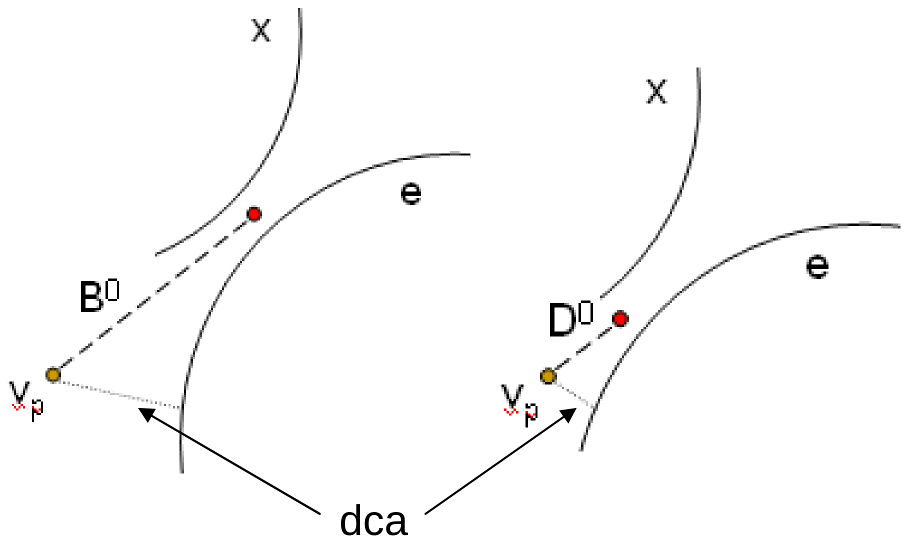
Additional Capability -- Semi-leptonic Channels

particle	$c\tau$ (μm)	Mass (GeV)	$q_{c,b} \rightarrow x$ (F.R.)	$x \rightarrow e$ (B.R.)
D^0	123	1.865	0.54	0.0671
$D^{\pm}$	312	1.869	0.21	0.172
B^0	459	5.279	0.40	0.104
$B^{\pm}$	491	5.279	0.40	0.109

B.R. =
Branching Ratio
F.R. =
Fragmentation Ratio



The distance of closest approach to primary vertex (dca):

Due to larger **$c\tau$,** $B \rightarrow e$ has broader distribution than $D \rightarrow e$

Dca of $D^+ \rightarrow e$ is more close to that of $B \rightarrow e$

Simulation on electron channel

- Signal + background events produced.

  Only semileptonic decay to electron channel.

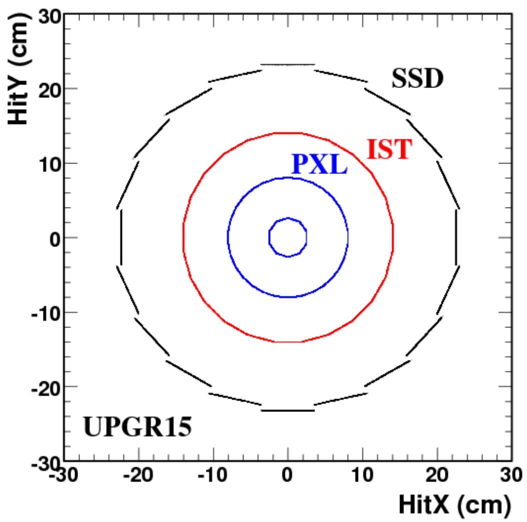
  Flat in $0 < p_T < 20$ GeV/c, p_T weighted using STAR measured D^0 spectrum power-law distribution for D mesons and FONLL calculation for B meson.

  Flat in $-1 < \eta < 1$ and flat in $0 < \varphi < 2\pi$

  Normalized by the F.R. and B.R., and total electron yield was normalized to STAR measured NPE spectrum. ($B \rightarrow e$) / NPE ratio was normalized to fit STAR measured data (from e-h correlation).

