Analysis Note of Centrality and Energy Dependence of Identified Particle v_2

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1 Abstract

Elliptic flow (v_2) values for identified particles at midrapidity in Au + Au collisions measured by the STAR experiment in the Beam Energy Scan at the BNL Relativistic Heavy Ion Collider at $\sqrt{s_{NN}}$= 7.7–62.4 GeV, are presented for three centrality classes. The centrality dependence and the data at $\sqrt{s_{NN}}$= 14.5 GeV are new. Except at the lowest beam energies we observe a similar relative v_2 baryon-meson splitting for all centrality classes which is in agreement within 15% with the number-of-constituent quark scaling. The larger v_2 for most particles relative to antiparticles, already observed for minimum bias collisions, shows a clear centrality dependence, with the largest difference for the most central collisions. Also, the results are fit with a Blast Wave model and compared with AMPT calculations.

2 Links

- **Latest Draft:**
  http://www.star.bnl.gov/protected/bulkcorr/posk/BES/PRC_centrality.pdf
- **Bulkcorr Presentation:**
  http://www.star.bnl.gov/protected/bulkcorr/posk/BES/BES_v2_cent_Bulkcorr.pdf
- **Previous Papers:**
  Observation of an Energy-Dependent Difference in Elliptic Flow between Particles and Antiparticles in Relativistic Heavy Ion Collisions
  http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.110.142301

  Elliptic flow of identified hadrons in Au+Au collisions at $\sqrt{s_{NN}}$=7.7 to 62.4 GeV
  http://journals.aps.org/prc/abstract/10.1103/PhysRevC.88.014902

  Blast wave fits to elliptic flow data at $\sqrt{s_{NN}}$=7.7 to 2760 GeV
  http://journals.aps.org/prc/abstract/10.1103/PhysRevC.91.024903

  Elliptic and Triangular Flow of Identified Particles from the AMPT Model at RHIC Energies
  http://arxiv.org/abs/1506.03158

- **Previous Presentations:**
  http://www.star.bnl.gov/protected/heavy/aschmah/Presentations/BulkCorr_Proton_Cent_091912.pdf
  http://www.star.bnl.gov/protected/heavy/aschmah/Presentations/aschmah_BES_v2_LBNL_Oct_2013_V2.pd
  http://www.star.bnl.gov/protected/heavy/aschmah/Presentations/aschmah_Purdue_July_2013_V2.pdf

The analysis method and codes have all been published except for slight changes for the 14.5 GV data.

3 14.5 GeV

The 14.5 GeV data are new. The centrality definitions were done by Daniel Brandenburg:
`http://www.star.bnl.gov/protected/lfspectra/jdb/run14/AuAu15/RefMultCorr/Run14AuAu15_Centrality_Systematics_BULK_May_20_15.pdf`

The particle identification for the other energies was done with 2D Gaussians. At this energy 2D student's-t distributions were used. We tink this makes no difference for the PID results. Figure 1 shows the 2D distribution and Fig. 2 shows it with the pions cut out. Fig. 3 is the resultant 1D distribution. Fig. 4 shows results for comparison of the new PID method with the old.

Figure 5 shows the invariant mass peak for phi mesons, and Fig. 6 shows it with the mixed event background subtracted.

A presentation is at:
`https://drupal.star.bnl.gov/STAR/system/files/14.5_elliptic_flow_collaboration_meeting.pdf`

4 Blast Wave

More Blast Wave figures can be seen at
http://www.star.bnl.gov/protected/bulkcorr/posk/BES/figsBW.pdf

5 Computer codes

At the moment the location of the computer codes is shown at http://www.star.bnl.gov/protected/bulkcorr/posk/BES/code.txt . They will be moved to CVS soon.

