

Dielectron Production in Au+Au-Collisions at $\sqrt{s_{NN}} = 39$ GeV at STAR

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for the STAR Collaboration

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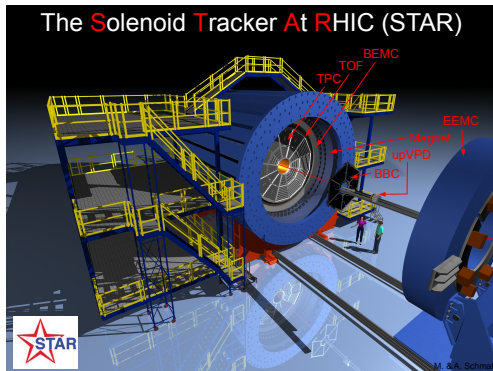
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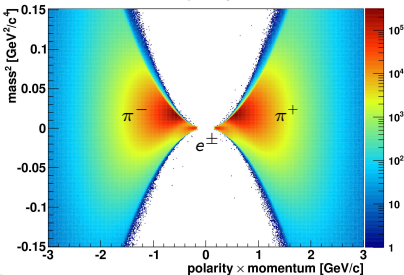
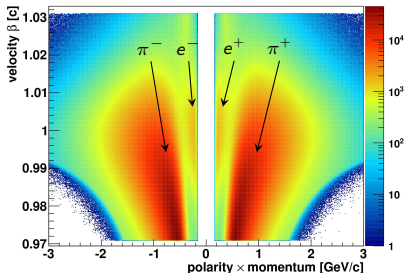
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Motivation & STAR

- As electromagnetic probes, e^+e^- pairs provide direct access to in-medium information
→ sensitive to early stage of collision
- additional tool to study QGP properties as possible signature for QCD phase boundary (R_{AA} , v_2)
- vector meson production in the region of low invariant masses (LMR: $M_{ee} < 1.2 \text{ GeV}/c^2$) w.r.t. peaks/widths/yields
- address physical cause of reported LMR enhancement (excess yield)
- Run 2010: TOF detector fully assembled
→ improved eID at large acceptance
- high statistics sample (169M) for $\sqrt{s_{NN}} = 39 \text{ GeV}$



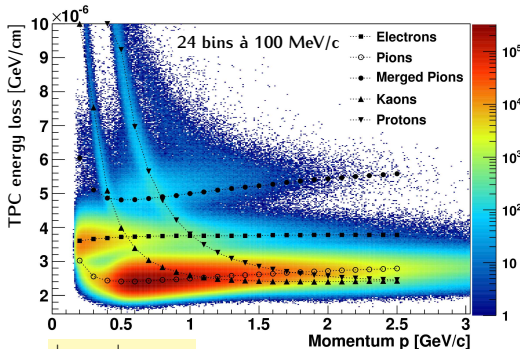
Electron Identification – TOF & TPC dE/dx



TPC energy loss

NIM A 562 154-197 (2006)

- $(dE/dx)^{theo}$ given by Bichsel functions
- $2 \cdot \frac{dE}{dx} \Big|_{Bichsel}^\pi$ for merged pion tracks



$$\left| \frac{1}{\beta} - 1 \right| < 0.03$$

$$m^2 < 0.15$$

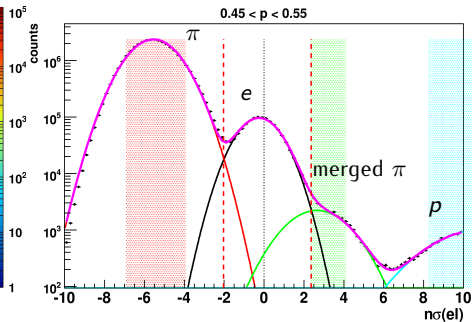
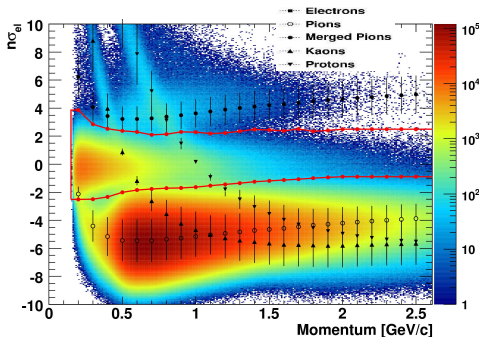
significant hadron background
reduction due to TOF

