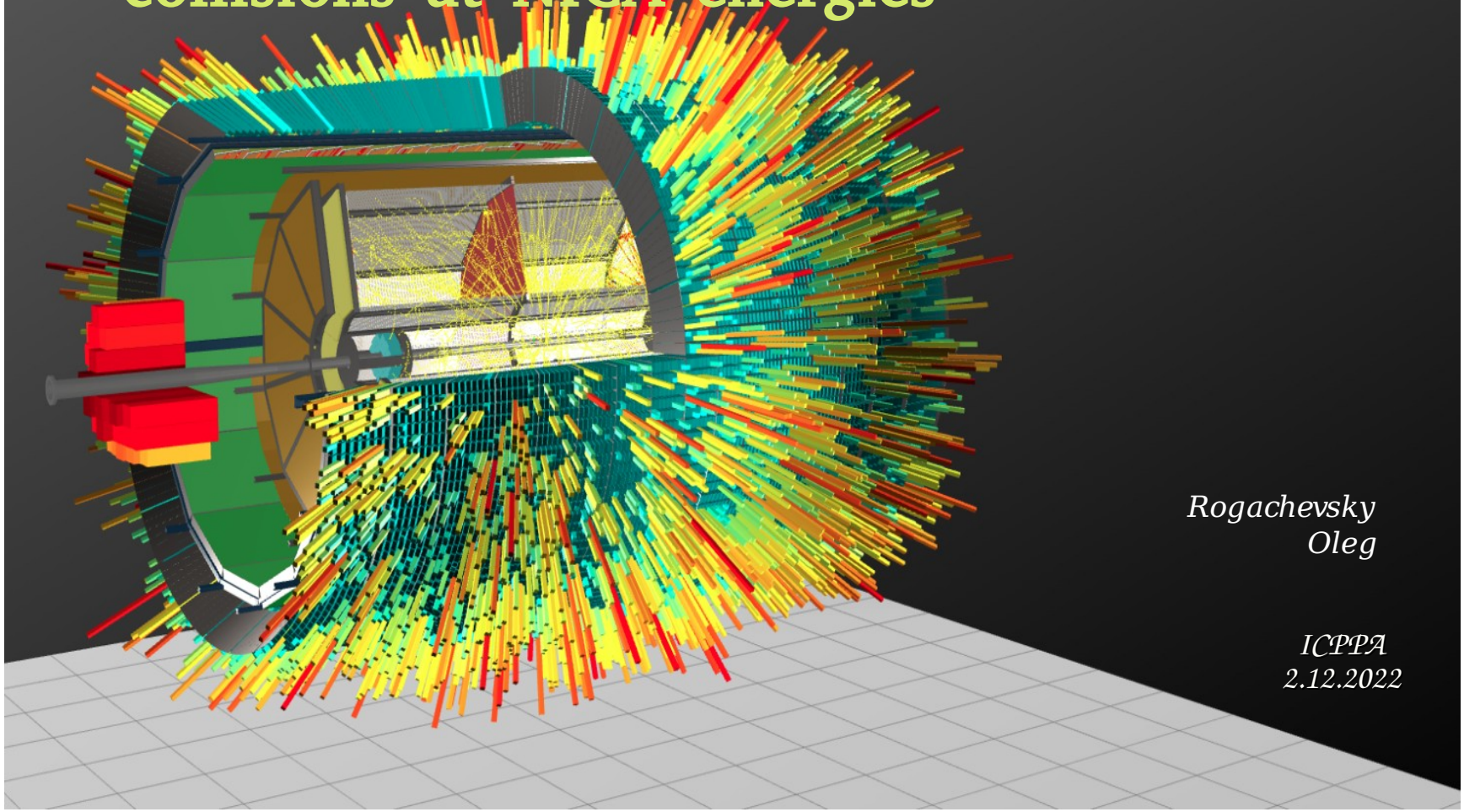
Two particles correlations in heavy ion collisions at NICA energies

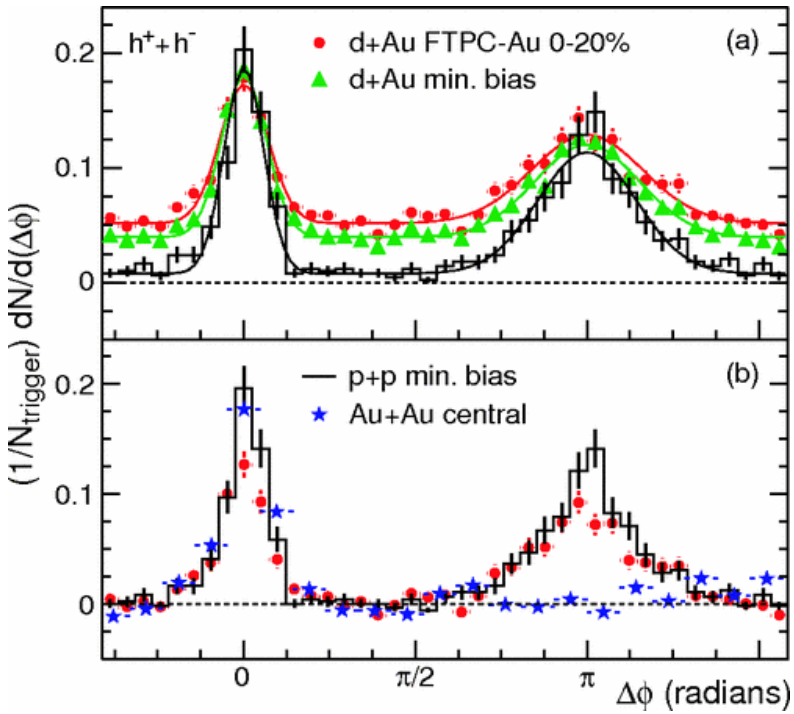


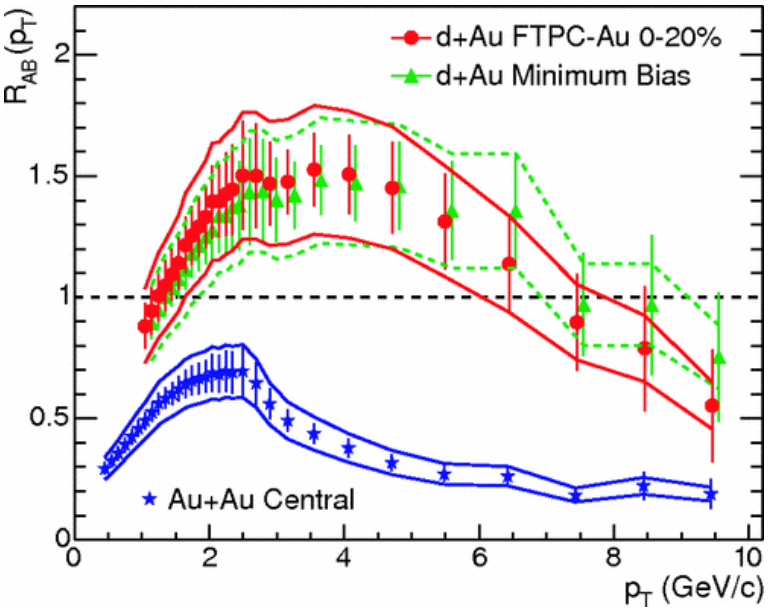
Rogachevsky Oleg

ICPPA
2.12.2022

Jet quenching

Phys.Rev.Lett. 91 072304, 2003





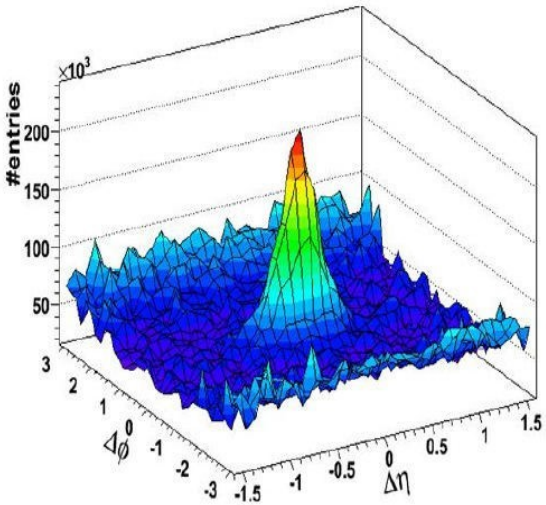
4 GeV/c < p_T^{trig} < 6 GeV/c

2 GeV/c < p_T^{assoc} < p_T^{trig}

Ridges@ RHIC

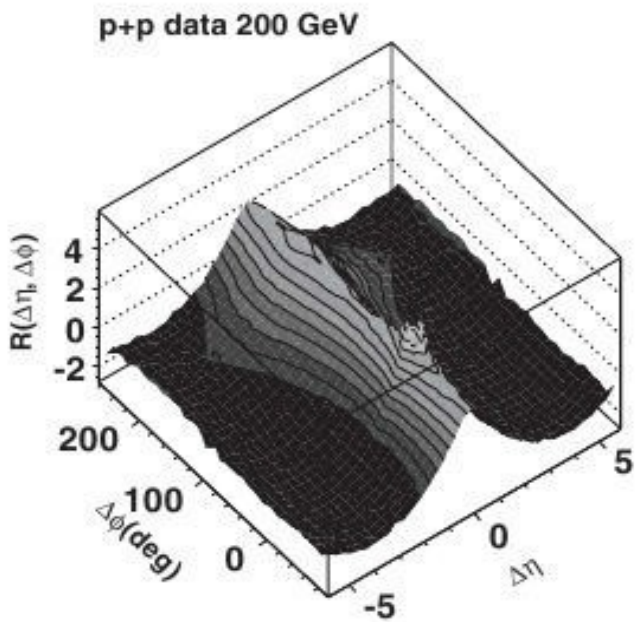
B. Abelev et al., Phys. Rev. C80, 064912 (2009).

d–Au

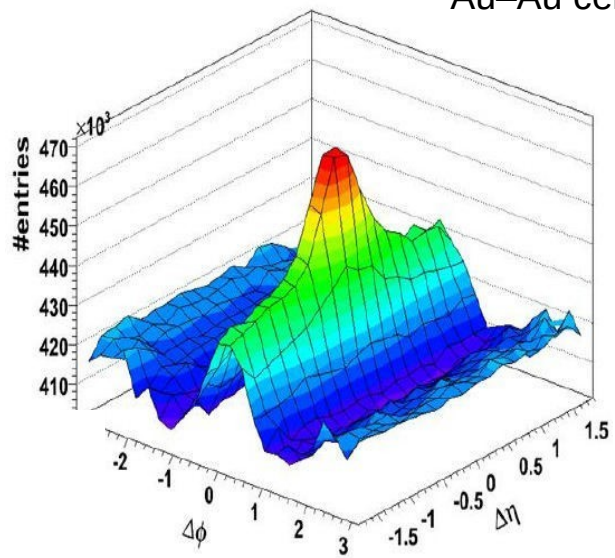


Two particle correlation function at 200 GeV/N from STAR experiment

PHYSICAL REVIEW C **75**, 054913 (2007)



