J/ψ production in Au+Au collisions at $\sqrt{S_{NN}}$ = 62.4 GeV and 39GeV from STAR

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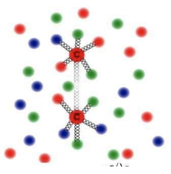
Abstract

The Relativistic Heavy Ion Collider (RHIC) is built to search for the Quark-gluon Plasma (QGP) and to study its properties in laboratory through high energy heavy-ion collisions. J/ψ suppression in heavy-ion collisions due to color screening of quark and anti-quark has been proposed as a signature of QGP formation. But other mechanisms are likely to contribute to the observed J/ψ suppression in heavy-ion collisions such as the cold nuclear matter effect, charm quark recombination, sequential suppression, and hot wind dissociation. Measurements of J/ψ invariant yields at different collision centralities can shed new light on understanding the interplay of these mechanisms for J/ψ production and medium properties.

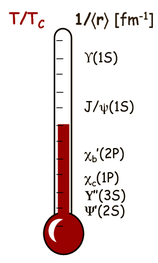
In this presentation we report the measurements of J/ψ signals in different transverse momentum (with p_T coverage: 0-5 GeV/c at mid-rapidity) in Au+Au collisions at $\sqrt{s_{NN}}$ 62.4 GeV and 39GeV taken in 2010 by STAR with full Time-of-Flight detector and Barrel ElectroMagnetic Calorimeter detector in operation. Centrality dependence of J/ψ signals are also presented.

Introduction



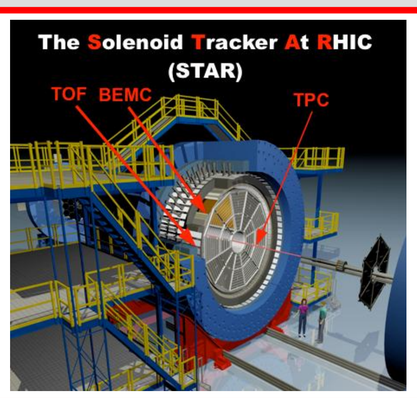
Matsui & Satz
PLB. 178, 416 (1986)

J/ψ suppression was proposed by Matsui and Satz as a smoking gun signature of the QGP.



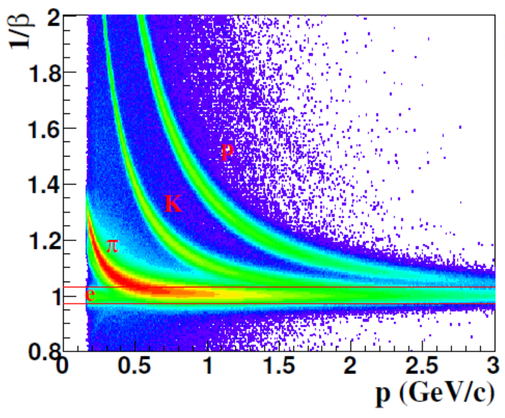
Mocsy & Petreczky
PRL. 99, 211602
(2007)

Quarkonium dissociation is suggested as a thermometer for the medium created at heavy ion collisions

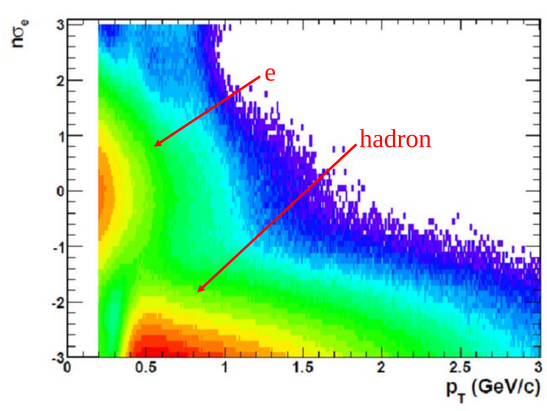


STAR has a large acceptance for electron identification after the full Time-Of-Flight (TOF) has been installed.
Large data samples in 2010:
--- 30M EMC triggered (E_T>2.6 GeV) 62 GeV Au+Au events (97 μb^{-1})
--- 168M MB 62GeV Au + Au events (18μb^{-1})
--- 14M EMC triggered (E_T>2.6GeV) 39 GeV Au+Au events (62 μb^{-1})
--- 258M MB 39GeV Au+Au events (30 μb^{-1})

