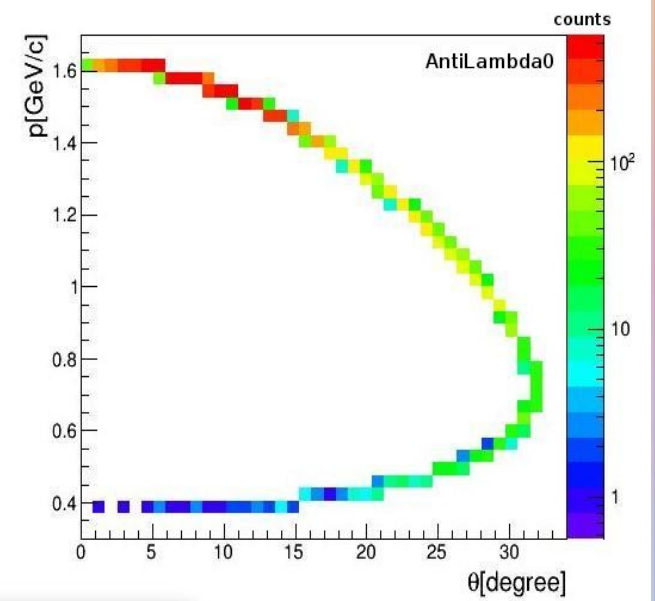
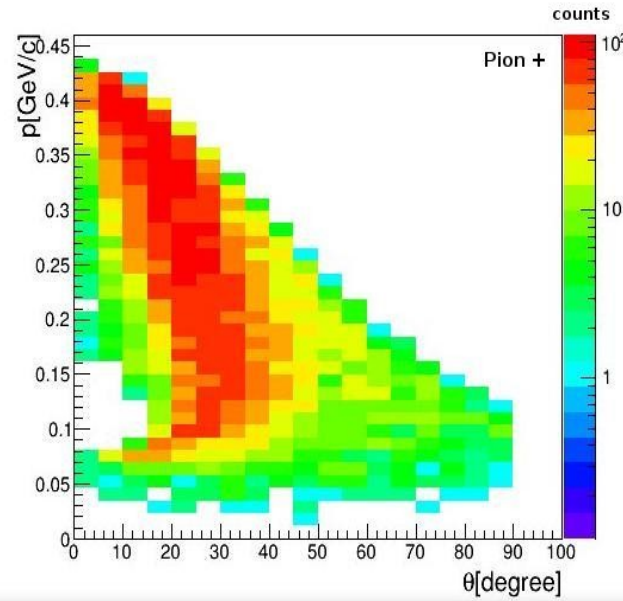
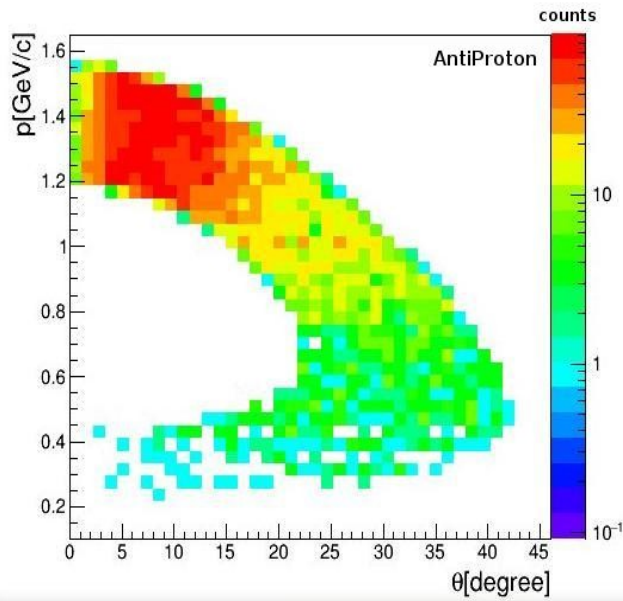
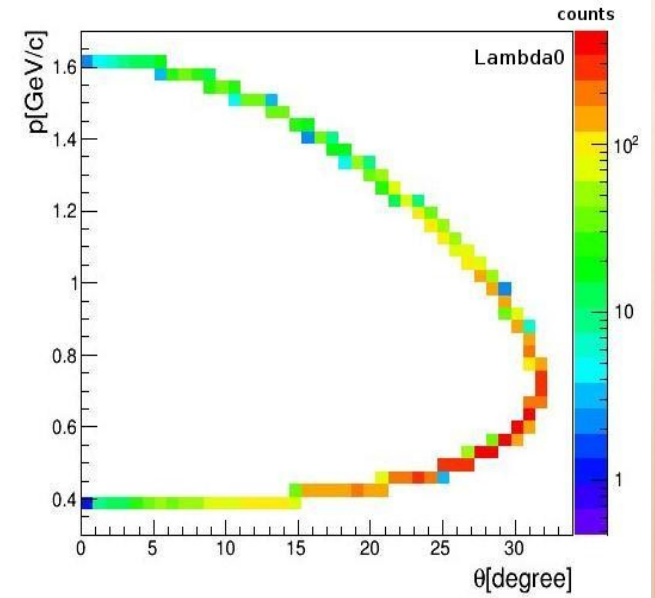
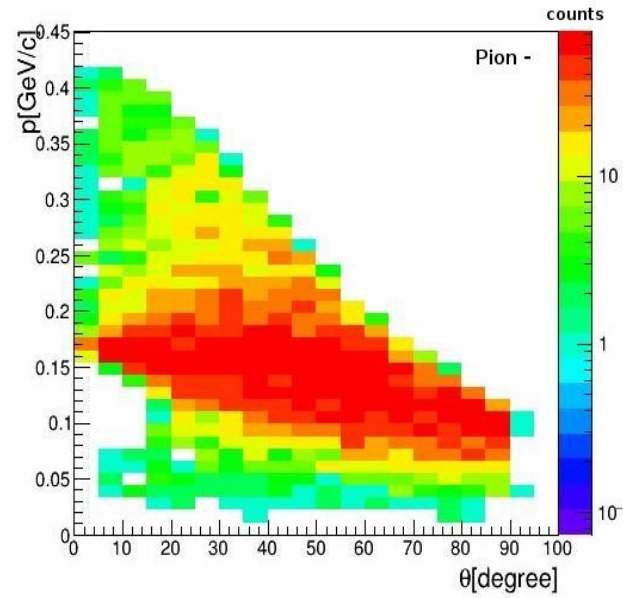
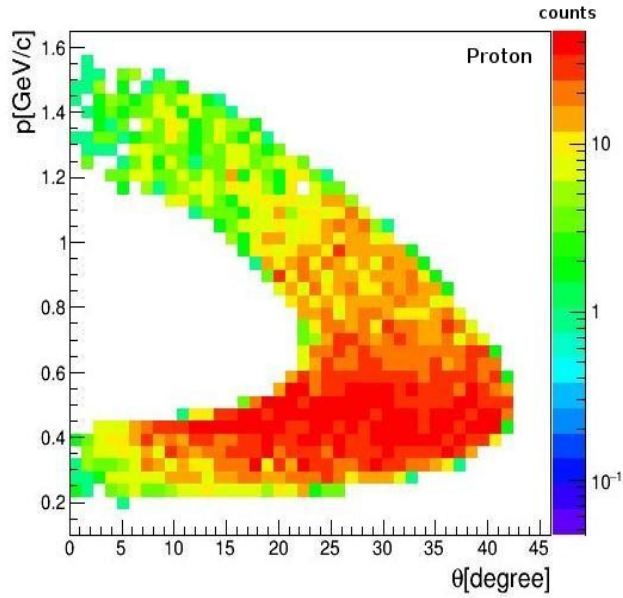


# Beam Momentum = 3GeV/c , Boosted distribution (Forward Peaking)



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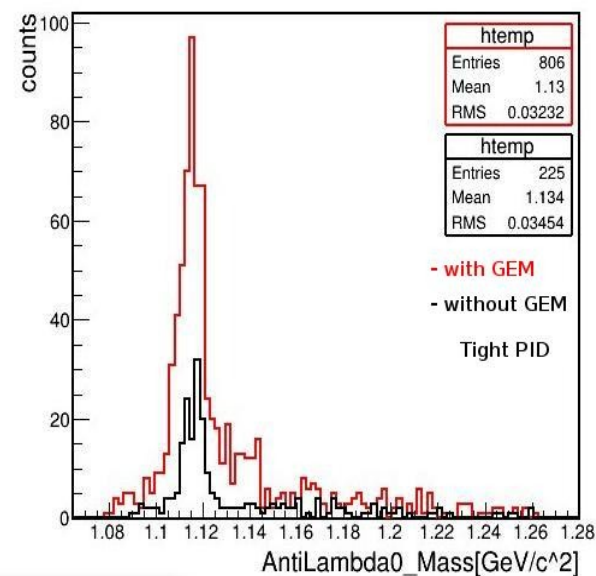
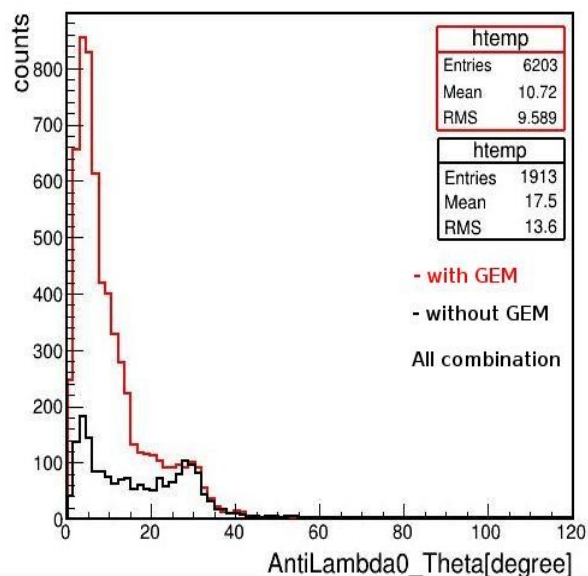
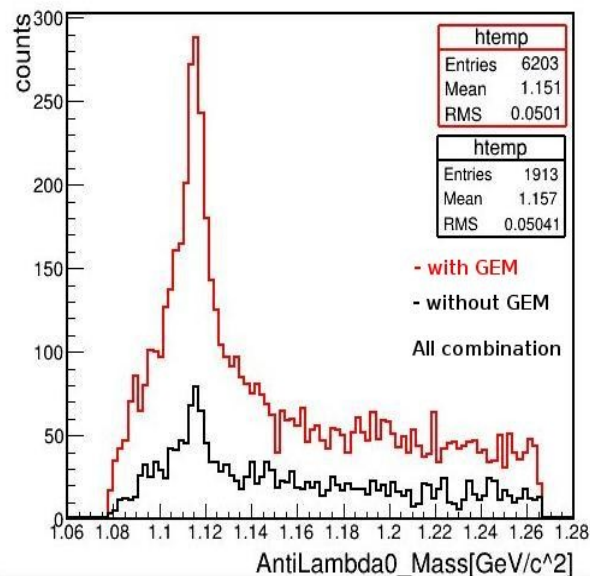
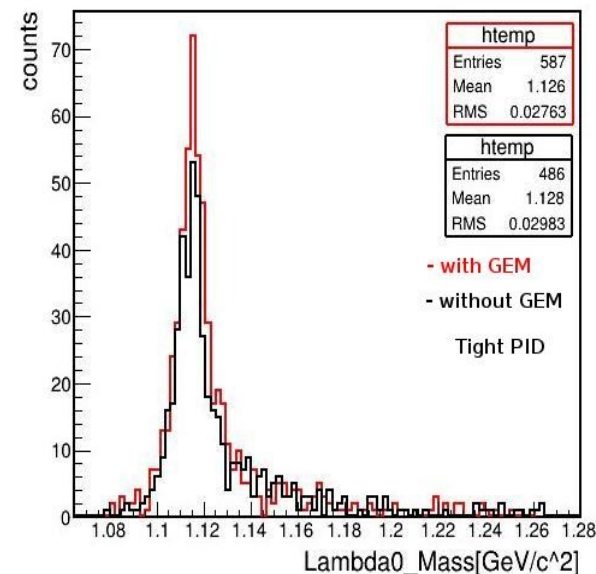
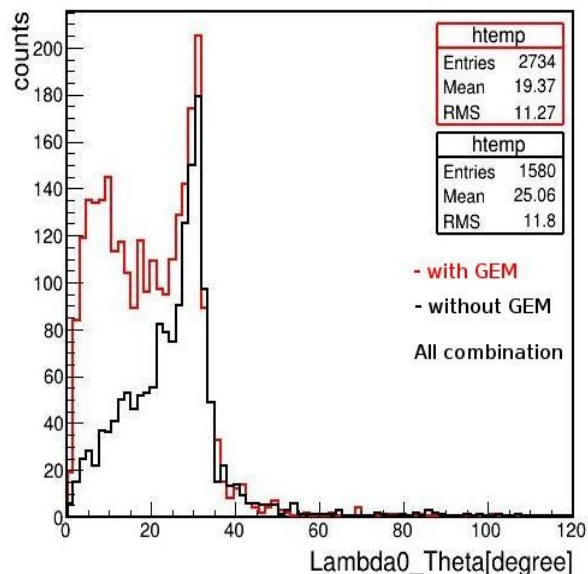
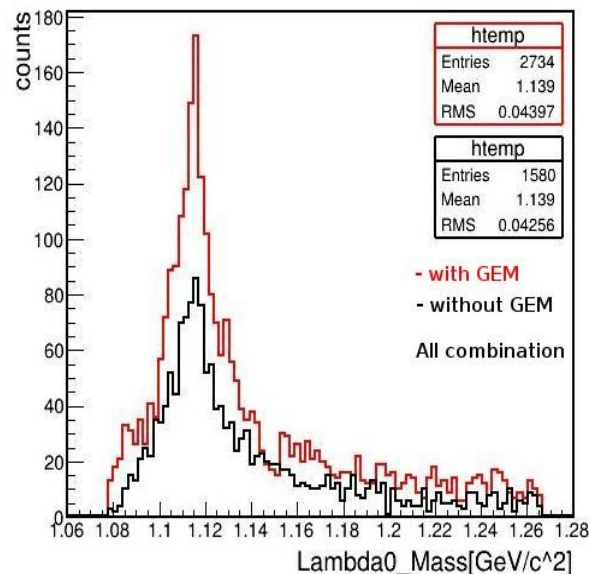
# Beam Momentum = 2GeV/c , Boosted distribution (Forward Peaking), p vs $\theta$



