Elliptic Flow and the Jet and Ridge Correlation

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Questions:

Does the presence of a jet deform the structure of the soft medium?

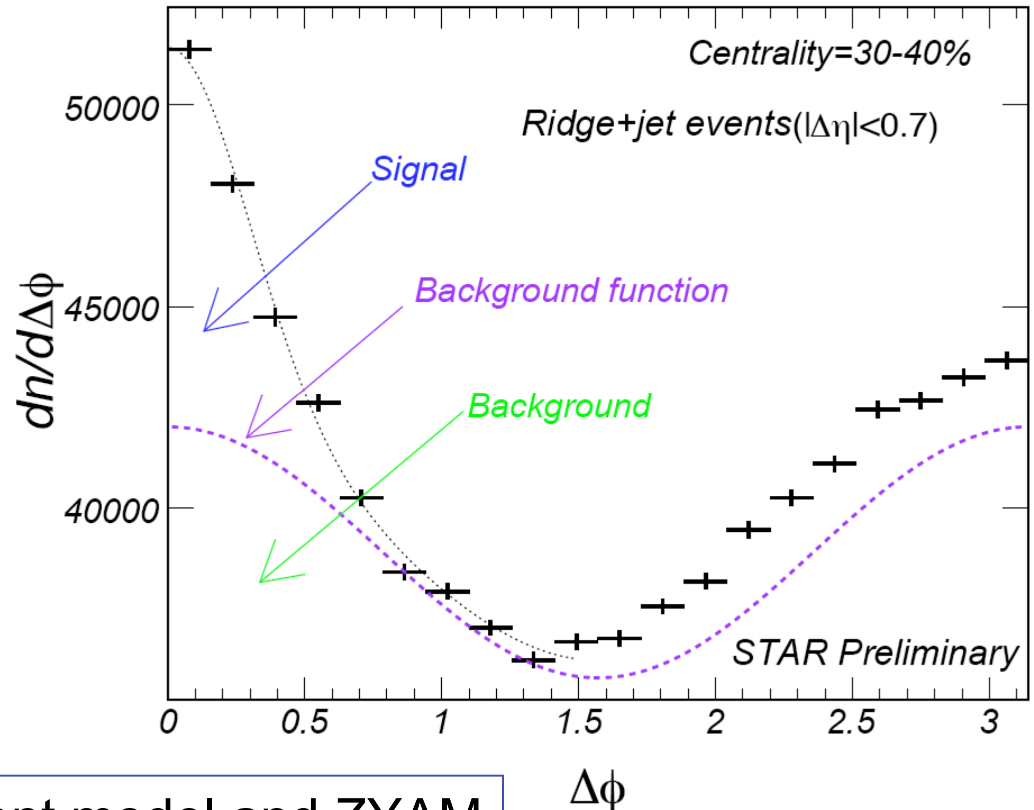
Does the space-momentum correlation that causes v_2 also cause the ridge?

To look for answers to these questions,
we look for coupling between the v_2 of soft particles $p_T<2.0$ GeV/c and the angular correlations of higher p_T particles

Talk outline:

- $dn/d\Delta\varphi$, ZYAM, and the two-component model
- one di-hadron pair per event and $\langle |q| \rangle$ vs $\Delta\varphi$ and $\Delta\eta$
- extracting dn/dq for the different components
- fitting dn/dq and interpreting the fit parameters
- **retraction of $v_2\{4\}$ for "jet"-events from QM08**

Introduction: dn/dΔφ & ZYAM



distribution of the angular seperation between the leading and next-to-leading hadron in 200 GeV Au+Au collisions

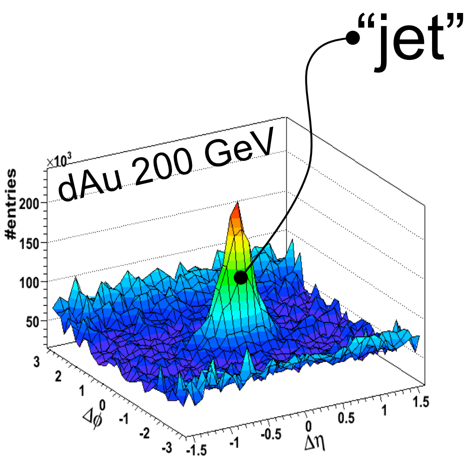
two-component model and ZYAM

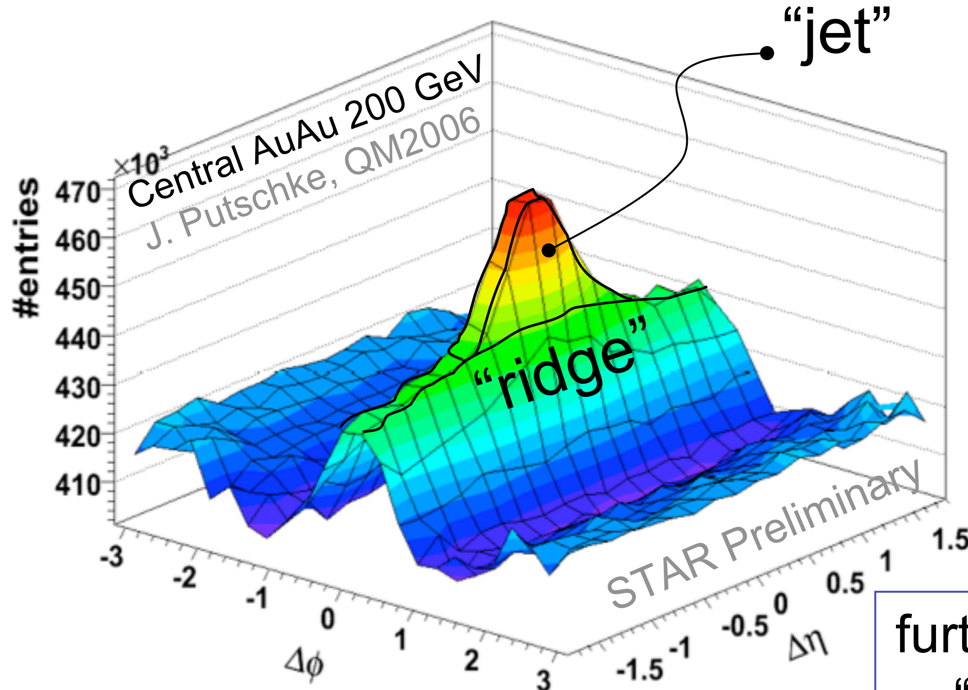
$$\frac{dn}{d\Delta\varphi} = \underbrace{b\left\{1 + 2\left(\langle v_2 \rangle^2 + \sigma_{v_2}^2\right)\cos(2\Delta\varphi)\right\}}_{} + \underbrace{J(\Delta\varphi)}_{}$$