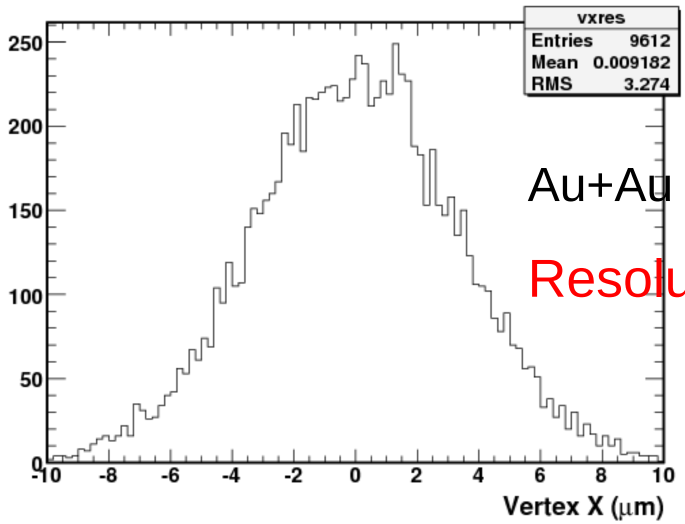
- Dca distributions and efficiency were obtained.
- Error estimation for spectra, ($B \rightarrow e$) / NPE ratio and v_2.

