SINGLE TRACK SIMULATIONS

First results for muons, protons and kaons

XXXX

I. Garzia, Università degli studi di Ferrara

Single track simulation

GOAL: debug the first version of the software. Cannot be used yet to draw conclusions on the performances of the CGEM

- CGEMBoss software 6.6.5.b and Boss version 665p01
- All detectors included in the simulation
- "fixpt" generator used to generate single particle tracks
- 10000 protons, muons and kaons
  - pt=(0.1, 0.15, 0.2, 0.3, 0.7) GeV/c
  - -0.93<cos(theta)<0.93
- **Difference in Reconstruction:**
  - 665p01: #include "$MDCXRECOROOT/share/jobOptions_MdcPatTsfRec.txt" (Runge-Kutta)
  - CGEMBoss: #include "$MDCXRECOROOT/share/jobOptions_MdcPatTsfRec_NoRK.txt"
- Observables:
  - pt reco after and before the Kalman fit
  - pt reco vs. theta after and before the Kalman fit
  - POCA after and before the Kalman fit
  - dr and dz (helix parameters) resolutions

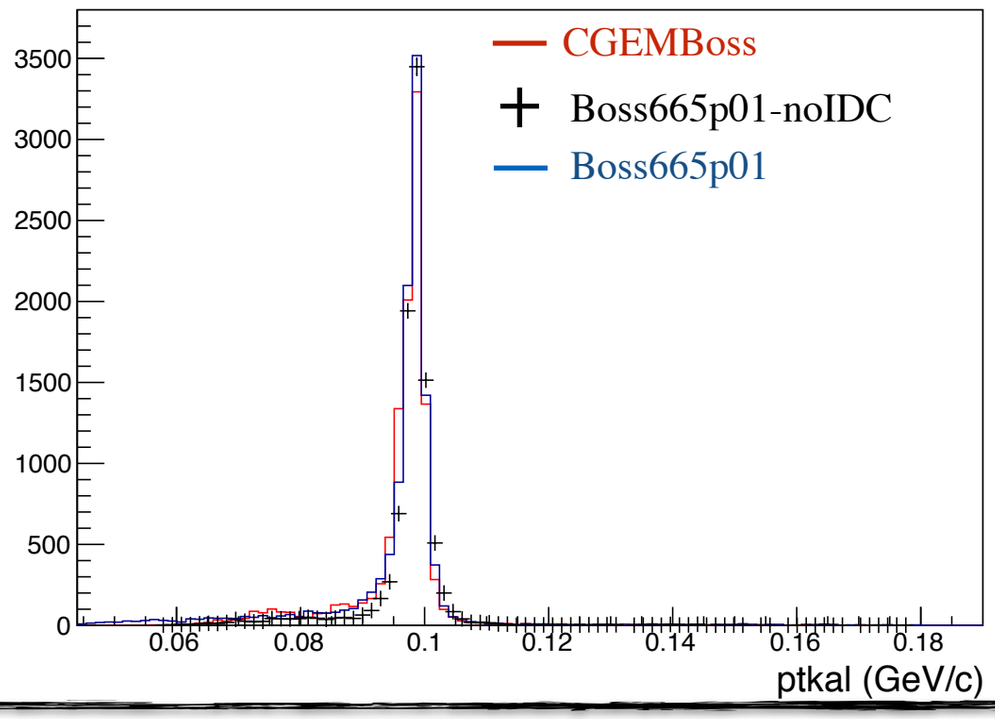
NOTE

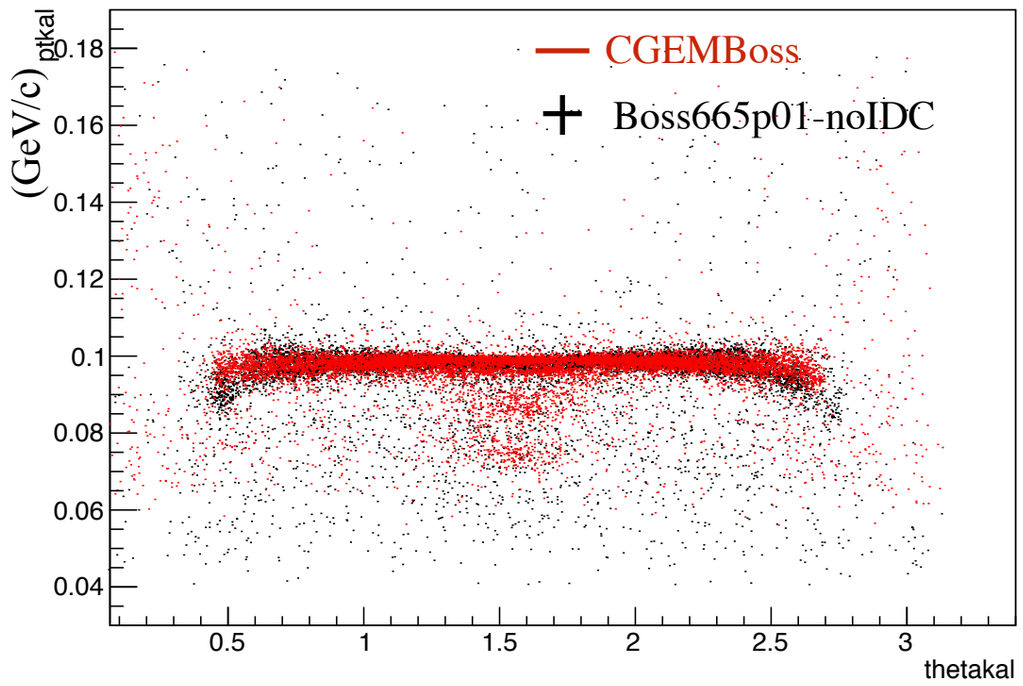
- **CGEMBoss: the observables before the kaman fit are the results of combination between CGEM and ODC. This means that cannot directly compare these variables**

