

# Software of Disc DIRC in PandaRoot

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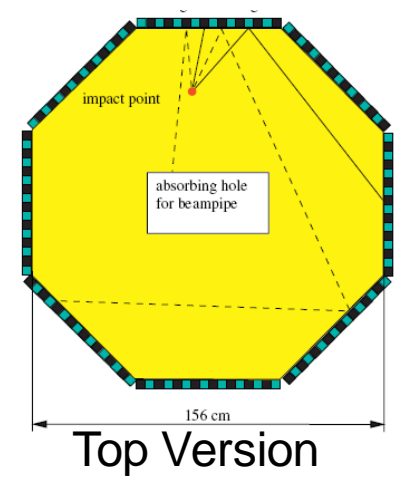
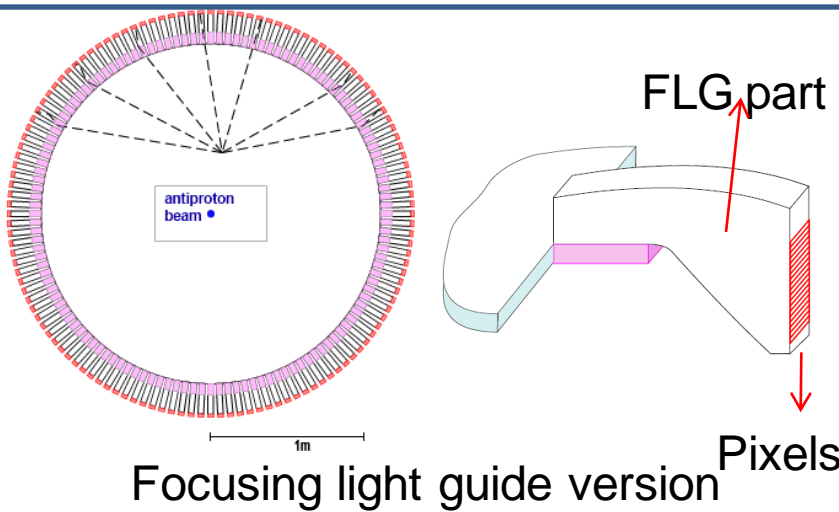
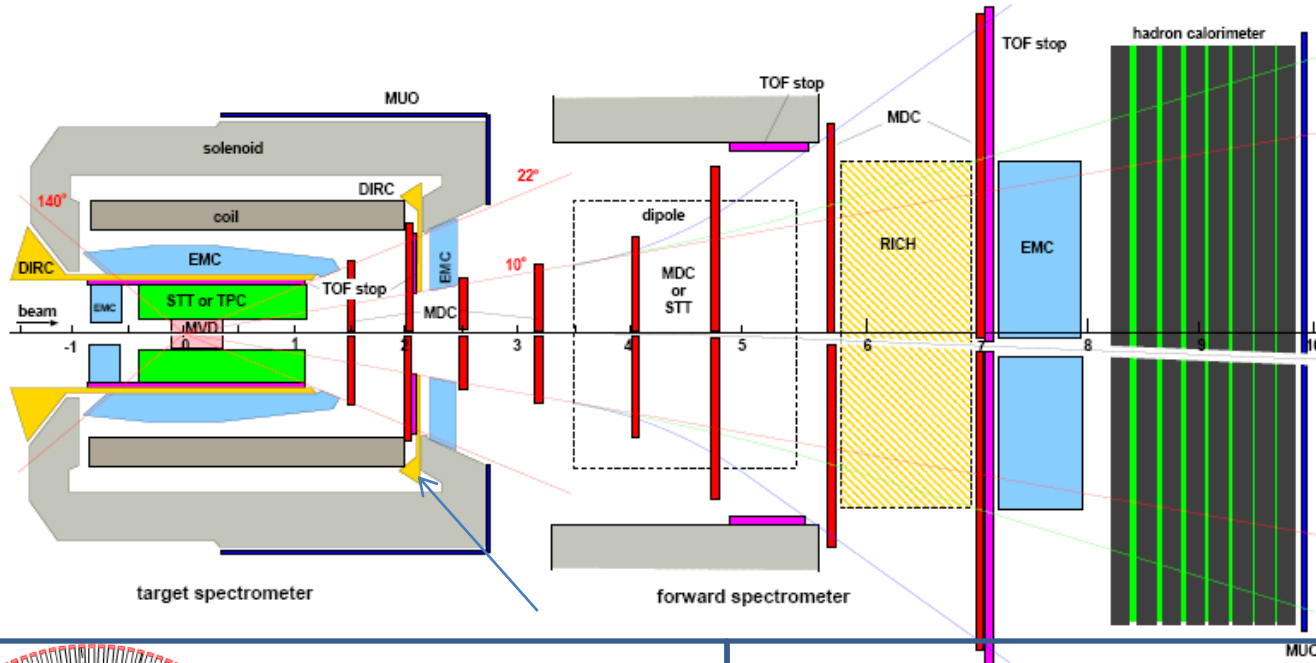
Giessen University  
June 14<sup>th</sup>, 2010

# Outline

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- **Introduction of Disc DIRC**
- **Software of Disc DIRC**
- **Test with a physics channel**
- **Summary**

# Introduction of Disc DIRC



# Software of Disc DIRC

## Simulation Process

$$f\theta_C = \arccos(1/(1.47*(fP/fEnergy)))$$

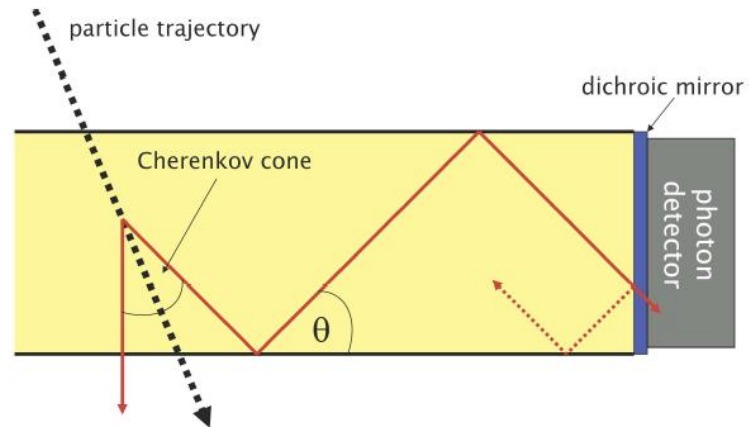
Resolution:  $0.01/\sqrt{n_{Phot}}$

$n_{Phot}$  is calculated with a theoretical formula.  
(same as the fast simulation)

PndDskParticle: (trackID, pos, ...,  $f\theta_C$ )

## Simulation Macro

```
PndDsk *Dsk = new PndDsk("DISK", kTRUE);  
//Dsk->SetGeometryFileName("dsk_top.root");  
fRun->AddModule(Dsk);
```