UPGR15



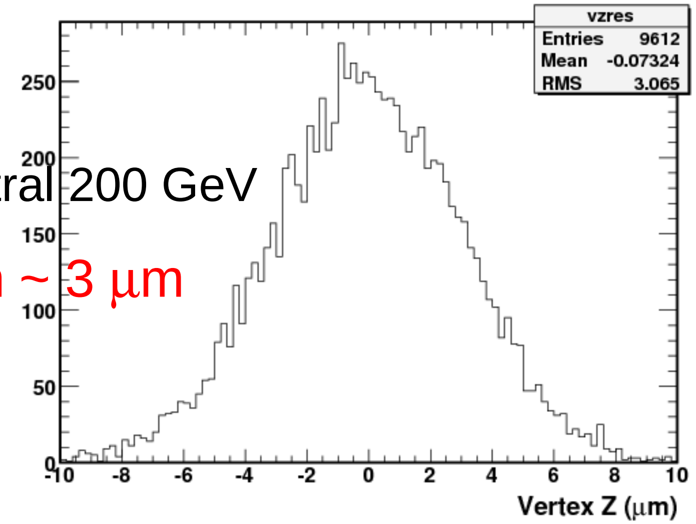
UPGR15 no TOF, using electron good PID

Old beam pipe

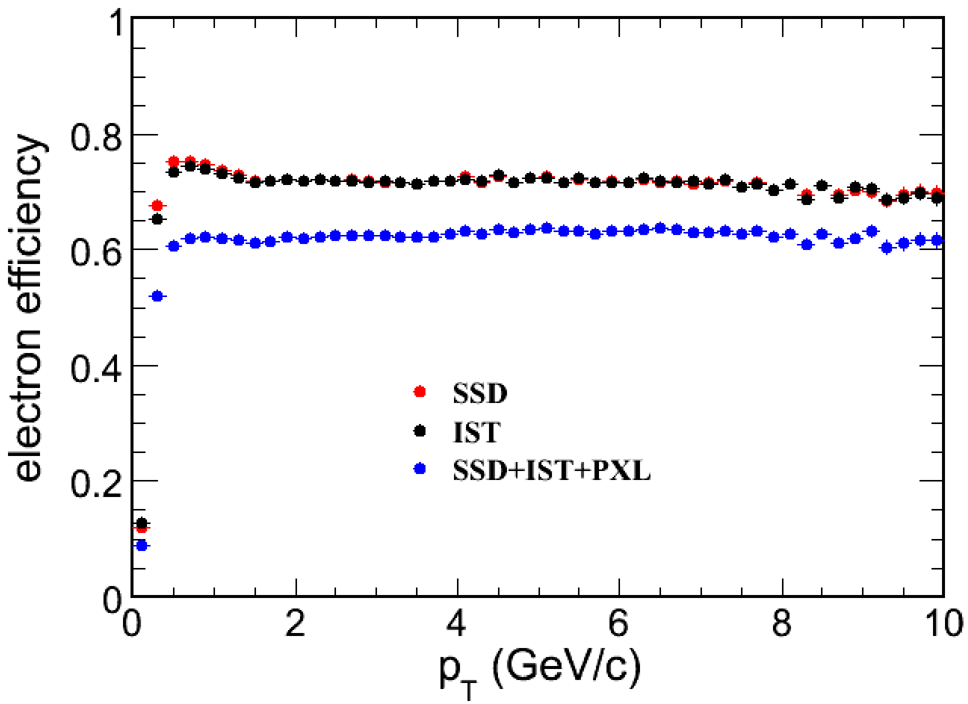


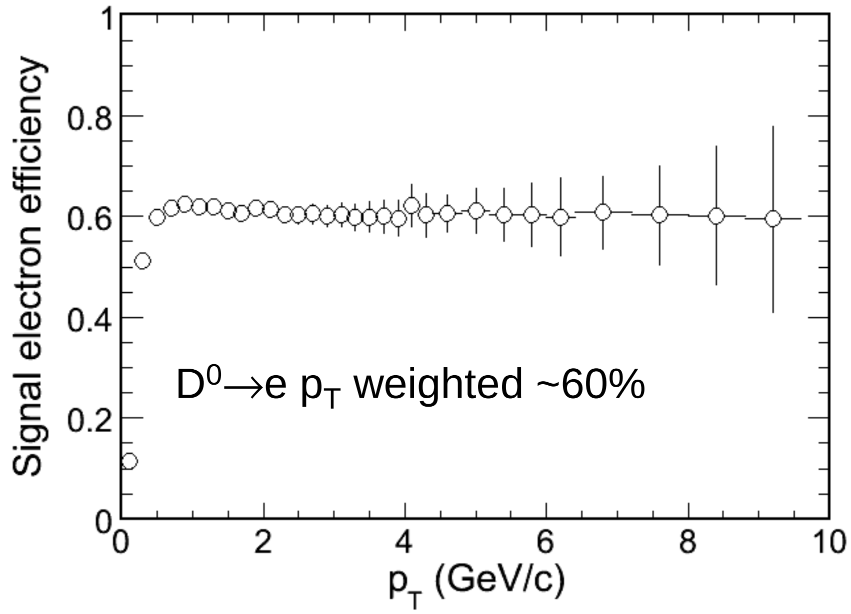
Au+Au central 200 GeV

Resolution ~ 3 μm



Electron efficiency





TPC tracking efficiency is included.

W/o PXL hits required, efficiency ~ 75%

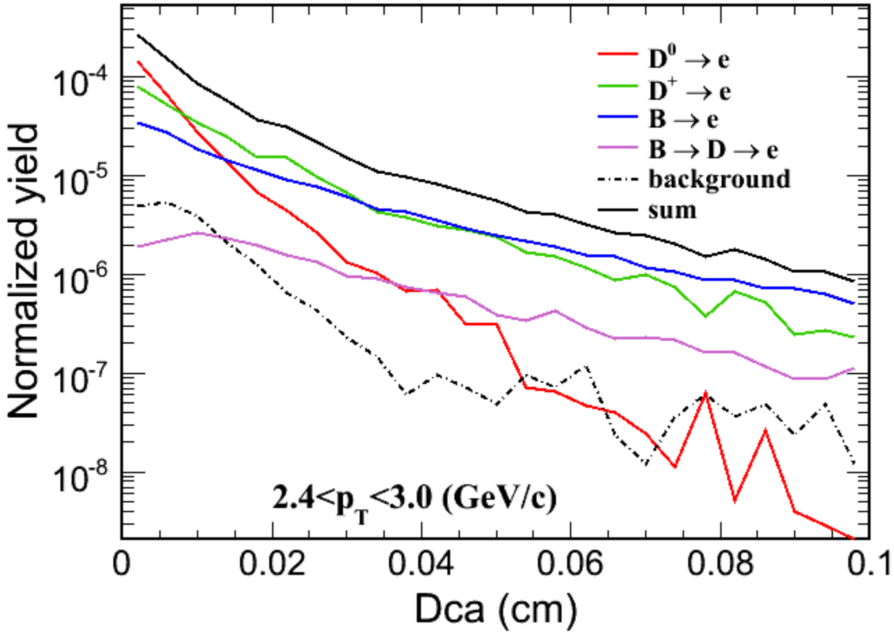
With PXL hits required, efficiency ~ 61%