Muons: pt reco

After Kalman fit pt=100 MeV

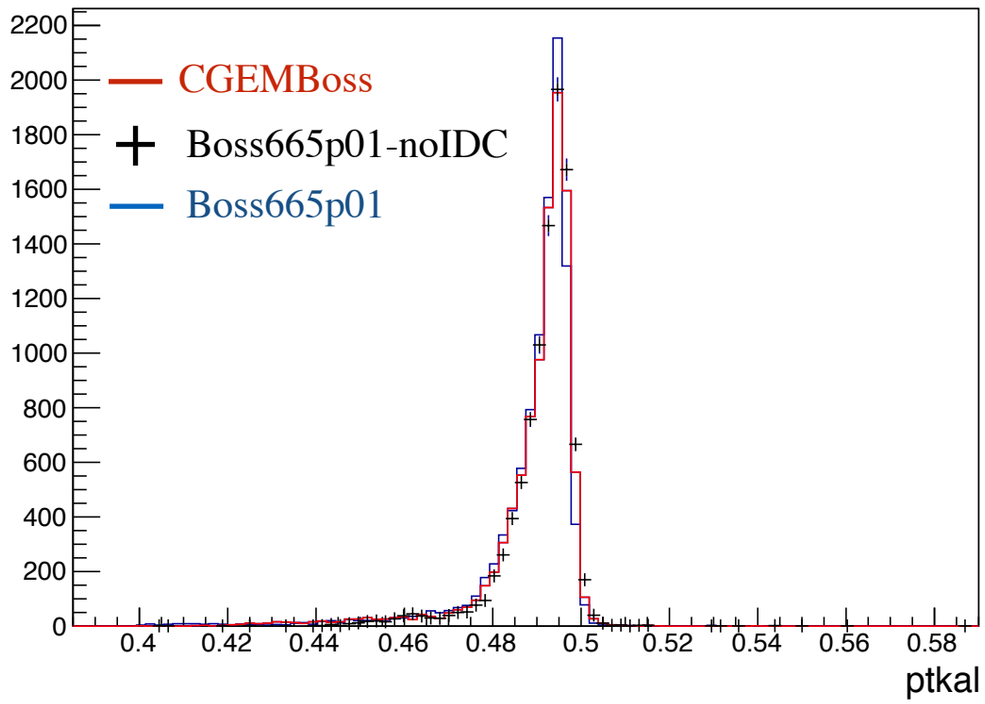
Good agreement before the Kalman fit

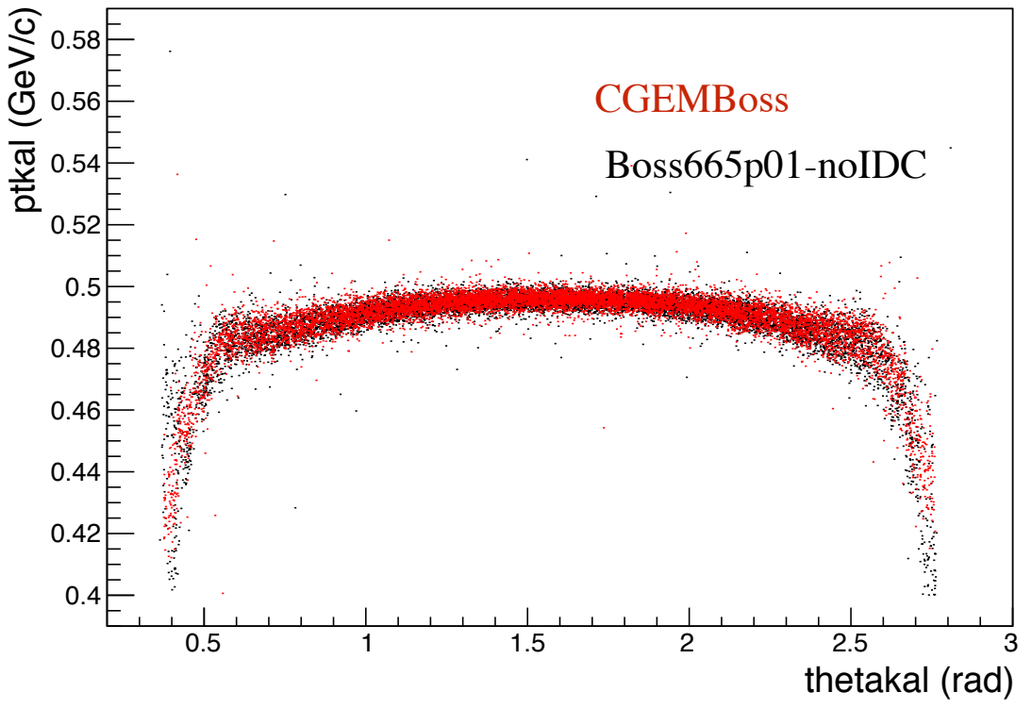




After Kalman fit pt=500 MeV

Good agreement before the Kalman fit

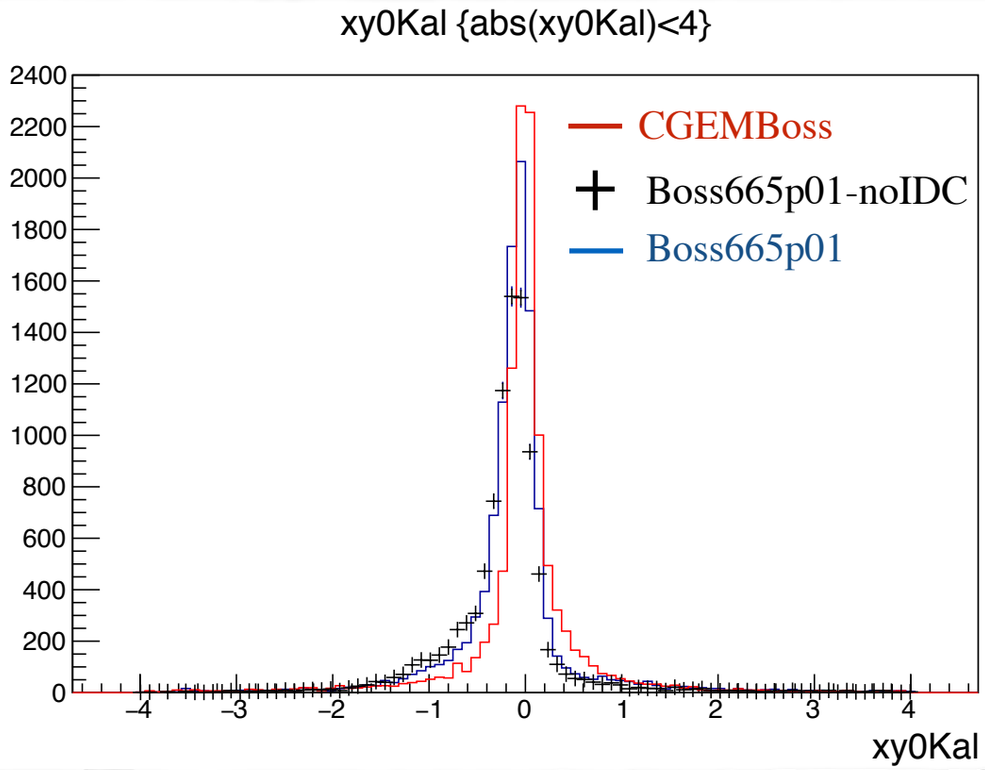


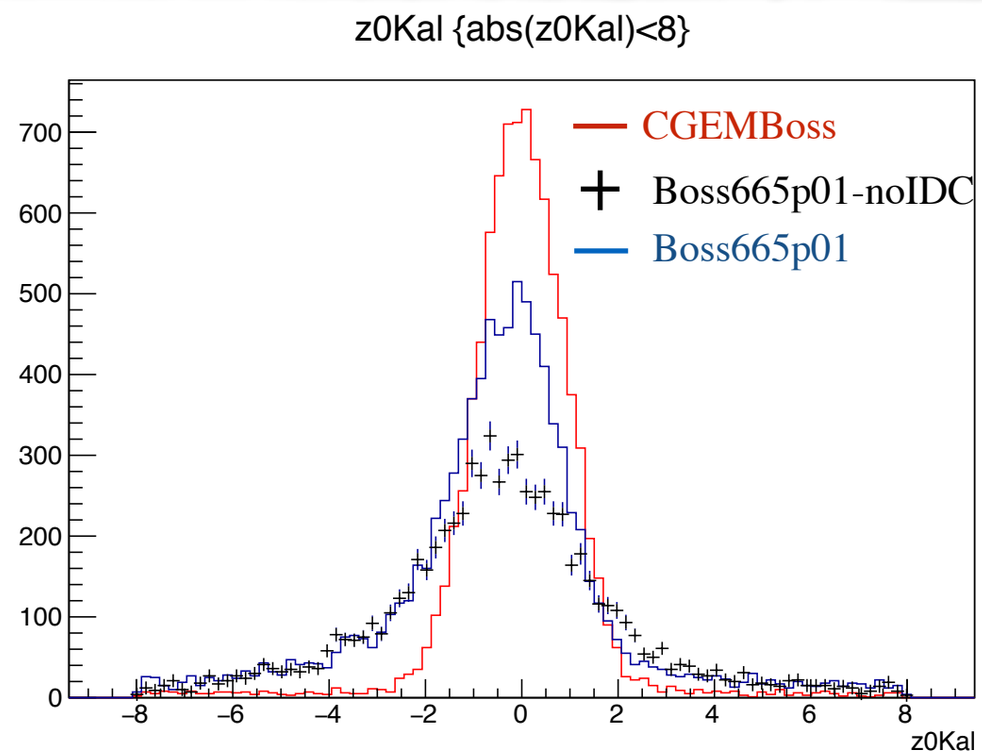


Muons: POCA

After Kalman fit pt=100 MeV

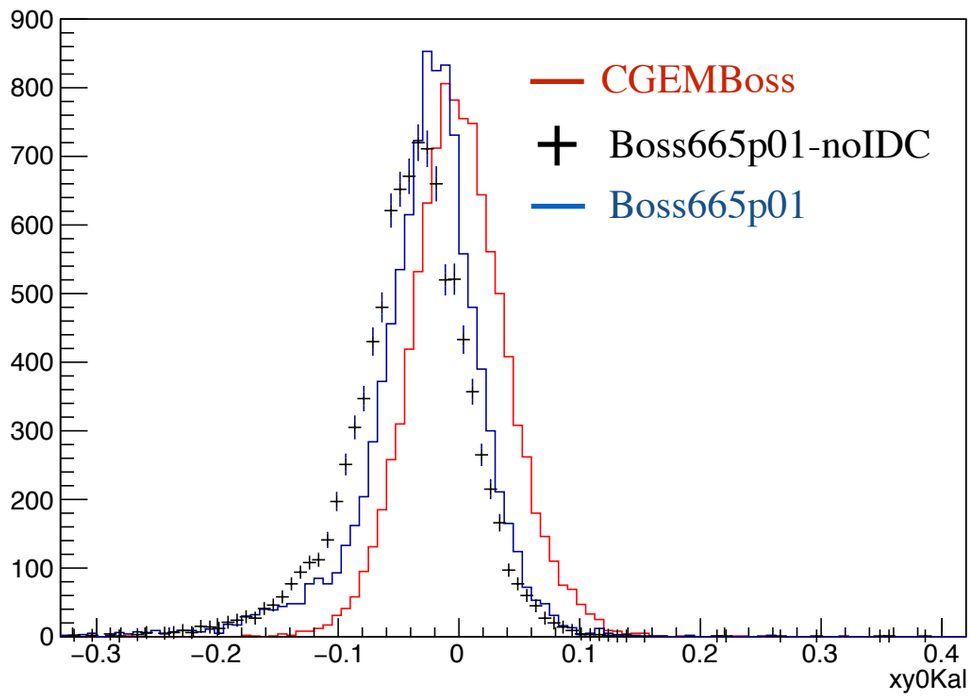
POCAz is better for CGEM

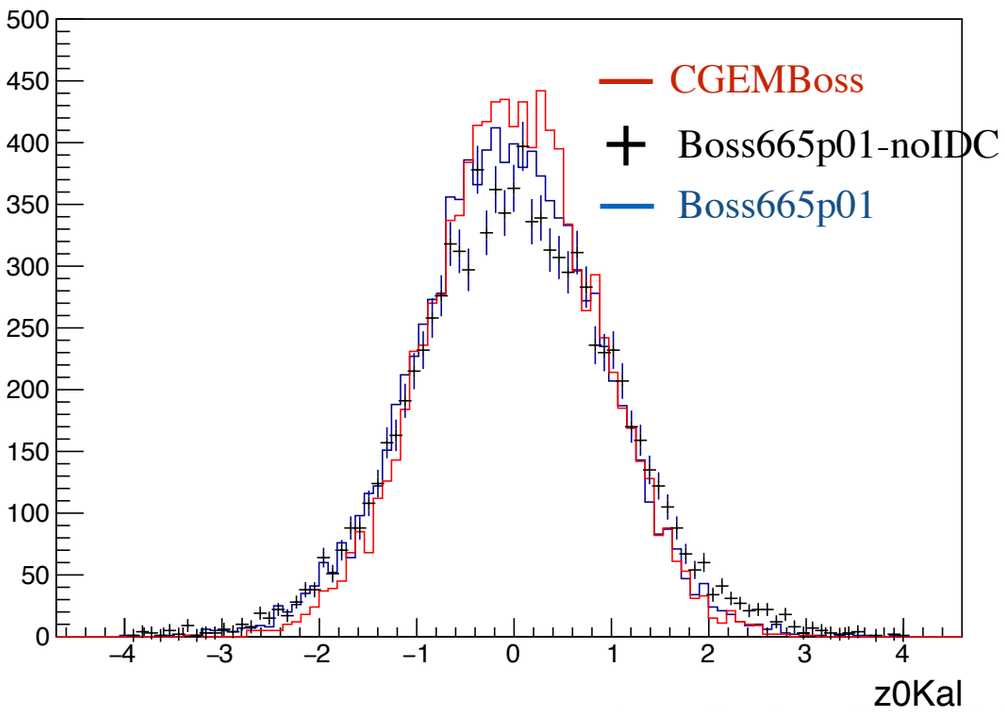




After Kalman fit pt=500 MeV

POCAz in agreement





Observation from the previous CGEM meeting

POCA: variable used up to now

```
HepVector a = mdcTrk->helix();
HepSymMatrix Ea = mdcTrk->err();
HepPoint3D point0(0.,0.,0.);   // the initial point for MDC rec.
HepPoint3D IP(xorigin[0],xorigin[1],xorigin[2]);
VFHelix helixip(point0,a,Ea);
helixip.pivot(IP);
HepVector vecipa = helixip.a();
double  Rvxy0=(vecipa[0]);  //the nearest distance to IP in xy plane
double  Rvz0=vecipa[3];   //the nearest distance to IP in z direction
double  Rvphi0=vecipa[1];
m_rvxy0=Rvxy0;
m_rvz0=Rvz0;
m_rvphi0=Rvphi0;
```

```
if(fabs(Rvz0) >= 10.0) continue;
if(fabs(Rvxy0) >= 1.0) continue;
```

