ϕ meson measurements via e^+e^- decays in *d* + Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR

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Motivation

Why ϕ?

ϕ is a vector meson with hidden strangeness ($s\bar{s}$), with mass close to baryon (p, Λ). The interaction cross sections between ϕ meson and other non-strange hadrons are relatively small, thus makes it a good probe of the early stage of the system. As a light vector meson, the mass of ϕ is thought to be generated due to the spontaneous breaking of chiral symmetry. Therefore, ϕ meson production is considered to be sensitive to possible in-medium modifications, such as mass shift or broadening of spectral function, due to the onset of chiral symmetry restoration in heavy ion collisions at RHIC.

Why $\phi \rightarrow e^+e^-$?

Electron is a good probe, which does not interact strongly in the medium. The shape and width of ϕ invariant mass peak from e^+e^- decay would be different from K^+K^- decay. As the mass of ϕ meson is close to twice of kaon mass, small change of ϕ mass will cause relatively large variation of the branching ratio of ϕ decays into K^+K^-. It would be interesting to compare the ratio between the yield of $\phi(e^+e^-)$ and that of $\phi(K^+K^-)$ in different collision systems.

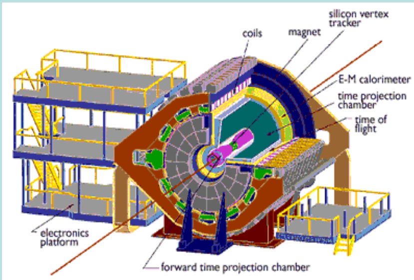
Why *d* + Au?

As an asymmetric collision system, *d* + Au collision will provide information of cold nuclear matter effect on ϕ meson production. This is useful for distinguishing the medium effect in heavy ion collision system.

STAR detector

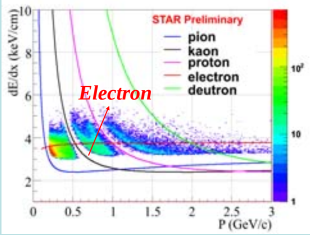
The Solenoidal Tracker at RHIC (STAR) is a detector which specializes in tracking the thousands of particles produced by each ion collision at RHIC. Weighing 1,200 tons and as large as a house (note ladder in image at left), STAR is a massive detector. It is used to search for signatures of the form of matter that RHIC was designed to create: the quark-gluon plasma. It is also used to investigate the behavior of matter at high energy densities.

STAR's "heart" is the Time Projection Chamber (TPC), made of many precise electronic systems, which tracks and identifies particles emerging from ion collisions. This cylindrical detector surrounds the beam pipe with full azimuthal coverage and pseudorapidity coverage over the range $-1.8 < \eta < 1.8$. The TPC provides a measurement of the momentum and energy loss of a detected particle within its acceptance. This allows for the identification of various particles created in the collision.

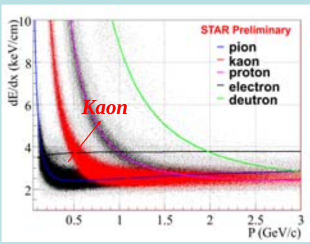


Particle identification

Run8: without any inner tracker
Significantly reduced material (~1/10) and background electrons



Electron PID cuts	
$n\sigma_e$	[-2.0, 3.0]
$\lvert n\sigma_\pi \rvert$	> 2.0
$\lvert n\sigma_K \rvert$	> 2.0
$\lvert n\sigma_p \rvert$	> 2.0
p_T (GeV/c)	[0.2, 12.0]
p (GeV/c)	[0.2, 12.0]

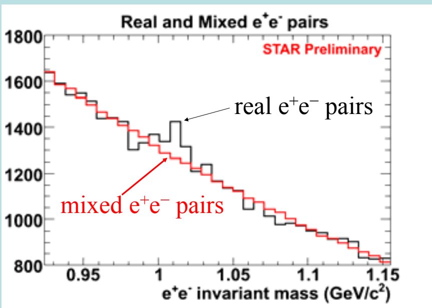


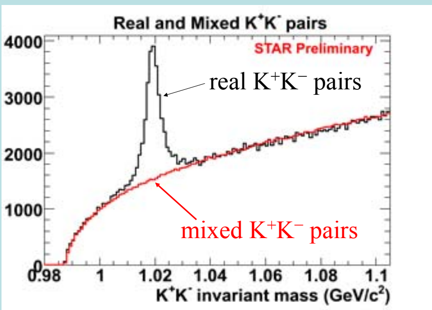
Kaon PID cuts	
$\lvert n\sigma_K \rvert$	< 2.0
p_T (GeV/c)	[0.1, 12.0]
p (GeV/c)	[0.1, 12.0]

In above tables, $n\sigma_i = \frac{1}{R}\log\frac{(dE/dx)_{measured}}{(dE/dx)_{expected}}$, where $(dE/dx)_{measured}$ and $(dE/dx)_{expected}$ are the measured ionization energy loss of the particle i in TPC and the expected one from Bichsel function, respectively. R is the measured *dE/dx* resolution of particle i.

ϕ reconstruction

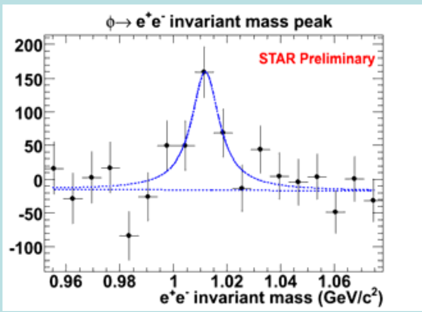
Background is reconstructed by mixed event technology

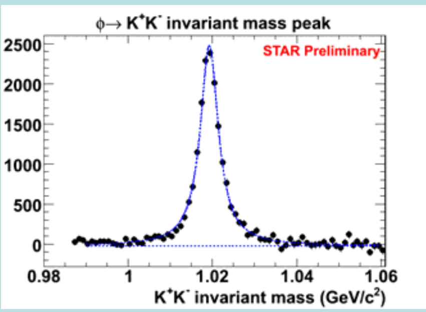




ϕ signal extraction

Breit-Wigner + linear function is used to fit ϕ invariant mass distribution after background substraction





Summary and outlook

Summary

We present the first STAR preliminary measurements of ϕ meson via its di-electronic decay mode. The observed signal is promising for further investigations.

Outlook

Time of Flight (TOF) with large area coverage will be used in 2009 p+p 500GeV collisions. With TPC +TOF, electron identification will be significantly improved, great for light vector meson and di-electronic spectral measurements.