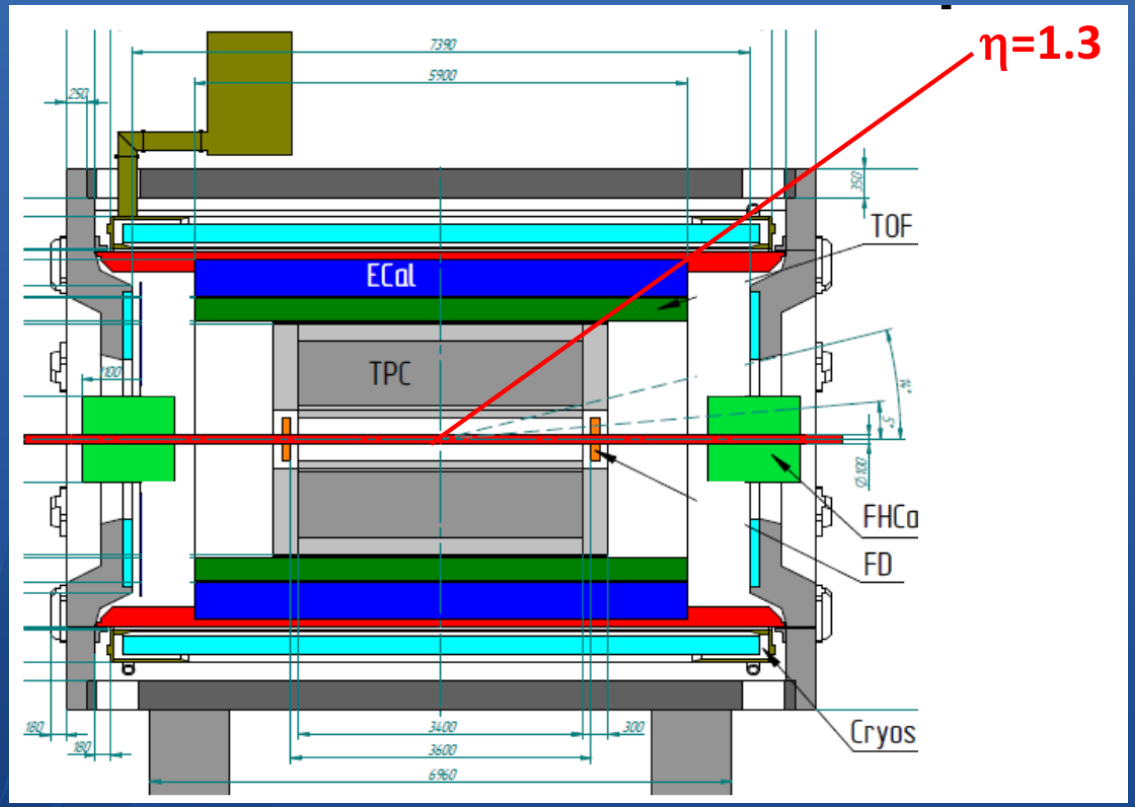
PWG3-FEMTO

Examining how momentum resolution distorts the correlation function

November 5, 2020
(#stay home again)

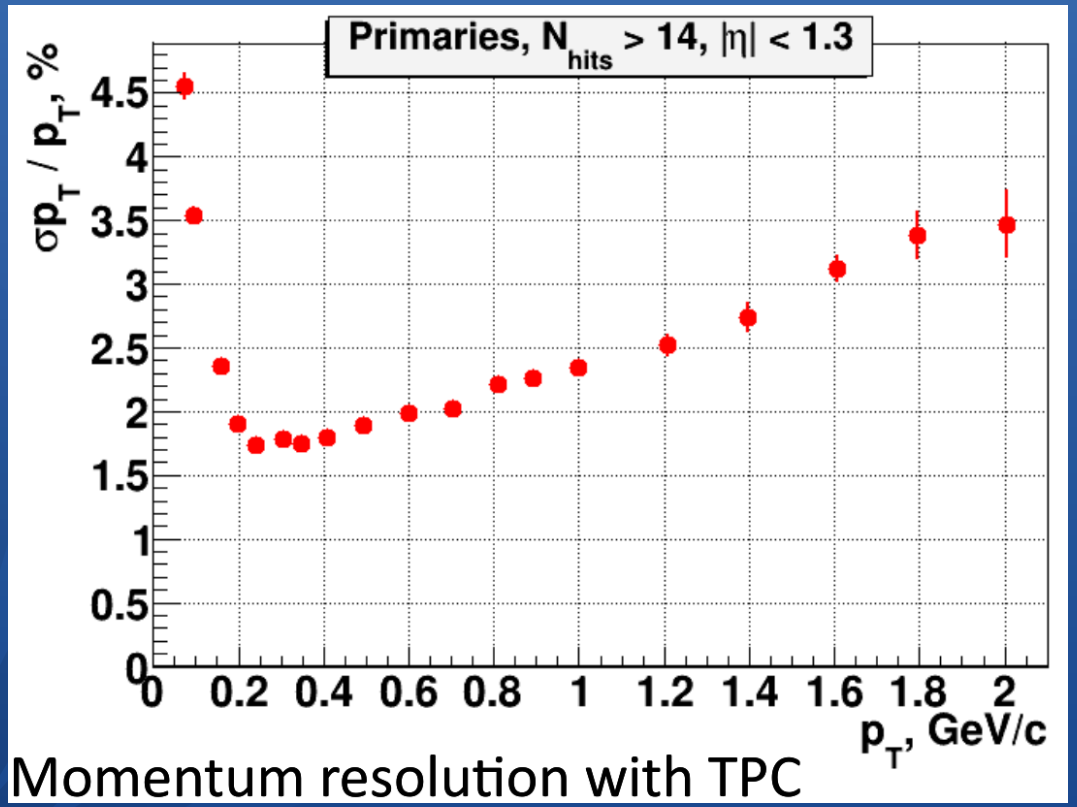
Stage I



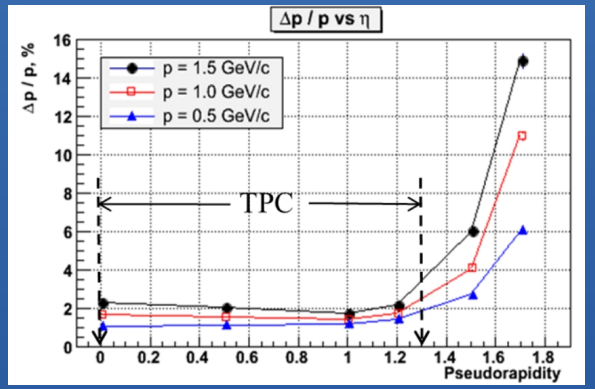
MPD at Stage-I:

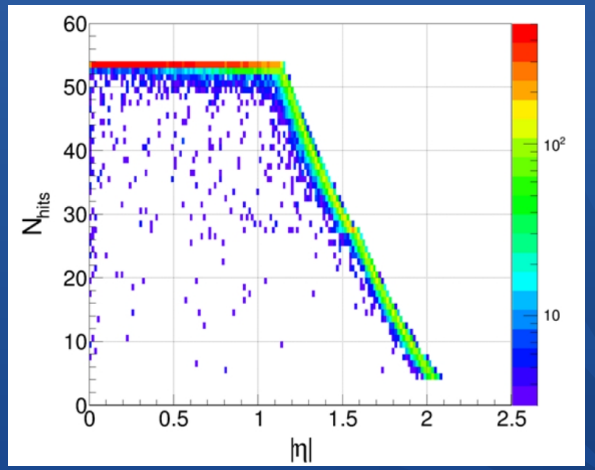
- TPC tracking: |η|<1.6 (Nhits>15)
- TOF & ECALcoverage: |η|<1.3
- PID: combined |η|<1.3, p_T<3 GeV/c, limited PID 1.3<|η|<1.6 (dE/dx)