Au–Au central



Cover an acceptance of $3 < |\eta| < 4.5$ and $-180^\circ < \varphi < 180^\circ$

5×10^5 200-GeV Au+Au

8×10^5 410 GeV p+p

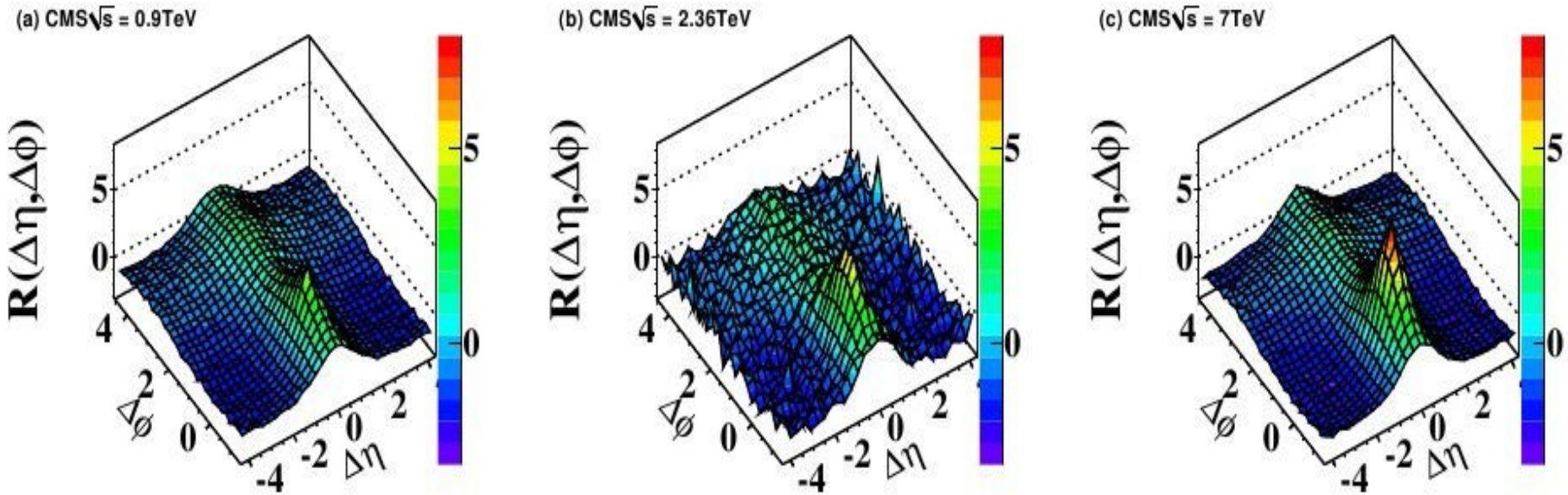
$|z_{vtx}| < 10$ cm

$3\ \text{GeV/c} < p_T^{trig} < 4\ \text{GeV/c}$

$2\ \text{GeV/c} < p_T^{assoc} < p_T^{trig}$

CMS jet + ridge

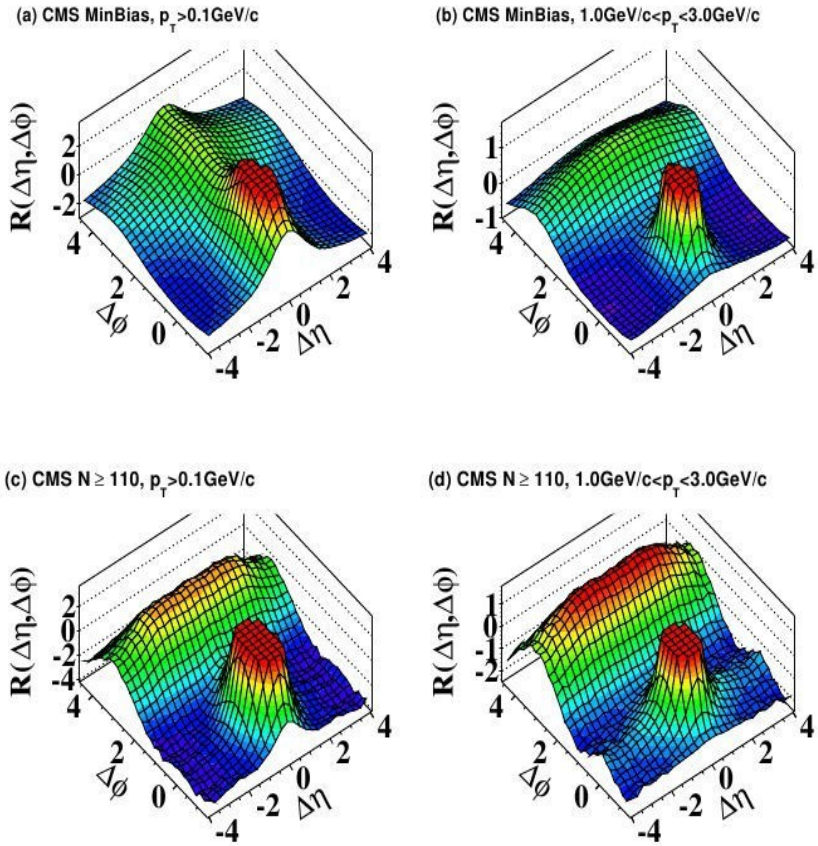
arXiv:1009.4122

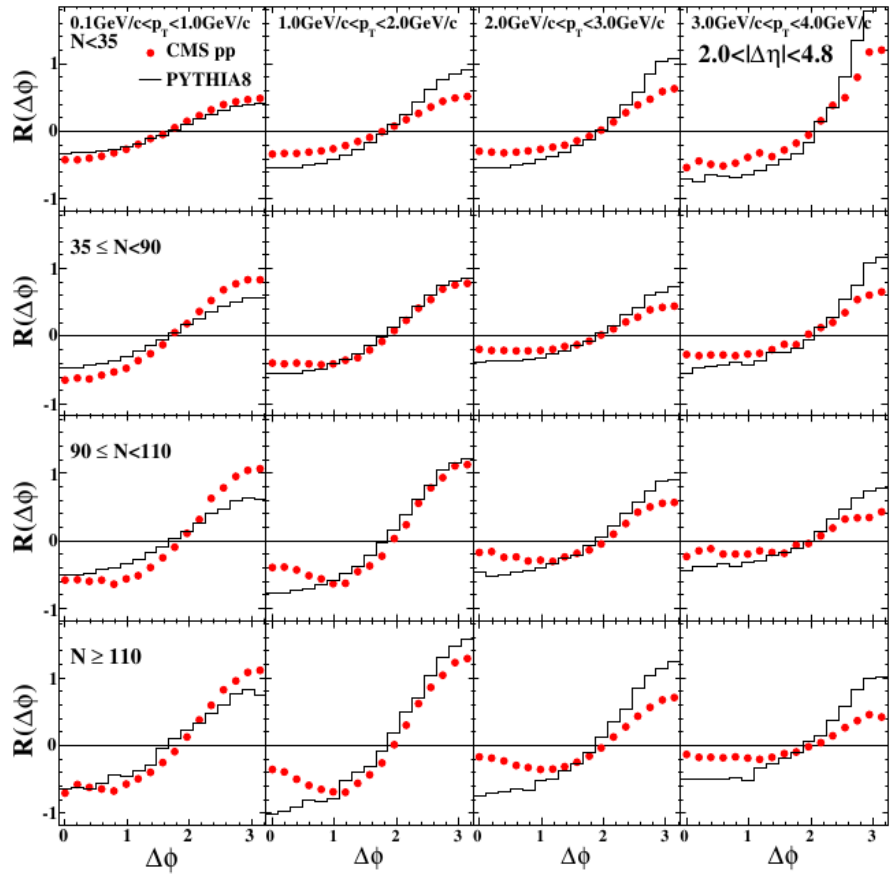


Two-particle correlation functions versus Δη and Δφ in pp collisions

CMS vs Pythia

pp @ 7 TeV





Interpretations

- Jet quenching
  David d'Enterria arXiv:0902.2011 (2009)
- Colour Glass Condensate effective theory
  K. Dusling et al., Nucl. Phys. A836, 159 (2010).
- Hydrodynamical expansion and many flux tubes
  K. Werner et al., Phys. Rev. Lett. 106, 122004 (2011)
- Effect of an elliptic flow manifestation.
  P. Bozek, Eur. Phys. J. C71, 1530 (2011)
- Int workshop "The Ridge" May, 2012
- Momentum kick model
  C. Y. Wong, Phys. Rev. C 76, 054908 (2007)
- Jet Quenching in Heavy-Ion Collisions The Transition Era from RHIC to LHC
  Barbara Betz arXiv:1211.5897, (2012)
- Jet quenching in high-energy heavy-ion collisions
  Guang-you Qin and Xin-Nian Wang, arXiv:1511.00790 (2015)
- Jet quenching and medium response in high-energy heavy-ion collisions: a review
  Shanshan Cao and Xin-Nian Wang, arXiv:2002.04028 (2020)
- From hydro to jet quenching, coalescence and hadron cascade
  W. Zhao, W. Ke, W. Chen, T. Luo and X. N.Wang, Phys.Rev.Lett. 128 (2022) 2, 022302.
- Conference "Jet Quenching In The Quark-Gluon Plasma" Jun 13 – 17, 2022 ECT

…

So far there is no consensus on the origin of the effects and various explanations of the these phenomena were proposed

