Kinematical correlations: from RHIC to LHC

Antoni Szczurek

INSTITUTE OF NUCLEAR PHYSICS

POLISH ACADEMY OF SCIENCES

IFJ PAN

AND

UNIVERSITY OF RZESZOW

Plan of the first part

Nonphotonic electrons – coincidences

Recent results of PHENIX and STAR
(see M. Luszczak talk for inclusive distributions)

Nonphotonic electrons

- 1) Heavy quark-antiquark production
  $gg \to c\bar{c}$ or $gg \to b\bar{b}$
  $q\bar{q} \to c\bar{c}$ or $q\bar{q} \to b\bar{b}$
  k_t-factorization approach, Kwiecinski UPDFs here.
- 2) Fragmentation
  $c \to D$ and $\bar{c} \to \bar{D}$
  $b \to B$ and $\bar{b} \to \bar{B}$
  Peterson fragmentation functions.
- 3) Semileptonic decays
  $D \to e^+$ and $\bar{D} \to e^-$ (see CLEO data)
  $B \to e^-$ and $\bar{B} \to e^+$ (see BBAR data)
  fit of the decay function to the decay data.
- 4) Drell-Yan dielectron production

Simultaneous fragmentation of Q and $\bar{Q}$

From heavy quarks/antiquarks to heavy mesons:

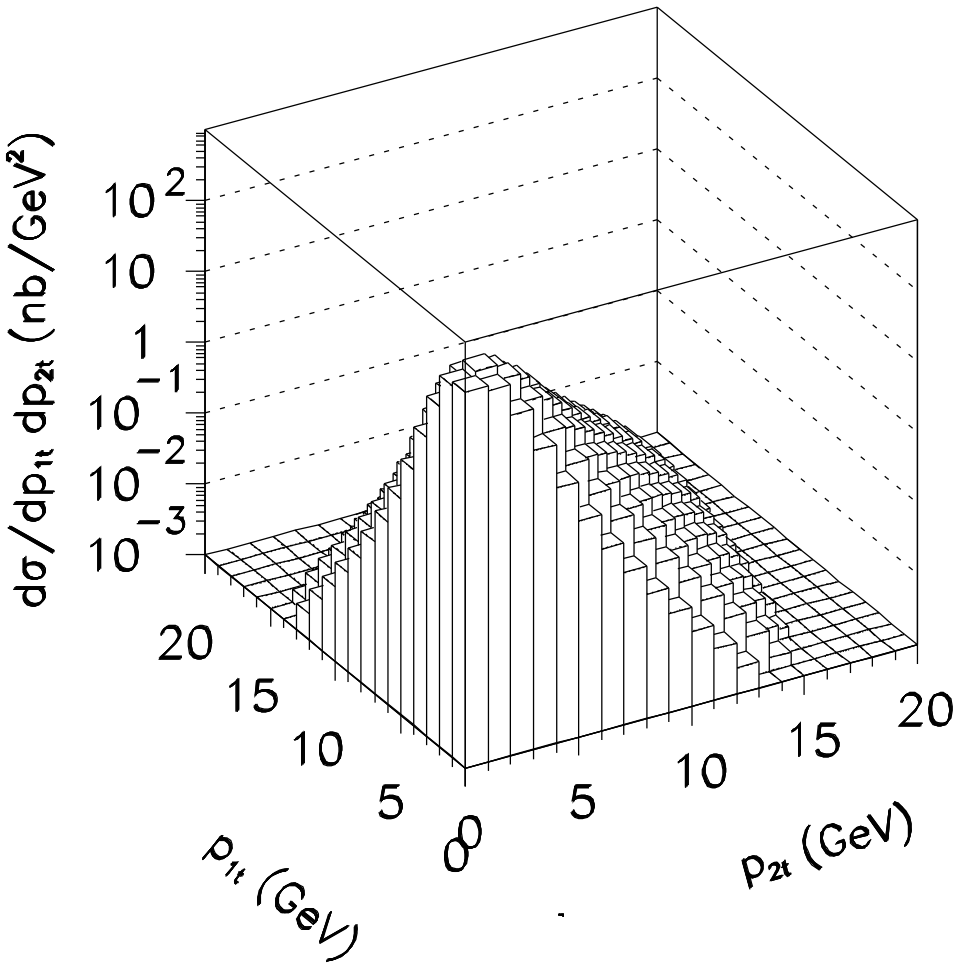
$$\frac{d\sigma(y_1, p_{1t}^M, y_2, p_{2t}^M, \phi)}{dy_1 dp_{1t}^M dy_2 dp_{2t}^M d\phi}$$