$n\sigma_{el}$ - distributions & - Cut

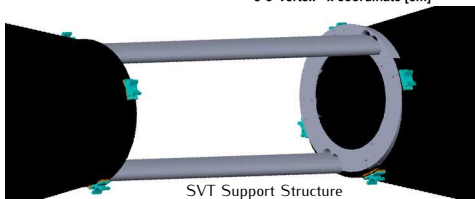
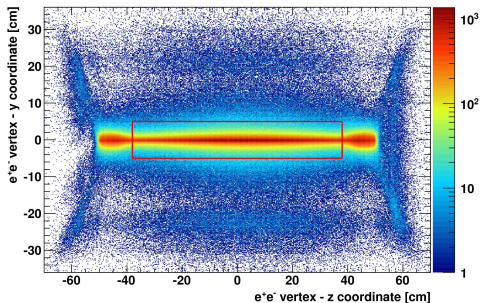
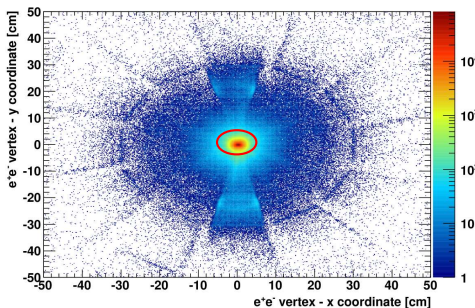
Cut on number of $\sigma_{electron}$ ($n\sigma_{el}$) deviation

$$(n\sigma_{el}) = \frac{0.38}{\sigma_{res}} \cdot \ln \left[\left(\frac{dE}{dx} \right) / \left(\frac{dE}{dx} \right)_{Bichsel}^{el} \right]$$

- dE/dx translated into $n\sigma_{el}$ as log. deviation from theoretical energy loss
- p-bin-wise particle contributions determined through multi-gaussian fits
- deduce various p-dependent $n\sigma_{el}$ cuts (S/N = 1, purity, $2\sigma_{el}$)



e^+e^- Vertex Investigation



Cuts

$$|z| < 38 \text{ cm}$$

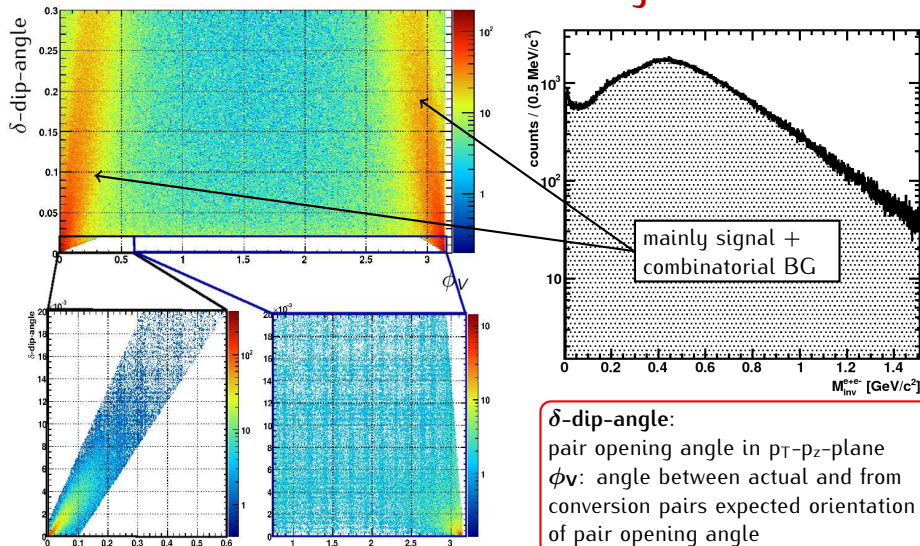
$$\text{radial distance} < 6 \text{ cm}$$