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# Beam Momentum = 2GeV/c , Boosted distribution (Forward Peaking)



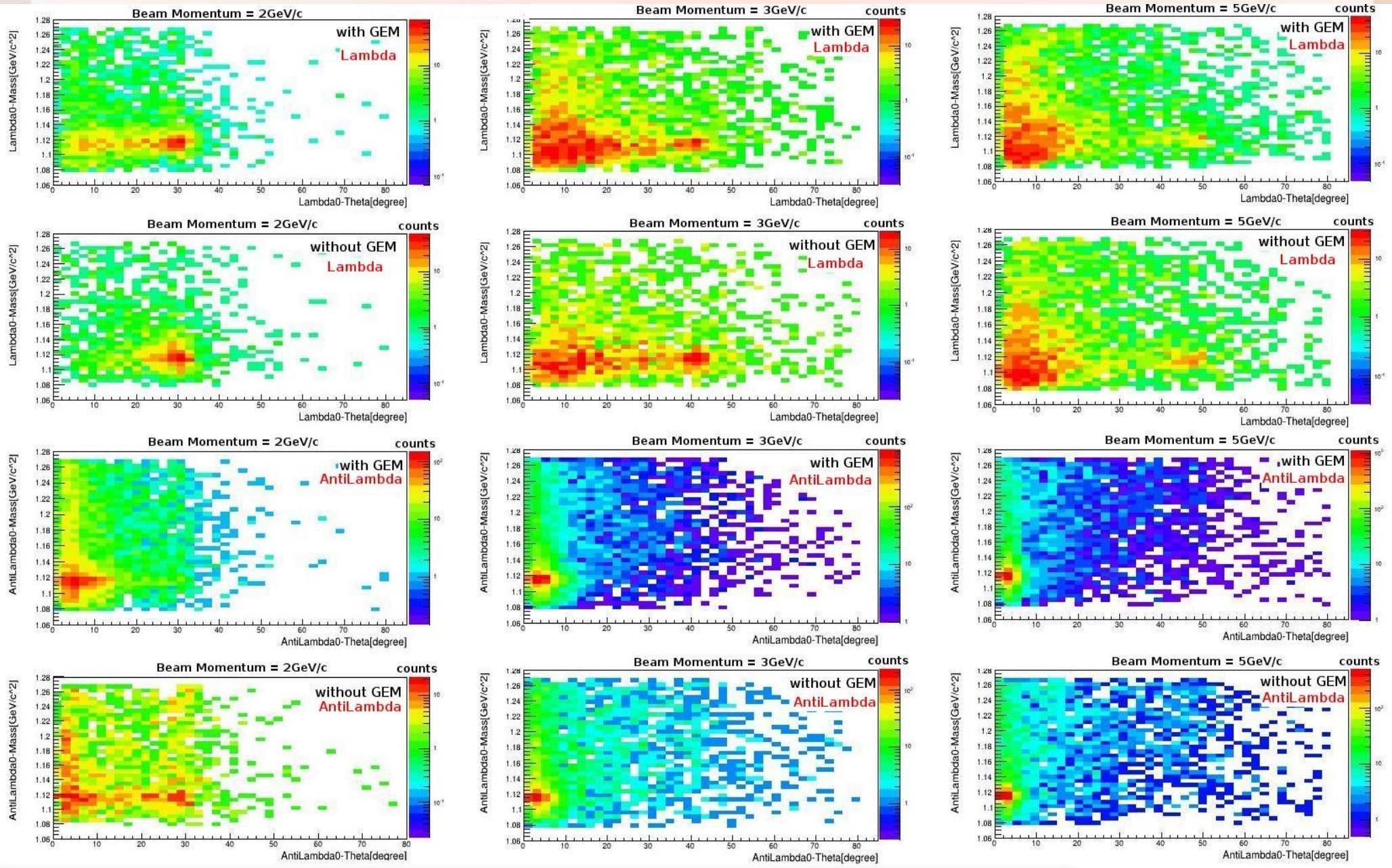
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# Beam Momentum = 2, 3, 5GeV/c , Boosted distribution (Forward Peaking)

Mass Resolution For Boosted Distribution All combination of particles		Realistic Pattern Recognition: <b>BarrelTF</b>			
		Reconstructed <b>Lambda</b>		Reconstructed <b>AntiLambda</b>	
Value	Mom	With fullGEM	noGEM	With fullGEM	noGEM
Mean	2GeV/c	1.11483± 3.55e-04	1.11448± 6.70e-04	1.11521± 2.54e-04	1.11508± 4.41e-04
	3GeV/c	1.11021± 6.19e-04	1.10986± 7.27e-04	1.11556± 1.31e-04	1.11543± 2.11e-04
	5GeV/c	1.10908± 1.06e-03	1.10595± 1.88e-04	1.11628± 1.18e-03	1.10629± 1.02e-04
Sigma	2GeV/c	7.00e-03± 5.74e-04	9.39e-03± 1.08e-03	4.82e-03± 4.12e-04	5.70e-03± 6.76e-04
	3GeV/c	1.16e-02± 9.15e-04	1.46e-02± 1.24e-03	4.25e-03± 1.64e-04	5.08e-03± 2.59e-04
	5GeV/c	2.73e-02± 2.07e-03	4.57e-03± 2.08e-04	2.44e-02± 2.39e-03	4.42e-03± 1.12e-04
Number of counts under peak	2GeV/c	1359	769	2340	613
	3GeV/c	1514	1041	6940	1802
	5GeV/c	1546	1154	5950	2967

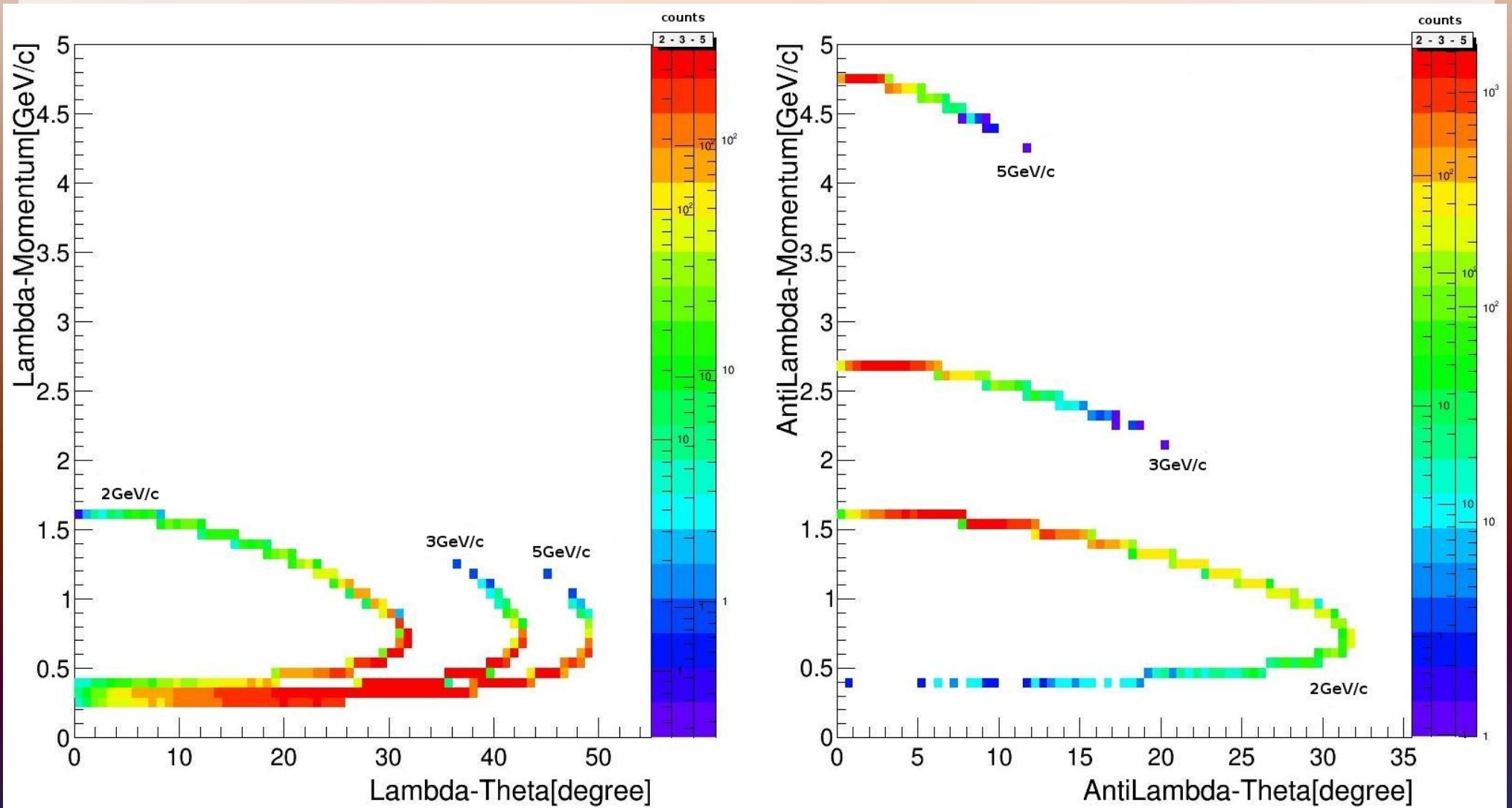
# Beam Momentum = 2, 3, 5 GeV/c , Boosted distribution (Forward Peaking) , mass vs $\theta$



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# Beam Momentum = 2, 3, 5 GeV/c , Boosted distribution (Forward Peaking) , $p$ vs $\theta$



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# Beam Momentum = 2, 3, 5 GeV/c , Reconstructed Efficiency[%]

For Boosted Distribution (Tight PID Checking)		Realistic Pattern Recognition: <b>SttMvdGemT</b>				Realistic Pattern Recognition: <b>BarrelTF</b>			
		Reconstructed Lambda Efficiency[%]		Reconstructed AntiLambda Efficiency[%]		Reconstructed Lambda Efficiency[%]		Reconstructed AntiLambda Efficiency[%]	
Algo	Mom	With fullGEM	noGEM	With fullGEM	noGEM	With fullGEM	noGEM	With fullGEM	noGEM
Realistic Particle Identification: <b>PidAlgoMSD</b>	2GeV/c	13.91	14.08	5.95	5.44	4.36	3.88	1.14	0.96
	3GeV/c	3.50	4.14	0.27	0.27	2.39	2.61	0.06	0.03
	5GeV/c	3.05	3.22	0.16	0.24	1.81	1.90	0.04	0.01
Realistic Particle Identification: <b>PidAlgoMSDDE</b>	2GeV/c	16.51	16.30	16.41	8.69	5.54	4.50	7.57	1.63
	3GeV/c	3.98	4.82	3.84	1.18	2.65	2.82	4.51	0.51
	5GeV/c	3.98	4.69	2.14	1.31	2.53	2.33	2.75	0.52
Realistic Particle Identification: <b>PidAlgoMSDDET</b>	2GeV/c	<b>17.51</b>	<b>16.63</b>	<b>18.59</b>	<b>9.44</b>	<b>5.80</b>	<b>4.58</b>	<b>8.53</b>	<b>1.85</b>
	3GeV/c	3.96	4.75	1.11	0.43	2.63	2.74	1.90	0.13
	5GeV/c	3.79	4.64	0.53	0.60	2.39	2.18	0.52	0.09
Realistic Particle Identification: <b>PidAlgoMSDDETM</b>	2GeV/c	17.16	16.62	18.54	9.52	5.82	4.58	8.56	1.85
	3GeV/c	3.98	4.77	1.11	0.42	2.62	2.74	1.88	0.13
	5GeV/c	3.78	4.64	0.55	0.60	2.39	2.18	0.54	0.08

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# Summary

- Study about forward peaking (boosted distribution) has done.
- It is good enough for AntiLambdas in the GEM region.
- Lambdas come from low momentum tracks and they have a large angular distribution.