v_2 modulated background

excess correlations

two dimensions: $d^2n/d\Delta\varphi d\Delta\eta$





near-side ridge

unique to Au+Au collisions

exhibits an abrupt onset with centrality

(Daugherity QM2008)

further sub-division: "jet" and "ridge"

$$\frac{dn}{d\Delta\varphi} = b\left\{1 + 2\left(\langle v_2\rangle^2 + \sigma_{v_2}^2\right)\cos(2\Delta\varphi)\right\} + J(\Delta\varphi)$$

v_2 modulated background

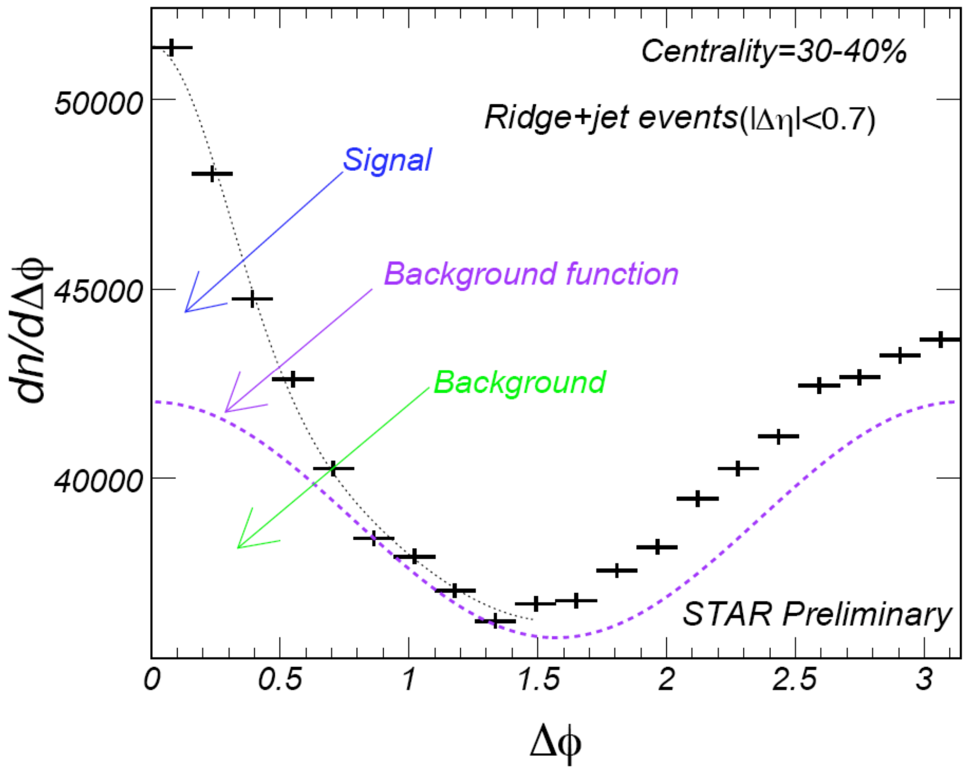
excess correlations

motivation

Can we learn more about the source of the ridge and jet structure by studying the characteristics of the underlying events?

analysis procedure

Select the leading dihadron pair satisfying our minimum p_T requirement → one pair per event

