Unfolding of event-by-event net-charge distributions in heavy-ion collision

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OUTILINE

- **Motivation**
- **Method**
- **Results**
- **Conclusion**

Motivation

-> Higher moments of the event-by-event distribution of conserved quantities are useful observable to characterize the system formed in the collisions.
Phys. Rev. Lett. 105, 022302 (2010)

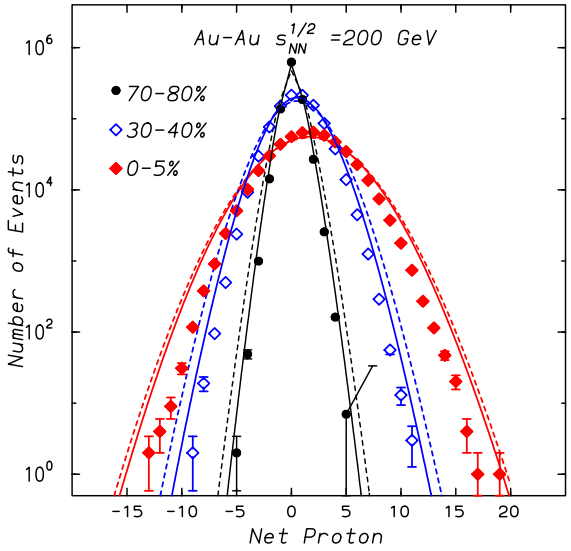
-> Higher moments have been shown to be related to the correlation length and susceptibilities of the system and hence can be used to look for signals of phase transition and critical point.
Phys. Rev. Lett. 107, 052301 (2011)

-> BUT Any experimental measurement is susceptible to the effects such as the finite acceptance, finite efficiency of counting the number of particles produced in the collisions and other background effects.
Phys. Rev. C 79, 034909 (2009)

But…

-> It is difficult to know some of these quantities for each event so as to correct for the effects in an event-by-event distribution.

-> Comparison of uncorrected experimental event-by-event distributions to theoretical calculations needs to be done carefully -> may lead to different conclusion



Net-proton distributions calculated in the HRG and compared with STAR data for Au-Au collisions at √s $_{NN}$ = 200 GeV for different centralities.

Phys. Rev. C 84, 064911 (2011)

-> While trying to remove the detector effects one arrive at constructs which loose the purity of moments or become involved functions of lower order moments.

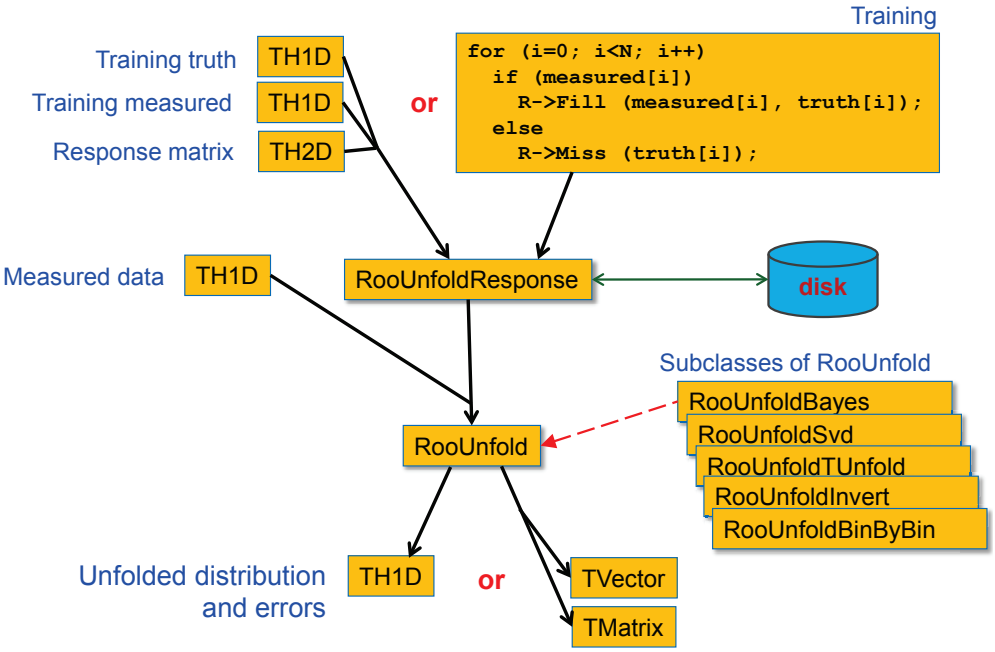
S. Mrowczynski, Phys. Lett. B 465 (1999) 8
S. A. Voloshin, V. Koch and H. G. Ritter, Phys. Rev. C 60, 024901 (1999)
A. Bialas, Phys. Rev. C 75, 024904 (2007)
B. C. Pruneau, S. Gavin and S. Voloshin, Phys. Rev. C 66, 044904 (2002)