Fall conferences

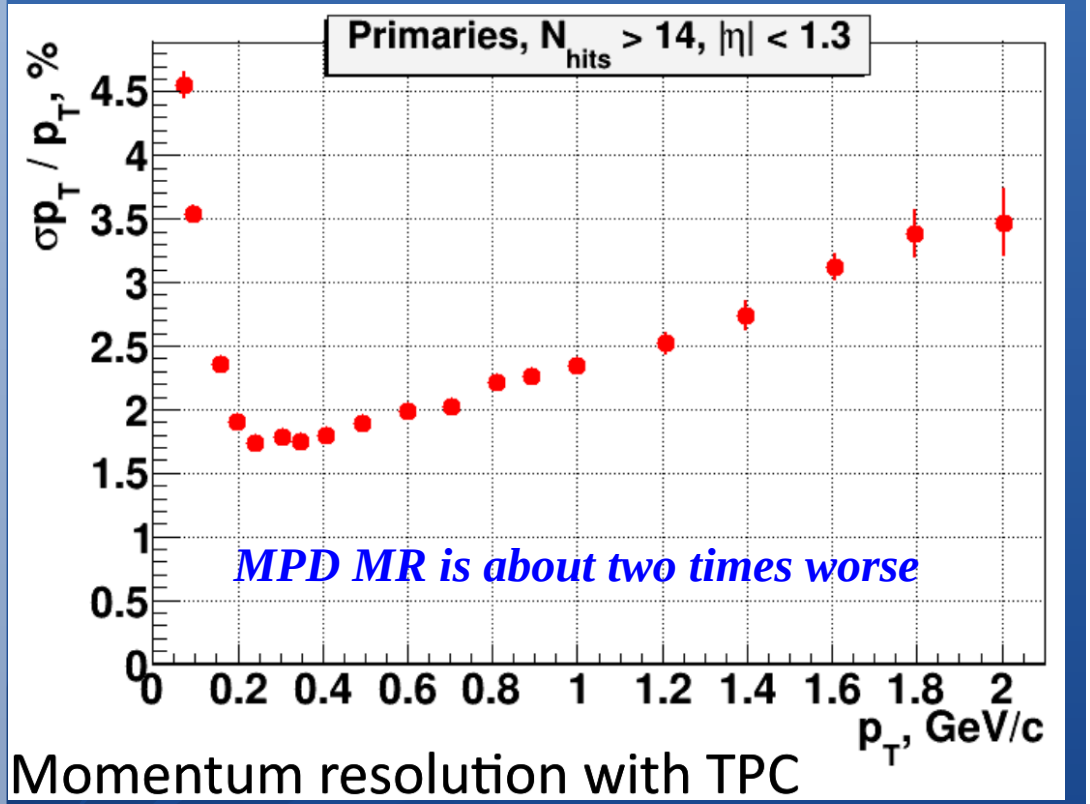


Momentum resolution with TPC

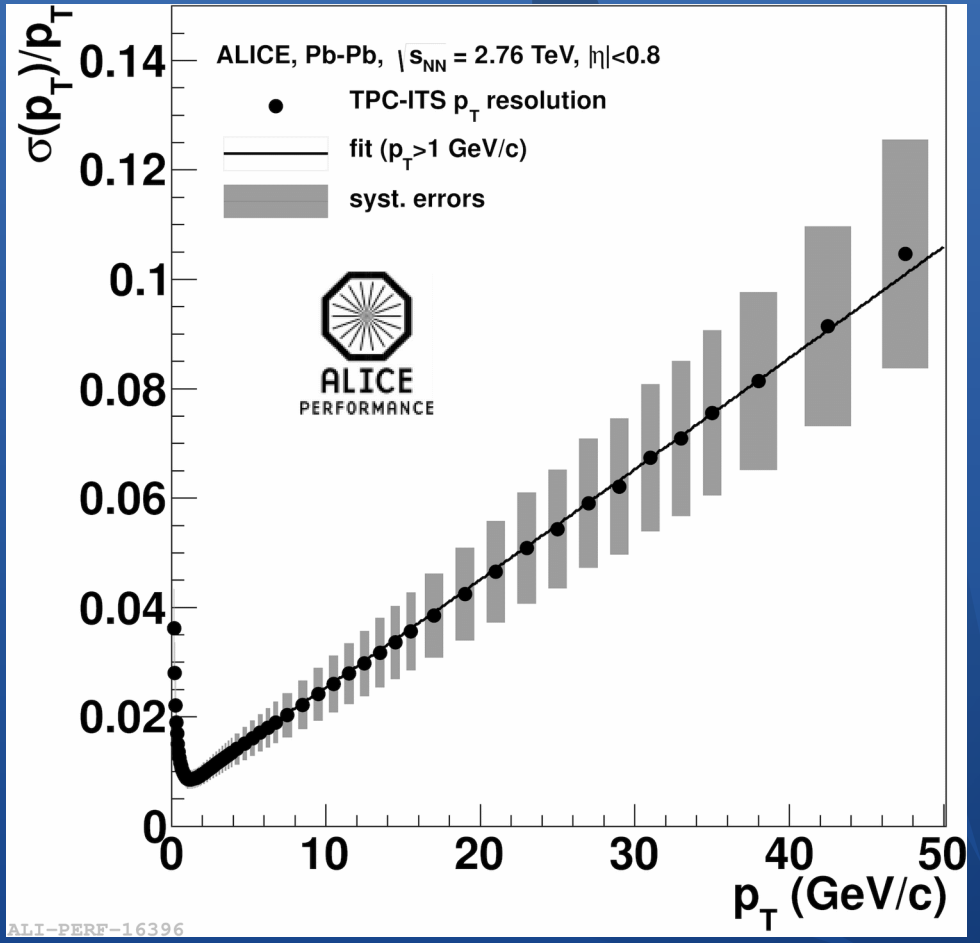




MPD and ALICE



Momentum resolution with TPC



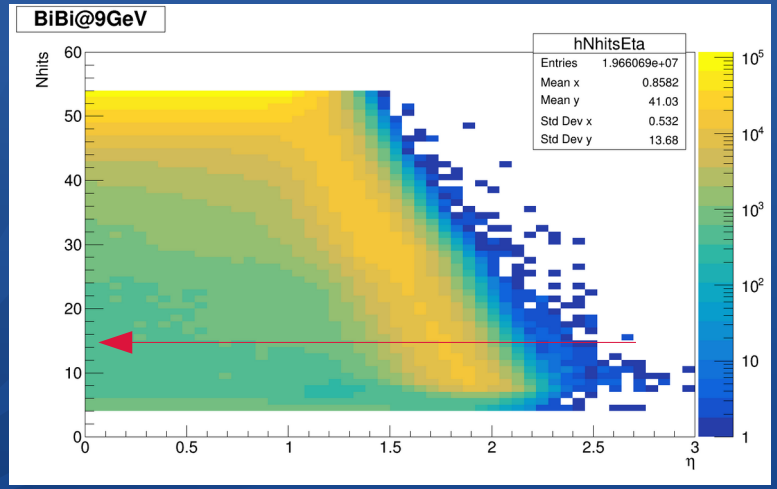
Input

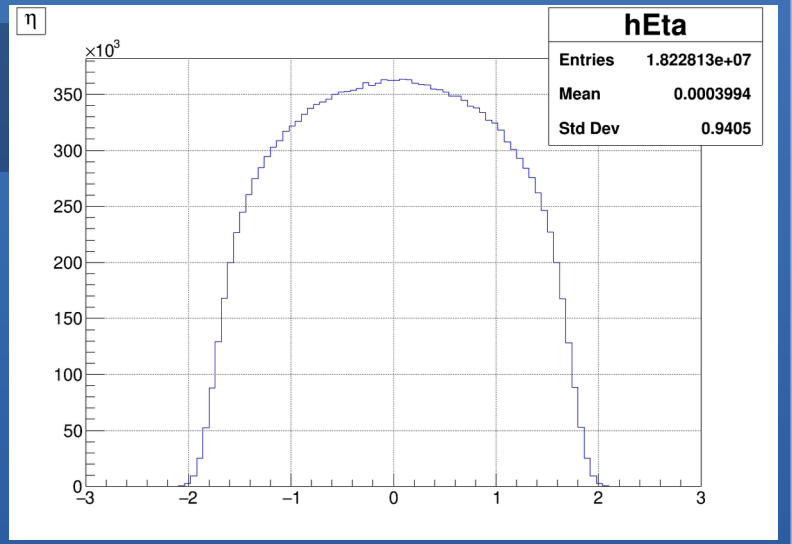
- UrQMD Bi+Bi $\sqrt{s_{NN}}$=9 GeV
- Minimum bias events
- Data stored at nica cluster in miniDST format* (1e5 events at laptop)
- Nhits>14
- |η|<1.3 (and also look at <0.5, 1.3<|η|<1.6)
- *Global* and *primary* reconstructed tracks vs MC tracks
- MC primary tracks only