## Questions:

- good channel for the GEM?
- PID for the GEM?
- good event generator for background study in case of forward peaking?

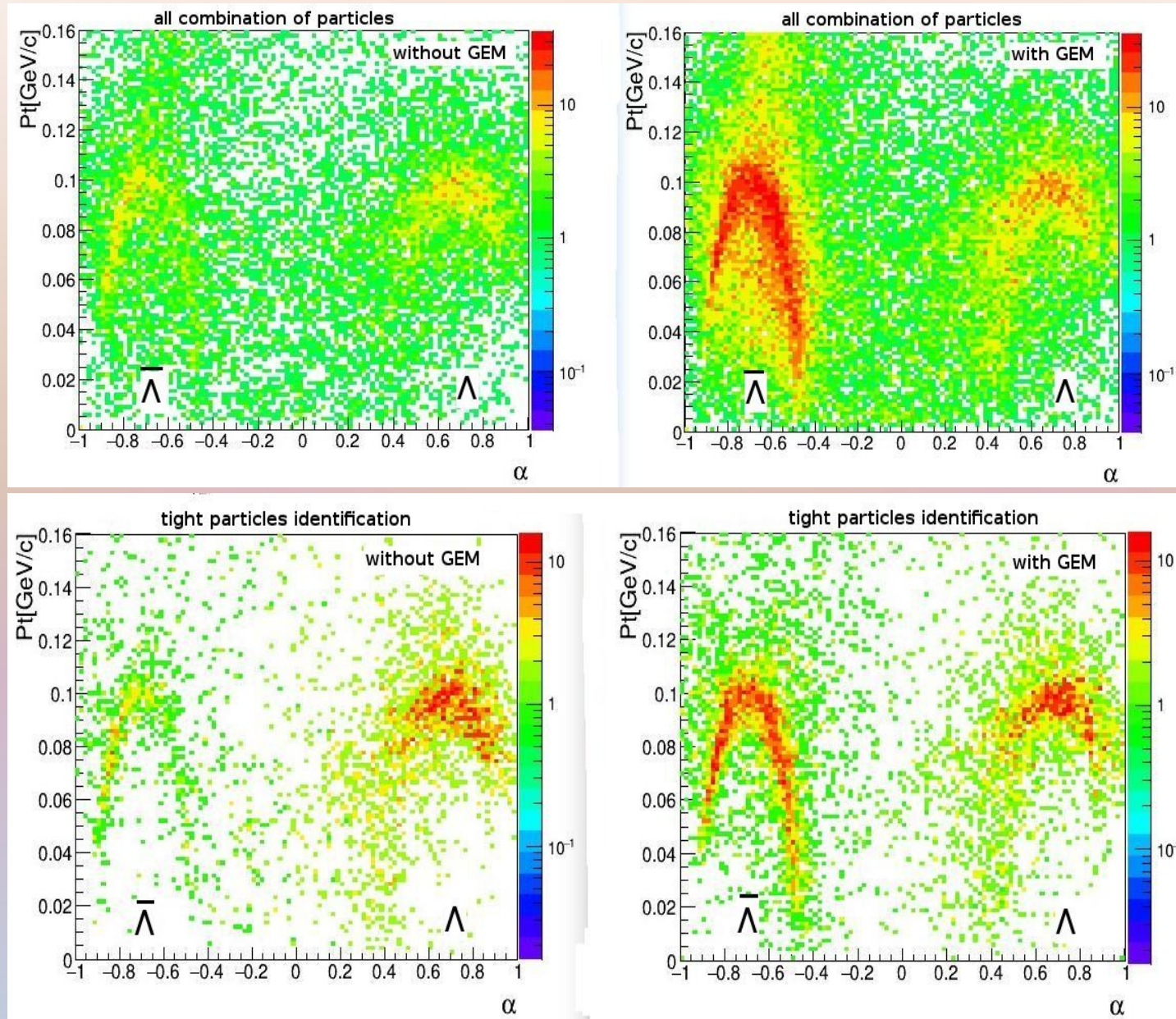


## More Results

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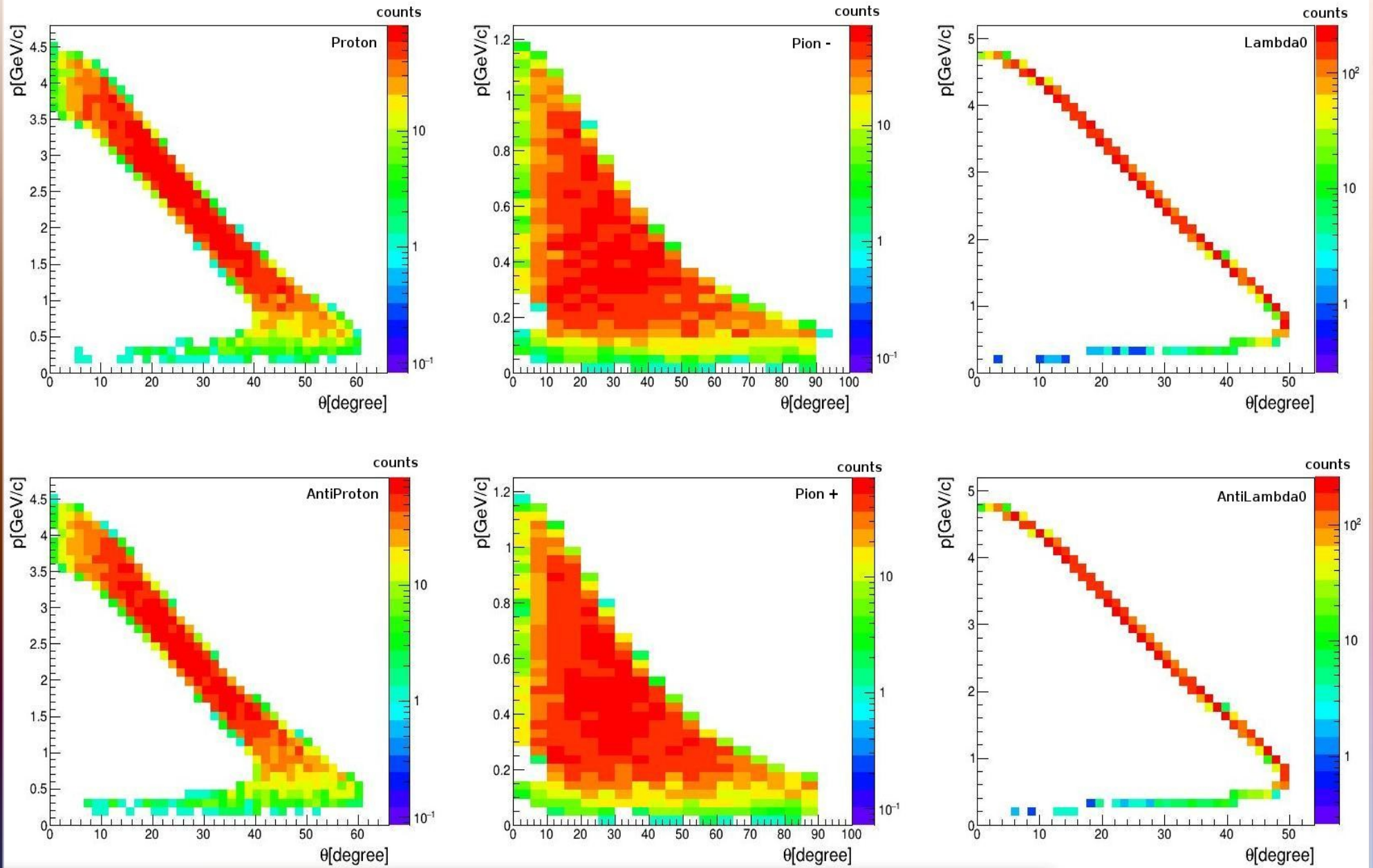
# Beam Momentum = 2 GeV/c , Boosted distribution (Forward Peaking) , pt vs $\alpha$



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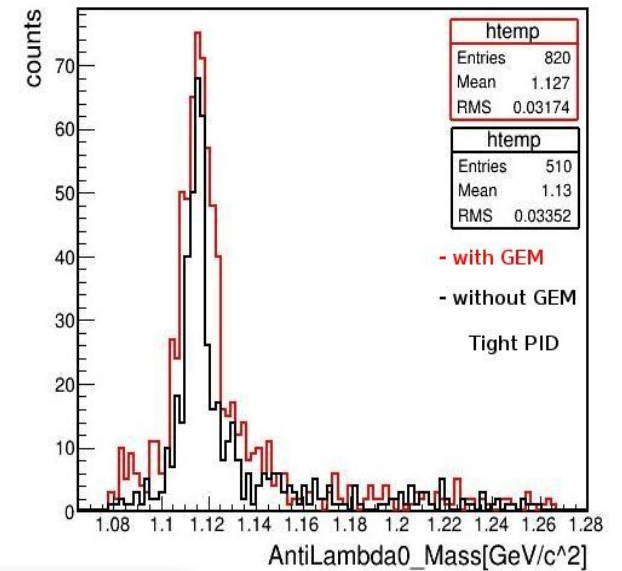
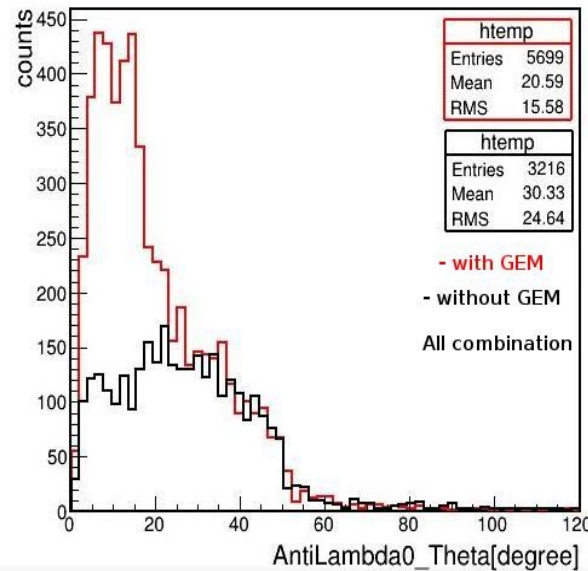
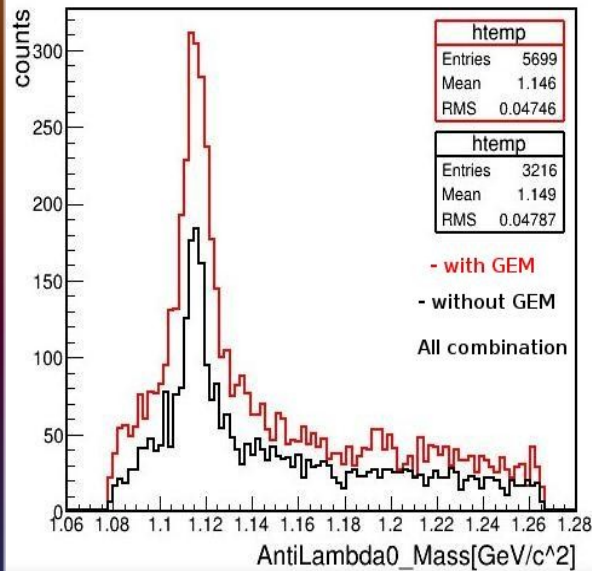
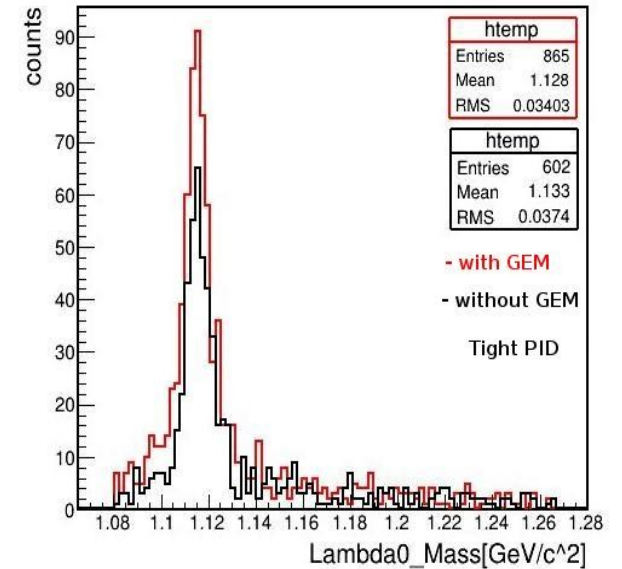
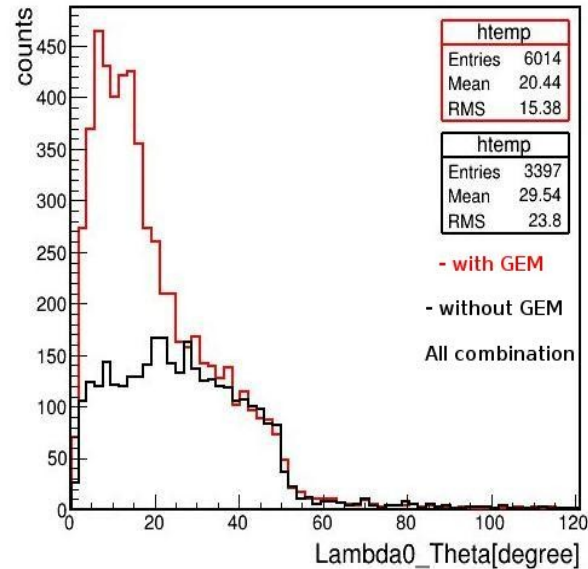
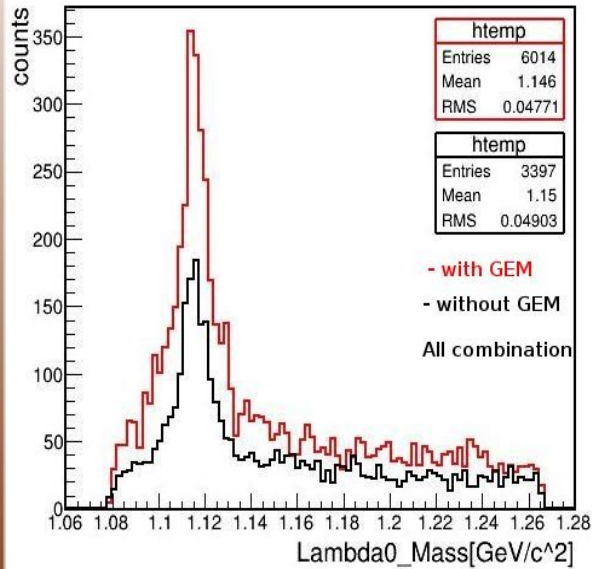
# Beam Momentum = 5 GeV/c , Isotropic distribution , p vs $\theta$