$$\approx \int \frac{D_{Q\to M}(z_1)}{z_1} \cdot \frac{D_{\bar{Q}\to \bar{M}}(z_2)}{z_2} \cdot \frac{d\sigma(y_1, p_{1t}^Q, y_2, p_{2t}^Q, \phi)}{dy_1 dp_{1t}^Q dy_2 dp_{2t}^Q d\phi}\, dz_1 dz_2 \quad . \quad (1)$$

where: $p_{1t}^Q = \frac{p_{1t}^M}{z_1}$, $p_{2t}^Q = \frac{p_{2t}^M}{z_2}$,
$z_1 = (0,1)$ and $z_2 = (0,1)$.
$D_{Q\to M}(z_1)$, $D_{\bar{Q}\to \bar{M}}(z_2)$ – Peterson fragmentation functions.

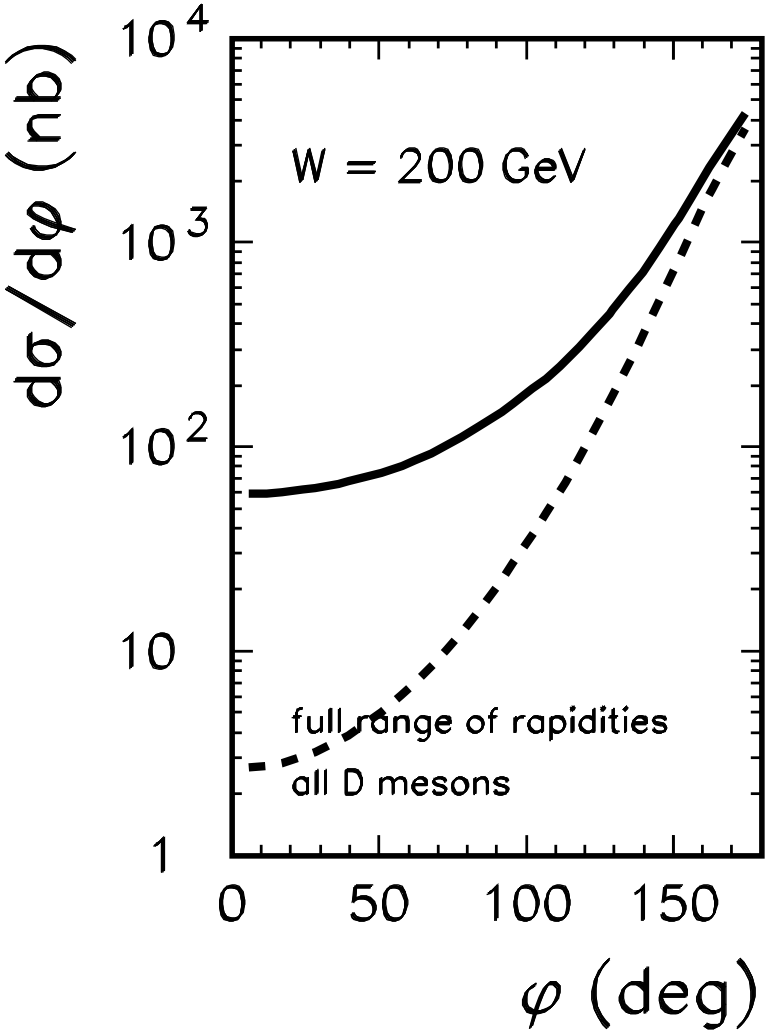
Approximation:
y_1, y_2, ϕ – unchanged in the fragmentation process (reasonable for heavy quarks/antiquarks).