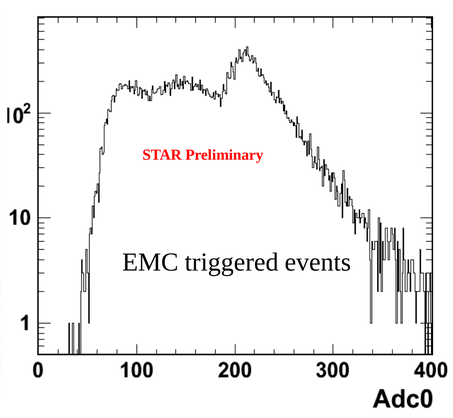
Electron ID



1/β from TOF



Normalized dE/dx from TPC after β selection



Adc0 from EMC

Low p_T: TPC + TOF is sufficient

High p_T: EMC for fast trigger of high-p_T electron

Adc0 is the offline adc value of the most energetic tower in a BTOW cluster

p/E to suppress hadrons

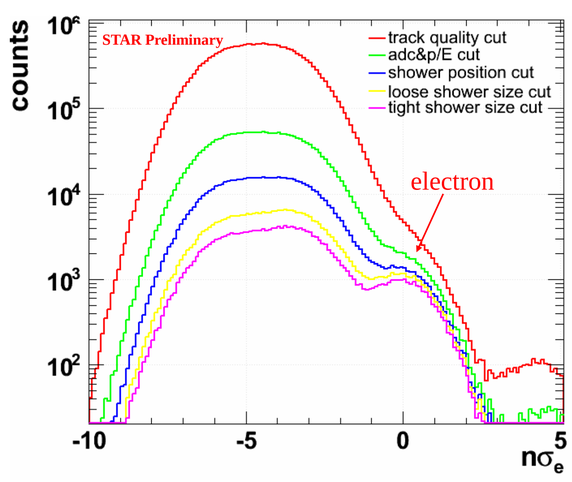
further suppression from SMD

combine with dE/dx from TPC

SMD: Shower Maximum Detector

$\Delta\eta \times \Delta\phi = 0.005 \times 0.005$ at ~$5X_0$

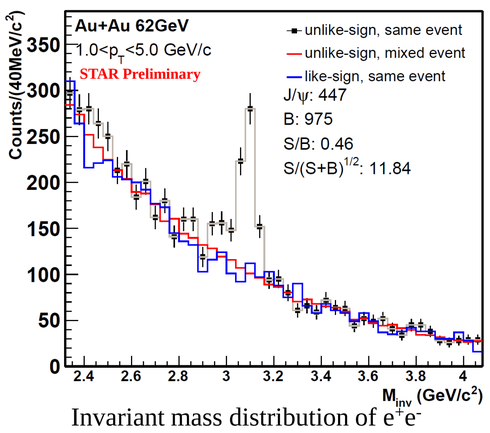
Detect shower size and shower position



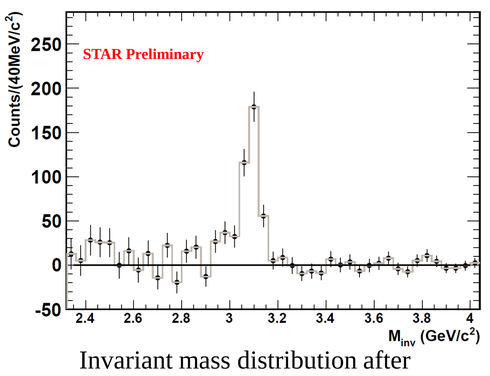
Normalized dE/dx distribution afer various cuts

J/ψ Reconstruction

Reconstruction method: "TPC electron sample" + "TPC+EMC electron sample"
TPC+EMC electron sample: triggered by EMC and identified by combining TPC and EMC information
TPC electron sample: identified by TPC AND TOF information



Invariant mass distribution of e^+e^- pairs at centrality 0 – 60%



Invariant mass distribution after background subtraction

Background reconstruction:

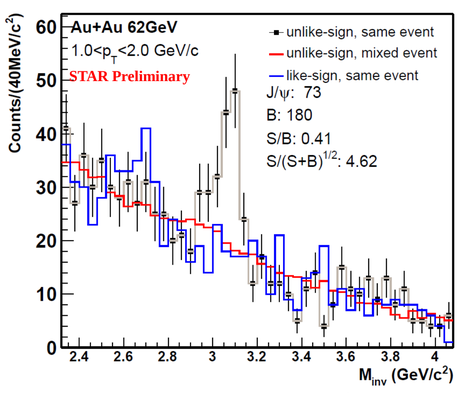
Like-Sign (same event): pair "EMC+TPC" and "TPC" candidates in the same events and require they have the same sign.

Unlike-Sign (mixed event): pair candidate with another in the events buffer.

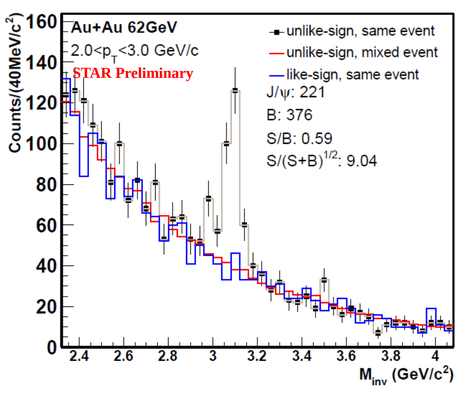
We normalize unlike-sign mixed events background to like-sign in the mass range 2.0 – 4.0 GeV/c^2.

background reconstruction methods work well.

