Charge balancing and the fall off of the ridge

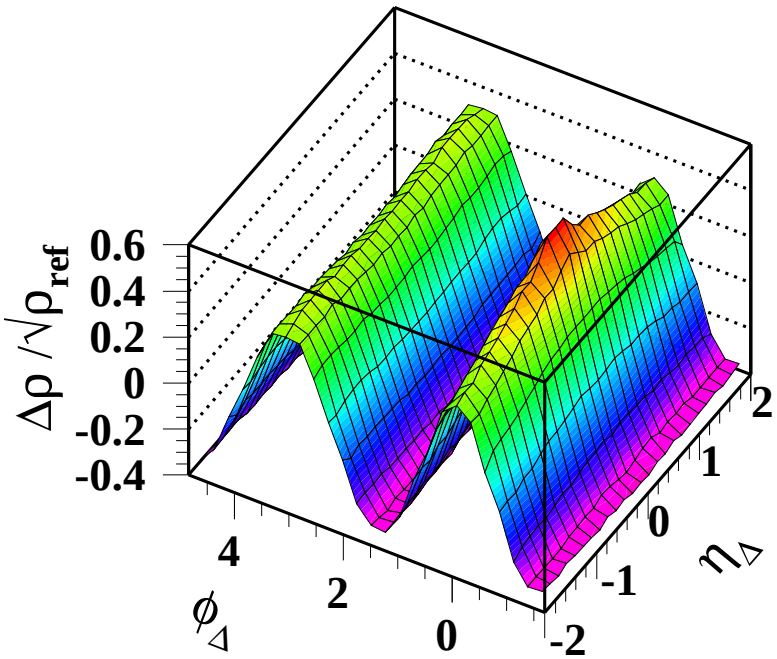
Piotr Bożek and Wojtek Broniowski

Institute of Nuclear Physics Kraków

QM 2012

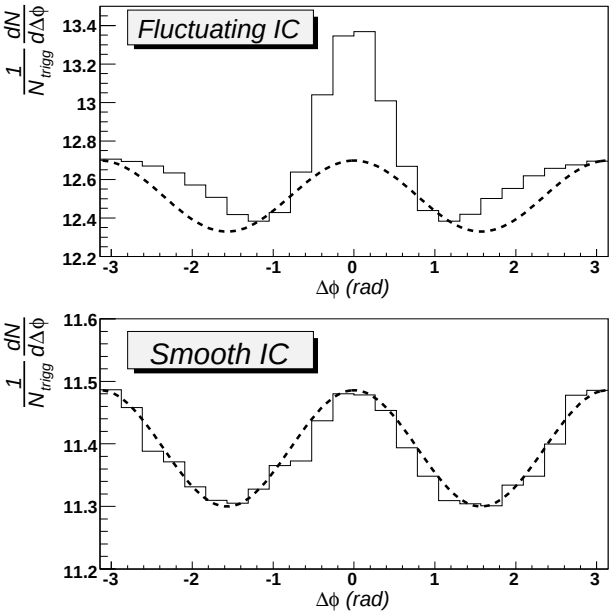
Two-particle correlations

$$C_2(\Delta\eta, \Delta\phi) = \frac{N^{\text{pairs}}_{\text{phys}}(\Delta\eta,\Delta\phi)}{N^{\text{pairs}}_{\text{mixed}}(\Delta\eta,\Delta\phi)}$$