D – $\bar{D}$ correlations in transverse momenta



Kwiecinski UGDF with $\mu^2 = 4m_c^2$ and b_0 = 1 GeV^{-1}

D – $\bar{D}$ azimuthal correlations

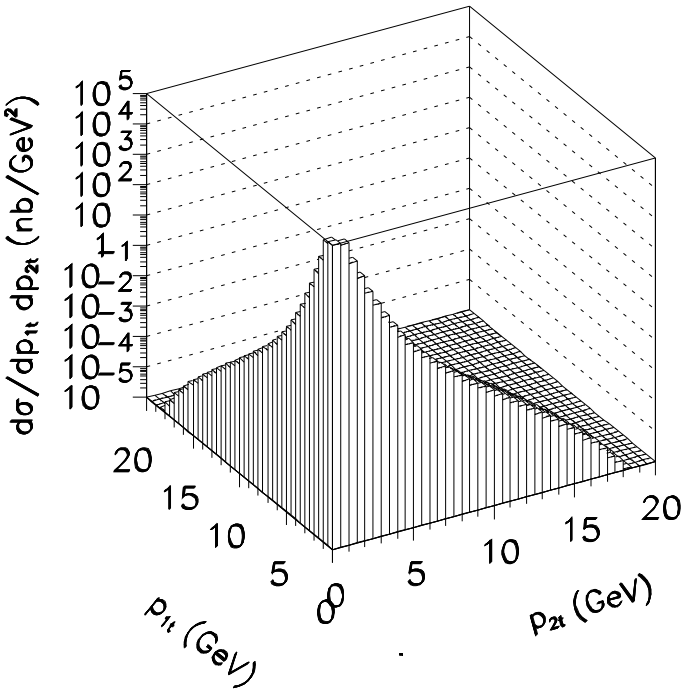


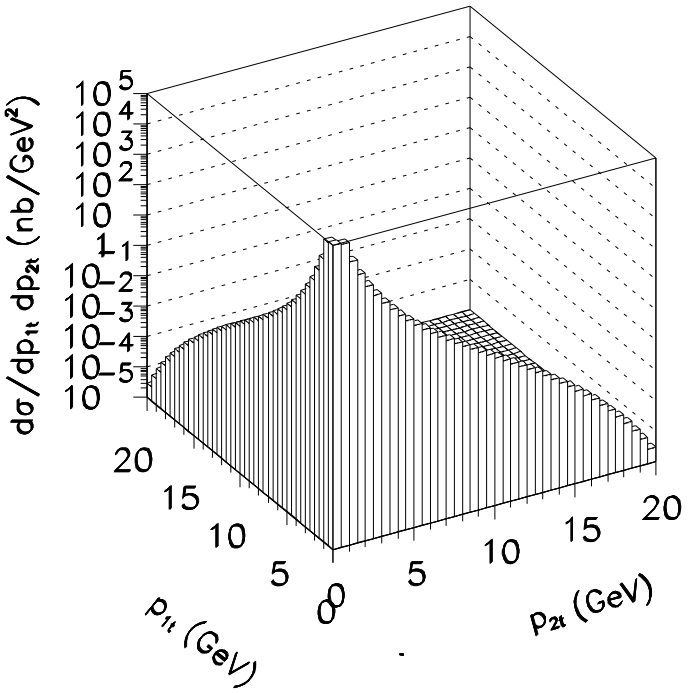
dashed: p_{1t}^{D}, $p_{2t}^{\bar{D}}$ > 0.5 GeV.

