Low-mass meson production through di-leptonic decays in p+p and Au+Au collisions at $\sqrt{S_{NN}}$ = 200 GeV from STAR

Bingchu Huang for the STAR collaboration
University of Science and Technology of China, Brookhaven National Laboratory

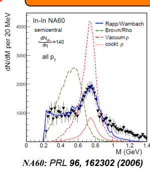
QUARK MATTER ANNECY 2011

Abstract

Ultra-relativistic heavy ion collisions provide a unique environment to study the properties of strongly-coupled Quark Gluon Plasma (sQGP) at high temperature and high energy density. One of the crucial probes to study the sQGP is the di-electron production in the low (M_{ll}<1.0 GeV/c^2) and the intermediate (1.0<M_{ll}<3 GeV/c^2) mass region. In the intermediate mass region, the di-electron production are directly related to thermal radiation of the sQGP. In the low mass range, we can study the production of vector mesons in the medium, where any modifications observed may relate to the possibility of chiral symmetry restoration. The newly installed STAR Barrel Time-of-Flight detector (TOF) provides high acceptance and efficiency for charged particle identification at mid-rapidity. By combining the time-of-flight from the TOF and the energy loss from Time Projection Chamber, STAR is able to identify electron with high purity from low to intermediate transverse momentum at mid-rapidity.

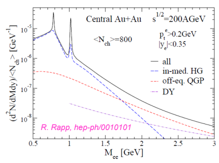
In this poster, we present the measurements of vector meson ω invariant yields via di-electron decays in 200 GeV p+p and Au+Au collisions and the di-electron continuum spectrum in 200 GeV p+p collisions at mid-rapidity. The limit on η→ee is discussed.

Introduction

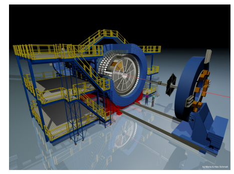


NA60: PRL 96, 162302 (2006)

Di-electron is a unique probe to detect the in-medium modifications of vector mesons which has a possible link to chiral symmetry restoration.

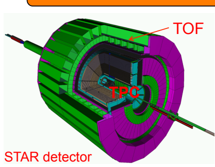


Di-electron at intermediate mass: study the QGP thermal radiation, heavy flavor modifications in the medium



STAR has a large acceptance for electron identification after the full Time-Of-Flight (TOF) was installed.
Large data samples --- 355M M.B. and 250M central Au+Au events in year 2010.

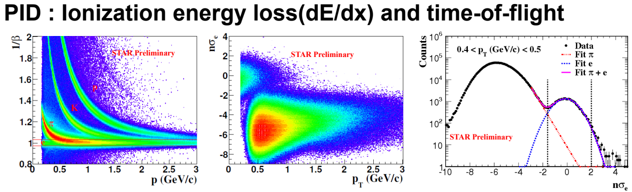
Data set and PID



p+p:107 M Minibias:
|vertexZ|<50 cm
p_T>0.2 GeV/c
|eta|<1

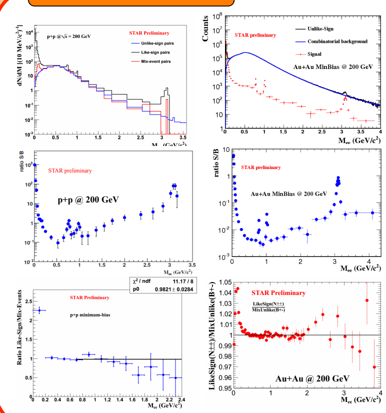
Au+Au:220 M Minibias:
|vertexZ|<30 cm
p_T>0.2 GeV/c
|eta|<1

PID : Ionization energy loss(dE/dx) and time-of-flight



Good electron identification with TOF, purity 99% in p+p, 97% in Au+Au.

Analysis



Background subtraction:
Subtract the like-sign at M_{ee}<0.7 GeV/c^2.

$$B_{LikeSign} = 2\sqrt{N_{++}\cdot N_{--}}\cdot\frac{B^{Mix}_{+-}}{2\cdot\sqrt{B^{Mix}_{++}\cdot B^{Mix}_{--}}}$$

Subtract mixed-event at M_{ee}>0.7 GeV/c^2.

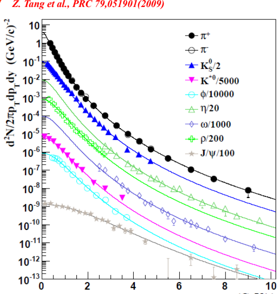
$$B_{+-}(m_{ee},p_T) = \frac{2\sqrt{B_{++}\cdot B_{--}}}{\int_0 B_{+-}(m_{ee},p_T)dm_{ee}dp_T}B_{+-}(m_{ee},p_T)$$

Normalization mass range:
p+p: 0.4-1.5 GeV/c^2
Au+Au: 0.7-3.0 GeV/c^2

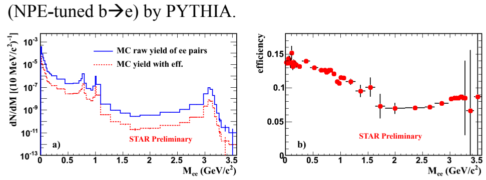
ω signal:
p+p: ~4σ
Au+Au: ~ 6σ

Simulation and Results

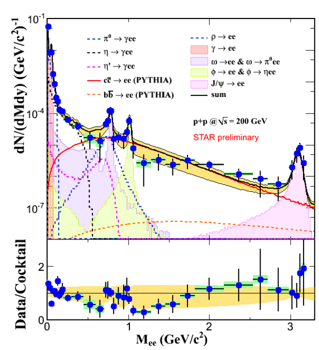
Z. Tang et al., PRC 79,051901(2009)



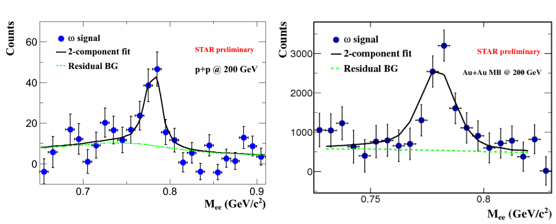
For mesons: input Tsallis-blast-wave fit spectra of each meson, reconstruct e^+e^- pairs after they decay in the STAR simulators. Same cuts applied as in data.
For heavy flavor: tune the ratio of b→e over STAR NPE measurement to the published results, then tune the c→e to (NPE-tuned b→e) by PYTHIA.



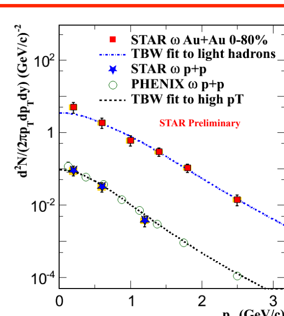
Efficiency as a function of mass.



Comparison of simulation and data after efficiency correction. Obtain an upper limit of η→ee branching ratio: 4.9e-6 at 90% C.L..



Fit ω by two components: ω and the rest of cocktail without ω.



ω invariant yields.

Conclusion and outlook

1. Di-electron continuum is obtained from data and simulation in p+p at 200 GeV. They are consistent with each other and provide a baseline for Au+Au.
2. ω invariant yields are obtained from p+p and Au+Au minimum-bias events.
3. The upper limit of η→ee branching ratio is obtained at 90% C.L.: 4.9e-6 .
4. Study the ρ meson in-medium modifications in Au +Au collisions in the future.

BROOKHAVEN NATIONAL LABORATORY