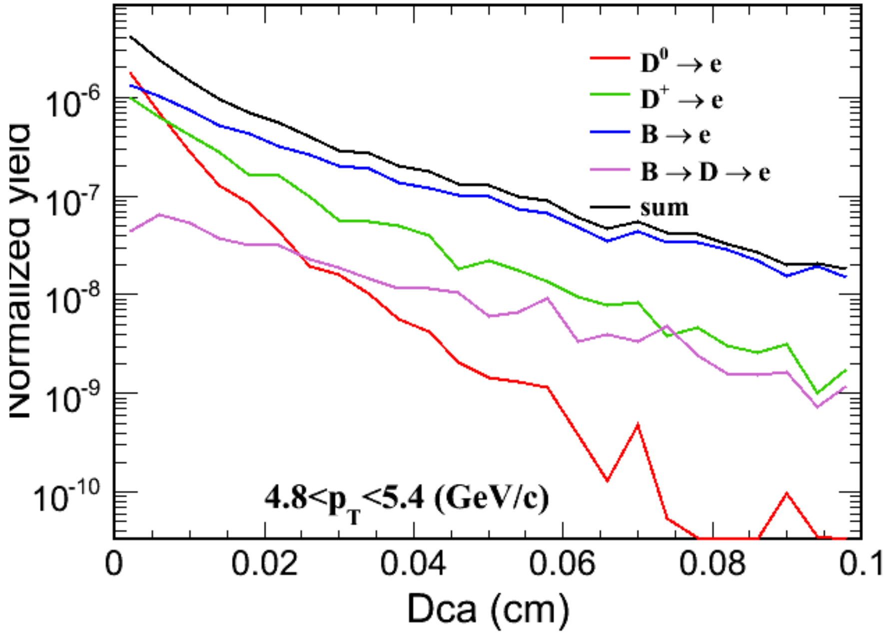
Dca distributions

Electrons: nFitPts > 15, -1 < eta < 1, 2 PXL hits required, in several p_T bins.

Photonic background can be removed from its small invariant mass character combining a pair of electrons. Other background is small. Due to background statistics, assuming its p_T decreasing exponentially, at high p_T, background will be neglected.

Normalized by the F.R. and B.R., and total electron yield was normalized to STAR measured NPE spectrum. (B→e) / NPE ratio was normalized to fit STAR measured data (from e-h correlation).

