

Feasibility study of pions femtoscopy correlations for 9.0 GeV Bi-Bi with UrQMD

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Activities within RFBR grant 18-02-40044

- Three Master and 1 PhD student in Femto group
- PWG3 Meetings: about 20 events(2020) → <https://indico.jinr.ru/category/346/>
- MPD Physics Seminars(+3 in 2019):
 - G.Nigmatkulov. «The MpdMiniDst data format (Part 1)». 16 July 2020
 - G.Nigmatkulov. «The MpdMiniDst data format (Part 2)». 6 Aug 2020
- Conferences(+3 in 2019):
 - ICPPA-2020: 3 talks
 - NUCLEUS-2020: 1 talk
 - RFBR Grants for NICA: 3 talks
 - VI MPD Collaboration meeting: 2 talks
- Publications(+1 in 2019):
 - P. N. Batyuk, L. V. Malinina, K. R. Mikhaylov, and G. A. Nigmatkulov, «Femtoscopia with Identified Charged Particles for the NICA Energy Range», Physics of Particles and Nuclei, 2020, Vol. 51, No. 3, pp. 252–257
 - + 5 proceedings(ICPPA, NUCLEUS and RFBR) will be published

- PWG3 Meetings: 22 events(2020) → http://triton.itep.ru/ions/NICA_FEMTO/
- MPD Physics Seminars: VI-th Collaboration Meeting of the MPD Experiment at the NICA Facility
- K. Mikhailov PWG3 Summary
- P.Batyuk “Data format for physics analysis (MiniDst) and package for femtosopic studies”

● Conferences:

-Malinina L. et al, “Study of strongly interacting matter properties at the energies of the NICA collider using the methods of femtoscopy and factorial moments” –“**RFBR grants for NICA**”, proceeding will be published ЭЧАЯ.

-Nigmatkulov G. and Batyuk P., “Packages for data storage and femtosopic analysis”, **RFBR grants for NICA**”, proceeding will be published ЭЧАЯ.

- Kodolova O. and Cheremnova M., “Factorial moments in NICA MPD experiment”, “**RFBR grants for NICA**”, proceeding will be published ЭЧАЯ.

-Cheremnova M. and Kodolova O. “Study of strongly interacting matter properties at the energies of the NICA collider using the methods of factorial moments” , **ICPPA-2020**. 5-9 Oct 2020:

-Grigory Nigmatkulov. “Measurements of the like-sign pion and kaon femtosopic correlations at NICA energies. “, **ICPPA-2020**. 5-9 Oct 2020

-Grigory Nigmatkulov. Probing properties of pion- and kaon-emitting sources at NICA energies.”, **NUCLEUS-2020**. 11-17 October 2020:

-Malinina L., “Femtосcopy measurements from LHC to NICA/FAIR”, 8-10 December 2020, “International workshop on tracking.”, proceedings will be published “Particles” 2021

-Nigmatkulov G. “Influence of detector effects on femtосcopy”, 8-10 December 2020, “International workshop on tracking.”, proceedings will be published “Particles” 2021

● **Publications:**

P. N. Batyuk, L. V. Malinina, K. R. Mikhaylov, and G. A. Nigmatkulov,
«Femtосcopy with Identified Charged Particles for the NICA Energy Range», Physics of Particles and Nuclei, 2020,
Vol. 51, No. 3, pp. 252–257

● **Packages:**

- new data format MPDMiniDst (for all MPD collaboration)
- new data format MPDMCDst (for all MPD collaboration)
- Package for femtосcopy analysis MpdFemtoMaker

Details of analysis pions

- 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/

- Only primary tracks

- `trackCut->setDetectorSelection(4);`
//0 TPC, 1 TOF, 2 TPC+TOF,
3 if(TOF) TPC+TOF,
else TPC, 4 TOF $p > p_{\text{thresh}}$