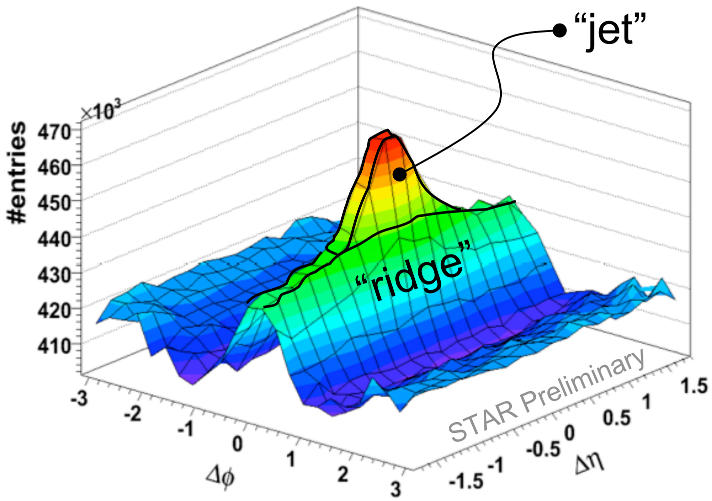


Jet =
Signal{|Δη|<0.7} - Ridge{|Δη|<0.7}

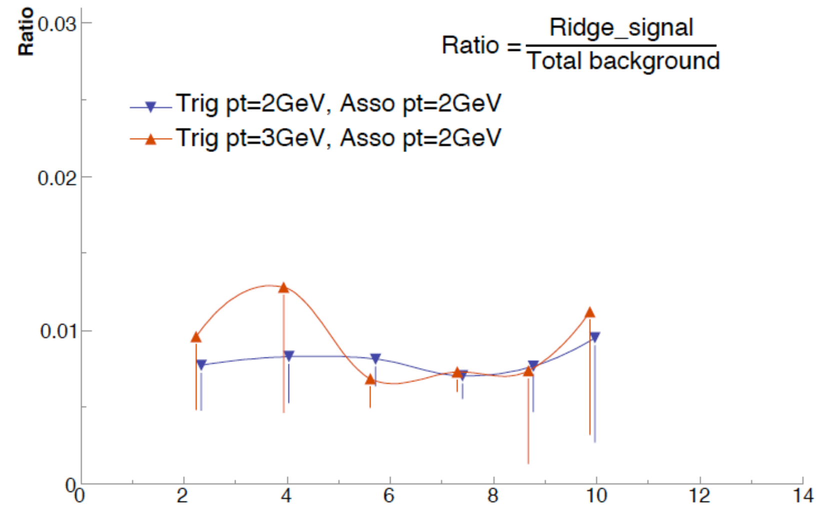
Ridge{|Δη|<0.7} =
Acc*Signal{|Δη|>0.7}

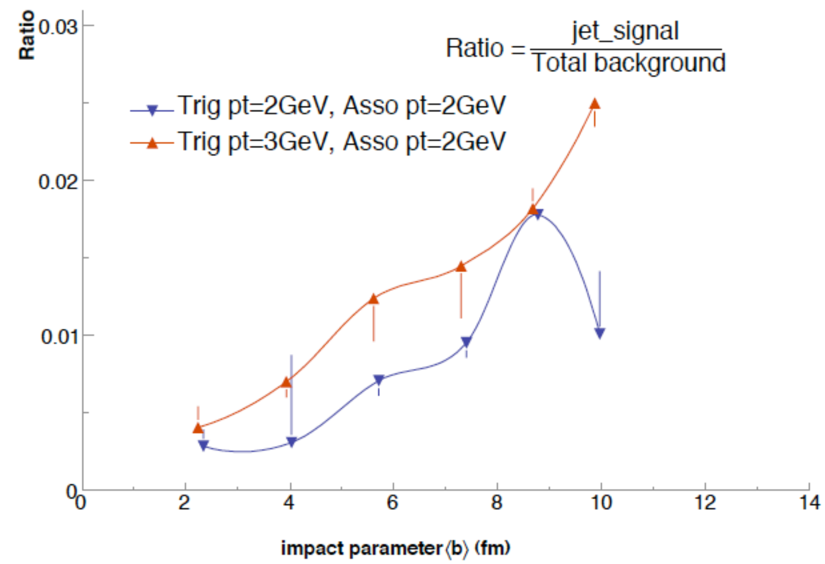
Acc =
Acceptance factor

jet and ridge yields



- the "ridge" is calculated by projecting $|\Delta\eta|>0.7$ correlation to $|\Delta\eta|<0.7$
- the "jet" is the remaining correlation at $|\Delta\eta|<0.7$ after subtracting the "ridge"





Ridge area scales with the background!
Ridge ratio is independent of minimum p_T cut

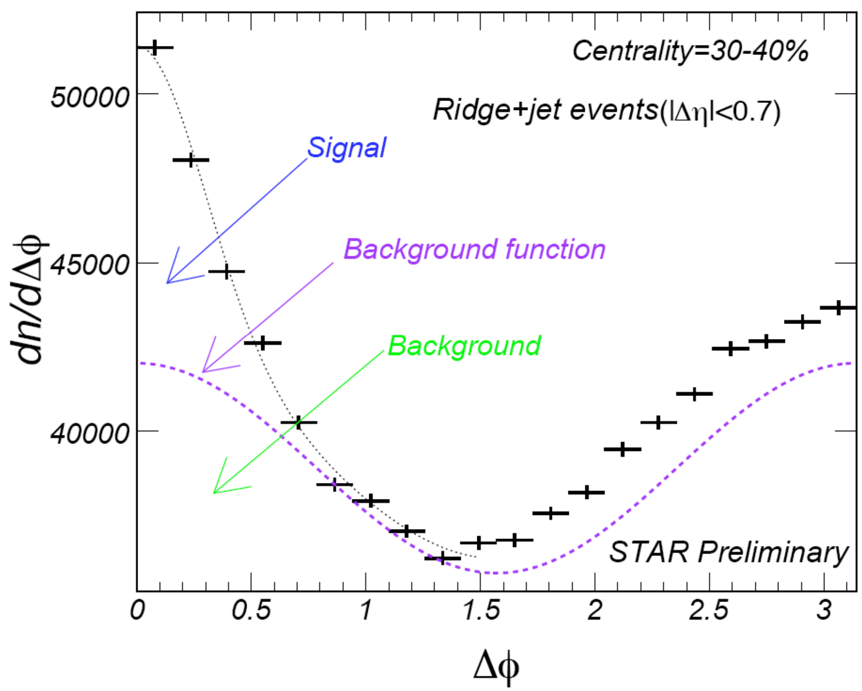
Jet signal diluted by combinatorics as expected
Jet ratio grows with minimum p_T cut

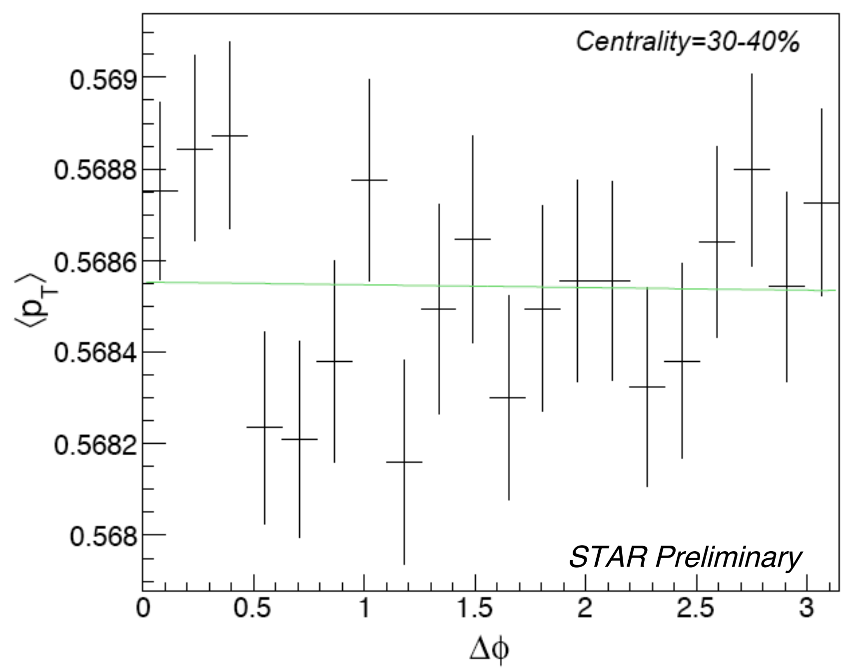
Caution: this is leading and subleading dihadrons (different quantity than usual associate particle yields)

event characteristics

The leading dihadron pair satisfying our minimum p_T requirement is selected → one pair per event

Let's study the characteristics of the events as a function of $\Delta\varphi$ and $\Delta\eta$ of the high p_T pair ($p_{T,min}$=2 GeV/c)





