Study of strongly interacting matter properties at the energies of the NICA collider using the methods of femtoscopy and factorial moments

within the RFBR Mega Grant # 18-02-40044

- RFBR 2020 : my impressions
- Панченко и др

SUCCESSFUL RESULTS OF THE PROGRAM

- The total number of publications for 2 years is - 192,
- The total number of publications in Web of Science database - 100
- The number of publications per project -5.3 (total) 2.8 (Web of Science)

- RFBR & MPD meeting 2020 my impressions:
- Trubnikov G.

2. Stages of The NICA Accelerator Complex

Stage Ia: Heavy ion beam for fixed target experiment
"The Baryonic Matter at Nuclotron" (BM@N) 2021

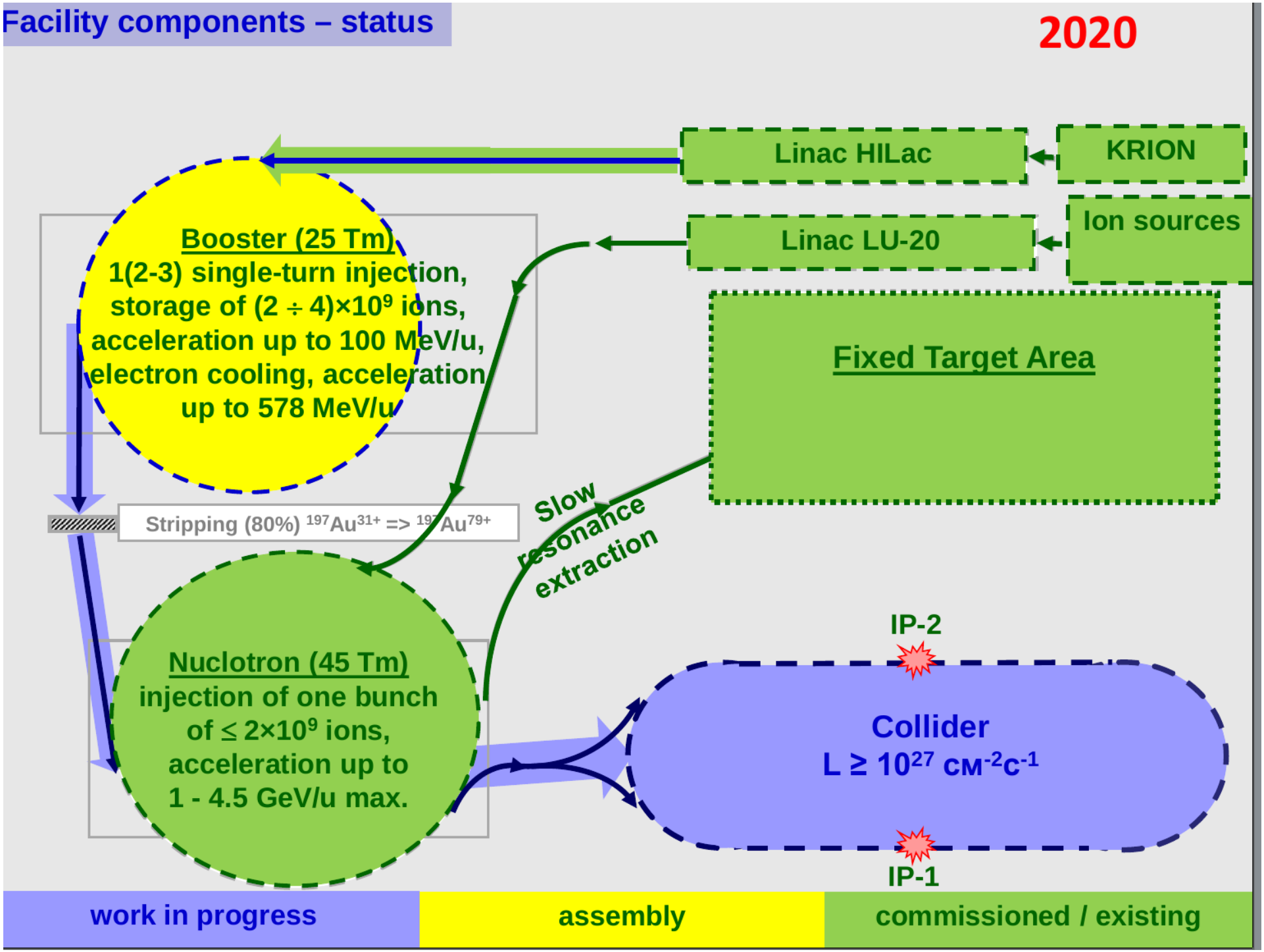
Stage Ib: First heavy ion colliding beams at reduced luminosity for the MPD test and very first experiments