Kwiecinski UGDF with $\mu^2 = 4m_c^2$ and b_0 = 1 GeV^{-1}

CDF has studied: $D^0 - D^{*-}$ and $D^+ - D^{*-}$ correlations.

Dielectron correlations $(p_{1t}(e^+), p_{2t}(e^-))$

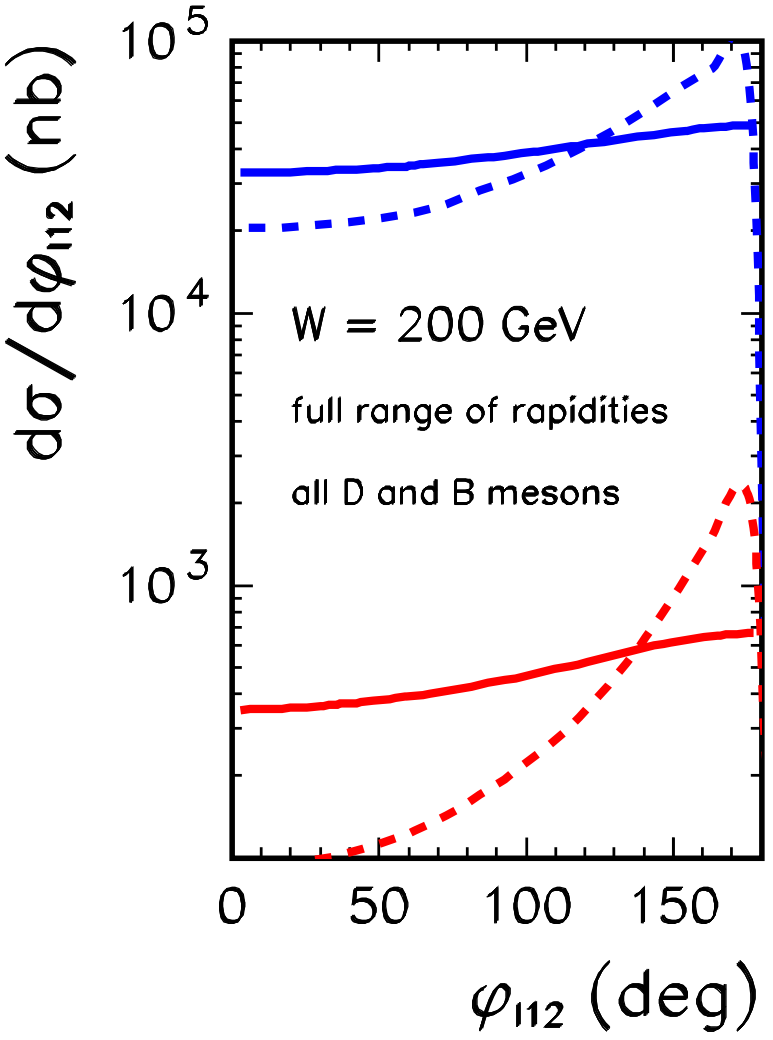