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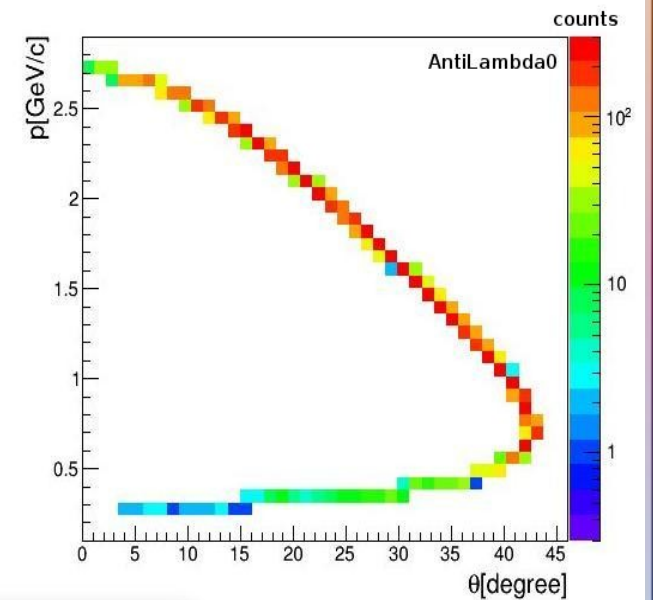
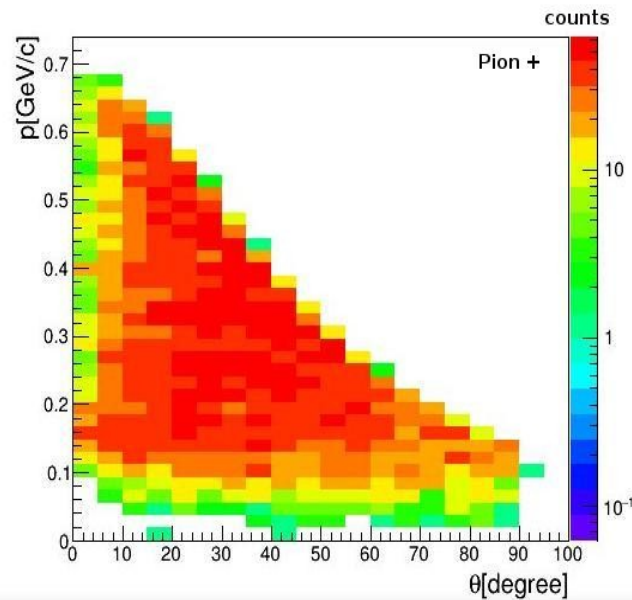
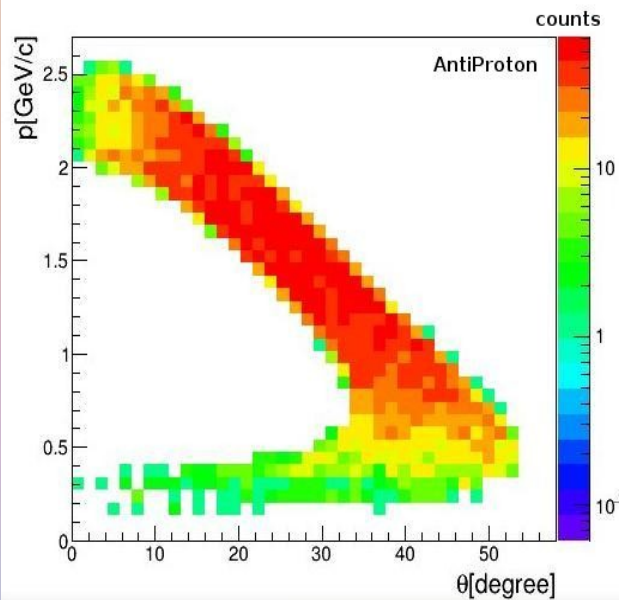
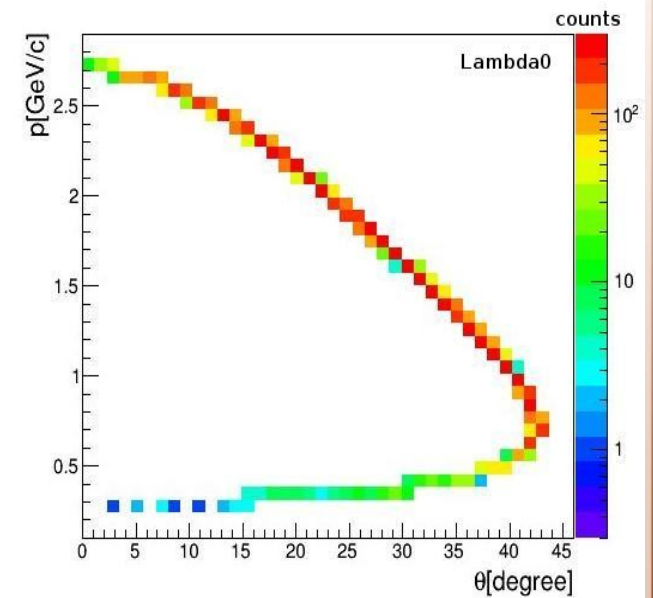
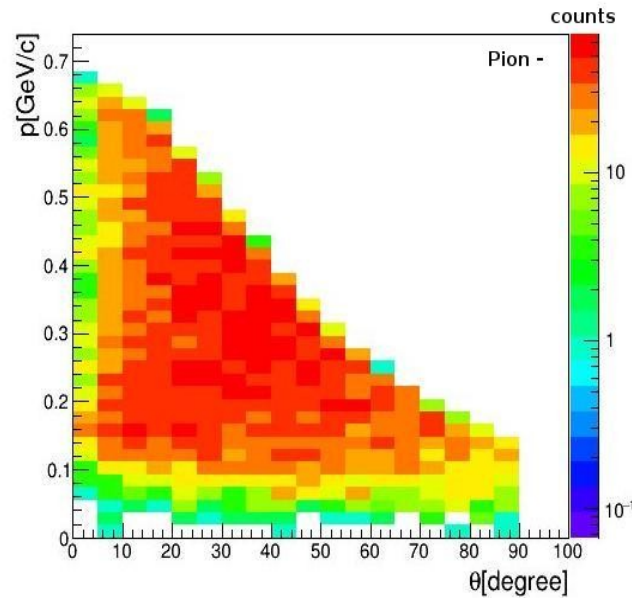
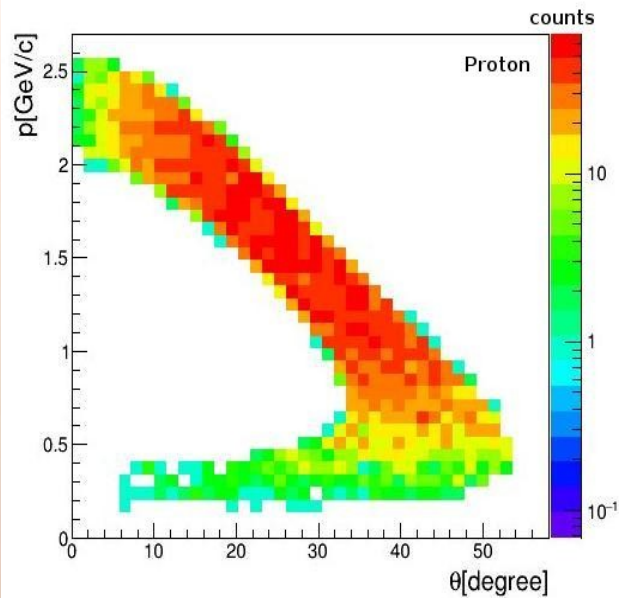
# Beam Momentum = 5GeV/c , Isotropic distribution



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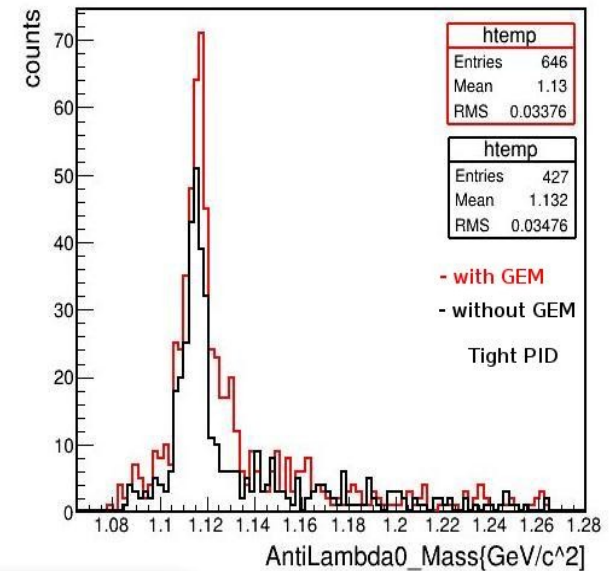
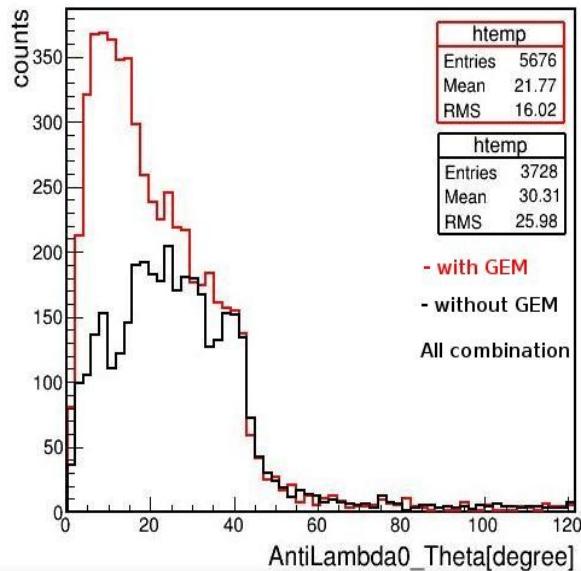
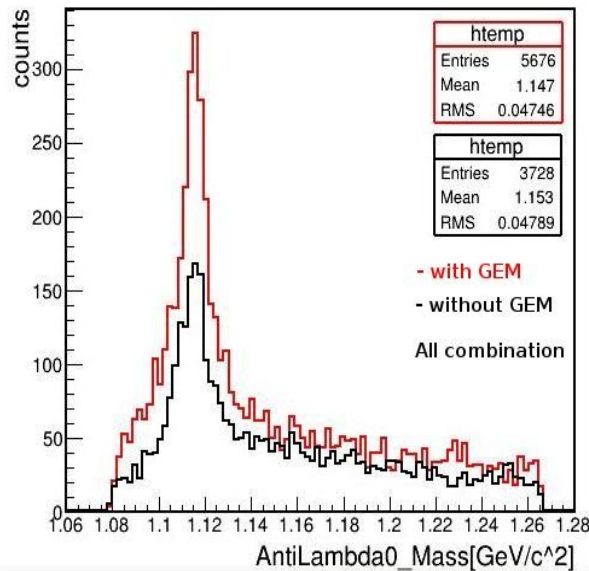
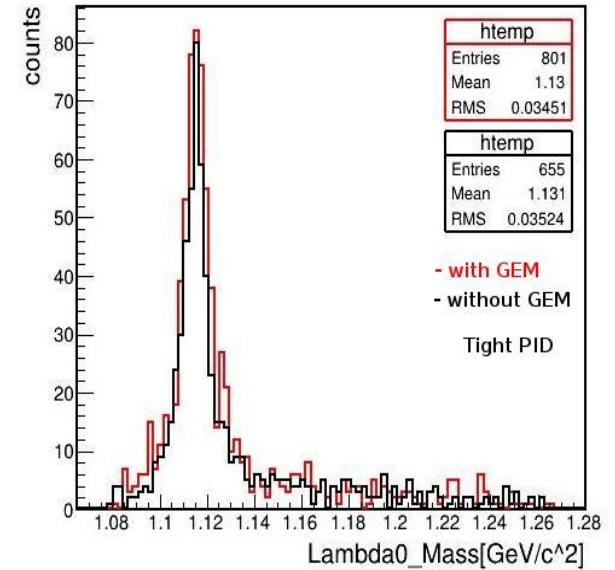
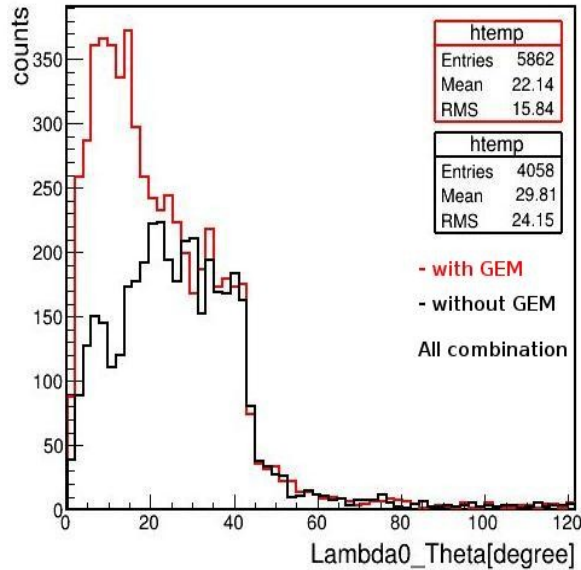
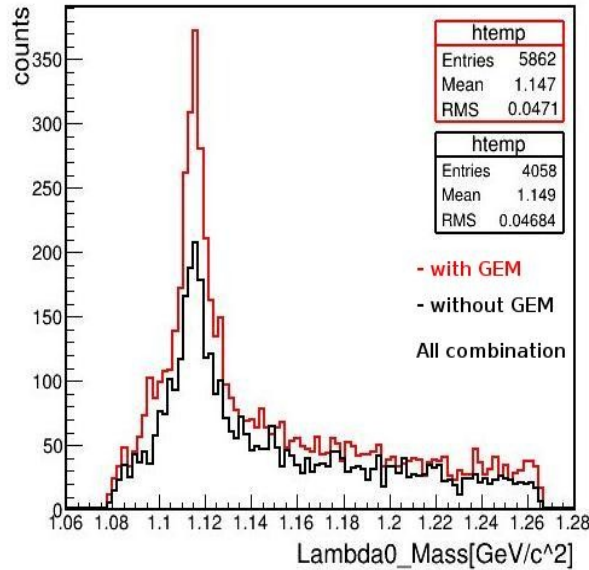
# Beam Momentum = 3GeV/c , Isotropic distribution , p vs $\theta$