$\langle p_T \rangle$ does not show a strong $\Delta\varphi$ dependence

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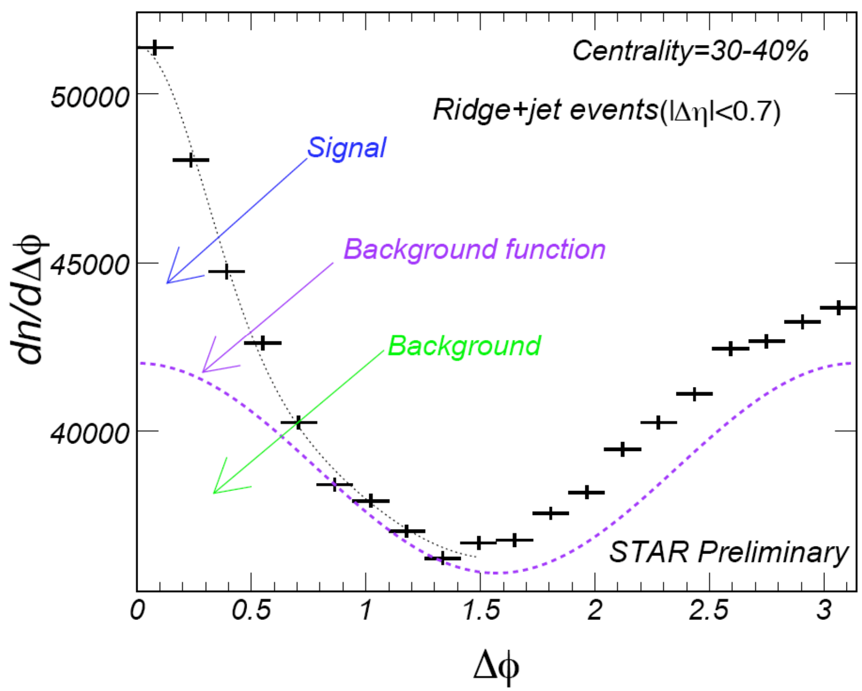
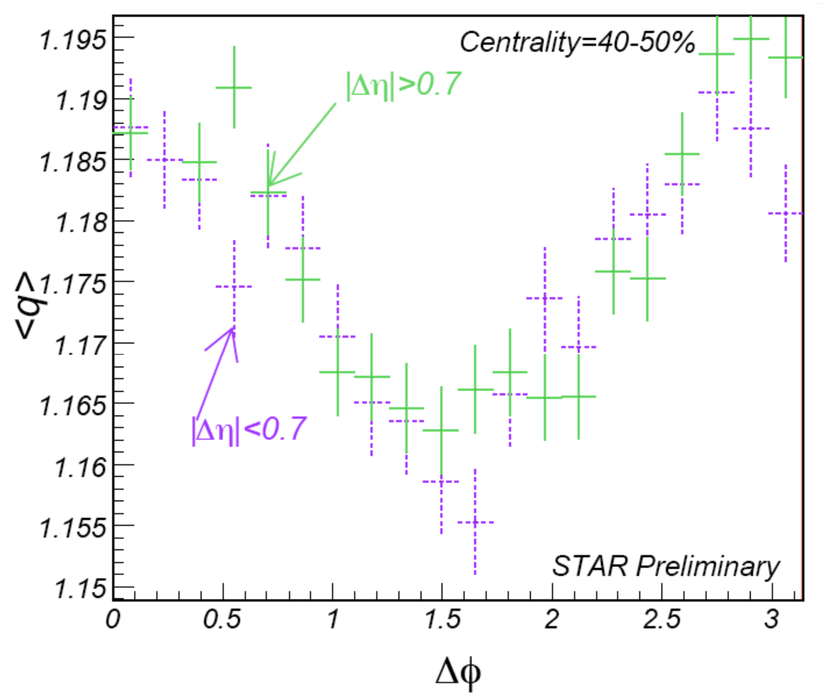
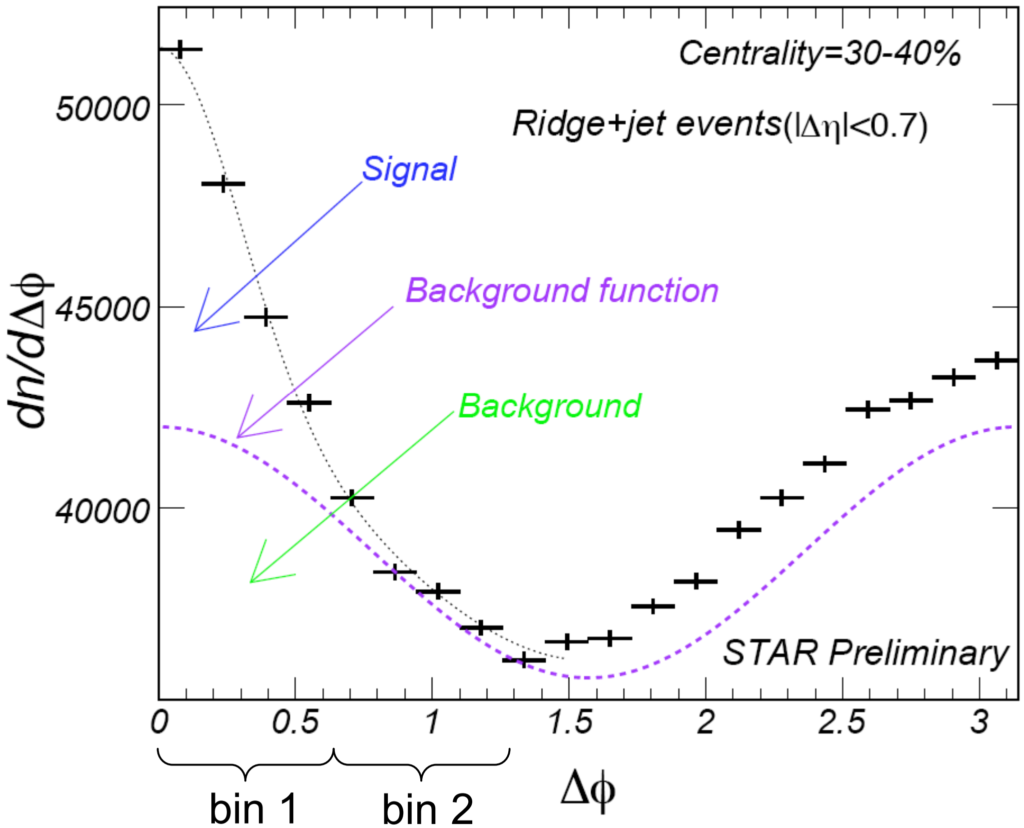