STAGE I 2022

Stage II: Heavy ion colliding beams of the design luminosity for search for the Mixed Phase and New Physics

Stage III: Polarized $p\uparrow$ & $d\uparrow$ colliding beams of the NICA Collider

- Butenko (доклад подробный и понятный)



- RFBR & MPD meeting 2020 my impressions: Kisiel A

Milestones of MPD assembly in 2020-2022

Year 2020

1. July 15th - MPD Hall and pit are ready to store and unpack Yoke parts
2. August - The first 13 plates of Magnet Yoke are assembled for alignment checks
3. Sept 15th - Oct 1st - Solenoid is ready for transportation from ASG (Italy)
4. November 10th - Solenoid is in Dubna
5. Nov-Dec - Assembling of Magnet Yoke and Solenoid at JINR

Year 2021

6. Jan- April - Preparation for switching on the Solenoid (Cryogenics, Power Supply et cet.)
7. May - June - Magnetic Field measurement
8. July - Installation of Support Frame
9. Jul- Dec - Installation of ECal and TOF, Electronics Platform, Cabling

Year 2022

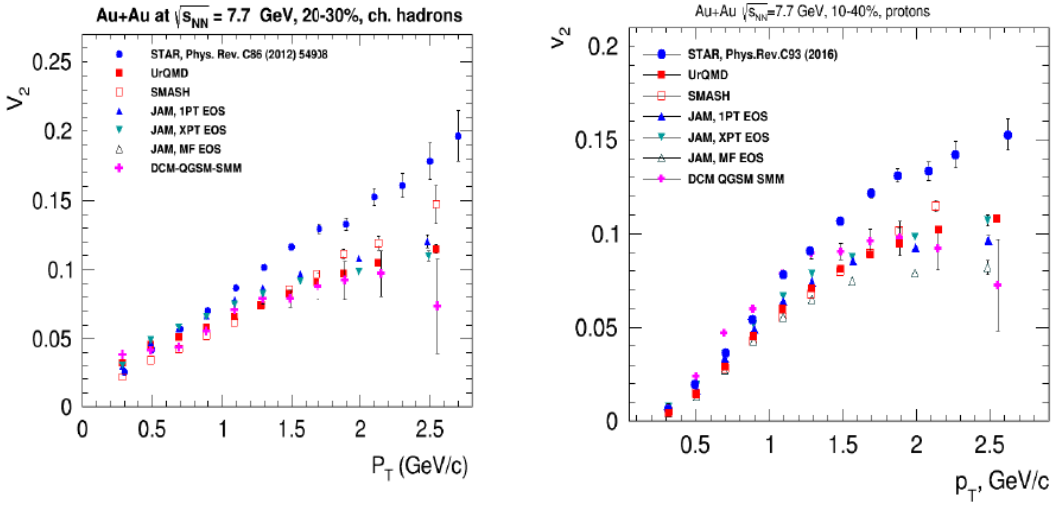
11. Jan- Mar - Installation of TPC, Electronics Platform, Cabling
12. March - Installation of beam pipe, FHCal, Cosmic Ray test system
13. April-Dec - Cosmic Ray tests
14. December - Commissioning

Year 2023

15. March - Run on the beam

RFBR & MPD meeting 2020 my impressions: Taranenko A.

Elliptic flow at NICA energies: Models vs Data comparison



Pure String/Hadronic Cascade models give smaller v_2 signal compared to STAR data for Au+Au $\sqrt{s_{NN}}$=7.7 GeV and above