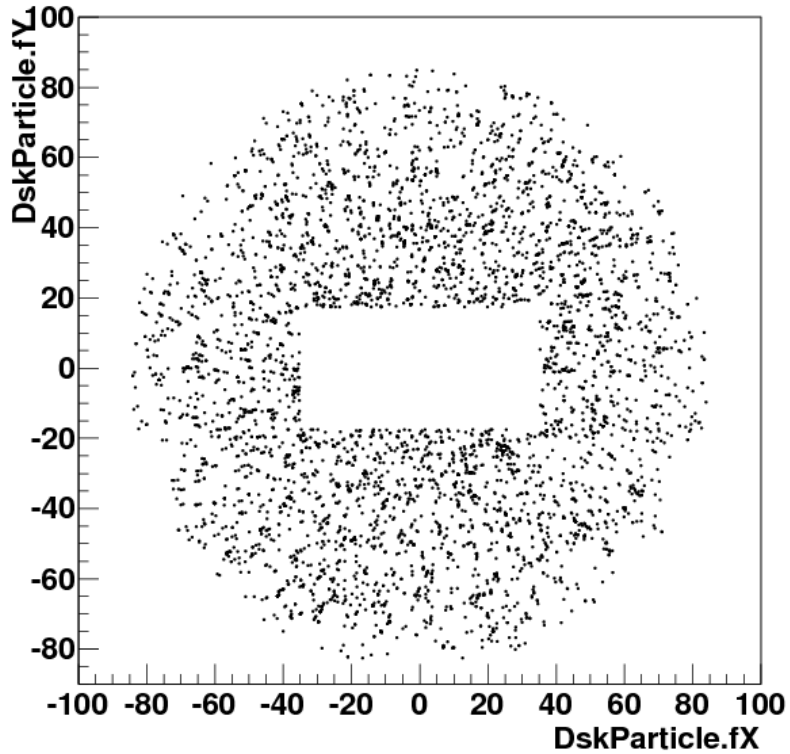
PndPidCorrelator.cxx

```
GetObject("DskParticle");  
For each central track  
find the closest DskParticle.
```

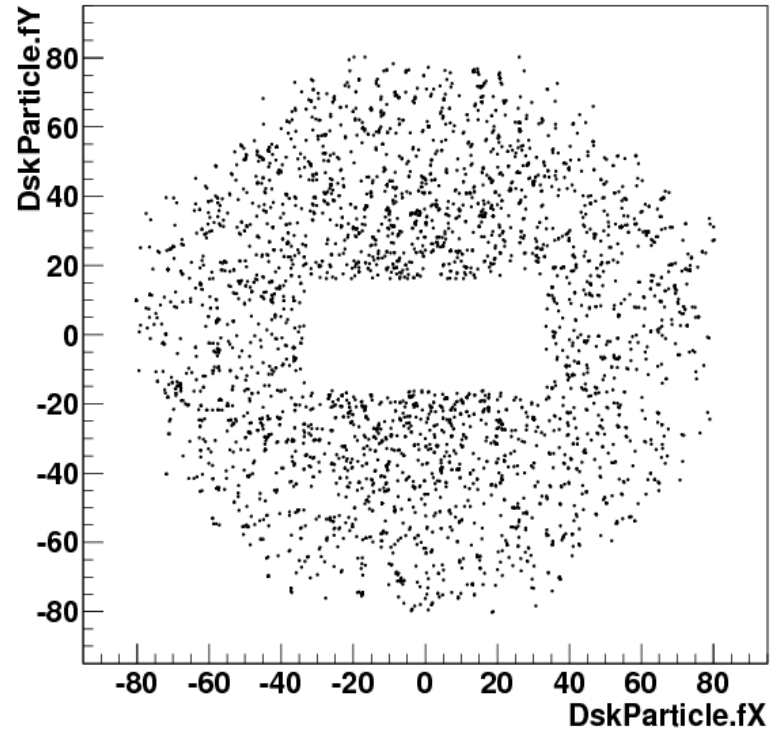
PndPidDiscAssociatorTask.cxx

implementation of disc pid

# Simulation of Disc DIRC

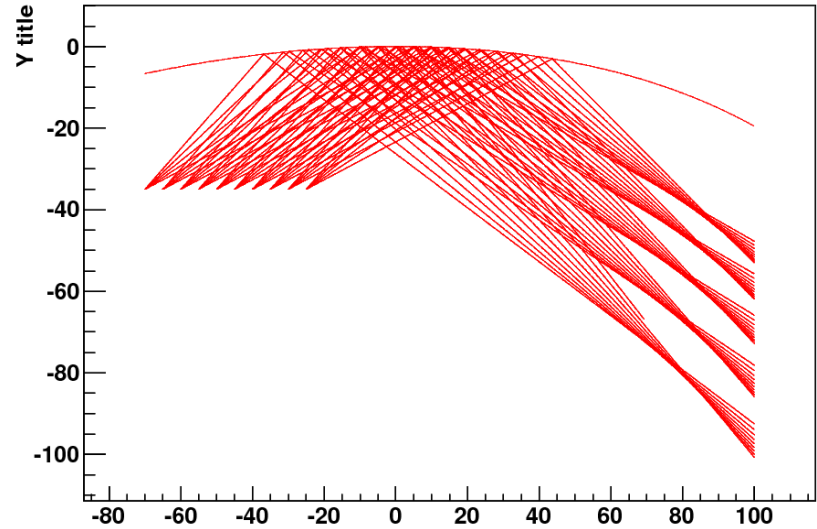
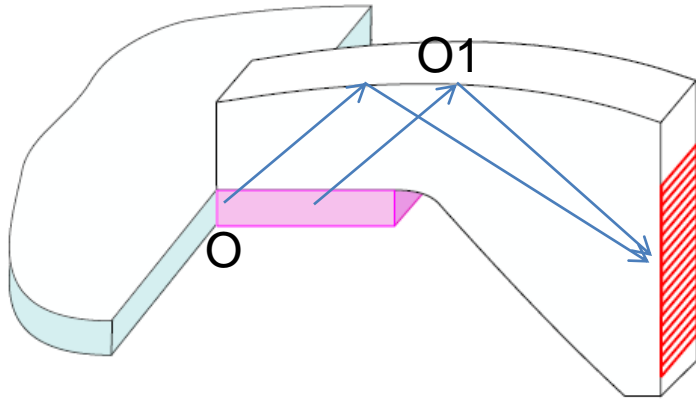