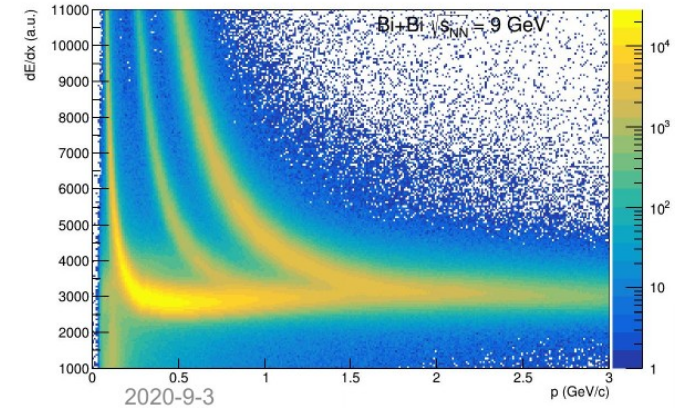
- `trackCut->setPthresh(0.5);`

- /// Set min and max momentum of the track for TPC identification
`trackCut->setTpcP(0.15,0.5);`
`trackCut->setTofP(0.5,1.45);`

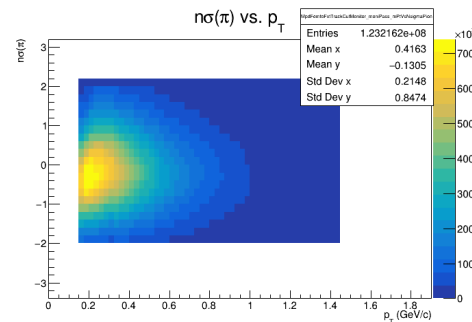
- /// Set min and max values of pion nSigma for TPC+TOF identification
`trackCut->setTnTNSigmaPion(-2., 2.)`

- `trackCut->setNSigmaPion(-2., 2.);`

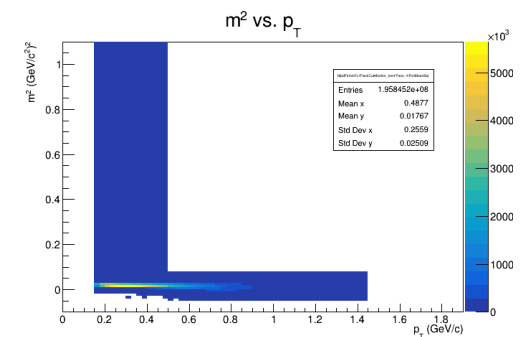
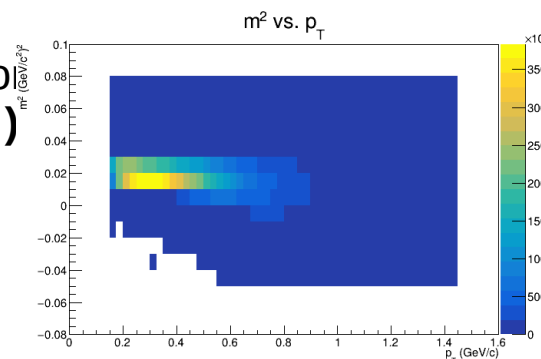
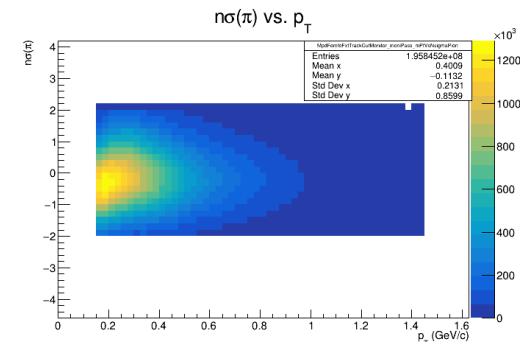
- No Average Separation cut