6 Conclusions

- Measured 10 identified particles, for 7 beam energies, at 3 centralities
- The much larger transverse radial flow of antiparticles causes the published particle-antiparticle v_2 difference
- The radial flow is larger for central collisions
- AMPT requires string melting with a few mb cross section

7 Figures

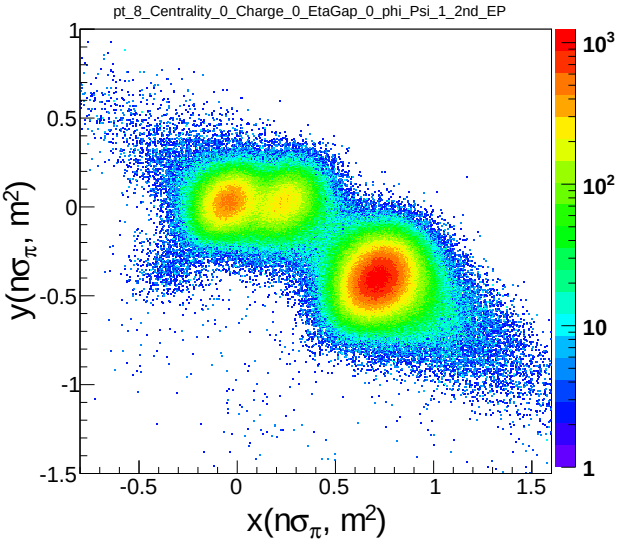

Figure 1: A 2D plot of the pi, K, p separation. The x, y(n, m^2) distributions for 1.8 $<p_T<$ 2.0 GeV/c from 0-80% cental Au+Au collisions at 14.5 GeV.

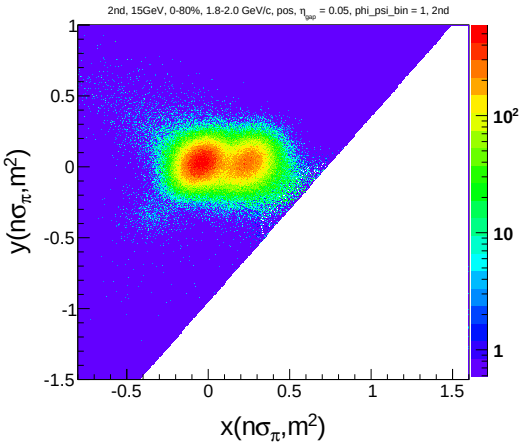

Figure 2: A 2D plot of the pi, K separation. The x, y(n, m^2) distributions for 1.8 $<p_T<$ 2.0 GeV/c from 0-80% cental Au+Au collisions at 14.5 GeV after cutting away the protons.

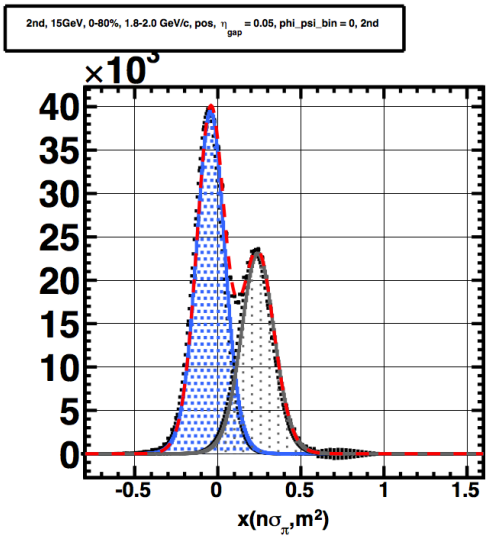

Figure 3: A 1D plot of the pi, K separation. The projected distribution to the x(n, m^2) axis for 1.8 $<p_T<$ 2.0 GeV/c from 0-80% cental Au+Au collisions at 14.5 GeV after cutting away the protons.