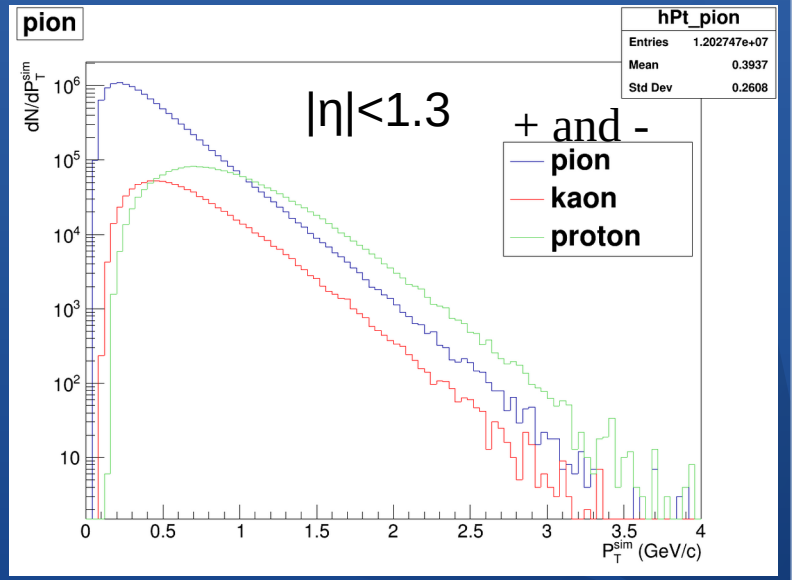
*/eos/nica/mpd/sim/data/MiniDst/dst-BiBi-09GeV-mp07-20-pwg3-250ev/BiBi/09.0GeV-0-14fm/UrQMD/BiBi-09GeV-mp07-20-pwg3-250ev-1/

Selection

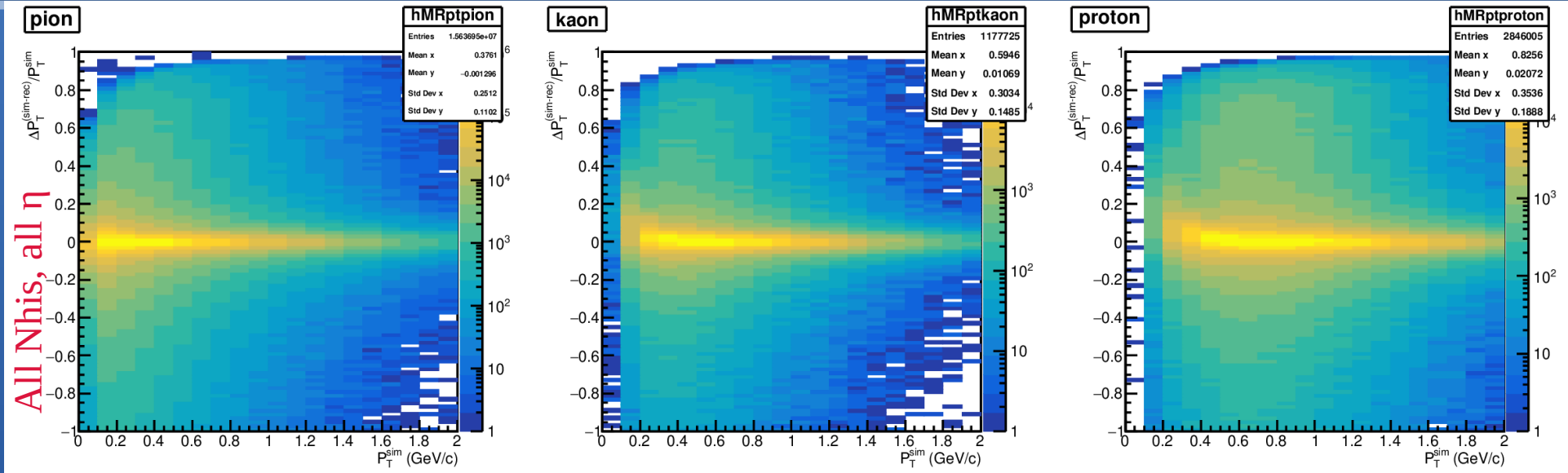
```
MpdMiniTrack *miniTrack = dst->track(j);
if(!miniTrack->isPrimary())continue;
Int_t nhits = miniTrack->nHits();
if(nhits<15)continue;
if(!miniTrack->hasMcTrack())continue;
mcindex = miniTrack->mcTrackIndex();
MpdMiniMcTrack *mcTrack = dst->mcTrack(mcindex);
TVector3 Psim(mcTrack->p());//MC track
hEta->Fill(Psim.PseudoRapidity());
hNhitsEta->Fill(Psim.PseudoRapidity(),nhits);
if(TMath::Abs(Psim.PseudoRapidity())>1.3)continue;
```