Pions: $1.2 \cdot 10^8$

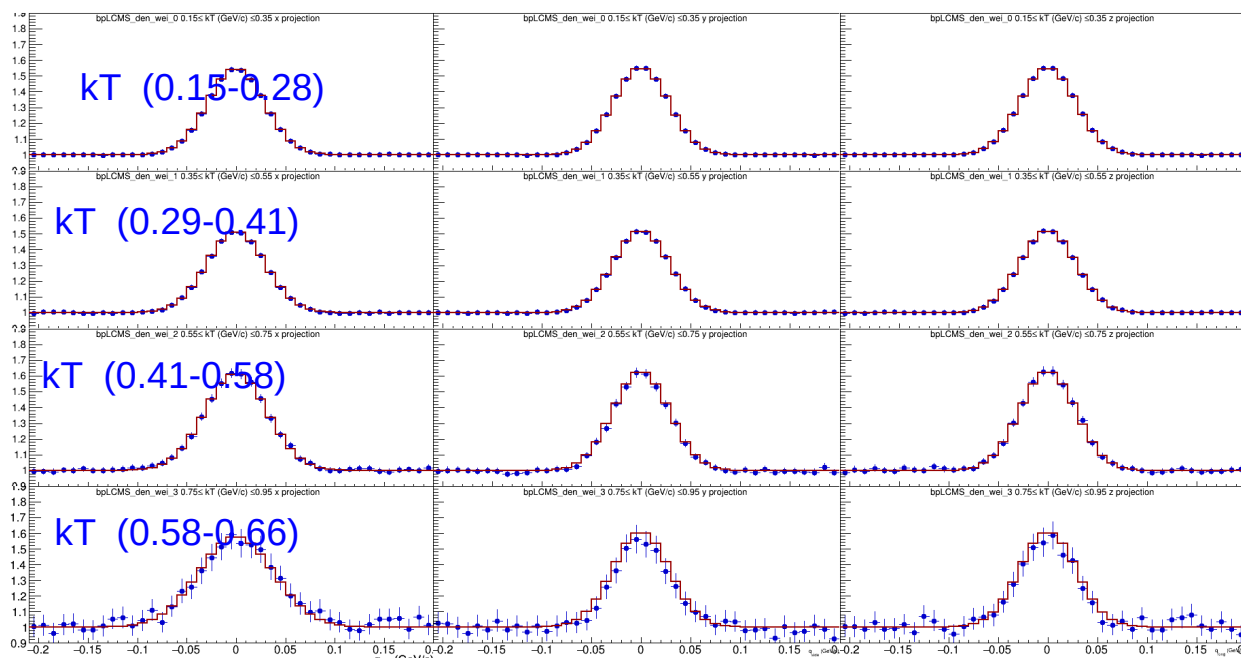


Pions: $2 \cdot 2.0 \cdot 10^8$



3D CF for pions : MpdFemtoModelBPLCMS3DCorrFctnKt class (all pdg codes)

Test 3D Gauss in LCMS $R_{\text{osl}} = 5 \text{ fm}$; 10 mln MB events
 kT (0.15-0.65) GeV/c & 4 kT bins – $\text{CF} = (\text{Dmixed, weight=QS}) / \text{Dmixed}$



pdg1 0 pdg2 211 weight 1 Qosl -0.0014 - 0.0072 0.247

Mass1 0.13957- px1 0.200 py1 -0.0972 pz1 0.0860

px2 0.204 py2 -0.0913 pz2 -0.1633

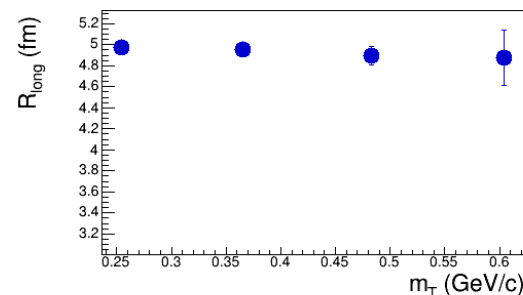
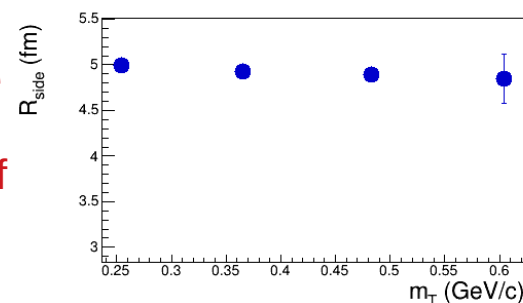
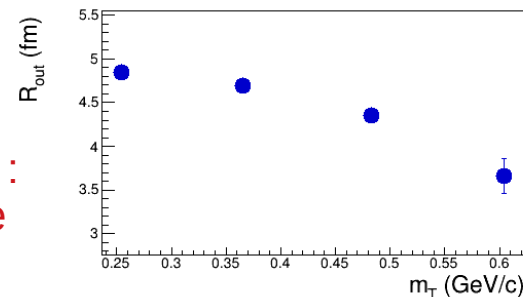
Lambda → pion + p