Method

TRUE-> Using **HIJING** and **THERMINATOR**

$|\eta| < 0.5$ and $0.2 < p_T\,(GeV/c) < 2.0$

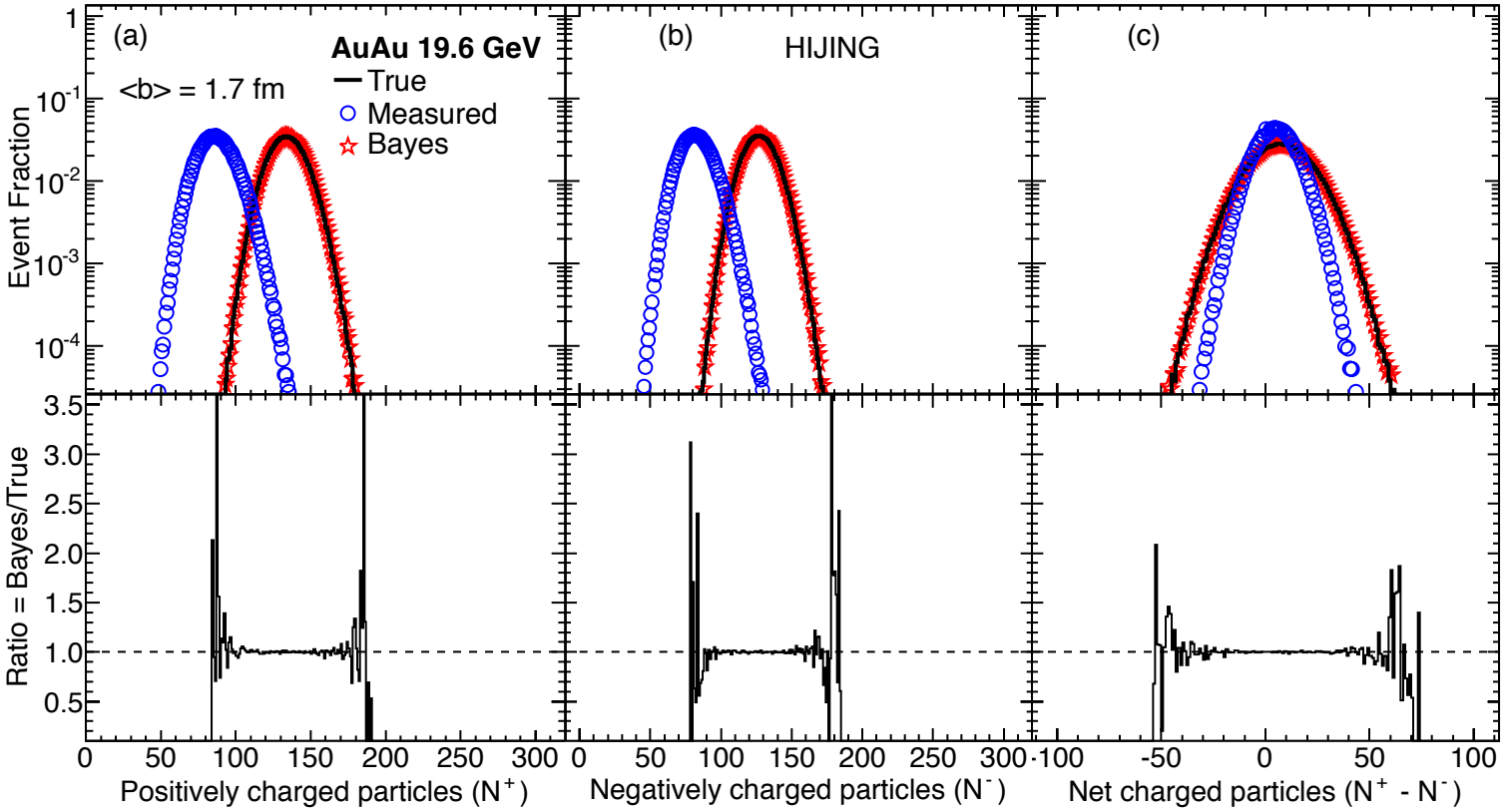
Measured-> smeared with a Gaussian function with the mean value corresponding to the average efficiency of 65% as obtained from the parameterization of the p_T dependent efficiency from STAR experiment



