Elliptic flow of ϕ mesons in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6 GeV in RHIC BES-II

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Abstract

Elliptic flow (v_2) is the second order flow coefficient in the Fourier series expansion of azimuthal distribution of particles in momentum space produced in heavy-ion collisions. v_2 is a sensitive observable to the initial state and transport properties of the medium created in the collision. In this poster, we present the v_2 (p_T) measurements of ϕ in Au+Au minimum bias collisions at $\sqrt{s_{NN}}$ = 14.6 GeV with high statistics Beam Energy Scan phase-II (BES-II) data at mid-rapidity (|y| < 1.0). The result for ϕ mesons is compared with BES-I results and the number of constituent quarks (NCQ) scaling is studied using other particles from BES-I.

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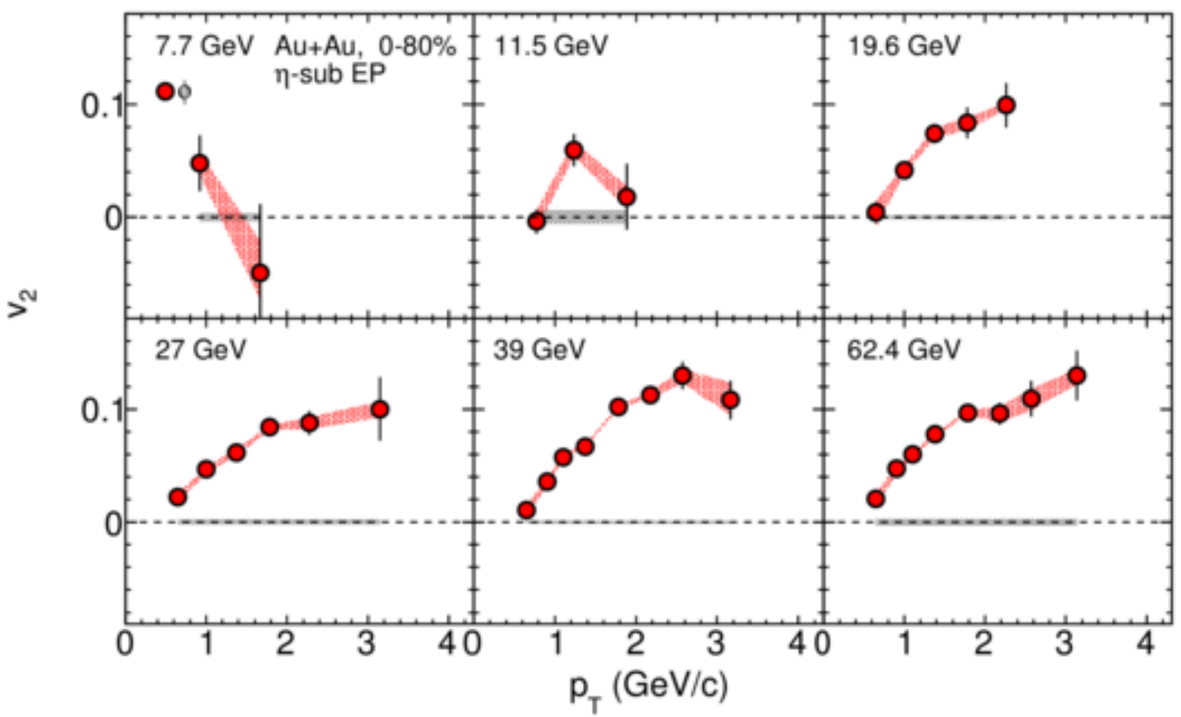
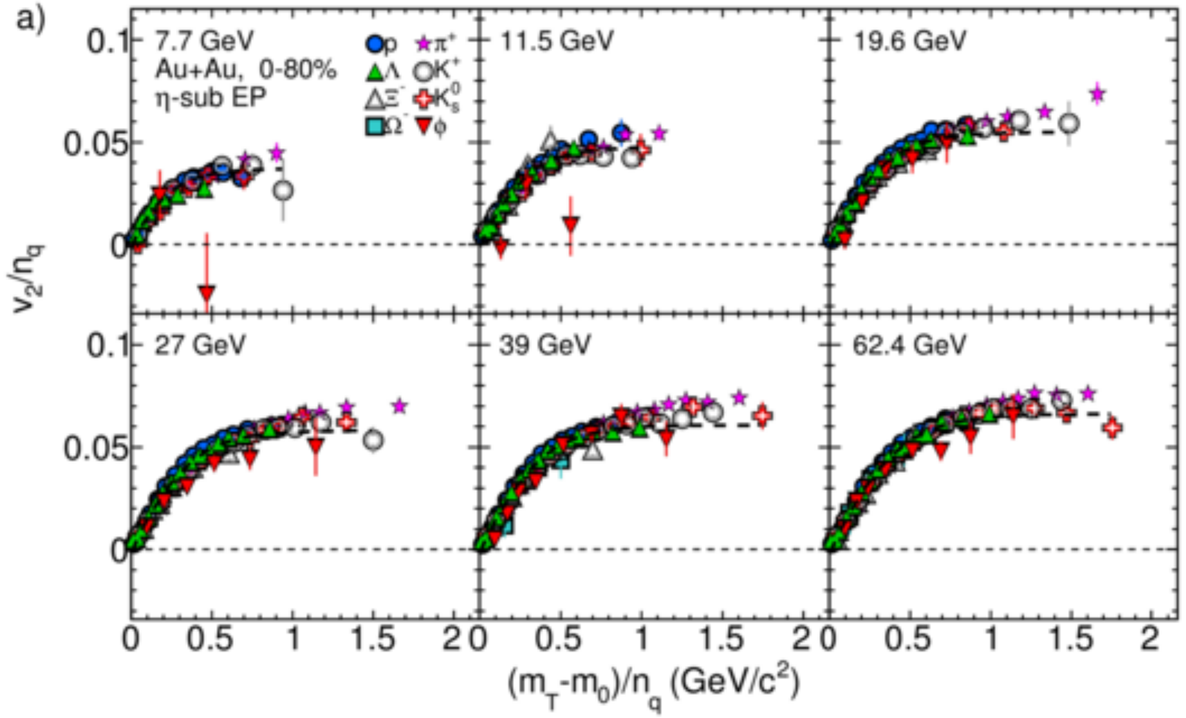
The STAR Collaboration
https://drupal.star.bnl.gov/STAR/presentations