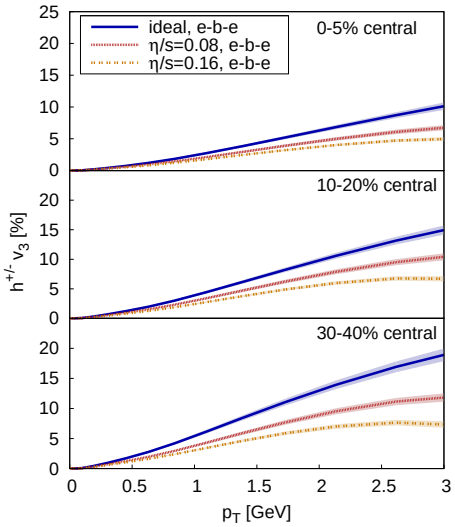
STAR

flow correlations

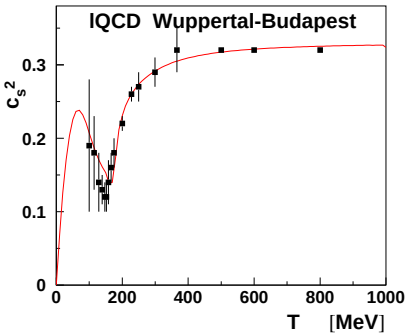


J. Takahashi et al. (2009)

3 + 1-D viscous hydrodynamics



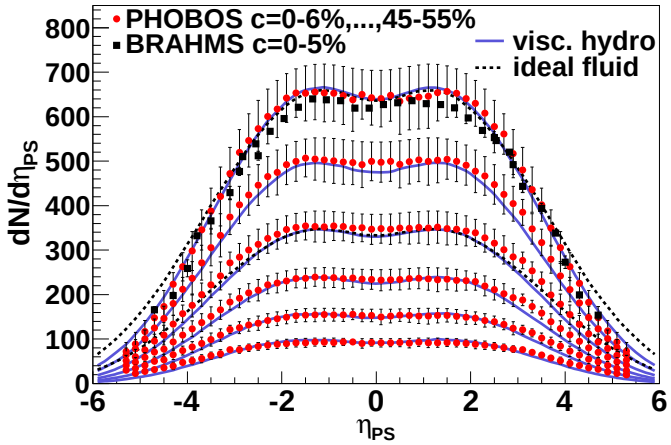
first 3+1D visc. : B.Schenke et al.

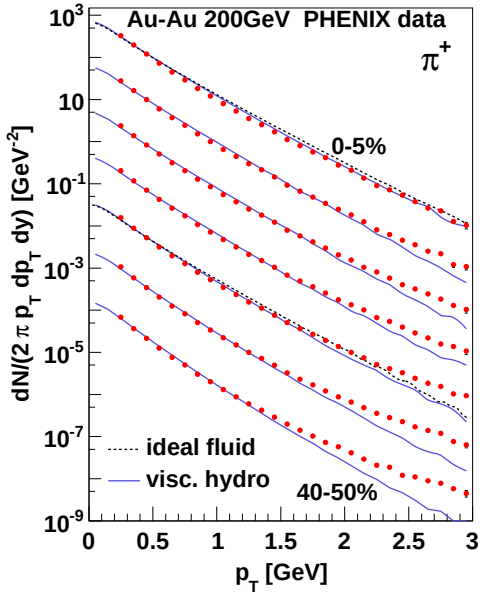


lQCD + Hadron Gas

$\eta/s = 0.08(0.16)$

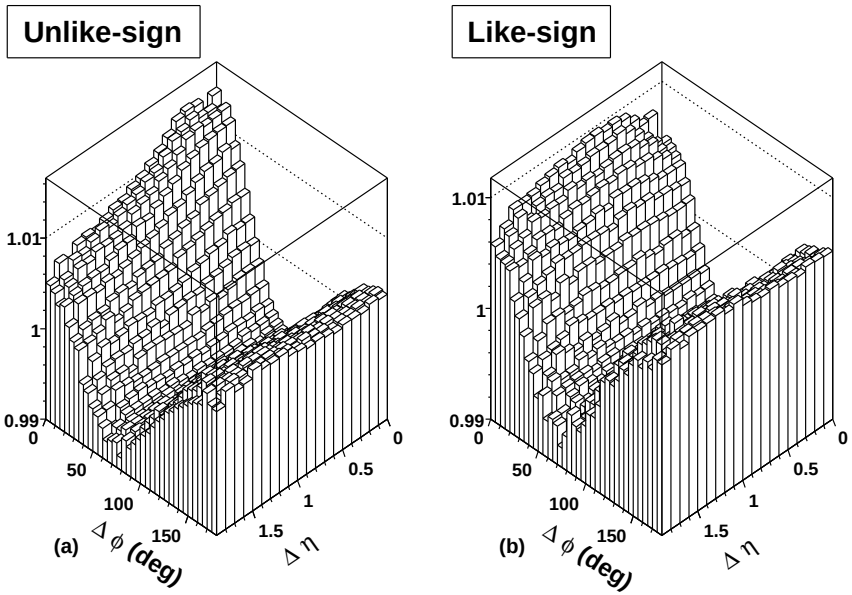
Au-Au 200GeV





2-D correlations

$(0.8 < p_T < 4$ GeV - "unbiased")