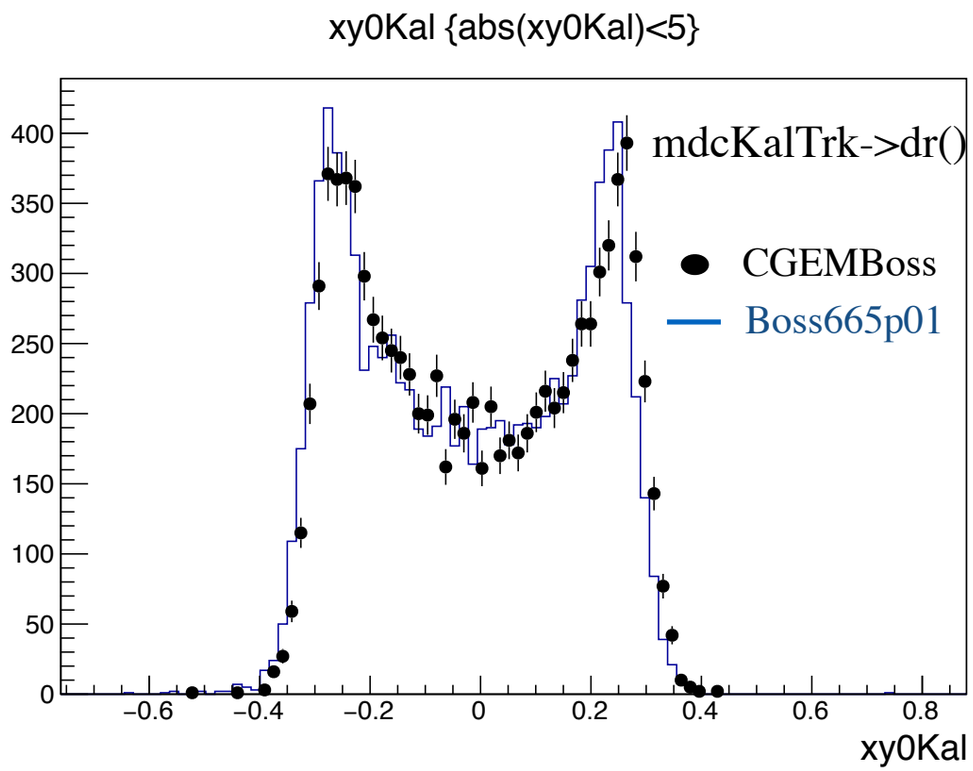
Variable used by Liangliang

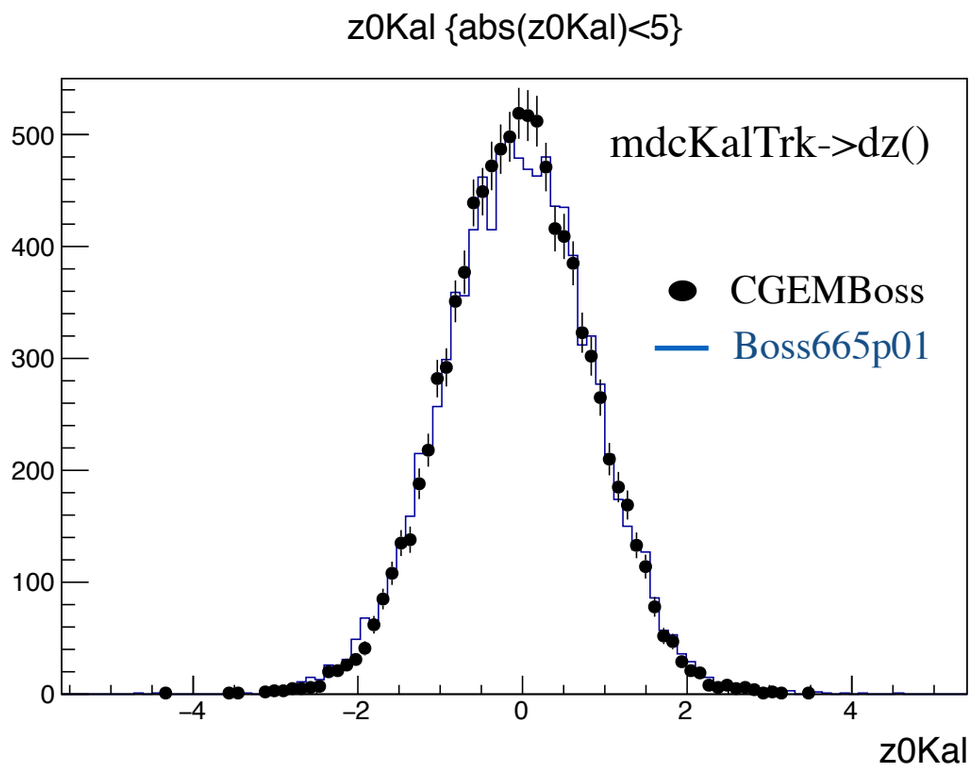
```
RecMdcKalTrack* mdcKalTrk = (*itTrk)->mdcKalTrack();
RecMdcKalTrack::setPidType  (RecMdcKalTrack::kaon);
```

```
m_xyRes = mdcKalTrk->dr() - mymcdr;
m_zRes = mdcKalTrk->dz() - mymcdz;
```