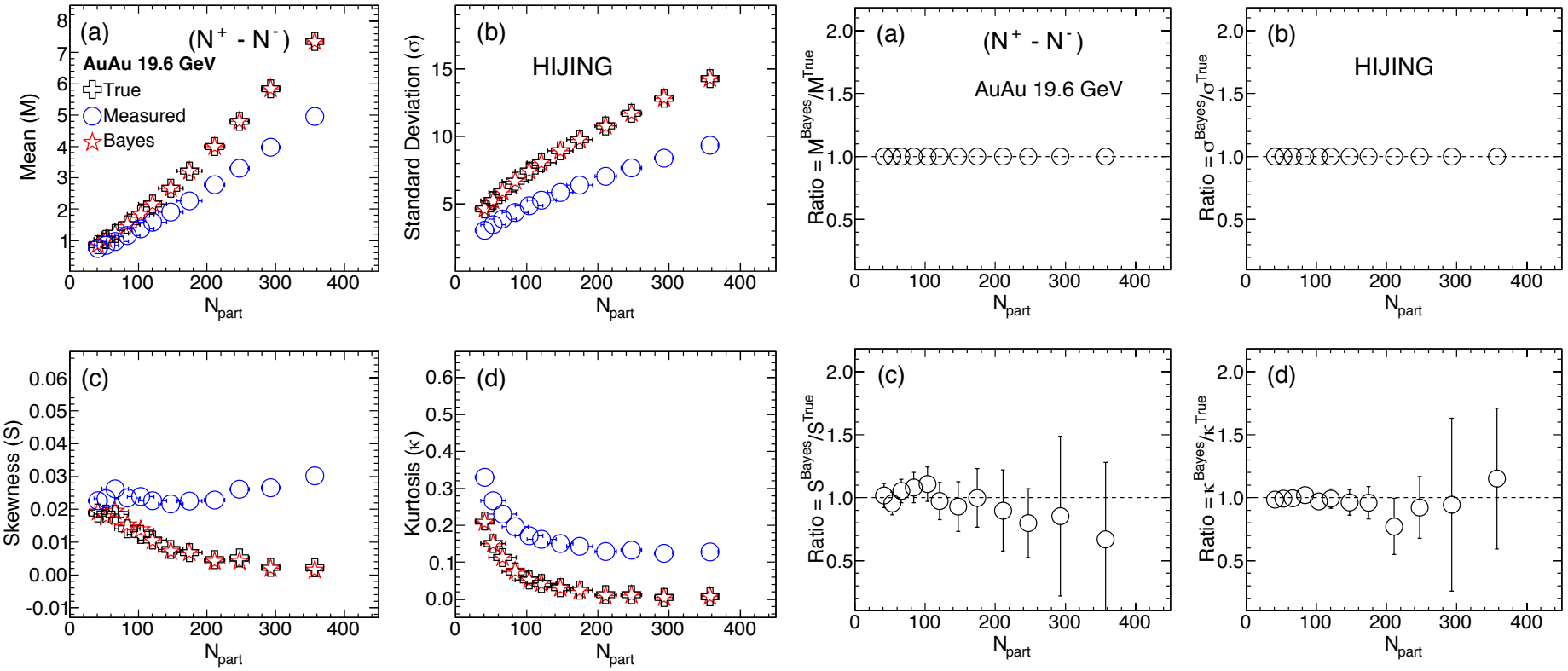
Unfolded the Measured using Bayes Theorem *G. D' Agostini, Nucl. Instrum. Meth. A 362, 487 (1995)*

