Single track simulations

UPDATES

CGEM software meeting
November 16, 2017

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Single track simulation

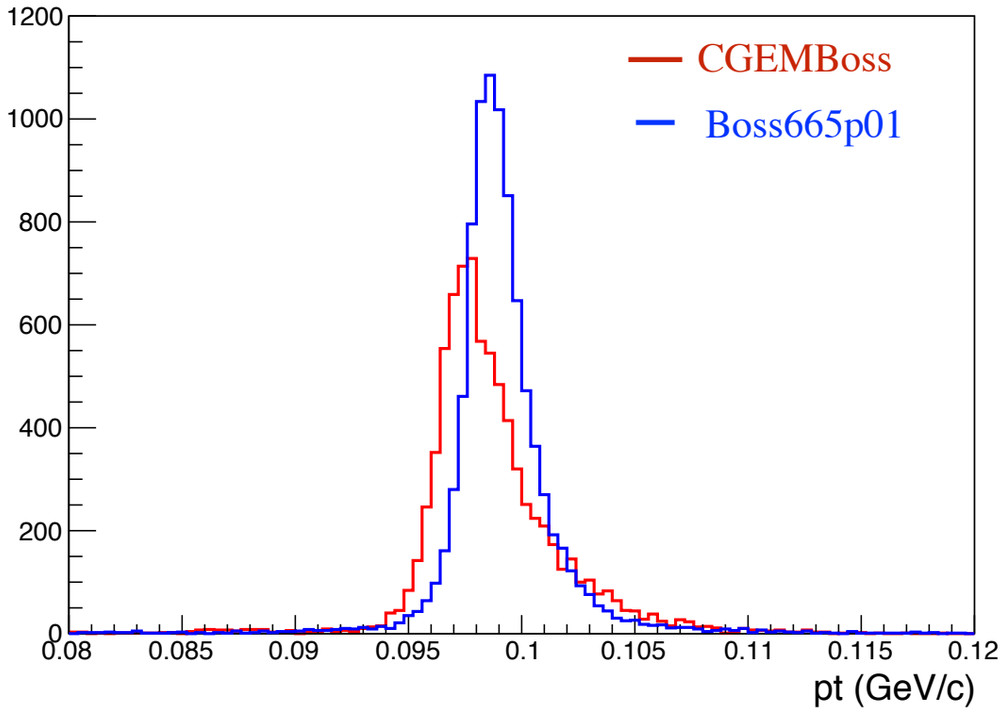
- CGEMBoss software 6.6.5.b and Boss version 665p01
- All detectors included in the simulation
- “fixpt” generator used to generate single particle tracks
- 10000 protons, muons, kaons, electrons and pions
  - pt=(0.1, 0.15, 0.2, 0.3, 0.7) GeV/c
  - -0.93<cos(theta)<0.93
- 10000 pions with pt = 60 MeV/c and 80 MeV/c
- **Difference in Reconstruction:**
  - 665p01: #include “$MDCXRECOROOT/share/jobOptions_MdcPatTsfRec.txt” (Runge-Kutta)
  - CGEMBoss: #include “$MDCXRECOROOT/share/jobOptions_MdcPatTsfRec_NoRK.txt"
- Observables:
  - reconstructed pt before and after the reconstruction
  - vertex resolution after the Kalman fit
  - Efficiency vs. pt and efficiency vs. cos(θ)

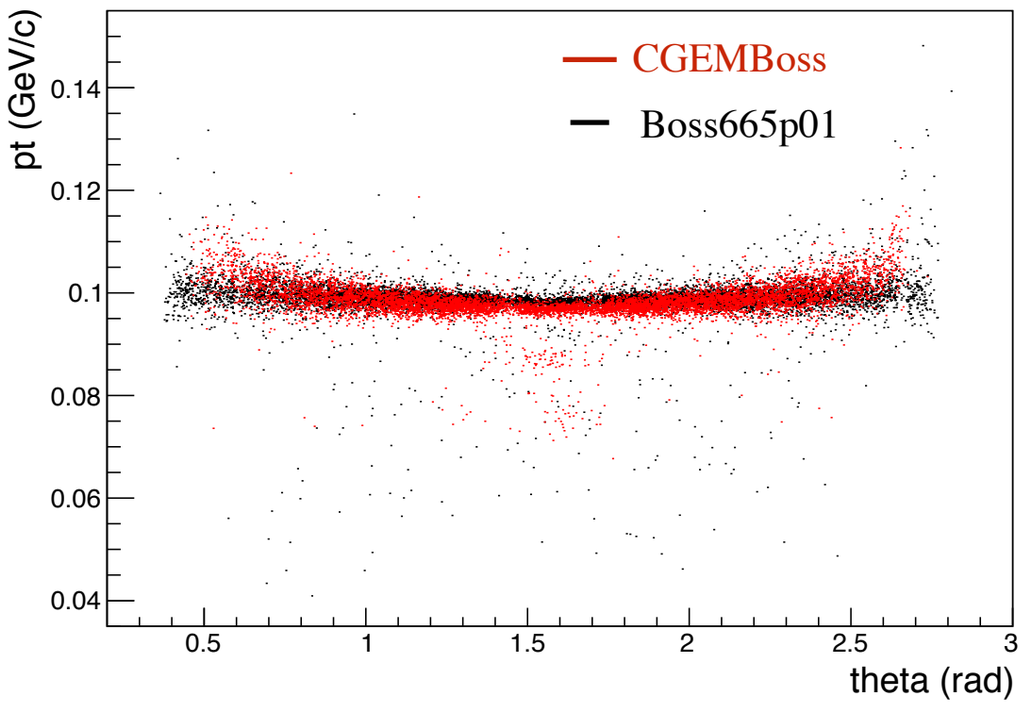
- **Bugs fixed in the simulation (non uniform magneti field setting)**
  - **old setting: BesSim.Field =1** (responsible of the small shift at low pt values and in the xyRes distributions)

Muons: pt reco

Before Kalman fit pt=100 MeV

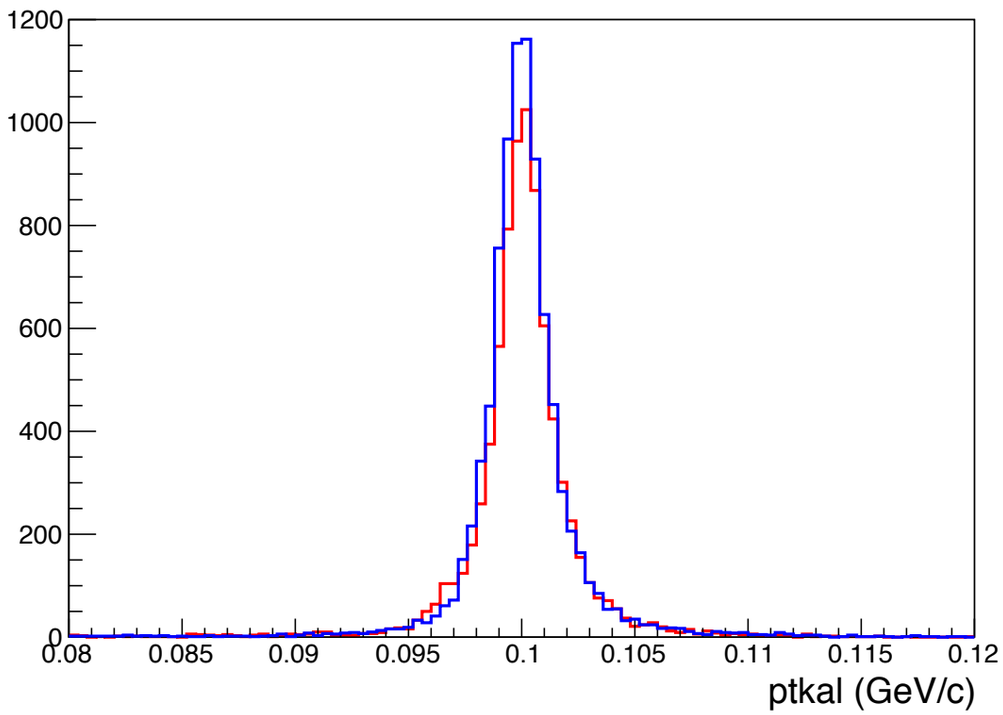
- RK fit for Boss665p01
- No global fit in CgemBoss

