Mid-rapidity ϕ production from Au+Au collisions at $\sqrt{s_{\rm NN}} = 130$ GeV

E. Yamamoto for the STAR Collaboration

Introduction: This is the first measurement of mid-rapidity ϕ meson production in Au+Au collisions at RHIC ($\sqrt{s_{NN}} = 130$ GeV) from the STAR detector. For the 11% most central collisions, the slope parameter from an exponential fit to the transverse mass distribution is $T = 379 \pm 50(\text{stat}) \pm 45(\text{syst})$ MeV, the yield $dN/dy = 5.73 \pm 0.37(\text{stat}) \pm 0.69(\text{syst})$ per event. The measured T for the ϕ meson at mid-rapidity do not change for the selected centrality bins.

The central topic of relativistic heavy ion physics is the study of quantum chromodynamics (QCD) in extreme conditions of high temperature and high energy density over large volumes [1]. Vector mesons may probe the dynamics of particles and chiral symmetry [2] in relativistic heavy ion collisions: their production mechanisms and subsequent dynamical evolution have been a topic of experimental investigation [3 4 5 6]. The ϕ meson is of particular interest due to its $s\bar{s}$ valence quark content, which may make the ϕ sensitive to strangeness production from a possible early partonic phase [7 8 9 10].

Results: The ϕ was reconstructed combinatorically [11] using the K^+K^- decay channel. The corrected ϕ invariant yields for three centrality bins are shown in Figure 1. All results presented here are for reconstructed ϕ mesons within one unit of rapidity centered around $y = 0$ ($|y| < 0.5$) and $0.46 < p_t < 1.74$ GeV/c. The spectra were fit to an exponential

$$\frac{1}{2\pi m_t}\frac{d^2N}{dm_t dy} = \frac{dN/dy}{2\pi T(m_\phi + T)} e^{-(m_t - m_\phi)/T} \qquad (1)$$

with the slope parameter T and yield dN/dy set as free parameters. The results from the fit are listed in Table 1.

Conclusions: The shape of the spectral distribution is independent of centrality, while the yield increases proportionally with the number of particles produced in the collisions. The lack of any centrality dependence needs to be investigated further: other particles of similar mass such as the antiproton show a correlation of the spectral shape with centrality, which is attributed to radial flow. More data is necessary to confirm this interpretation.

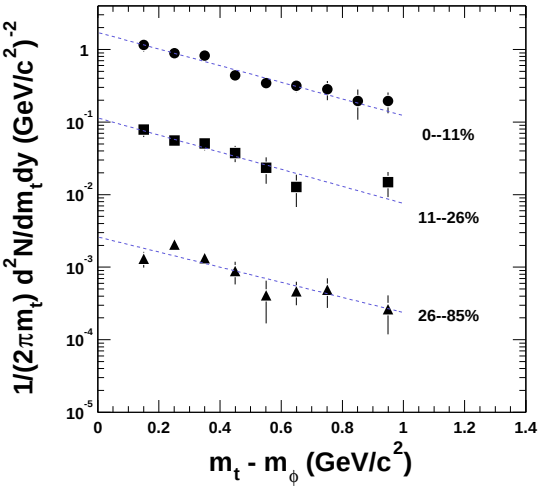

Figure 1: Transverse mass distributions of ϕ from Au+Au collision at $\sqrt{s_{NN}} = 130$ GeV for three centrality bins. Dashed lines are exponential fits to the data. For clarity, data points from the 11–26% and 26–85% centrality bins are scaled by 0.1 and 0.01, respectively. Error bars shown are statistical only.

Centrality	0–11%	11–26%	26–85%
T(MeV)	379±50	369±73	417±75
dN/dy	5.73±0.37	3.33±0.38	0.98±0.12

Table 1: Mid-rapidity ϕ slope parameters T and extrapolated yield dN/dy for three centrality bins. Errors shown are statistical only.

Future Directions: There is a factor of 10 more data from the year 2001–2002 RHIC Au+Au run at $\sqrt{s_{\rm NN}} = 200$ GeV. There is also a large set of $p+p$ data at 200 GeV, which will be used as a baseline for comparison to the Au+Au data. With this data, we will look closer at the centrality dependence of the ϕ meson. A measurement of the anisotropic flow parameter, v_2, for the ϕ is a new goal for the 200 GeV data. A systematic comparison of v_2 from the ϕ and other particles may give us insight into the early time evolution of the collision system.

Footnotes and References

[1] F. Wilczek, Physics Today, **53**, Aug. 2000, pg. 22.
[2] T. Hatsuda and T. Kunihiro, Phys. Rep. **247**, 221 (1994).
[3] S.V. Afanasiev *et al.*, NA49 Collaboration, Phys. Lett. **B491**, 59 (2000).
[4] N. Willis *et al.*, NA50 Collaboration, Nucl. Phys. **A661**, 534c (1999).
[5] Y. Akiba *et al.*, E802 Collaboration, Phys. Rev. Lett. **76**, 2021 (1996).
[6] R.K. Seto and H. Xiang, E917 Collaboration, Nucl. Phys. **A661**, 506c (1999).
[7] J. Rafelski and B. Müller, Phys. Rev. Lett. **48**, 1066 (1982).
[8] A. Shor, Phys. Rev. Lett. **54**, 1122 (1985).
[9] P. Koch, B. Müller and J. Rafelski, Phys. Rep. **142**, 167 (1986).
[10] S.A. Bass *et al.*, Nucl. Phys. **A661**, 205 (1999).
[11] E. Yamamoto, Ph.D. thesis, University of California - Los Angeles, 2001.)