FLG version

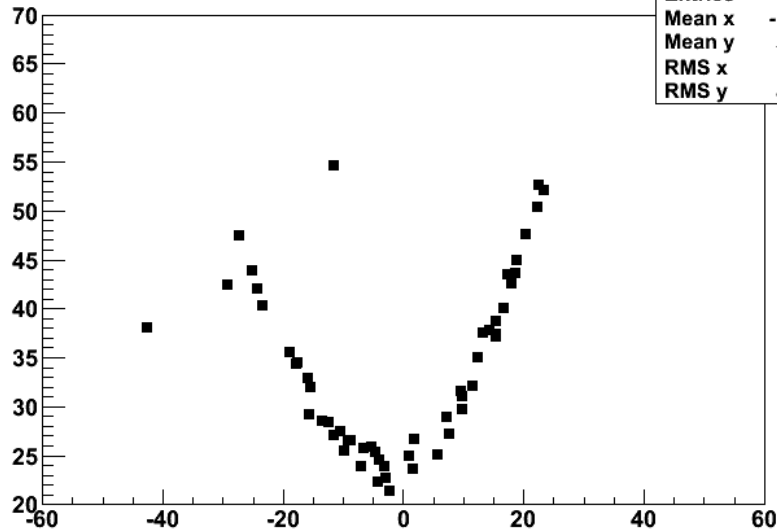


Top Version

# Hit Pattern of FLG Version

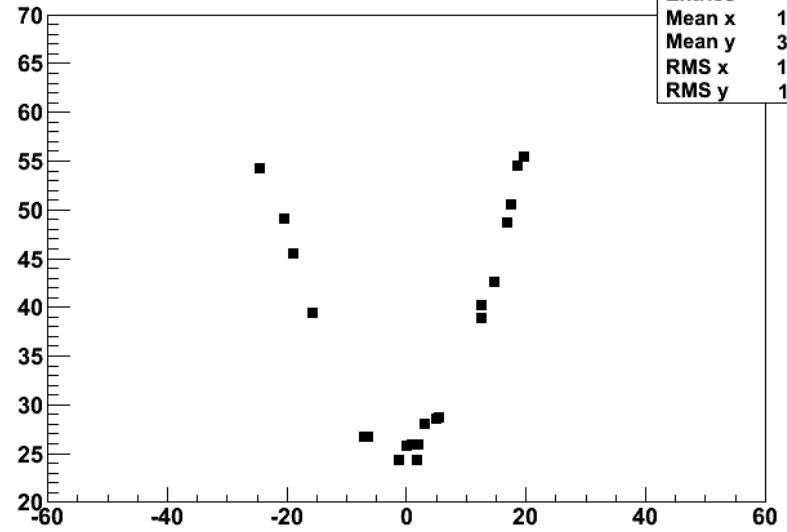


pixelVSGuide



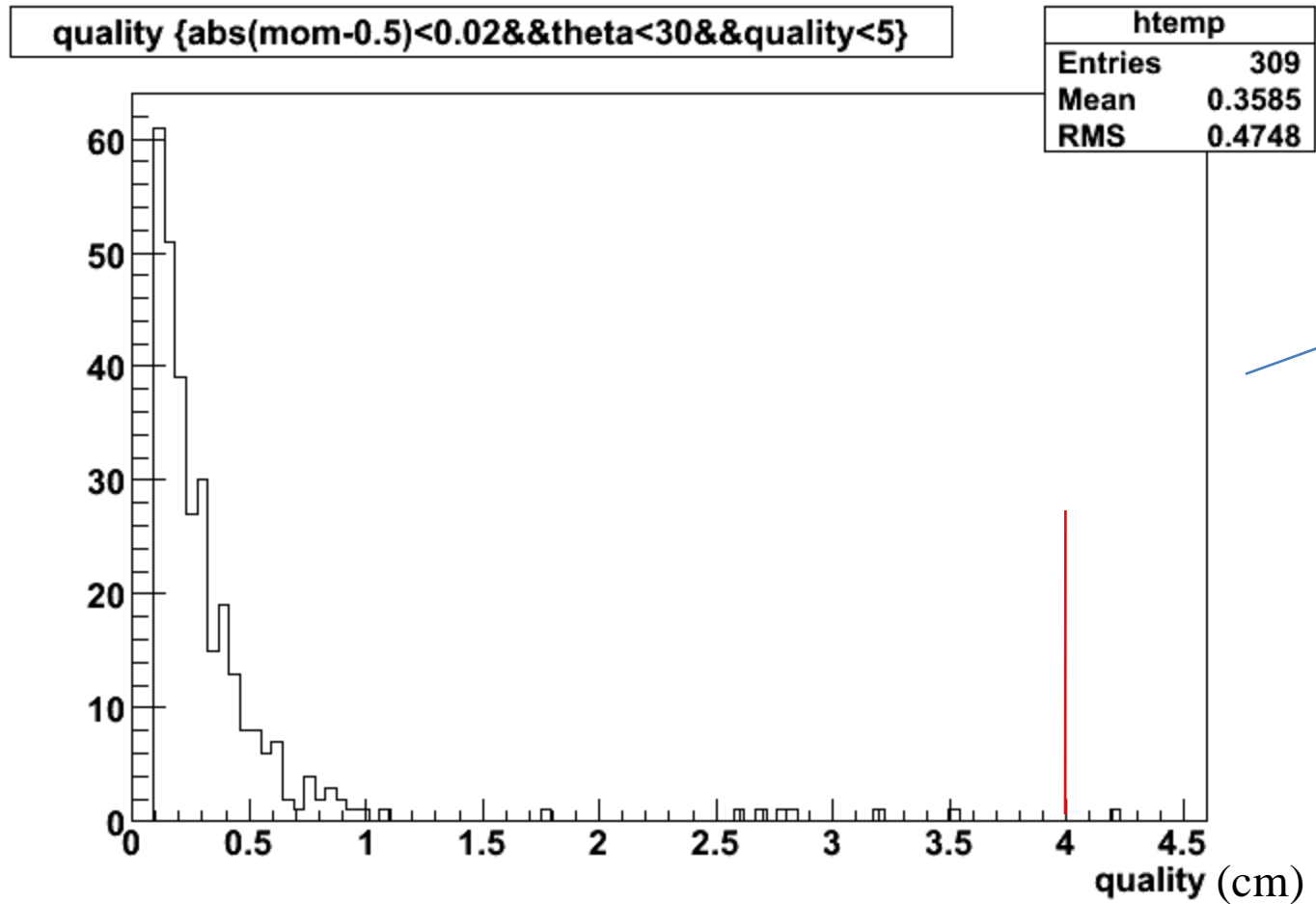
pixelVSGuide	
Entries	54
Mean x	-1.796
Mean y	33.48
RMS x	15.73
RMS y	8.877

pixelVSGuide



pixelVSGuide	
Entries	21
Mean x	1.286
Mean y	36.76
RMS x	12.96
RMS y	11.36

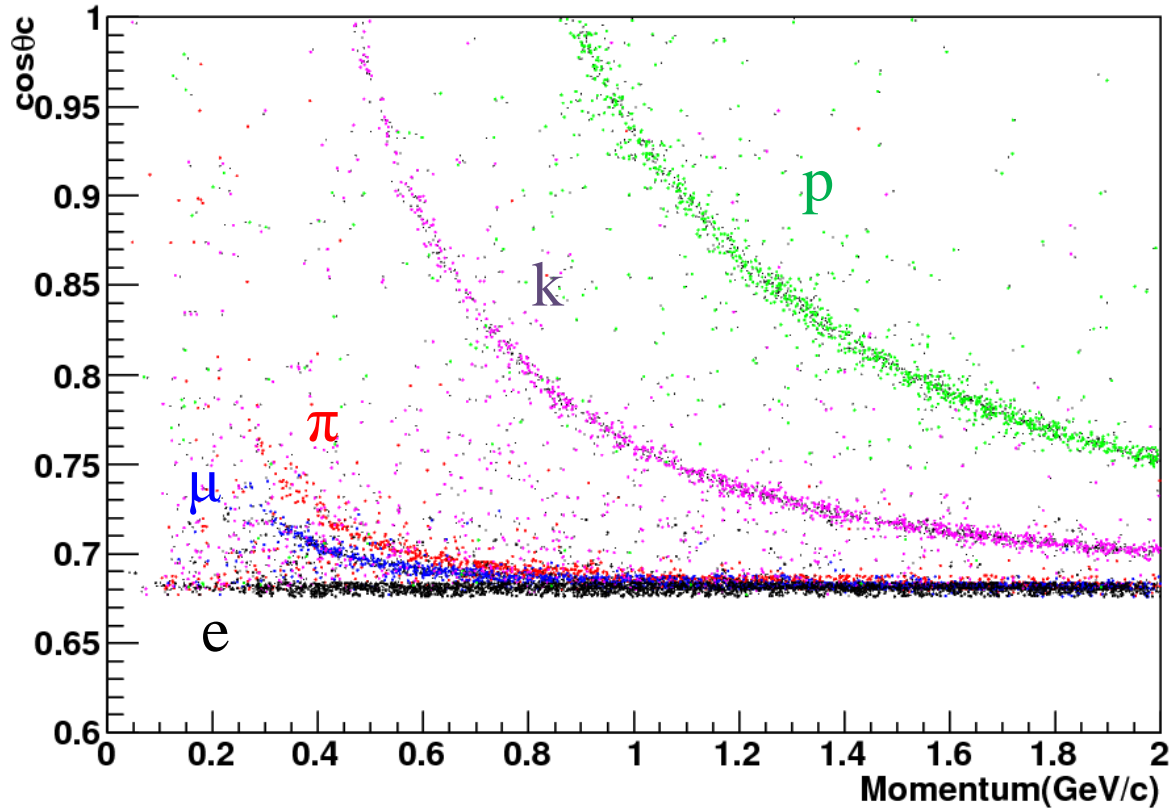
# PndPidCorrelator– match of central track with dsk hit