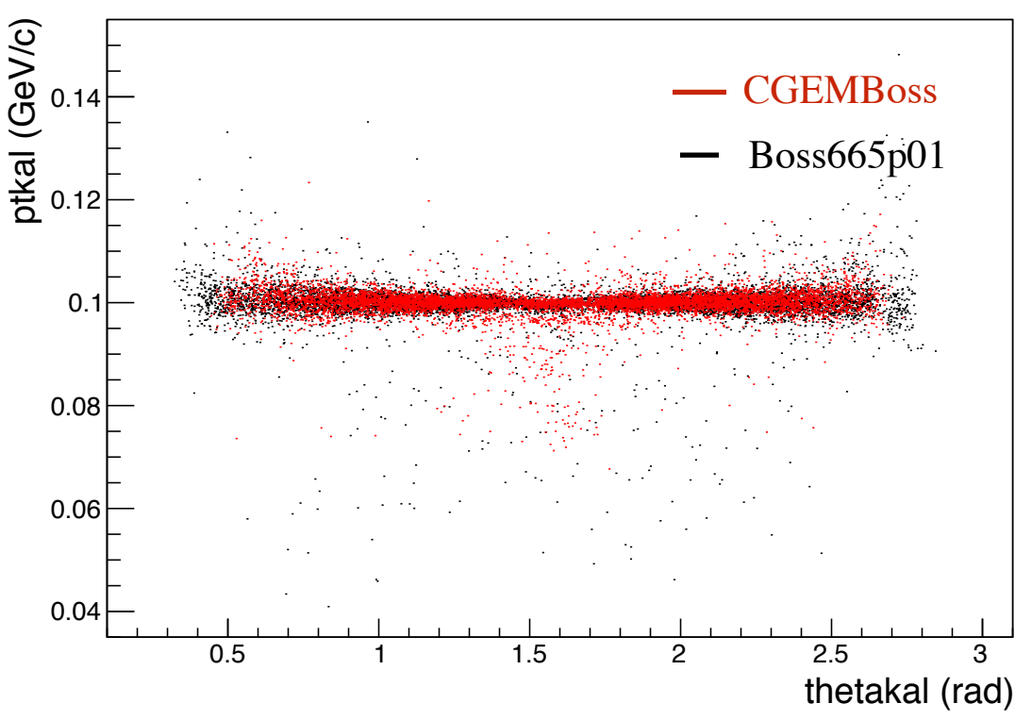




After Kalman fit pt=100 MeV

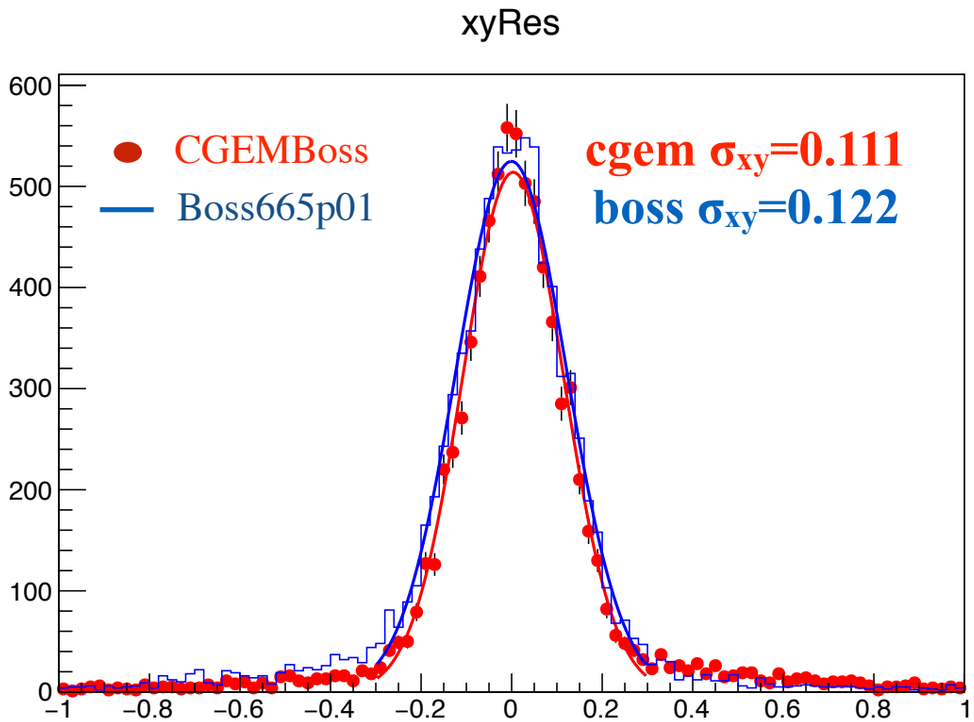
Good agreement after Kalman fit

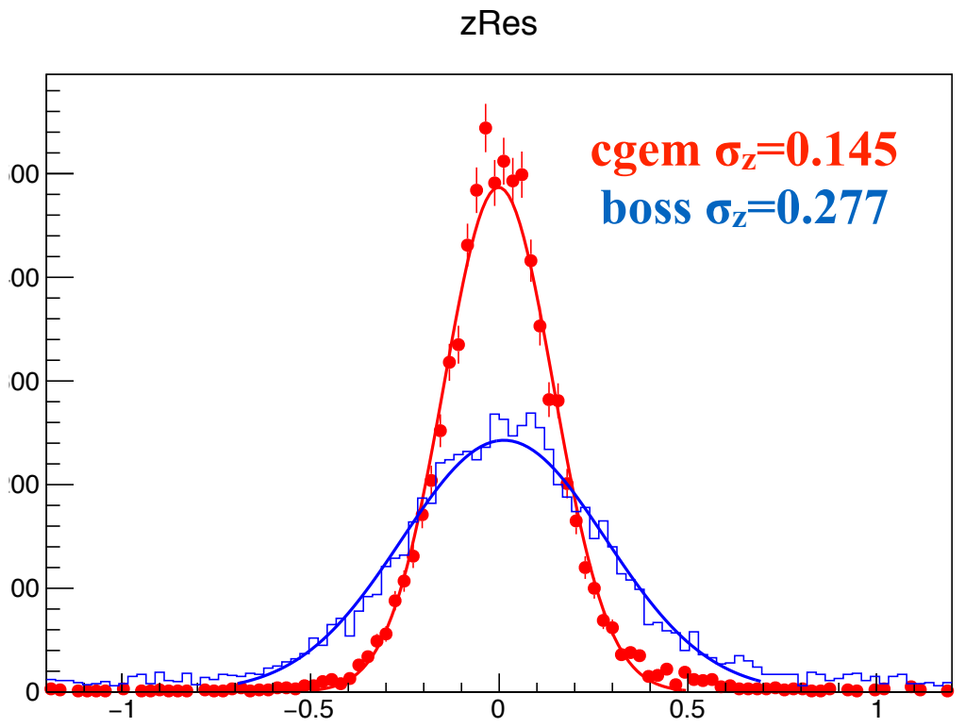




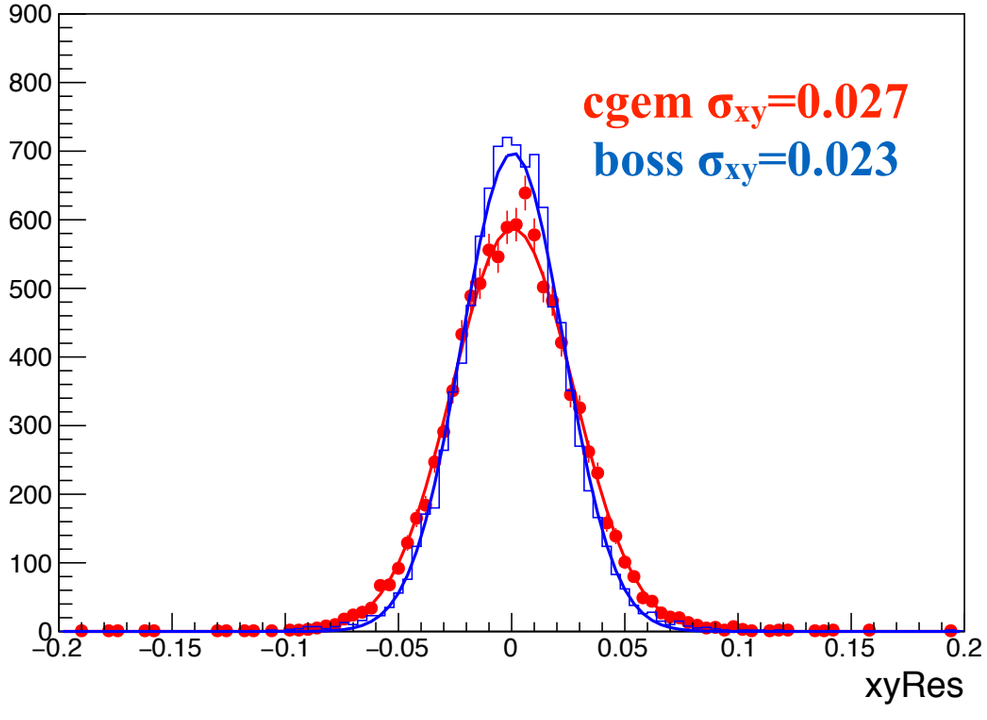
Vertex resolution

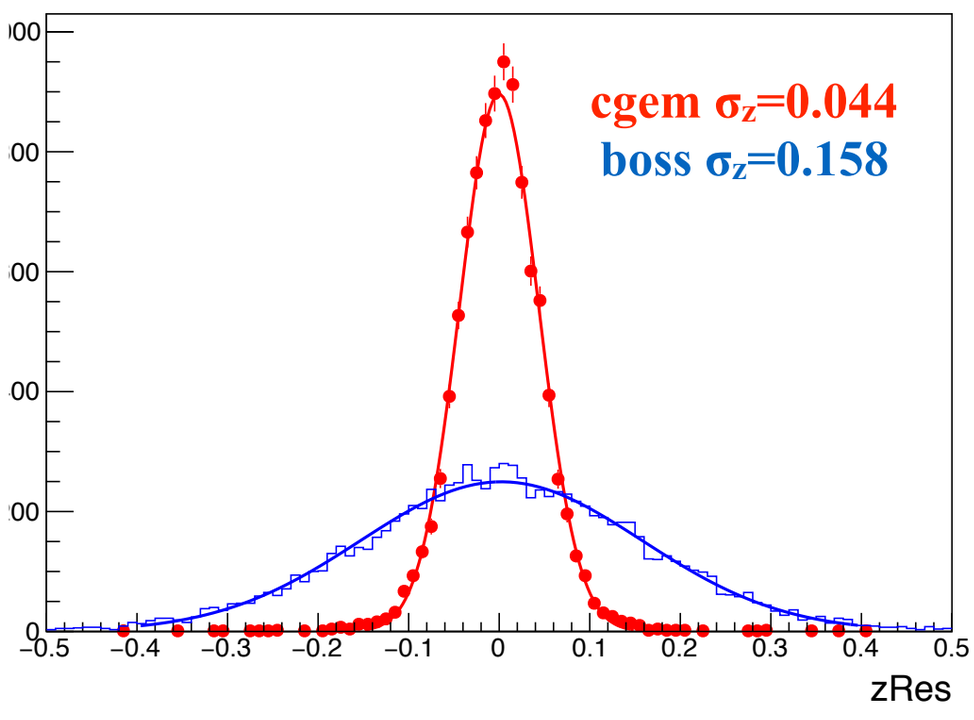
MUONS:
pt=100 MeV





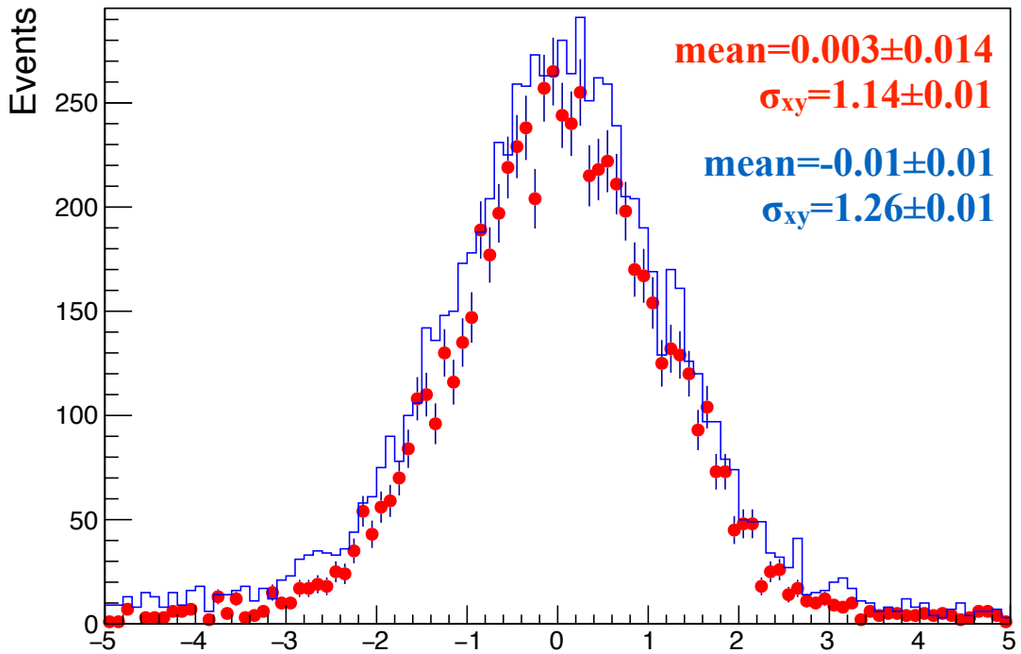
MUONS:
pt=500 MeV

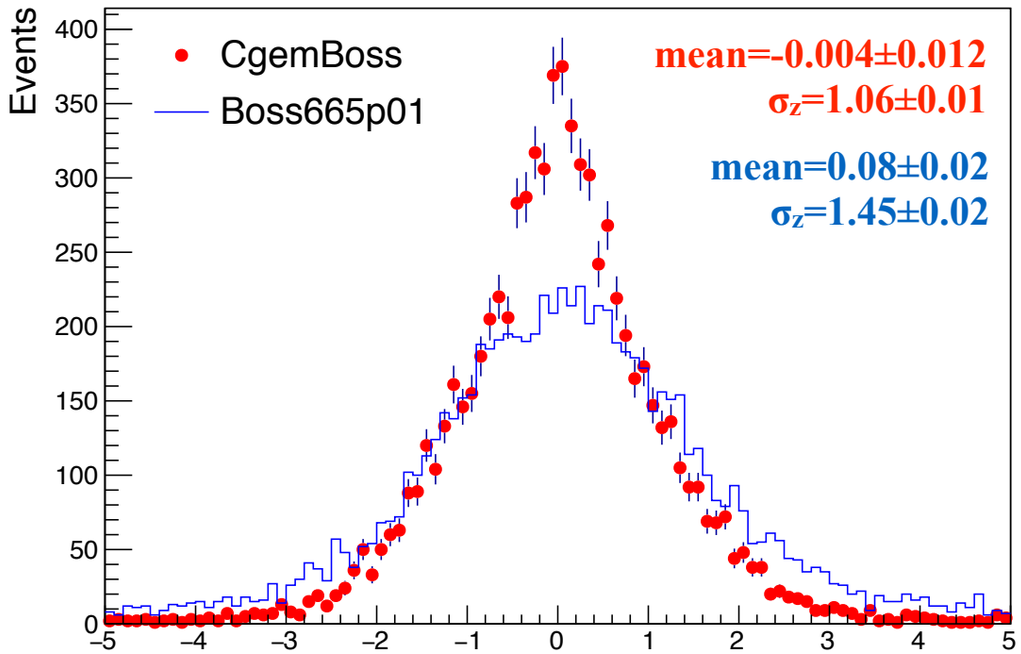




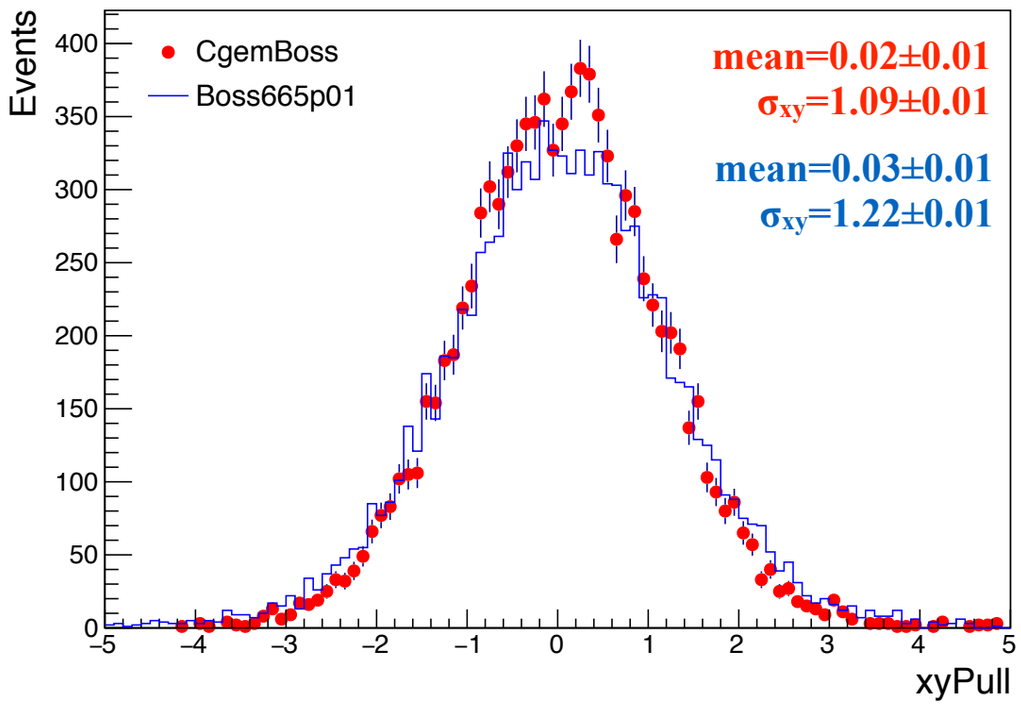
Pull Distributions

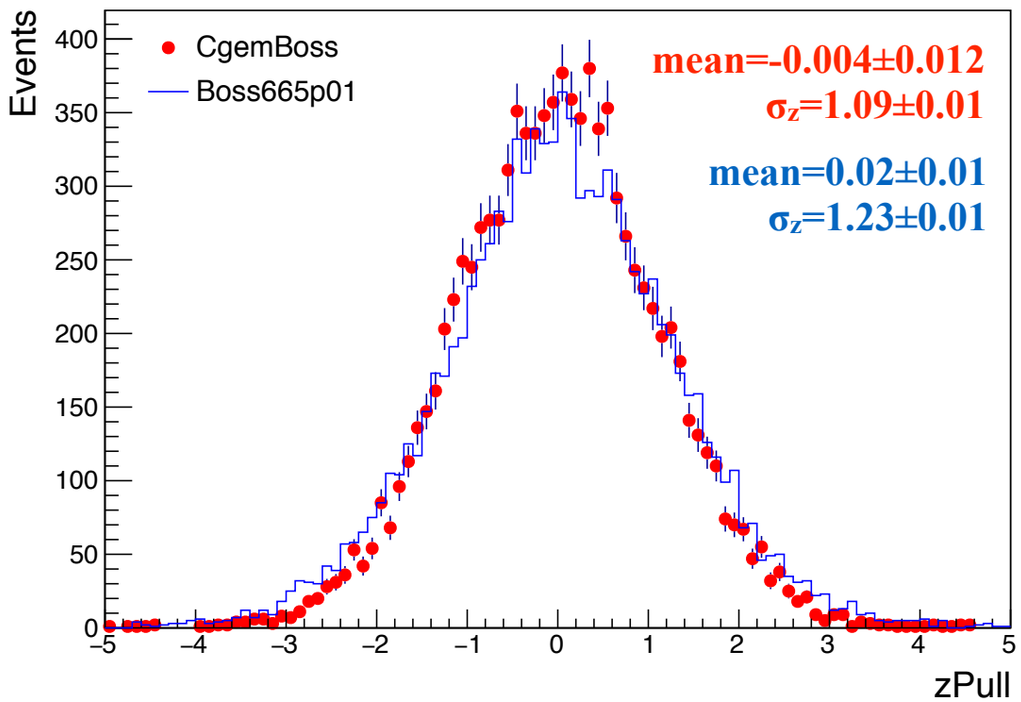
MUONS:
pt=100 MeV



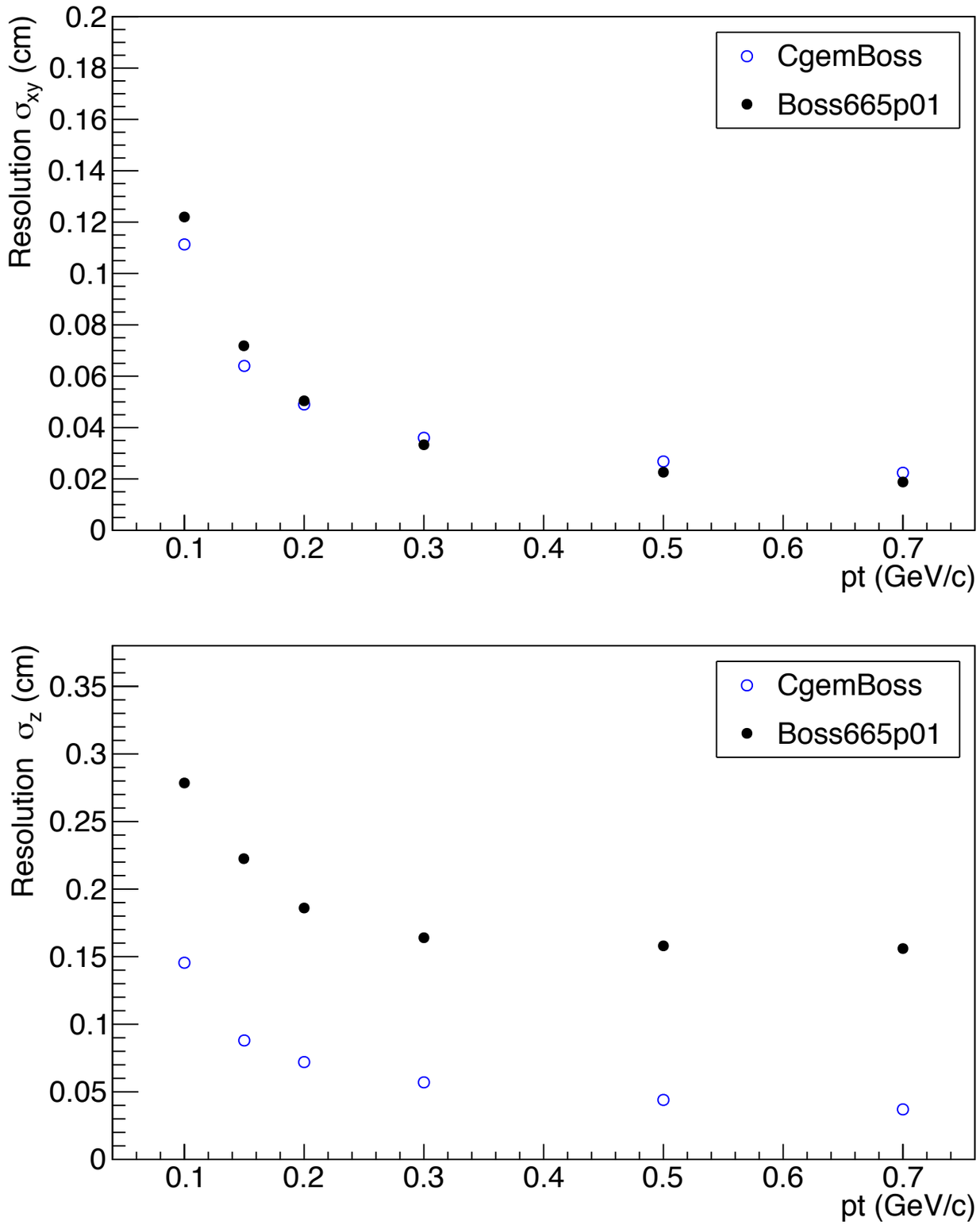


MUONS:
pt=500 MeV



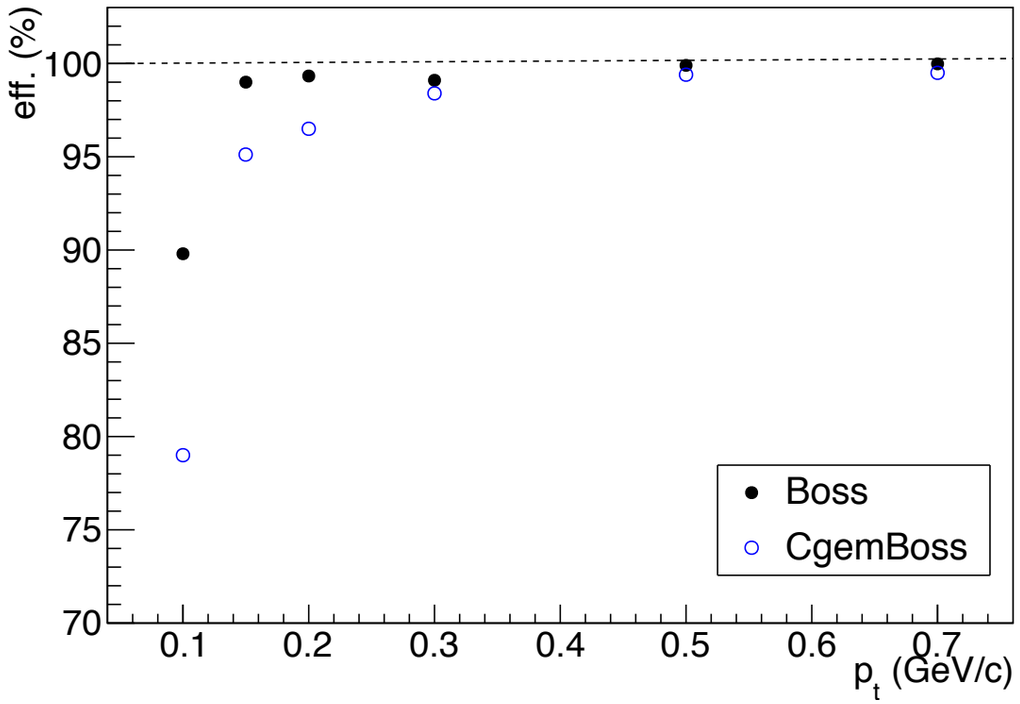


MUONS summary: vertex resolution vs. pt

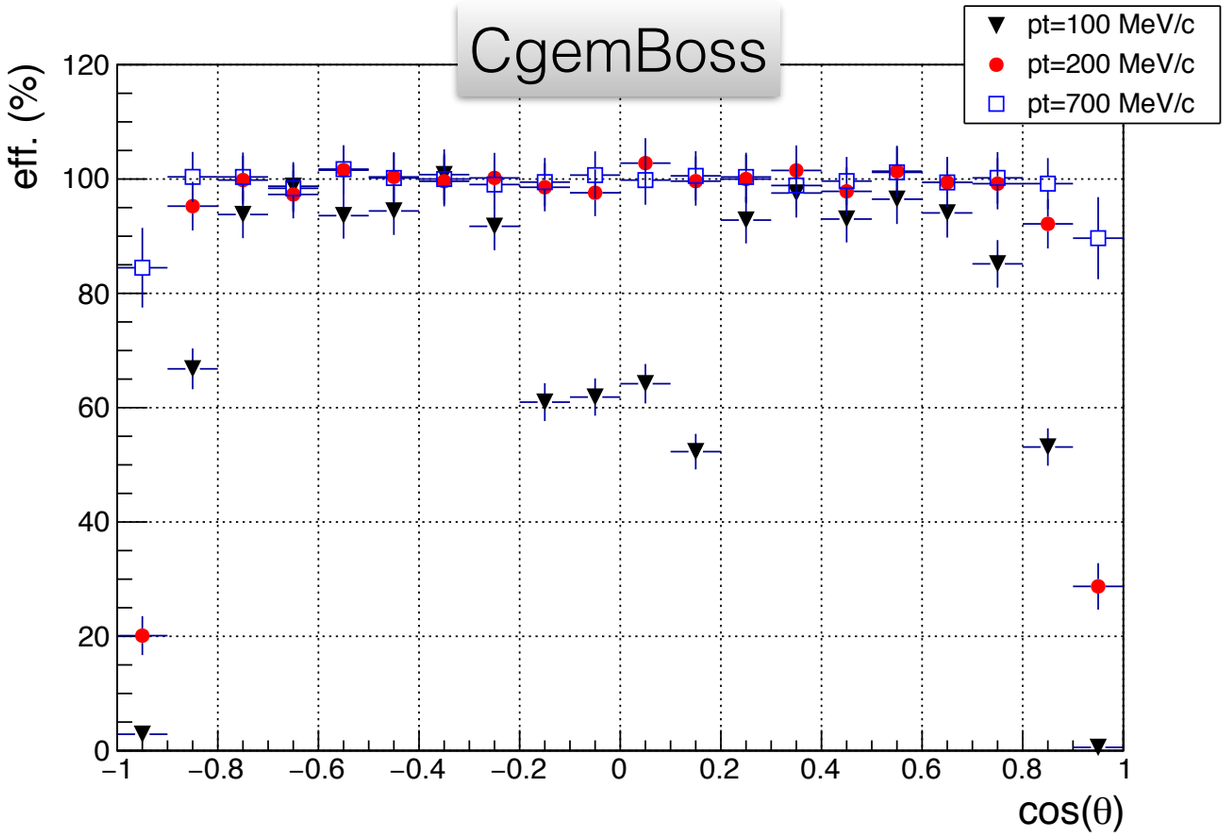


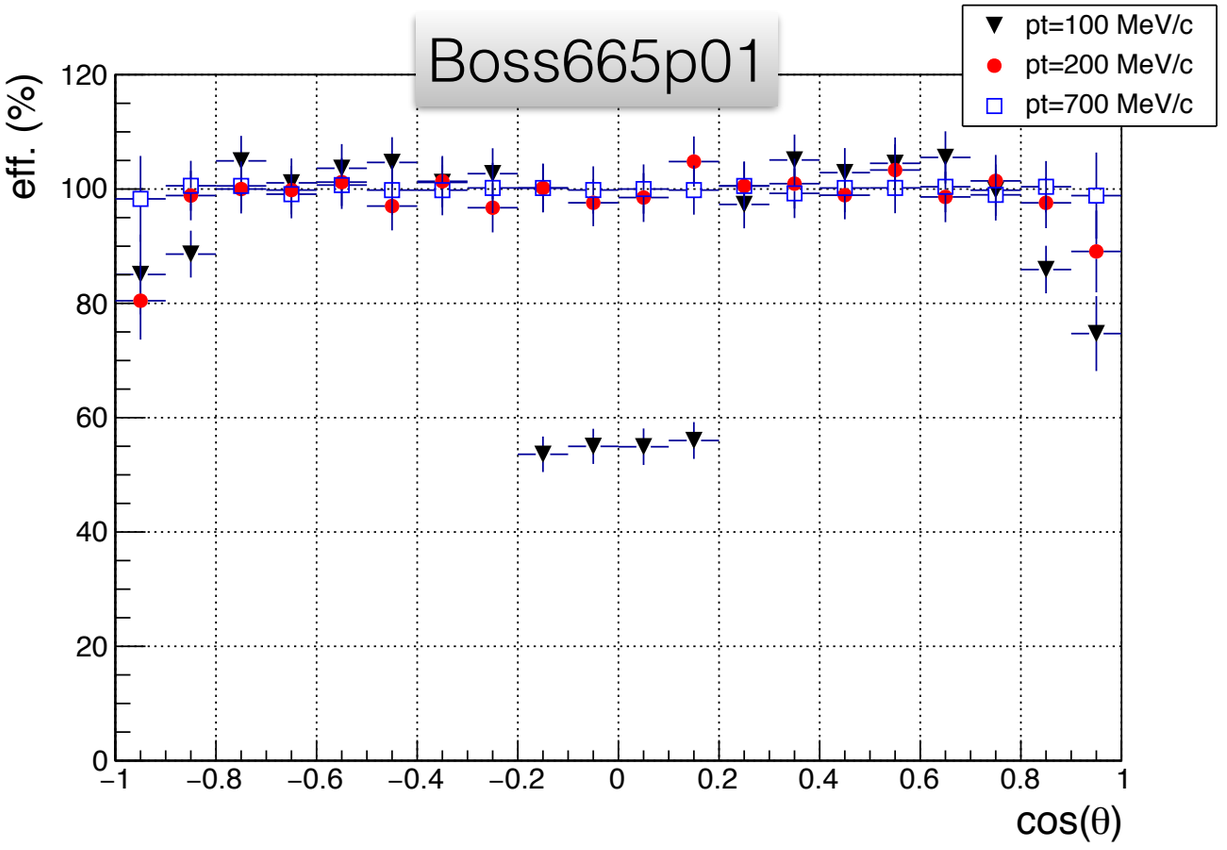
- **Consistency of the vertex resolution in the XY plane**
- **Strong improvement of the vertex resolution along the z direction for CgemBoss (by a factor of about 3)**

MUONS summary: efficiencies



- **The resolution is always lower for CgemBoss (know problem due to the matching procedure)**
  - **the effect is more pronounced for low pt**
- **Efficiency vs. cos(θ):**
  - **for low pt, larger loss of efficiency in CgemBoss at the boundaries and in the central region (perpendicular to the beam direction)**