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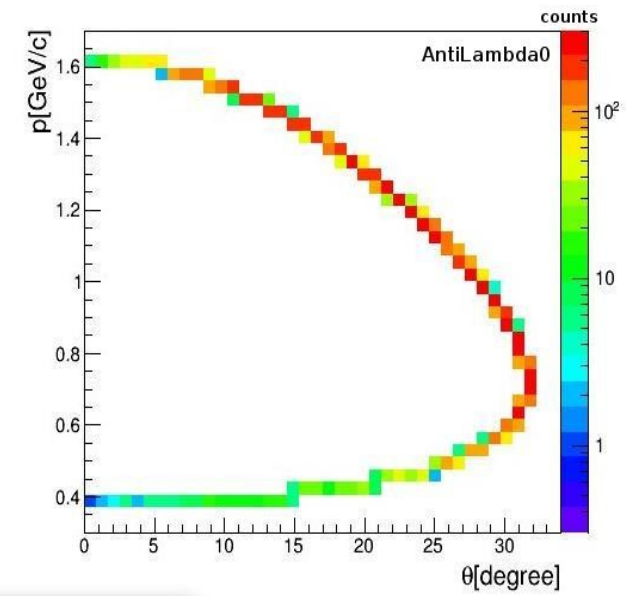
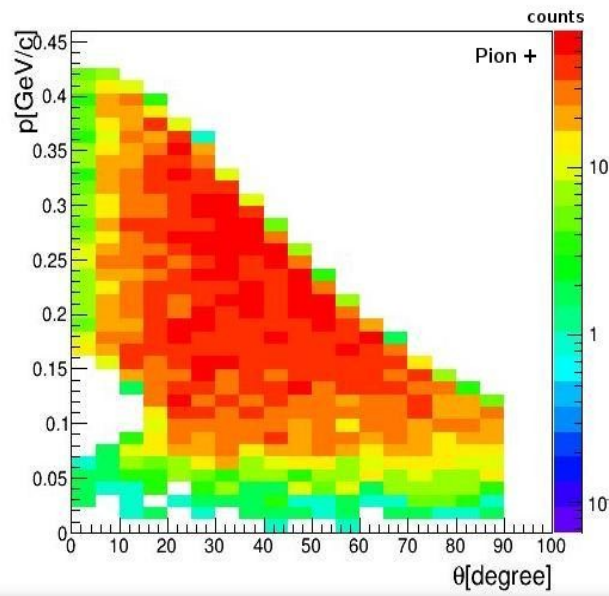
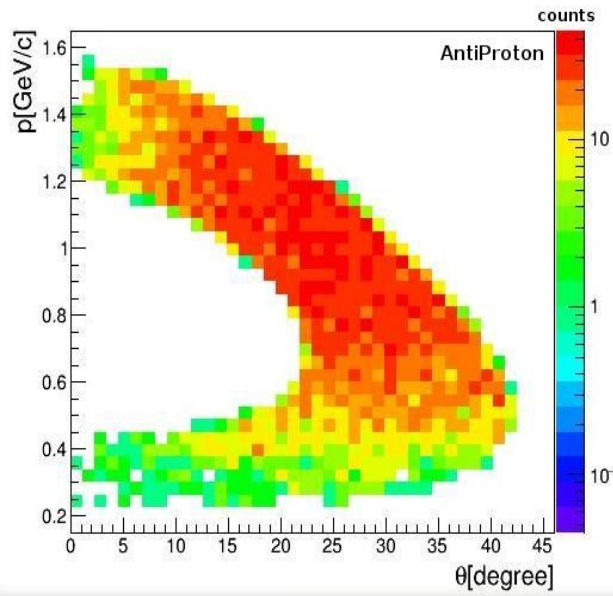
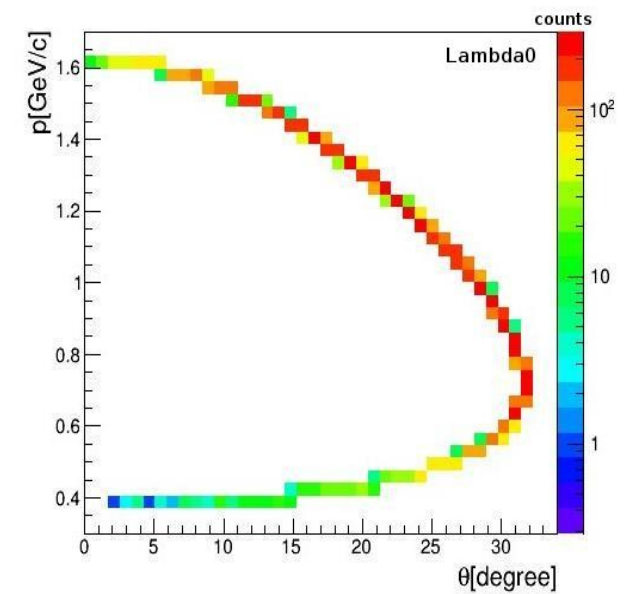
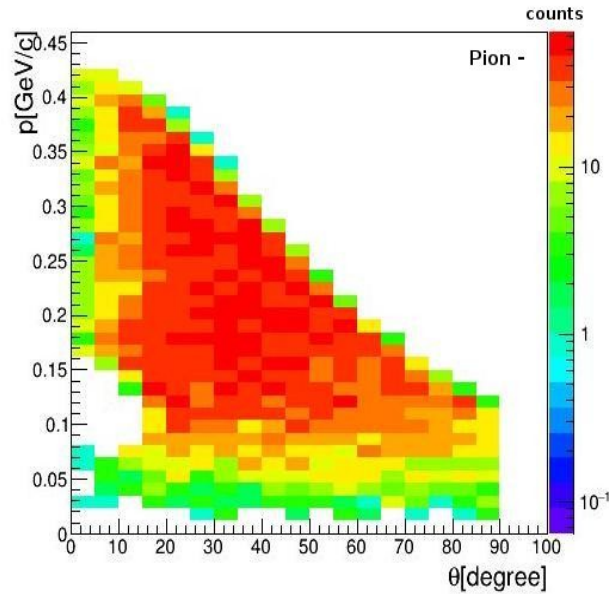
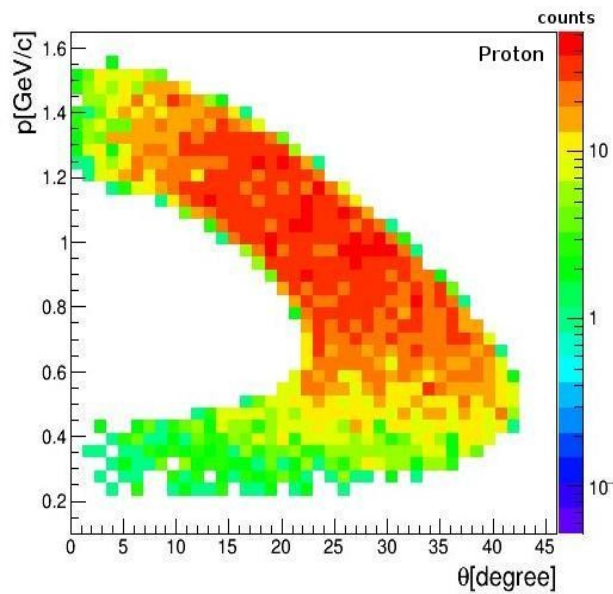
# Beam Momentum = 3GeV/c , Isotropic distribution