⟨|q|⟩ has a non-trivial shape

dn/dq for signal and background



- consider two bins on the near-side: each with a different signal to background ratio
- measure dn/dq for each bin
- solve two equations for two unknowns

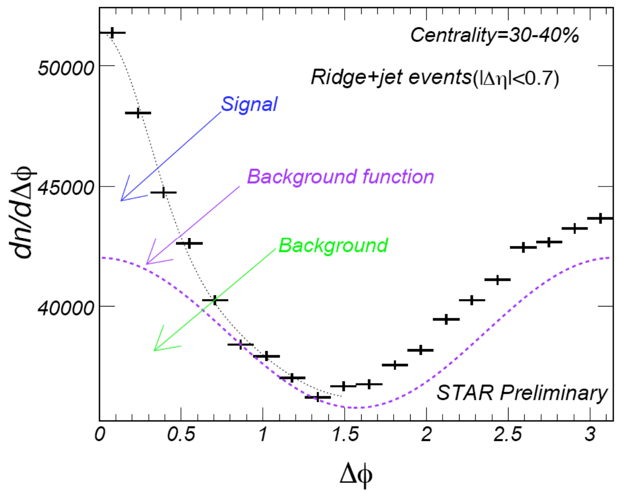
observables

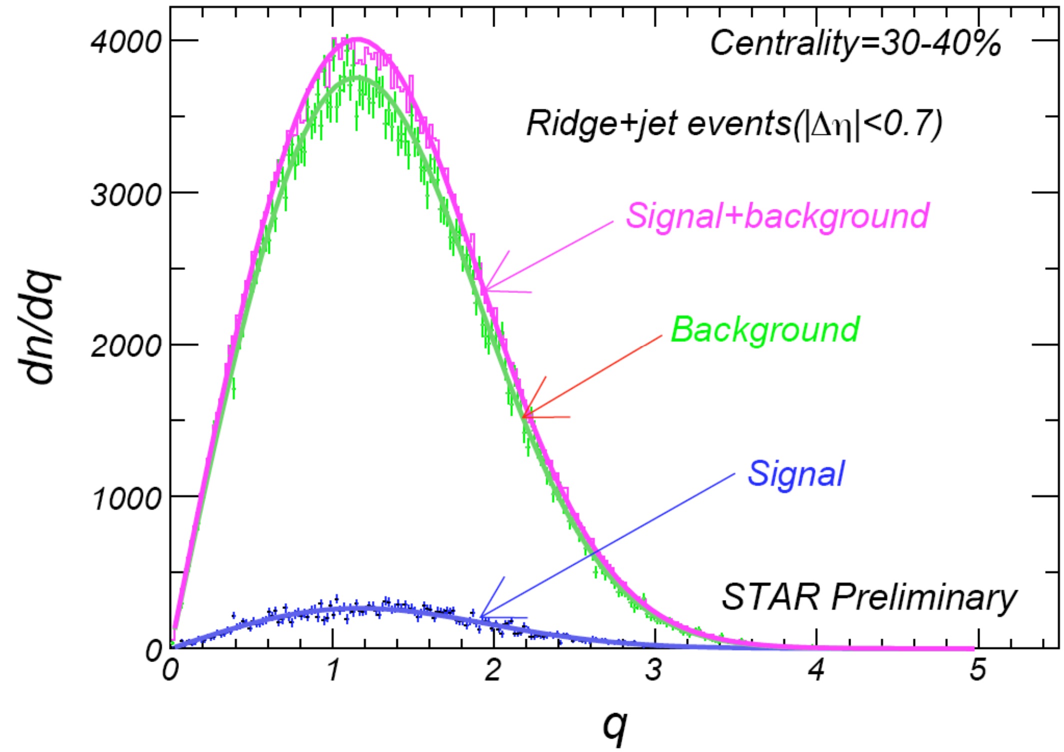
$$(S_1 + B_1)\frac{dn_1}{dq} = S_1\frac{dn_S}{dq} + B_1\frac{dn_B}{dq}$$

$$(S_2 + B_2)\frac{dn_2}{dq} = S_2\frac{dn_S}{dq} + B_2\frac{dn_B}{dq}$$

unknowns

dn/dq for signal and background





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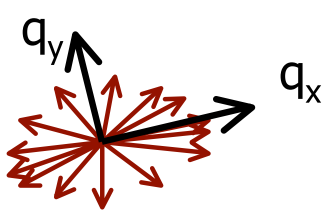
$$(S_1 + B_1)\frac{dn_1}{dq} = S_1\frac{dn_S}{dq} + B_1\frac{dn_B}{dq}$$

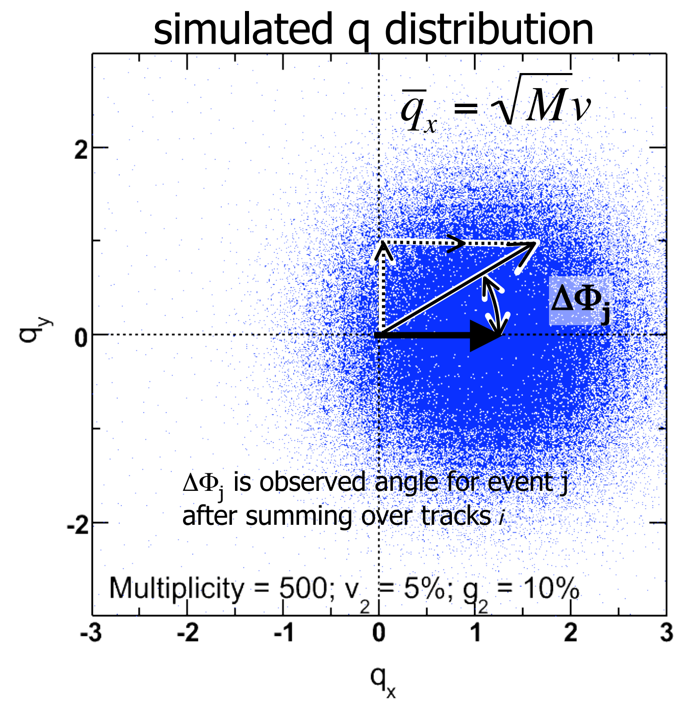
$$(S_2 + B_2)\frac{dn_2}{dq} = S_2\frac{dn_S}{dq} + B_2\frac{dn_B}{dq}$$