Motivation

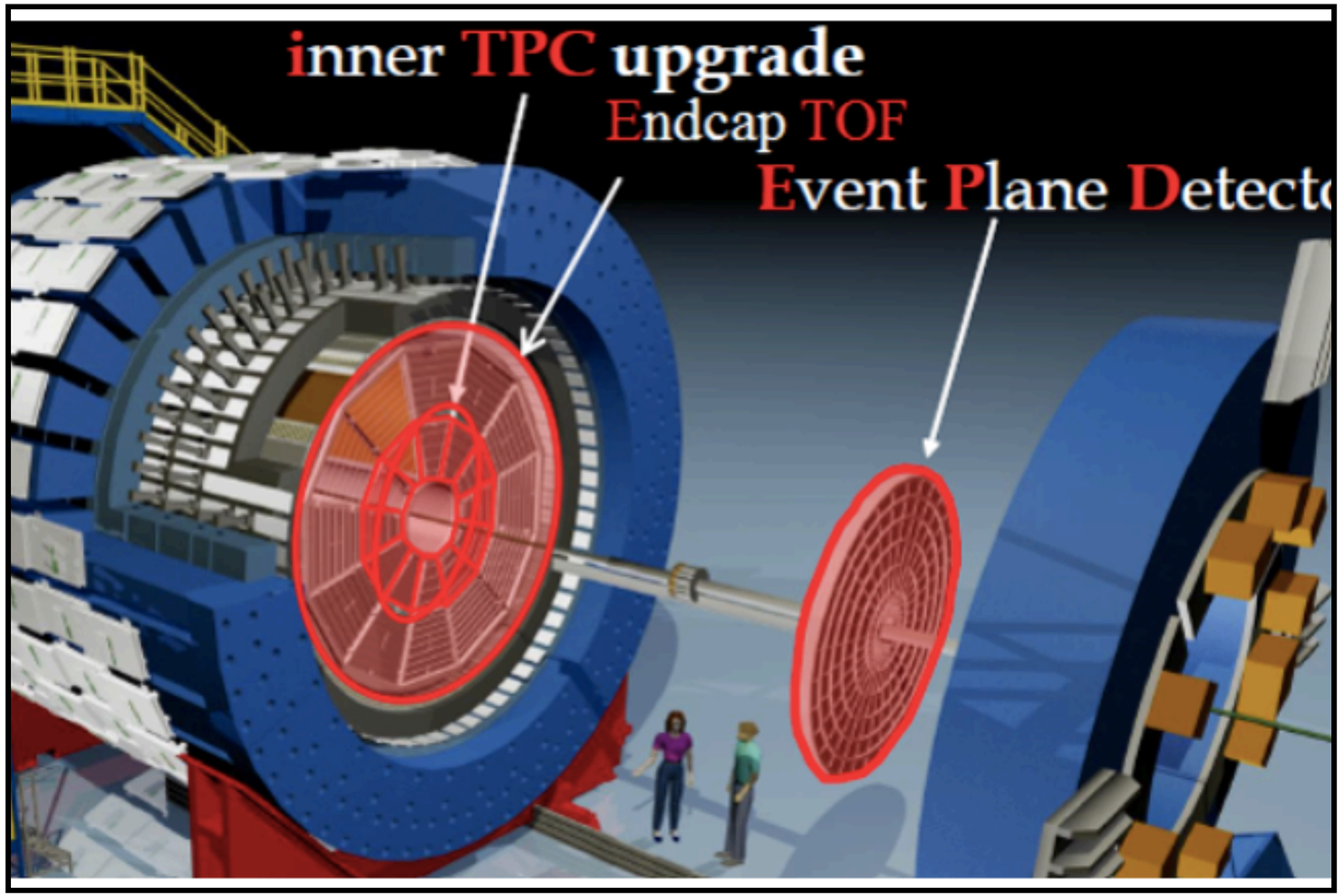
STAR, Phys. Rev. C 88 (2013) 14902





- The v_2 of ϕ mesons show different trend below $\sqrt{s_{NN}} < 19.6$ GeV.
- The number of constituent quark (NCQ) scaling fails to hold for ϕ mesons at $\sqrt{s_{NN}} < 19.6$ GeV.