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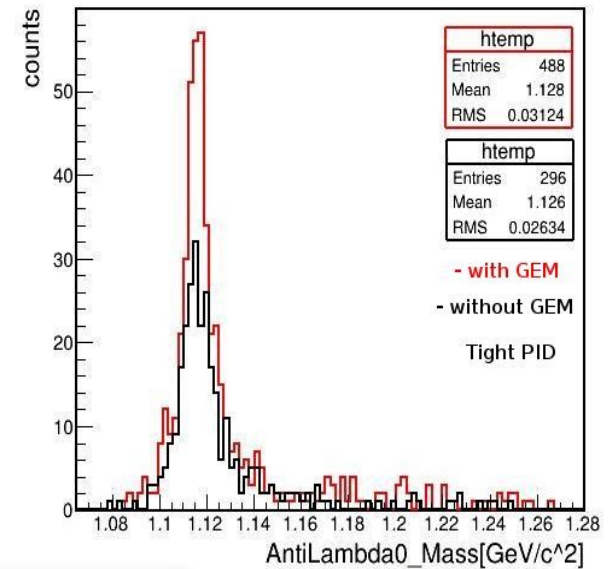
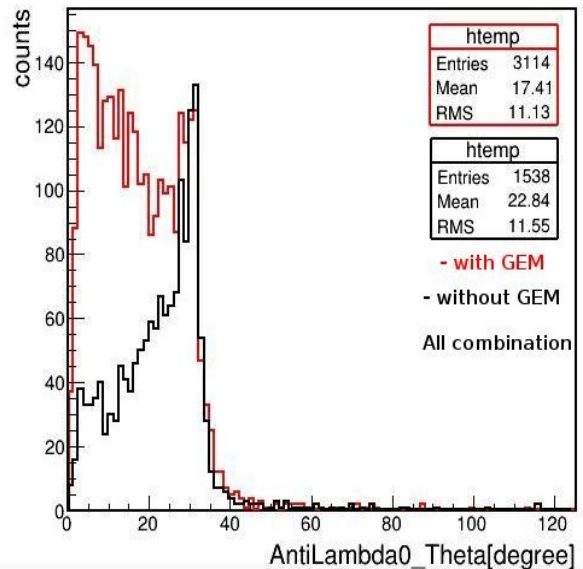
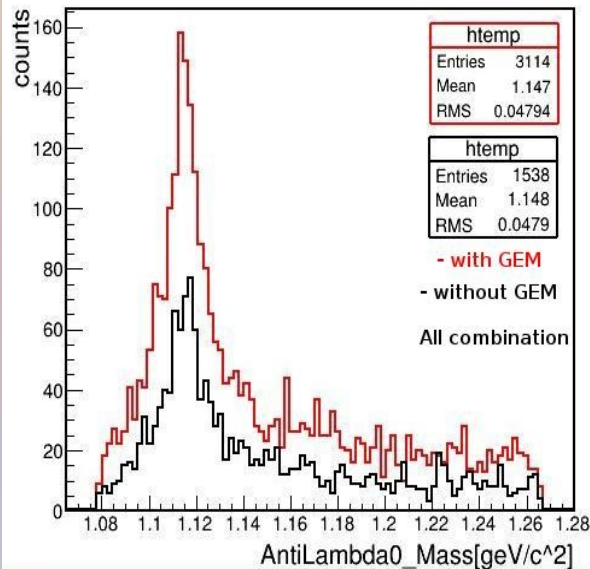
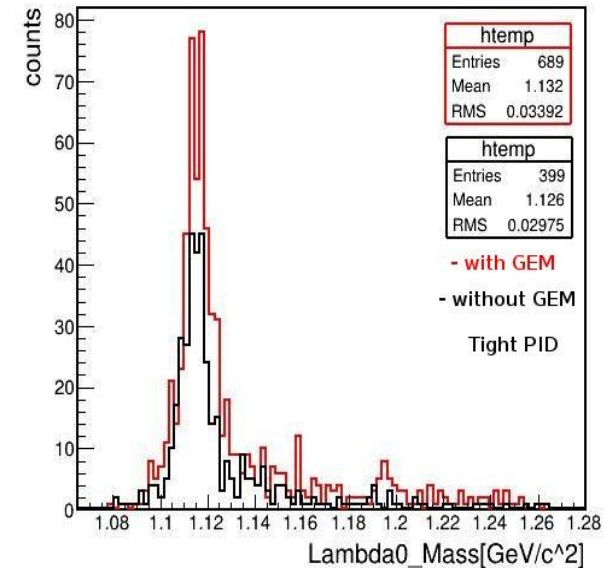
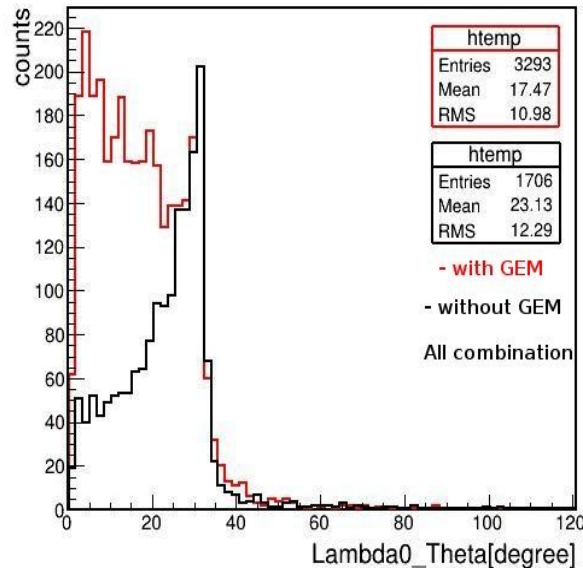
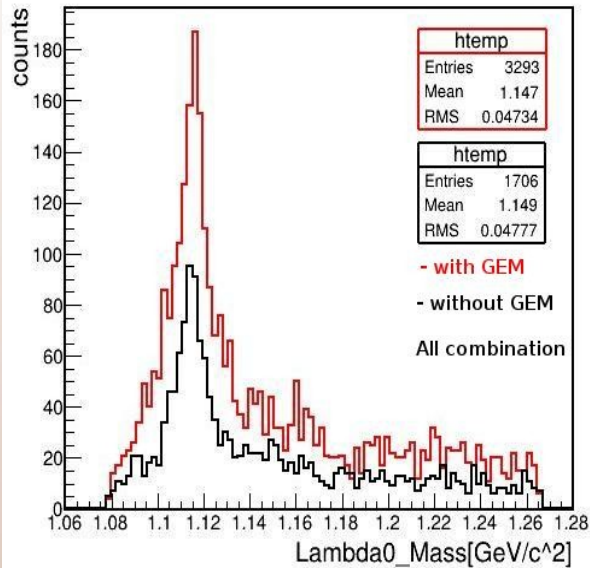
# Beam Momentum = 2GeV/c , Isotropic distribution , p vs $\theta$



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# Beam Momentum = 2GeV/c , Isotropic distribution

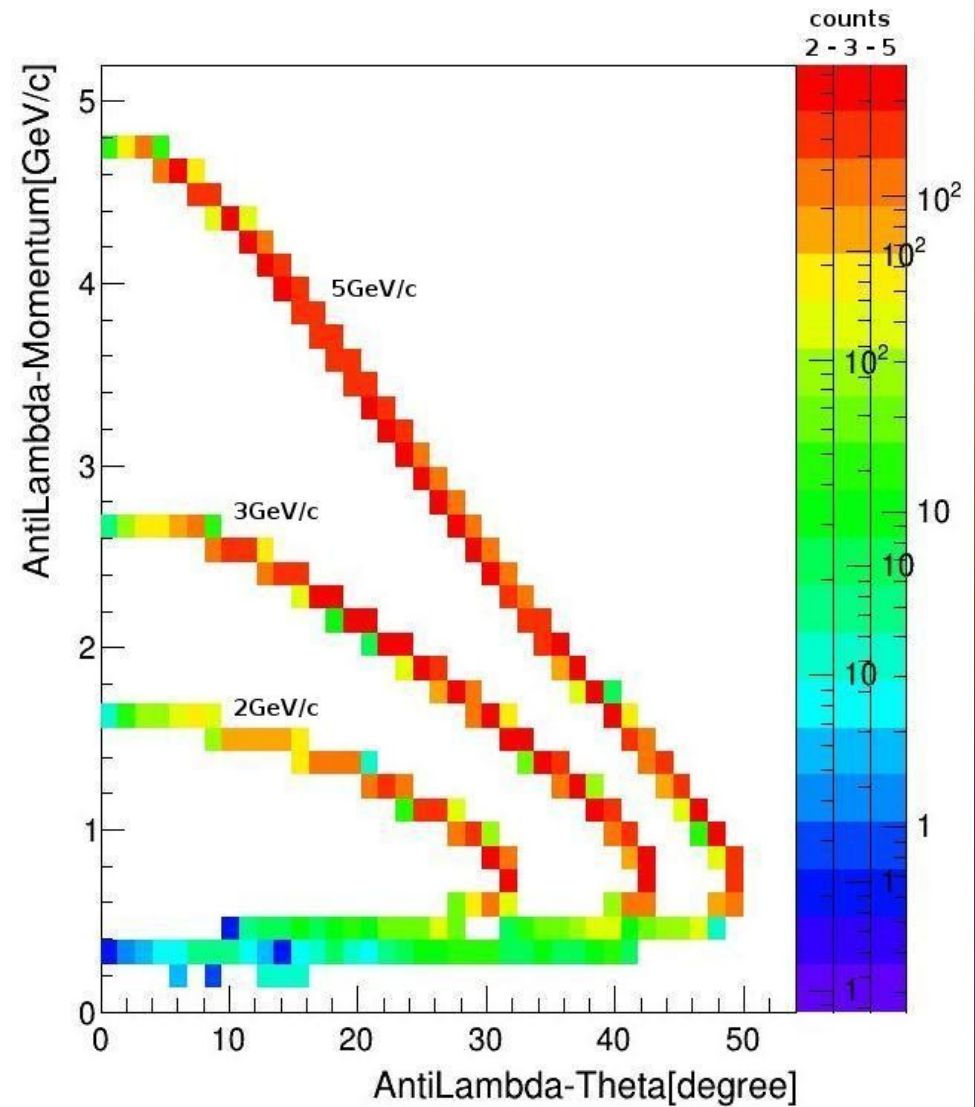
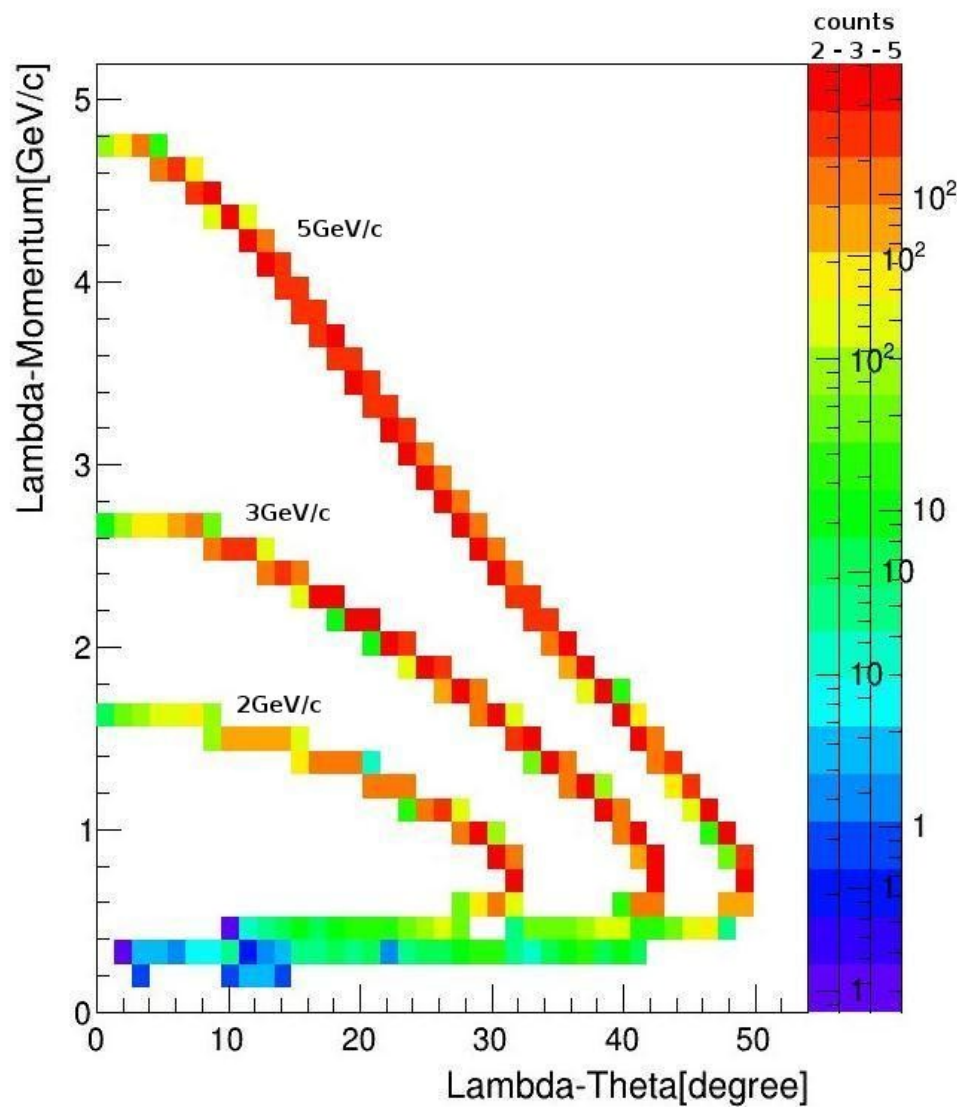