Vertex resolution I

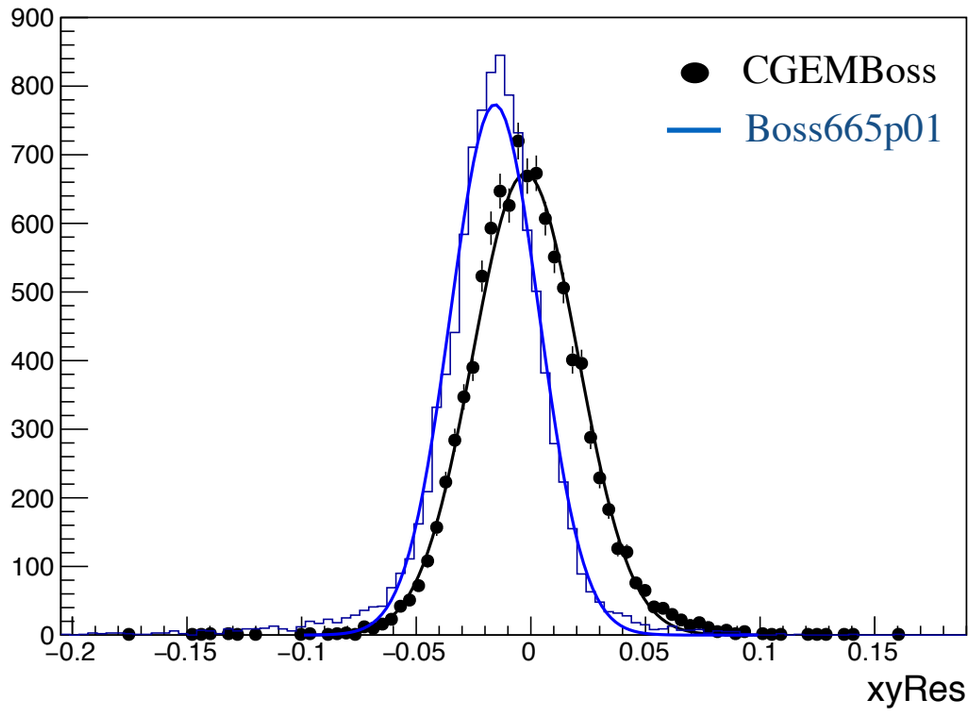
MUONS:
pt=700 MeV

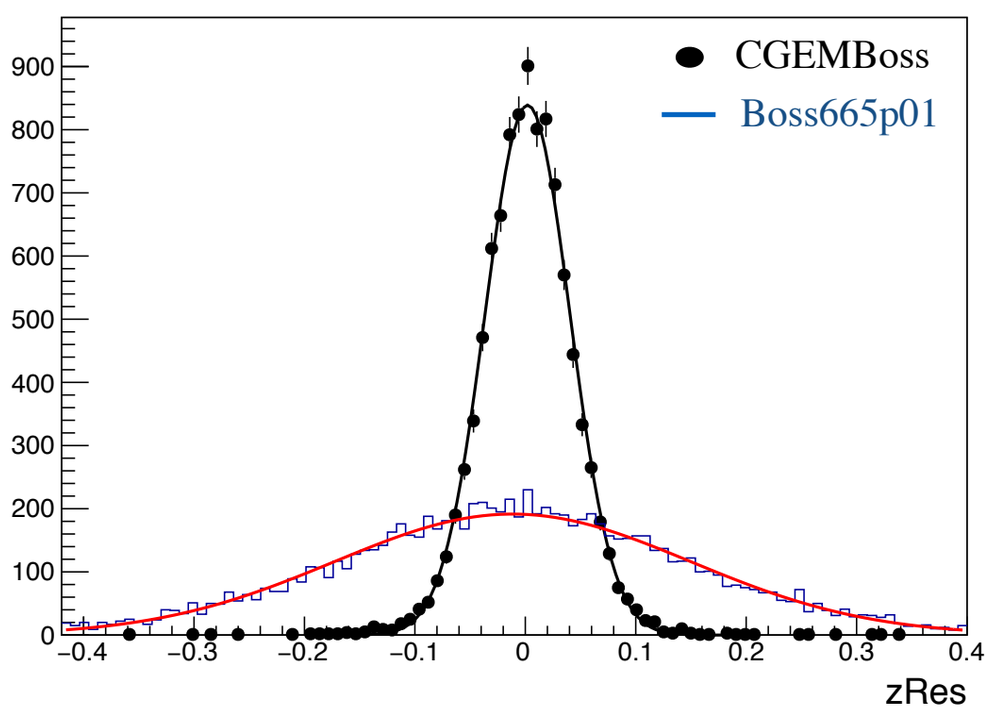




Residual distributions: reco - MCtruth

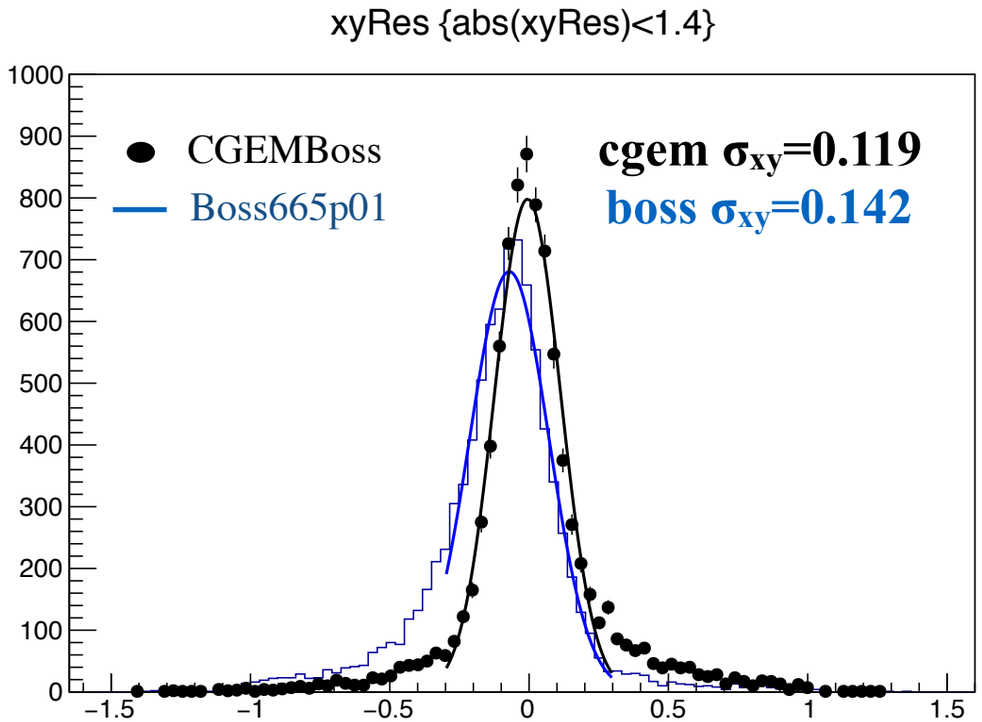
MUONS:
pt=700 MeV

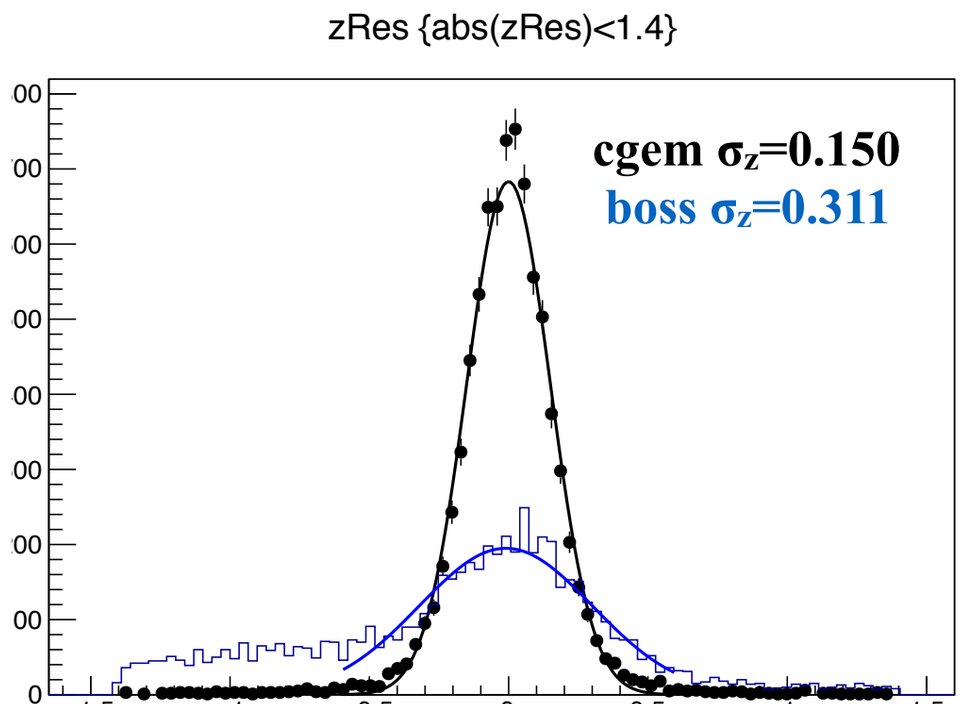




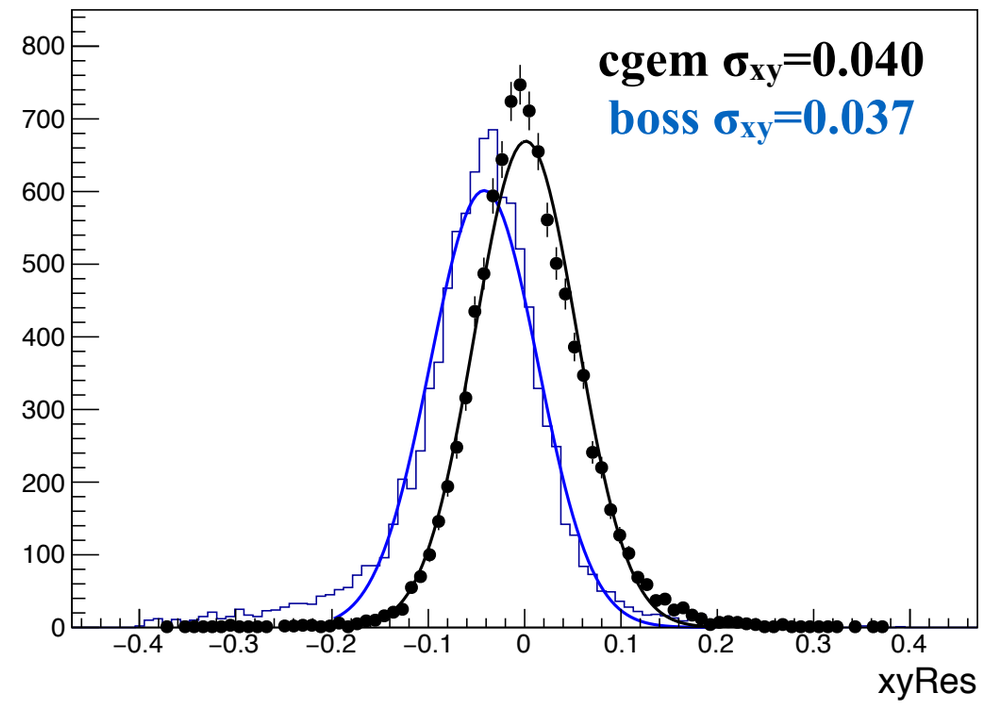
Vertex resolution II

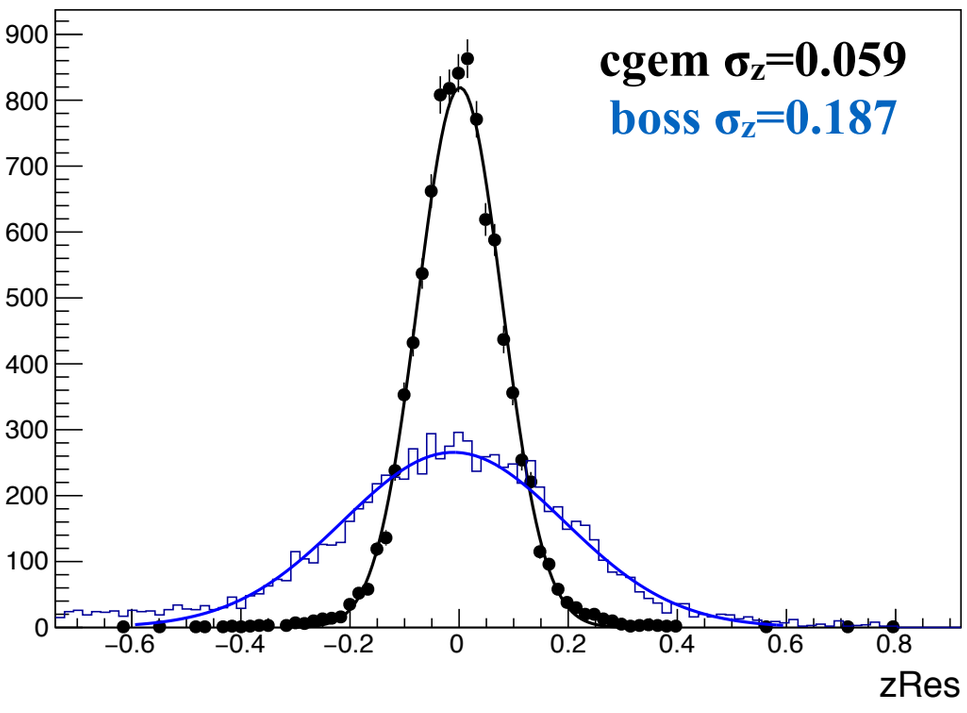
MUONS:
pt=100 MeV



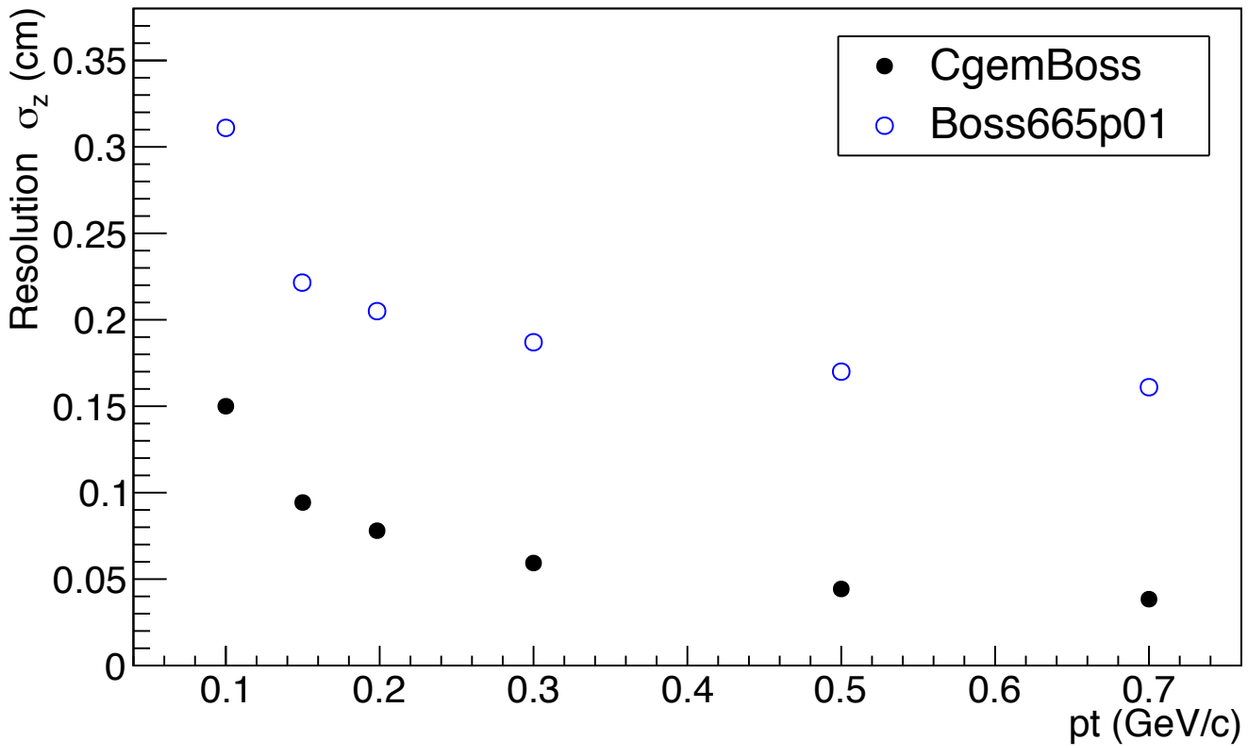


MUONS:
pt=300 MeV

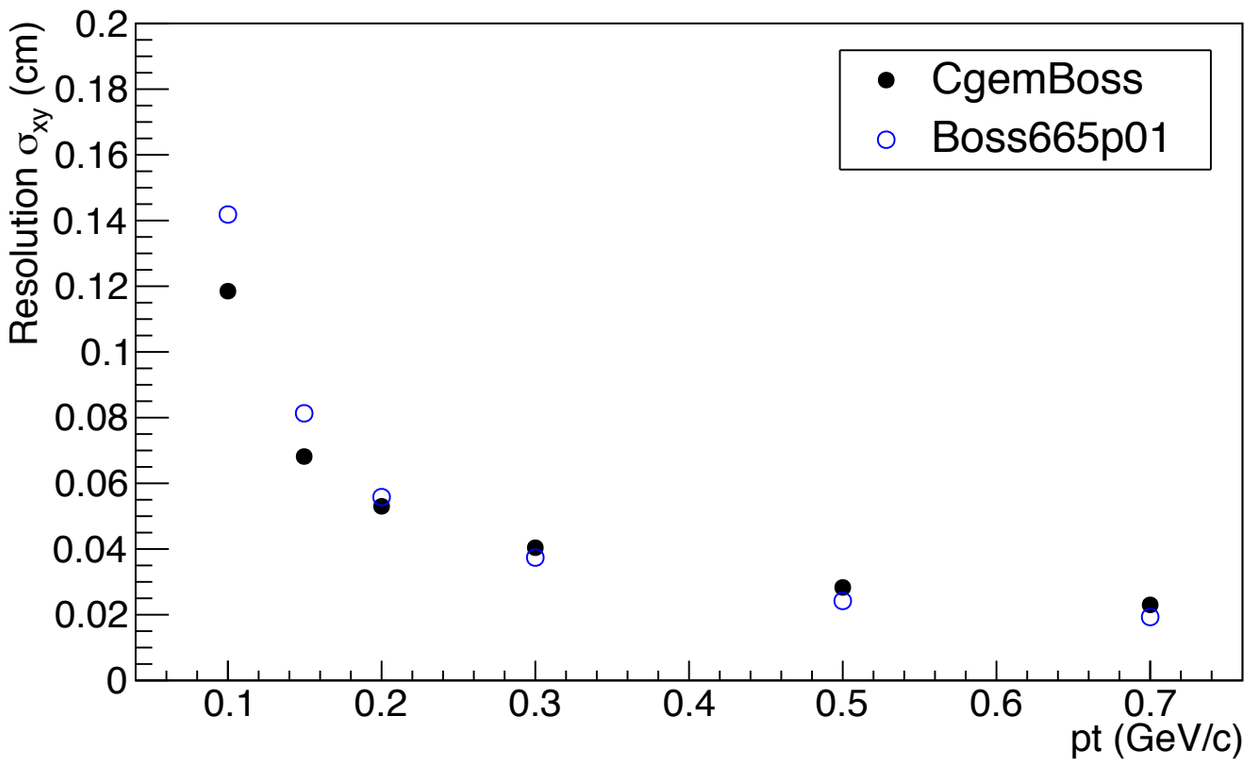


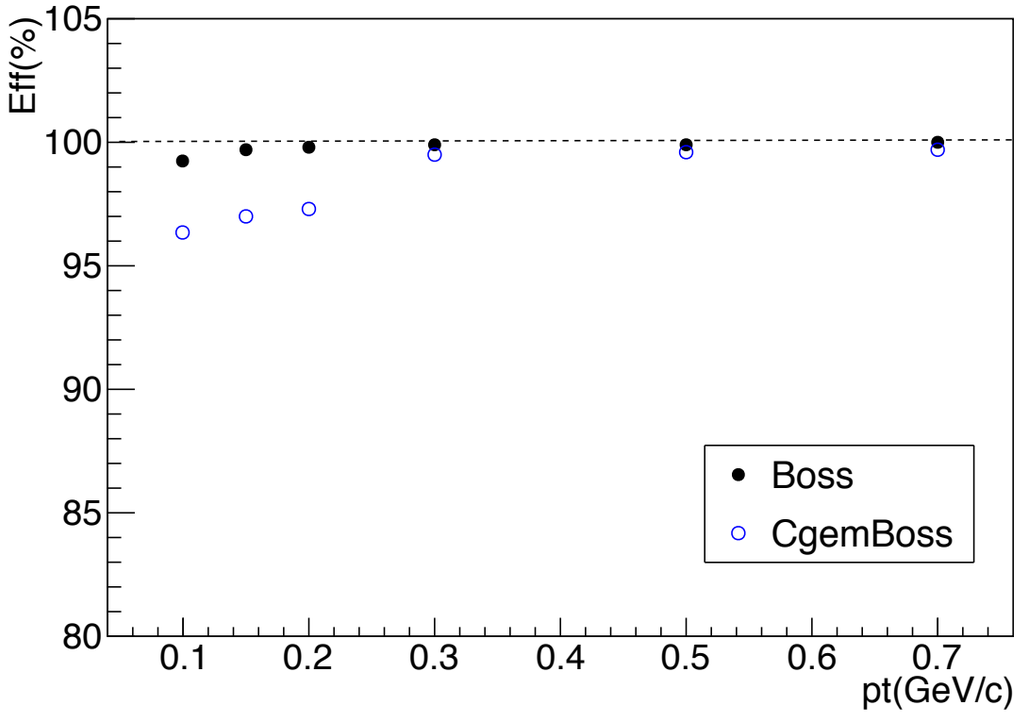


MUONS: summary



- **CgemBoss efficiency < Boss efficiency**
- **Vertex resolution along z direction better for CGEM (by a factor of about 3)**
- **Good consistency of the vertex resolution in the XY plane for pt > 300 MeV/c**