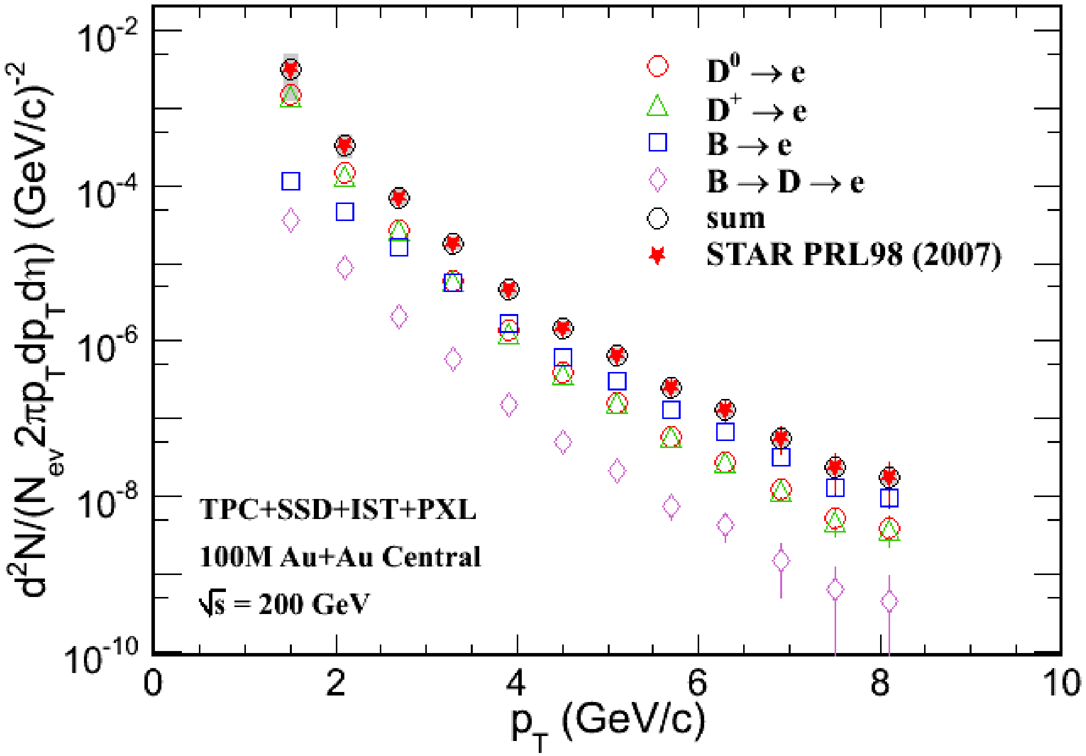




Errors estimate of spectra

In real experimental data, we can use the different dca distributions to fit the total dca distribution to extract the raw yield of each source of electrons.

From the dca distributions and the efficiency, the D→e, B→e and B→ D→e spectra can be obtained, and the statistical errors were estimated for 100M Au+Au central 200 GeV events (non-special trigger).



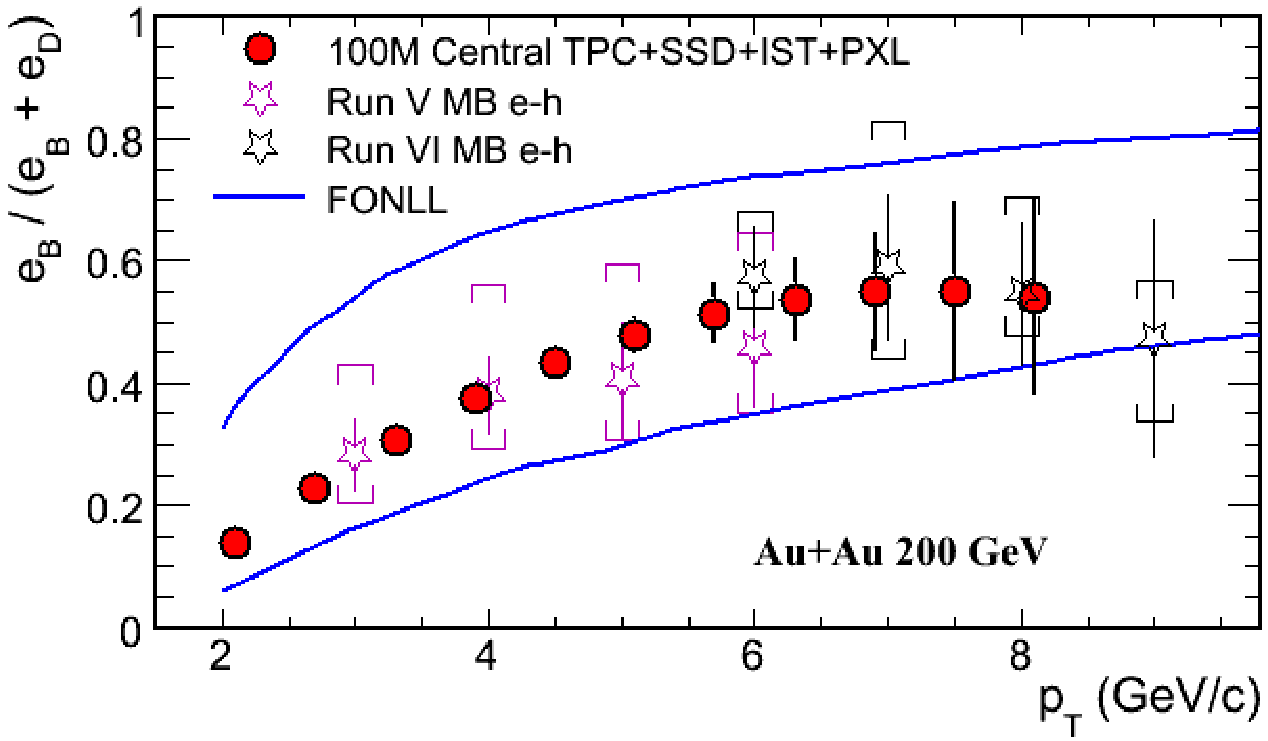
R_{AA} can be measured directly from the spectra with D→e, B→e separated.