- The number of events at lower energies is not sufficient to make firm conclusion. A high statistics measurements in BES-II with improved detector conditions and wider pseudorapidity coverage can shed light on the lower energy regimes.

Data sets and STAR detector



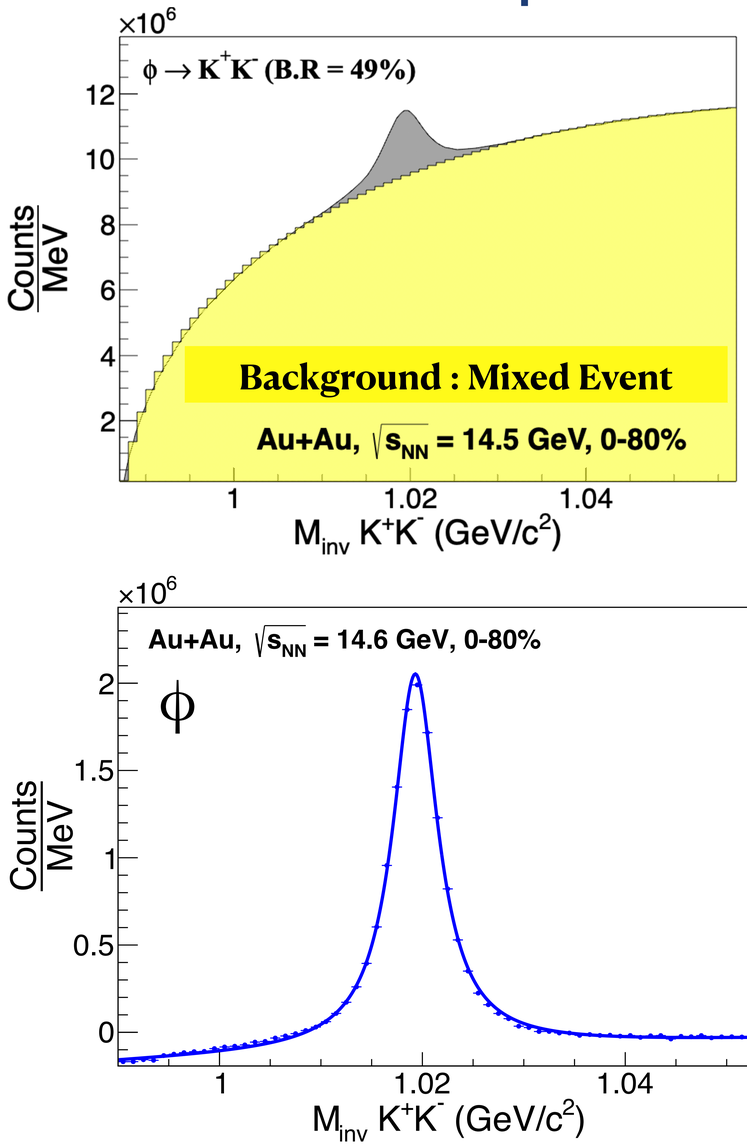
Data set information for this analysis:

- System: Au+Au
- Collision energy: 14.6 GeV
- Number of events: ~180 M (~10 times higher than BES-I 14.5 GeV data)

- Uniform acceptance
- Full azimuthal coverage
- Upgraded TPC has large pseudorapidity coverage ($|\eta|<1.5$) compared to BES-I measurements.
- Excellent particle identification capability

Analysis details

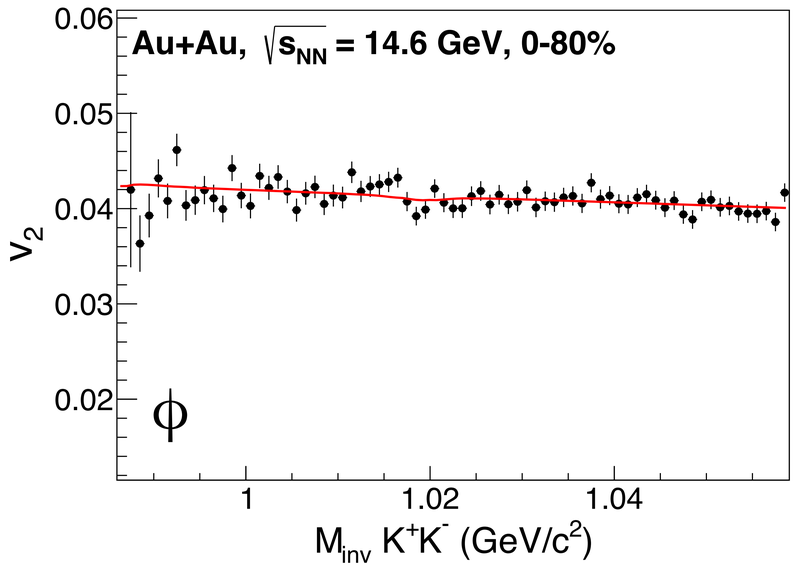
Reconstruction of ϕ mesons



v_2 measurement methods for ϕ mesons

Invariant mass method