full range of rapidities

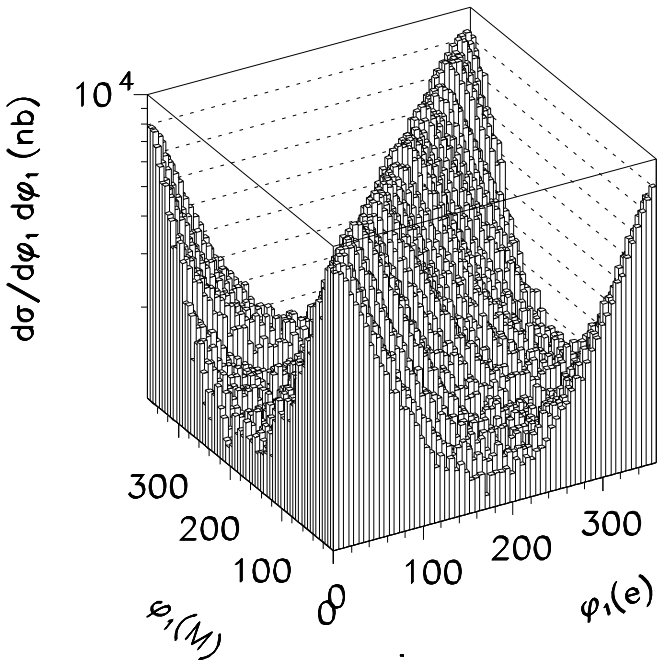
Kwiecinski and Kharzeev-Levin UGDFs

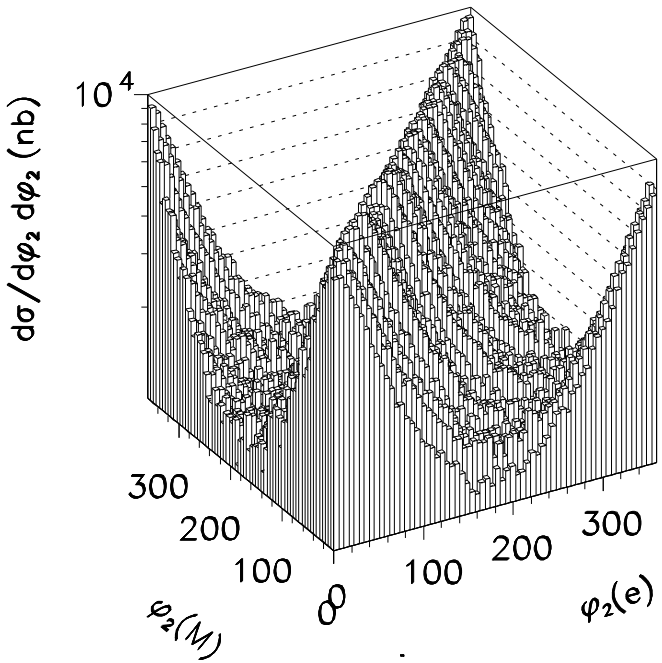
Azimuthal correlations between e^+ and e^-