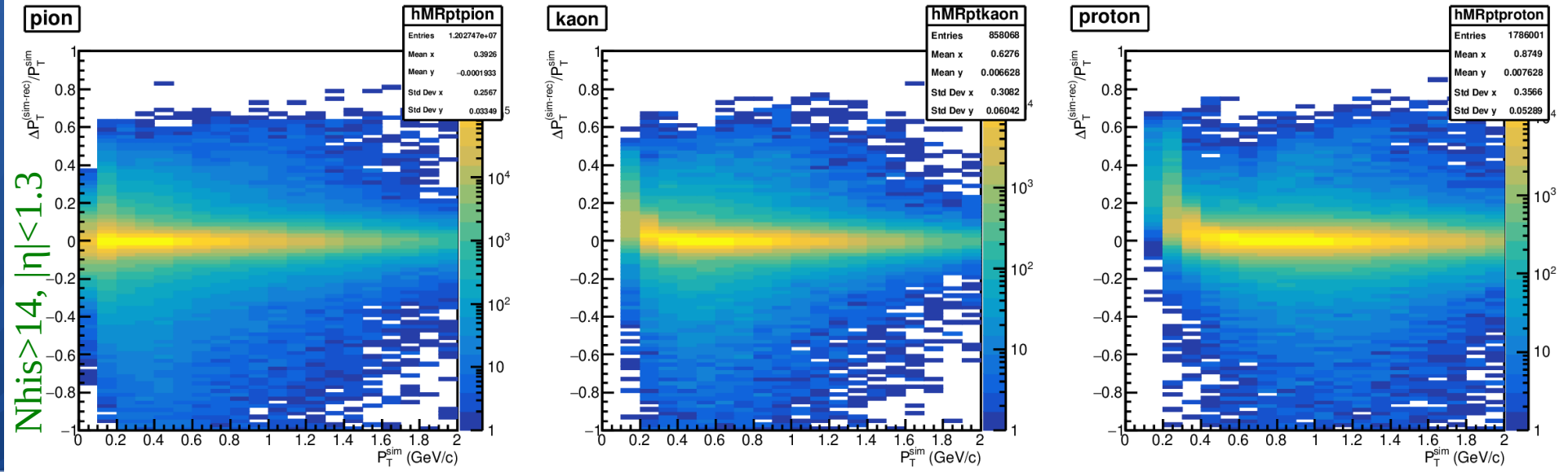




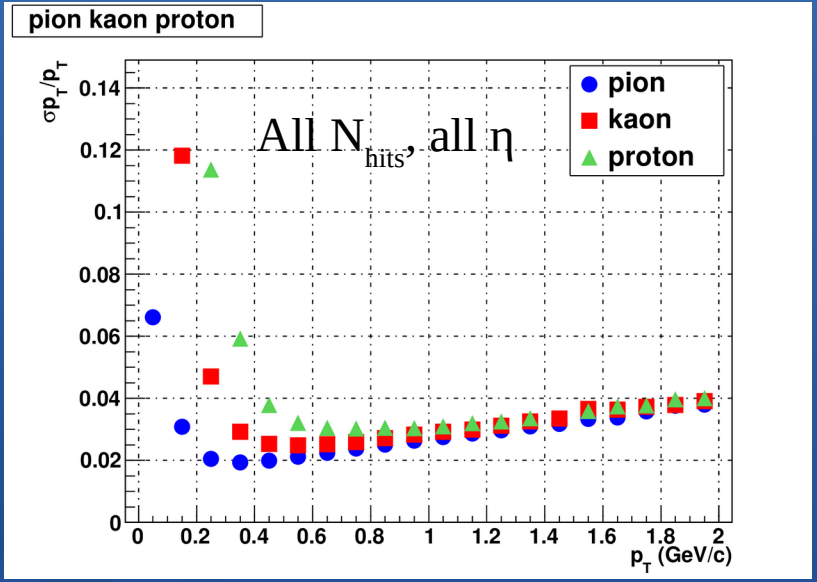


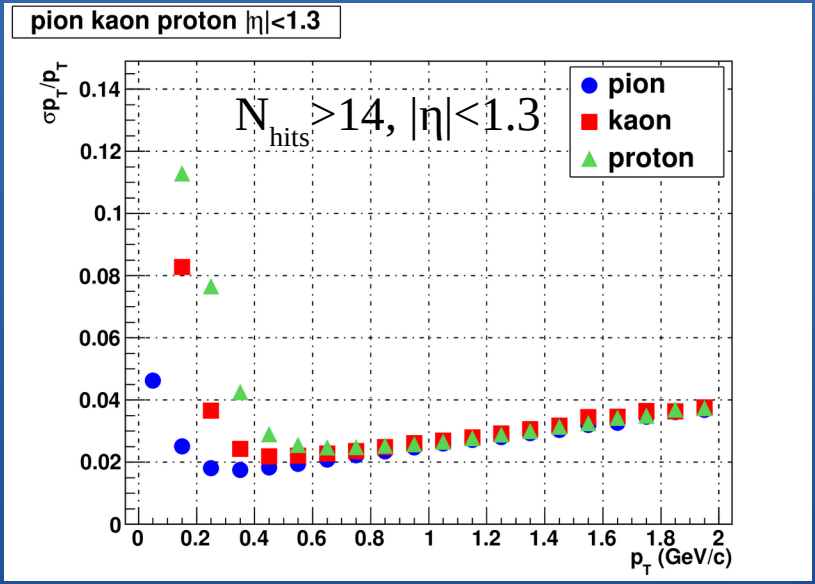
$\Delta p_T/p_T$


pion
hMRptpion
Entries 1.563695e+07
Mean x 0.3761
Mean y -0.001296
Std Dev x 0.2512
Std Dev y 0.1102
kaon
hMRptkaon
Entries 1177725
Mean x 0.5946
Mean y 0.01069
Std Dev x 0.3034
Std Dev y 0.1485
proton
hMRptproton
Entries 2846005
Mean x 0.8256
Mean y 0.02072
Std Dev x 0.3536
Std Dev y 0.1888
All Nhis, all η
$\Delta P_T^{(sim-rec)}/P_T^{sim}$
P_T^{sim} (GeV/c)


pion
hMRptpion
Entries 1.202747e+07
Mean x 0.3926
Mean y -0.0001933
Std Dev x 0.2567
Std Dev y 0.03349
kaon
hMRptkaon
Entries 858068
Mean x 0.6276
Mean y 0.006628
Std Dev x 0.3082
Std Dev y 0.06042
proton
hMRptproton
Entries 1786001
Mean x 0.8749
Mean y 0.007628
Std Dev x 0.3566
Std Dev y 0.05289
Nhis>14, |η|<1.3
$\Delta P_T^{(sim-rec)}/P_T^{sim}$
P_T^{sim} (GeV/c)

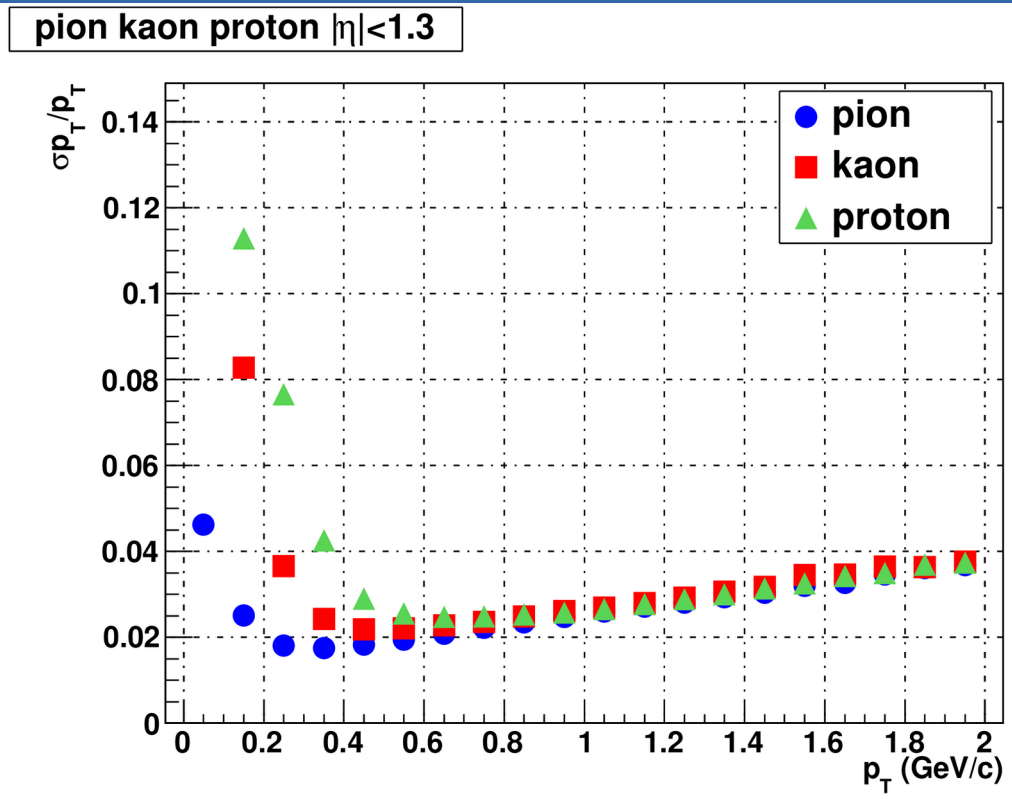
σ(w/o and w/ cuts)