theta: 0.3-0.6deg phi: 0.8-1.5 deg (2-3cm)  
beta: 0.005-0.02

Provided by  
Klaus Foehl

# PndPidDiscAssociatorTask



2000 e  $\mu$   $\pi$  k p

P: 0.1-2GeV/c

$\theta$ : 5°-22°

$\Phi$ : 0°-360°

Pdf: Gaus

Center:  $\cos\theta_c = 1/n\beta$

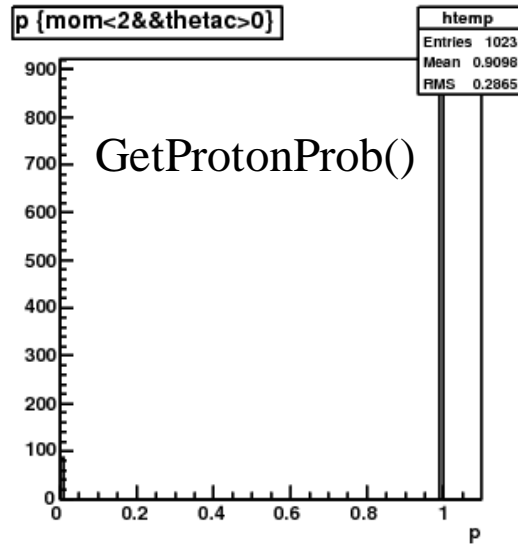
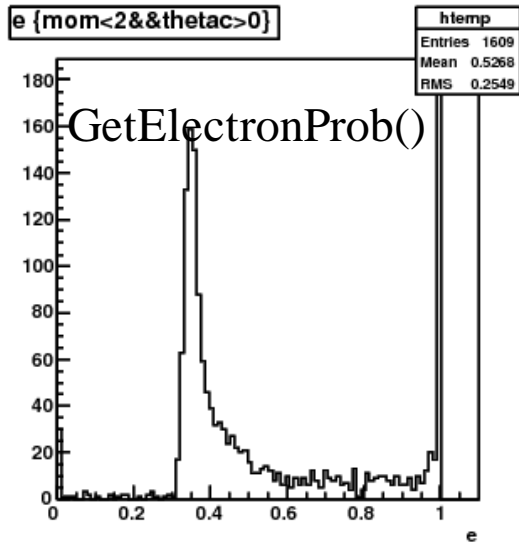
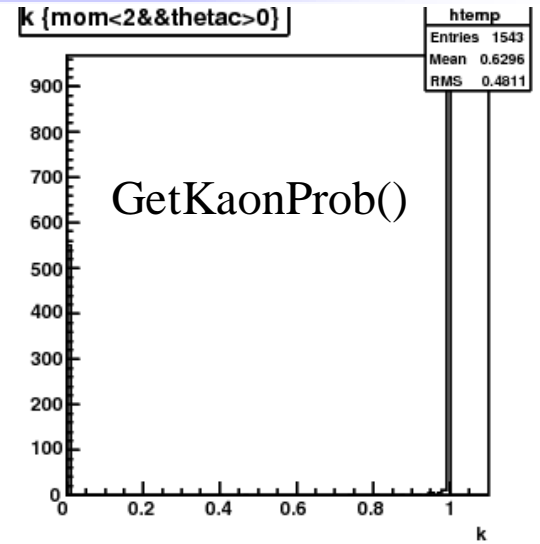
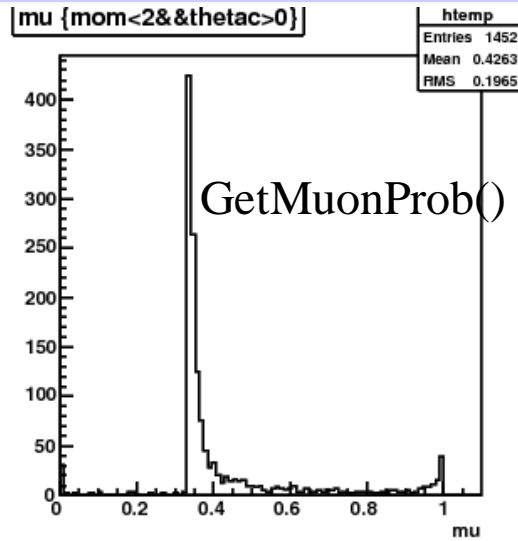
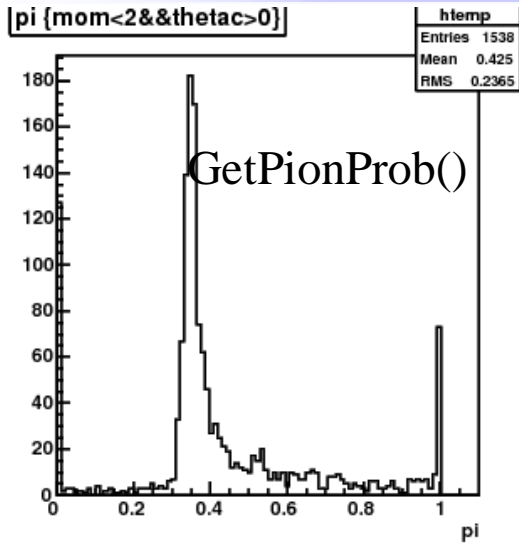
Sigma: parameterization