Decorrelation due to decays

Decorrelation due to semileptonic decays



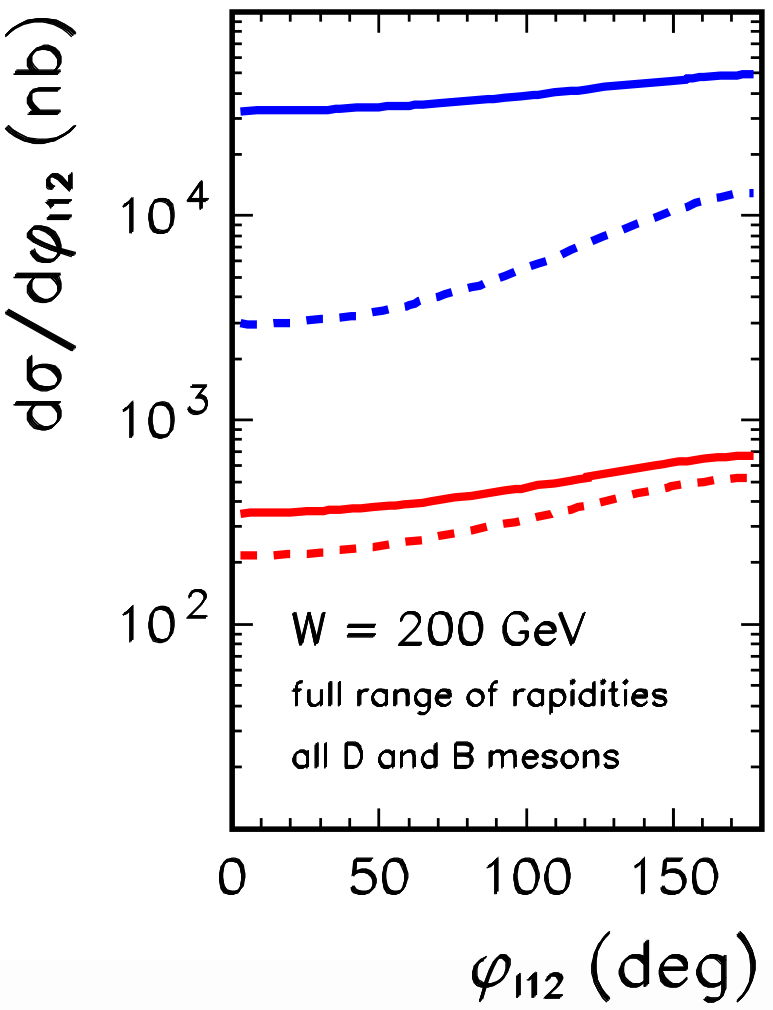


Lost of memory (small transverse momenta)

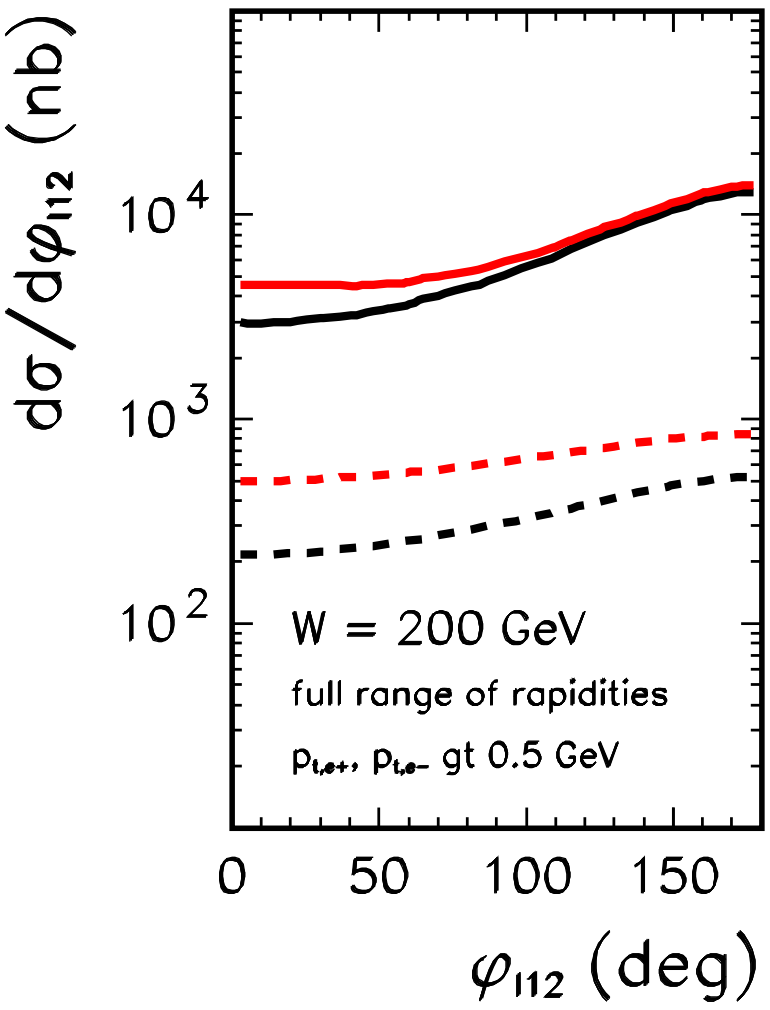
Azimuthal correlations between e^+ and e^-

Cut on electron transverse momenta:

$p_{1t}(e^+), p_{2t}(e^-) > 0.5$ GeV

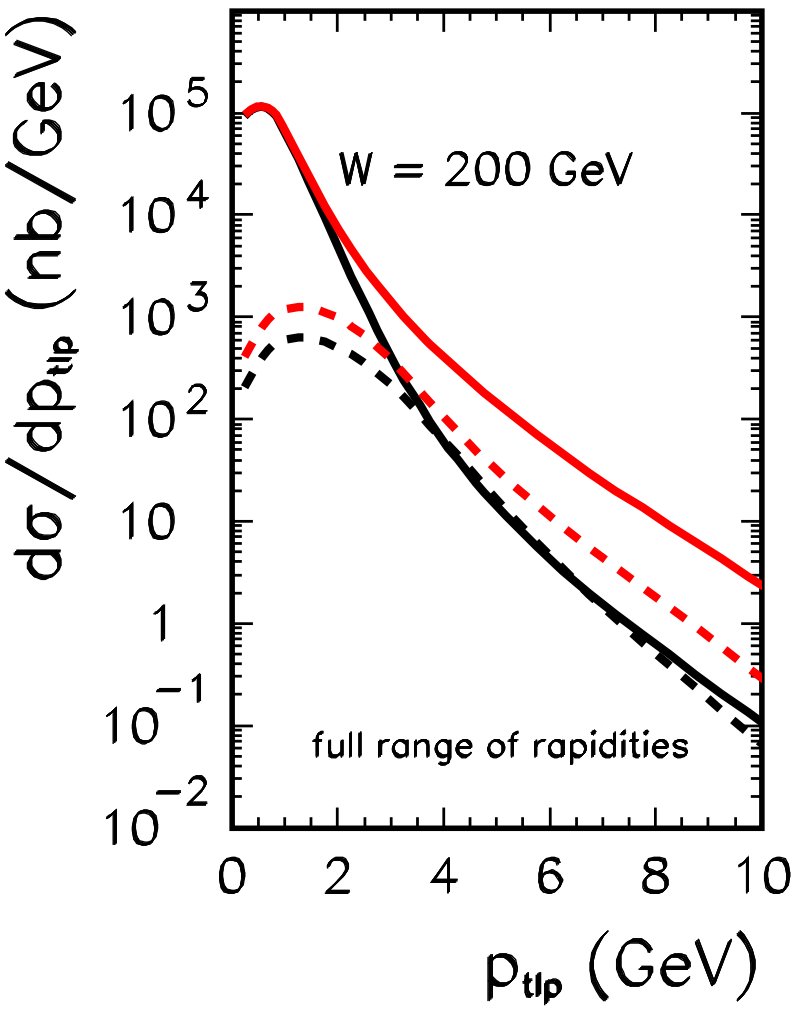


UGDF dependence of azimuthal correlations



Kwiecinski (black), Kharzeev-Levin (red)

Pair transverse momentum distribution



Kwiecinski (black) versus Kharzeev-Levin (red)

Invariant mass distribution

$$\frac{1}{N_{evt}}\frac{dN}{dM_{ee}} = \frac{1}{\sigma_{ine}}$$

$$\Big(\quad BR(D \to e) \cdot BR(D \to e) \cdot \frac{d\sigma}{dM_{ee}}(gg \to c\bar{c} \to D\bar{D} \to e^+e^-; cuts)$$

$$+ \quad BR(B \to e) \cdot BR(B \to e) \cdot \frac{d\sigma}{dM_{ee}}(gg \to b\bar{b} \to B\bar{B} \to e^+e^-; cuts)$$