STAR data, 2007

2-D correlations

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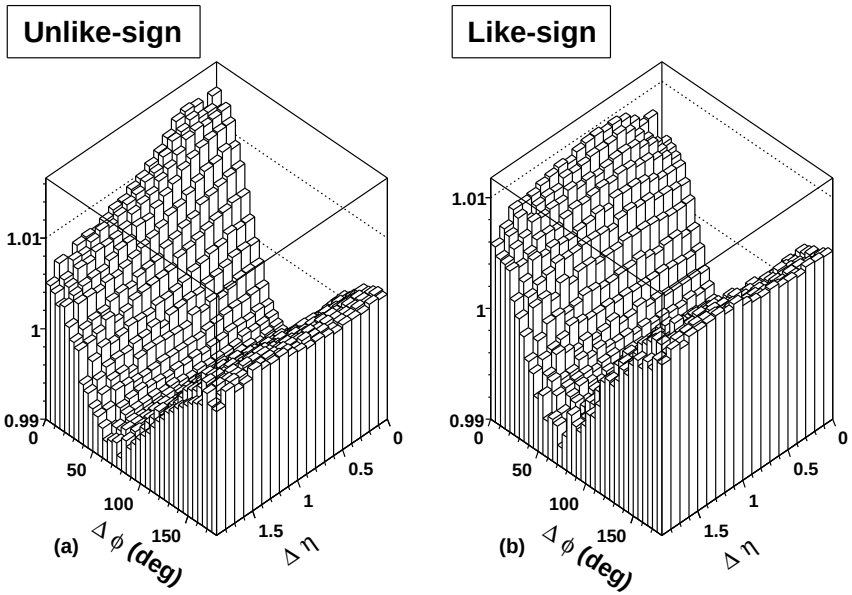
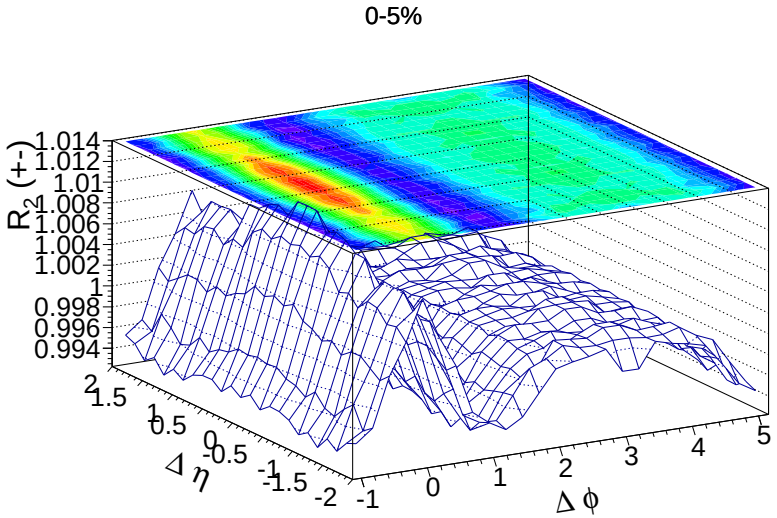
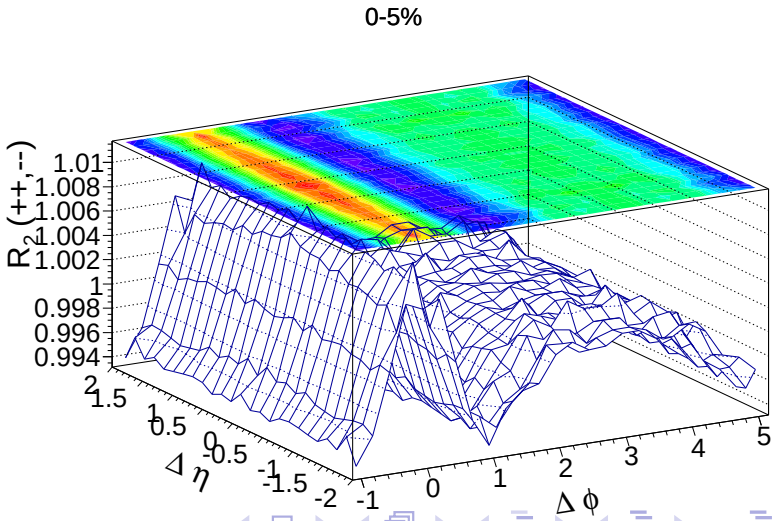