p, k : 0.005

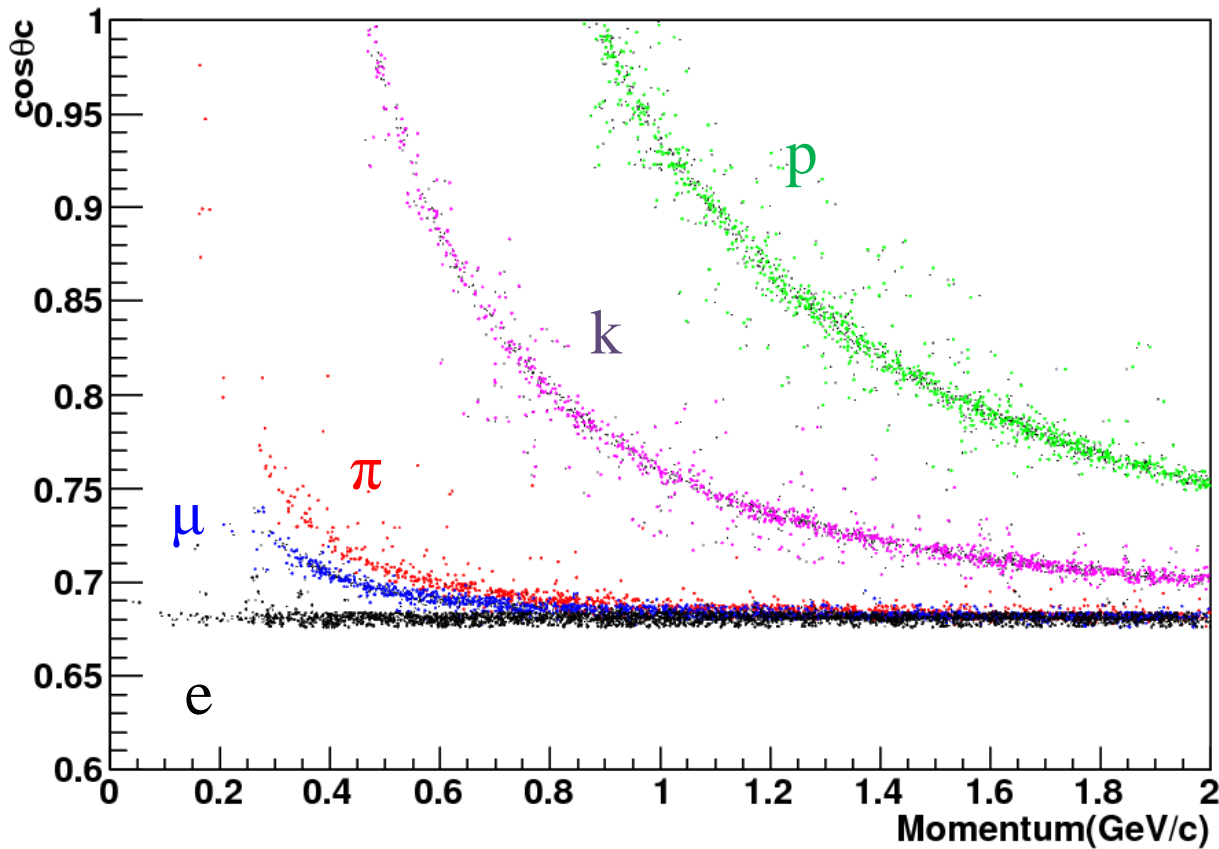
e,  $\mu$ ,  $\pi$ : 0.006



# Pdf of each charged particles



# PndPidDiscAssociatorTask



Prob(p)>0.2  
Prob(k)>0.2  
Prob( $\pi$ )>0.2  
Prob( $\mu$ )>0.2  
Prob(e)>0.2

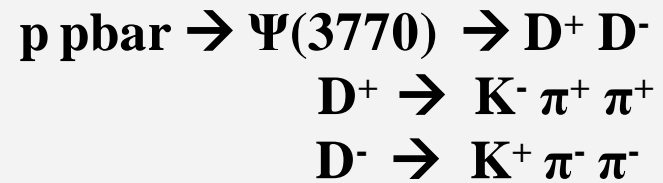
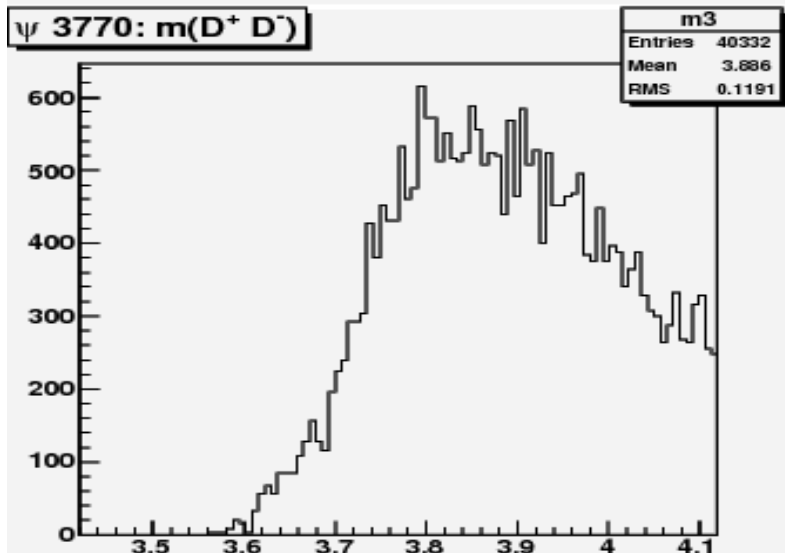
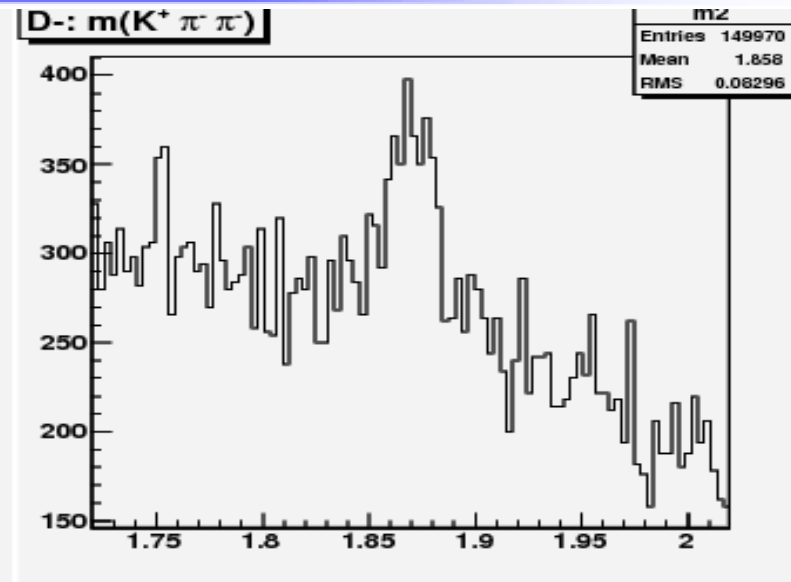
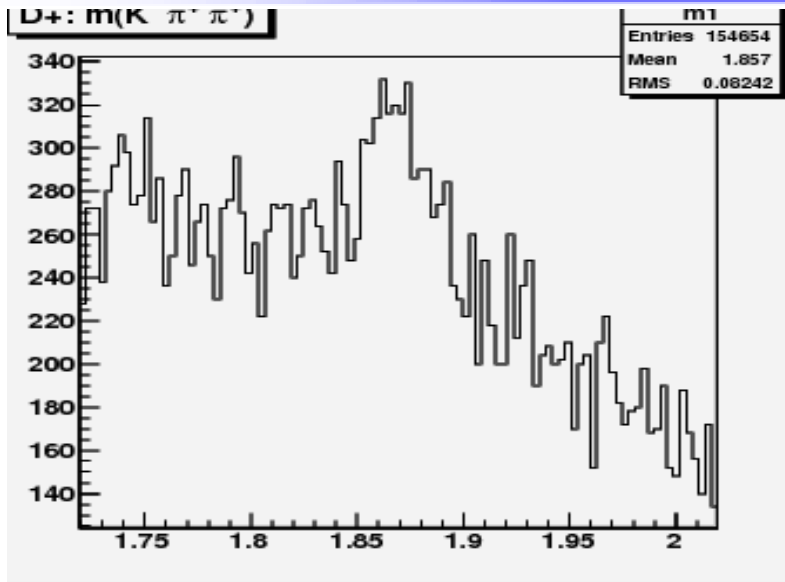
X: Prob(X)>0.2&&Prob(X)>Prob(others)

# Status of Disc DIRC Software

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PndDsk.cxx	: simulation
PndDskFLGHitProducerIdeal.cxx	: produce FLG hit
PndPidCorrelator.cxx	: match lhetrack with disc hit
PndPidDiscAssociatorTask.cxx	: implementation of disc pid
PndDskFLGHit.cxx	: basic class of FLG hit