what we learn from |q|



$$q_{n,x} = \frac{1}{\sqrt{M}} \sum_{i=1}^{M} \cos(n\varphi_i)$$

$$q_{n,y} = \frac{1}{\sqrt{M}} \sum_{i=1}^{M} \sin(n\varphi_i)$$



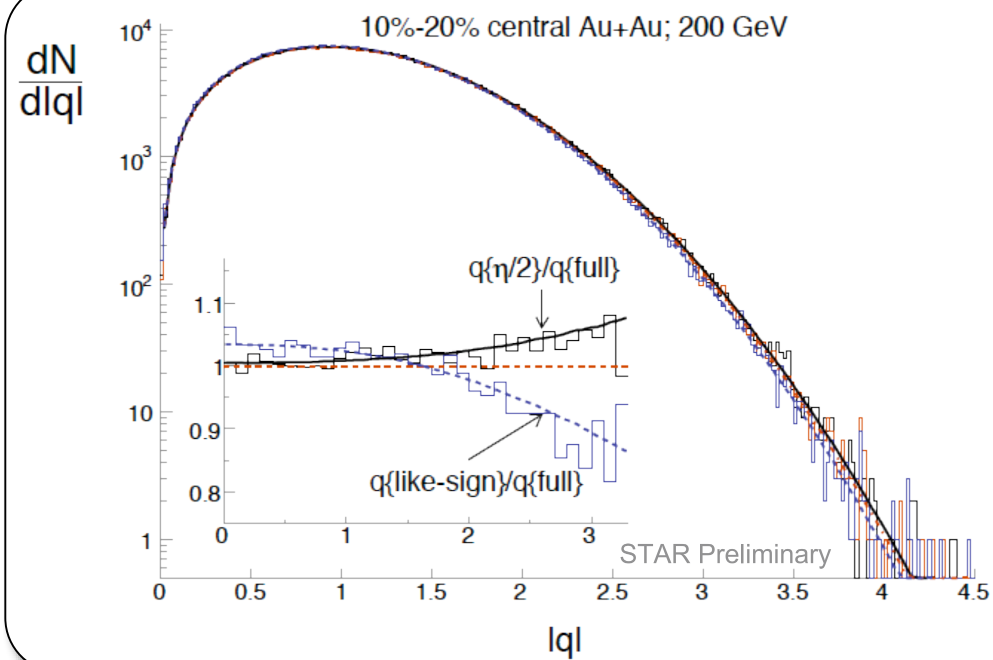
if the preferred axis (x) is the reaction plane, then the q-vector and v_2 are related by definition: $v_2 = \langle\cos(2\varphi_i)\rangle = \langle q_{2,x}\rangle/\sqrt{M}$.

then what we can extract from dN/d|q| is:

$$\langle v_2\rangle^2 - \sigma_{v_2}^2 = v_2\{4\}^2 \qquad \sigma_{q2,dyn}^2 = \delta_2 + 2\sigma_{v_2}^2 = v_2\{2\}^2 - v_2\{4\}^4$$

<q> will be influenced by non-flow, fluctuations and v_2

fitting dn/dq



the well constrained combinations of fit parameters are:

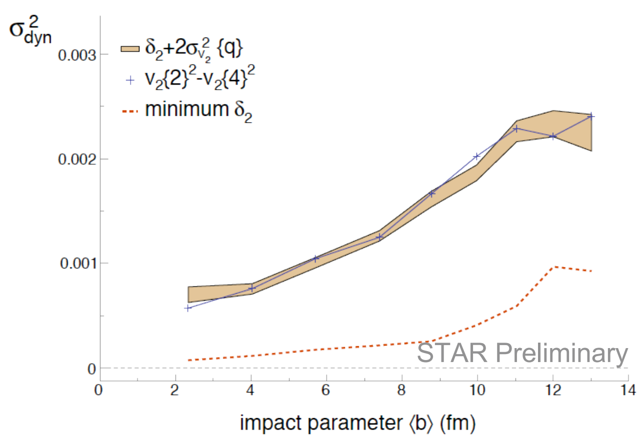
$$\langle v_2 \rangle^2 + \sigma_{v_2}^2 + \delta_2 = v_2\{2\}^2$$

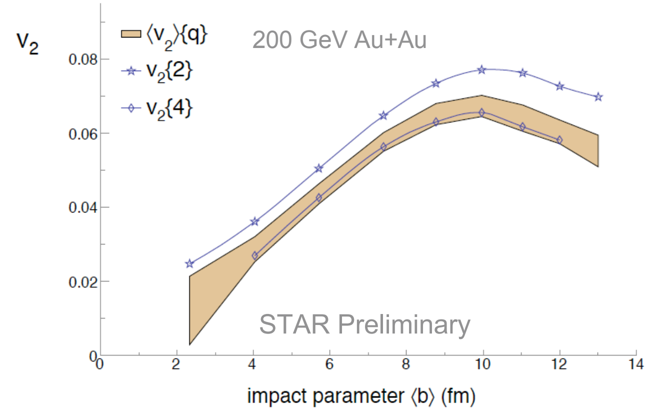
$$\langle v_2 \rangle^2 - \sigma_{v_2}^2 = v_2\{4\}^2$$