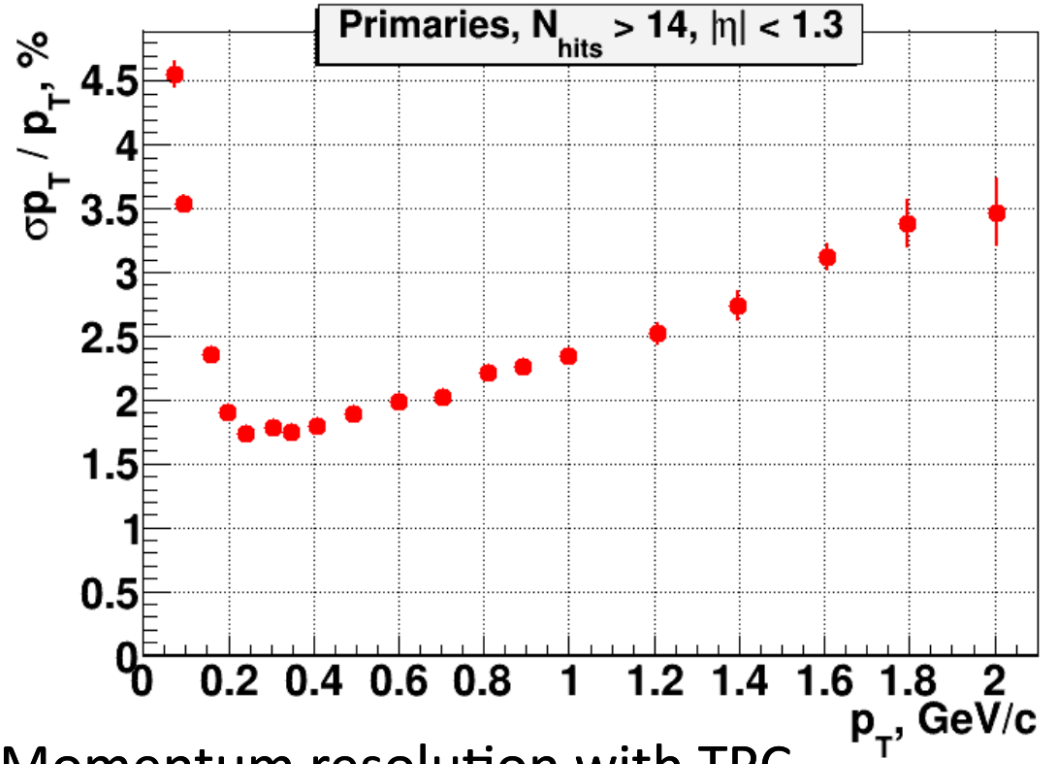




N_{hits} and pseudorapidity cuts do a good job at low momentum

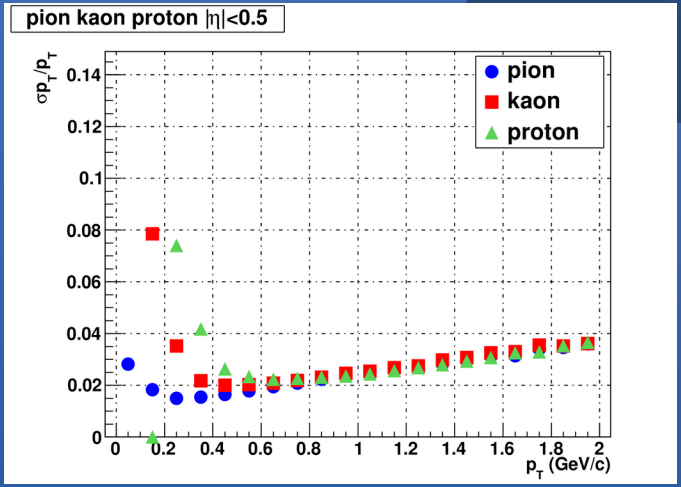
AK and Femto

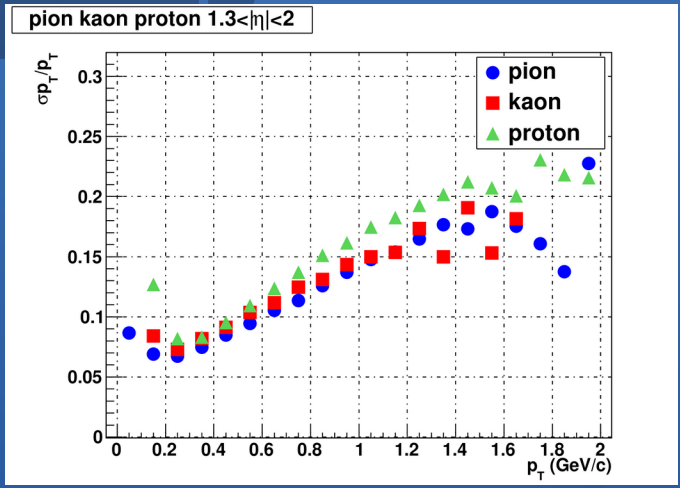




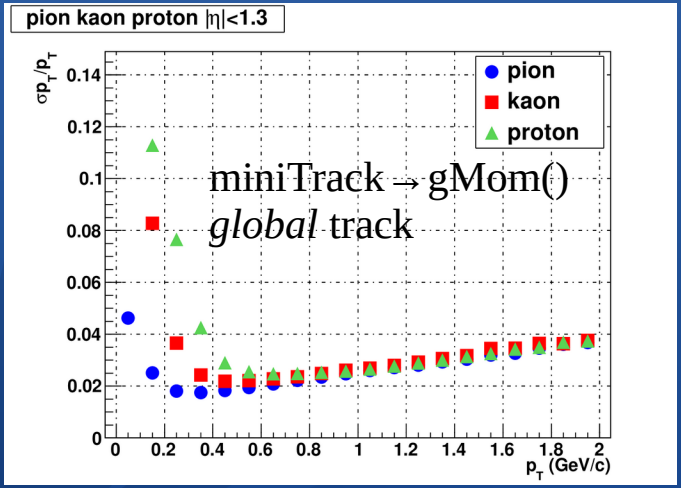
Momentum resolution with TPC

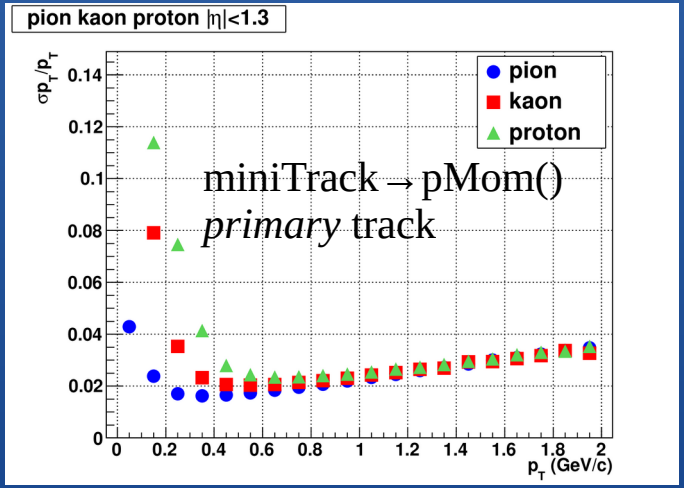
σ vs η





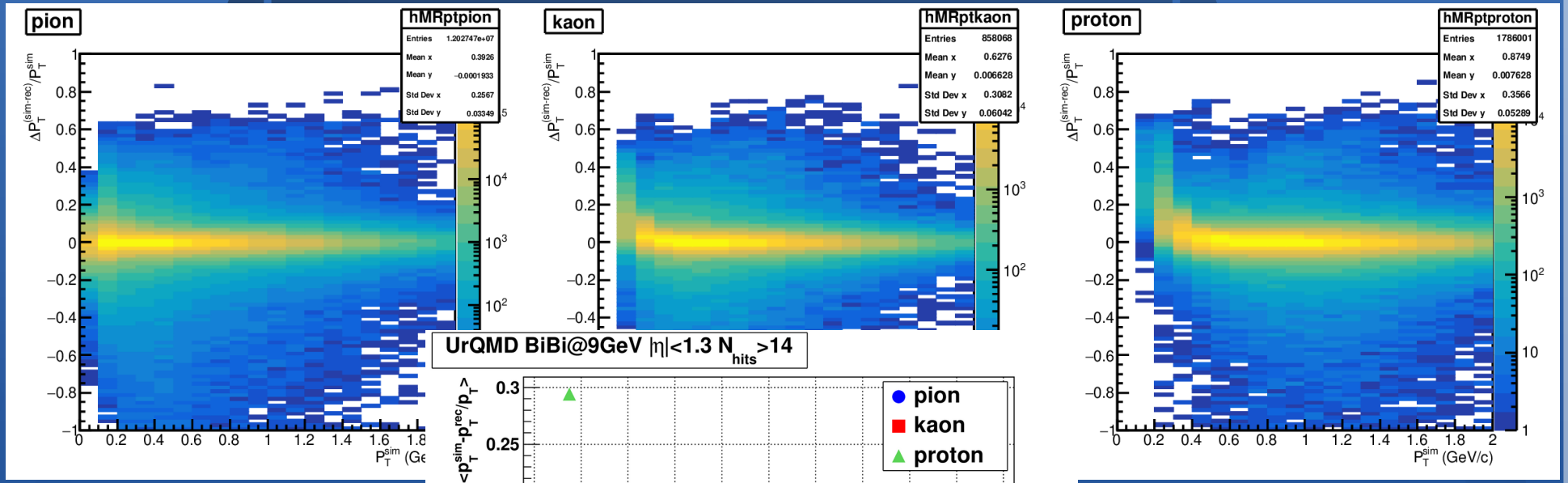
Approximately the same

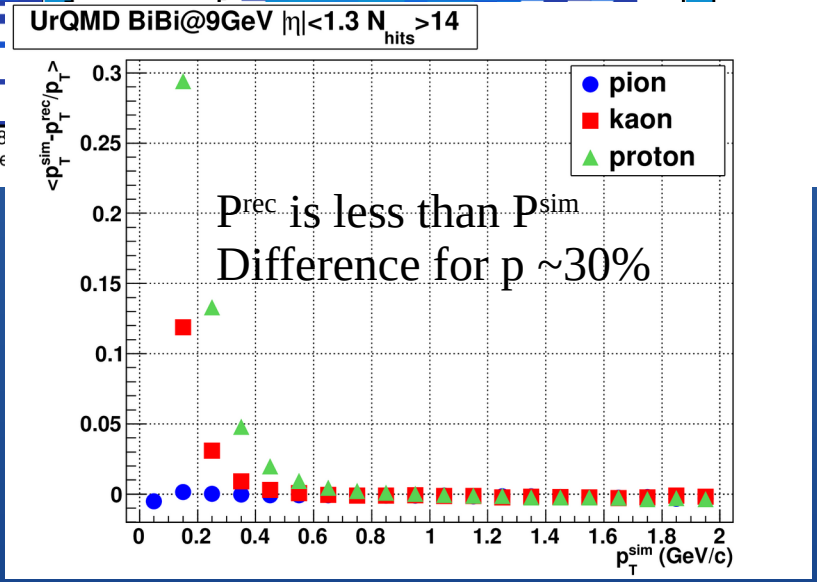




3 times worse
Low stat. at high pT

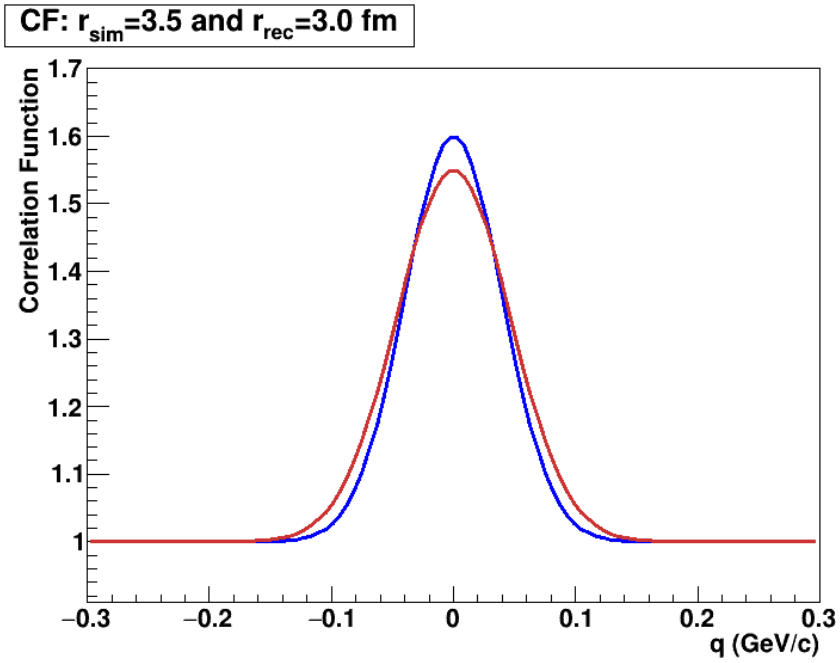
$\langle p_T^{sim} - p_T^{rec} \rangle / p_T$