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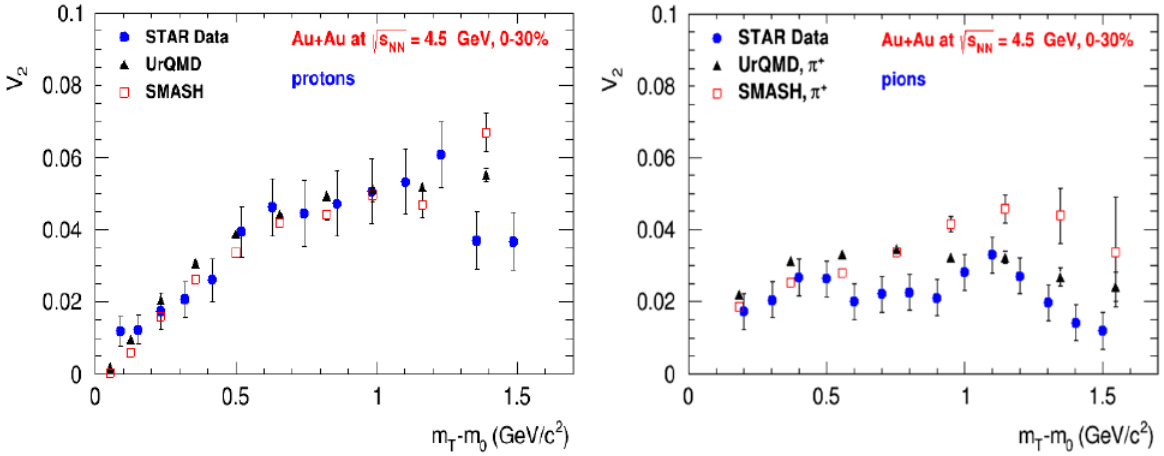
- ALL microscopic models can't describe v2(pT) at sqrt(sNN)>7 GeV
- But microscopic models describe v2(pT) at sqrt(sNN)<=4.5 GeV
- UrQMD – SMASH ? What is difference ?
- It is no sense to test ALL existing models
- WE NEED once mode modern hydro-cascade model with different EoS.

Elliptic flow at NICA energies: Models vs Data comparison

STAR Data, https://arxiv.org/abs/2007.14005



Pure String/Hadronic Cascade models give similar v_2 signal compared to STAR data for Au+Au $\sqrt{s_{NN}}$=4.5 GeV

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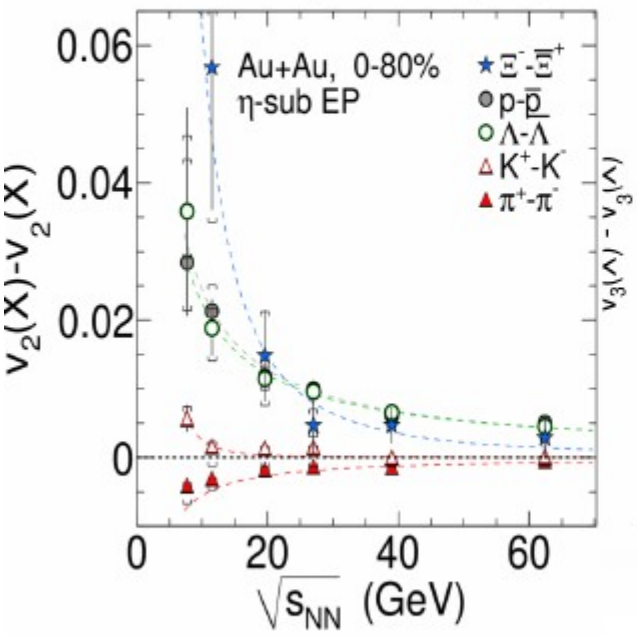
- RFBR & MPD meeting 2020 my impressions: Taranenko A.

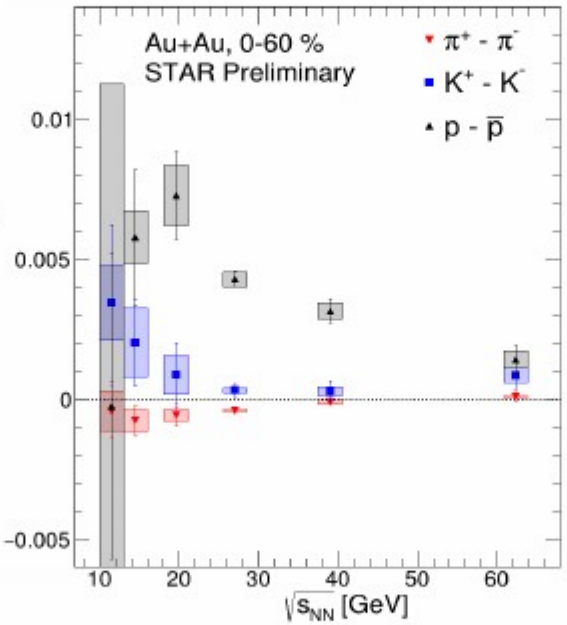
Beam-energy dependence of v_2 and v_3 particle-antiparticle difference

Petr Parfenov for STAR Collaboration (ICPPA2020)