Understanding the heavy quark energy loss mechanisms.

Errors estimate of (B→e)/NPE

(B→e)/NPE ratio can be directly measured from spectra. The statistical errors are estimated for 100M Au+Au central 200 GeV events.

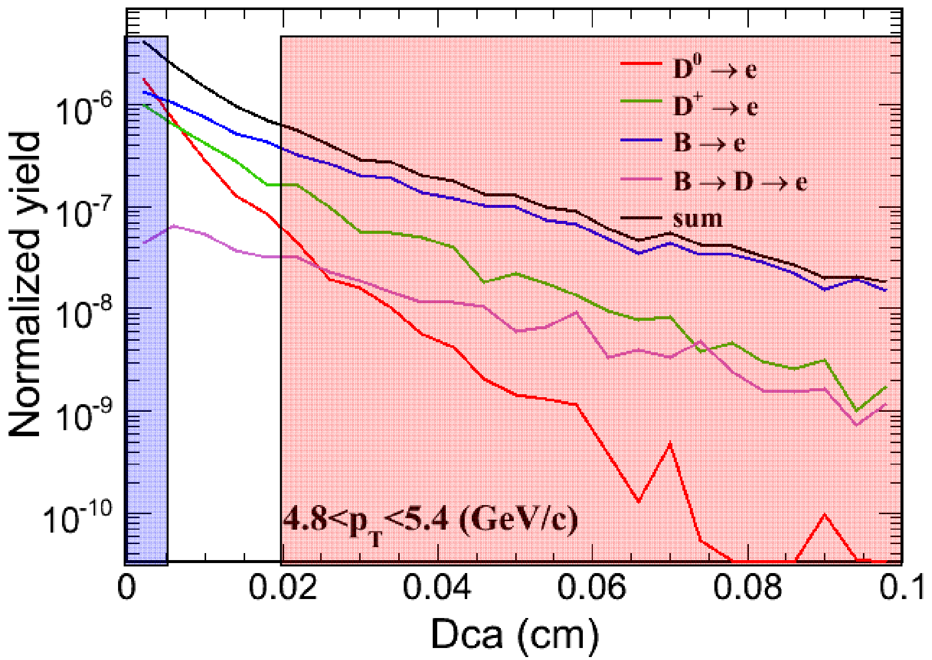
We will have high p_T electron trigger (EMC HT) in the future, high p_T statistics will not be a problem.



Measure v_2 from dca

B $\rightarrow$ e v_2 and D $\rightarrow$ e v_2 can be measured from different dca cuts. For example:

Case	Cut (cm)	e(D) eff. (%)	e(B) eff. (%)	r = e(B)/NPE
I	< 0.005	45.5	22.3	0.325
II	> 0.02	15.3	39.6	0.718