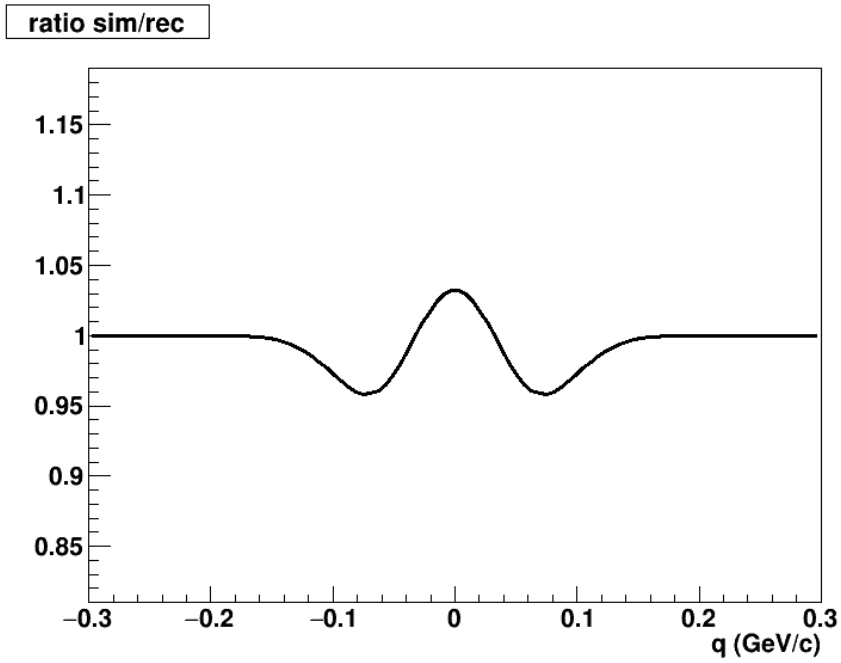




Correlation function

E.g. MR smears the CF → become wider. Radius becomes smaller.
MR correction required.

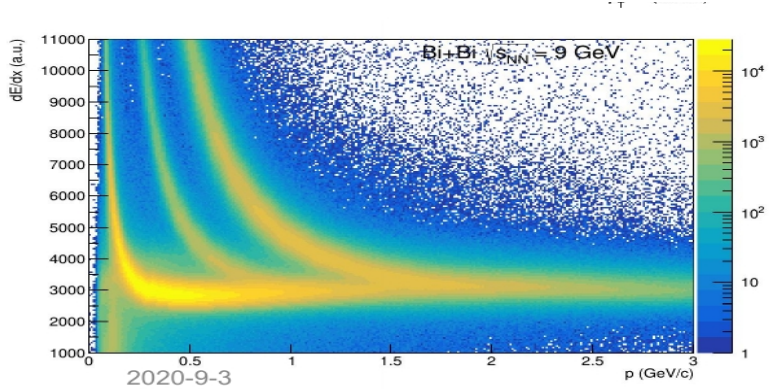


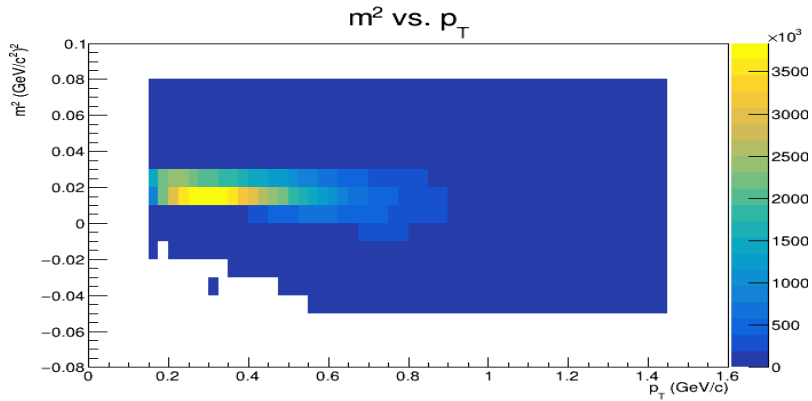


Слайды Людмилы

Analysis of reconstructed data using MPD software

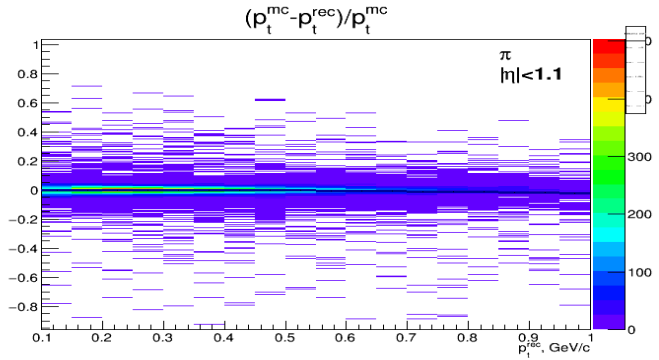
- Dataset (reconstructed in MPD tracks) production:
  /eos/nica/mpd/sim/data/MiniDst/dst-BiBi-09GeV-mp07-20-pwg3-250ev/BiBi/09.0GeV-0-14fm/UrQMD/'
- - 10 mln
    UrQMD Minimal Bias events
    BiBi 9 GeV
  - Mini Dst format
- 2 kT bins (0.15-0.65) GeV/c
- Kinematic conditions for pions
  pT (0.15-1.45) GeV/c
  |eta|<1.0
- Nhits TPC > 15
  DCA < 3 cm
  |VertexZ| < 75
  PID : Nsigma for pion selections in TPC & TOF = 2