STAR Collaboration, Phys. Rev. C 88 (2013) 14902



New results

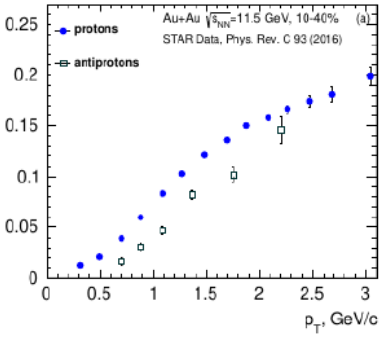


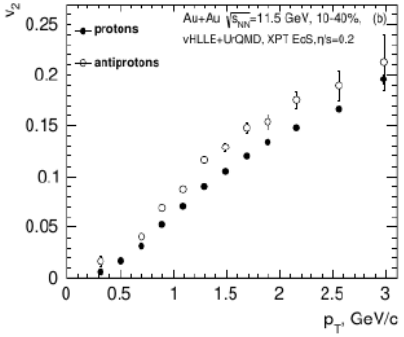
- Several theoretical scenarios of possible sources of the observed difference in v_2:
  - Transported and produced protons (or quarks) have different v_2
  - Mean-field potentials in the hadronic phase: particles feel Coulomb attraction or repulsion corresponding to their charge sign
  - Possible artificial increase of the baryon-antibaryon difference may be attributed to the way event plane is defined in the measurements
- The difference cannot be quantitively reproduced within those scenarios

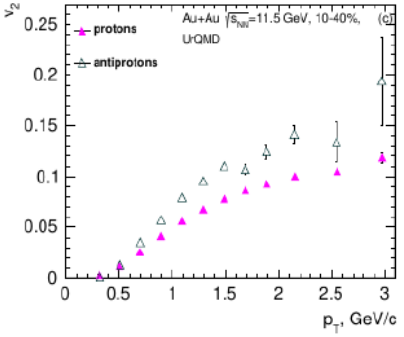
- Interesting obsevation what about STAR FEMTO results pions / kaons / protons ?

- RFBR & MPD meeting 2020 impressions: Taranenko A.

Elliptic flow: protons vs. antiprotons



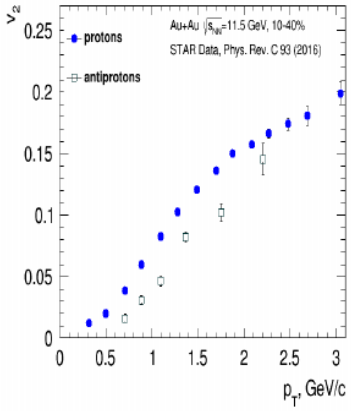


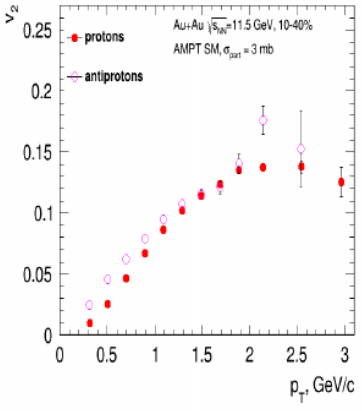


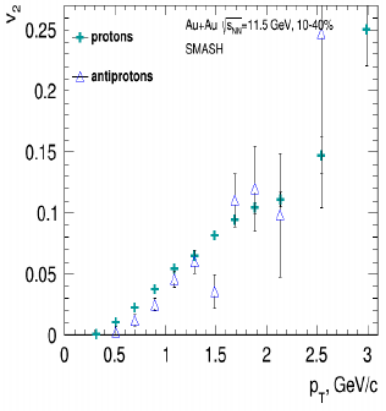
- Both vHLLE+UrQMD and UrQMD predict $v_2(p) < v_2(\bar{p})$ but experimental data shows $v_2(p) > v_2(\bar{p})$

- Interesting obsevation what about STAR FEMTO results pions / kaons / protons ?