$r * v_2(B) + (1\text{-}r) * v_2(D) = v_2(NPE)$

$v_2(B)$ is B $\rightarrow$ e v_2

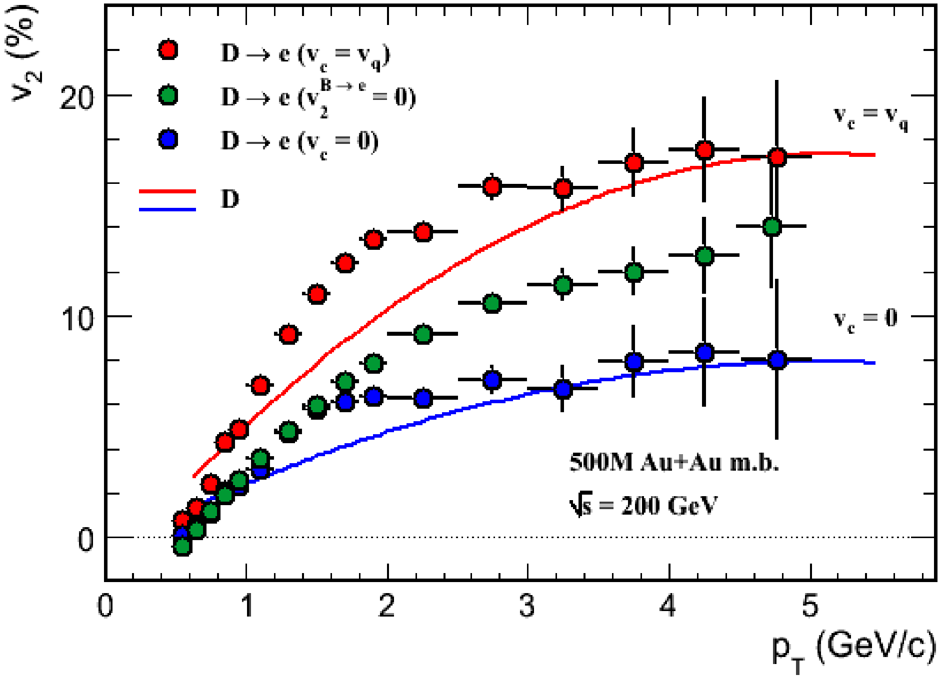
$v_2(D)$ is D $\rightarrow$ e v_2

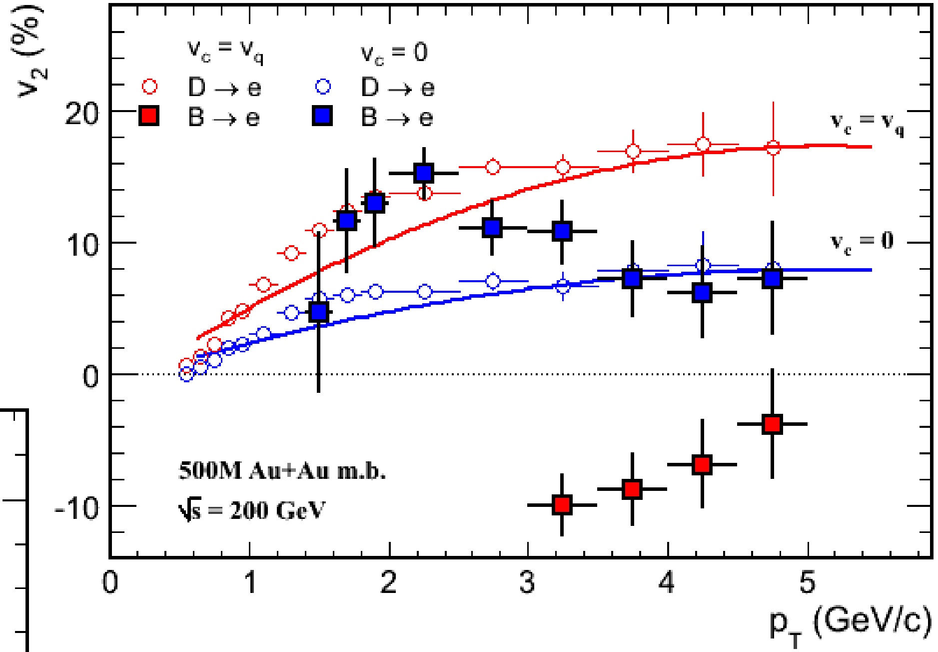
$v_2(NPE)$ is the total non-photonic electron v_2 after dca selection.

Error estimate for v_2

Assuming D meson v_2, using decay form factor to generate $D \rightarrow e$ v_2 distributions.

$r * v_2(B) + (1-r) * v_2(D) = v_2(NPE)$
$v_2(D)$ is $D \rightarrow e$ v_2
$v_2(B)$ is $B \rightarrow e$ v_2





Heavy quark collectivity
Study charm and bottom separately to understand the mass effect of such heavy quarks.
Probe medium properties.