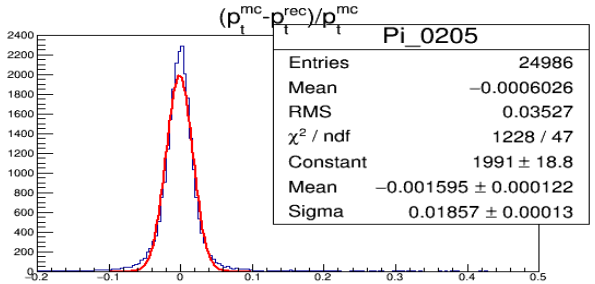


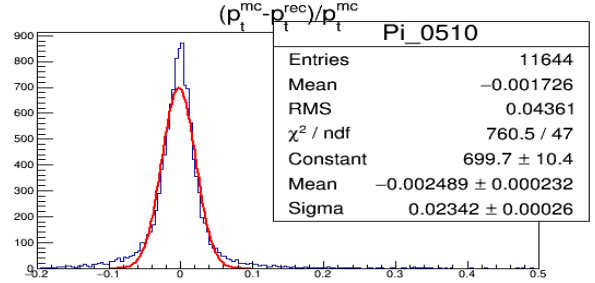


Our previous (2018, KM) study of p_T reconstruction in TPC

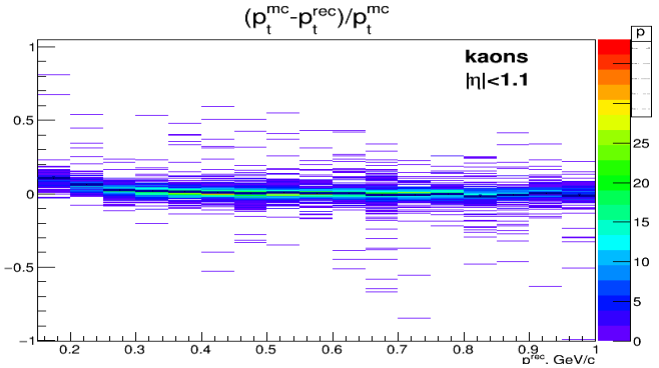
pions

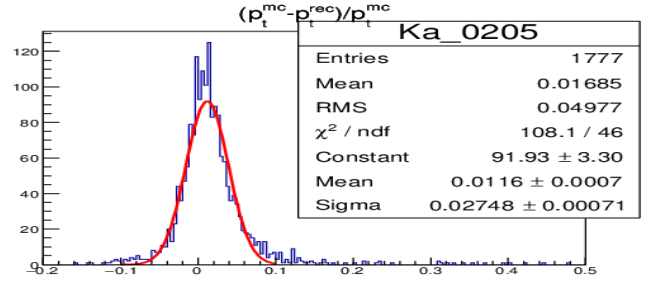


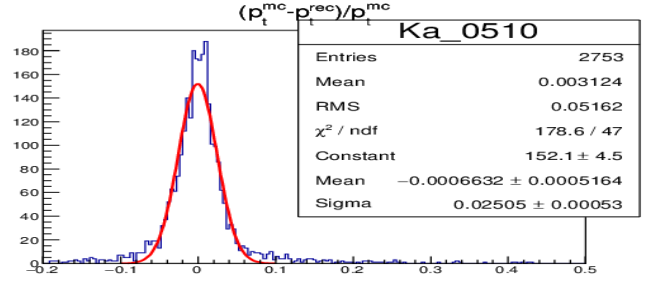




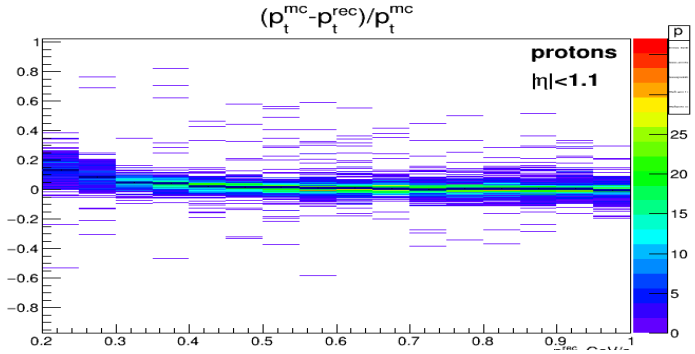
kaons

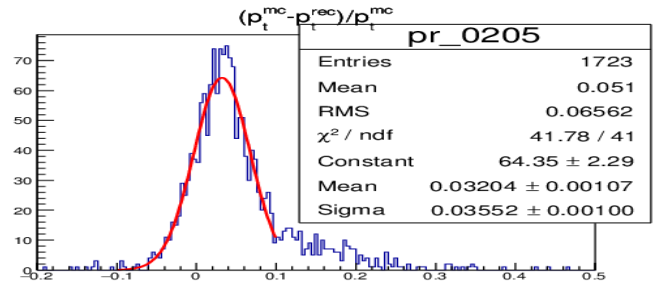


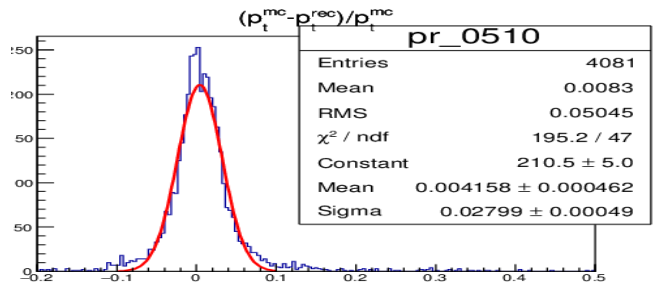




protons

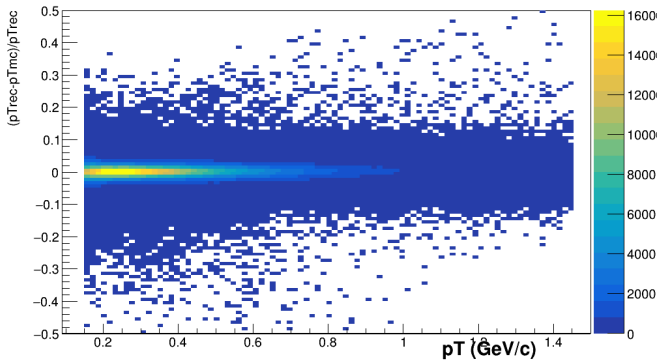


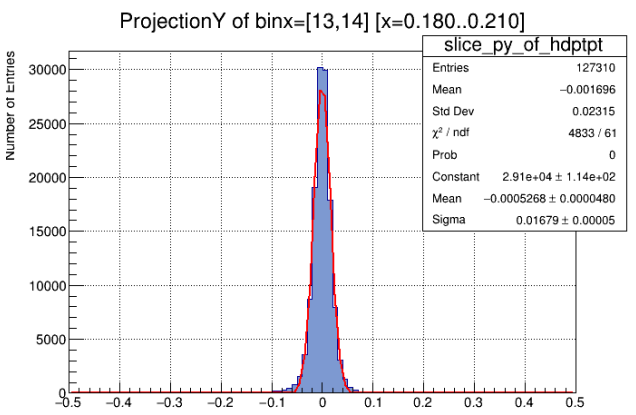


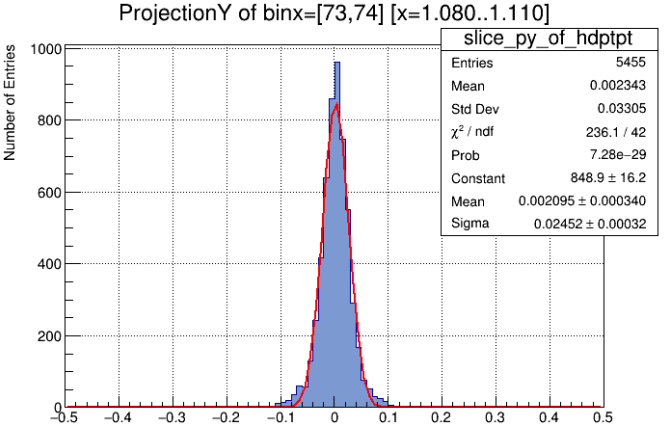


Our current study of p_T reconstruction in TPC (miniDST)