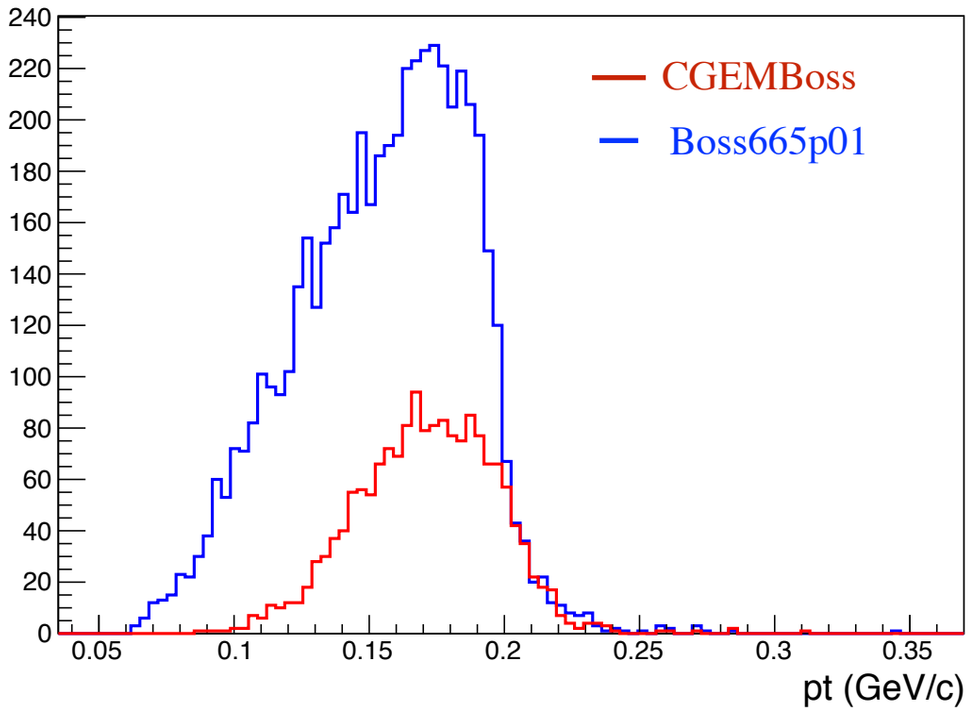


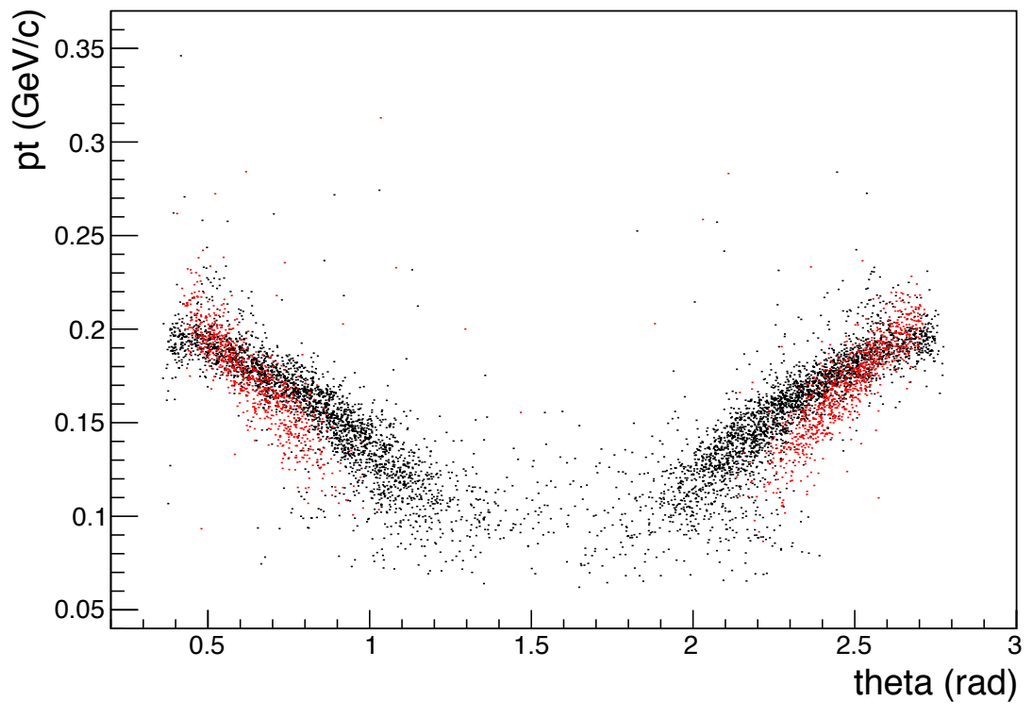


Protons

Protons: pt = 200 MeV/c

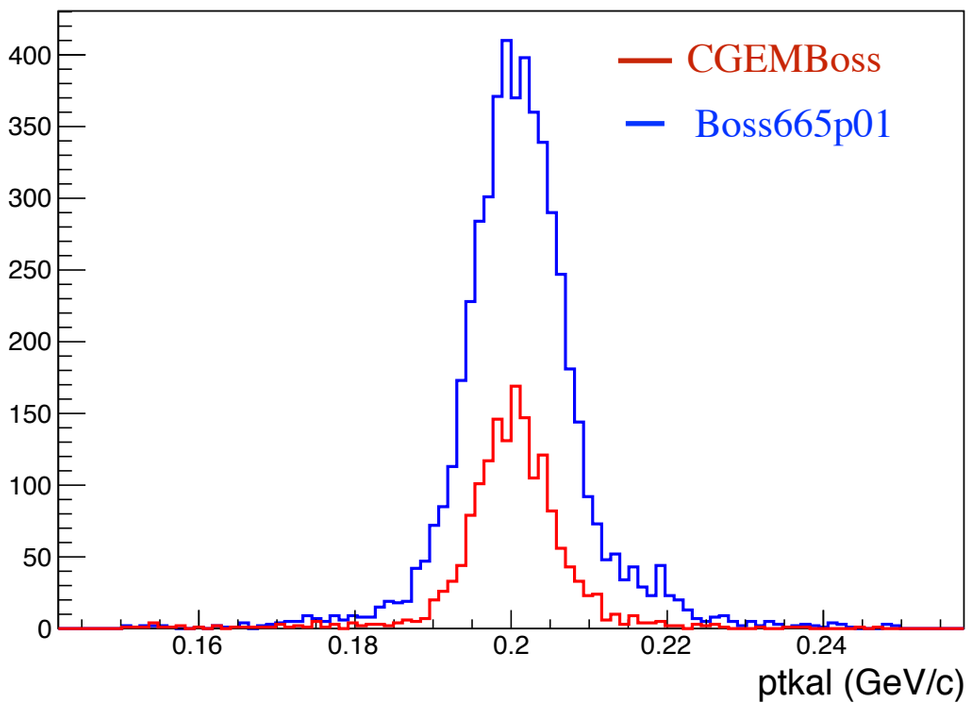
Before Kalman fit pt=200 MeV

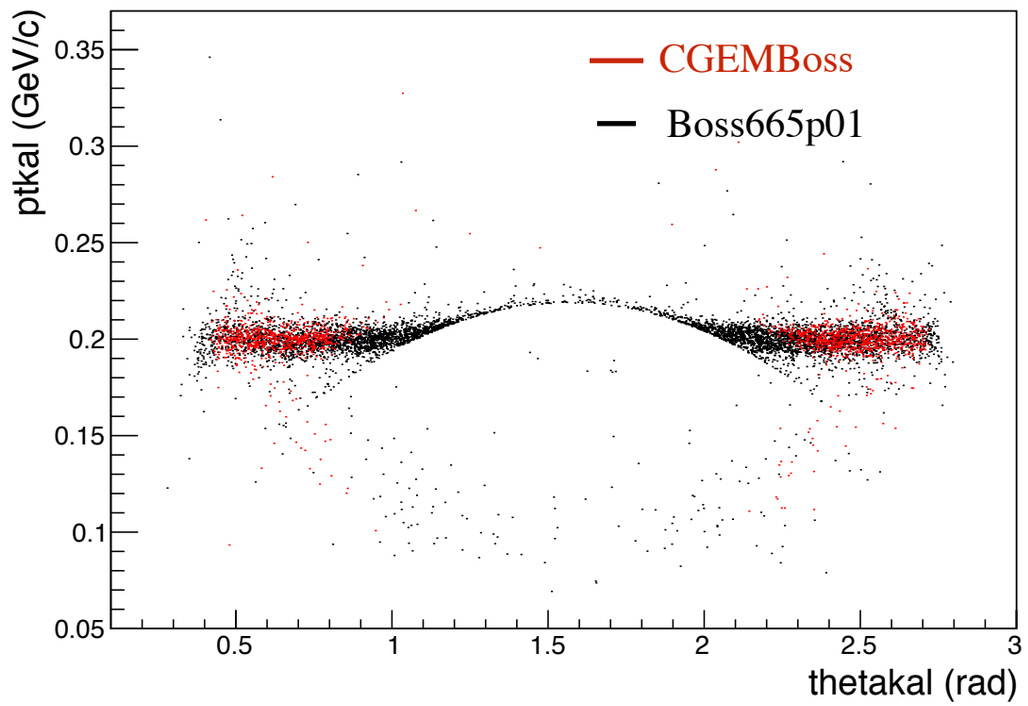




After Kalman fit pt=200 MeV

Good agreement after Kalman fit

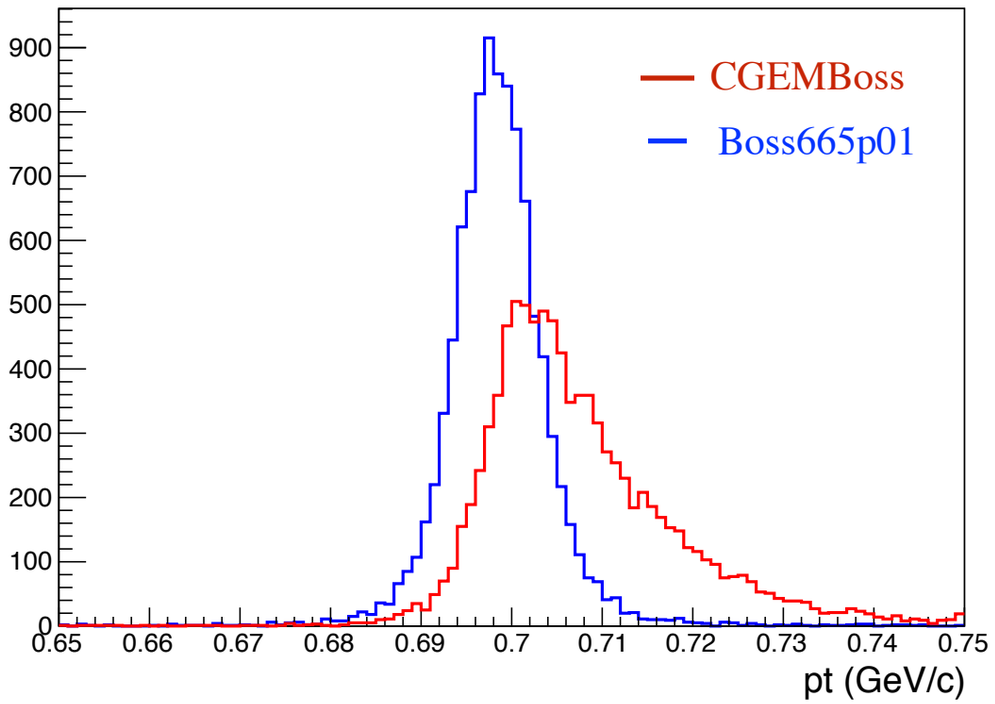


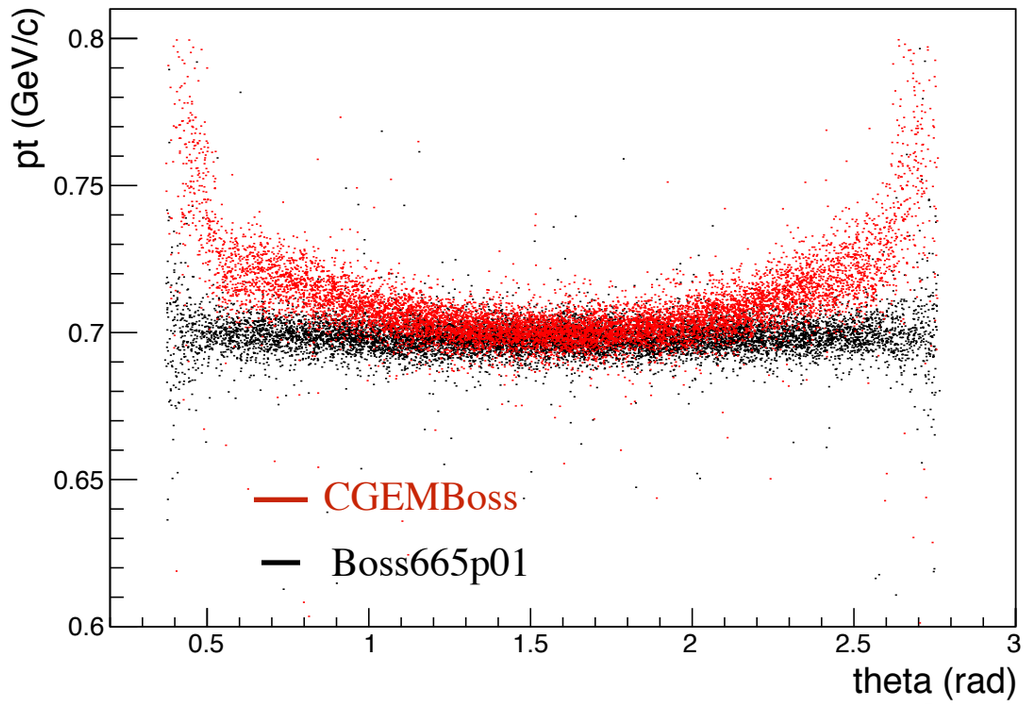


Protons: pt = 700 MeV

Before Kalman fit pt=700 MeV

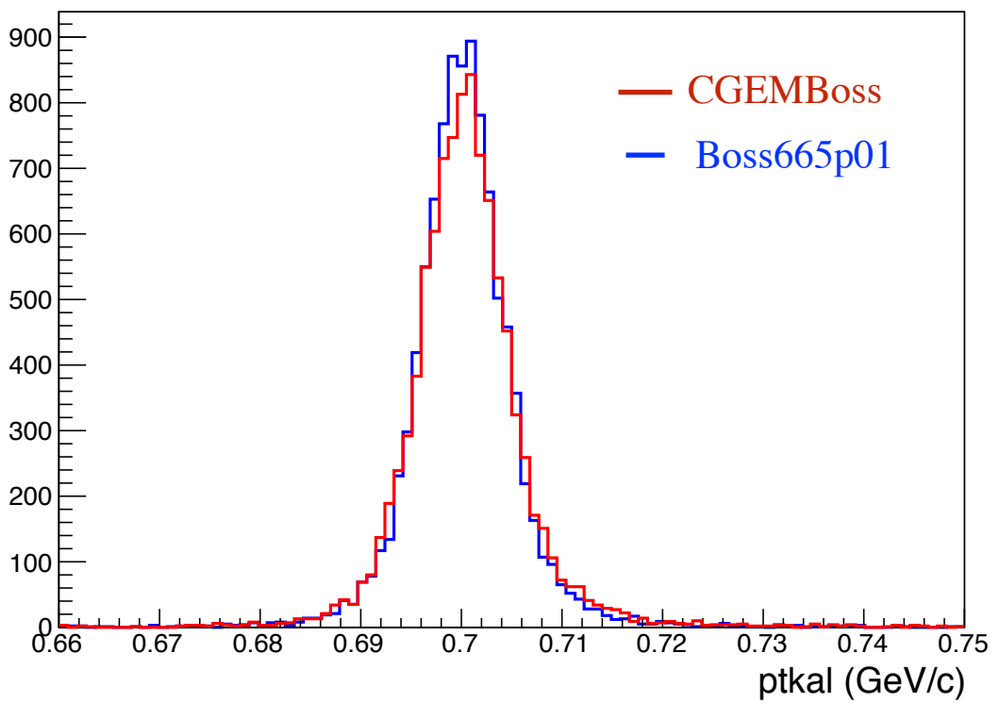
- RK fit for Boss665p01
- No global fit in CgemBoss