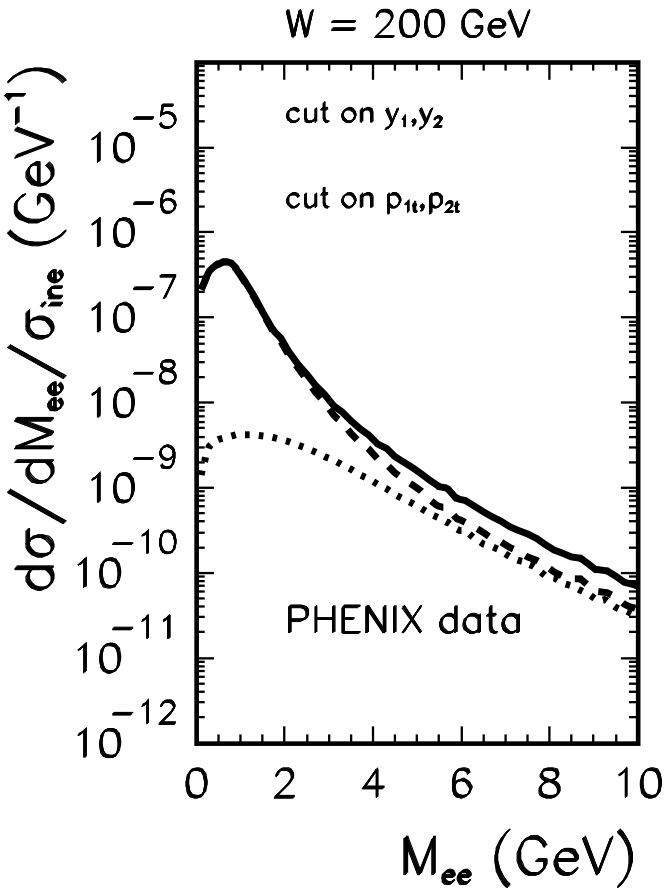
$$+ \quad \frac{d\sigma}{dM_{ee}}(q\bar{q} \to e^+e^-; cuts)$$

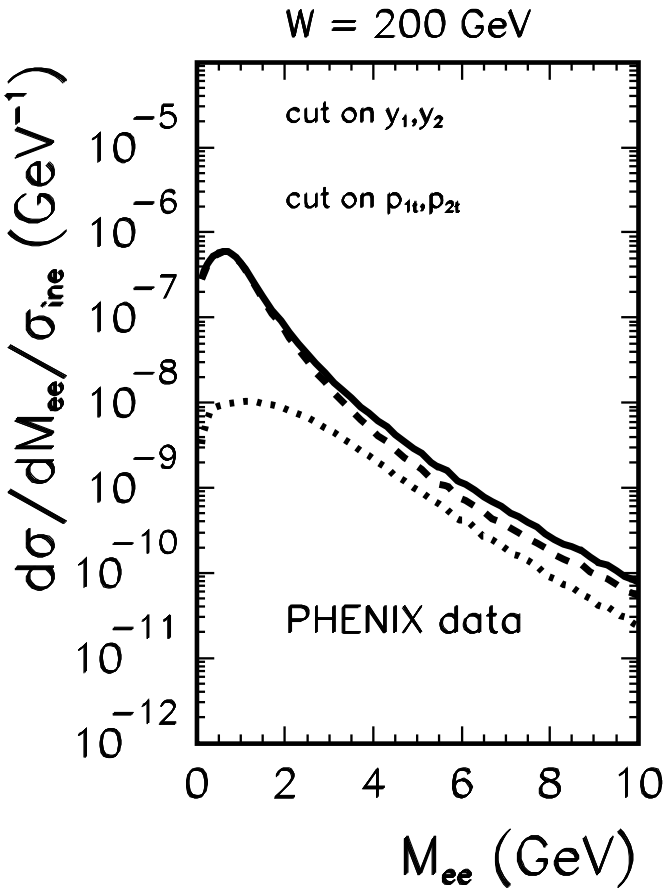
$\sigma_{ine}(W = 200GeV) =$ 42.2 mb
$BR(D \to e) \approx$ 0.1
$BR(B \to e) \approx$ 0.1

(3)

PHENIX experimental cuts:
-0.35 $< y(e^+), y(e^-) <$ 0.35,
$p_{1t}(e^+), p_{2t}(e^-) >$ 0.2 GeV .

Comparison with recent PHENIX data





Kwiecinski and Kharzeev-Levin UGDFs