Pions from Lambda decays have pdg==0 in MC DST !
 So weight = 1; Is it OK ?

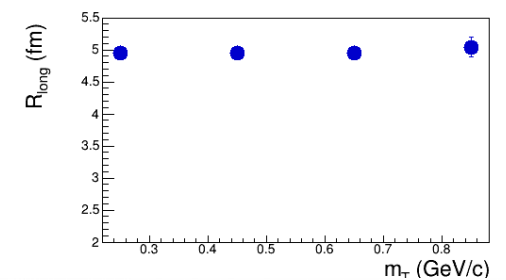
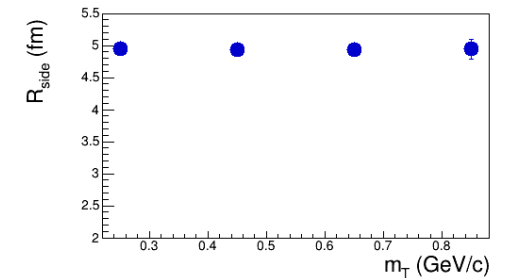
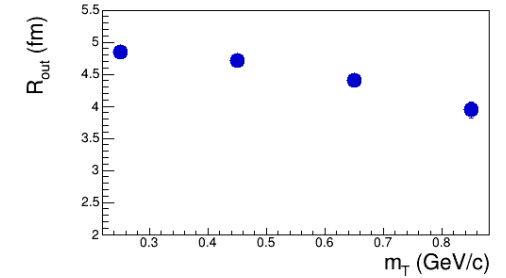
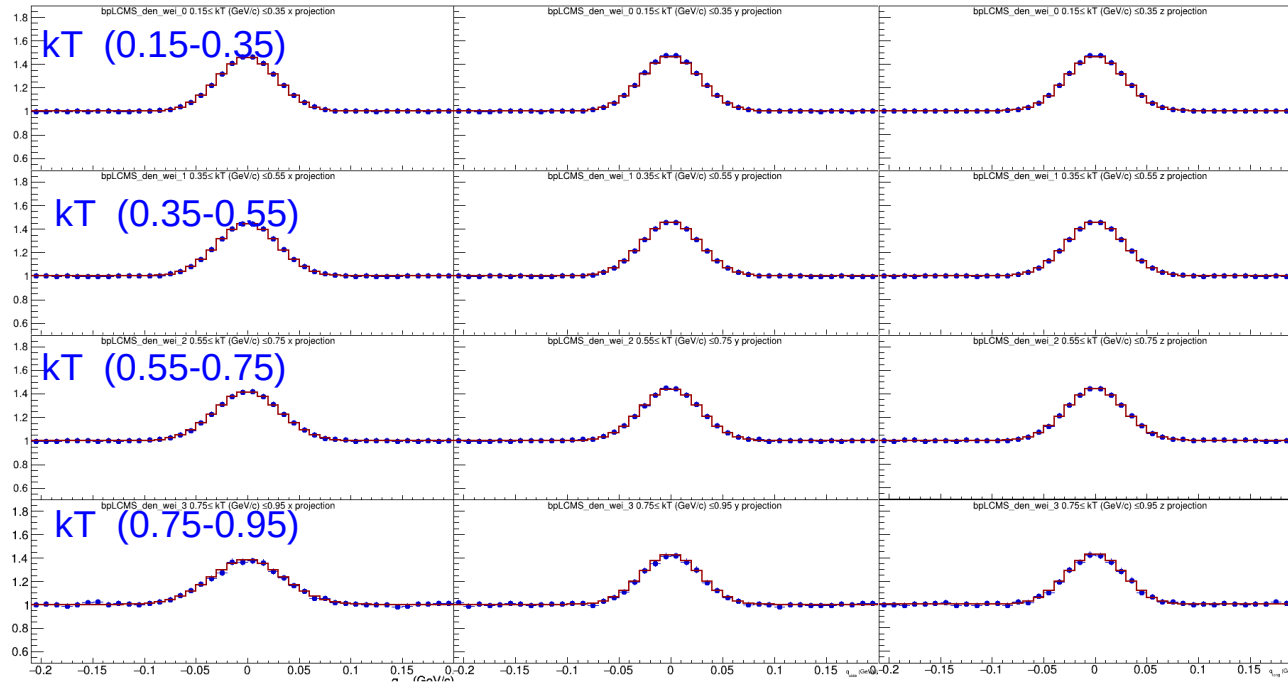
Test: just exclude such particles