N. Borghini and J.-Y. Ollitrault, Phys. Rev. C 70, 064905 (2004)

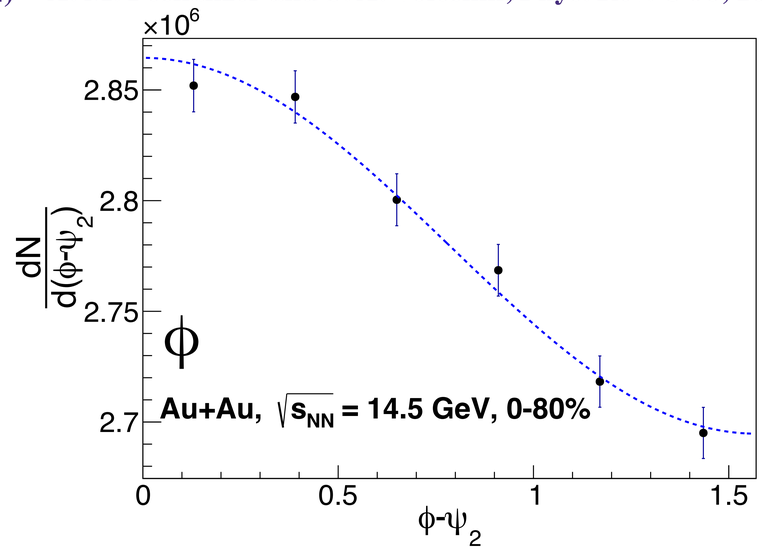


$$v_n^{S+B}(M_{inv}) = v_n^S \frac{S}{S+B}(M_{inv}) + v_n^B \frac{B}{S+B}(M_{inv})$$

Where, $v_n^B(M_{inv}) = p_0 + p_1 M_{inv}$

Event plane method

A. M. Poskanzer and S. A. Voloshin, Phys. Rev. C 58, 1671 (1998)



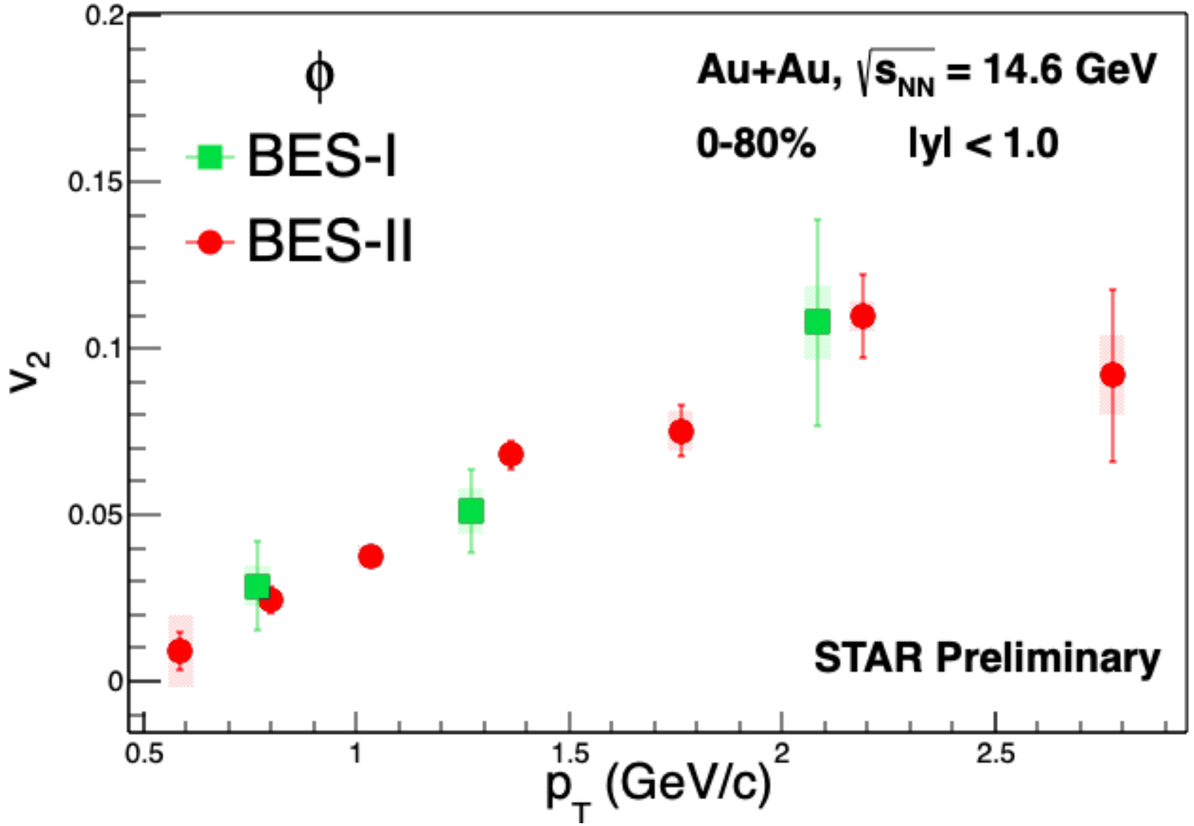
$$\frac{dN}{d(\phi-\psi_2)} = \frac{N_0}{2\pi}\left(1 + v_2 \cos 2(\phi-\psi_2)\right)$$