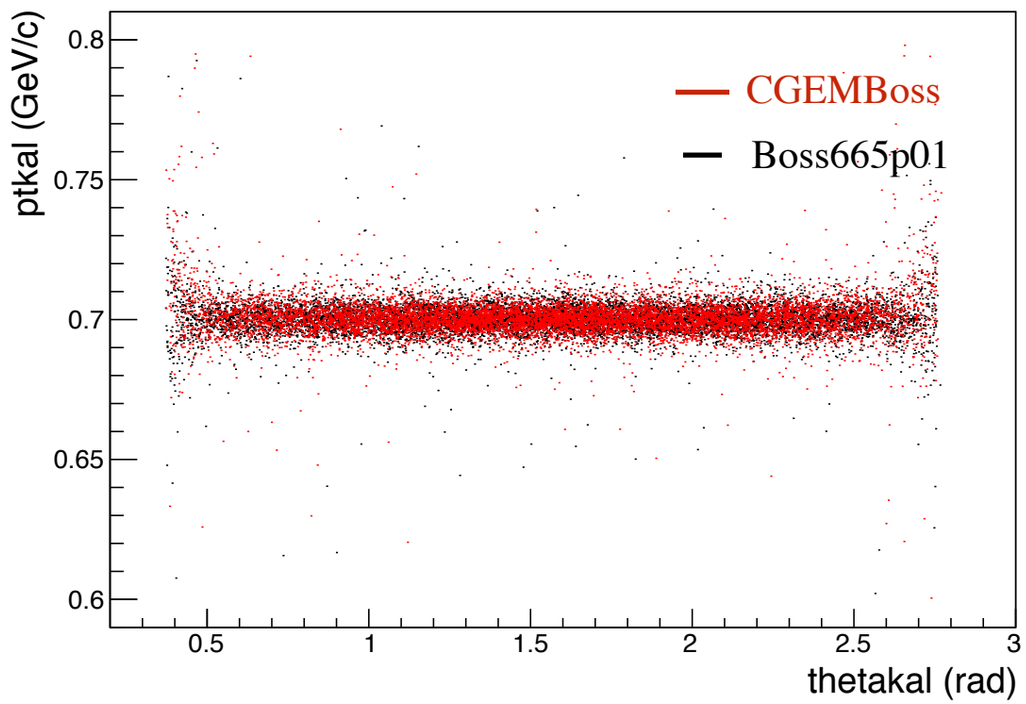




After Kalman fit pt=700 MeV

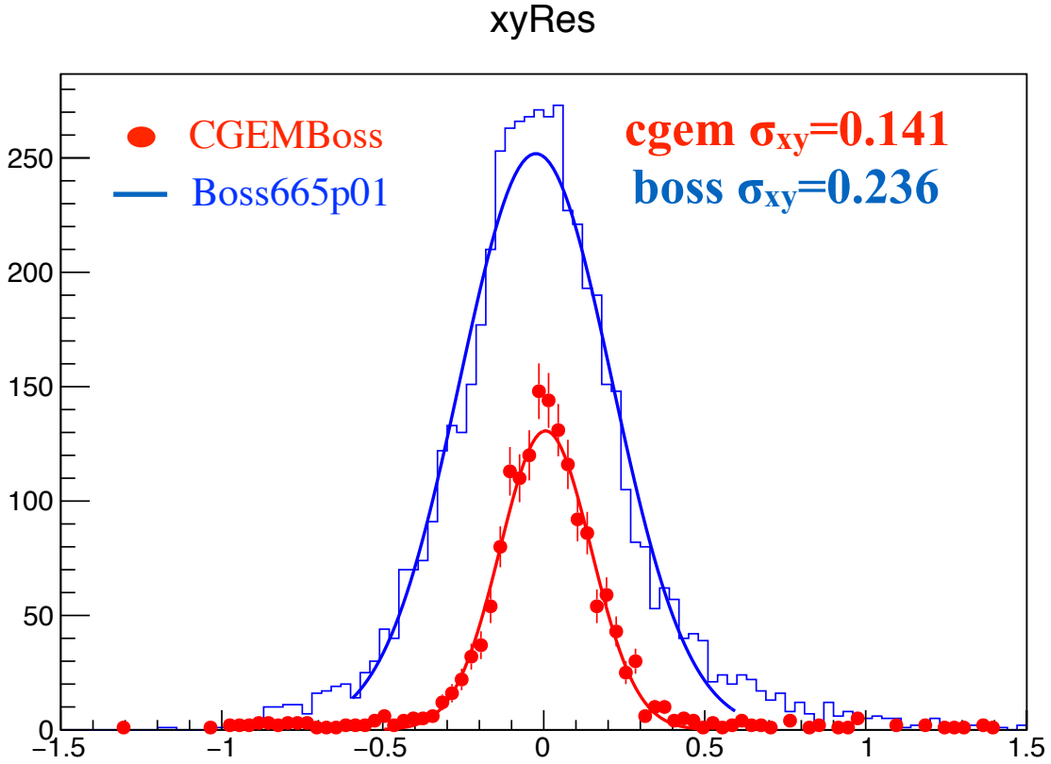
Good agreement after Kalman fit

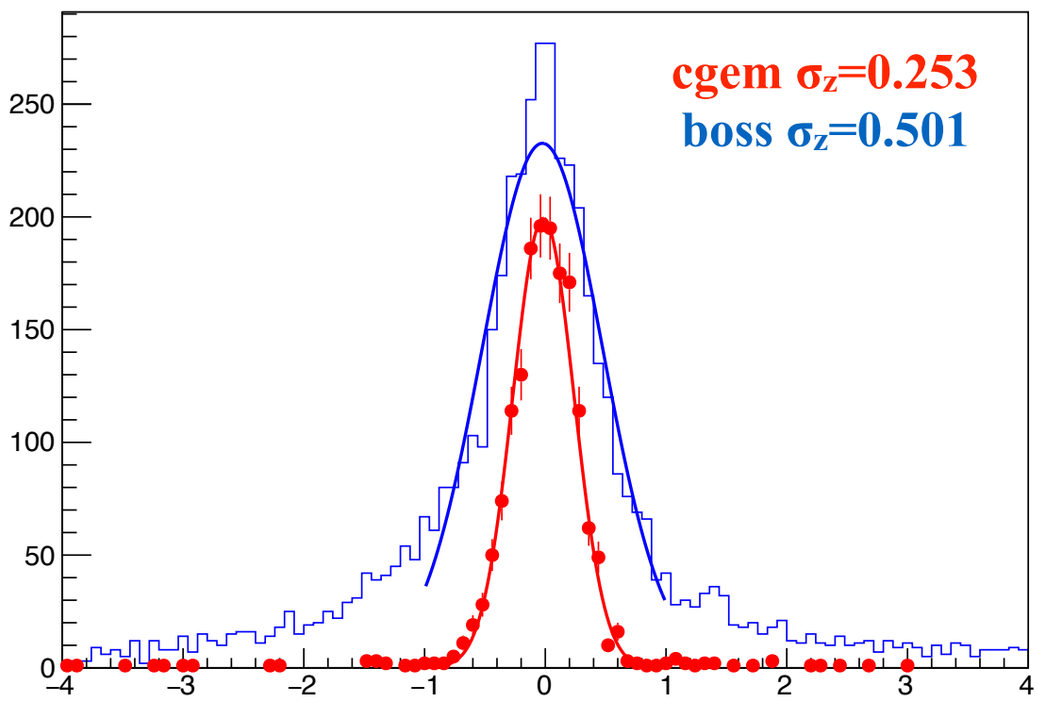




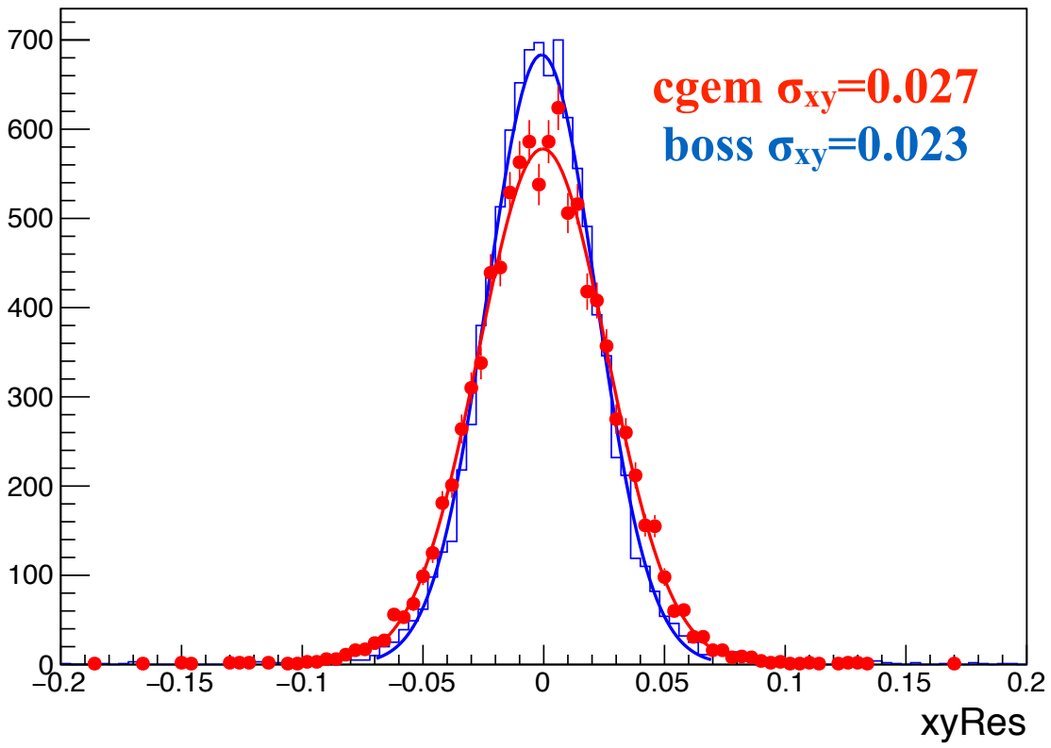
Vertex resolution for protons

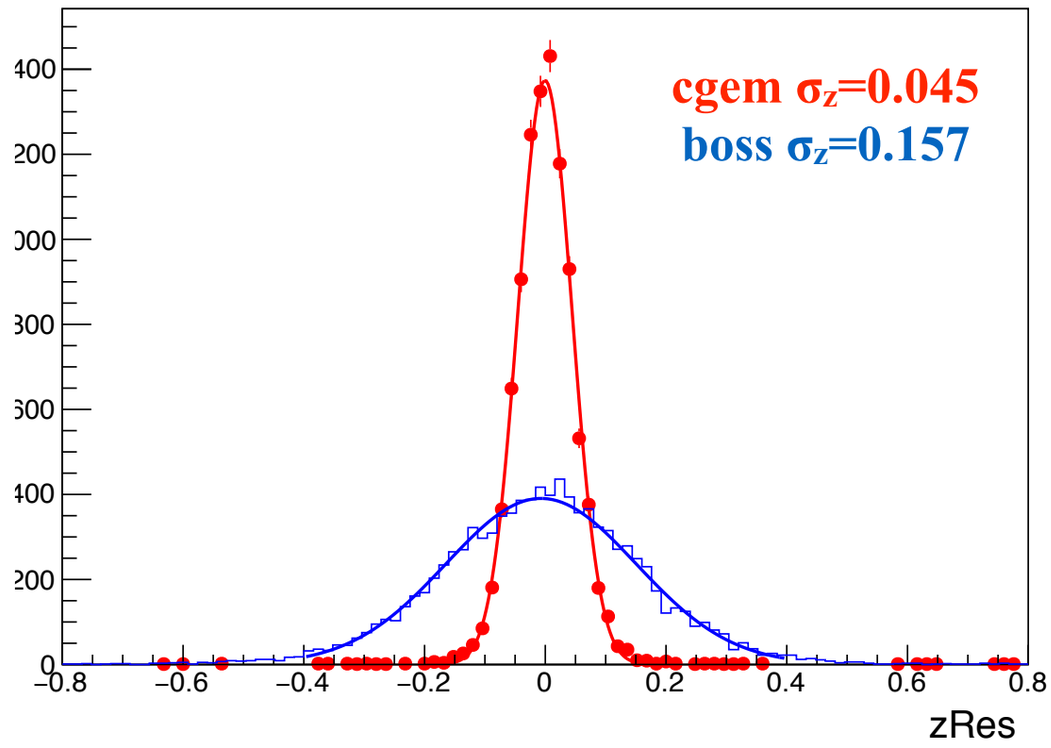
Protons:
pt=200 MeV





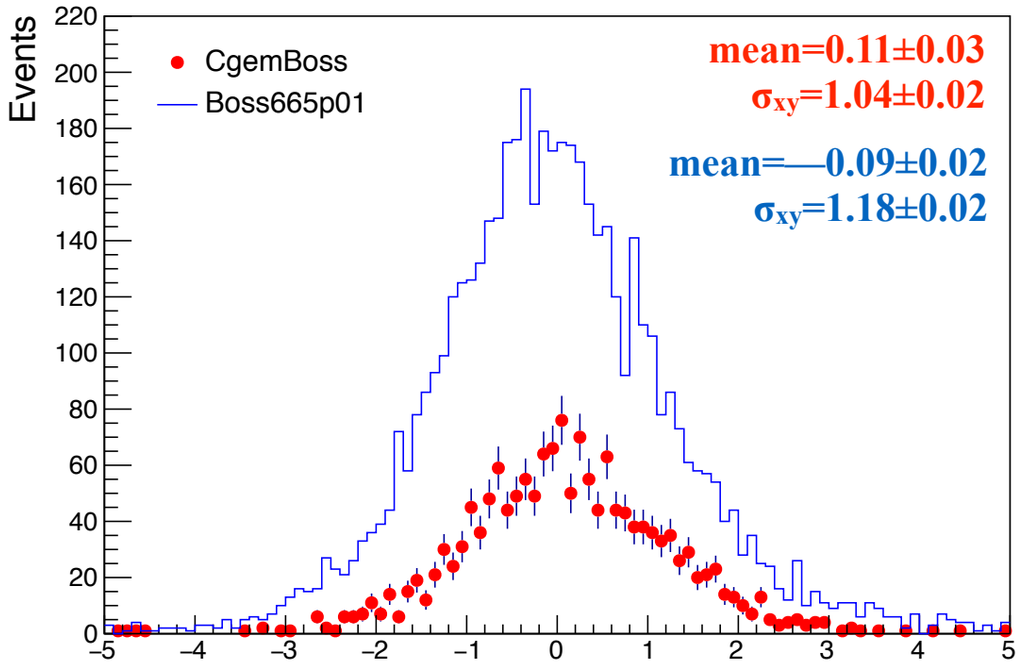
Protons:
pt=700 MeV

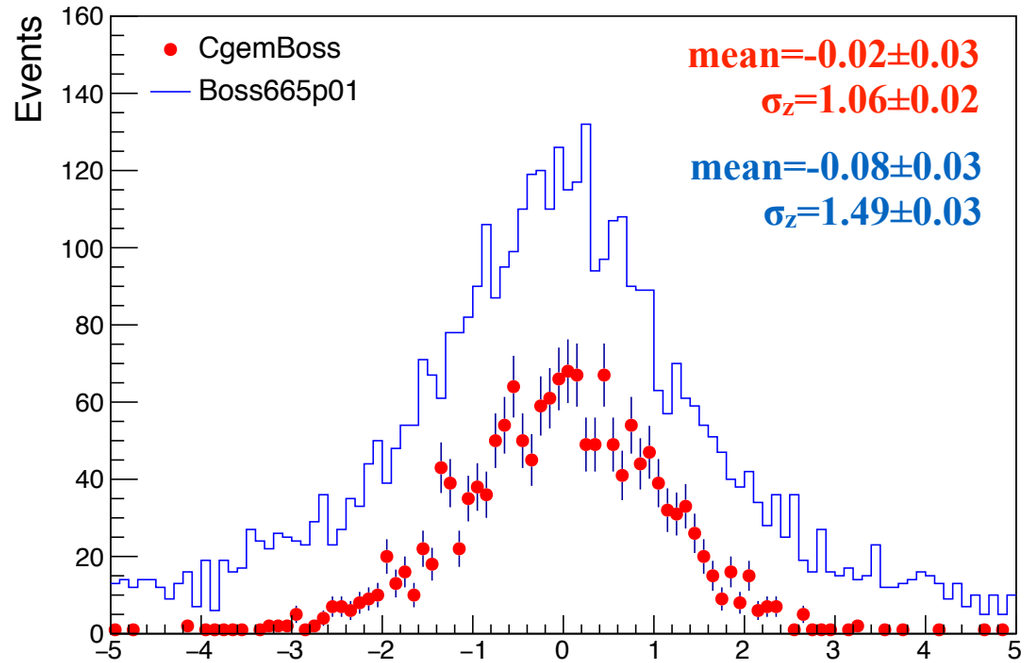




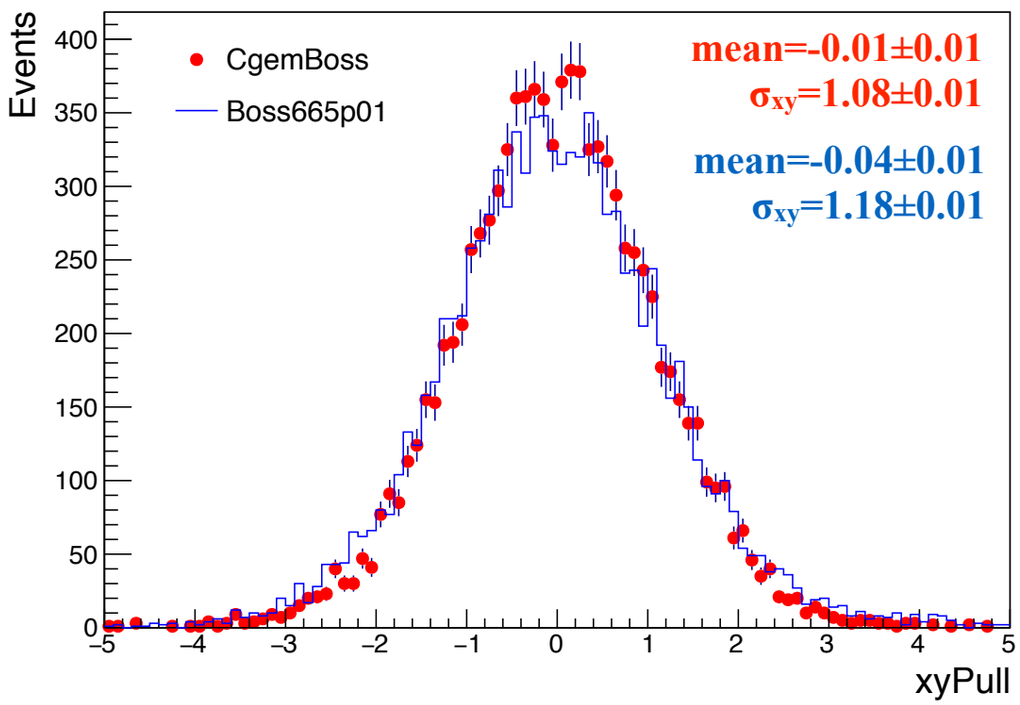
Pull distributions for protons

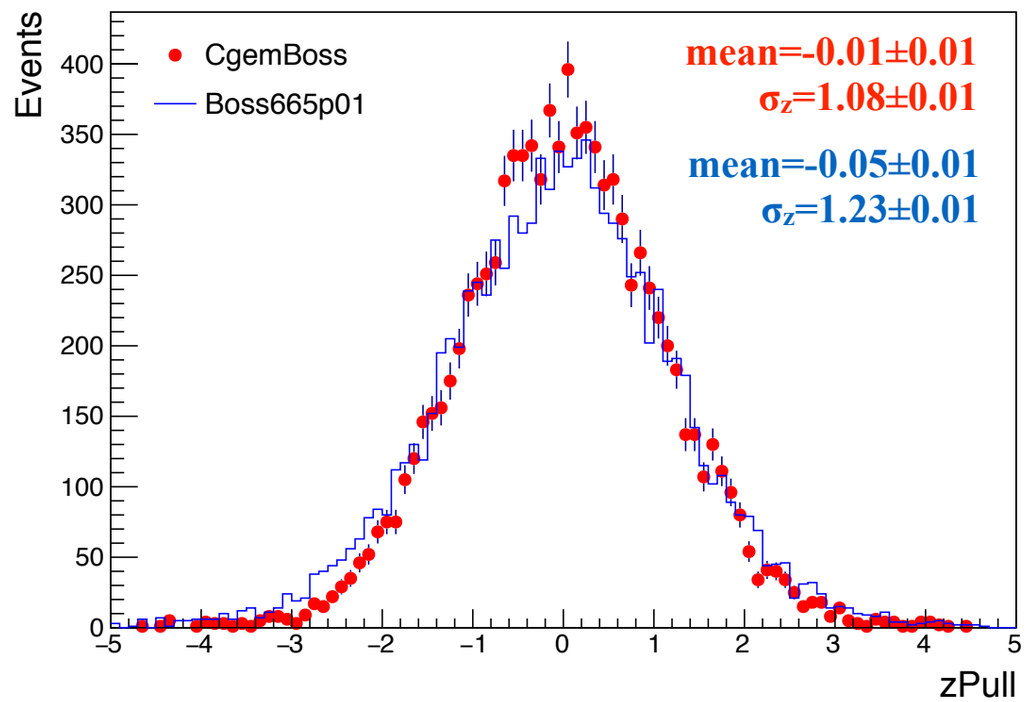
Protons:
pt=200 MeV



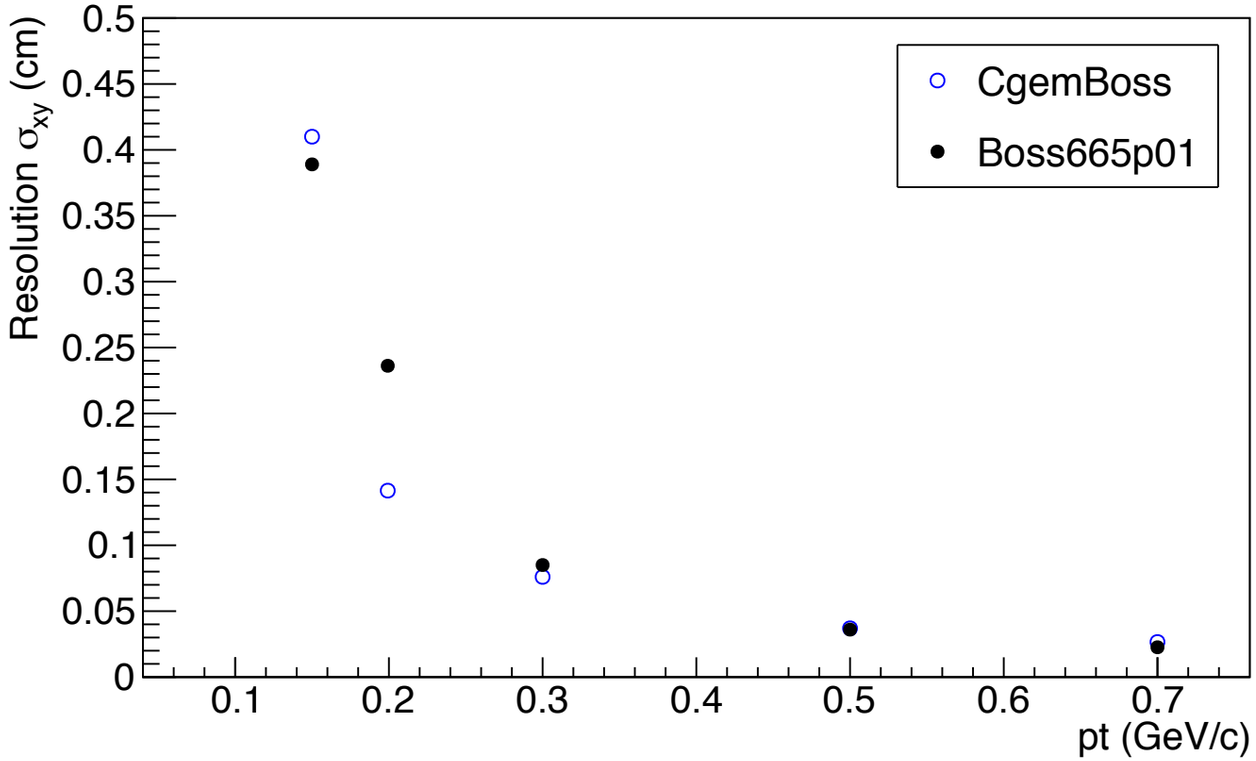


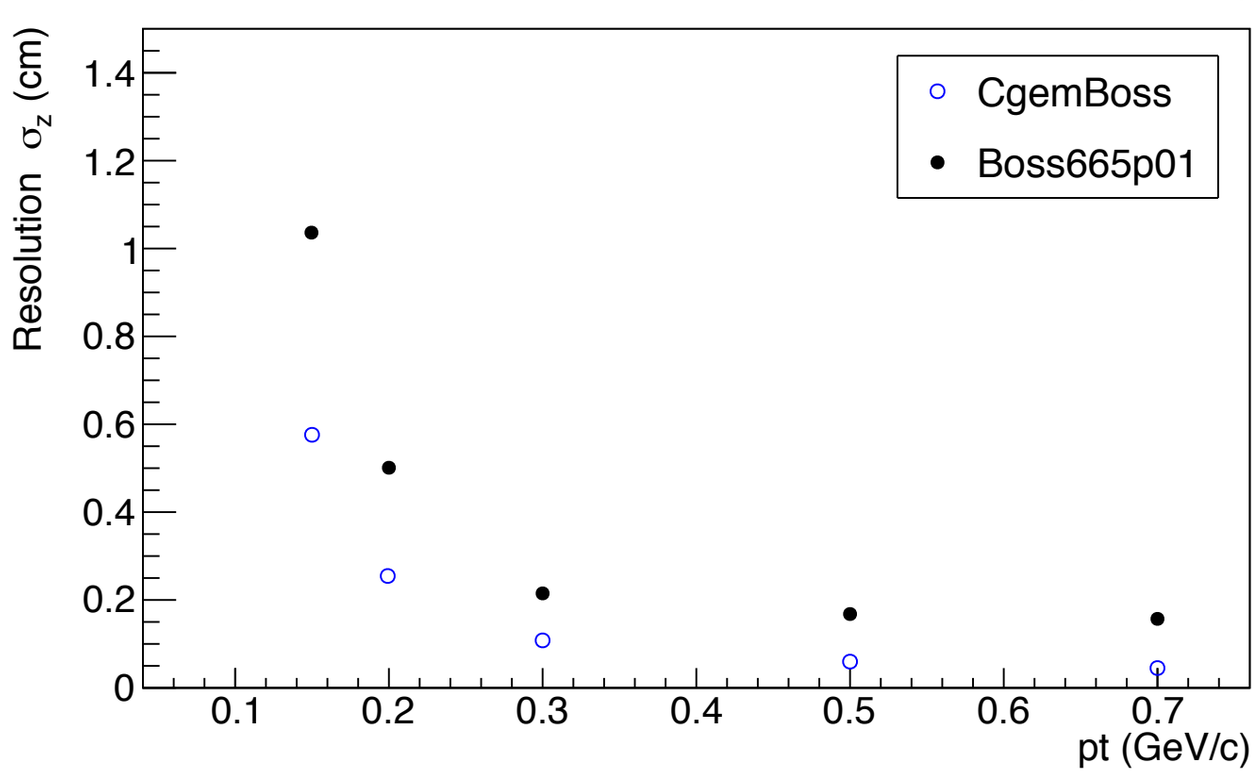
Protons:
pt=700 MeV





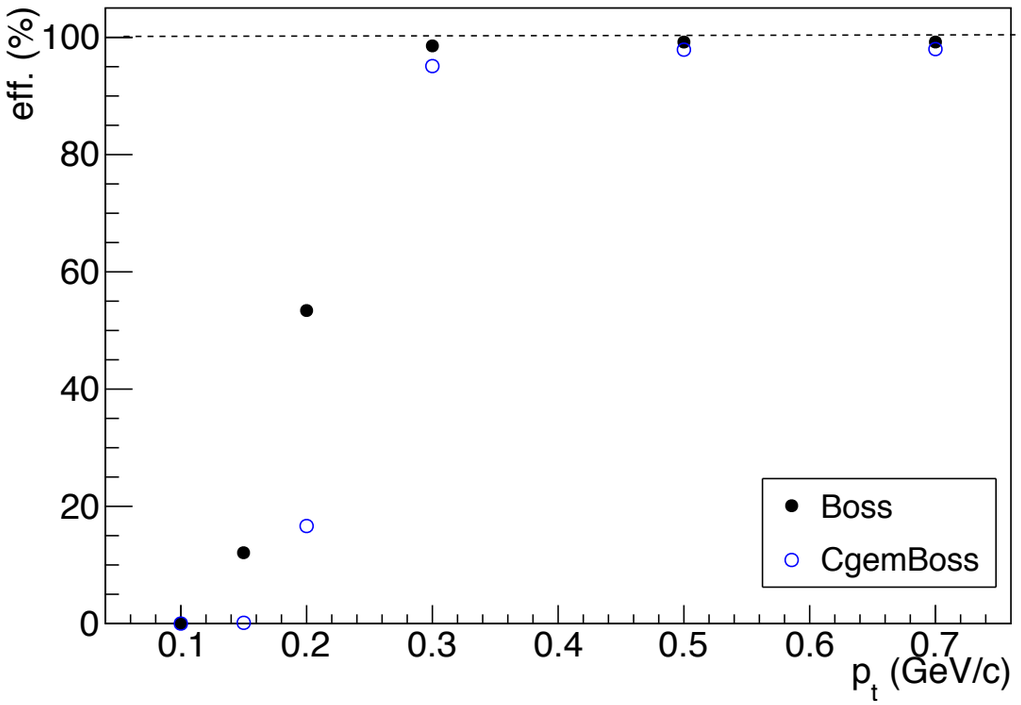
PROTONS summary: vertex resolution vs. pt



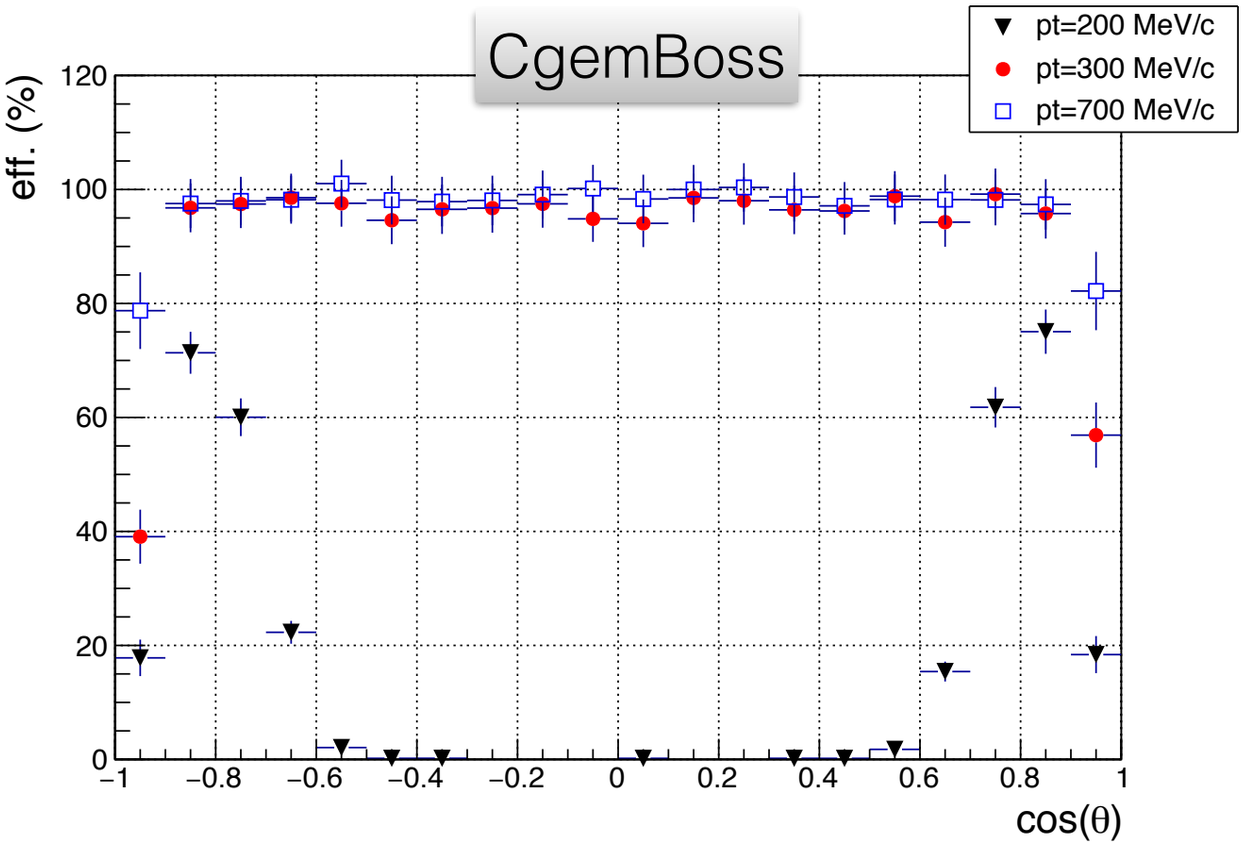


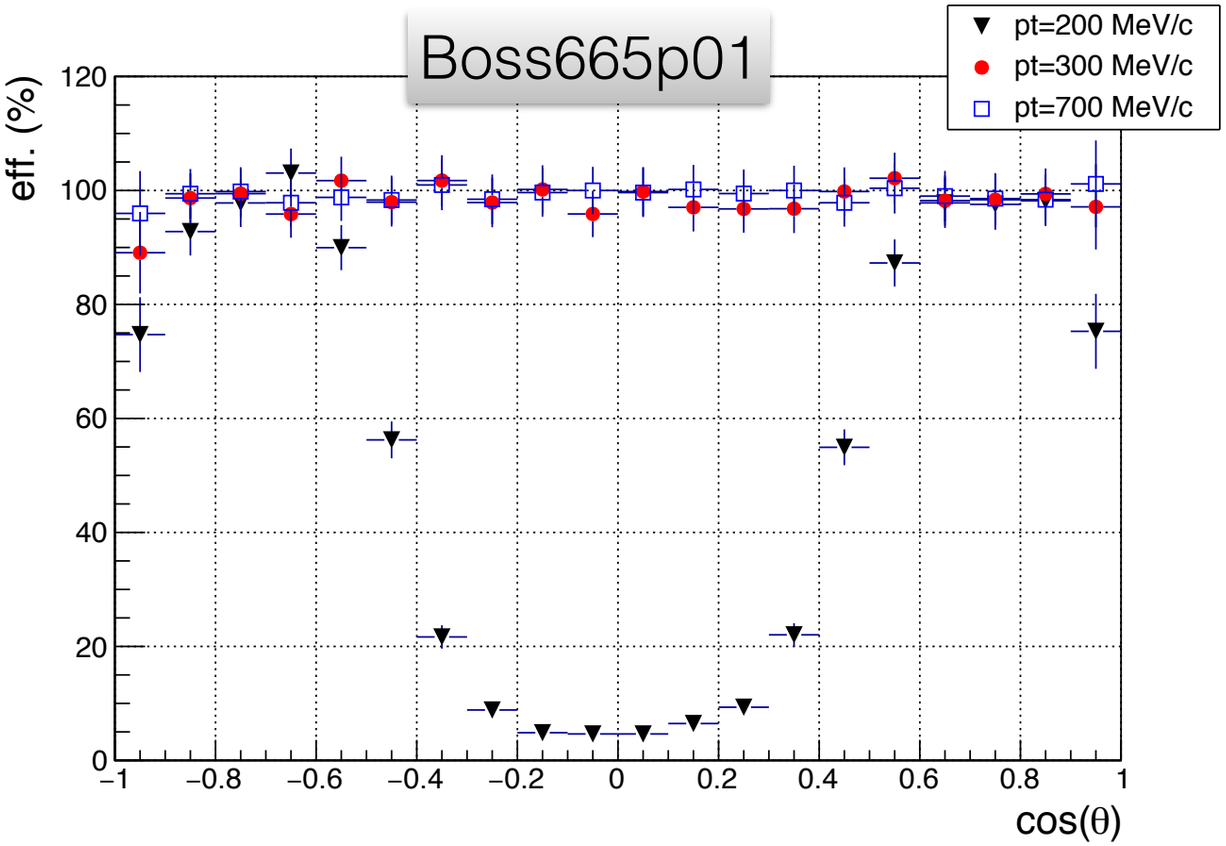
- **Better resolution in Boss665p01 for pt>0.5 GeV/c, worse for lower momenta**
- **Strong improvement of the vertex resolution along the z direction for CgemBoss (by a factor of about 3)**