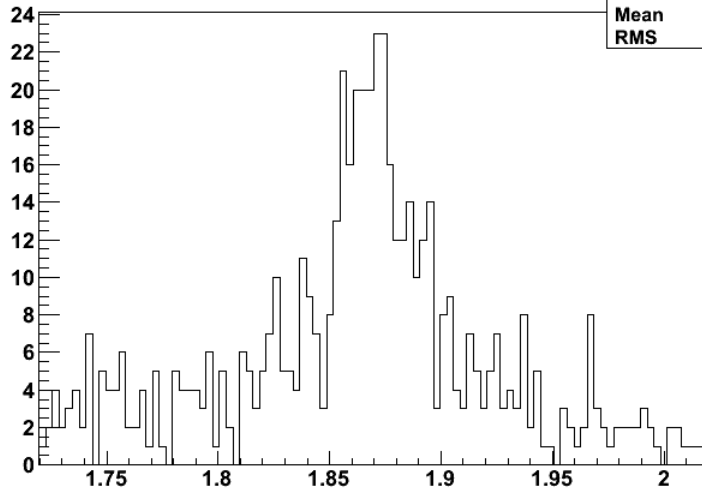
# Test with a physics channel



4000 events

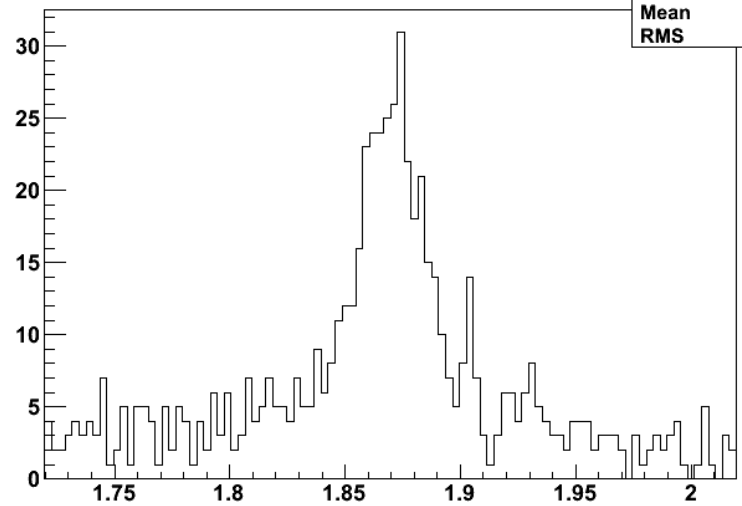
# Test with a physics channel

D+:  $m(K^- \pi^+ \pi^+)$



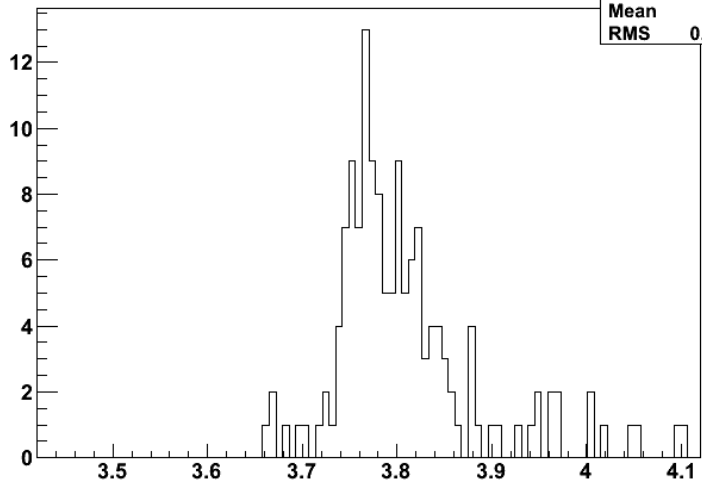
m1	
Entries	1411
Mean	1.863
RMS	0.0604

D-:  $m(K^+ \pi^- \pi^-)$



m2	
Entries	1411
Mean	1.865
RMS	0.06

ψ 3770:  $m(D^+ D^-)$

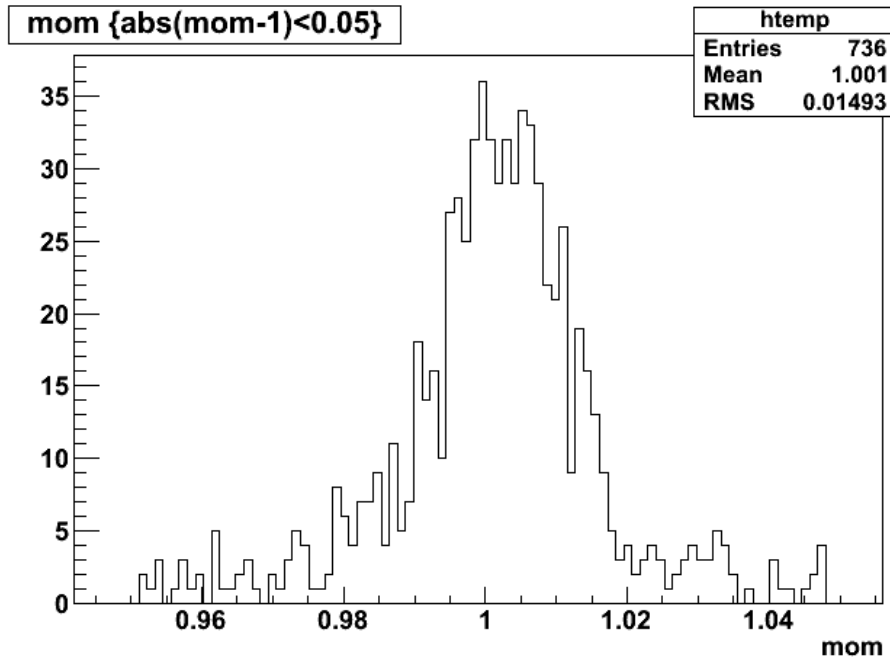


m3	
Entries	162
Mean	3.809
RMS	0.07966

4000 → 162 survived  
Effi: ~4%

# Test with a physics channel

1. 6 particles with  $\theta > 10^\circ$  and  $p > 0.2\text{GeV}$ : 30%



2.  
1000 single pi, 1GeV/c  
  
Theta(5-10degree)effi: ~36%  
Theta(10-30) effi: 82%  
Theta(30-90) effi: 80%  
  
6 tracks ~ 26%

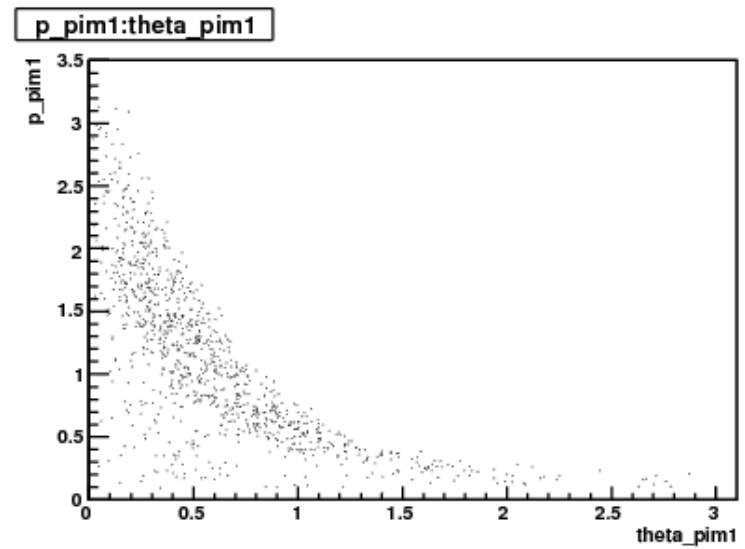
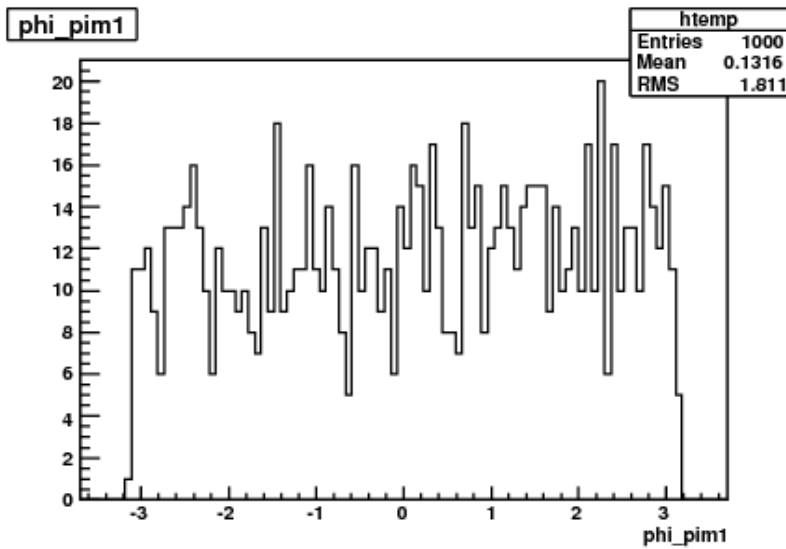
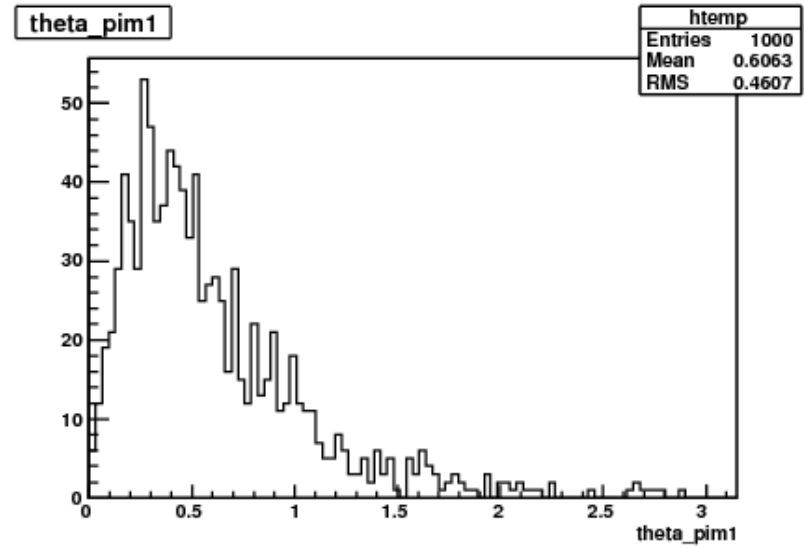
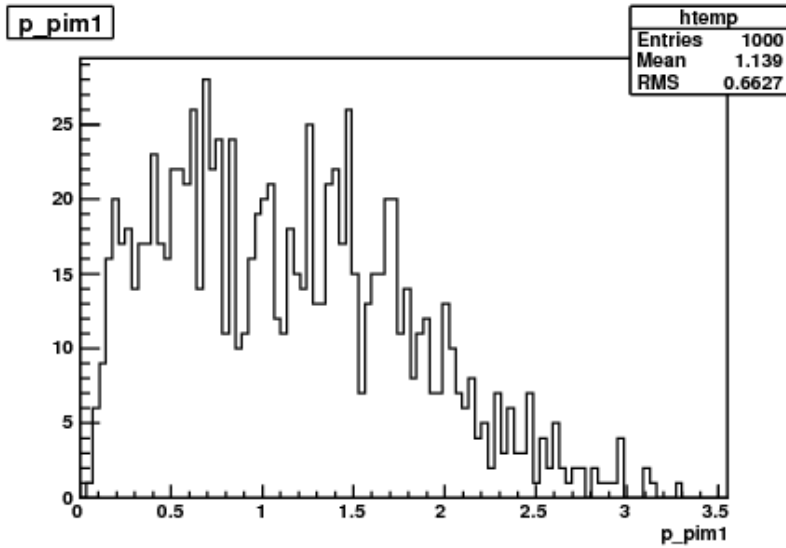
3. Total effi: 30% \* 26% ~ 8%