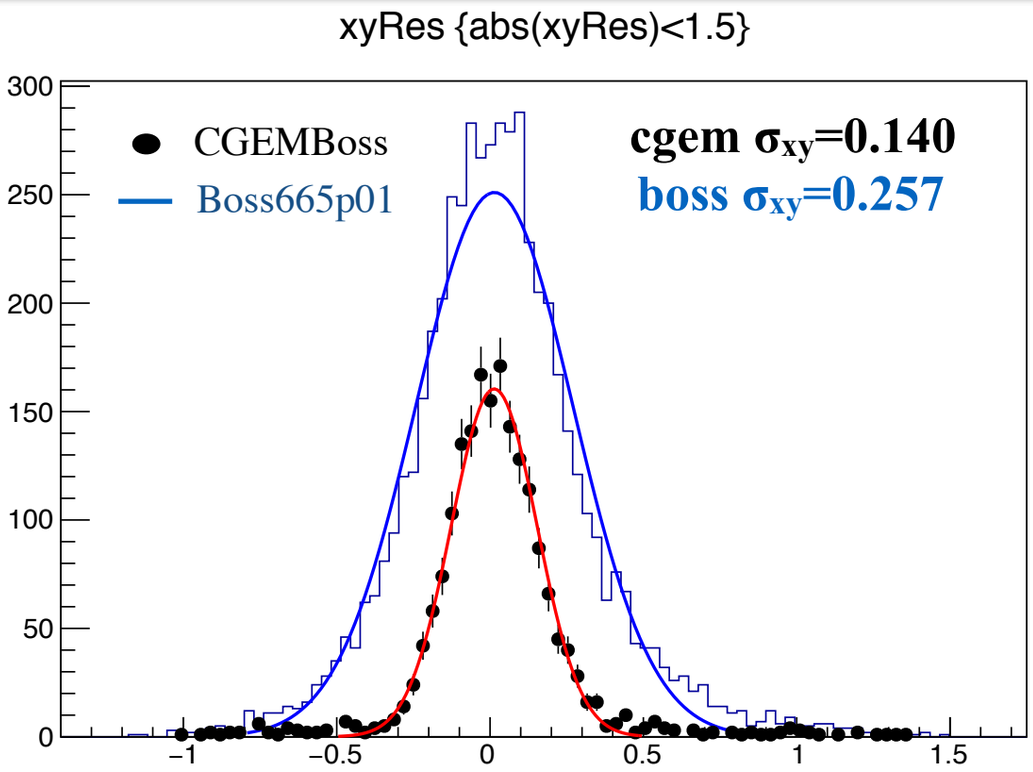


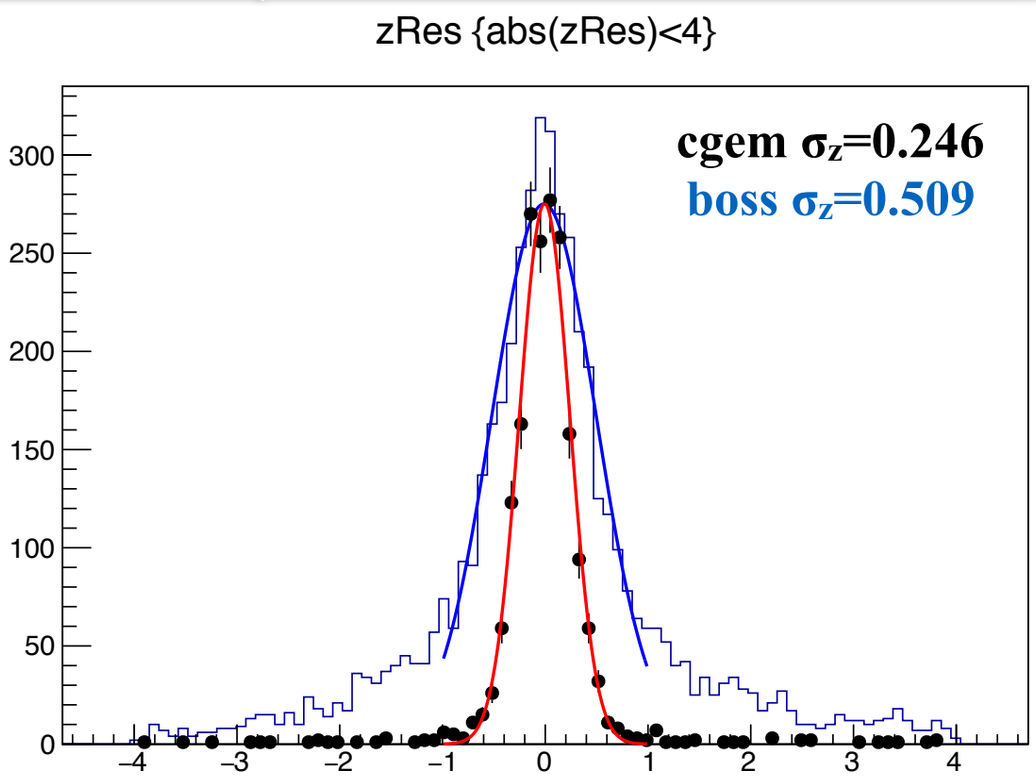


Protons

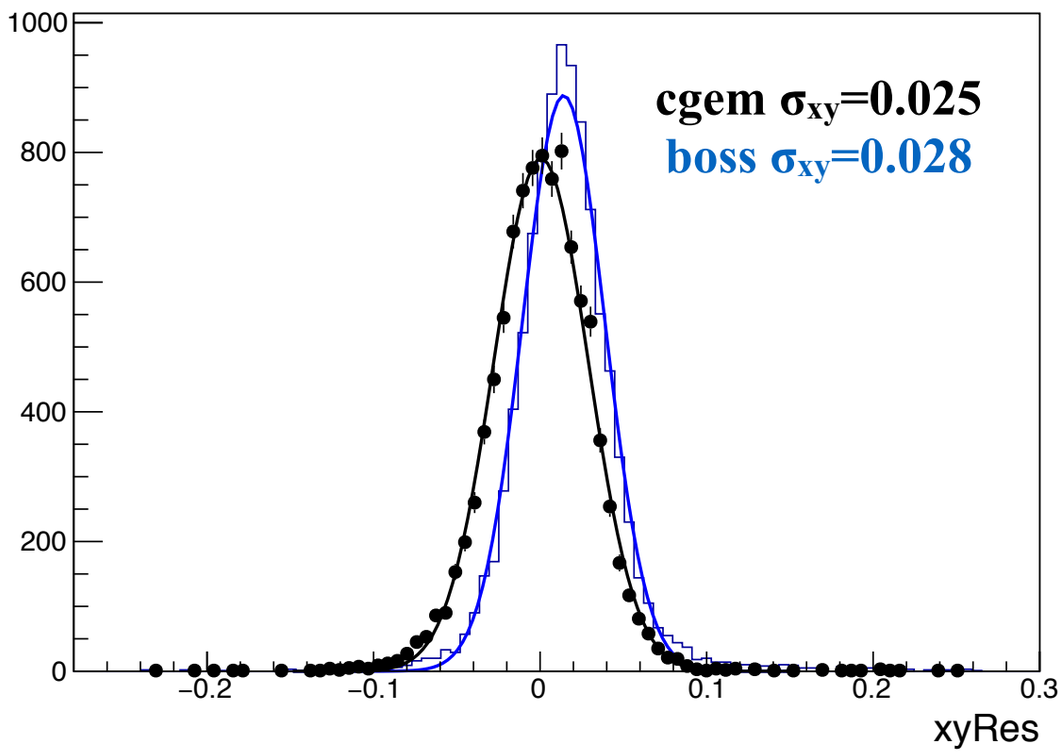
Vertex resolution for protons

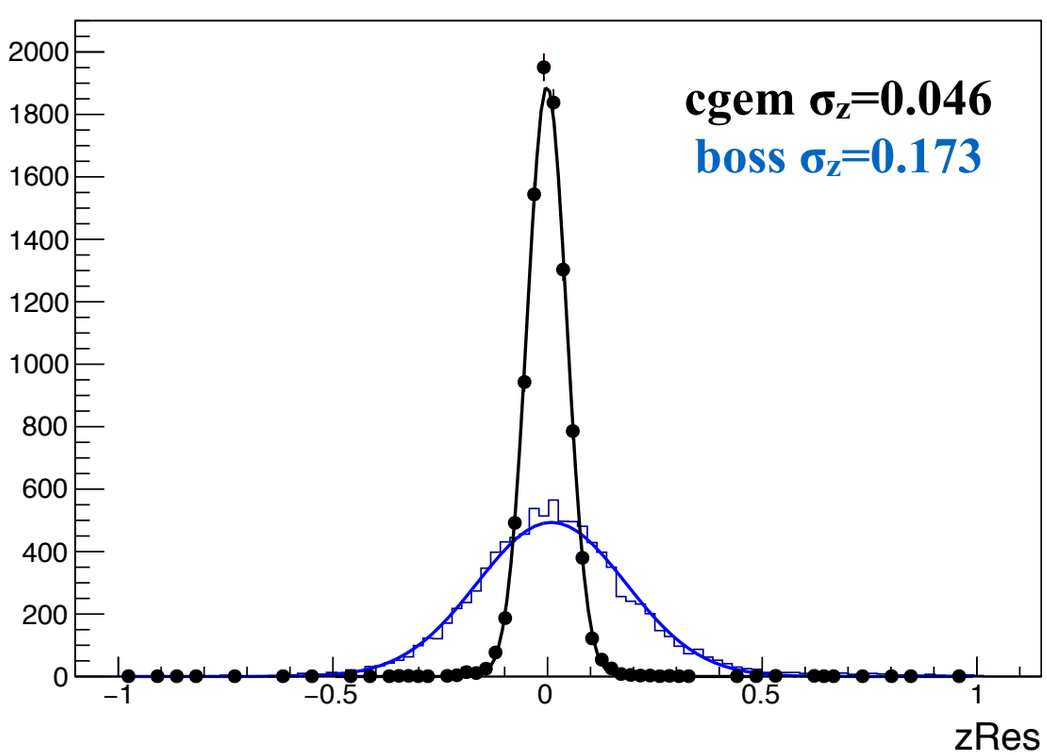
Protons:
pt=200 MeV



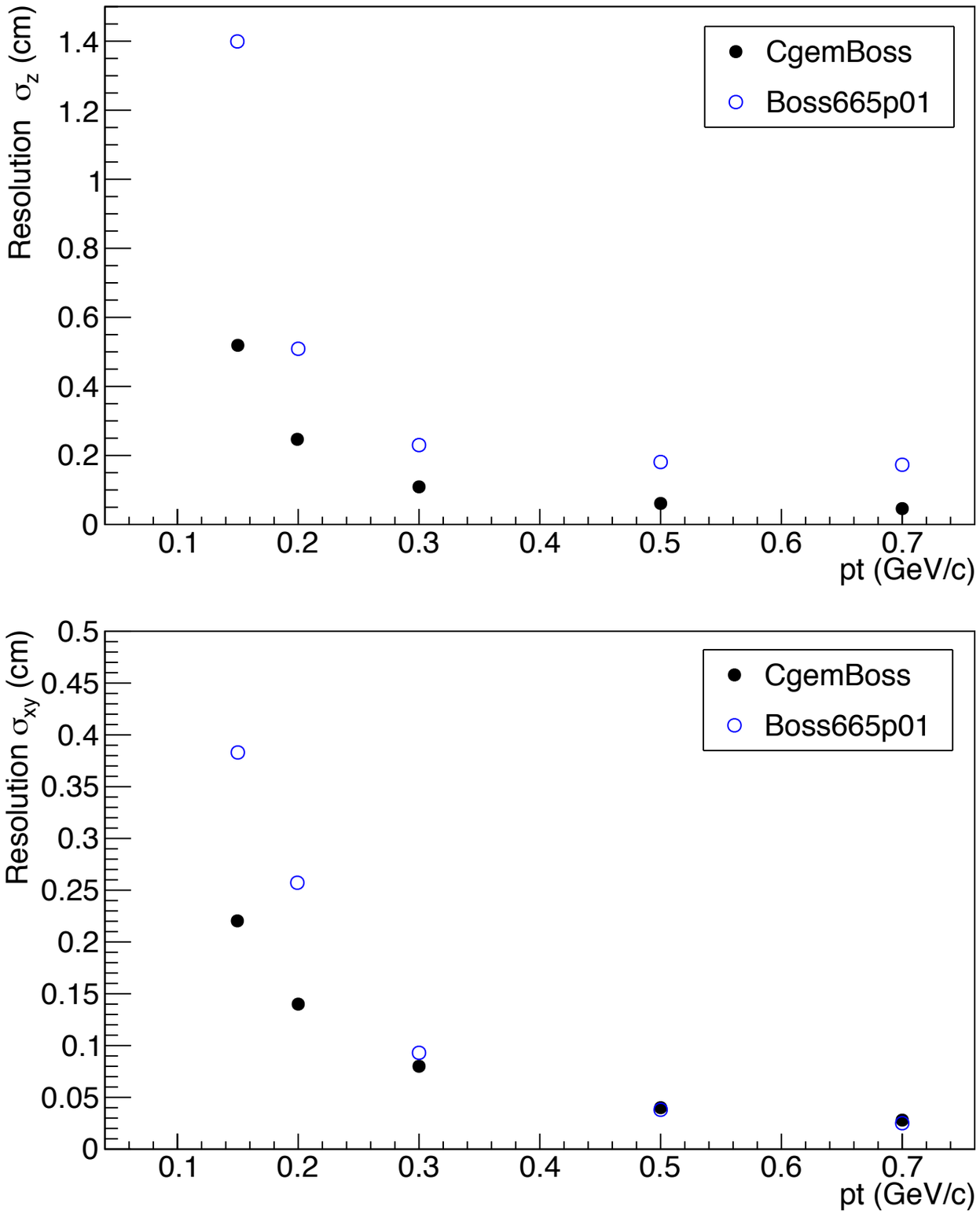


Kaons:
pt=700 MeV

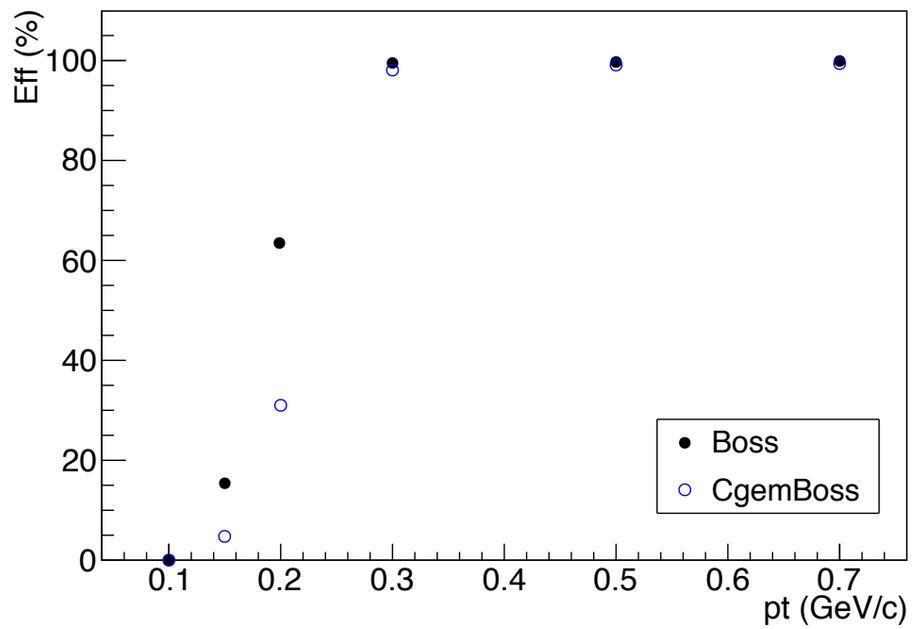




PROTONS: summary



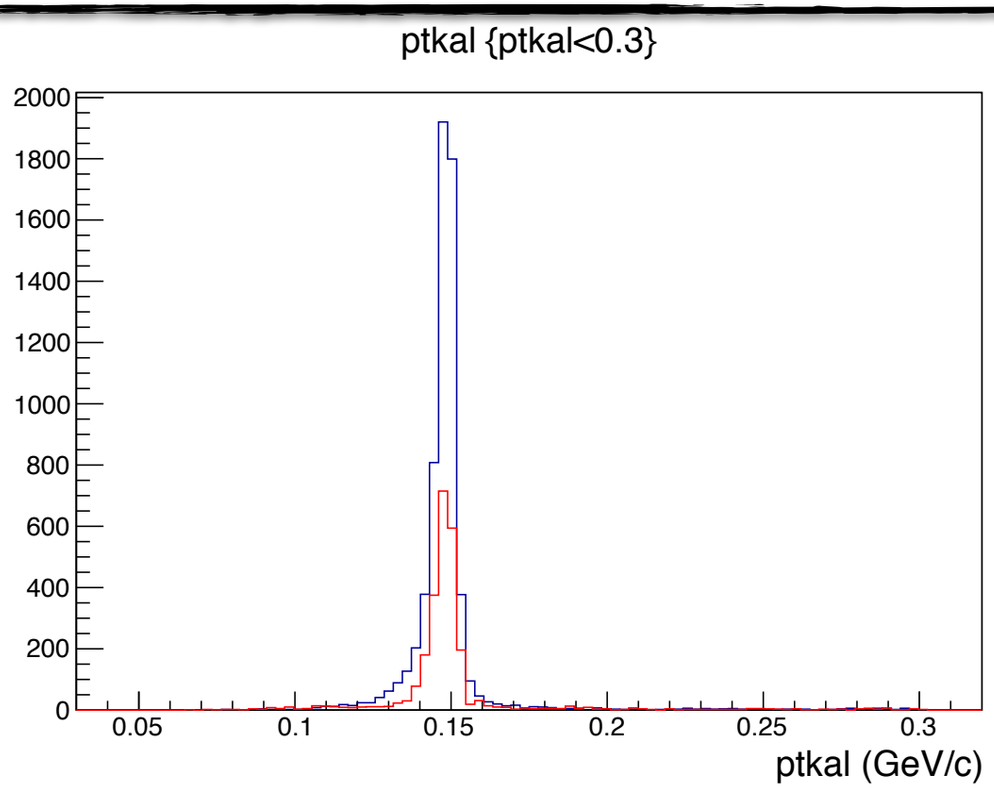
- **CgemBoss efficiency < Boss efficiency**
- **Vertex resolution along z direction better for CGEM (by a factor of about 3)**
- **Good consistency of the vertex resolution in the XY plane for pt > 300 MeV/c**