$$dca_{e^\pm}(p)$$

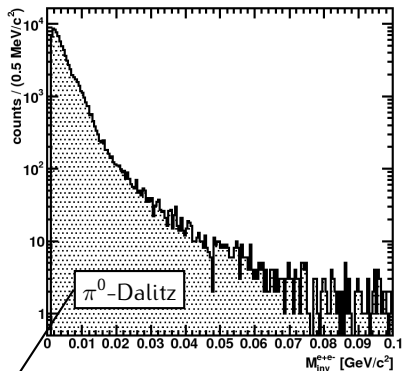
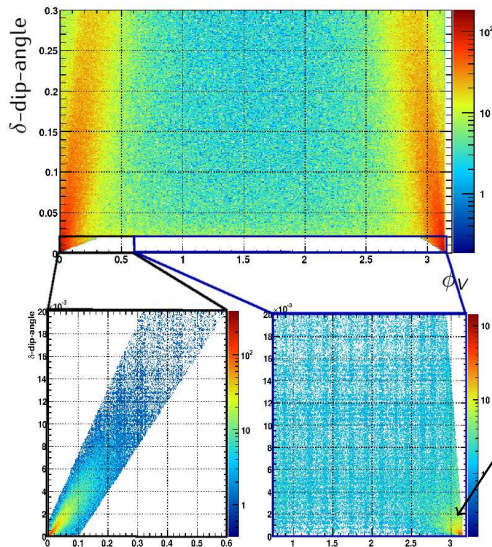
$$dca_{e^+e^-} < 2 \text{ cm}$$

dca = distance of closest approach between reconstructed track and primary vertex

Residual Conversion Background



Residual Conversion Background

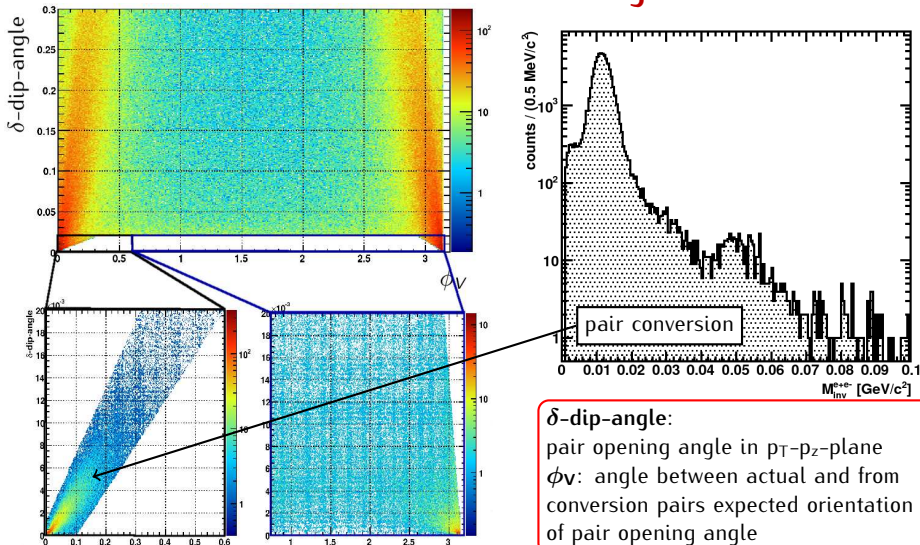


δ -dip-angle:

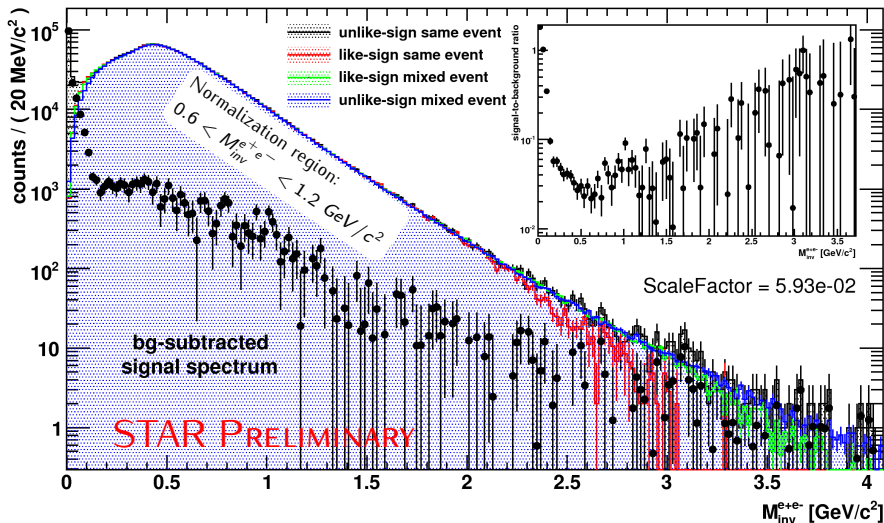
pair opening angle in p_T - p_z -plane

ϕ_V : angle between actual and from conversion pairs expected orientation of pair opening angle