# Summary

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1. One simple version of software for disc DIRC is usable now. Two detector versions, FLG or Top, could be set up.
2. With one physics channel, the software is tested, and seems good.
3. Hit pattern of FLG version is produced. Reconstruction algorithm has not been implemented.

# Test with a physics channel





```
double lambda1 = 280e-9; //range of wavelength
double lambda2 = 330e-9;
double alpha=7.2974e-3; //finestructure constant

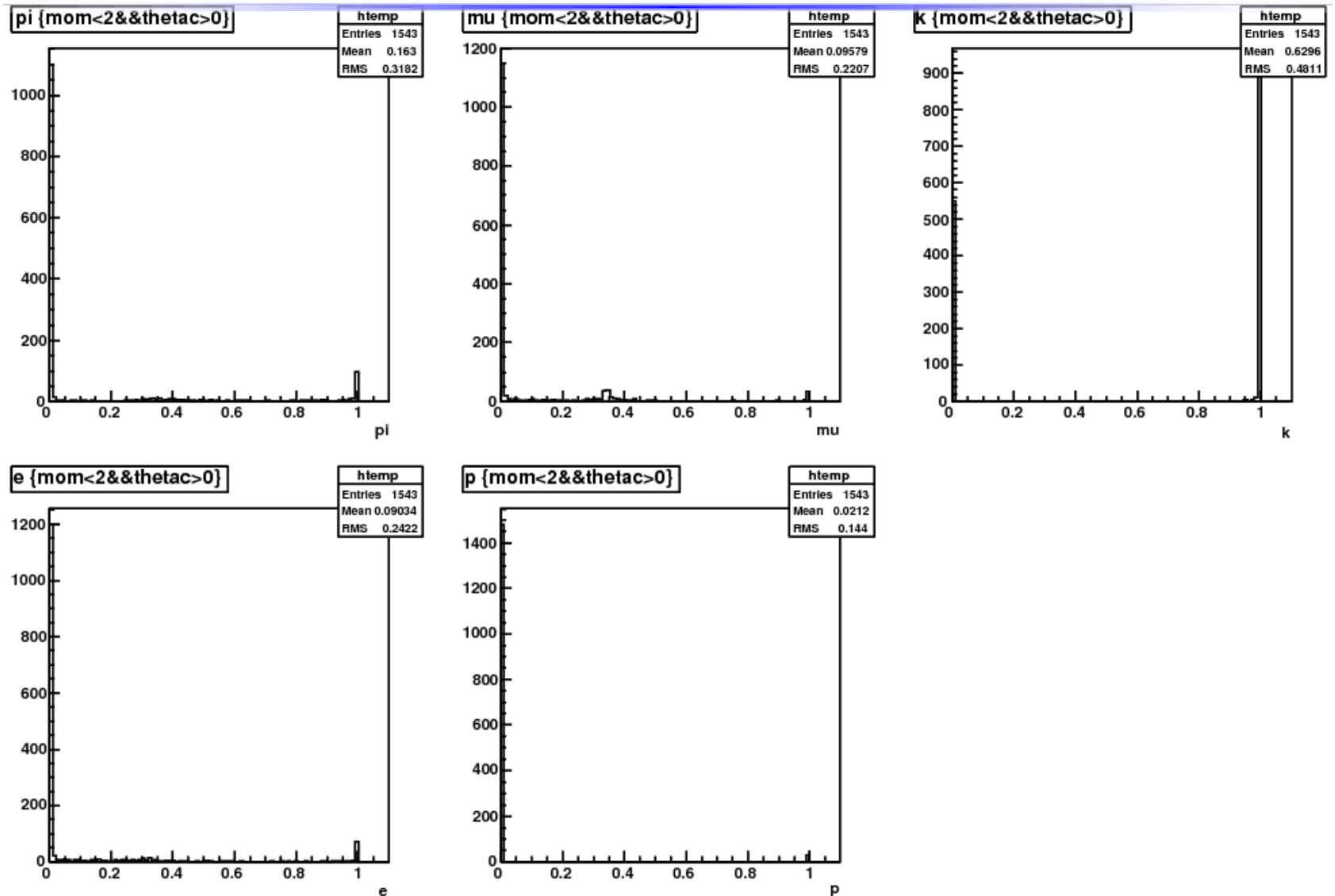
nPhot = 2*TMath::Pi()*alpha*I*(1./lambda1 - 1./lambda2)*(1 -
(fEnergy*fEnergy)/(fP*fP*1.47*1.47));

nPhot = gRandom->Poisson(nPhot);

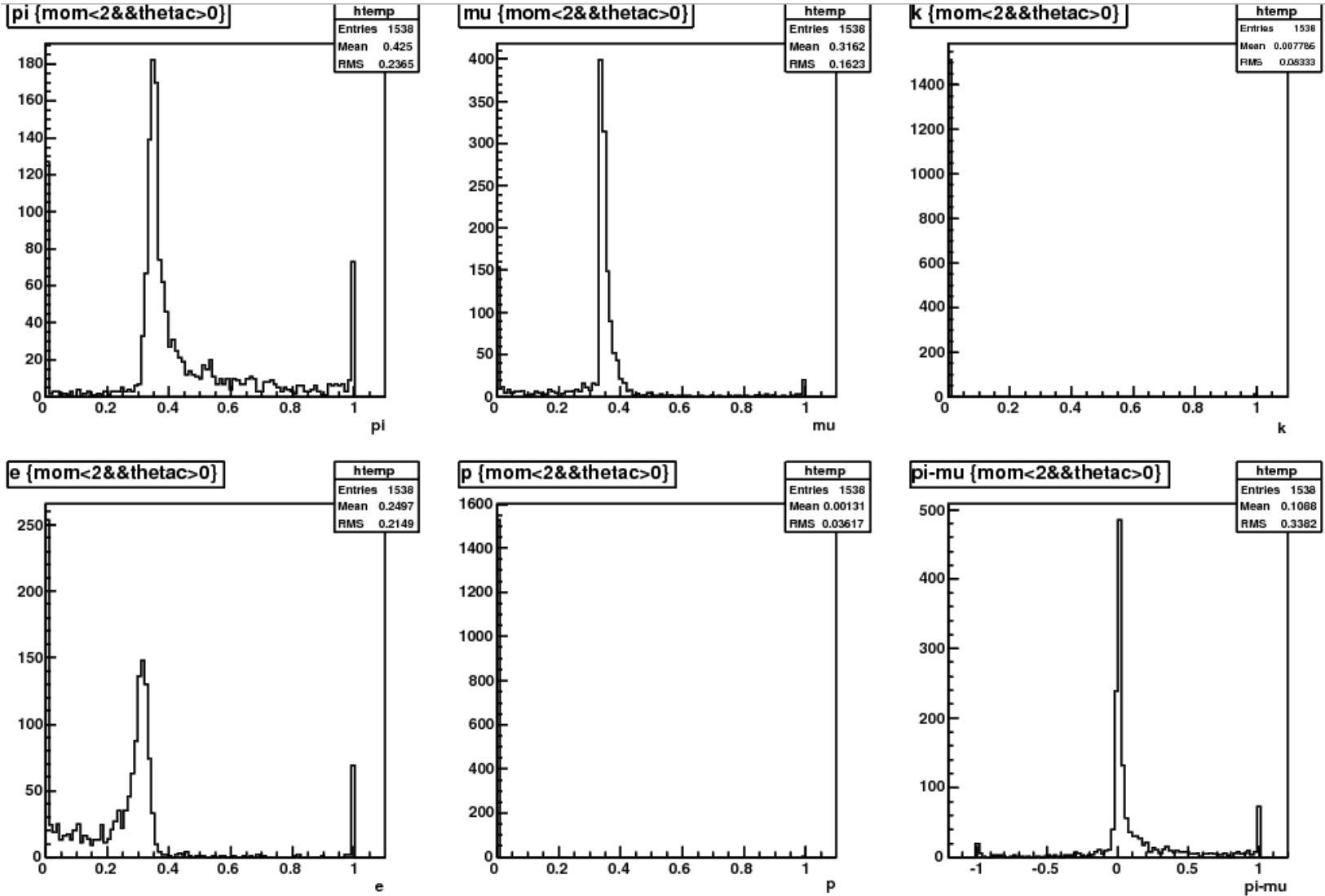
nPhot *= trapped*effNphotons;

res = 0.01/sqrt(nPhot);
```