No problems with Shape :
 No Average Separation cut

But strange too strong decrease of R_{out} with kT(?)

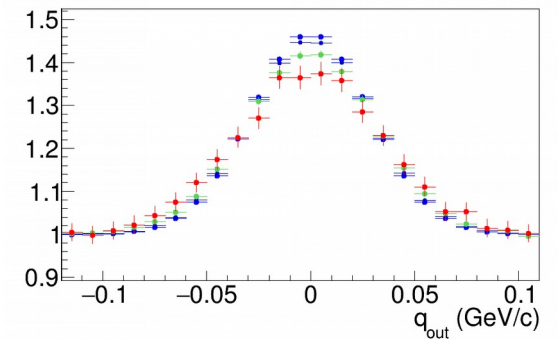


Test 3D Gauss in LCMS $R_{\text{osl}} = 5 \text{ fm}$; 10 mln MB events
 kT (0.15-0.95) GeV/c & 4 kT bins – CF = (Dmixed, weight=QS)/ Dmixed



Resolution (?) effect on R_{out} is still too strong at large kT

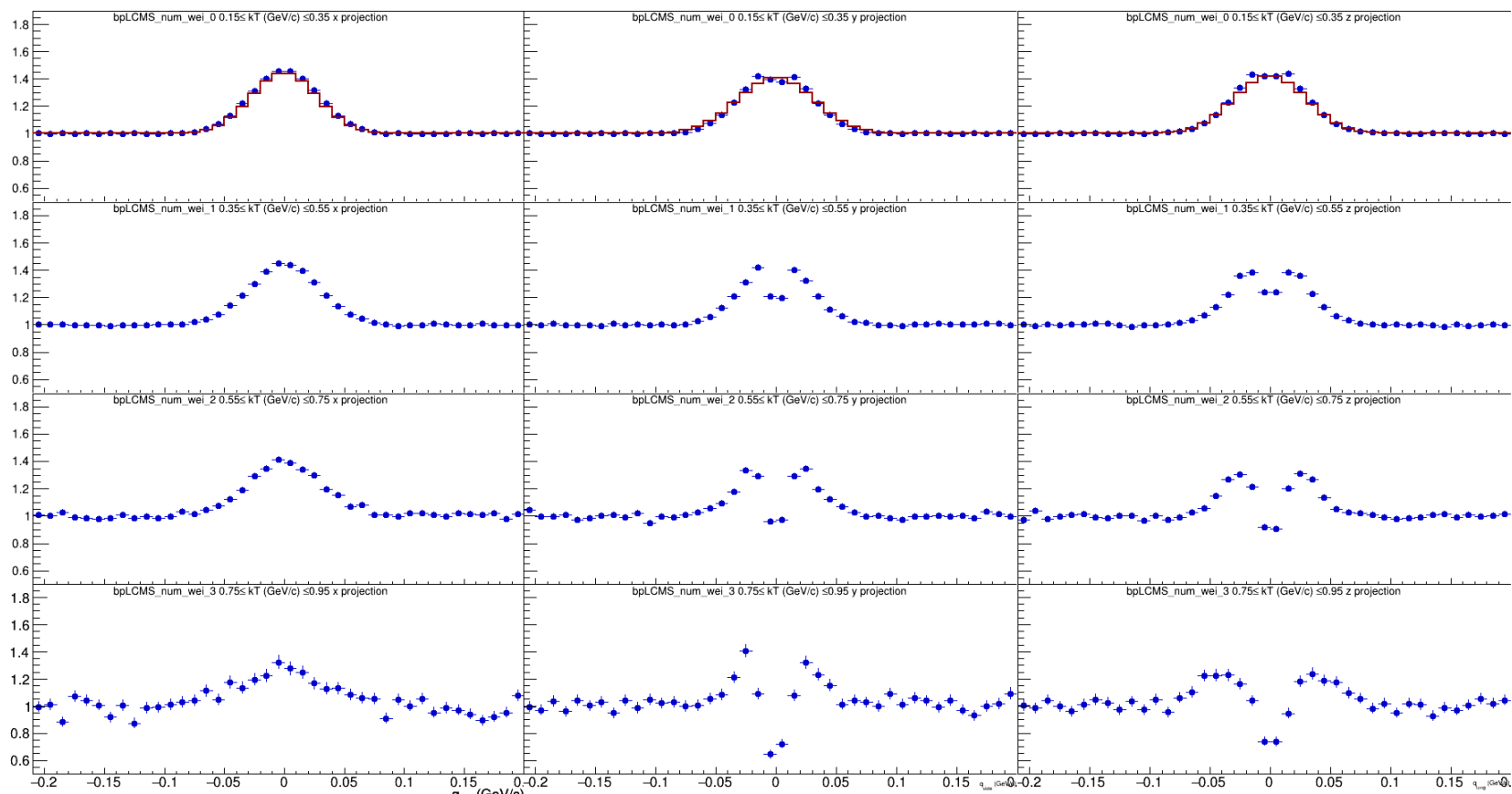
$k_t = 0.25$ $R_o = 4.847488 \pm 0.005226$ $R_s = 4.956505 \pm 0.004983$ $R_l = 4.947654 \pm 0.005106$ $\lambda = 0.958 \pm 0.001$
 $k_t = 0.45$ $R_o = 4.718767 \pm 0.014146$ $R_s = 4.940356 \pm 0.014853$ $R_l = 4.944714 \pm 0.014940$ $\lambda = 0.931 \pm 0.003$
 $k_t = 0.65$ $R_o = 4.403823 \pm 0.045291$ $R_s = 4.934560 \pm 0.051359$ $R_l = 4.949266 \pm 0.051070$ $\lambda = 0.868 \pm 0.011$
 $k_t = 0.85$ $R_o = 3.946473 \pm 0.123089$ $R_s = 4.946592 \pm 0.154297$ $R_l = 5.044883 \pm 0.154403$ $\lambda = 0.802 \pm 0.032$



MpdFemtoModelBPLCMS3DCorrFctnKt class:

Test Rosl = 5 fm ; 10 mln MB events

kT (0.15-0.95) GeV/c & 4 kT bins – CF = (Nsame, weight=QS)/ Dmixed



“Merging-like” effect increases with kT
Average separation cut should depend on kT range ?

Conclusions

We have to understand these problems:

- why there is so strong resolution dependence on kT while for single resolution study it is not so strong ?
- merging effect also is strong and strongly kT dependent

Tracking ?

- MC dst: $pdg=0$ for particles from decays of long-lived particles in Geant:
Lambda and $K0s$ ets –
How to do it better ?
In perspective we need mother information

Conclusions