Results

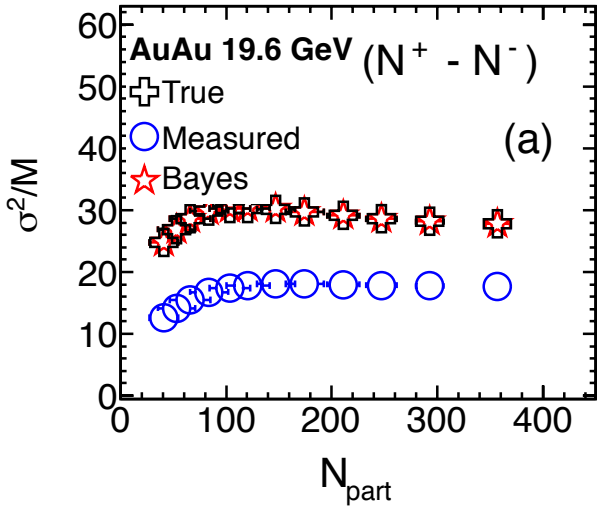
Event-by-event distribution of positive, negative and net-charge

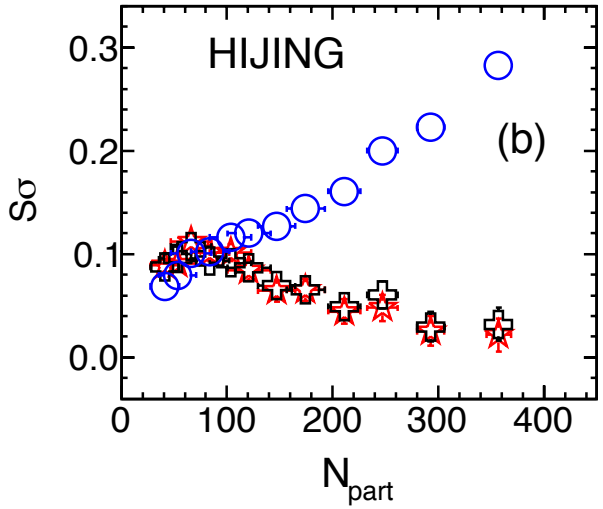


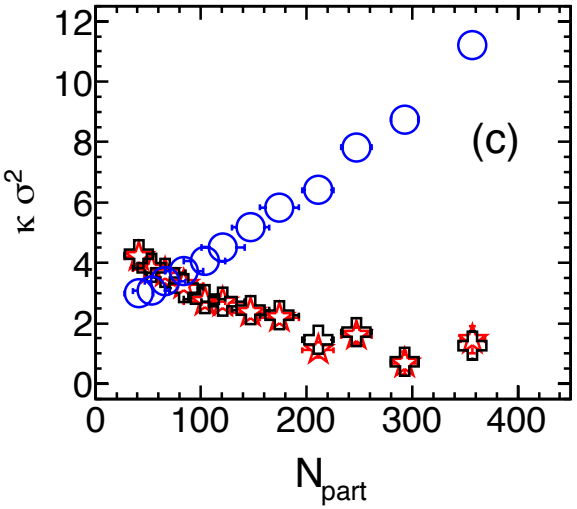
Moments of Net-Charge [HIJING]