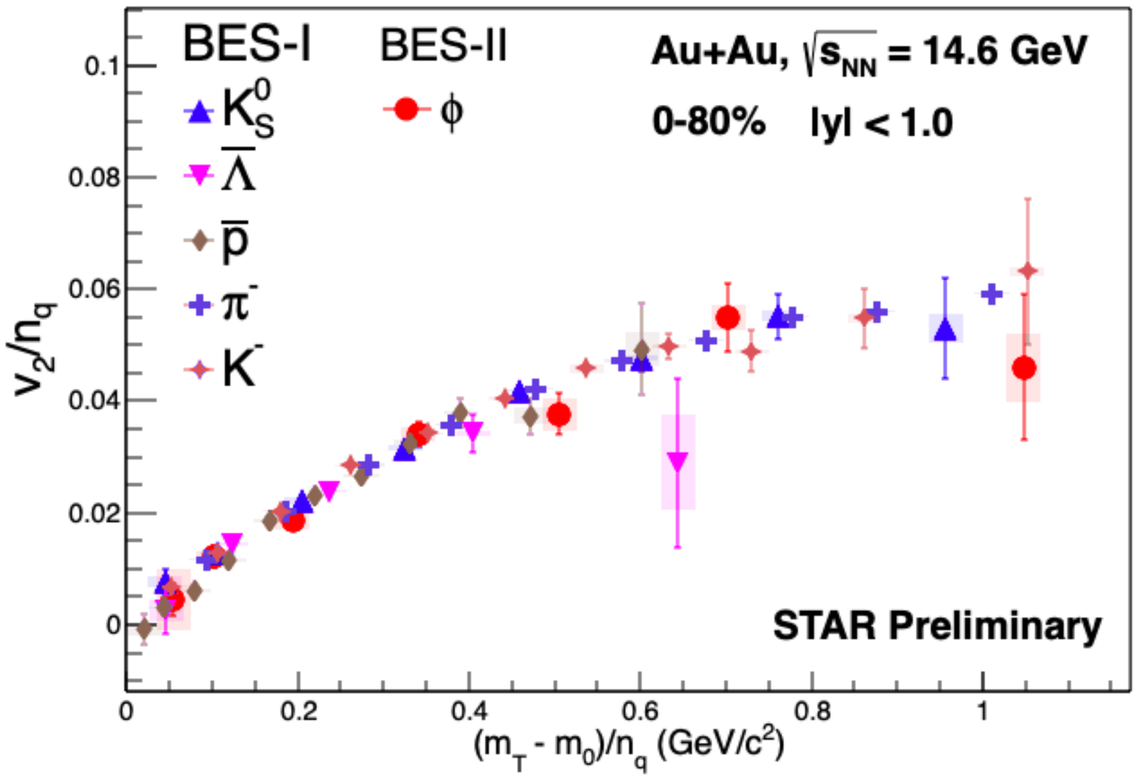
In order to remove auto-correlation two sub-event planes, ψ_A and ψ_B, in opposite pseudorapidity hemispheres with η gap 0.1 are used to calculate v_2.

Due to finite resolution of the event plane the observed v_2 must be corrected with the resolution factor given by: $R_{sub} = \sqrt{\cos 2(\psi_A - \psi_B)}$

The resolution corrected v_2 is given by: $v_2 = v_2^{obs} \langle \frac{1}{R_{sub}} \rangle$

Results and summary





Reference for 14.5 BES-I v_2 : **STAR, Phys. Rev. C 93 (2016) 14907**

- The BES-II result is more precise and has a higher p_T reach compared to BES-I.
- NCQ scaling holds for all the particles which supports the idea of quark recombination model of hadronization.

Dénes Molnár and Sergei A. Voloshin, Phys. Rev. Lett. 91, 092301 (2003).