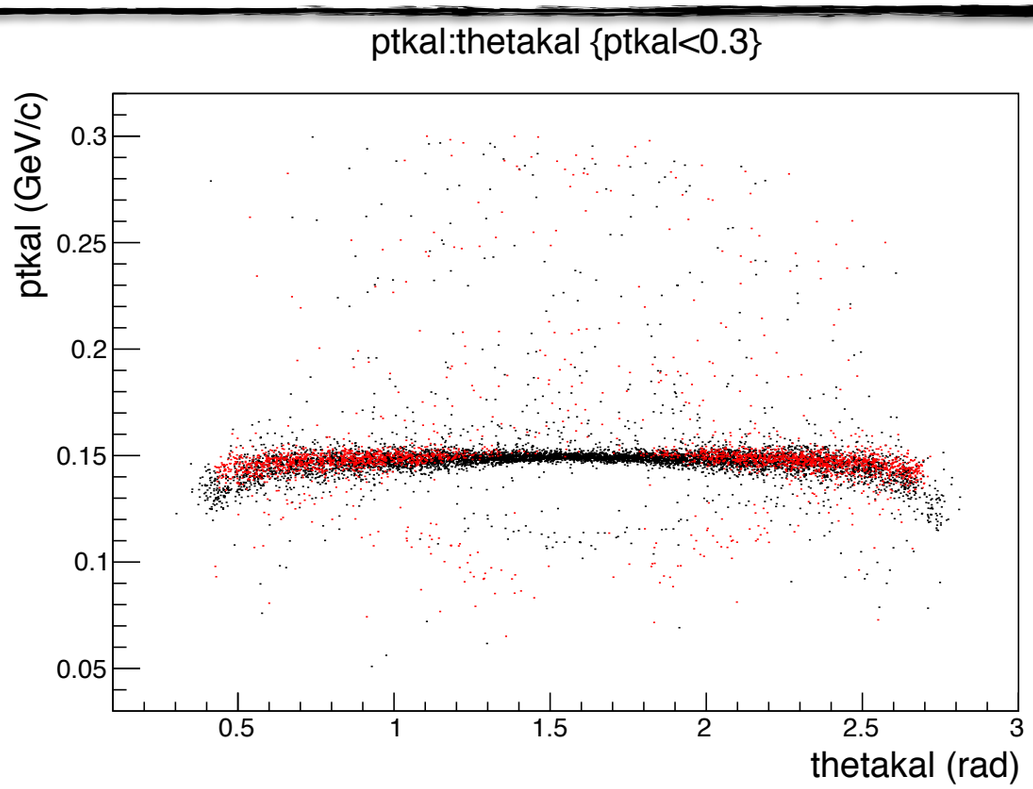


Kaons

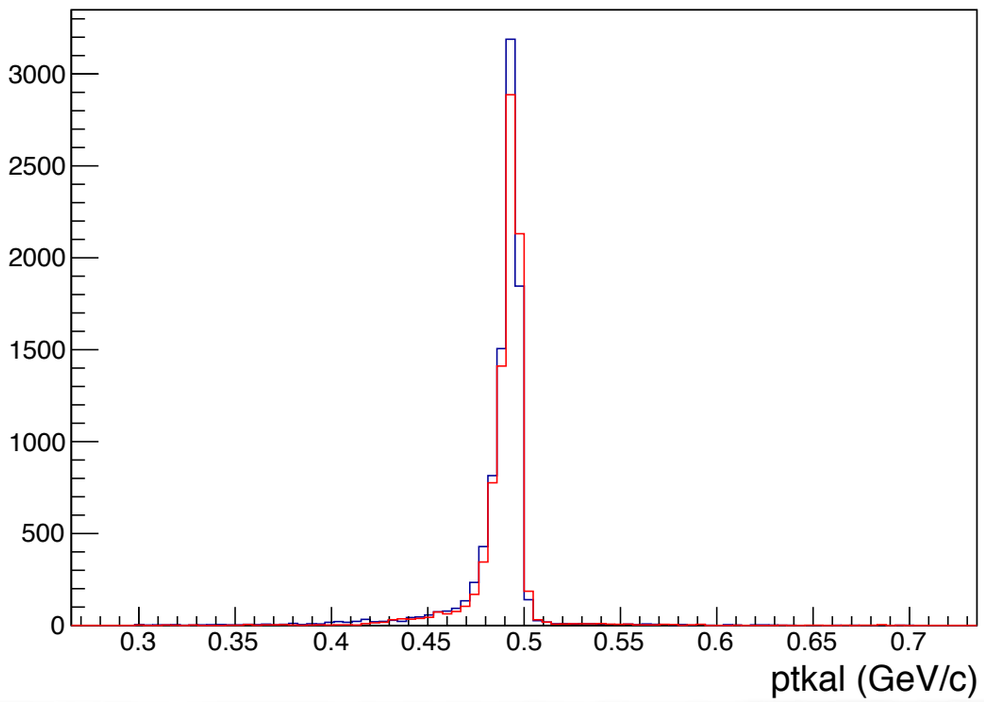
Kaons: pt reco

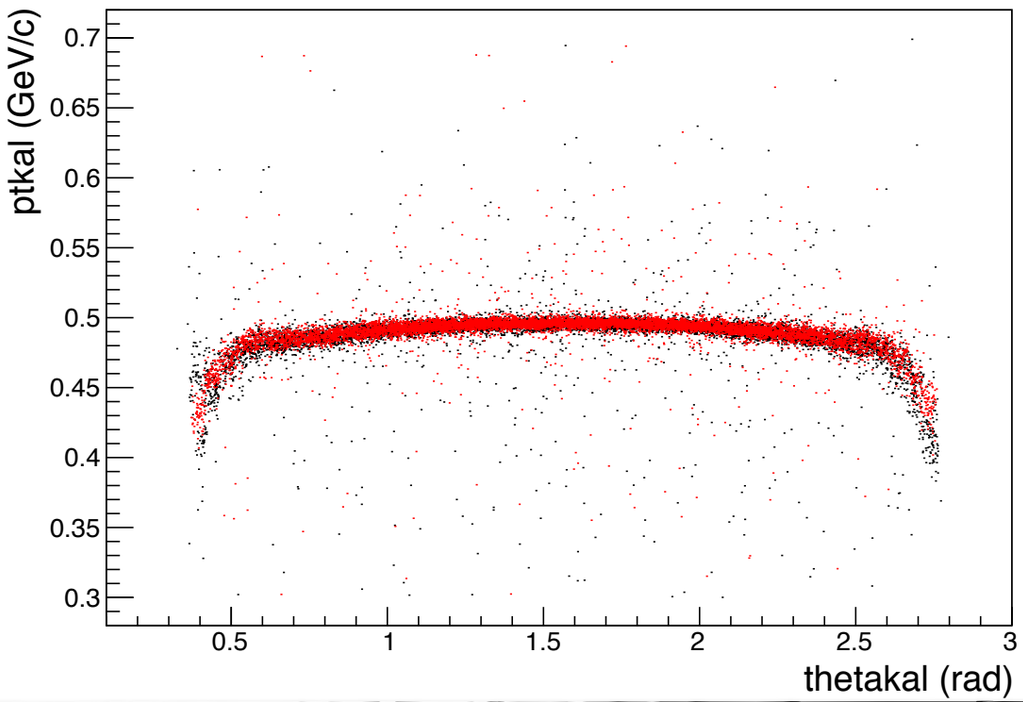
After Kalman fit pt=150 MeV





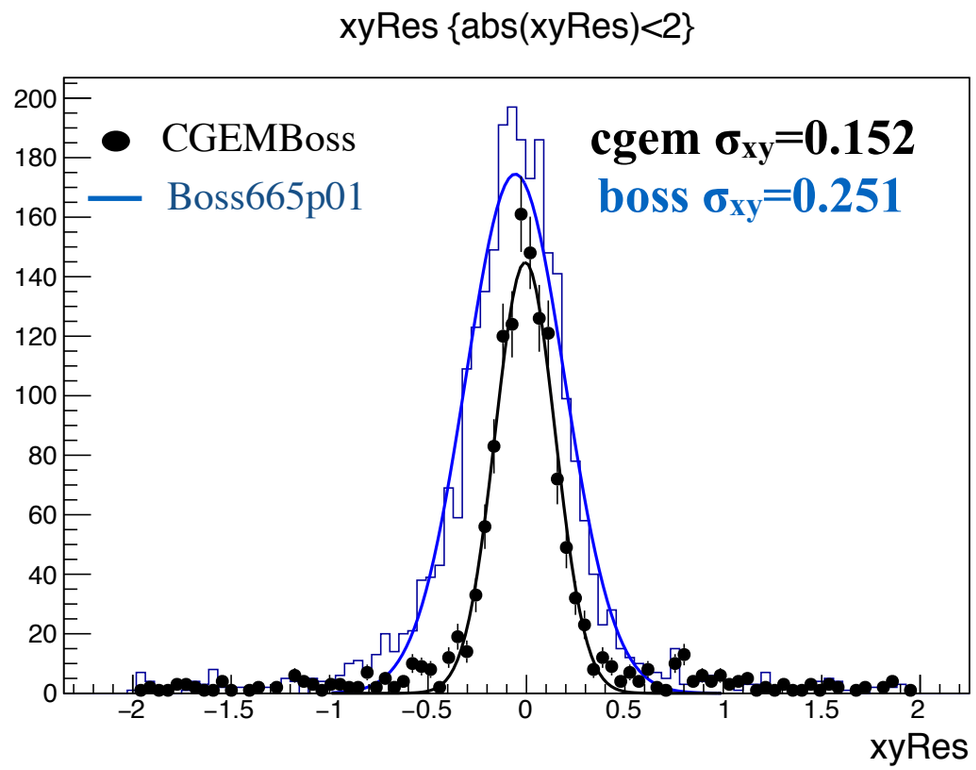
After Kalman fit pt=500 MeV

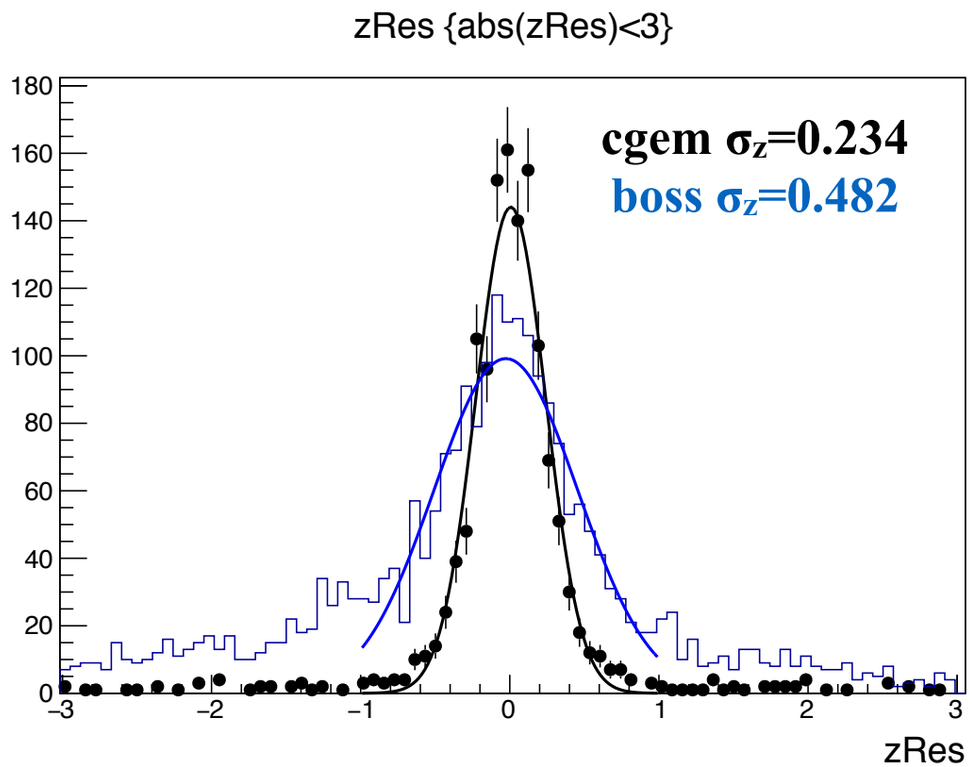




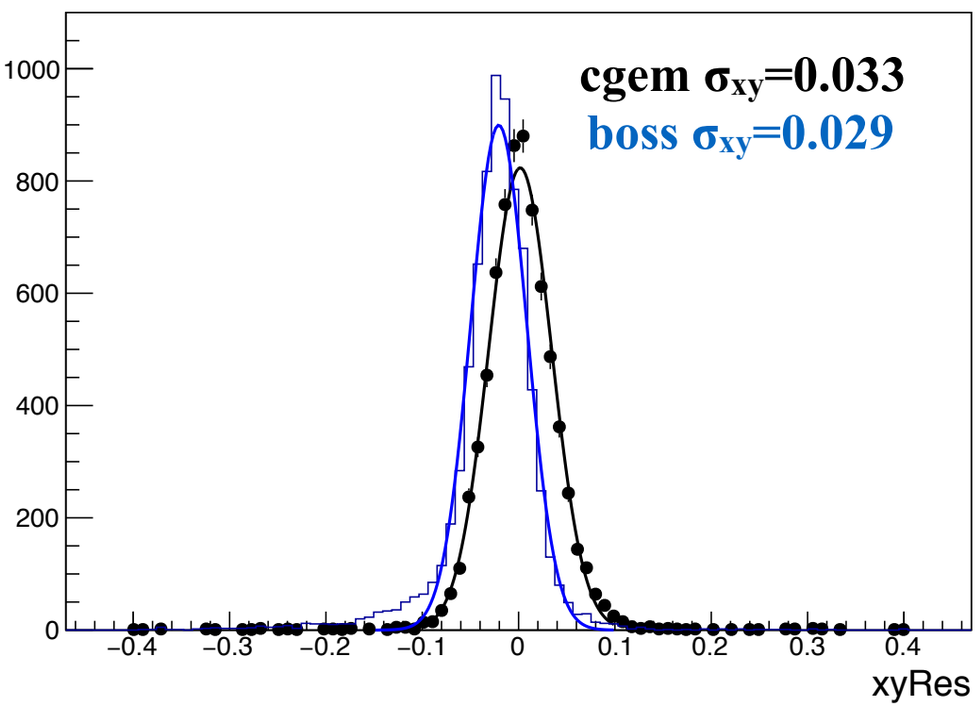
Vertex resolution for kaons

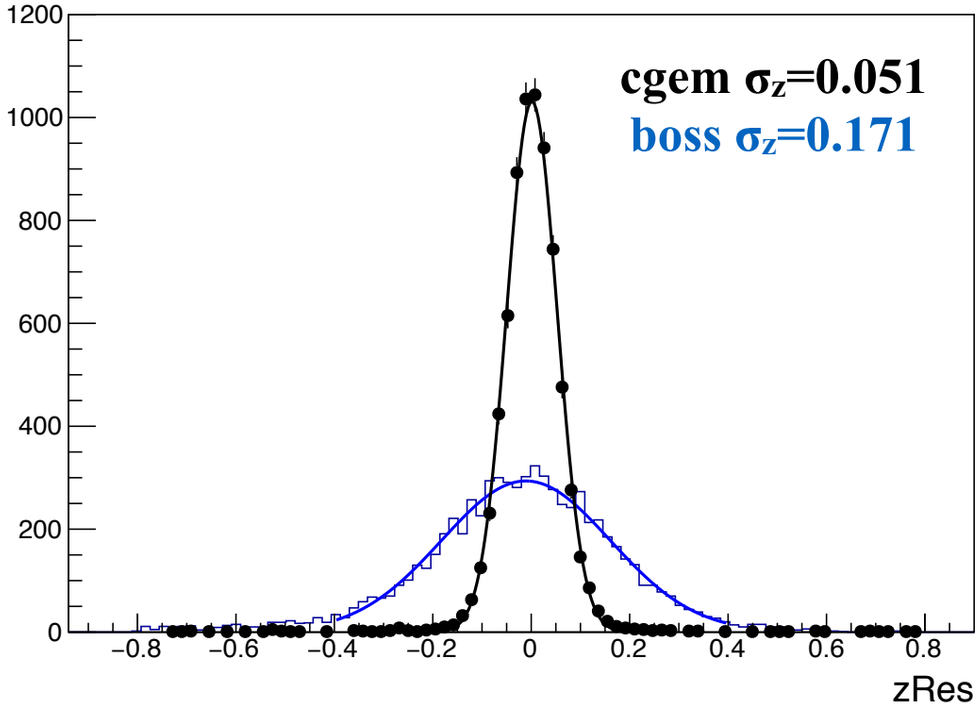
Kaons:
pt=150 MeV



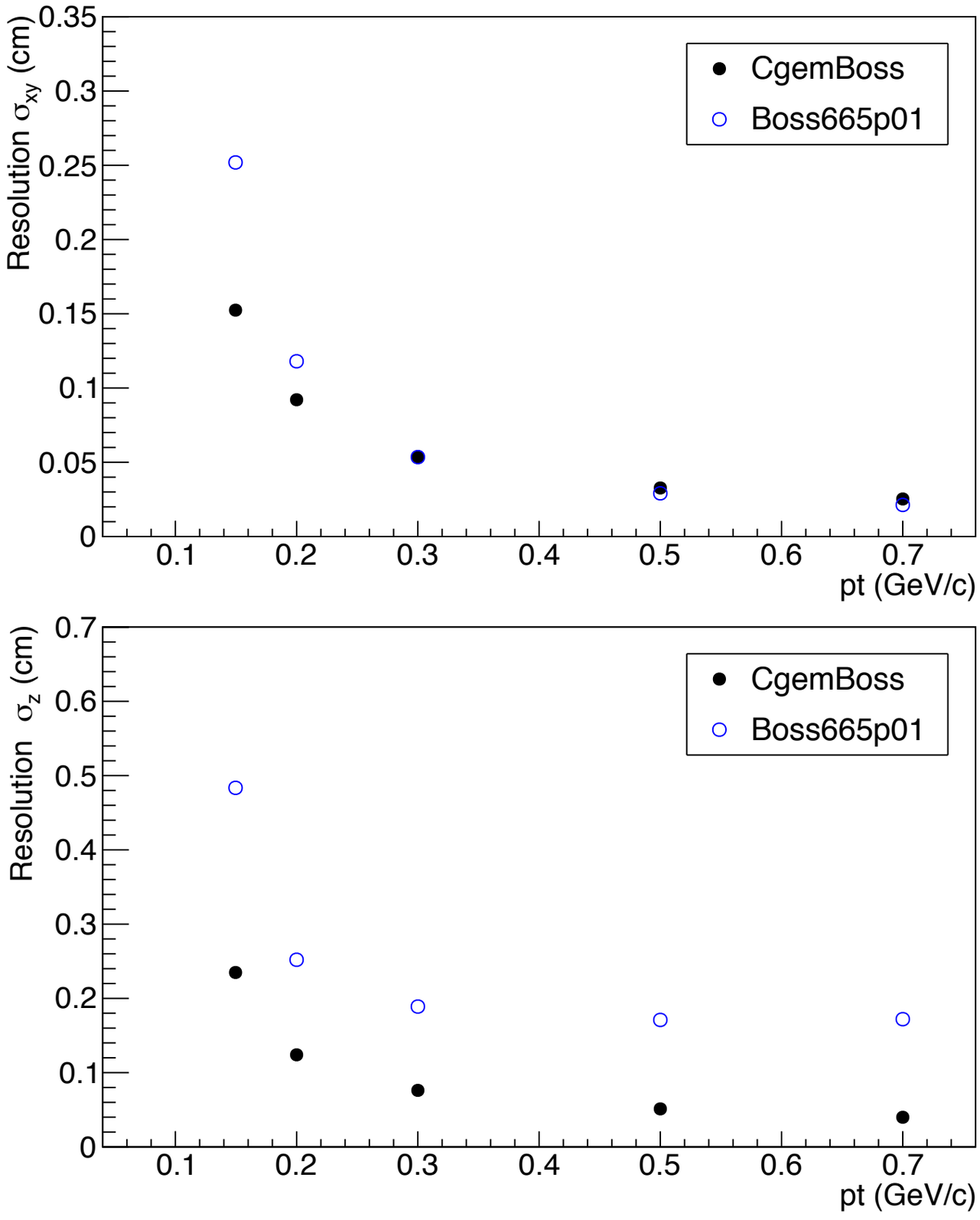


Kaons:
pt=500 Me





KAONS: summary



- **CgemBoss efficiency < Boss efficiency**
- **Vertex resolution along z direction better for CGEM (by a factor of about 3)**
- **Good consistency of the vertex resolution in the XY plane for pt > 300 MeV/c**

Conlcusions

First version of CGEMBoss software

- Single track simulations: useful to identify bugs, problems, and to find possible solutions
- Still a preliminary version
  - the observables are a combination between those from CGEM and ODC
  - Improve the Kalman filter (on implement the RK)