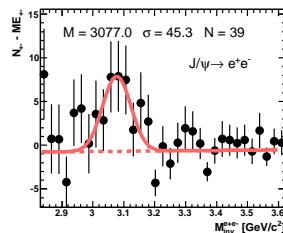
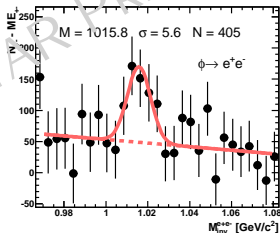
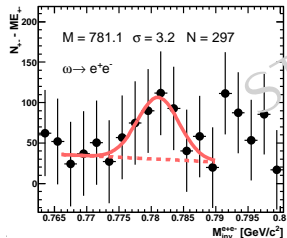
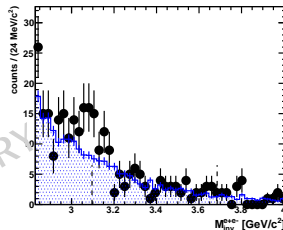
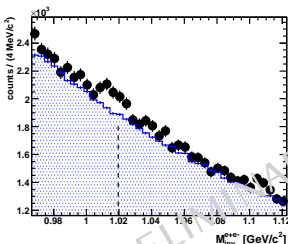
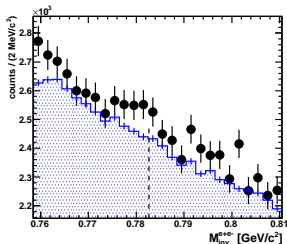
Residual Conversion Background



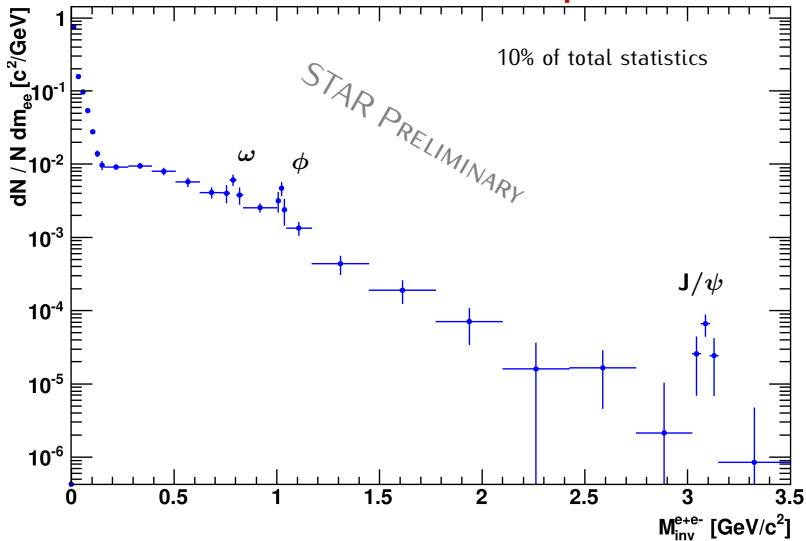
Comb. Background – Normalization & S/B



ω , ϕ and J/ψ signals



raw e^+e^- invariant mass spectrum



Summary & Conclusions

Summary

- 1 promising results with 17M of in total 169M recorded events in Au+Au-collision at $\sqrt{s_{NN}} = 39$ GeV with STAR
- 2 dilepton measurements with STAR possible due to fully assembled TOF detector and large acceptance coverage
- 3 1st raw spectrum of vector meson production at this energy at STAR
- 4 $\omega \rightarrow e^+e^-$, $\phi \rightarrow e^+e^-$ and $J/\psi \rightarrow e^+e^-$ reconstructed after mixed event subtraction
- 5 systematic hadronic background studies, tracking efficiency correction and simulations still needed to be carried out.