Cuts for jet quenching & ridge

Ridge

RHIC AuAu

$3\ \mathrm{GeV/c} < p_T^{trig} < 4\ \mathrm{GeV/c}$

$2\ \mathrm{GeV/c} < p_T^{assoc} < p_T^{trig}$

LHC pp

$0.1\ \mathrm{GeV/c} < \ldots < p_T < \ldots < 5.\ \mathrm{GeV/c}$

Multiplicity $N > 110$

Jet Quenching

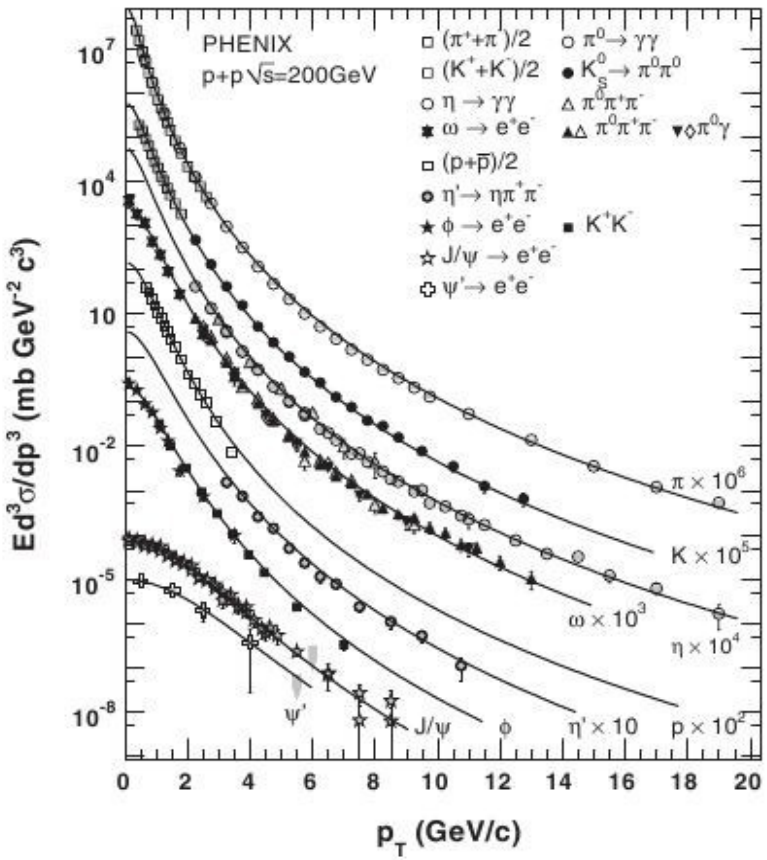
RHIC AuAu

$4\ \mathrm{GeV/c} < p_T^{trig} < 6\ \mathrm{GeV/c}$

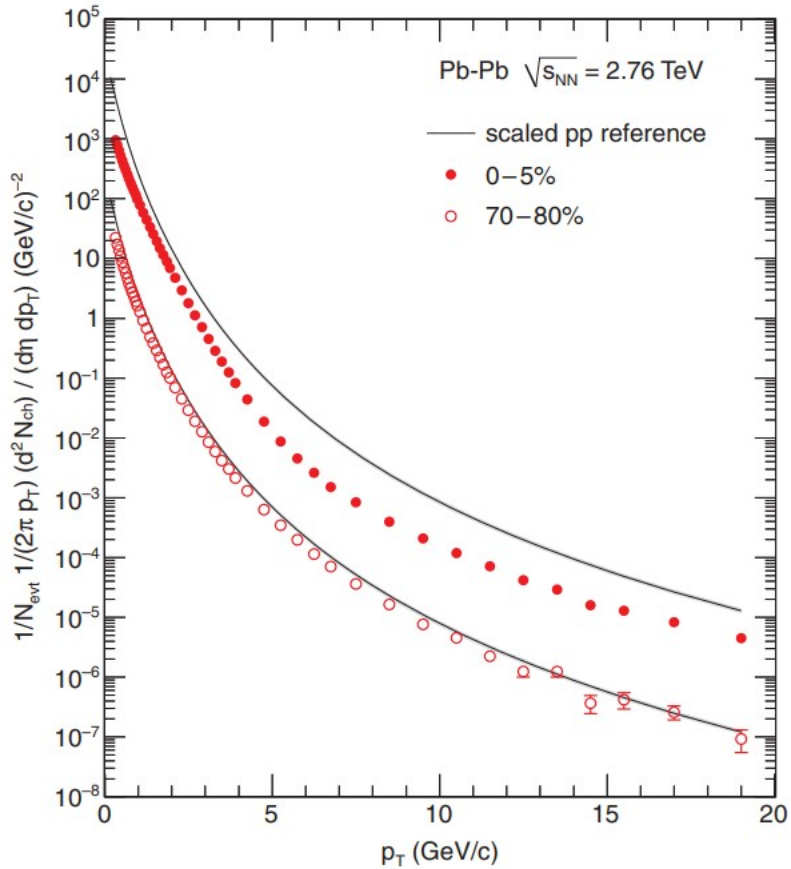
$2\ \mathrm{GeV/c} < p_T^{assoc} < p_T^{trig}$

P_T particles spectra

PHENIX P.R. D 83, 052004 (2011)
+ Tsallis fitting

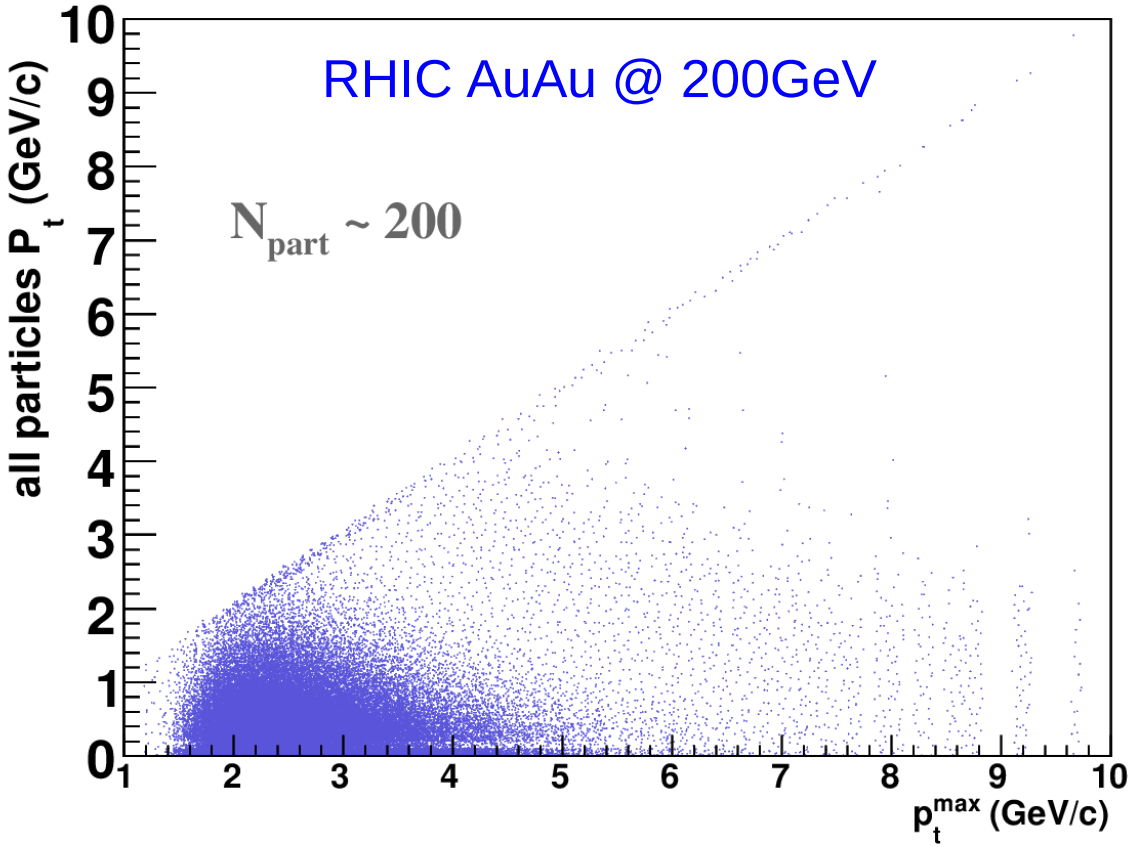


LHC



Universal events structure with p_T^{max}

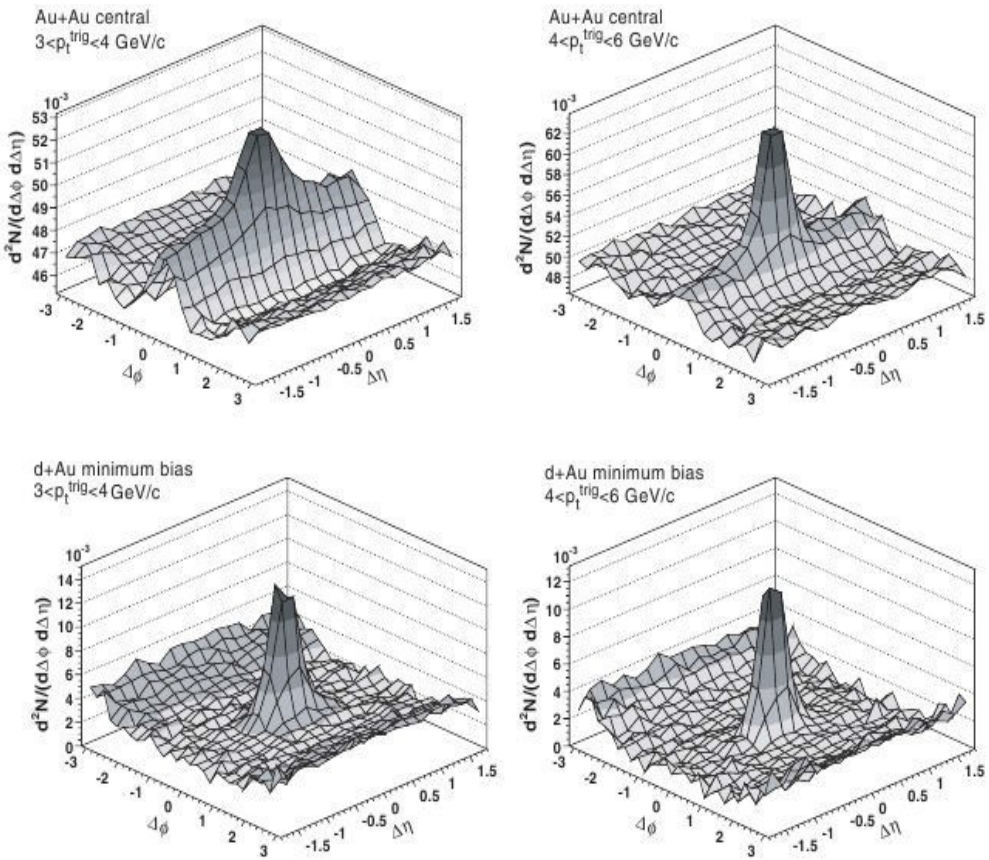
R.O. ICHEP 2006 v.2 p.443-446
Scale dependent analysis approach for STAR events



Does not depend on:

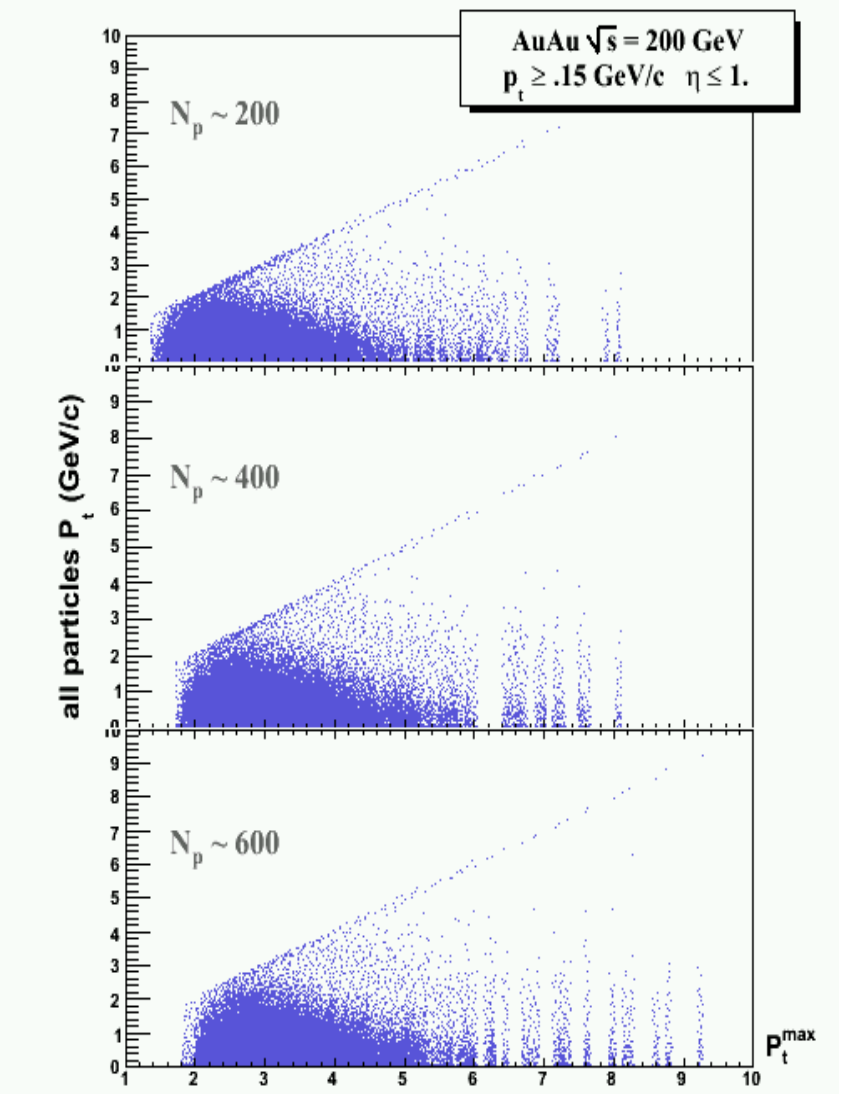
- Multiplicity
- Collision energy
- Colliding particles
- Produced particles