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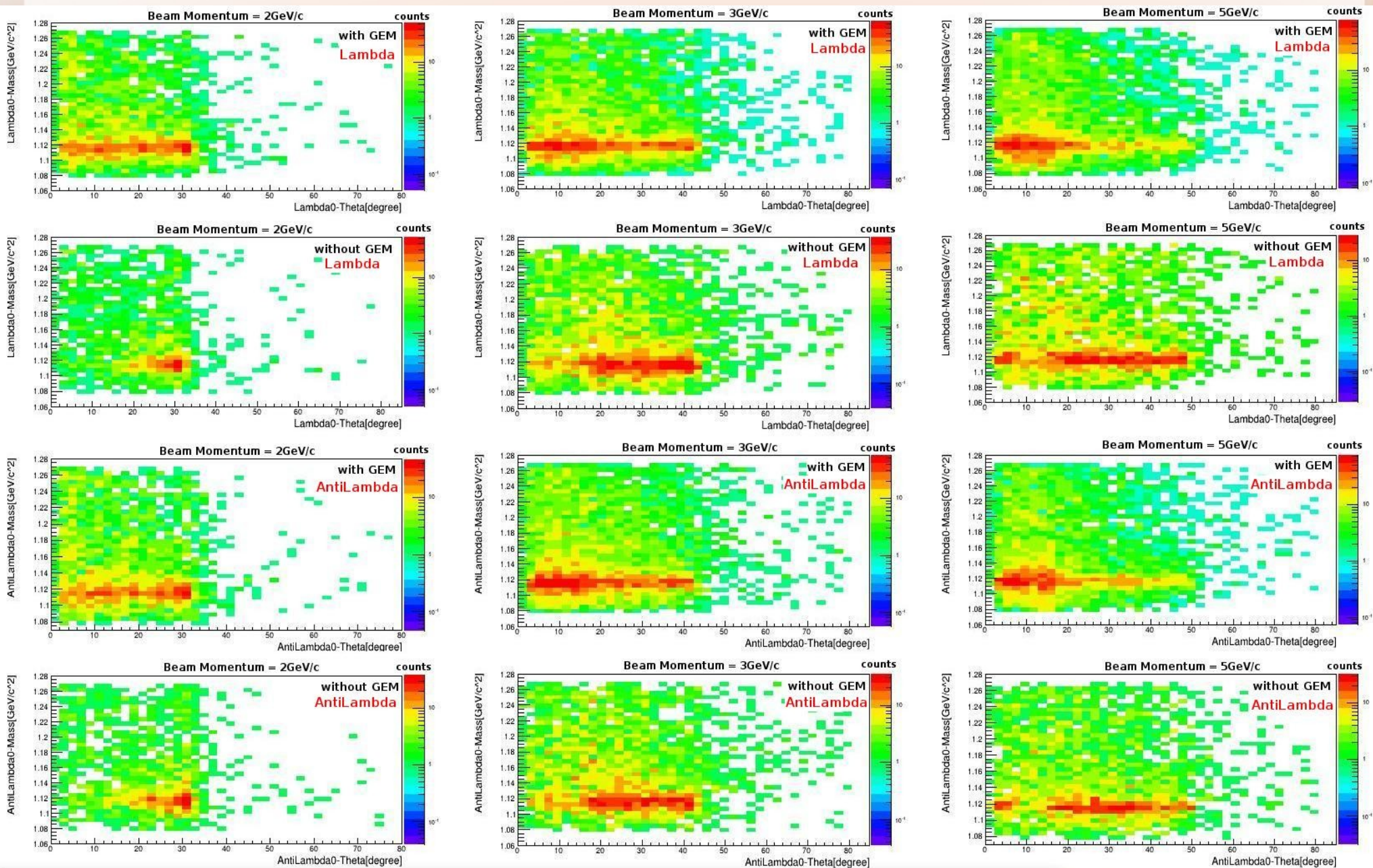
# Beam Momentum = 2, 3, 5 GeV/c , Isotropic distribution , p vs $\theta$



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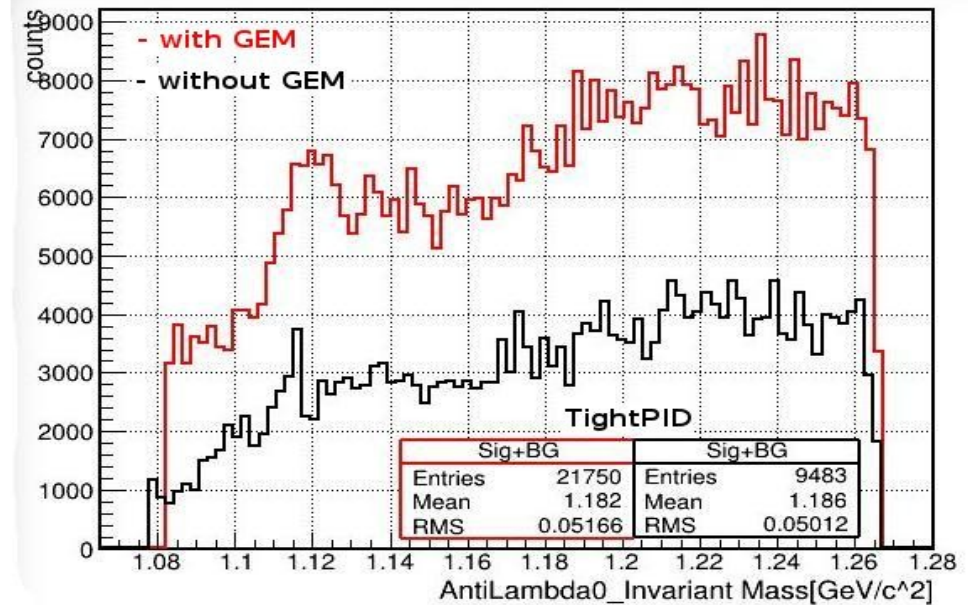
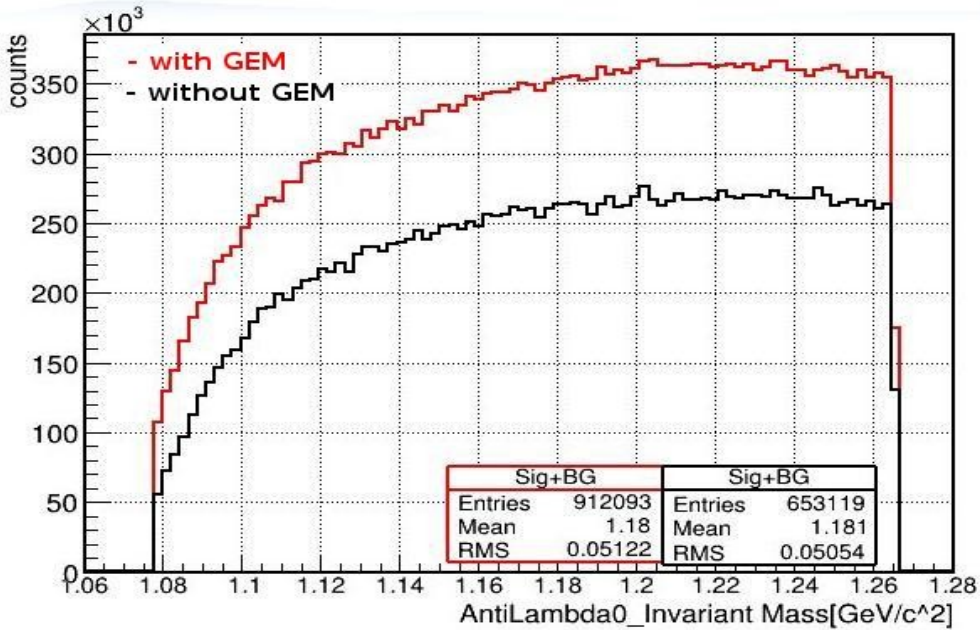
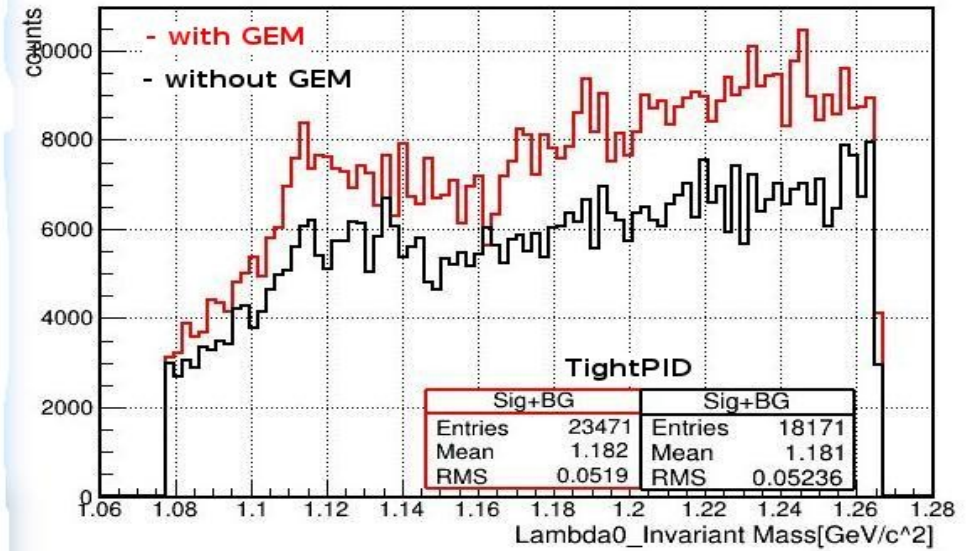
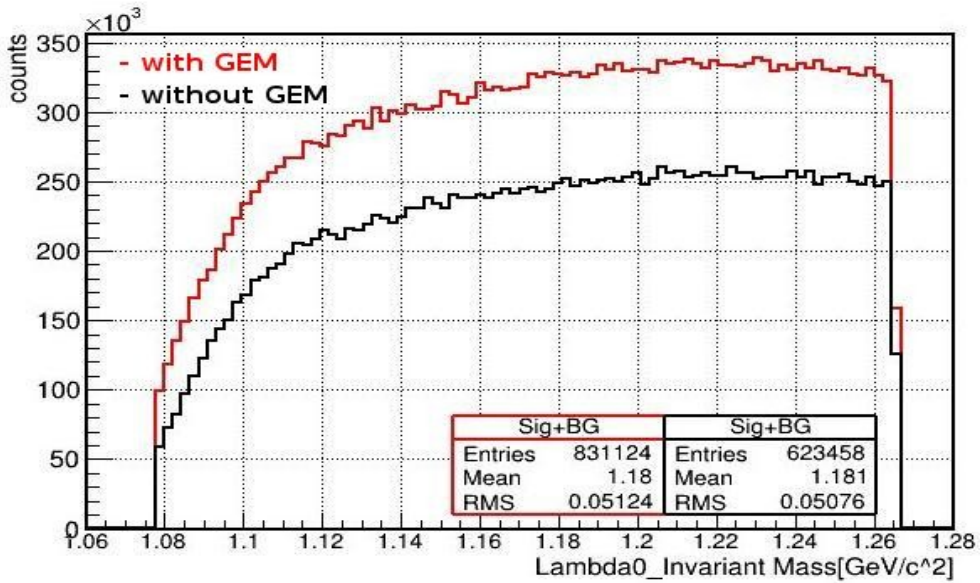
# Beam Momentum = 2, 3, 5 GeV/c, Isotropic distribution, mass vs $\theta$



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# Background Study



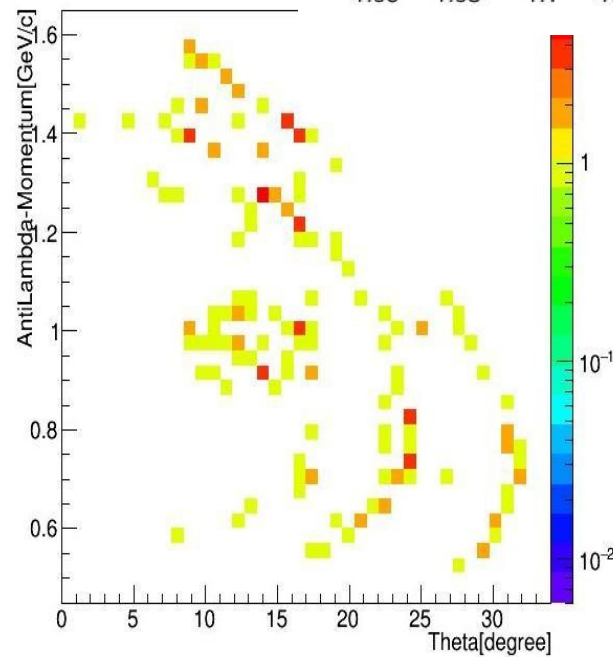
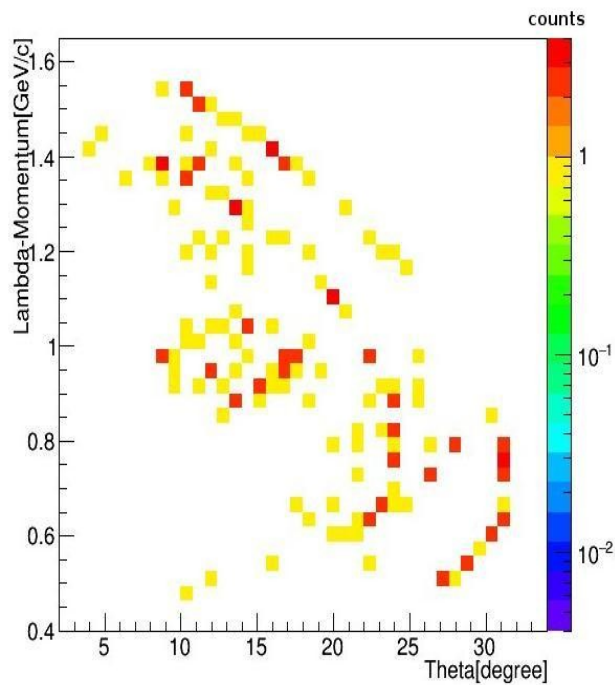
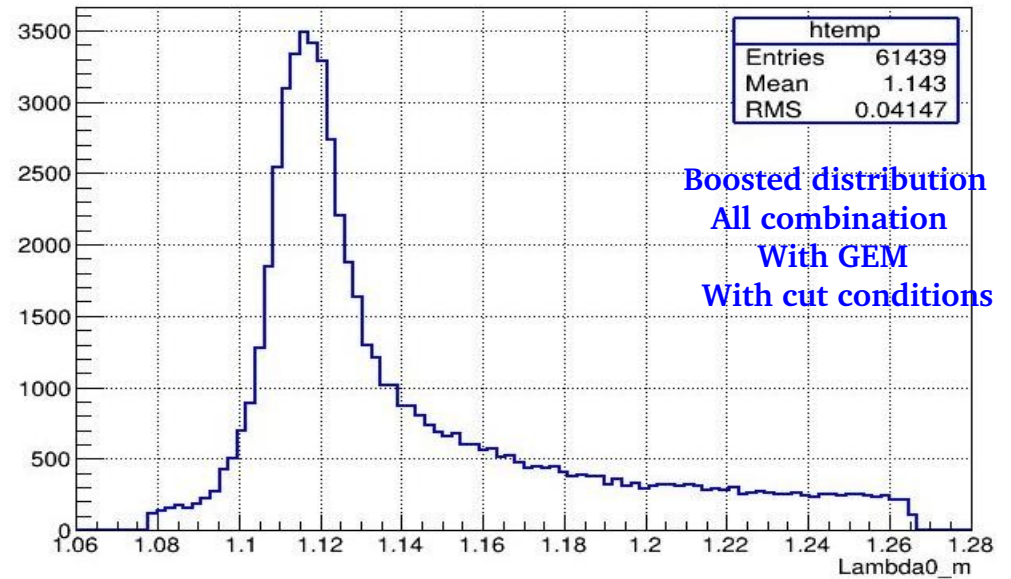
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# Background Study