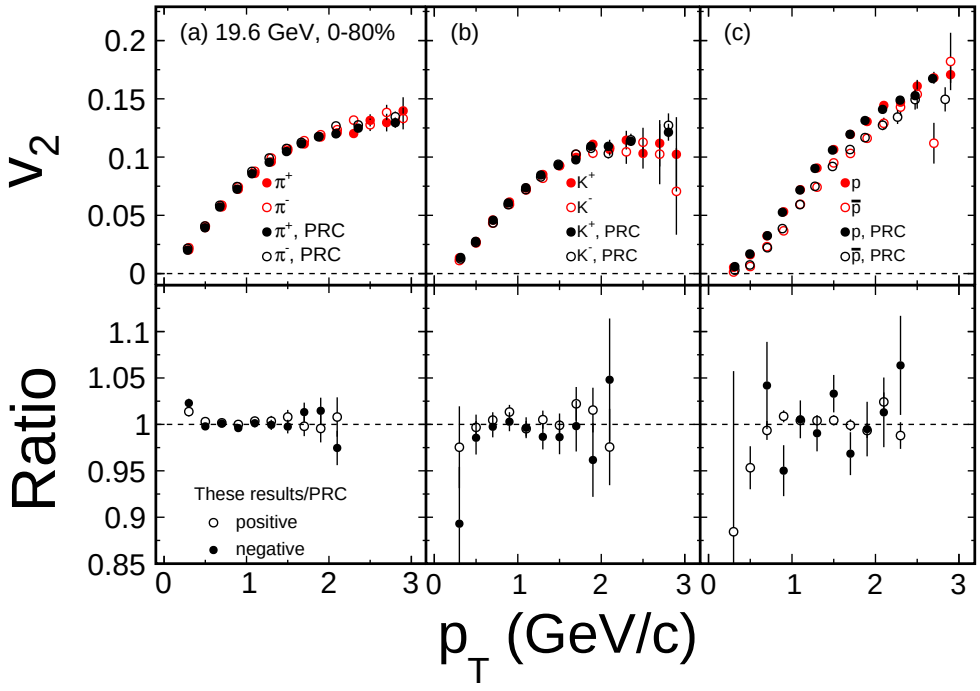

Figure 4: Comparison of the present method for 19.6 GeV with the published 19.6 GeV data.

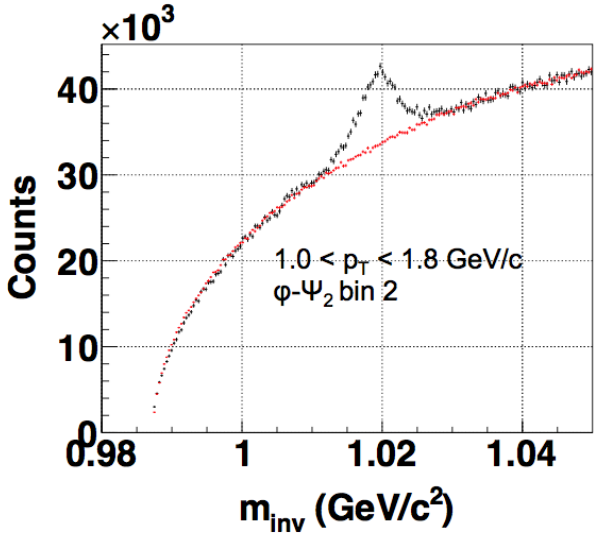

Figure 5: The invariant mass distribution of the phi meson.

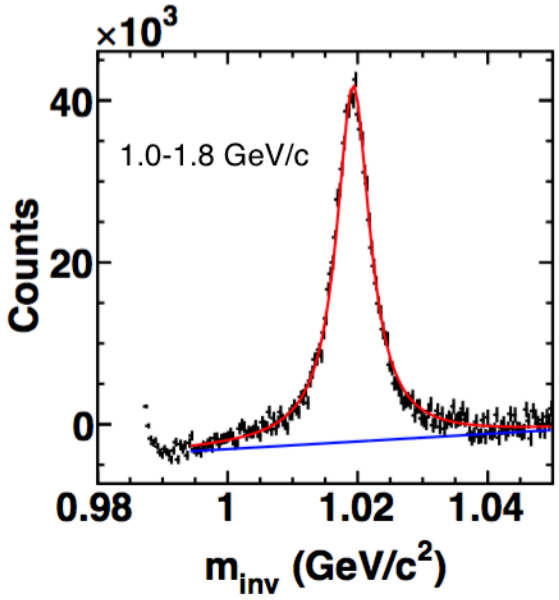

Figure 6: After subtraction of mixed events.