Ridge @ STAR



$2\ \mathrm{GeV/c} < p_T^{assoc} < p_T^{trig}$

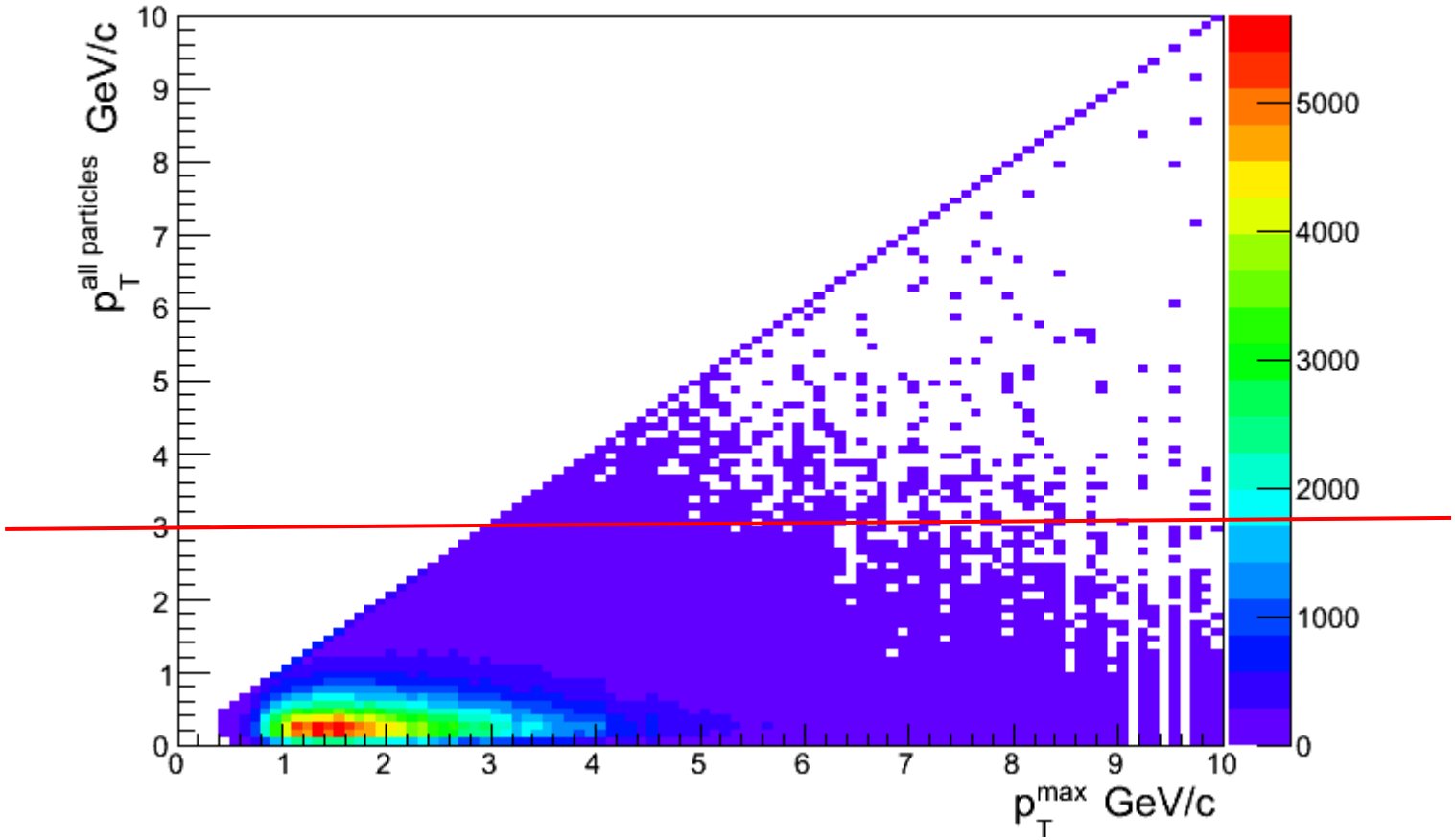
R.O. STAR events



pp @ √s = 7 TeV

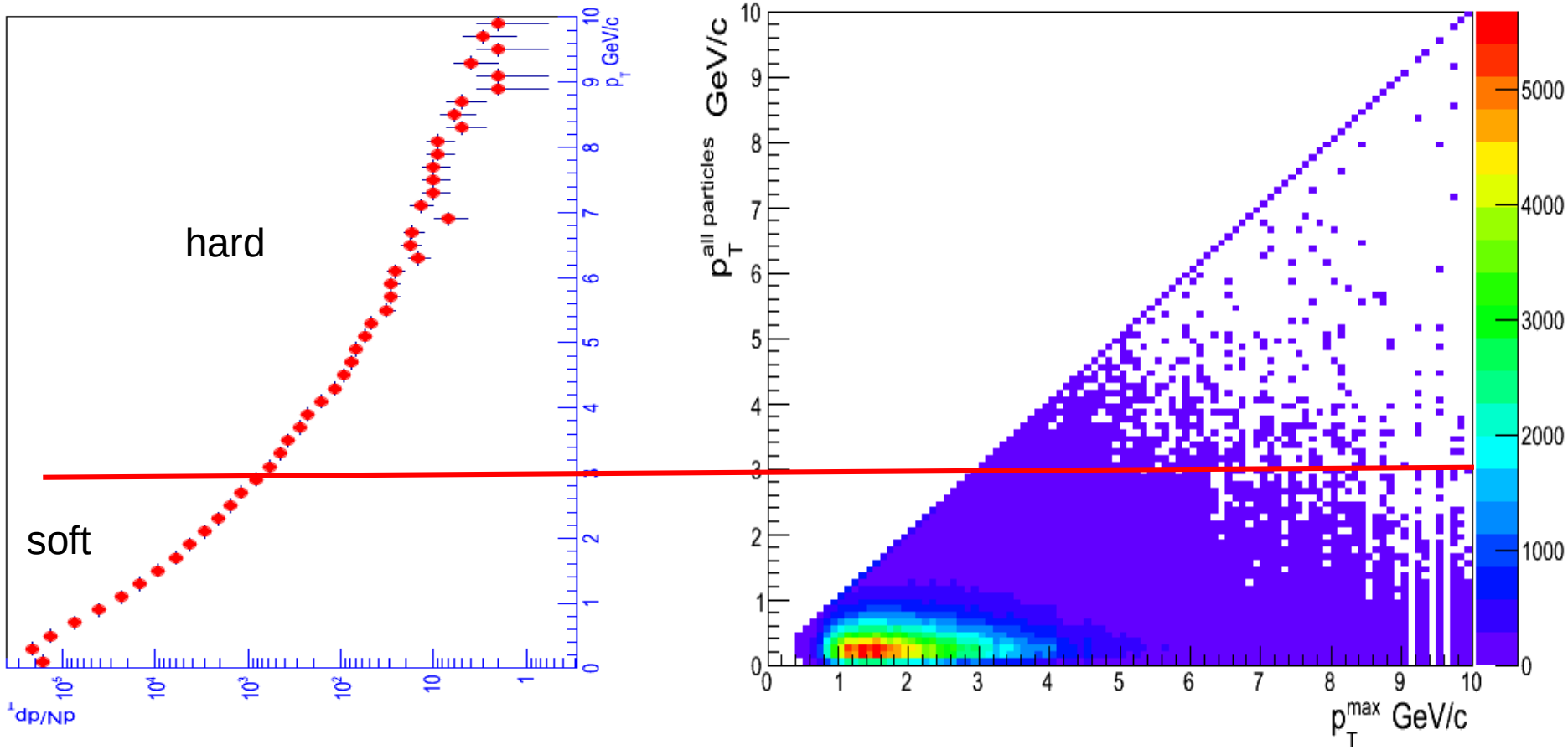
Pythia v.6 - 424

All charged particles



pp @ √s = 7 TeV

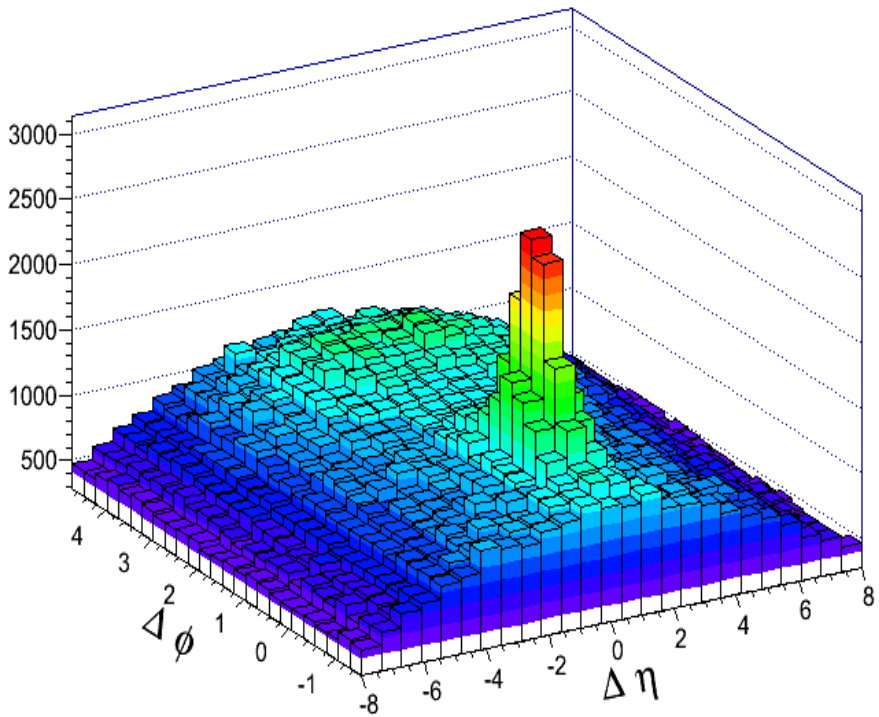
Pythia v.6-424 10K events
All charged particles