# Pdf of kaon as each particle hypothesis

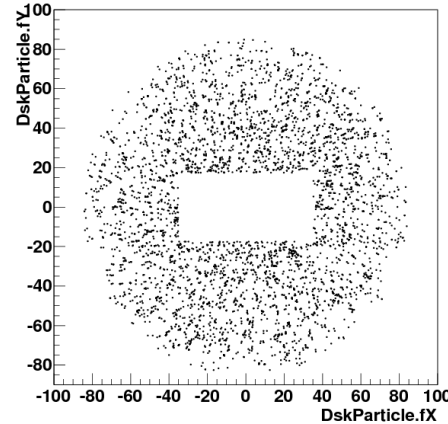


# Pdf of pion as each particle hypothesis

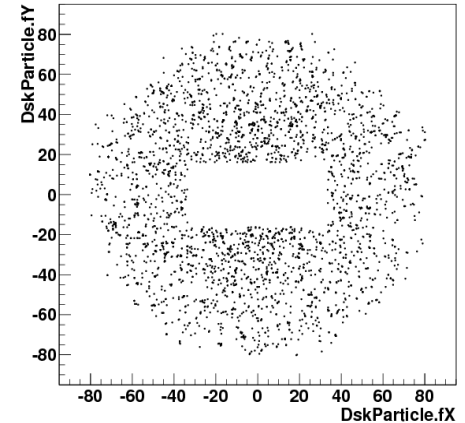


# Status of Disc DIRC Software in PandaRoot

**Simulation:** Like fast simulation, the  $\theta_c$  is calculated and stored. For FLG version, the hit pattern could be simulated.



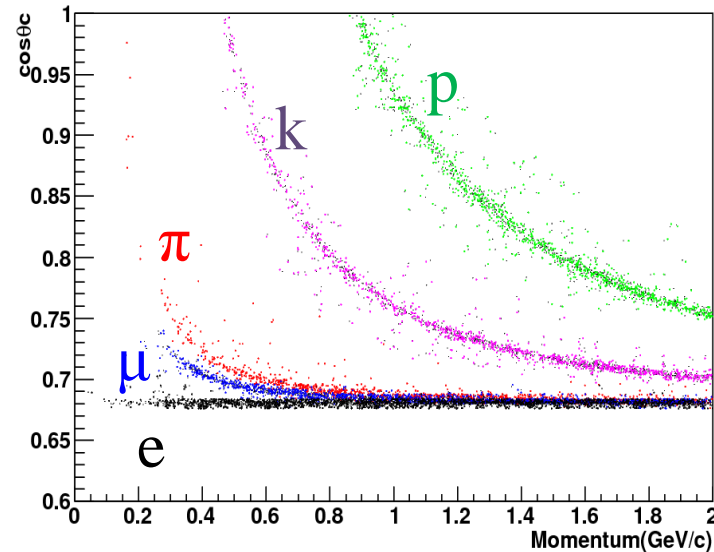
FLG version



Top Version

**Reconstruction:** Not started yet.

**PID:** 1. Match of disc hit with central track. (PndPidCorrelator)  
2. Implementation of pid. (PndPidDiscAssociatorTask)  
Pdf: Gaus  
Center:  $\cos(\theta_c)$   
Sigma: Parametrization



Prob(p) > 0.2  
Prob(k) > 0.2  
Prob( $\pi$ ) > 0.2  
Prob( $\mu$ ) > 0.2  
Prob(e) > 0.2

## Probability Density Function - II

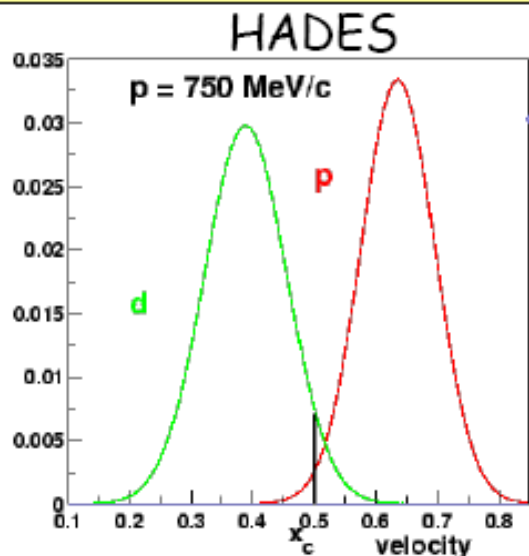


Fig.1 Probability density functions of velocities for protons and deuterons at particle momentum 750 MeV/c

gaussian  
distributions

For each particle hypothesis  
 calculation of (normalized) pdf

- from simulation
- from experimental data

$x$  - signal ( $p, dE/dx, \theta_c \dots$ )

$h$  - particle hyp ( $e, \mu, \pi, K, p$ )

$$p(\vec{x}, h)$$

depends on  
 detector response