the dynamic width is the difference between the above equations

$$\sigma_{dyn}^2 = \delta + 2\sigma_{v_2}^2 = v_2\{2\}^2 - v_2\{4\}^4$$

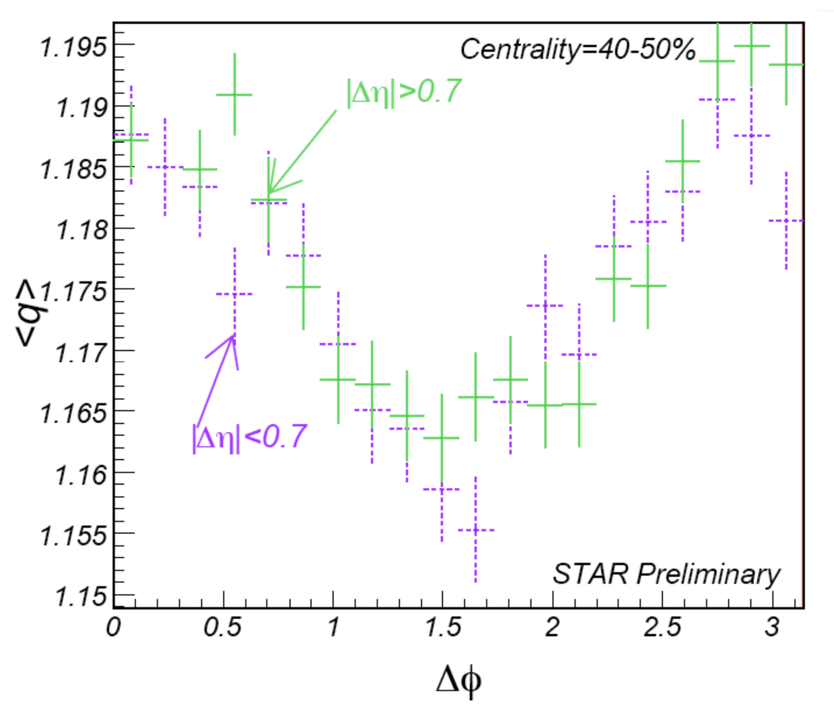
we report $v_2\{4\}$ and σ_{dyn}^2

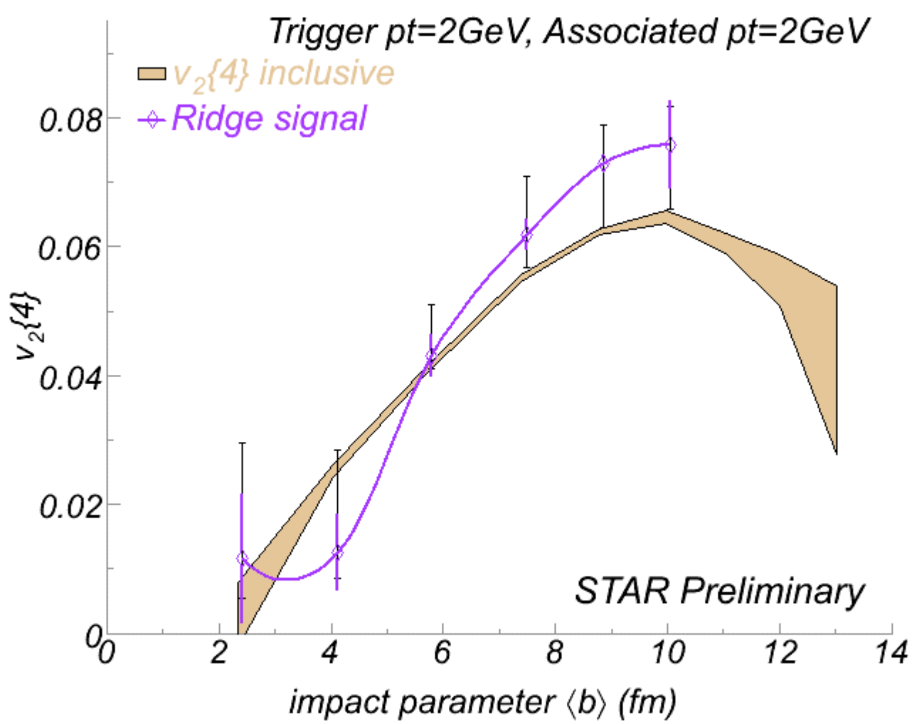




dn/dq parameters

Modulation of ⟨|q|⟩ manifests in increase of $v_2\{4\}$ and/or σ_{dyn}^2 for events contributing a pair to the ridge



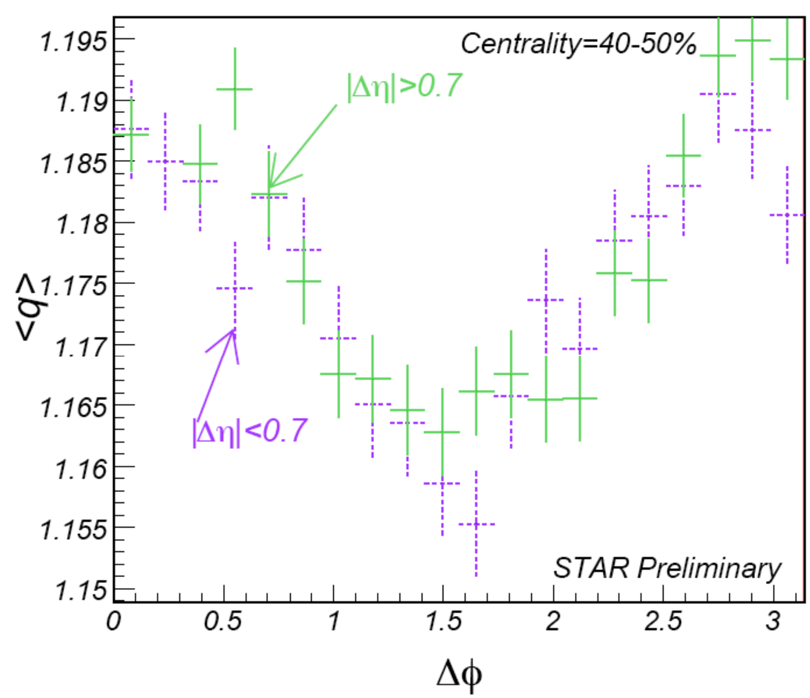


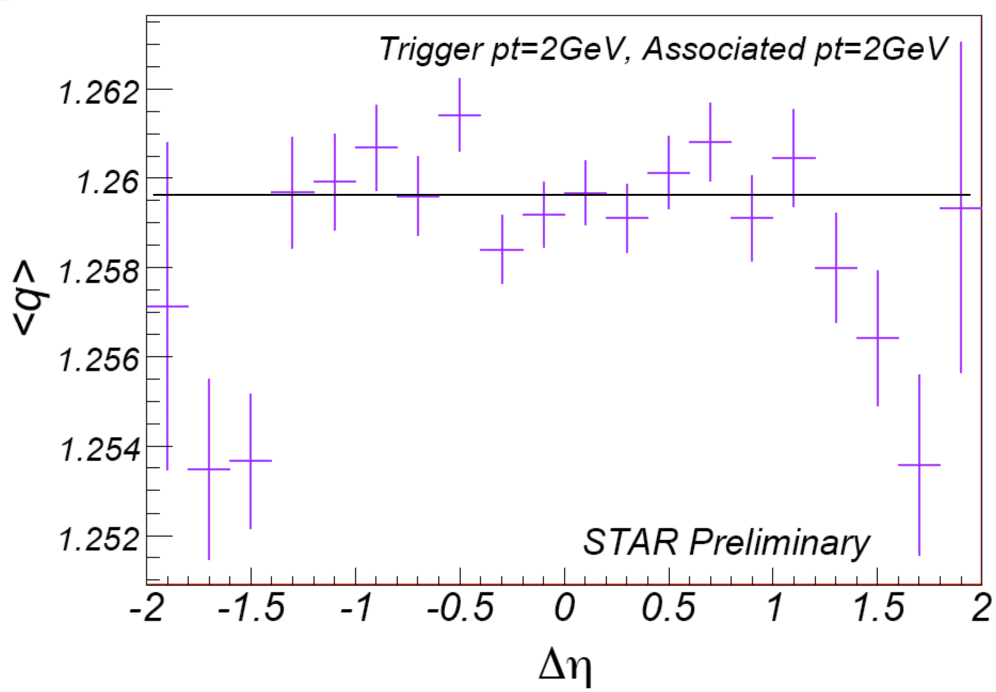
systematic errors from relaxation of ZYAM and track merging studies