pp collisions

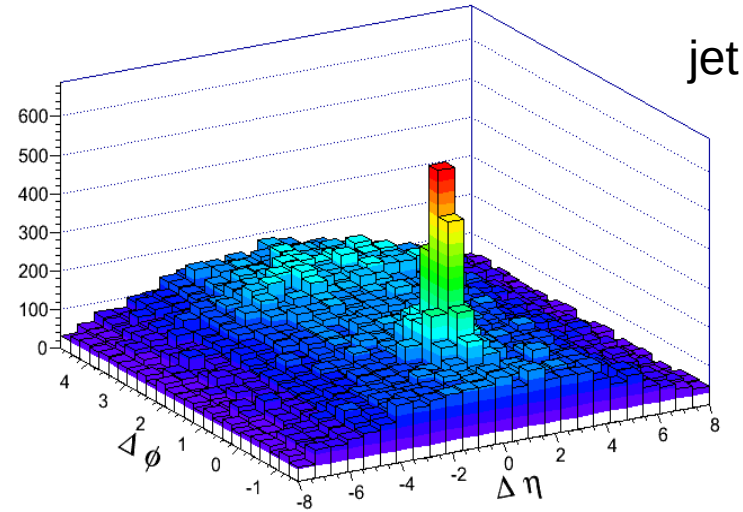
Pythia v.6-424

10K events √s =7 TeV all charged particles



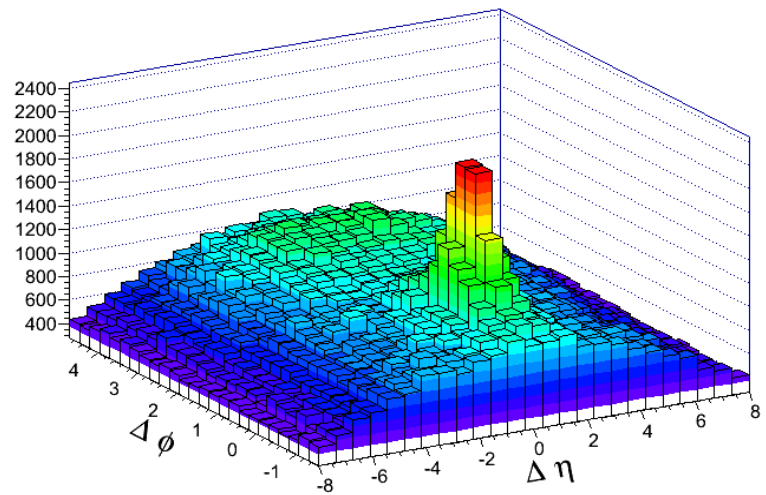
$P^{max} >$ 4 GeV/c

jet



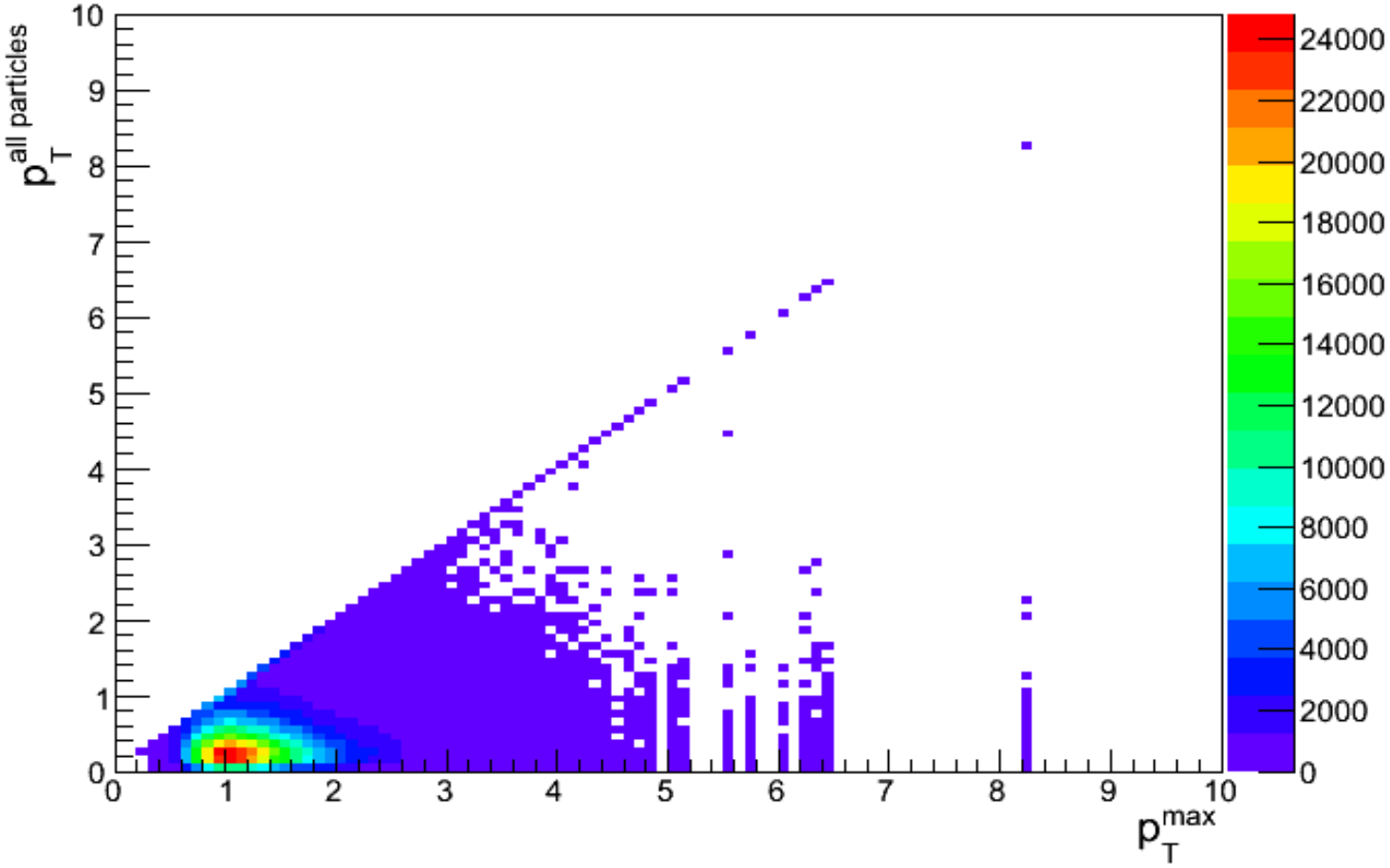
$P^{max} \leq$ 4 GeV/c

flow



pp @ √s = 200 GeV

50K events at √s =200 GeV
All charged particles

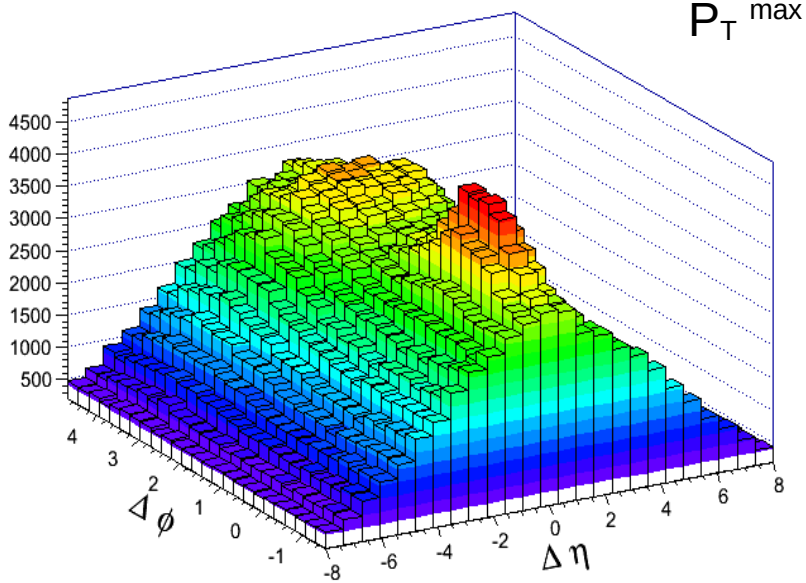


pp @ √s = 200 GeV

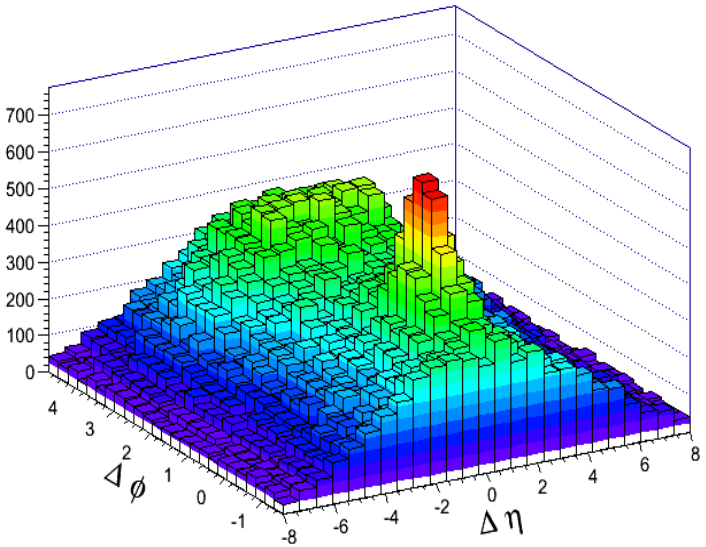
Pythia v.6-424