STAR data, 2007

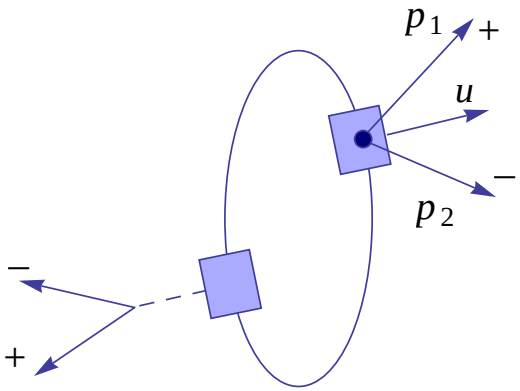
No balancing



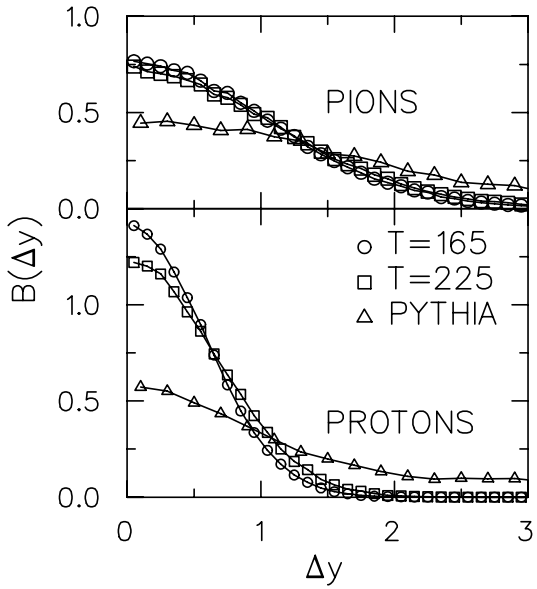


Charge balancing

local charge conservation



charge balance function

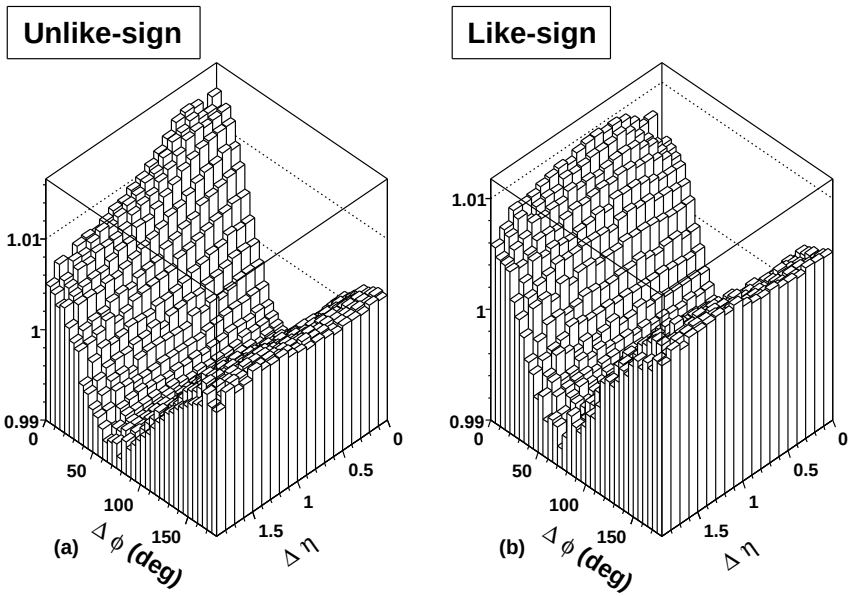


Bass et al. (2000)

2-D correlations

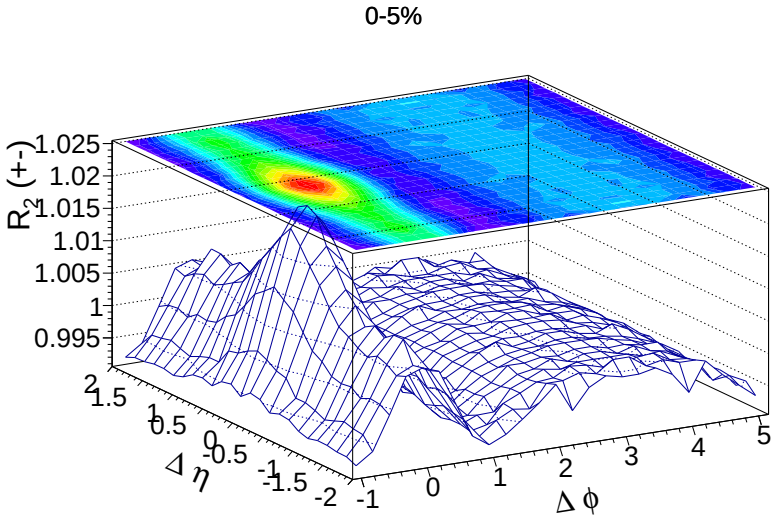
$$R_2(\Delta\eta, \Delta\phi) = \frac{N^{\text{pairs}}_{\text{phys}}(\Delta\eta,\Delta\phi)}{N^{\text{pairs}}_{\text{mixed}}(\Delta\eta,\Delta\phi)}$$