PROTONS summary: efficiencies

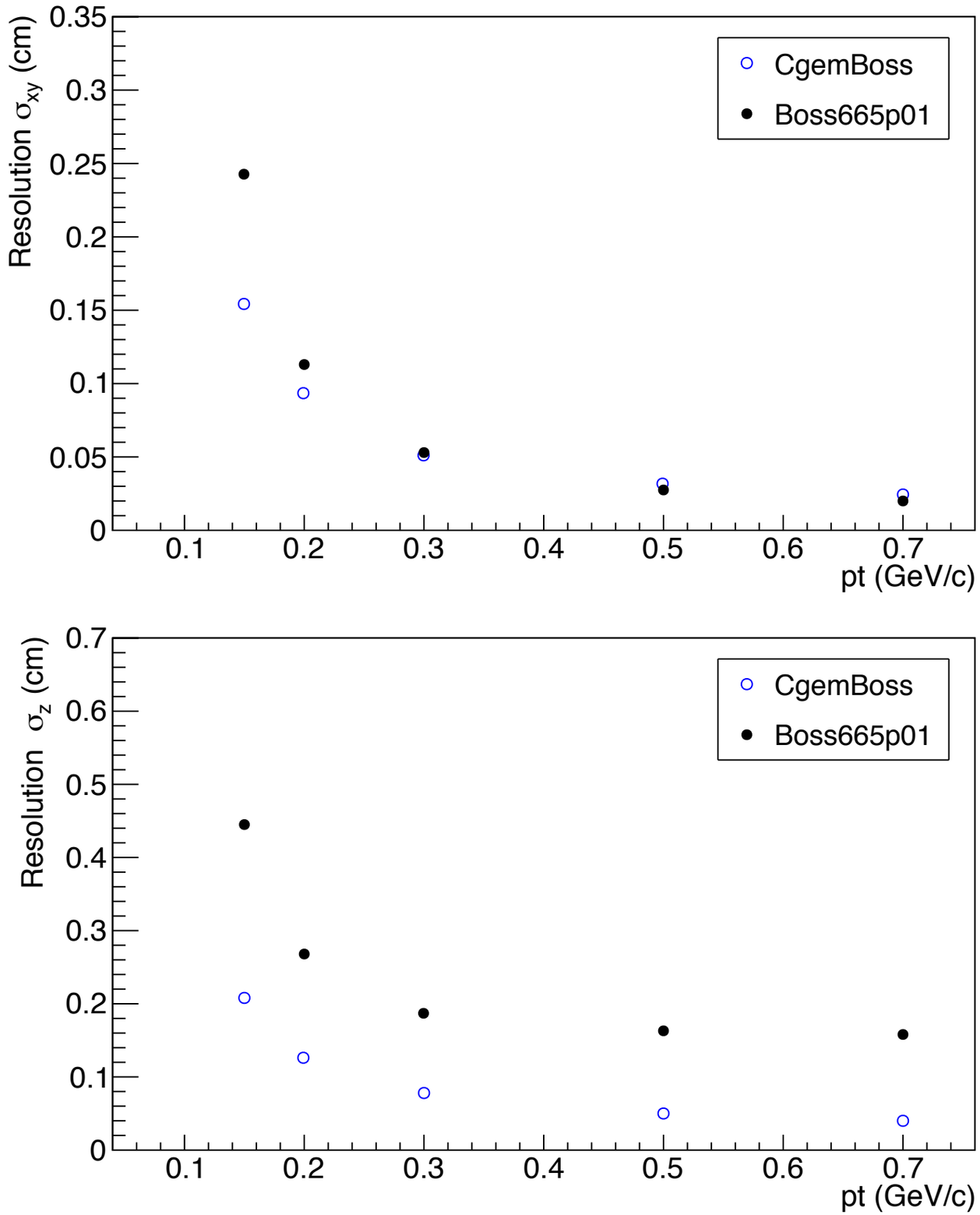


- **The resolution is always lower for CgemBoss (know problem due to the matching procedure)**
  - **the effect is more pronounced for low pt**
- **Efficiency vs. cos(θ):**
  - **for low pt, larger loss of efficiency in CgemBoss at the boundaries and in the central region (perpendicular to the beam direction)**



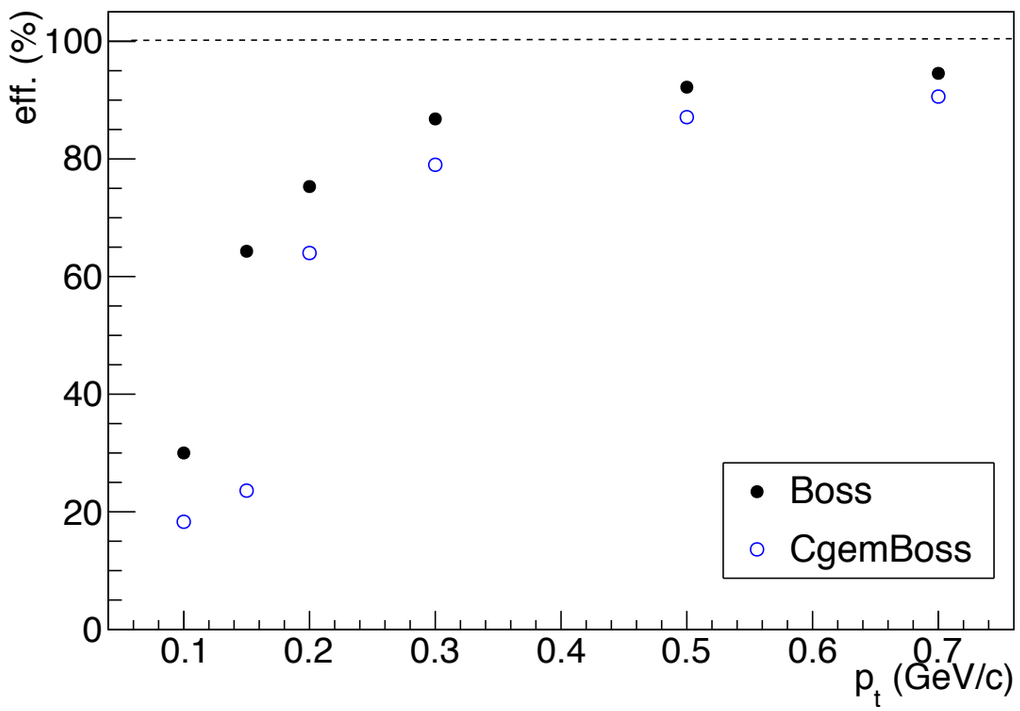


KAONS summary: vertex resolution vs. pt

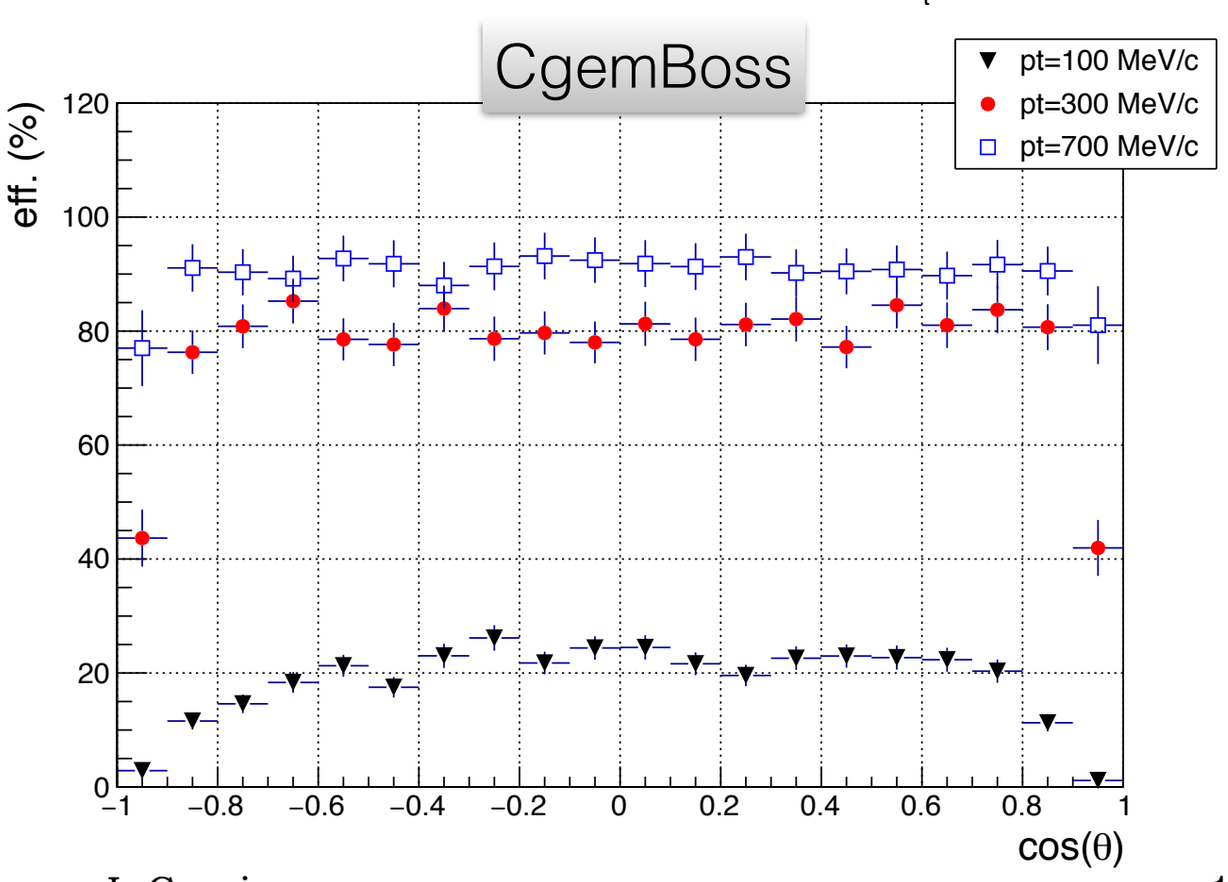


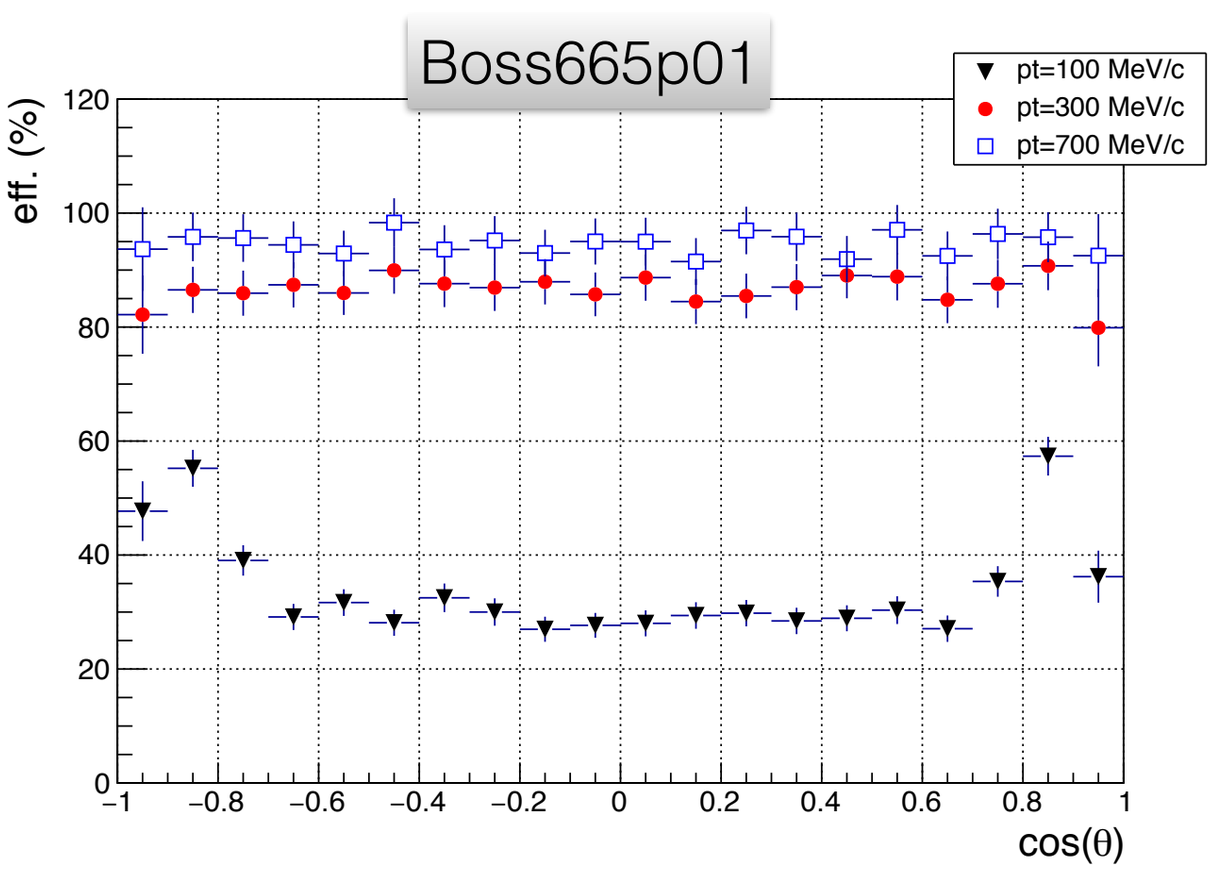
- **Better resolution in Boss665p01 for pt>0.4 GeV/c, worse for lower momenta**
- **Strong improvement of the vertex resolution along the z direction for CgemBoss (by a factor of about 3)**

KAONS summmary: efficiencies

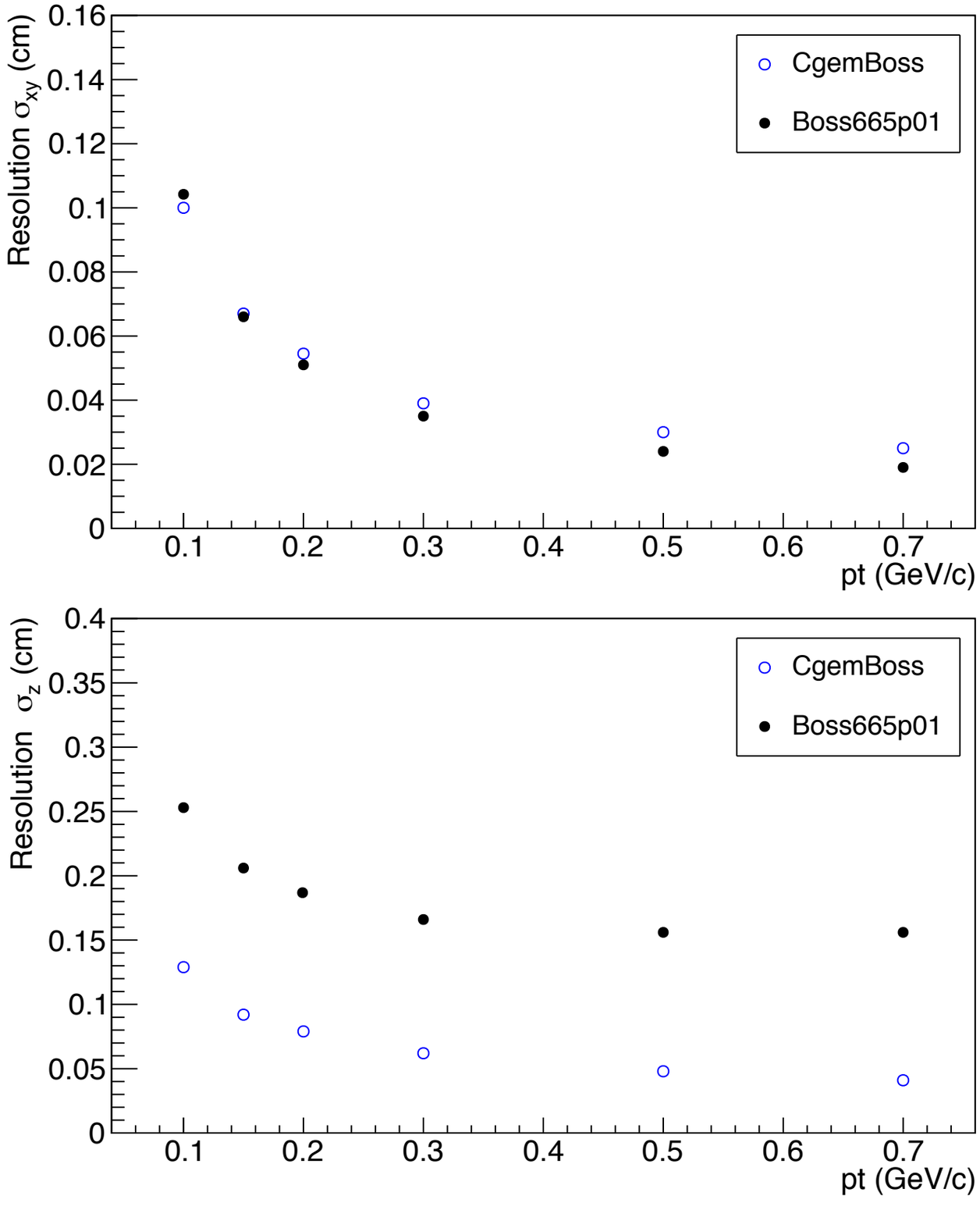


- **The resolution is always lower for CgemBoss (know problem due to the matching procedure)**
- **Efficiency vs. cos(θ):**
  - **for low pt, larger loss of efficiency in CgemBoss at the boundaries**
- **Pull distributions (see bk slides): consistent with the expectations for pt>200 MeV/c**