  - Global Hough transformation under development
- Promising results after the comparison between CGEMBoss and Boss 665p01
  - HUGE improvement of the vertex resolution along the z direction
  - about a factor 3
  - observed for muons, kaons, and protons in the full pt range analyzed

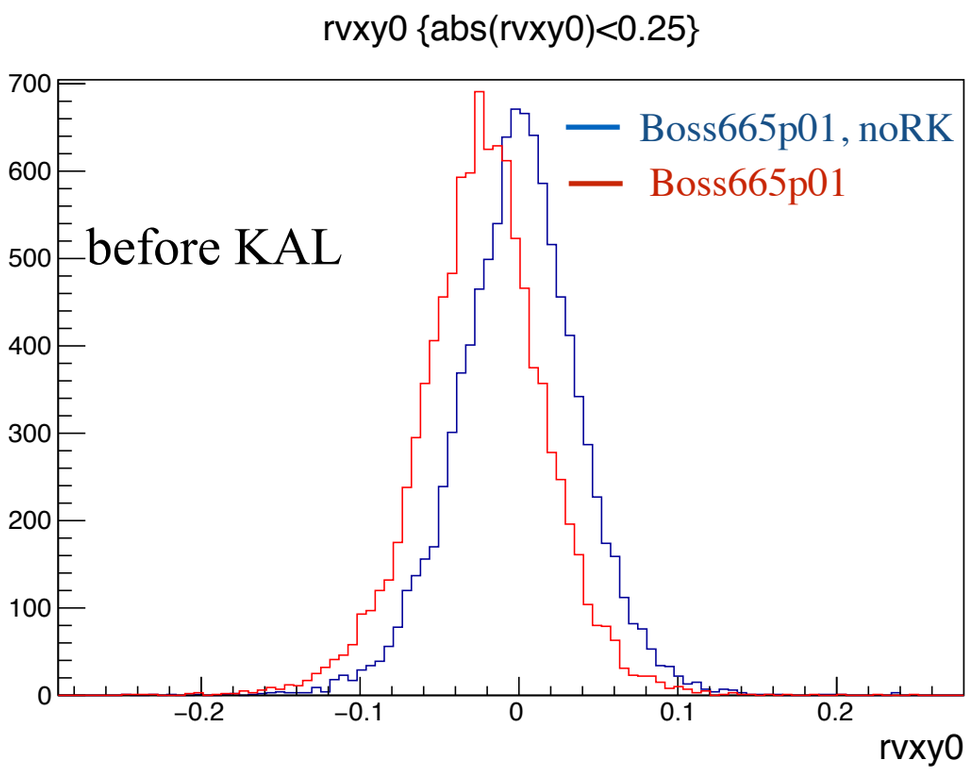
To be done:

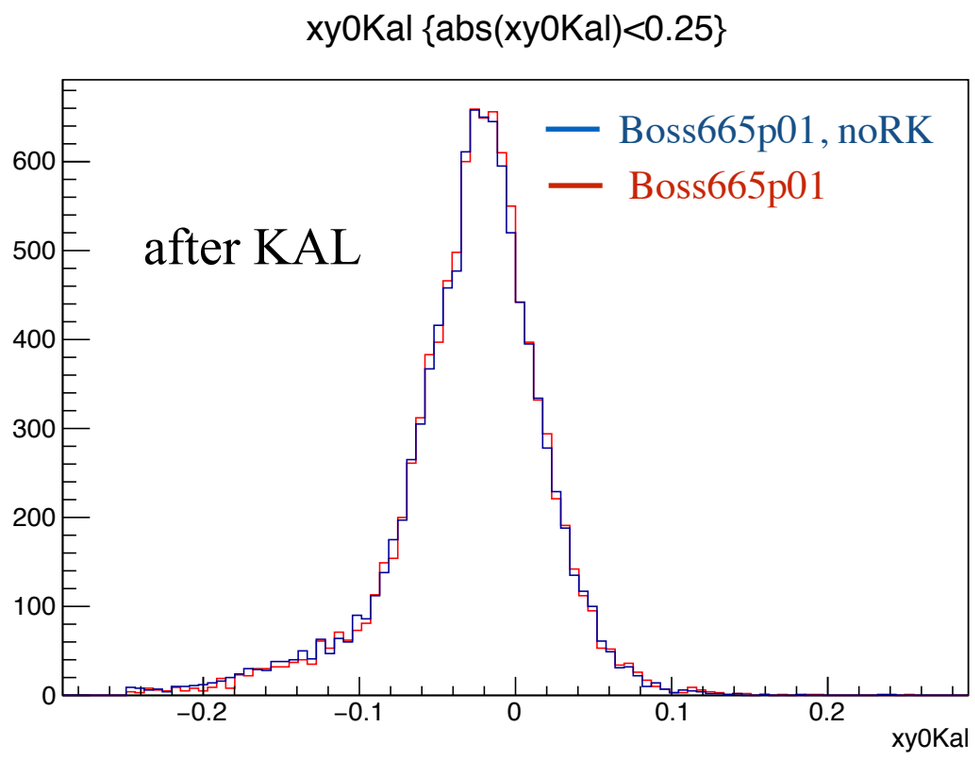
- **Define common observables (pt, vertex resolution, …) which will be used in all the benchmark physics studies**
- Extract the vertex resolution for the physics benchmark channels
- $J\psi \rightarrow \pi^+\pi^-\pi^0$ channel

spares

Muons, pt = 0.5 GeV/c
RK and noRK

Check the difference between jobOptions_MdcPatTsfRec.txt and jobOptions_MdcPatTsfRec_NoRK.txt,
Boss665p01 (no Inner DC): #include "…jobOptions_MdcPatTsfRec.txt" (STANDARD)
Boss665p01(no Inner DC): #include "…jobOptions_MdcPatTsfRec_NoRK.txt" (as for CGEMBoss)





- By using jobOptions_MdcPatTsfRec_NoRK.txt, the distributions are now centered in zero
- Same conclusions also for higher pt