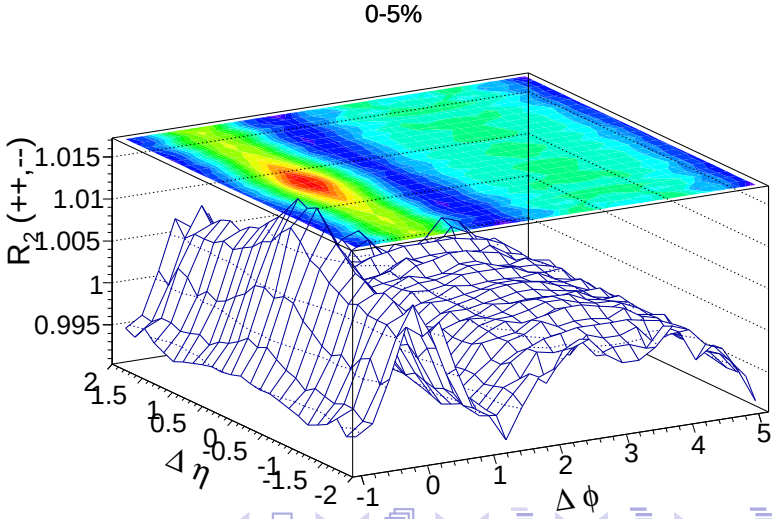
$(0.8 < p_T < 4$ GeV)



STAR data

With balancing!

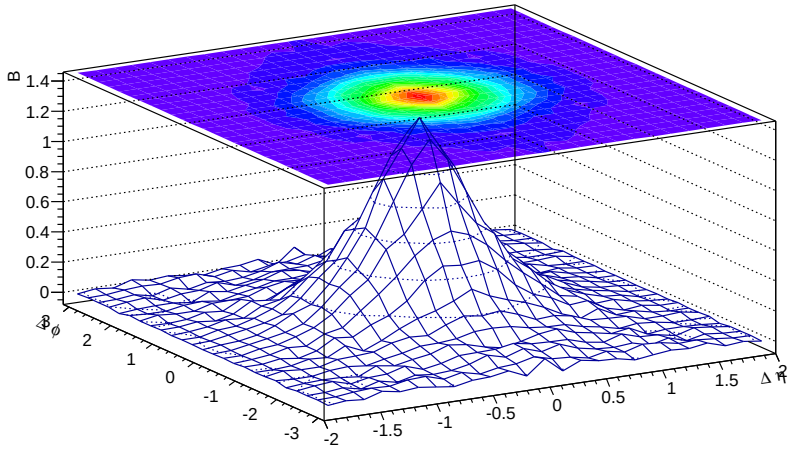




2D balance functions

$$B(\Delta\eta, \Delta\phi) = \frac{\langle N_{+-} - N_{++} \rangle}{\langle N_{+} \rangle} + \frac{\langle N_{-+} - N_{--} \rangle}{\langle N_{-} \rangle}$$

$c = 0 - 5\%$



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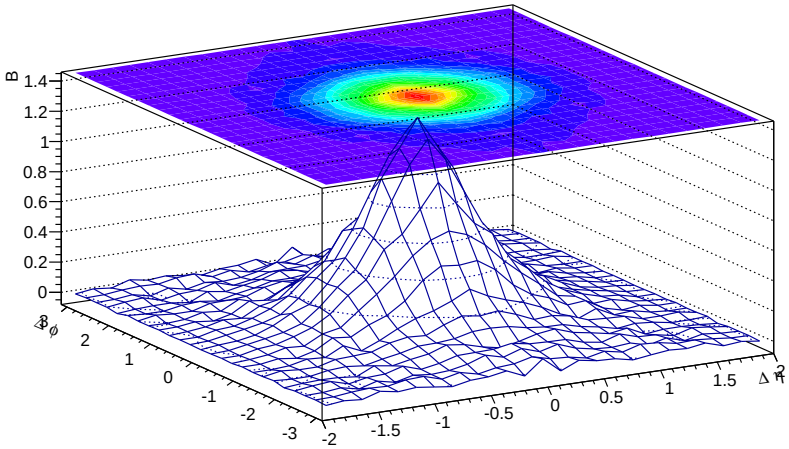
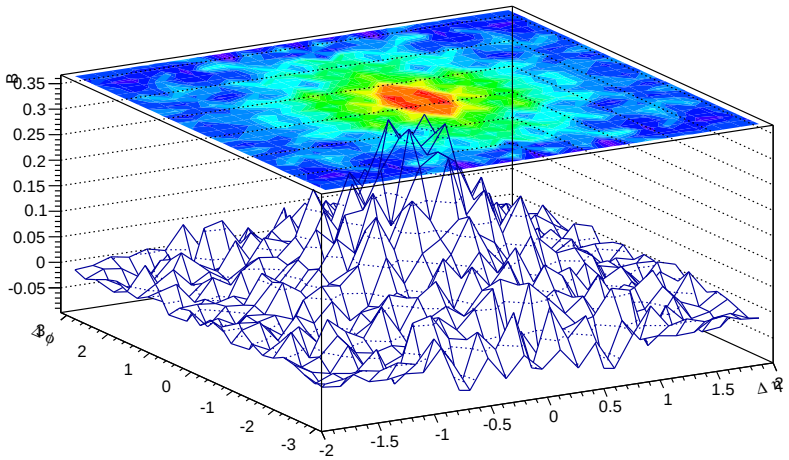