50K events √s =200 GeV
All charged particles

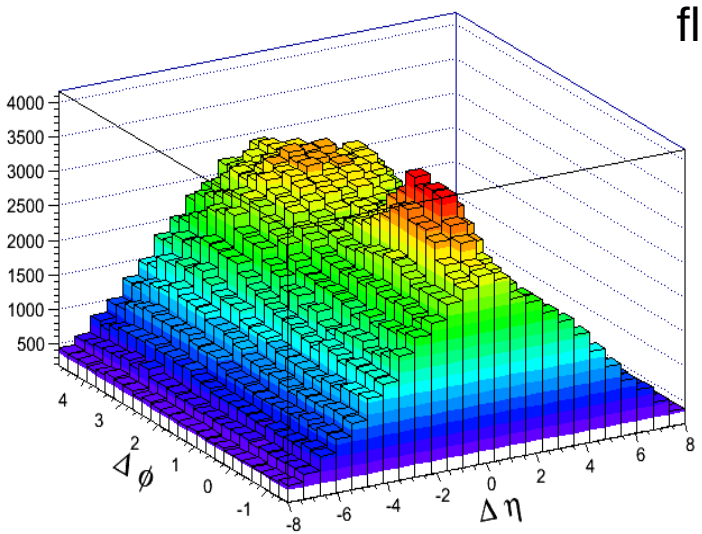
P_T^{max} cut = 2 GeV/c

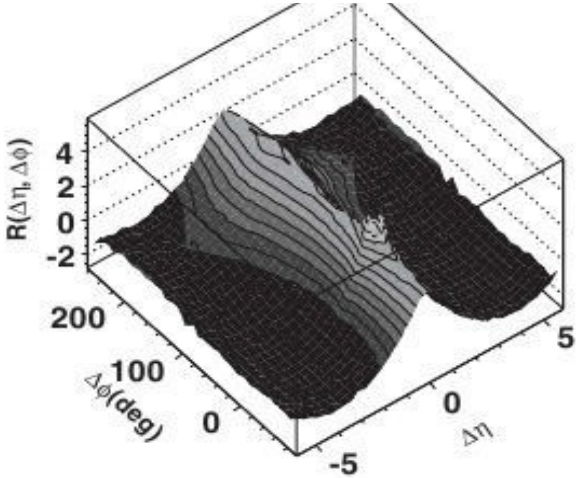


jet



flows

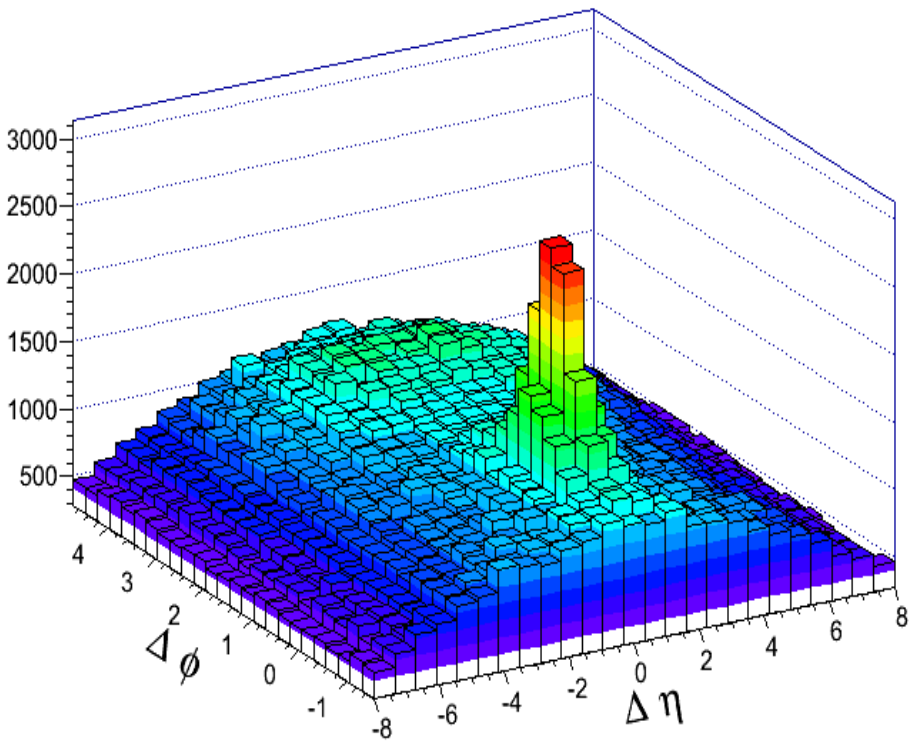




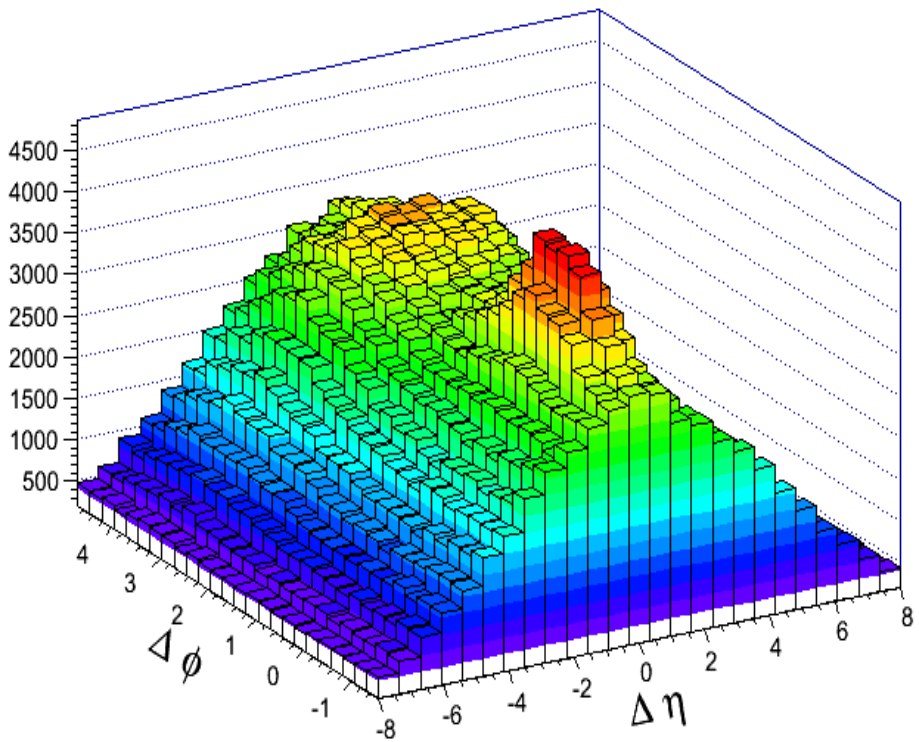
pp √s = 200 GeV vs √s = 7 TeV

Pythia v.6-424

√s =7 TeV

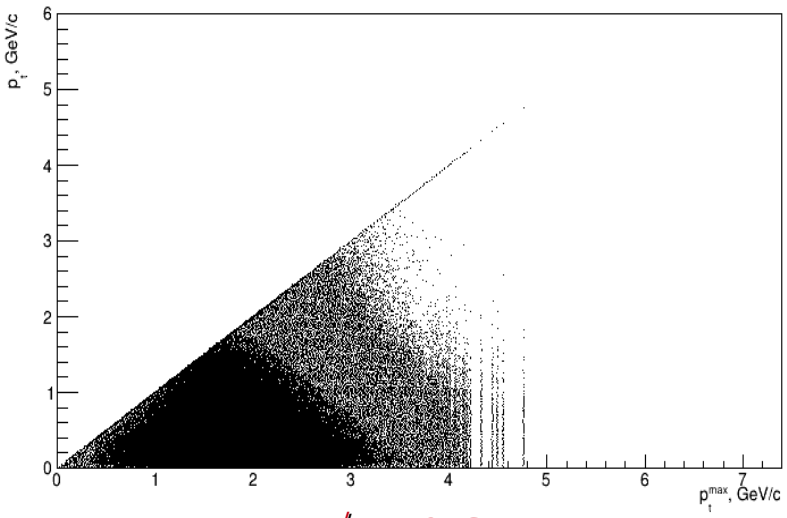


√s =200 GeV

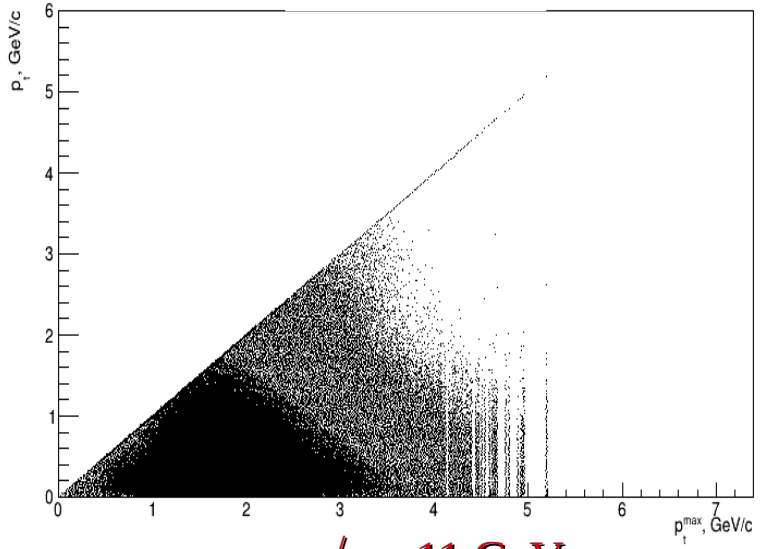


p_T^{max} for NICA energies