Event generator = DPM  
For forward peaking  
Background events = 1,500,000  
Signal events = 50,000  
Production ratio =  $1.7 \times 10^{-3}$   
Branching ratio = 0.639  
Scaling factor = 31

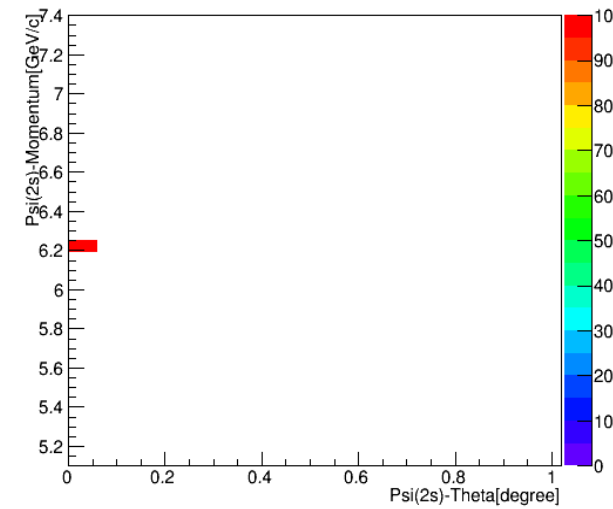
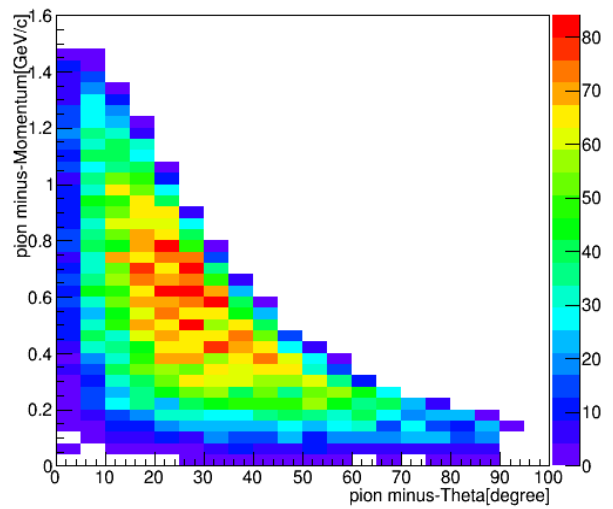
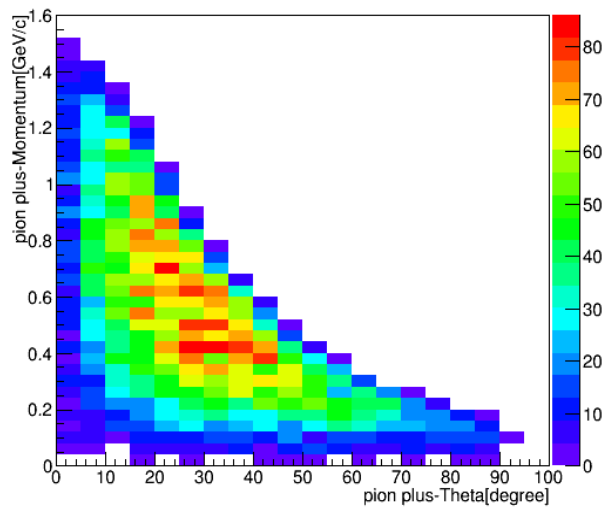
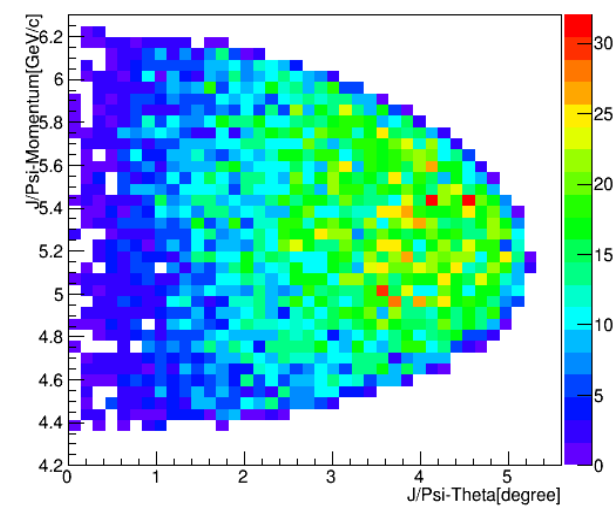
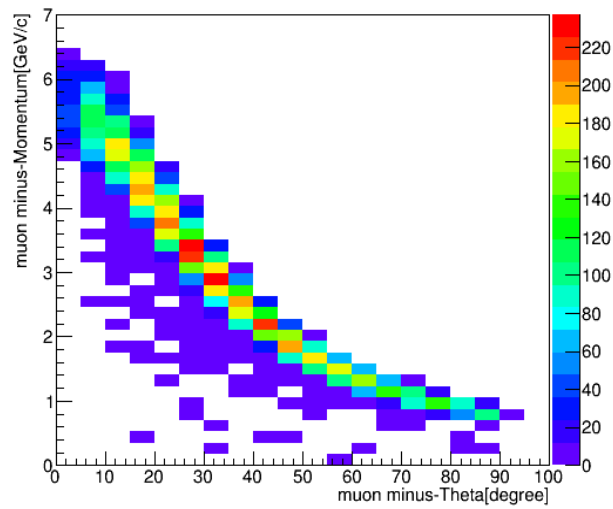
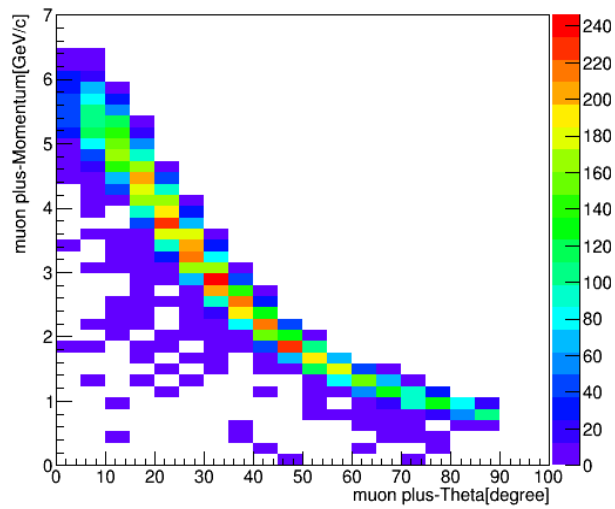
Lambda0\_m (HitTag==1&&VtxFit\_HowGood==1&&MassFit\_prob>0.01)



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# J/Psi channel, Beam Momentum = 6.23 GeV/c , Isotropic distribution , p vs $\theta$

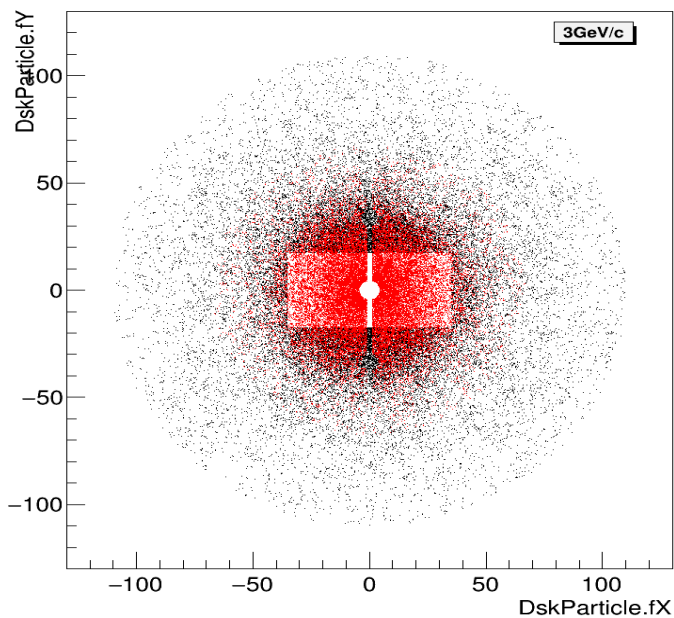


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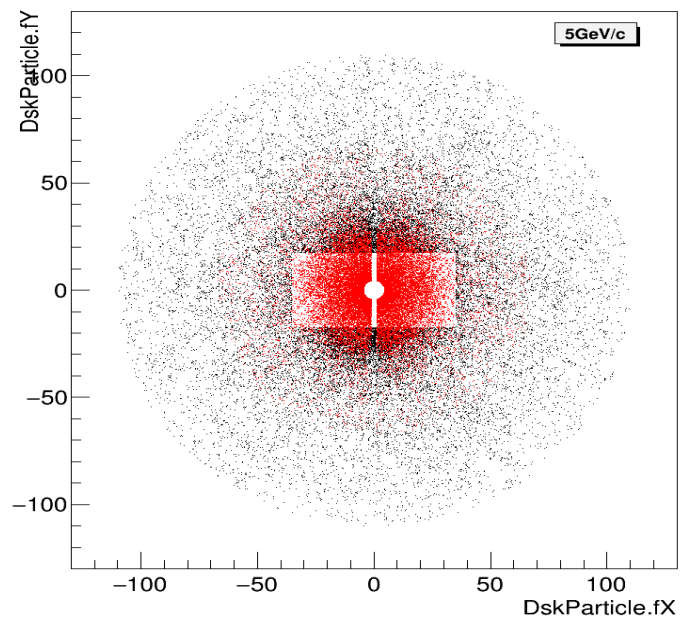
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# Need PID for the GEM

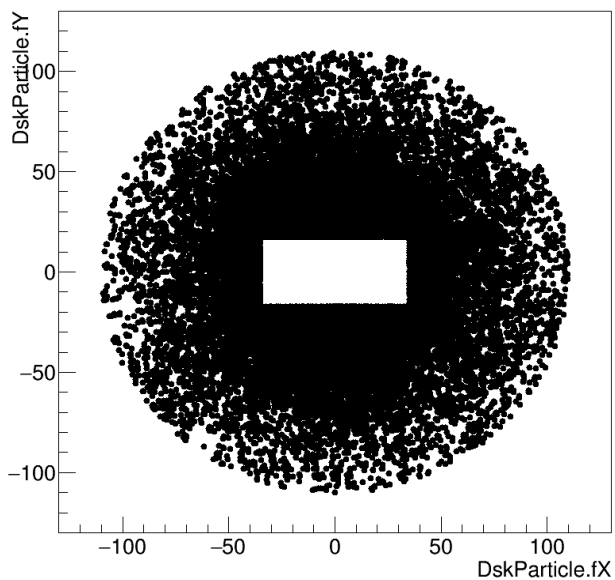
DskParticle.fY:DskParticle.fX



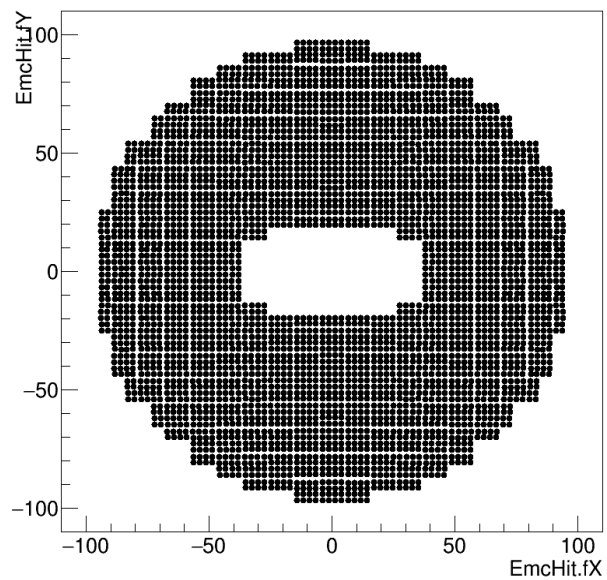
DskParticle.fY:DskParticle.fX



DskParticle.fY:DskParticle.fX



EmcHit.fY:EmcHit.fX {abs(EmcHit.fZ-220)<10}



FTSPoint.fX:FTSPoint.fY {FTSPoint.fZ<300}