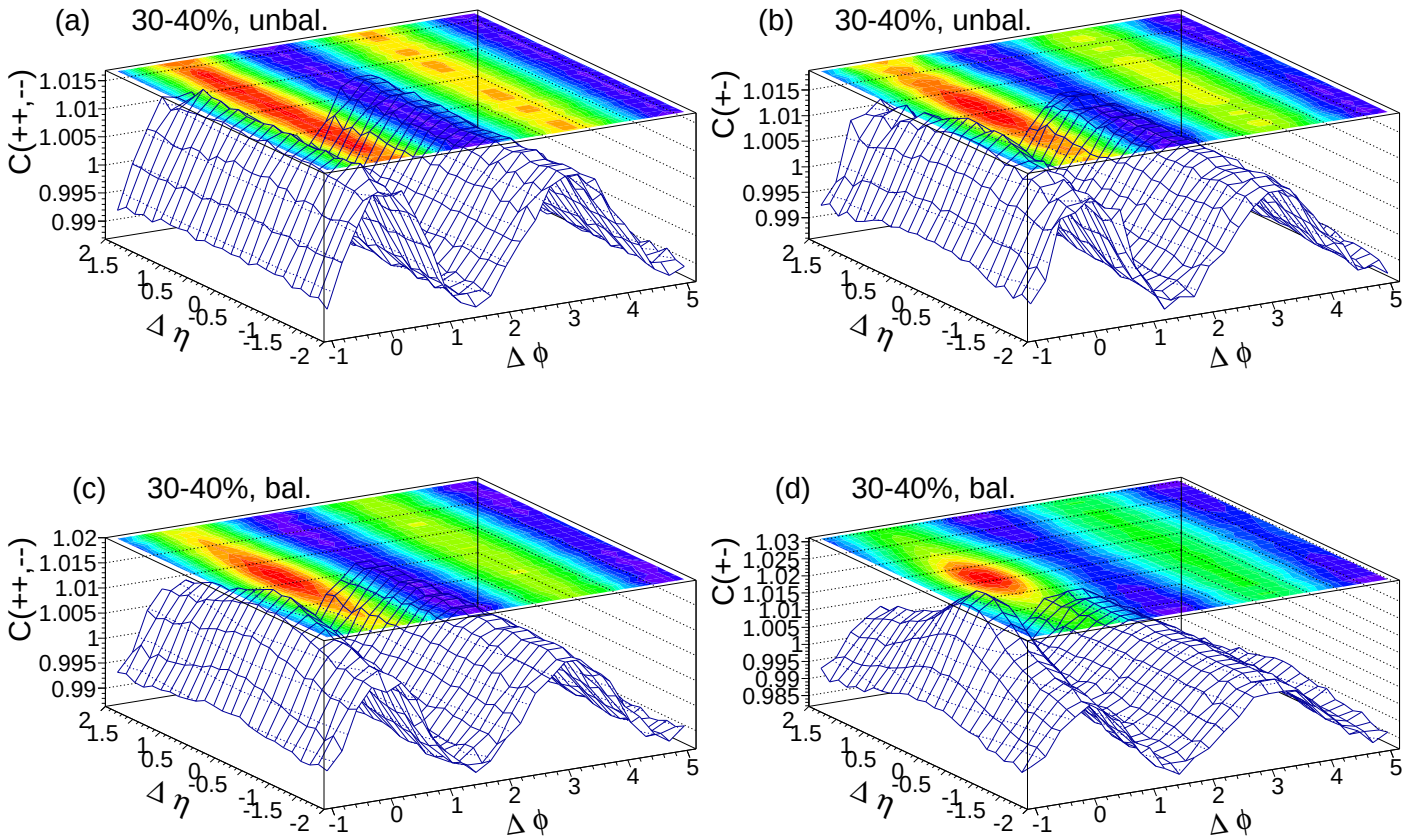
big (direct balancing)

small (resonance decays only)