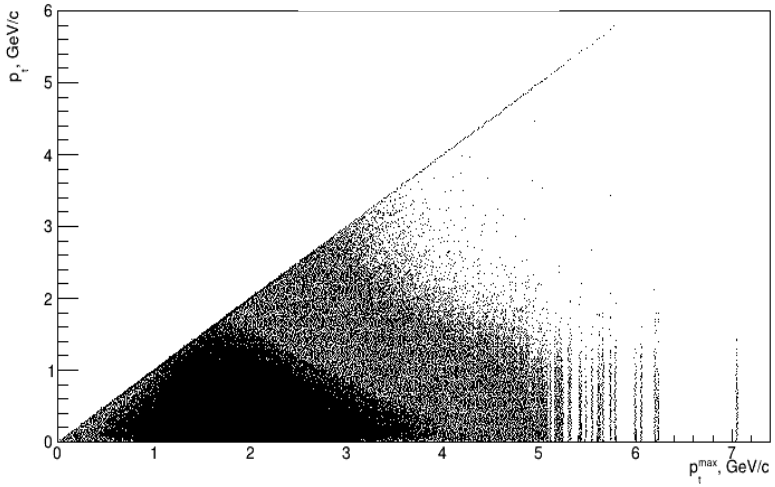
√s = 4 GeV



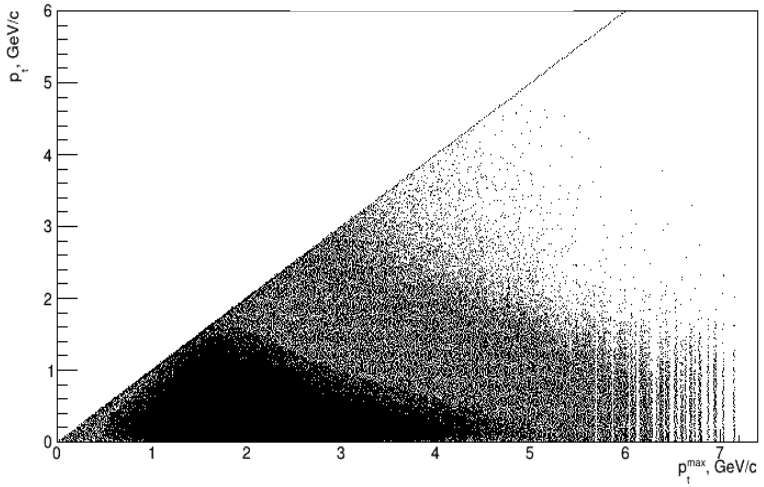
√s = 7 GeV



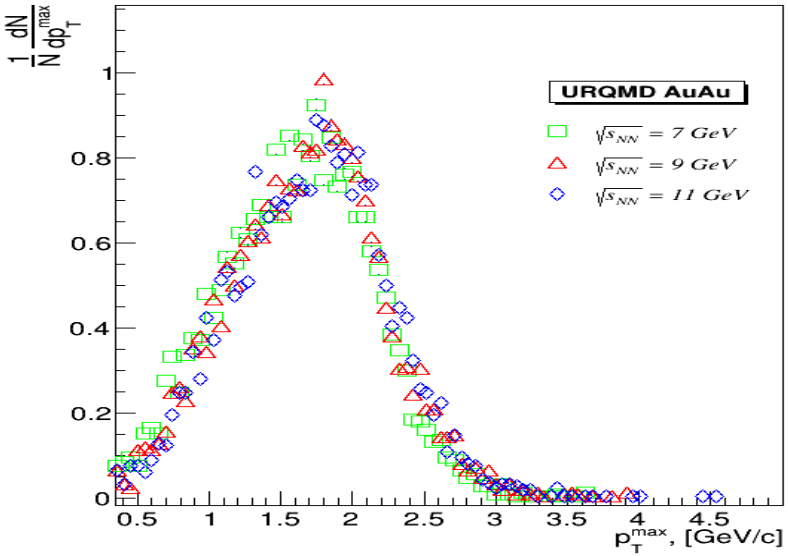
√s = 9 GeV

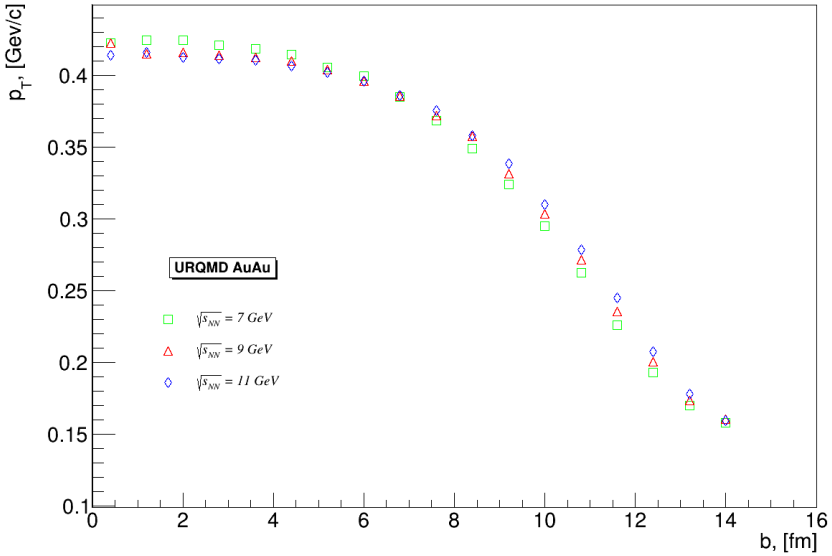


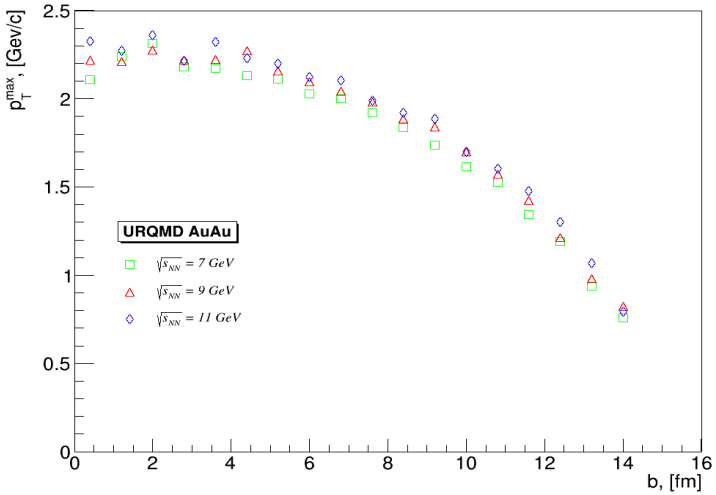
√s = 11 GeV

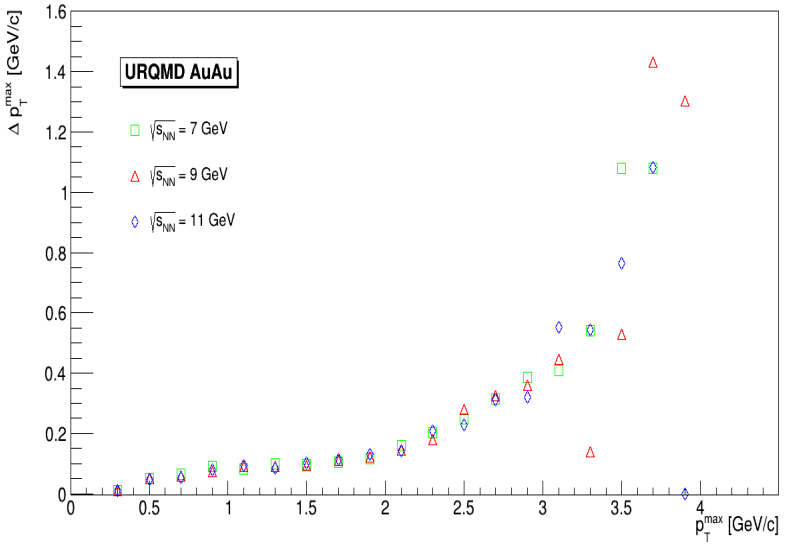


NICA energies: UrQMD

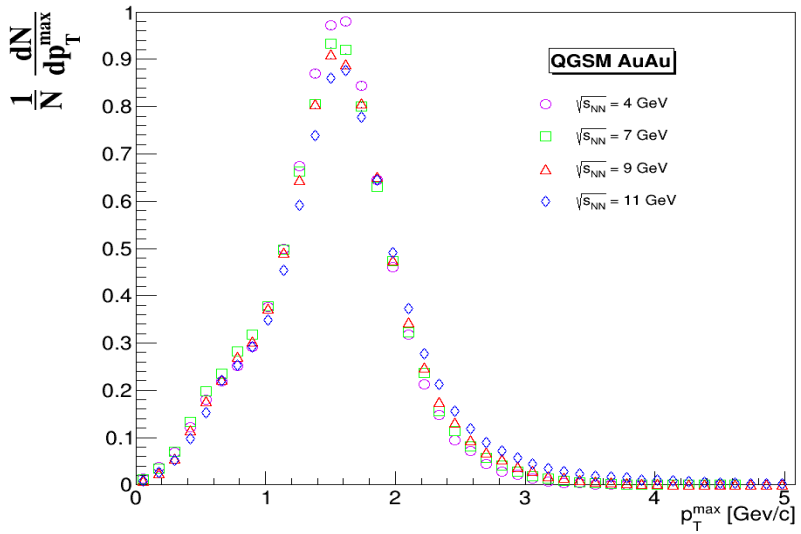


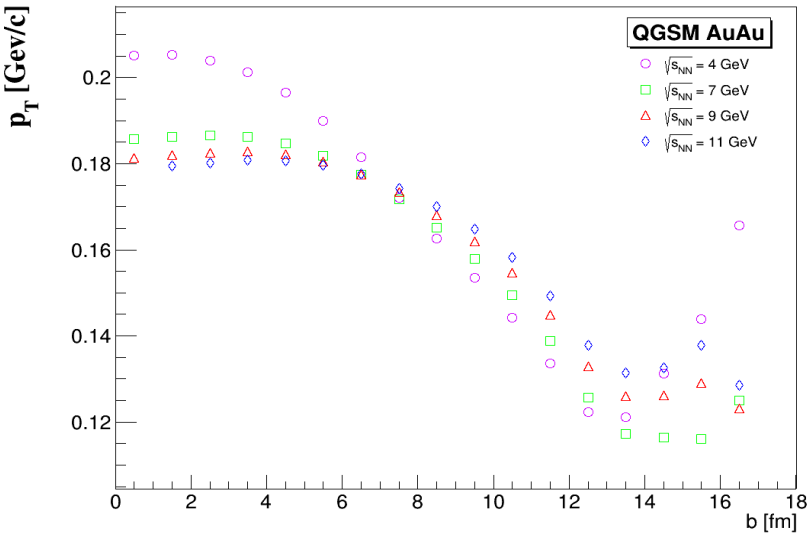


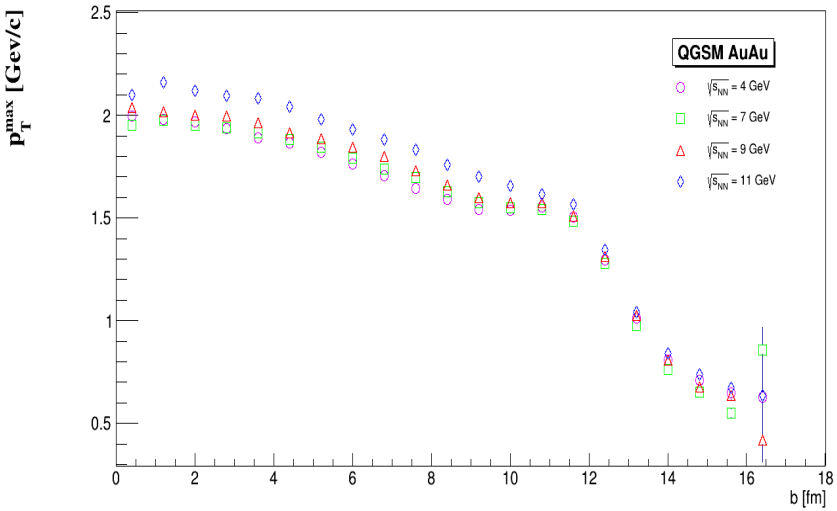