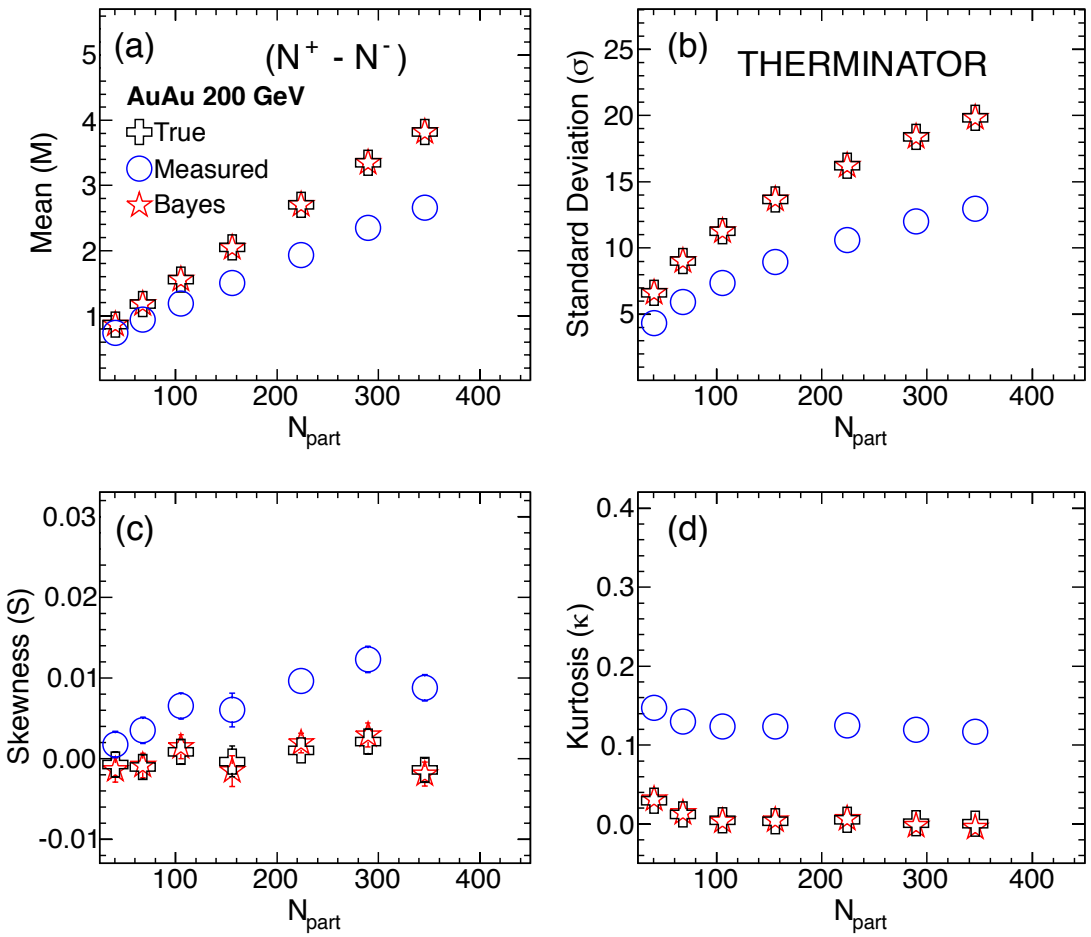
Ratio and product of moments



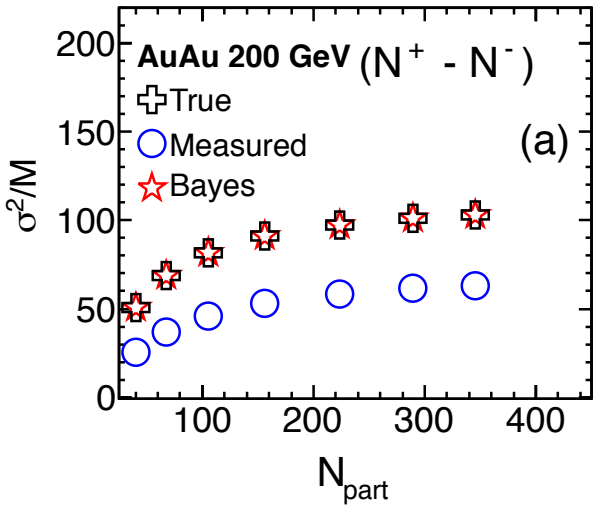


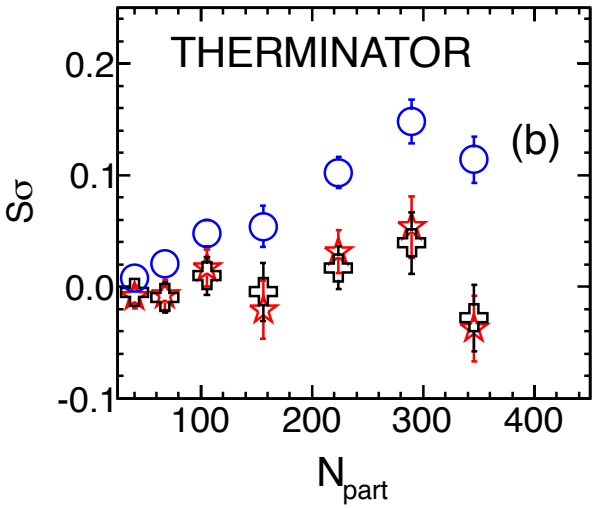


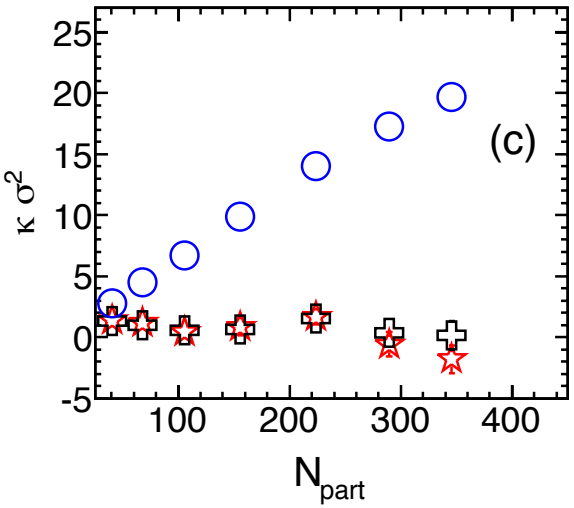
Moments of Net-Charge [THERMINATOR]