balancing $\rightarrow$ collimation

important non-flow effect, a way to look at the data

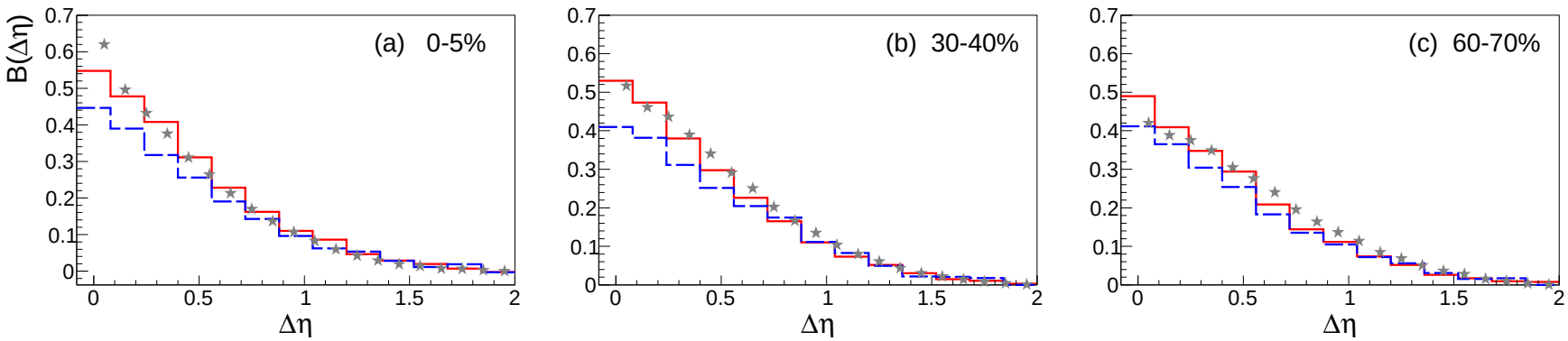
Model Summary



Balance functions in relative rapidity

Jeon & Pratt 2002, ...