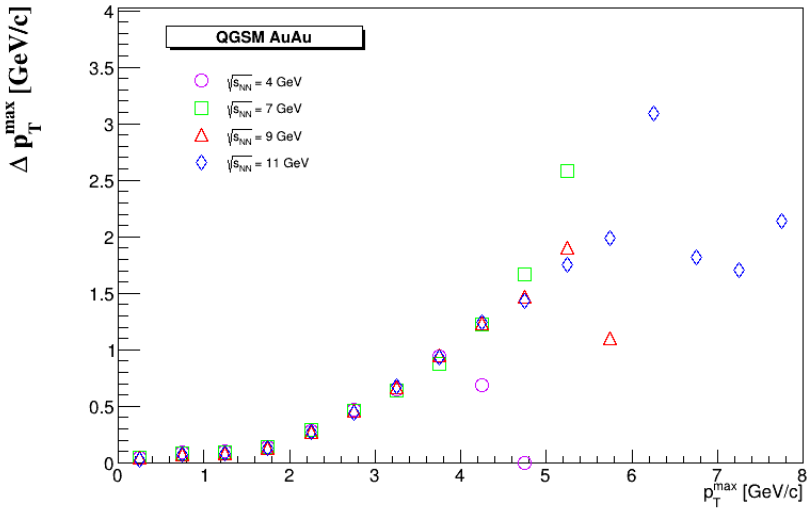


NICA energies: QGSM

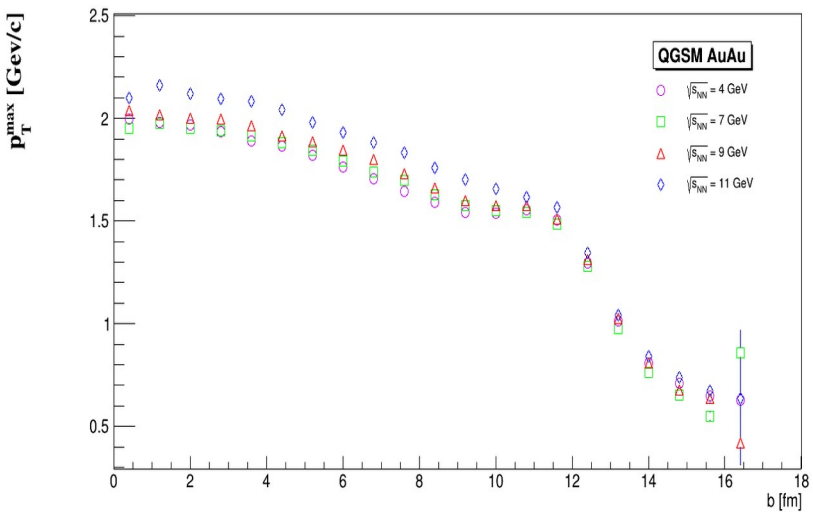


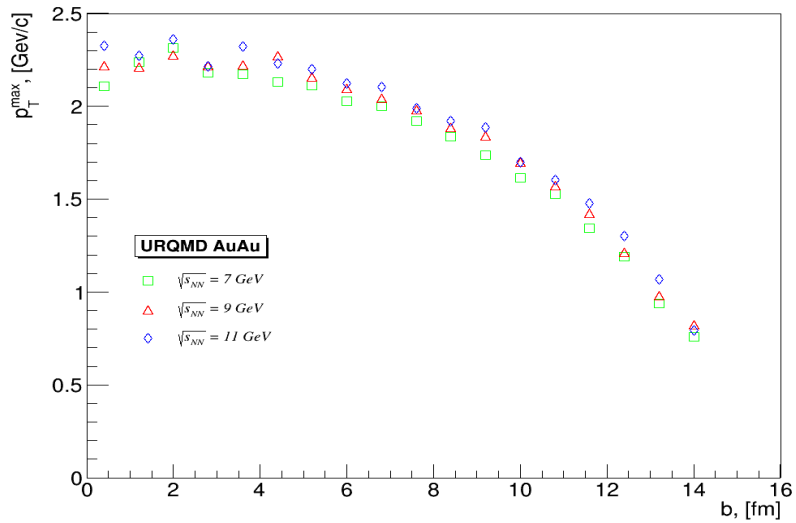


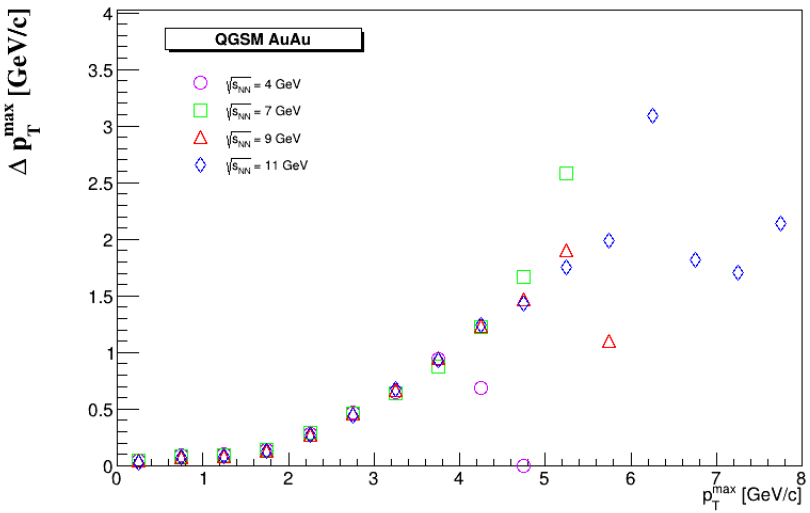


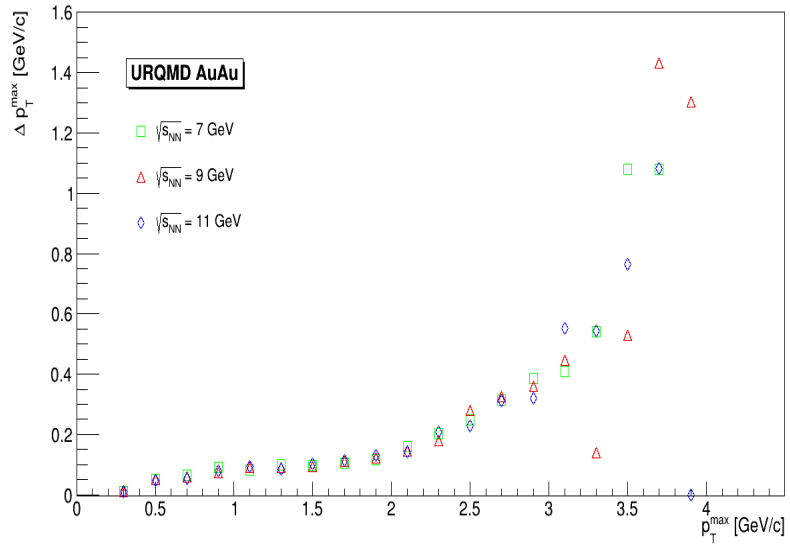


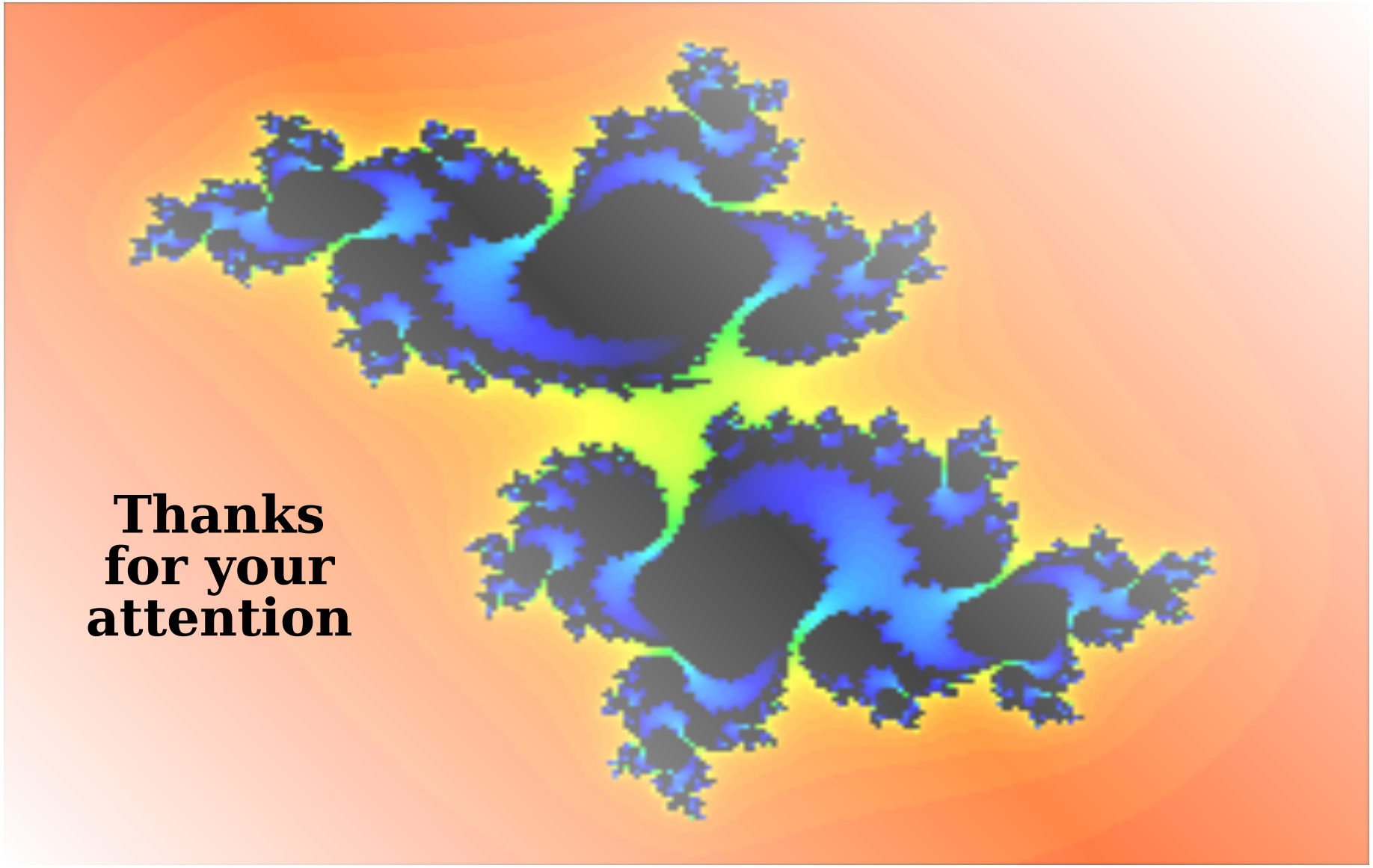
NICA : QGSM vs UrQMD





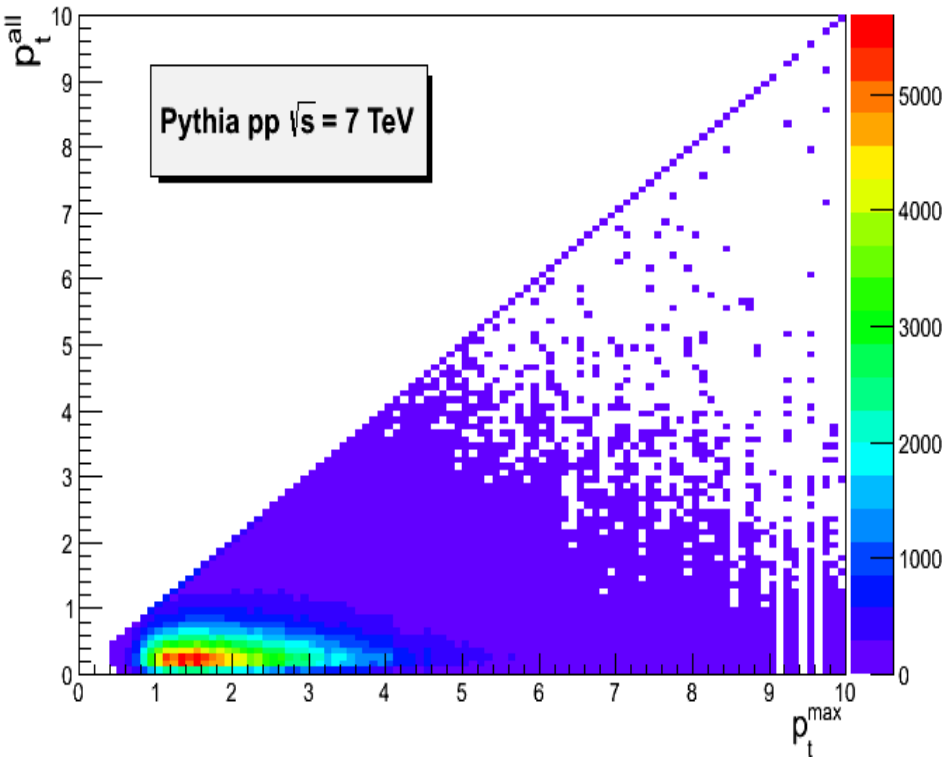





Thanks
for your
attention

All charged particles

Pythia √s =7 TeV



STAR √s =200 GeV