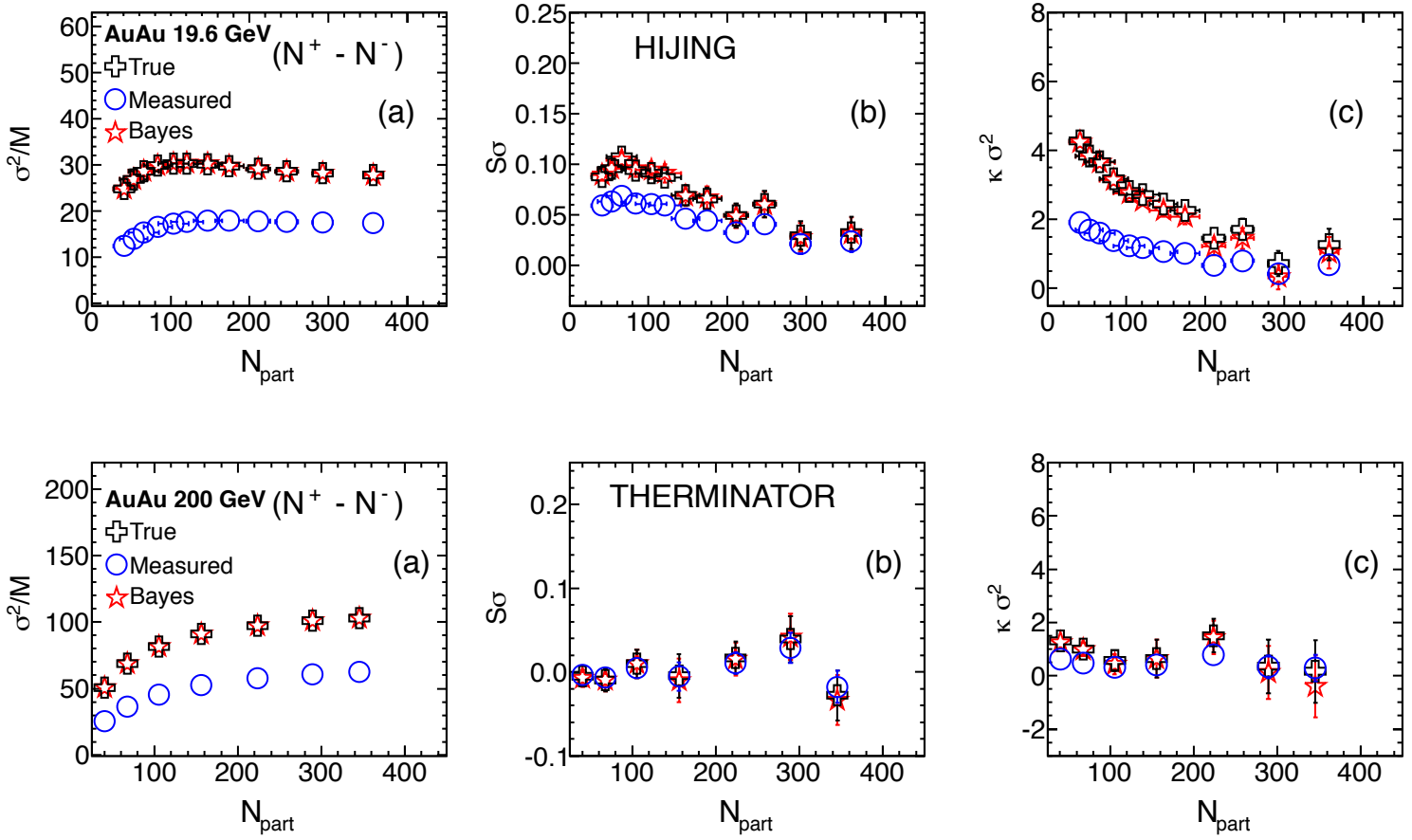
Ratio and product of moments



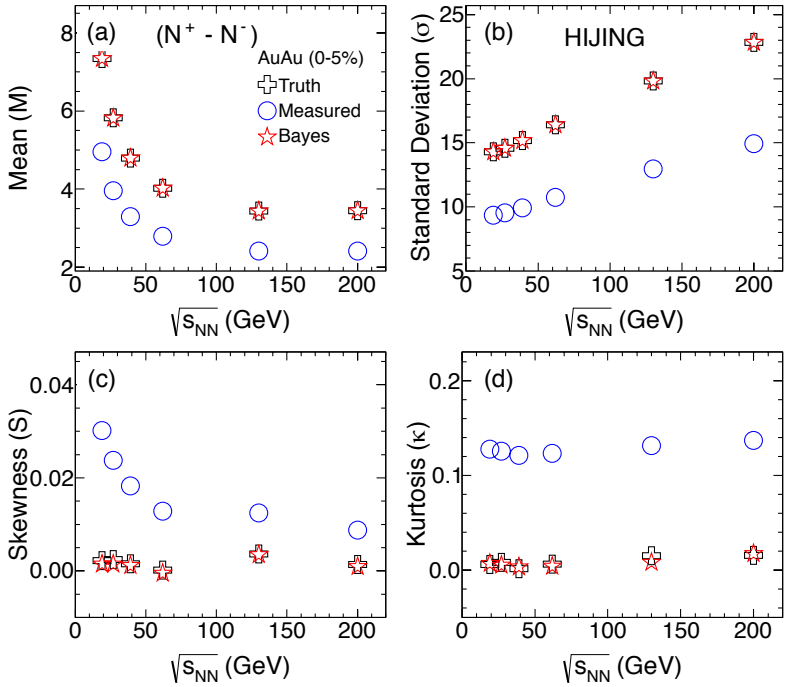


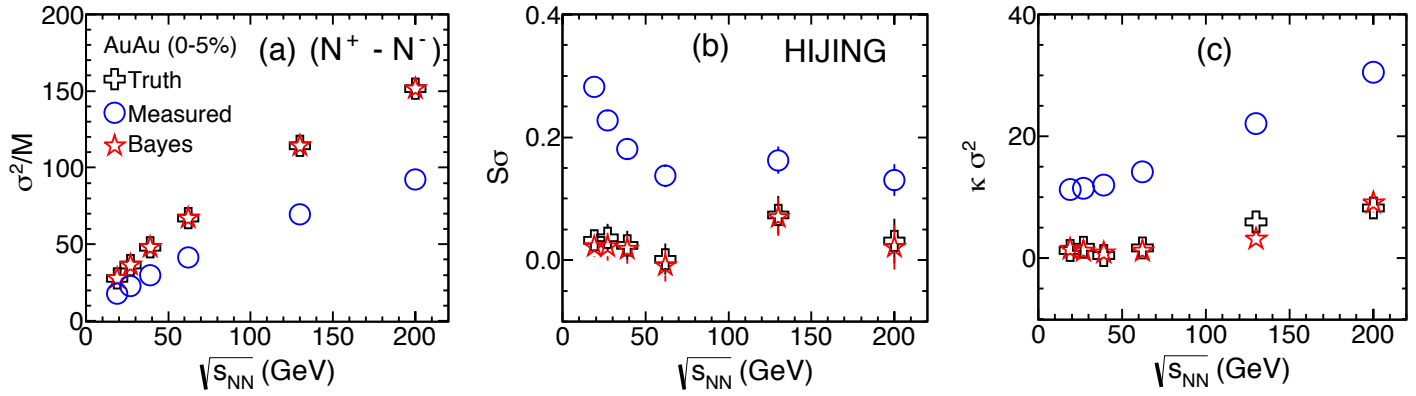


Effect of Constant Efficiency



Moments as a function of $\sqrt{s_{NN}}$





Conclusion

- It is necessary to account for detector effects before associating the higher moments of net-charge distributions with physical quantities or phenomena.

- We demonstrated a method to obtain the event-by-event true distributions of net-charge

- cases where the efficiency of charged particle counting is constant for all events, the differences between the measured and true are small for the product $S\sigma$ and $\kappa\sigma^2$ compared to the ratio σ^2/M.

- There are limitations, in terms of need for a proper modeling of the detector response and works well for high multiplicity and high event statistics dataset.