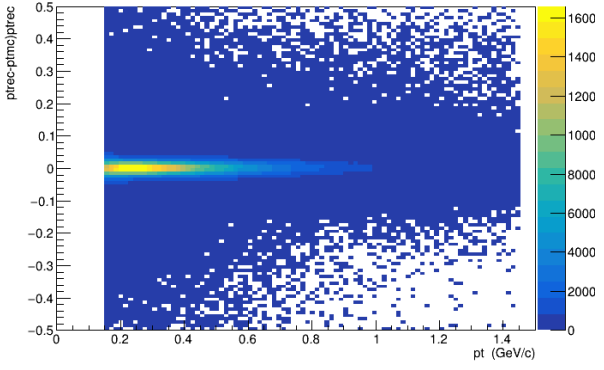
Pions, primary

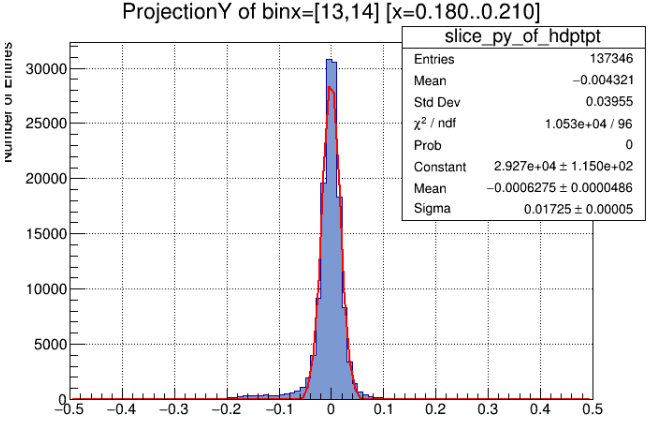


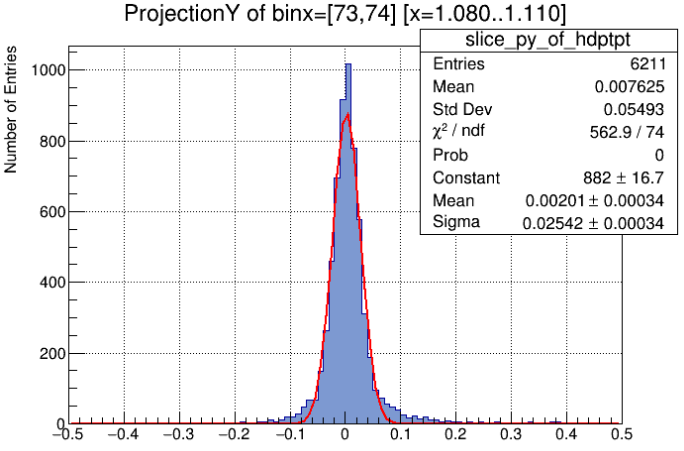




Pions, all



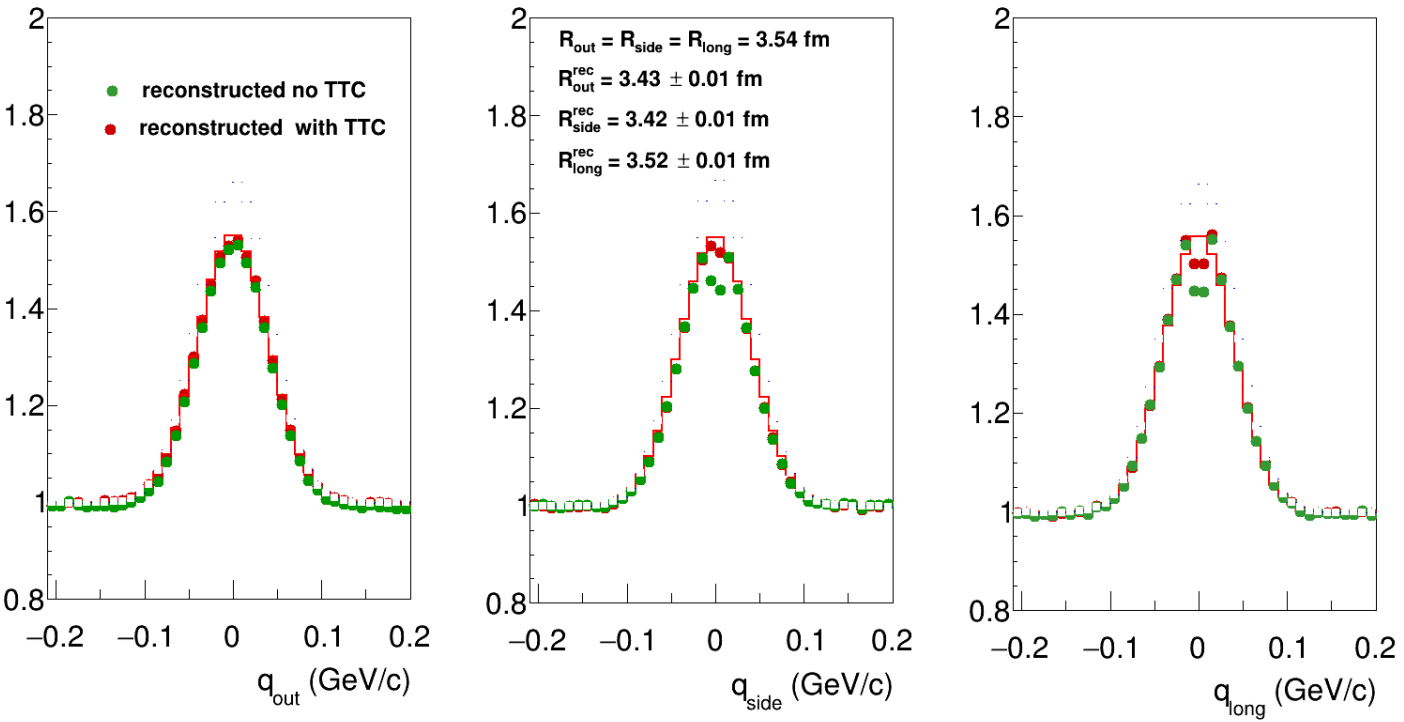




3D Correlation functions with QS weights : Resolution / TTC

Pavel implemented information from generator : momenta and freeze-out coordinates from generator in “hidden info” structure in MPD FEMTO;

Example of using MpdFemtoModelBPLCMS3DCorrFctnKt class: Rosl = 3.54 fm



Resolution correction coefficient (ALICE method) 3D case

Weights are calculated with momenta from generator for Gaussian source in LCMS taking into account QS (now), then QS+Coulomb

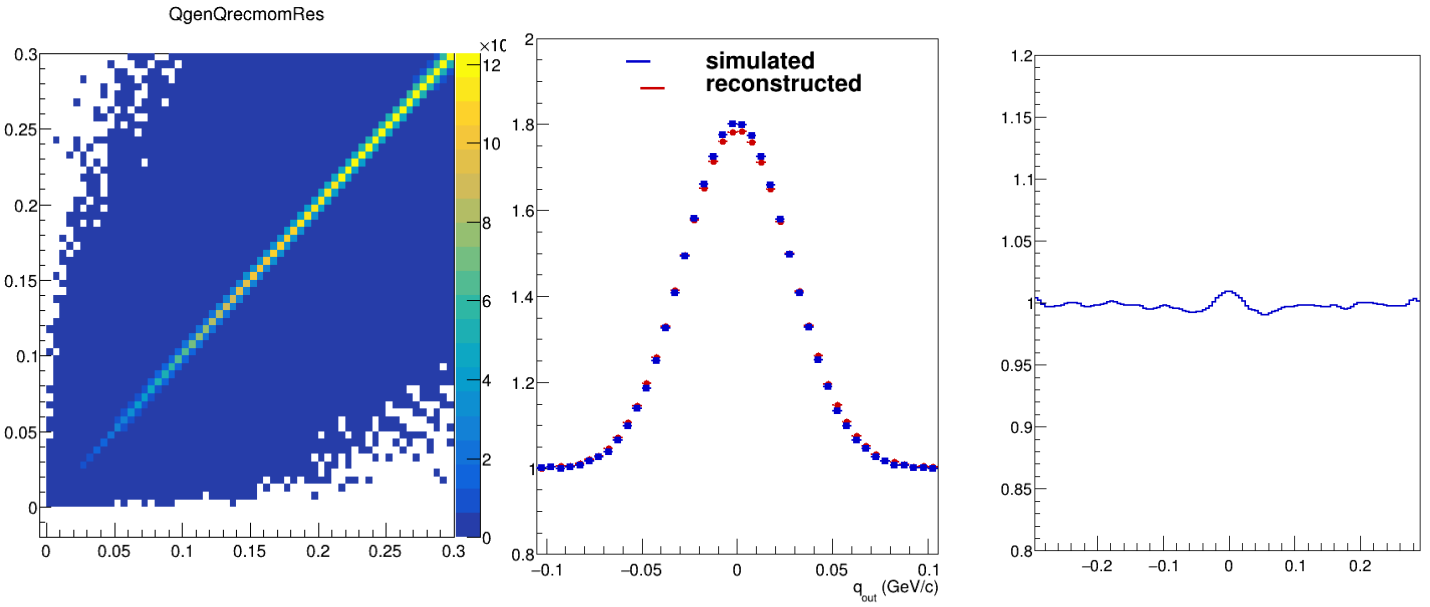
Correction factor (q_{inv}) = CF($q_{osl}^{reconstructed}$) / CF($q_{osl}^{simulated}$)

CFs shoud be divided by correction factors calculated individually for each combination of Rout, Rside,Rlong (e.g. 333, 555, 556, 455)

Pavel implemented information from generator : momenta and freeze-out coordinates from generator in “hidden info” structure in MPD FEMTO;

and created class MpdFemtoModelCorrFctnMomResolution – resolution calculation “a-la ALICE”

Example of using MpdFemtoModelCorrFctnMomResolution class: Rosl = 5 fm;pairCut→ pairCut->setKt(0.15, 0.66);



Macros MPD FEMTO (3D case)

```
 MpdFemtoModelWeightGeneratorLednicky* hbtWeight = new
MpdFemtoModelWeightGeneratorLednicky();
   hbtWeight-
>setPairType(MpdFemtoModelWeightGeneratorLednicky::PionPlusPionPlus());
   hbtWeight->setCoulOff();
   hbtWeight->setQuantumOn();
   hbtWeight->setStrongOff();
   hbtWeight->set3BodyOff();

   //----- Freeze-out generator ----------------------

   MpdFemtoModelGausLCMSFreezeOutGenerator* hbtGenerator = new

MpdFemtoModelGausLCMSFreezeOutGenerator();
   hbtGenerator->setSizeOut(5.0*TMath::Sqrt(2.0));
   hbtGenerator->setSizeSide(5.0*TMath::Sqrt(2.0));
   hbtGenerator->setSizeLong(5.0*TMath::Sqrt(2.0));

   // Theoretical model manager.....……

   MpdFemtoModelManager* thModelManager = new
MpdFemtoModelManager();
   thModelManager->setFreezeOutGenerator(hbtGenerator);
   thModelManager->setWeightGenerator(hbtWeight);
   thModelManager→createCopyHiddenInfo(kTRUE);
```

```
 int qBPNbins = 60;
 double qBPRange[2] = { -0.3, 0.3 };

  MpdFemtoModelBPLCMS3DCorrFctnKt *qosl =
    new MpdFemtoModelBPLCMS3DCorrFctnKt( "bpLCMS", qBPNbins,
qBPRange[0], qBPRange[1],
    kTBins, kTRange[0], kTRange[1] );

    qosl->connectToManager(thModelManager);



  MpdFemtoModelCorrFctnMomResolution* corrFunctMomRes = new
MpdFemtoModelCorrFctnMomResolution("momRes", 60, -0.3, 0.3);
  corrFunctMomRes->connectToManager(thModelManager);
  //hbtAnalysis→addCorrFctn(corrFunctMomRes);

// Add correlation function to the analysis

  hbtAnalysis->addCorrFctn(corrFunctMomRes);
  hbtAnalysis->addCorrFctn( qosl );
```