Elliptic flow: protons vs. antiprotons





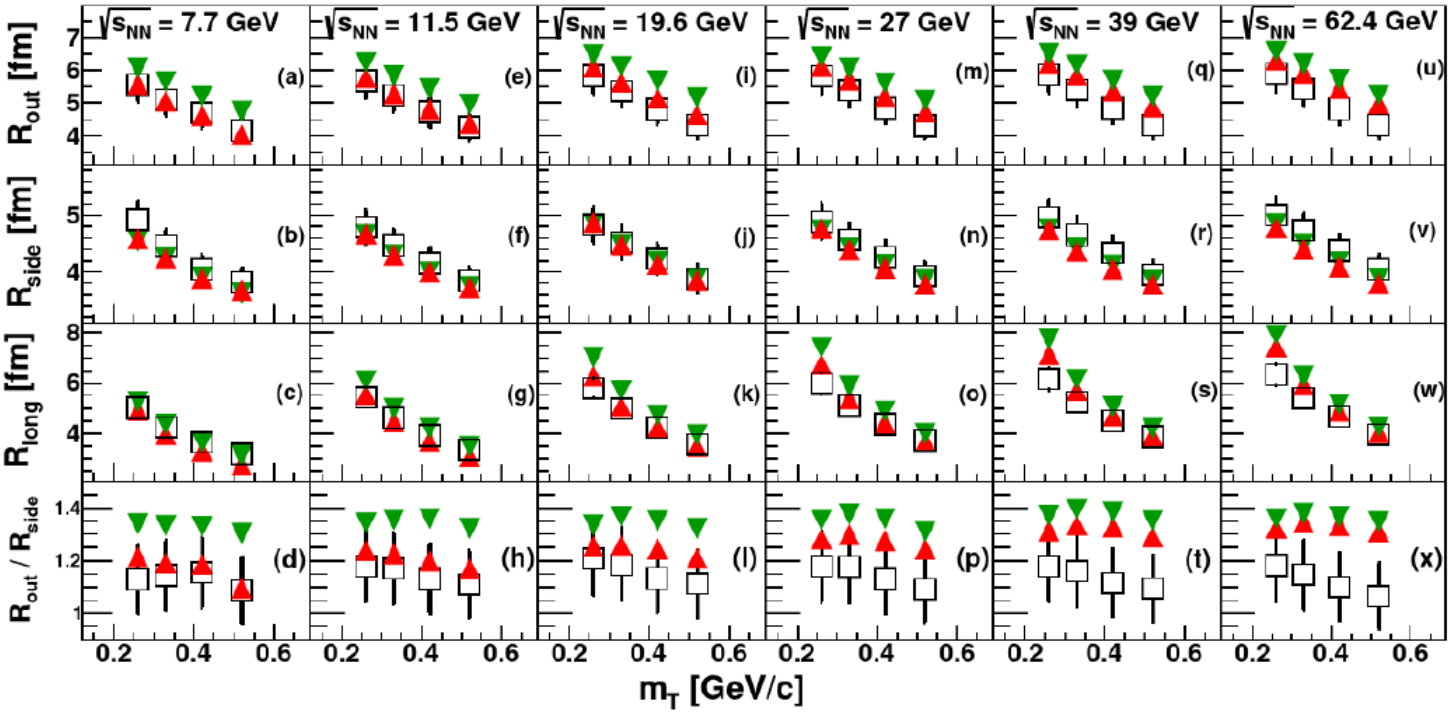


- The same trend is apparent in both UrQMD and AMPT
- SMASH gives a different trend – close to the data

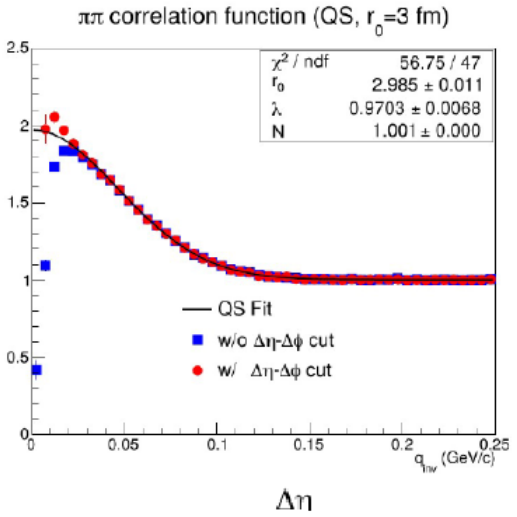
- RFBR 2020 my impressions: Kisiel A.

System size sensitive to phase transition

- Femtoscopy based on two-particle correlation technique (similar to HBT effect in astronomy) probes system size in HIC
- Measurement for pions straightforward and robust, large discovery potential in correlations for kaons and protons, as well as correlations including hyperons



1st order phase transition
cross-over transition



- Clear sensitivity of pion source size to the nature of the phase transitions
- Important and sensitive cross-check of detector performance (two-track resolution)

- We shell provide Adam of our new results !

Practical conclusions:

- We have a lot of materials for 2 articles:

  - Femto pions+ kaons vHLLE+UrQMD and UrQMD
    enough materials ; we can simply make a plan and start to write the text

  - Intermittency
    (my presonal opignion – may be I'm not right) – we need
    once more model to confirm/understand 1PT sqrt(sNN)=7.7 GeV behavior
    Which model we can take and use quickly : HKM (Yura), EPOS, UrQMD.3.14 ?

  both for EPJA – Blashke !!!

- New things to do not so urgently:

  - Start to use the new models, new EoS
  -
  -

- Continue FEMTO package testing / development

Additional slides