careful mapping of 2-D χ^2 contours ($v_2\{4\}$ vs σ_{dyn}^2) is still needed to establish which parameter accounts for the Δφ dependence

jet-event $v_2\{4\}$ from QM08

- small jet-event $v_2\{4\}$ reported at QM08 was due to error
- η dependence of <q> is still under study
- update planned for ICHEP08 (stay tuned)





summary

An analysis has been developed to search for jet interactions with the medium and/or physics that couples the high p_T ridge correlations to v_2 *(are the ridge and v_2 both manifestations of the same space-momentum correlations for example?)*

Variation in the shape of dn/dq vs $\Delta\varphi$ indicates possible effects to be further studied

Source of variation needs much further investigation

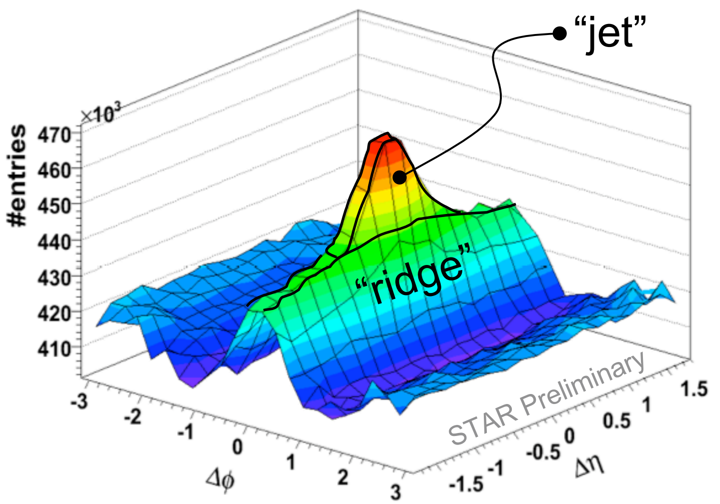
- are ZYAM and the two-component model applicable?
- is $\cos(2\Delta\varphi)$ the right shape for the background modulation?
- what are the effects of momentum conservation?
- can non-flow account for entire effect?

Small $v_2\{4\}$ for events yielding a jet-like correlation reported at QM08 was in error

Updated results will be presented soon.

end

jet and ridge yields



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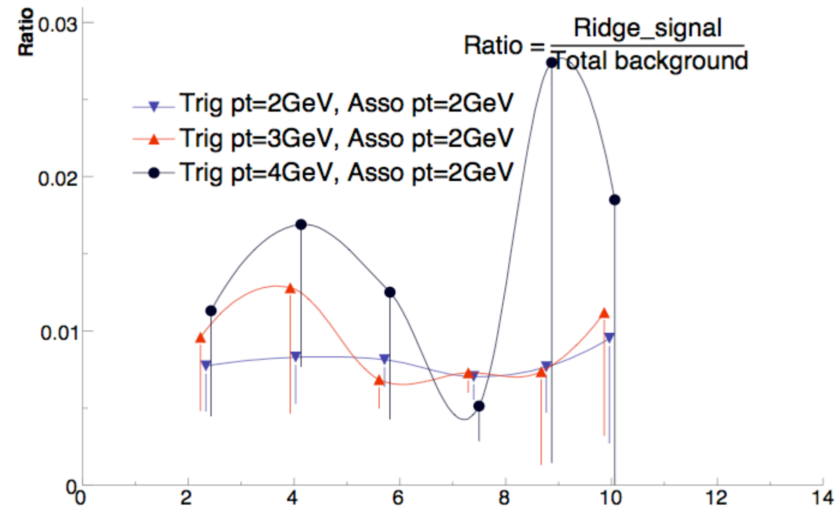

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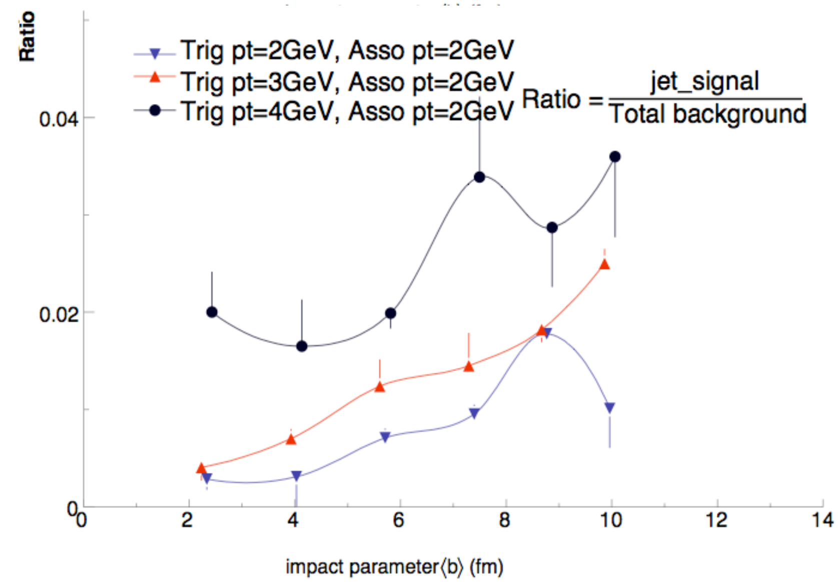

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