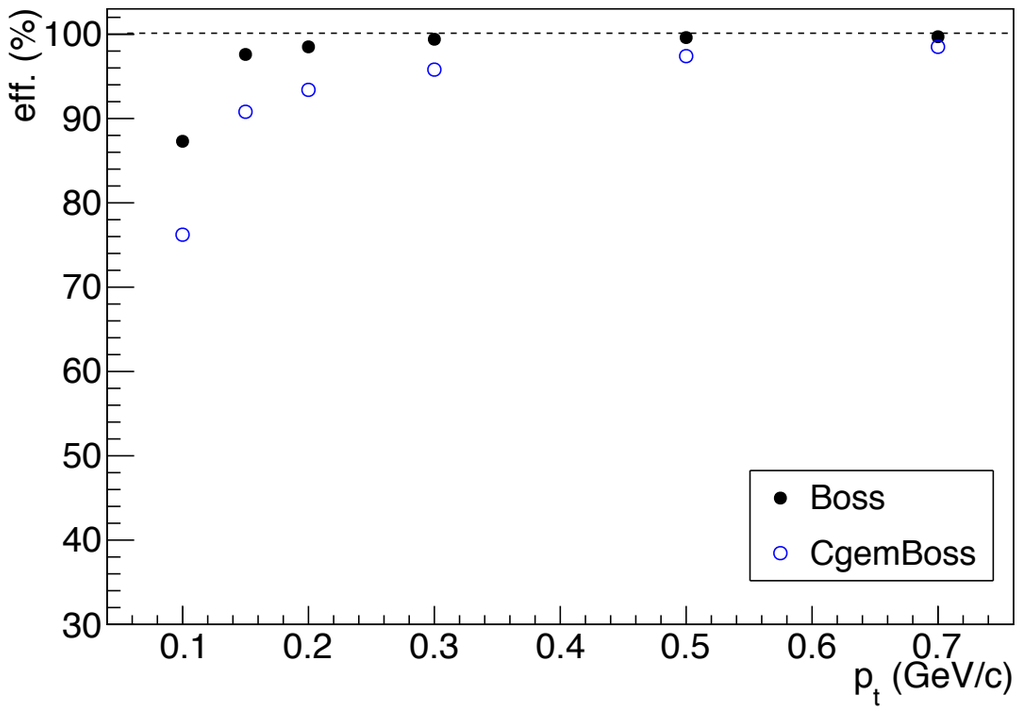


Electrons summary: vertex resolution vs. pt

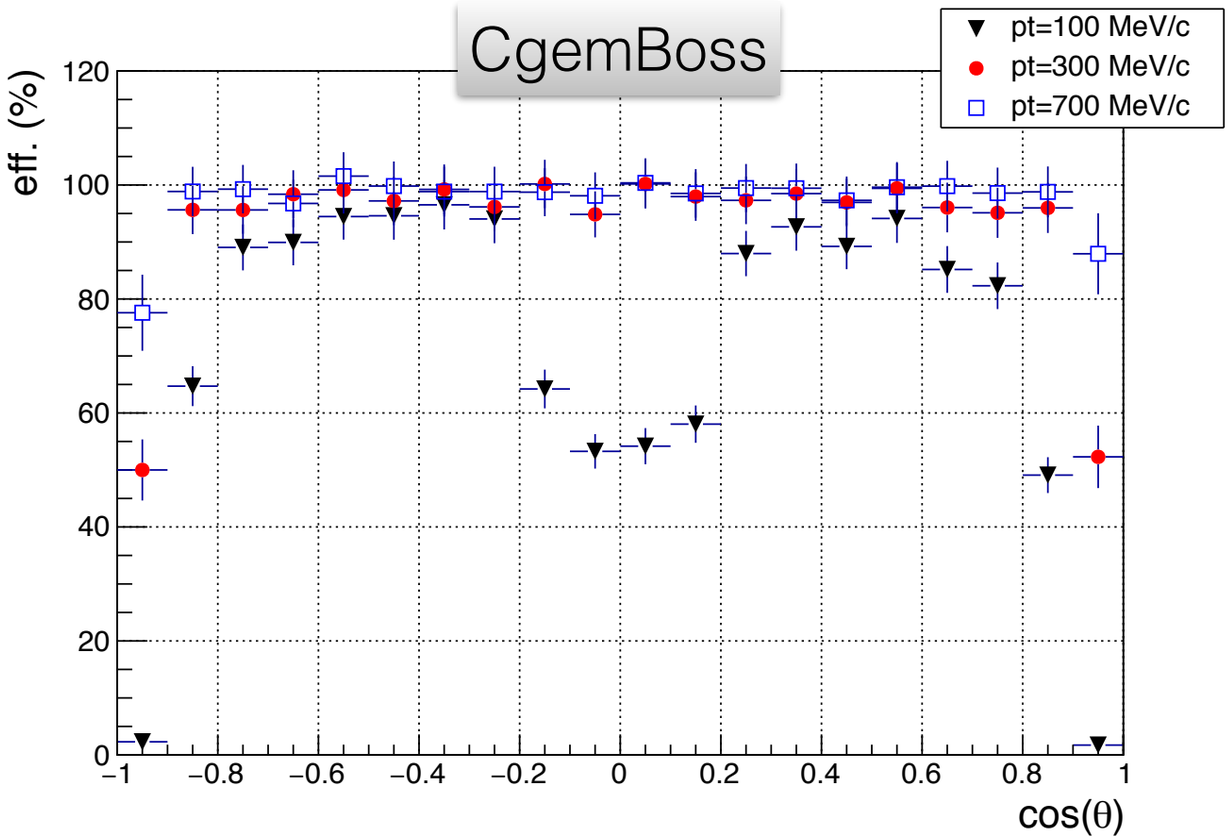


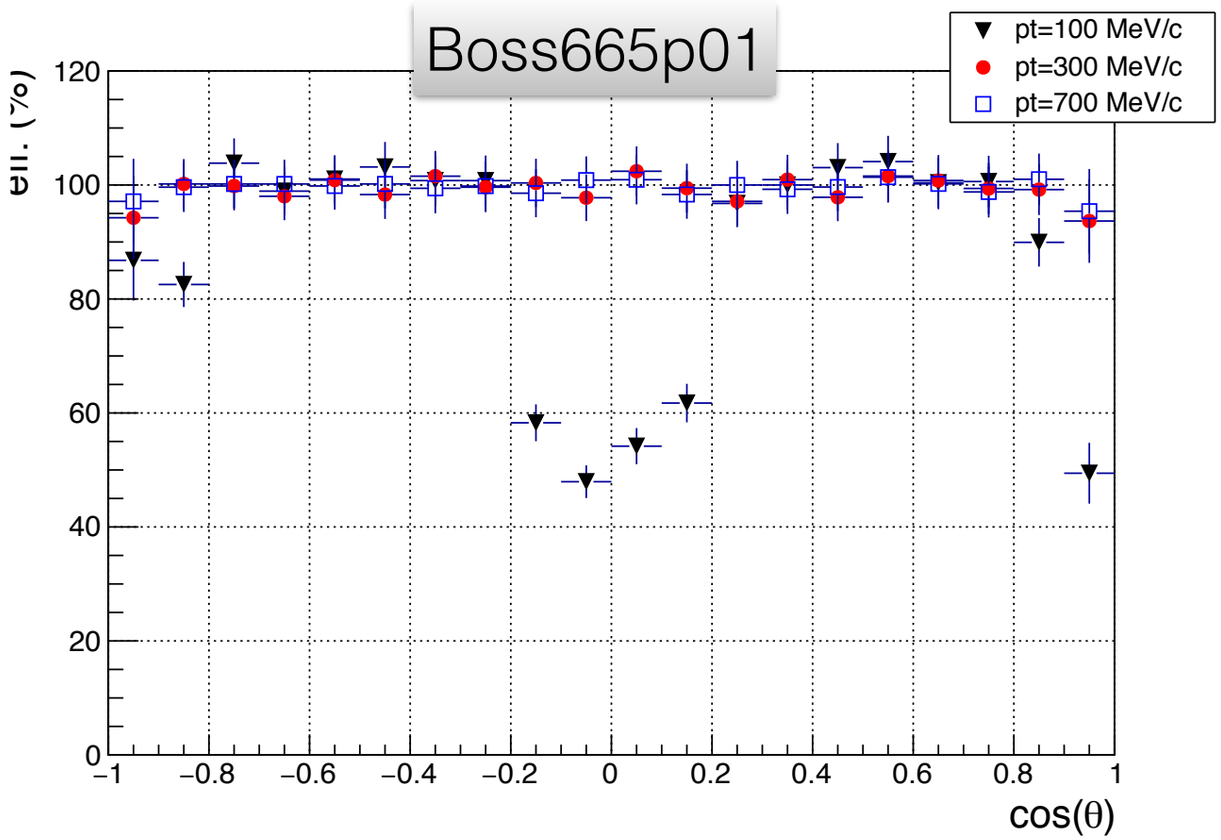
- **Better resolution in Boss665p01 for pt>0.2 GeV/c, slightly worse for lower momenta**
- **Strong improvement of the vertex resolution along the z direction for CgemBoss (by a factor of about 3)**

Electrons summary: efficiencies

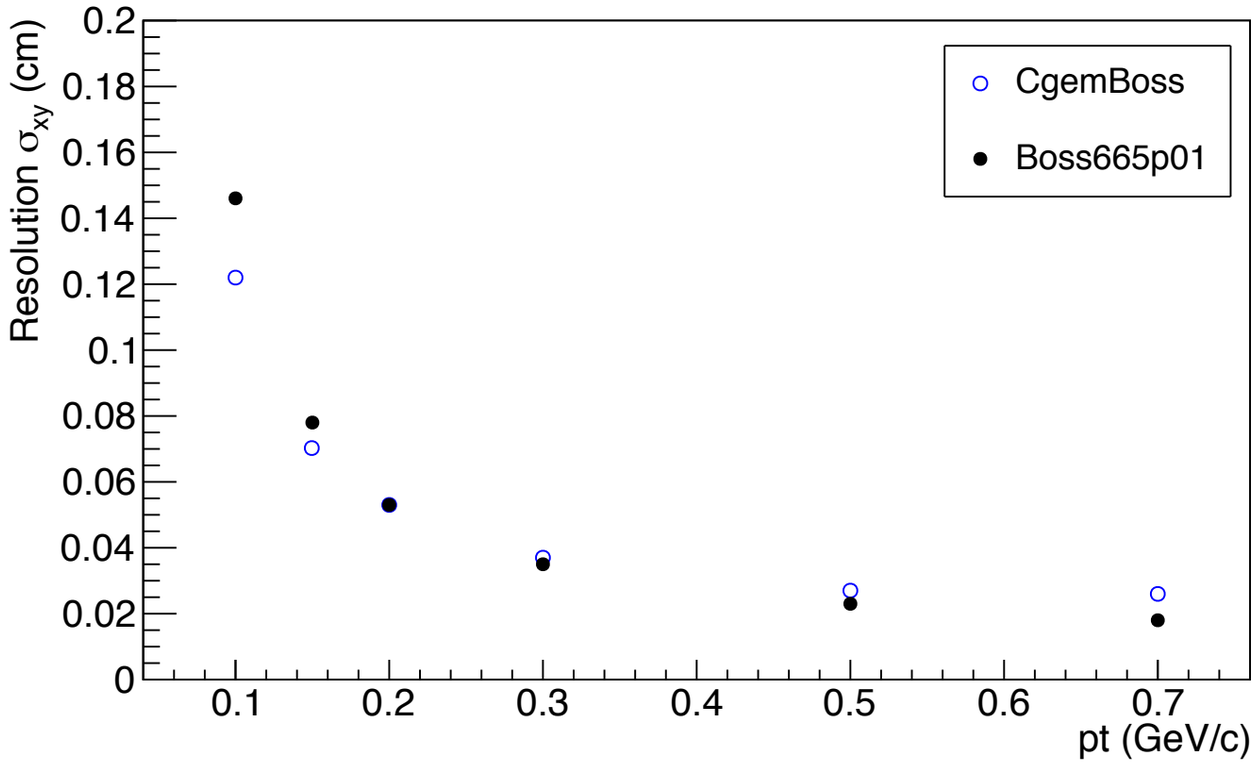


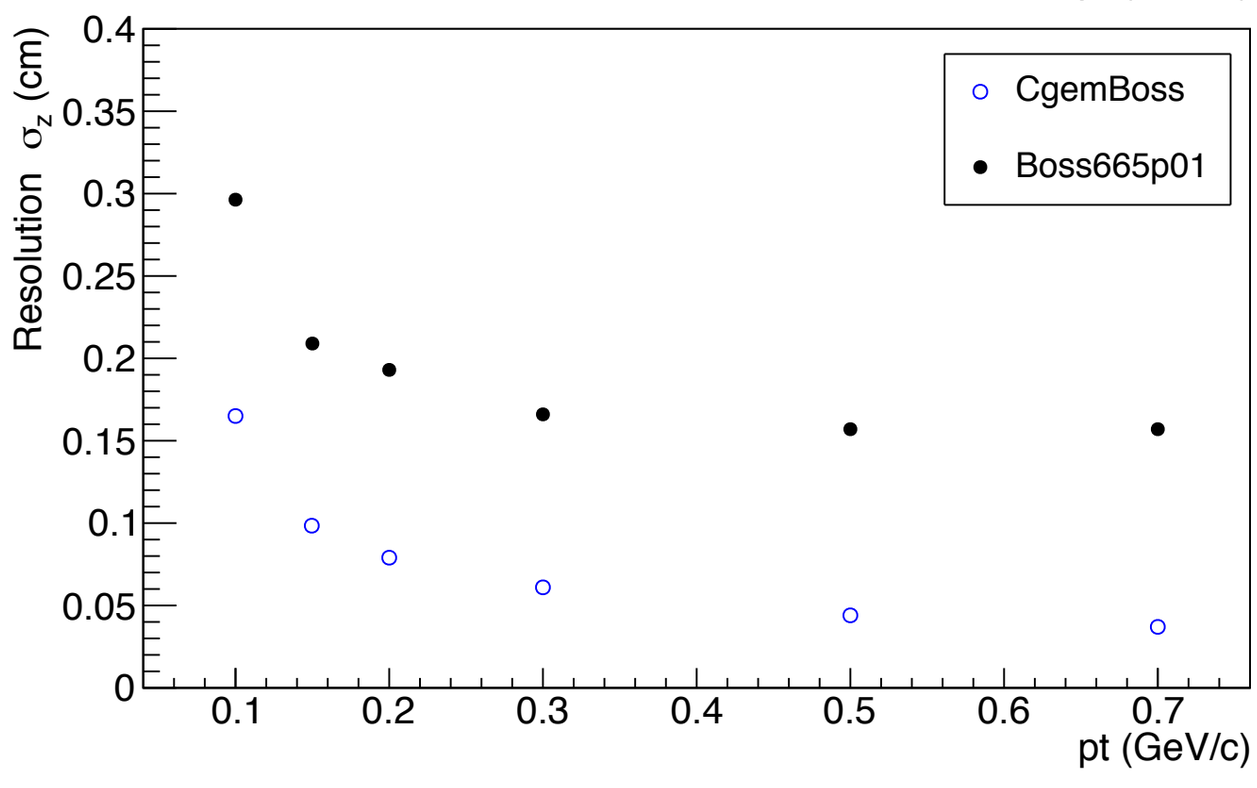
- **The resolution is always lower for CgemBoss (know problem due to the matching procedure)**
- **Efficiency vs. cos(θ):**
  - **similar as for muons**
  - **for low pt, larger loss of efficiency in CgemBoss at the boundaries and in the central region (perpendicular to the beam direction)**
- **Pull distributions (see bk slides): consistent with the expectations for pt>100 MeV/c**





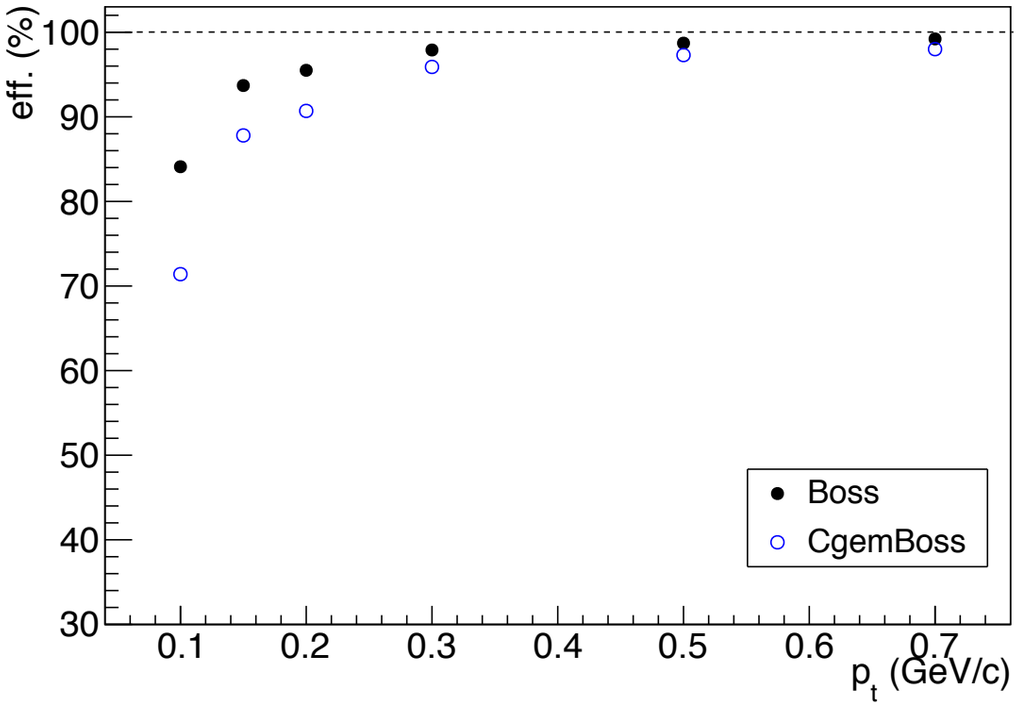
Pions summary: vertex resolution vs. pt



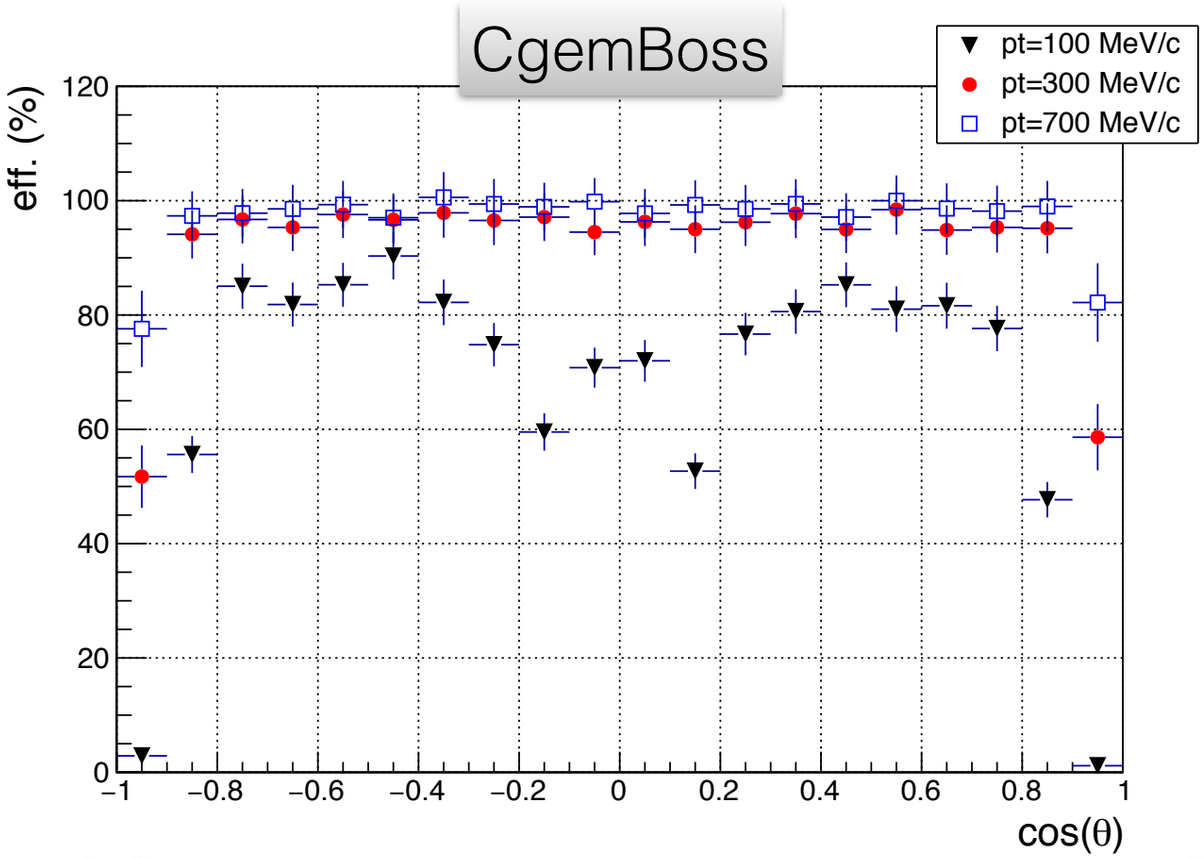


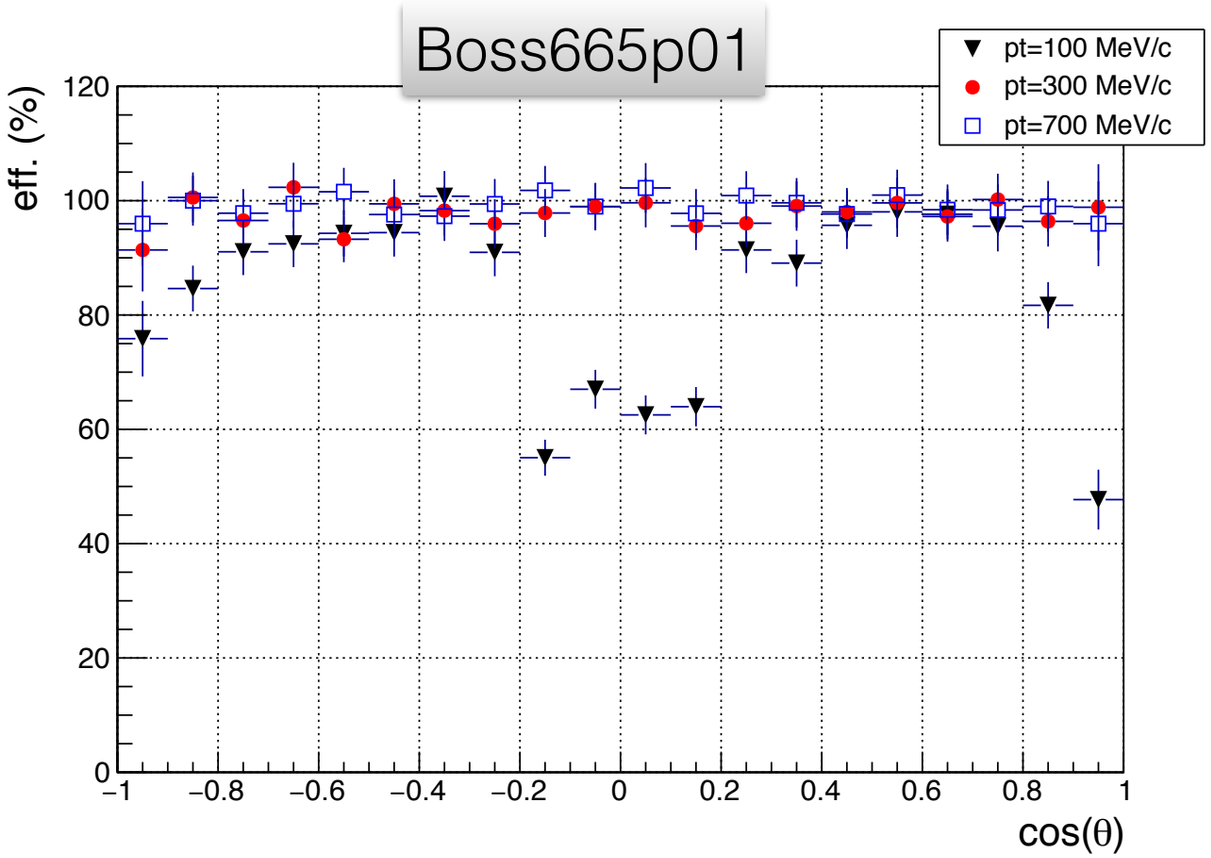
- **Better resolution in Boss665p01 for pt>0.2 GeV/c, worse for lower momenta**
- **Strong improvement of the vertex resolution along the z direction for CgemBoss (by a factor of about 3)**