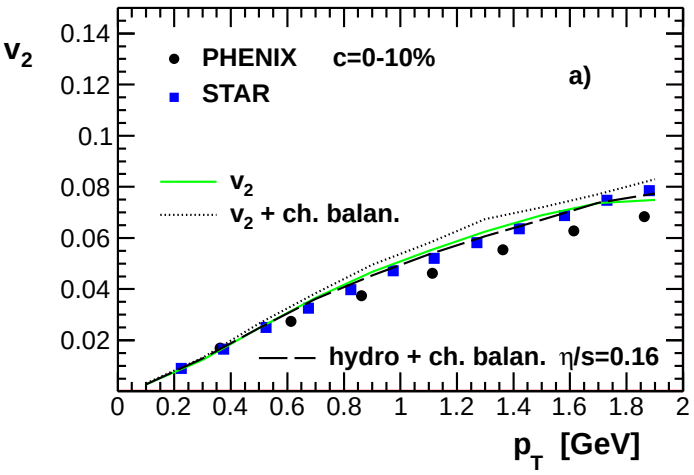
charge balance function in $\Delta\eta$

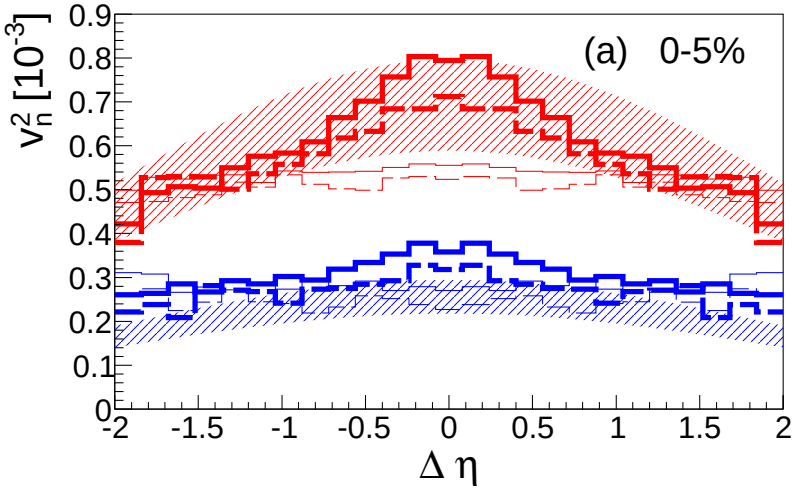


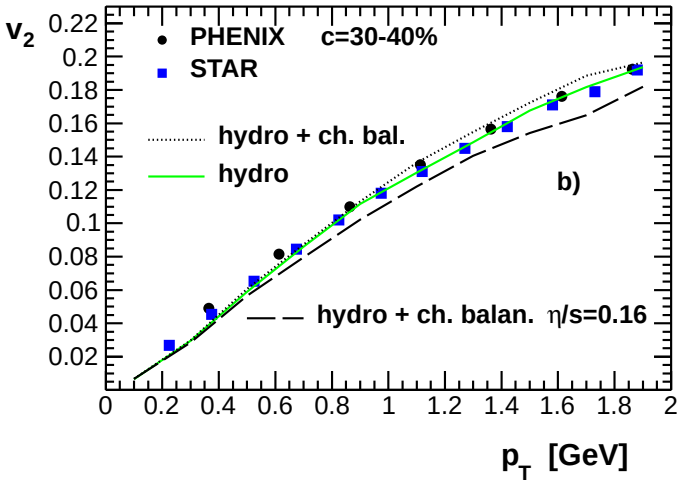
comparison to the STAR data

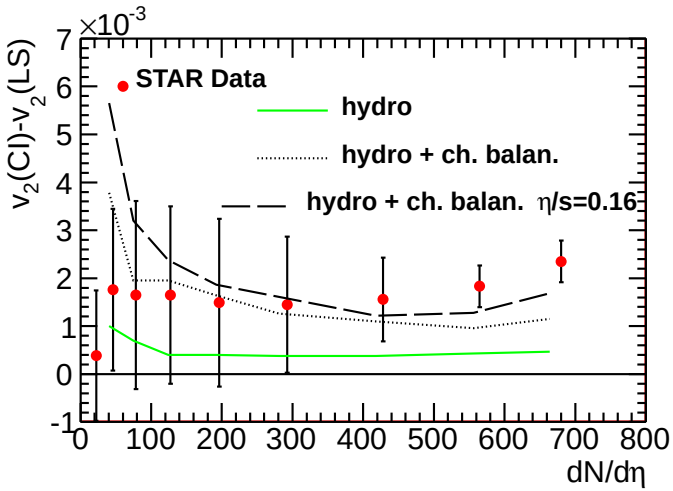
solid: $T_f = 140$ MeV, dashed: $T_f = 150$ MeV

Non-flow effect on v_n





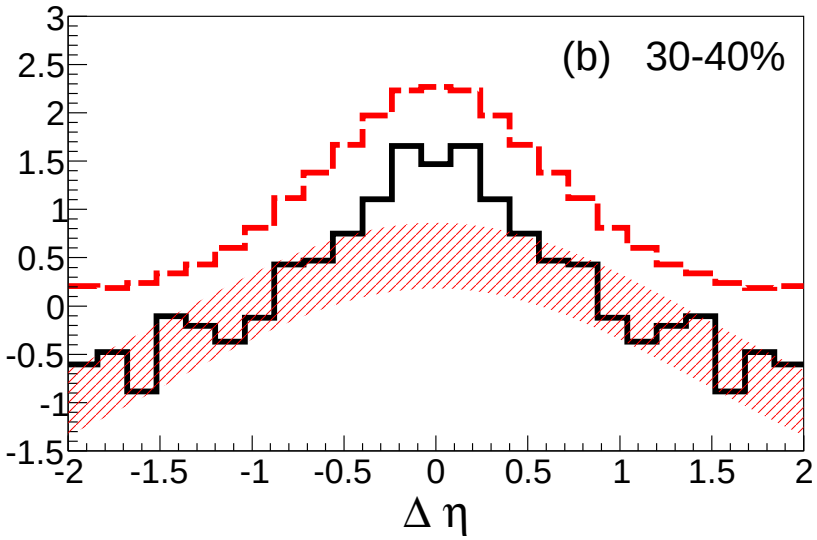


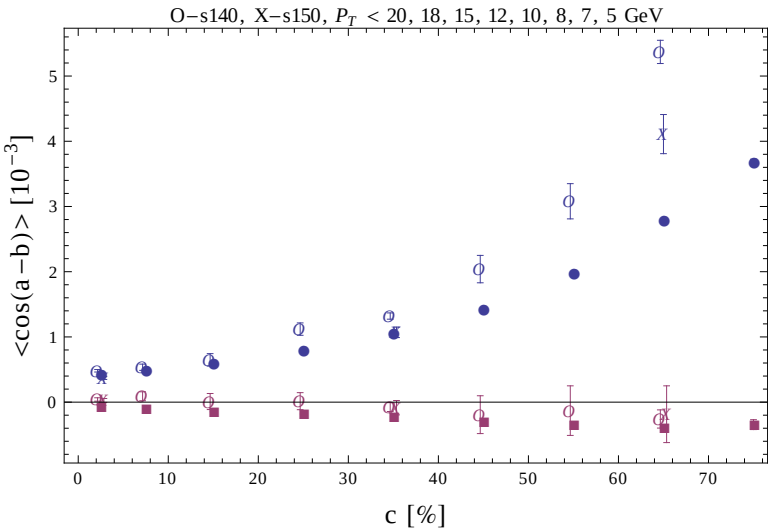


event-by-event

v_1 - parity violation observable

transverse-momentum conservation lowers $v_1^2 \equiv \langle \cos(\phi_1 - \phi_2) \rangle$





comparison to the STAR data

Pratt, Schlichting (2011), Bzdak, Koch, Liao (2011)

Summary

- E-by-e hydro with charge balancing for 2-D correlation function
- **Charge balancing** explains the shape of the same-side ridge - major **non-flow** effect
- Charge balancing increases $v_n^2\{2\}$ by a few % and splits the like-sign and unlike-sign case
- Transverse-momentum conservation important for v_1^2, parity violation obs. semi-quantitative agreement
- **Substract** charge conservation effects to look for early correlations