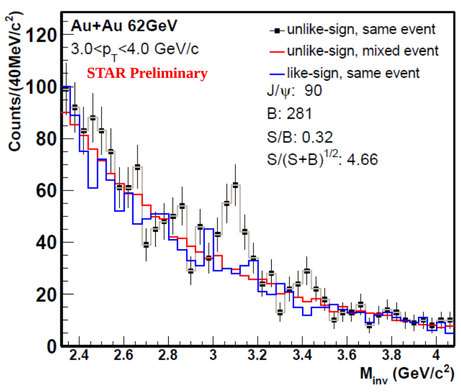
J/ψ signal in Au+Au 62 GeV



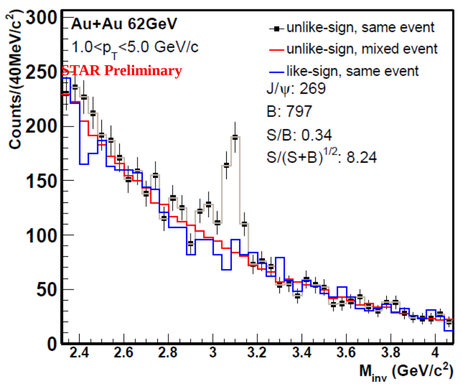
Invariant mass distribution for 1<p_T <2 GeV/c at centrality 0 – 60%



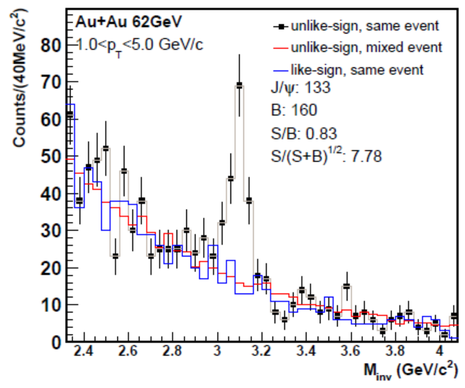
Invariant mass distribution for 2<p_T <3 GeV/c at centrality 0 – 60%



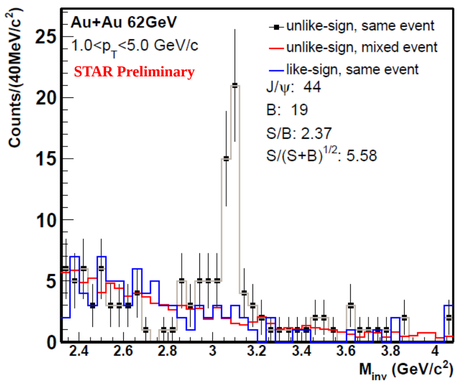
Invariant mass distribution for 3<p_T <4 GeV/c at centrality 0 – 60%



Invariant mass distribution at centrality 0 – 20%

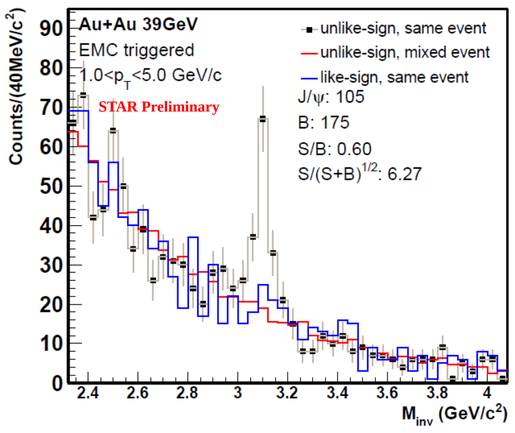


Invariant mass distribution at centrality 20 – 40%

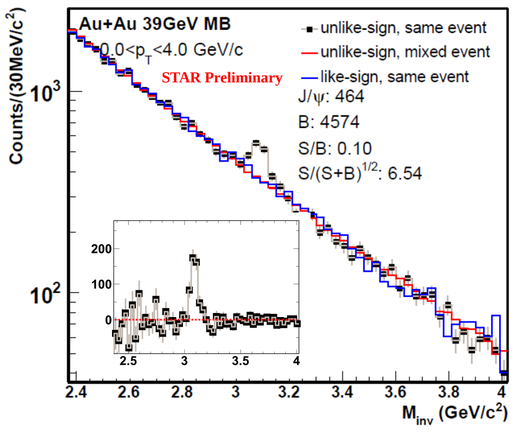


Invariant mass distribution at centrality 40 – 60%

J/ψ signal in Au+Au 39 GeV



Invariant mass distribution at centrality 0 – 60%



Invariant mass distribution at centrality 0 – 60%

Summary and outlook

1. We observe clear J/ψ signals at different p_T and centrality bins from Au+Au collisions at 62 and 39 GeV.
2. Estimation of efficiencies is ongoing.
3. Estimation of systematic uncertainty is in progress.
4. Measurement of J/ψ R_{cp} for different centrality and energy will be done in the future.