Pions summary: efficiencies

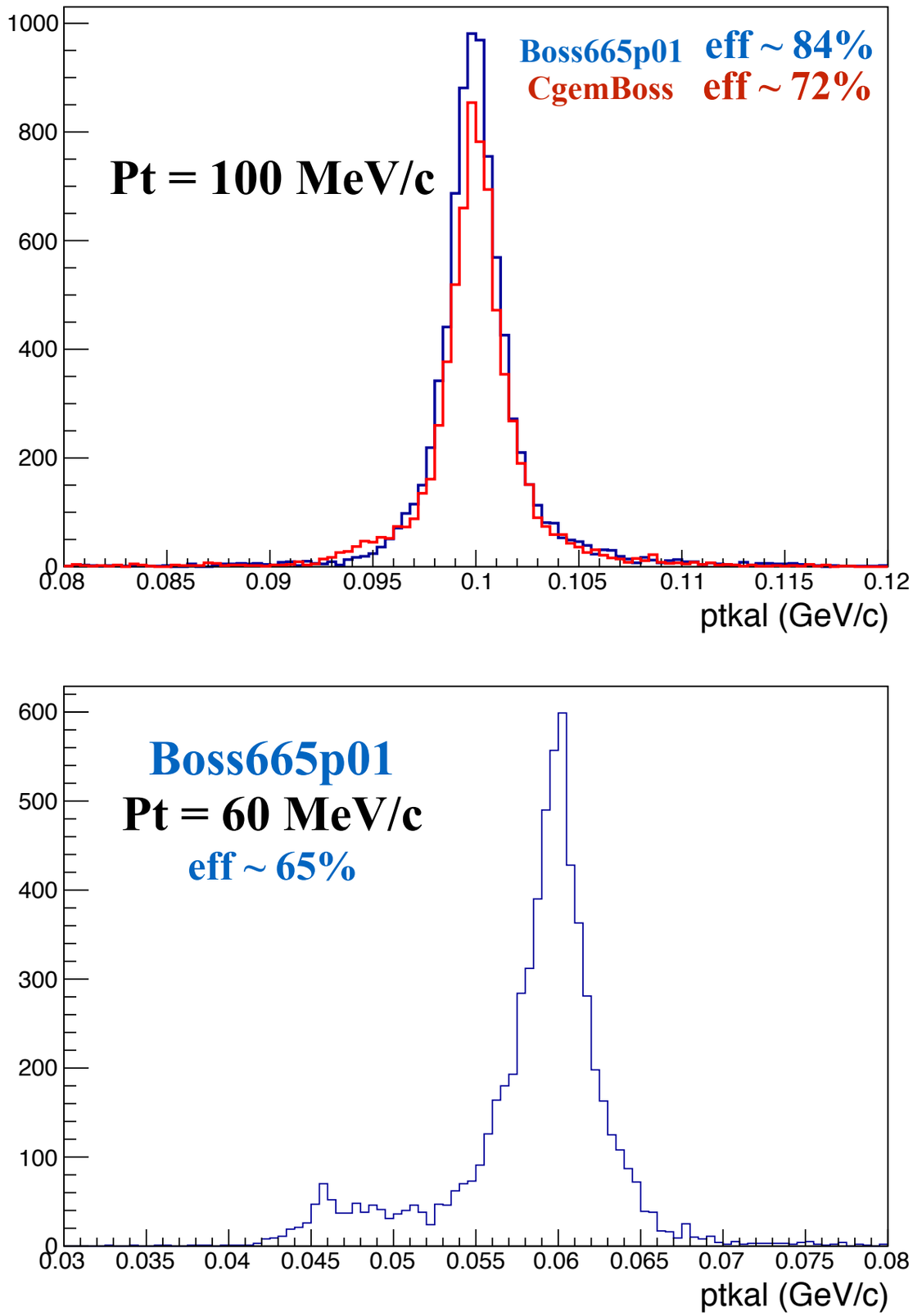


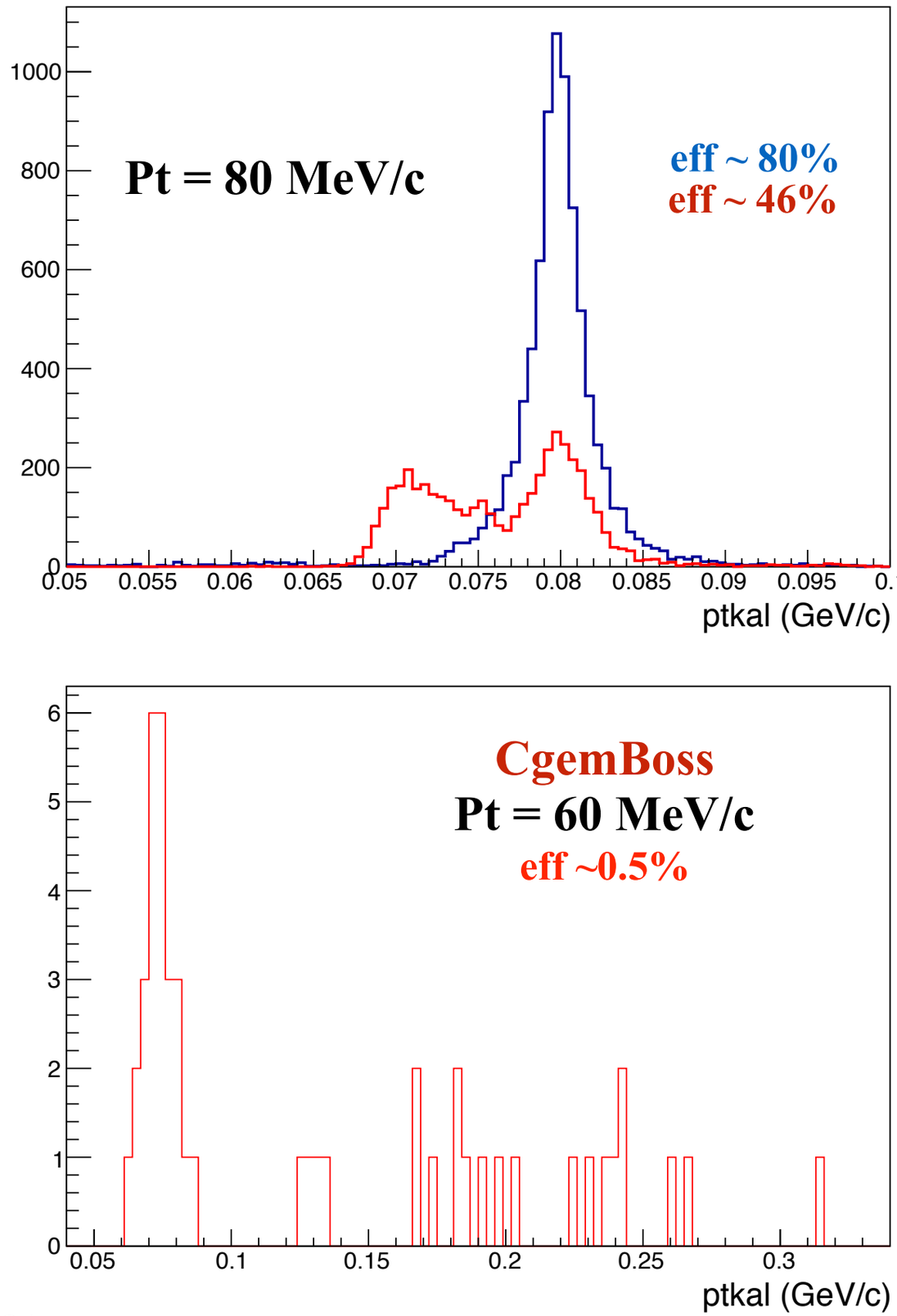
- **The resolution is always lower for CgemBoss (know problem due to the matching procedure)**
- **Efficiency vs. cos(θ):**
  - **for low pt, larger loss of efficiency in CgemBoss at the boundaries and in the central region (perpendicular to the beam direction)**
- **Pull distributions (see bk slides): consistent with the expectations for pt>100 MeV/c**



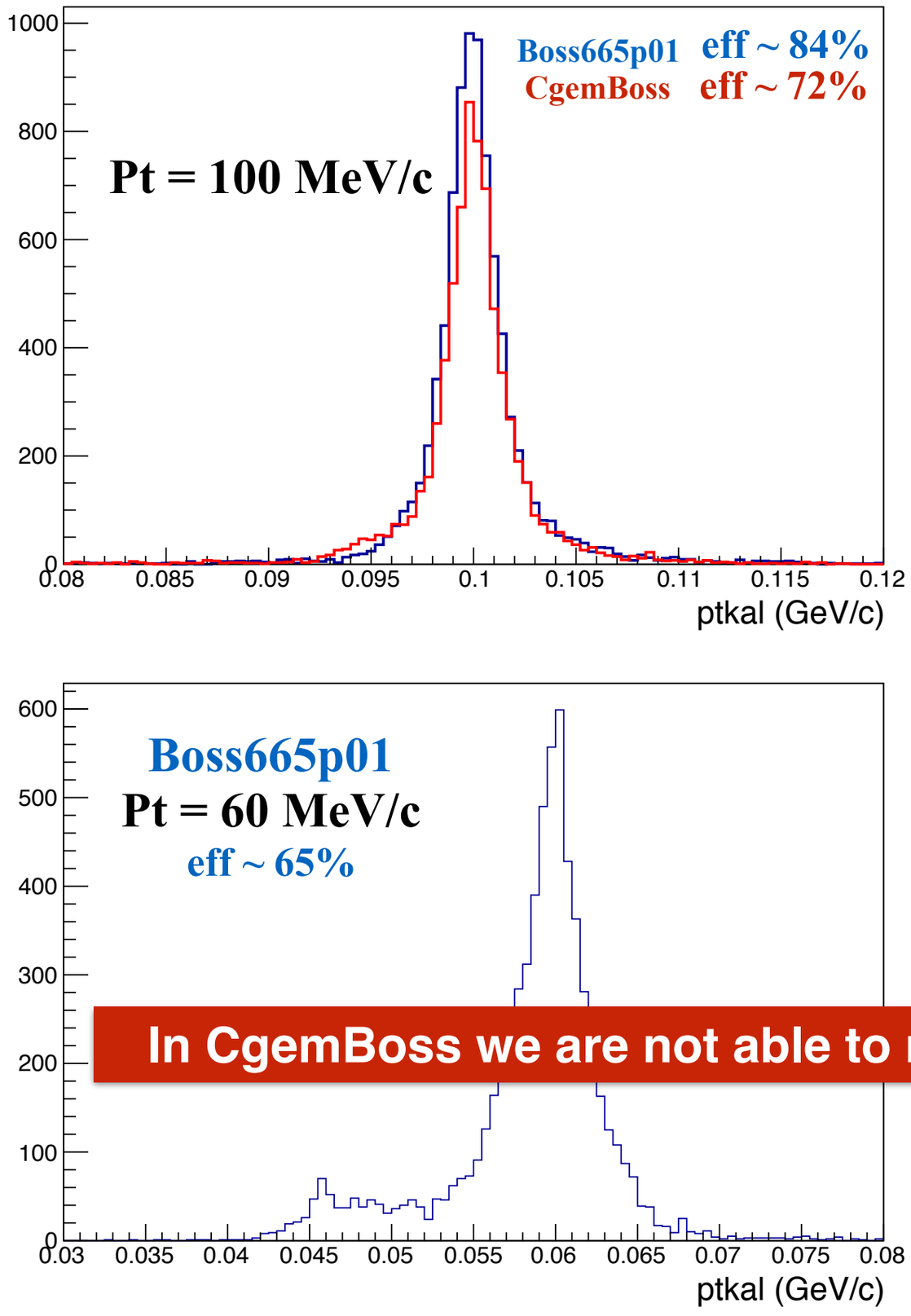


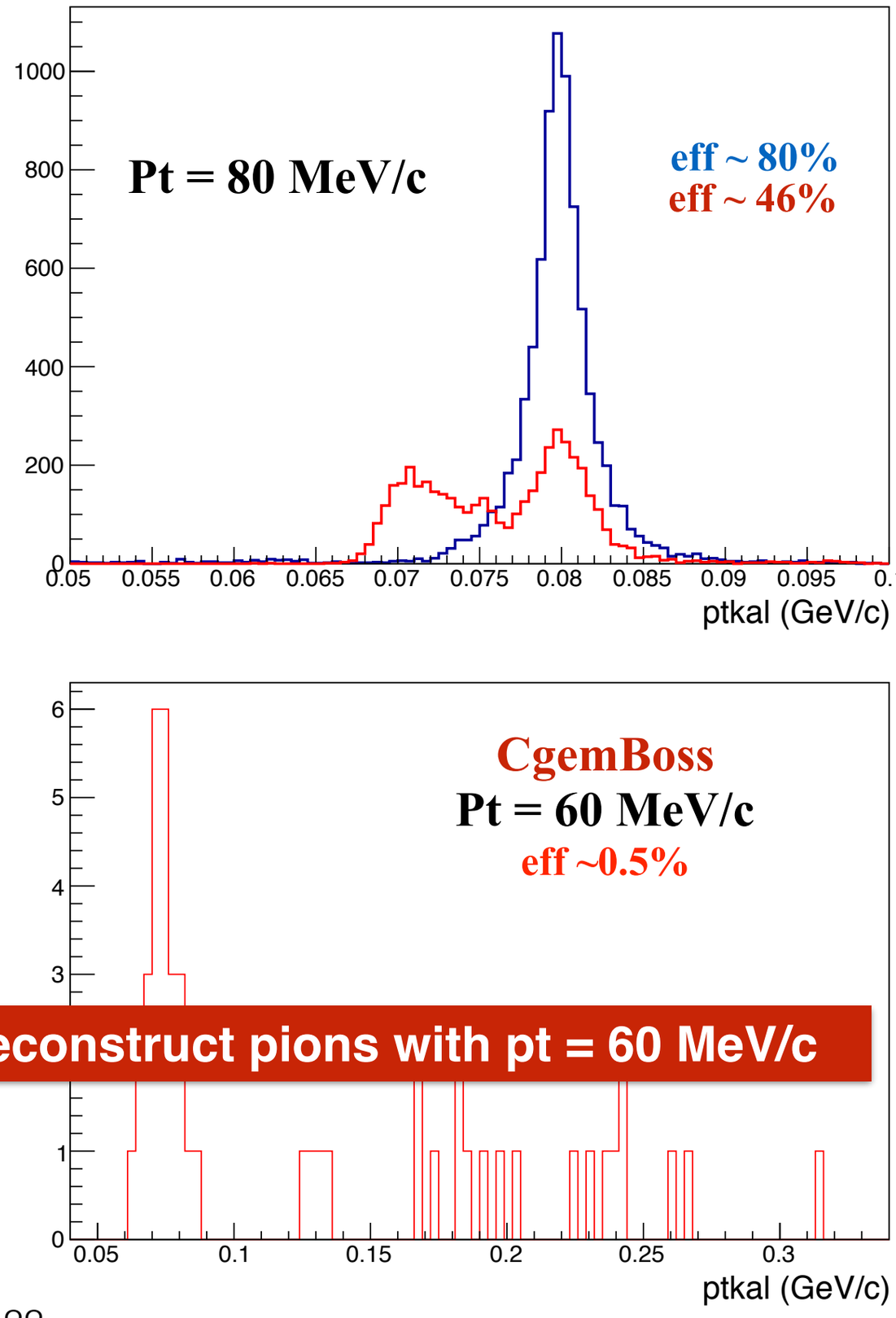
Soft pions (pt<100 MeV/c)





Soft pions (pt<100 MeV/c)

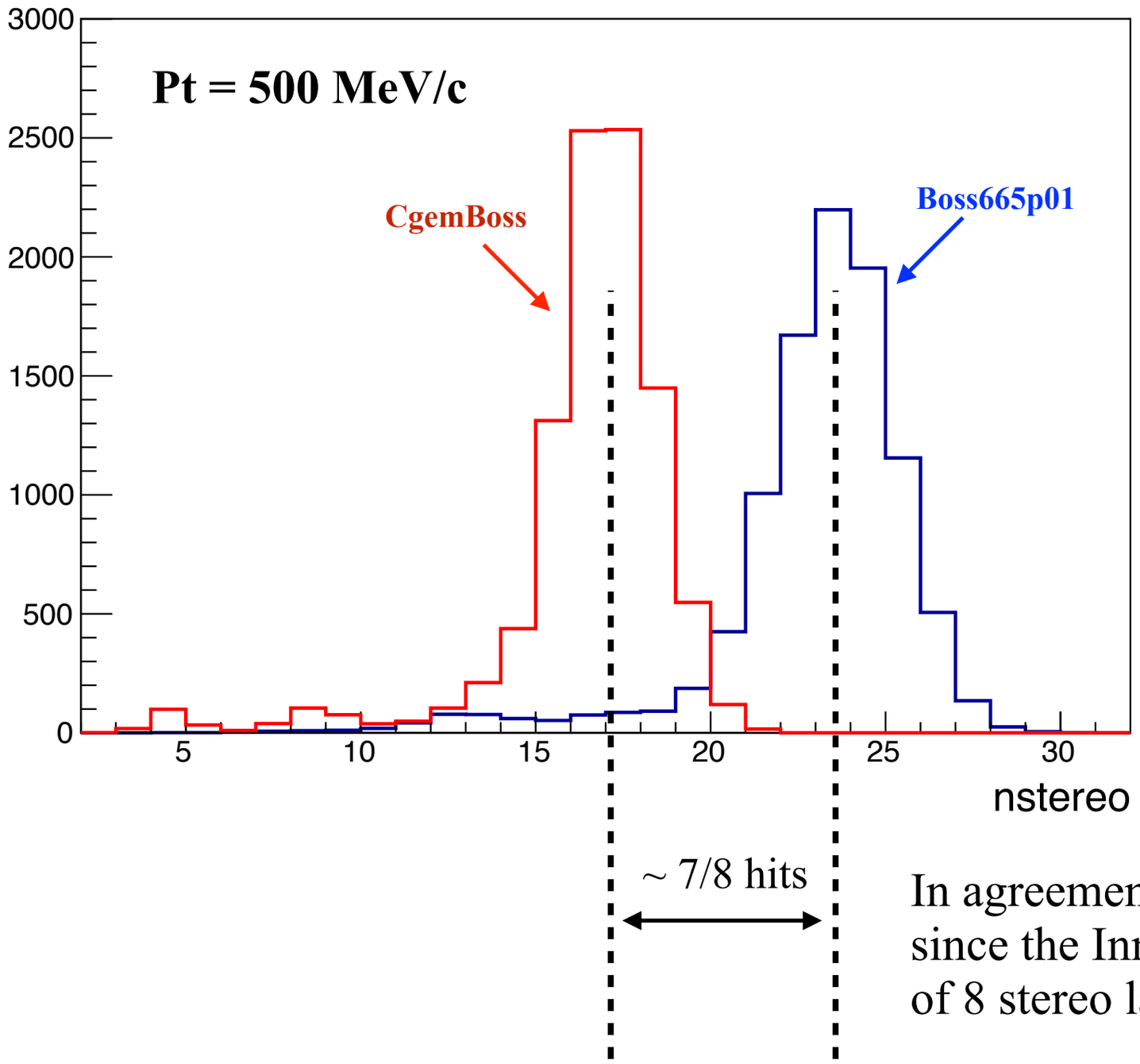




In CgemBoss we are not able to reconstruct pions with pt = 60 MeV/c

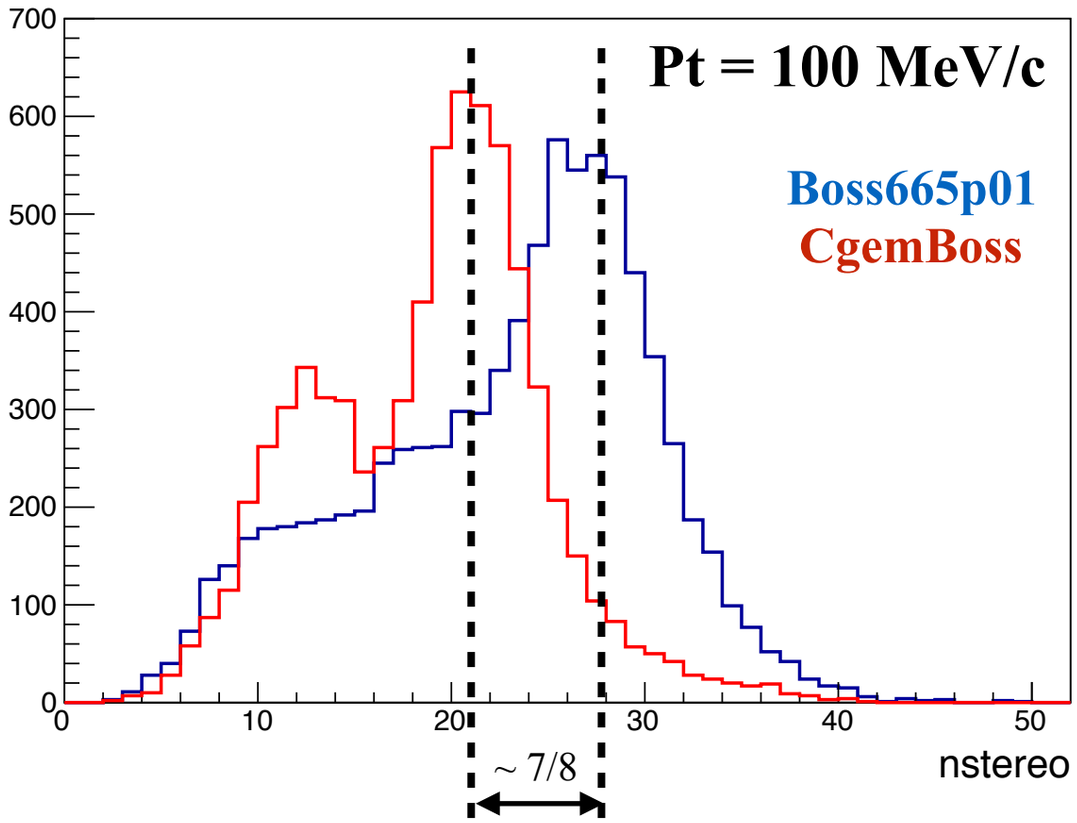
nstereo hits

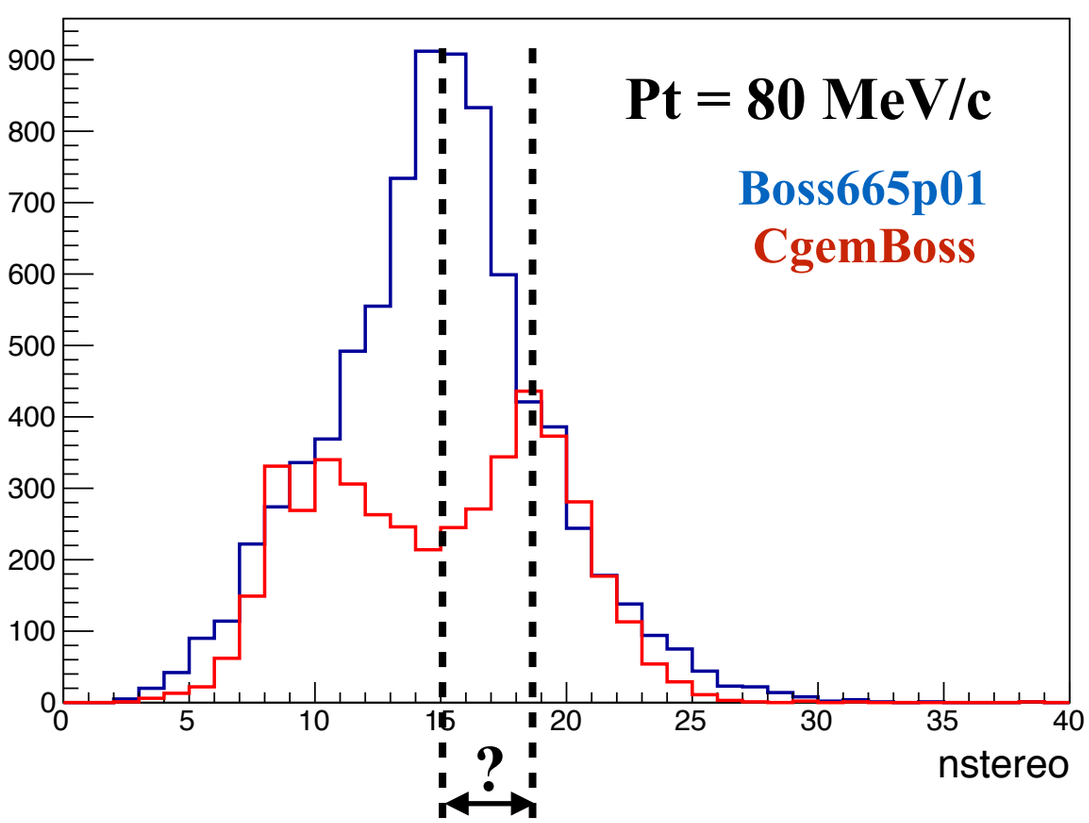
What is the distribution for pions with large pt? (pt > 100 MeV/c)

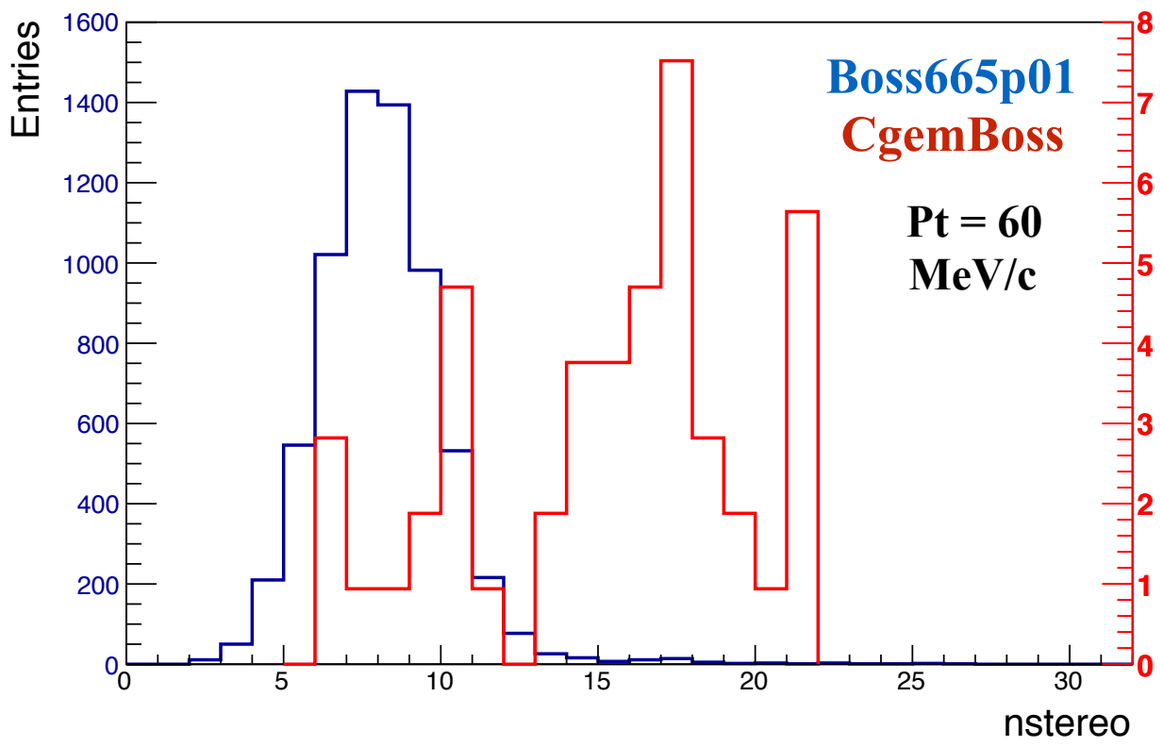


In agreement with the expectation since the Inner DC (IDC) consists of 8 stereo layers

nstereo hits







- Good tracks reconstruction for pt > 100 MeV/c
- For pt<100 MeV/c
  - few pions reach the stereo hits of the Outer DC
  - **the matching between ODC and CGEM fails: if no tracks are reconstructed in the ODC, there is no matching and the track is not reconstructed. This is the reason of the low efficiency for low momentum tracks**
- **The comparison between CgemBoss and Boss-665p01 without the IDC gives consistent distributions**
  - **proof of the previous conclusion**

Conclusions

Single track simulation

- Useful to identify bugs, problems, and to find possible solutions
- Pt shift problem to low values w.r.t. the nominal one was understood and fixed
  - BesSim.Field =1 option, which call a uniform magnetic field
- Efficiencies vs. pt and cos(θ) studied for pions, muons, electrons, protons and kaons
  - CgemBoss efficiency lower than Boss due to the matching between CGEM and ODC
- Vertex resolution
  - HUGE improvement of the vertex resolution along the z direction of about a factor 3
  - Almost consistent in the XY plane
  - Pull distributions consistent with the expectations

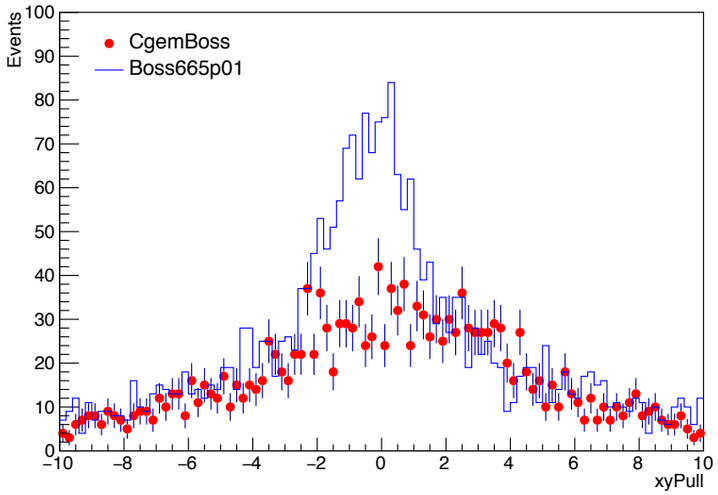
From soft pion studies we can conclude that the matching procedure between CGEM and ODC is not sufficient to reach a reasonable reconstruction efficiency

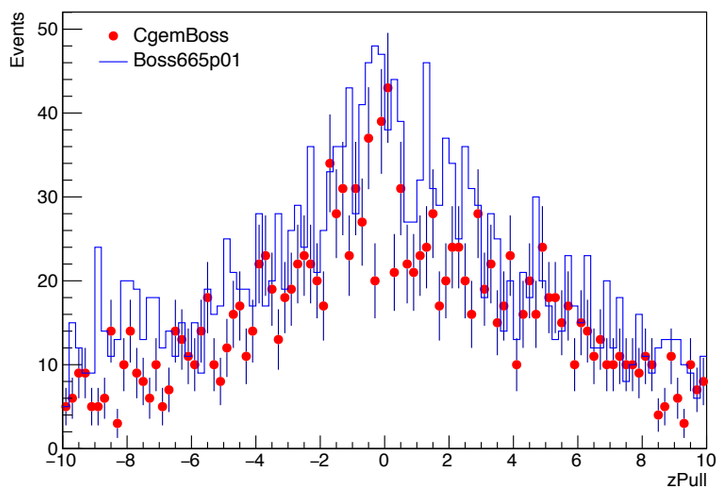
- Hough transform could help to solve this problem

BK slides

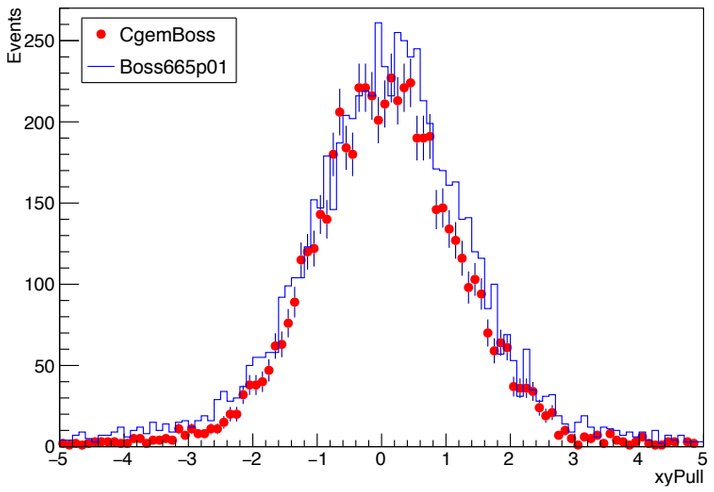
KAONS: Pull distributions

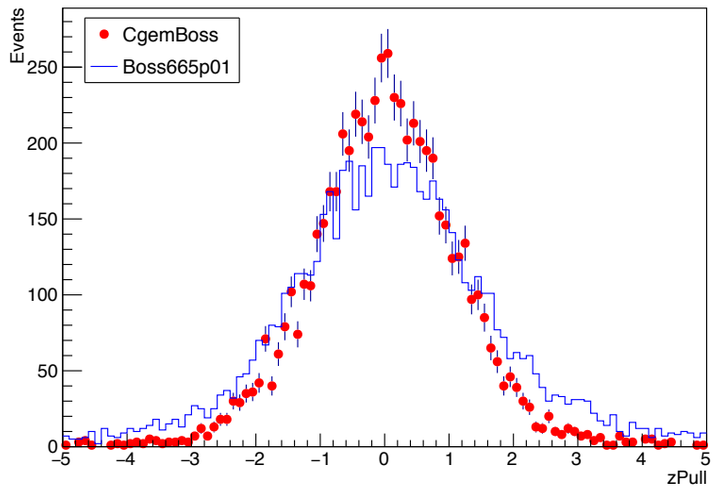
Kaons:
pt=100 MeV



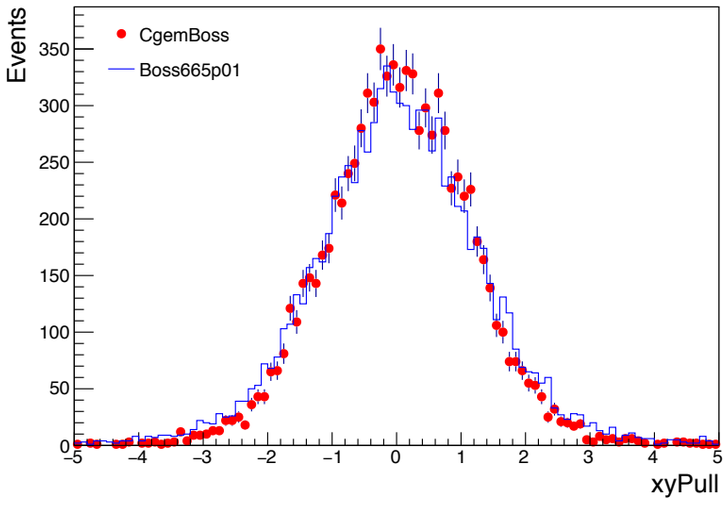


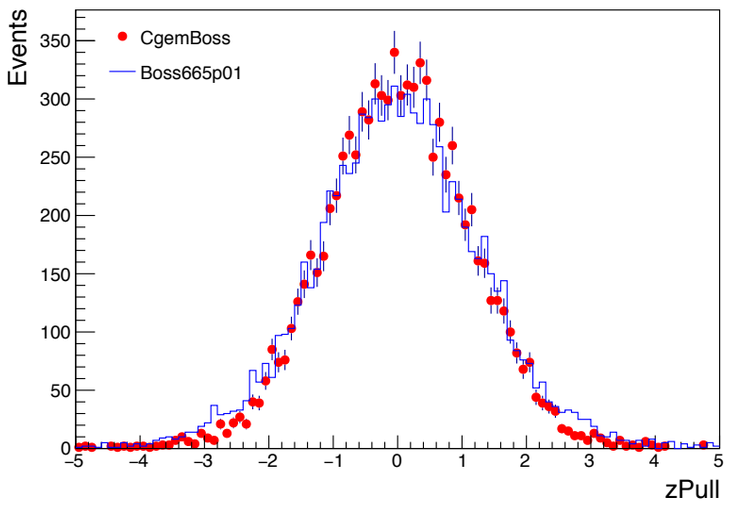
Kaons:
pt=200 MeV





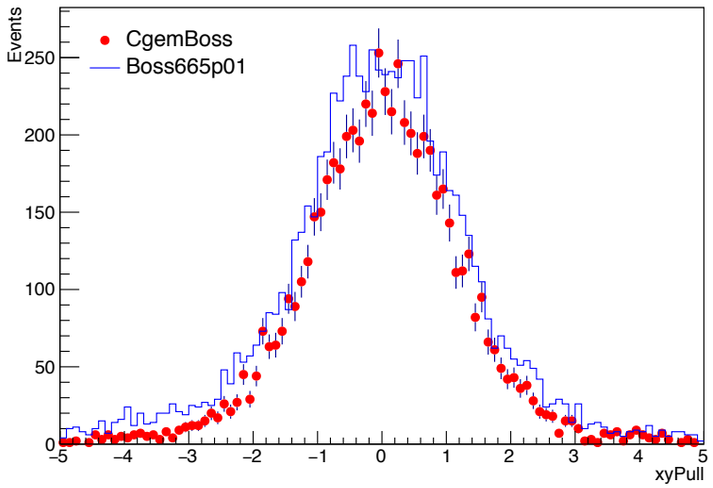
Kaons:
pt=700 MeV

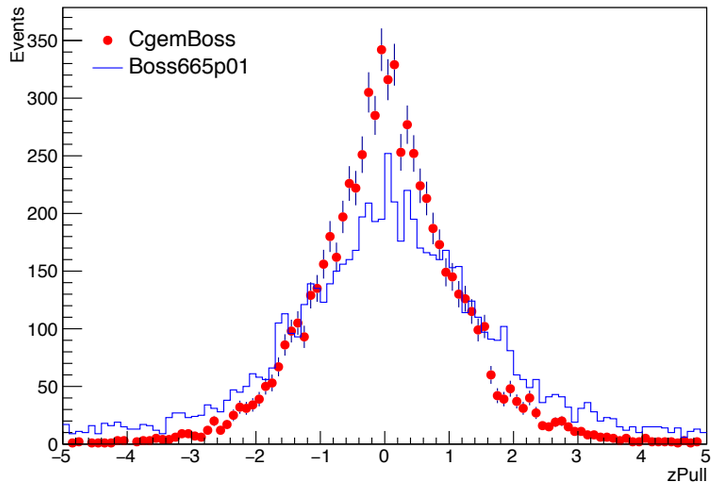




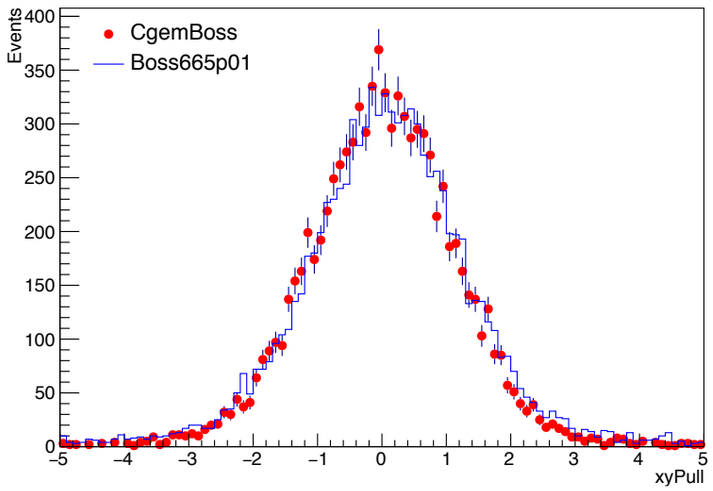
PIONS: Pull distributions

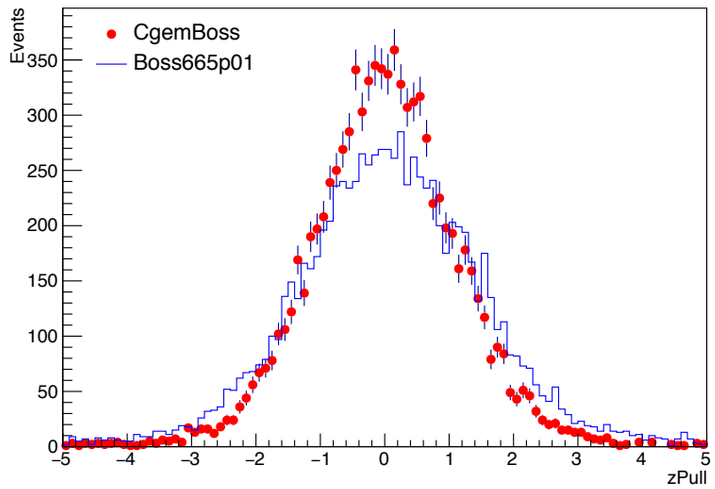
Pions:
pt=100 MeV



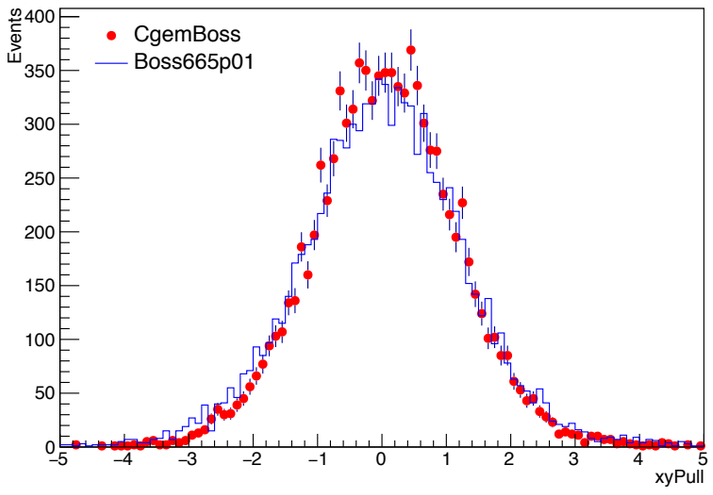


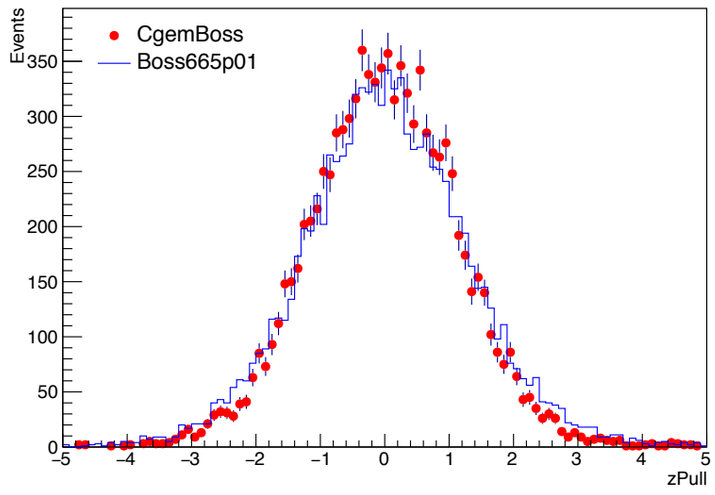
Pions:
pt=200 MeV





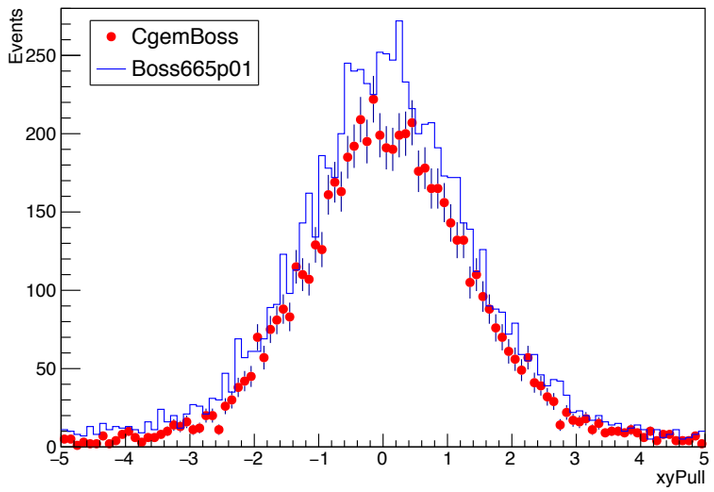
Pions:
pt=700 MeV

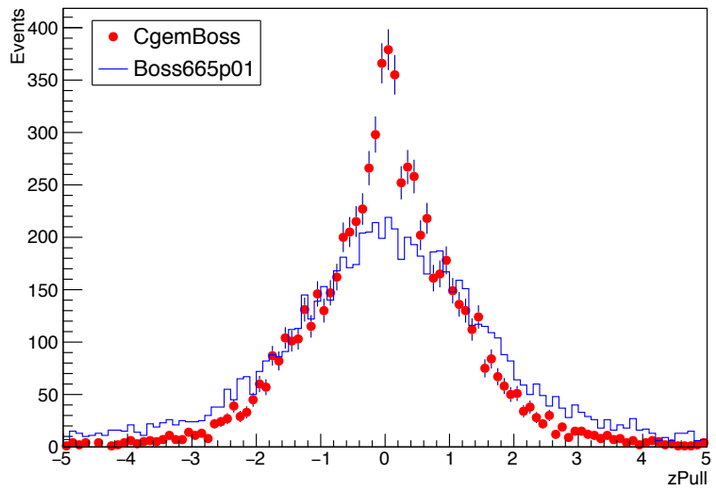




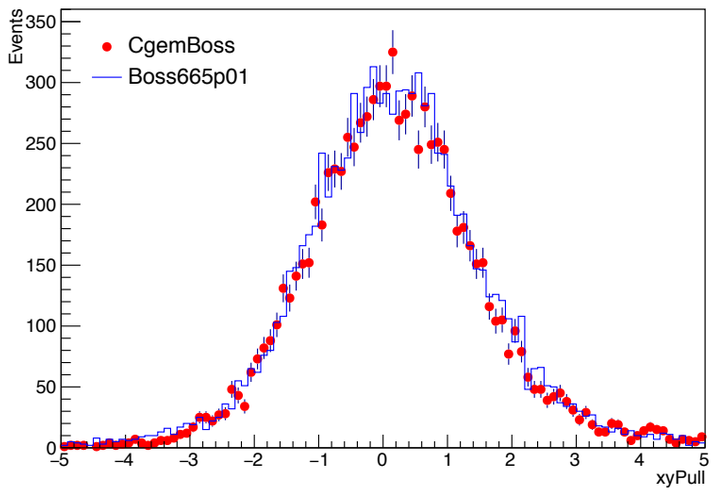
ELECTRONS: Pull distributions

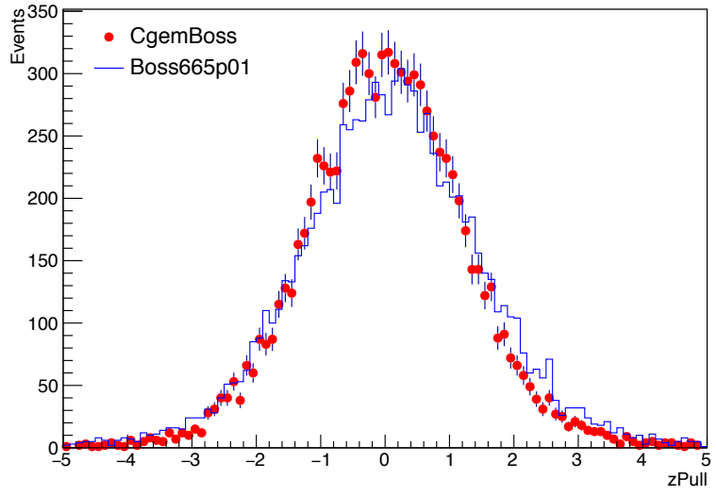
Electrons: pt=100 MeV



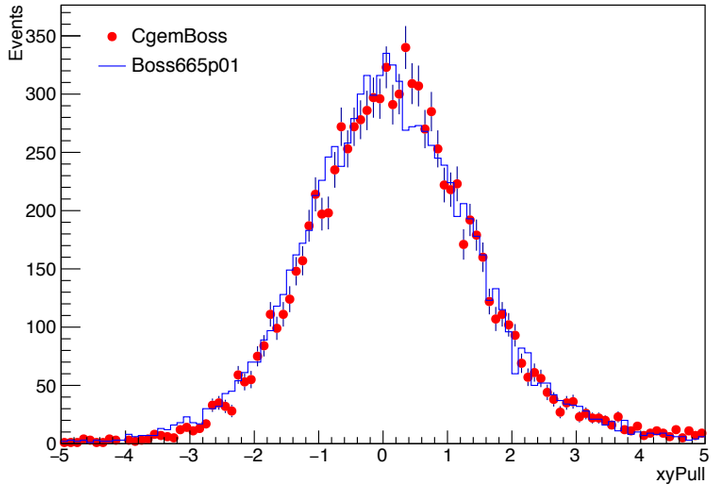


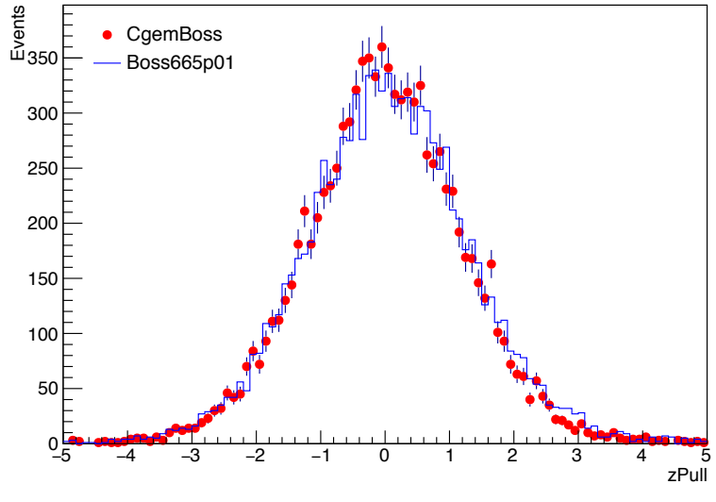
Electrons: pt=200 MeV





Electrons: pt=700 MeV





CgemBoss vs Boss-noIDC