Azimuthal anisotropy of prompt J/ψ in PbPb collisions in CMS

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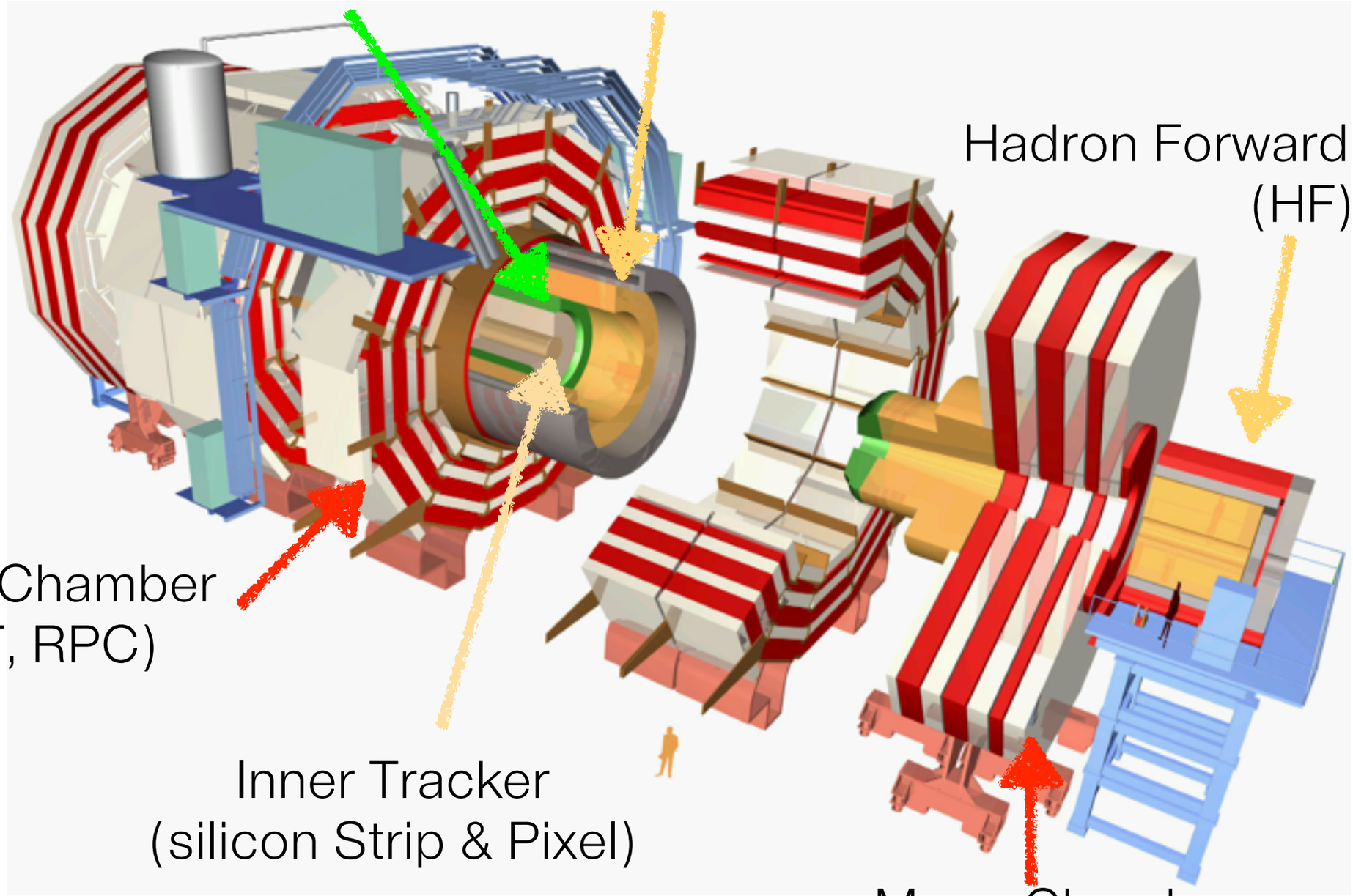
CMS detector configuration

Calorimeters
(Electromagnetic & Hadron)



Hadron Forward Calorimeter
(HF)

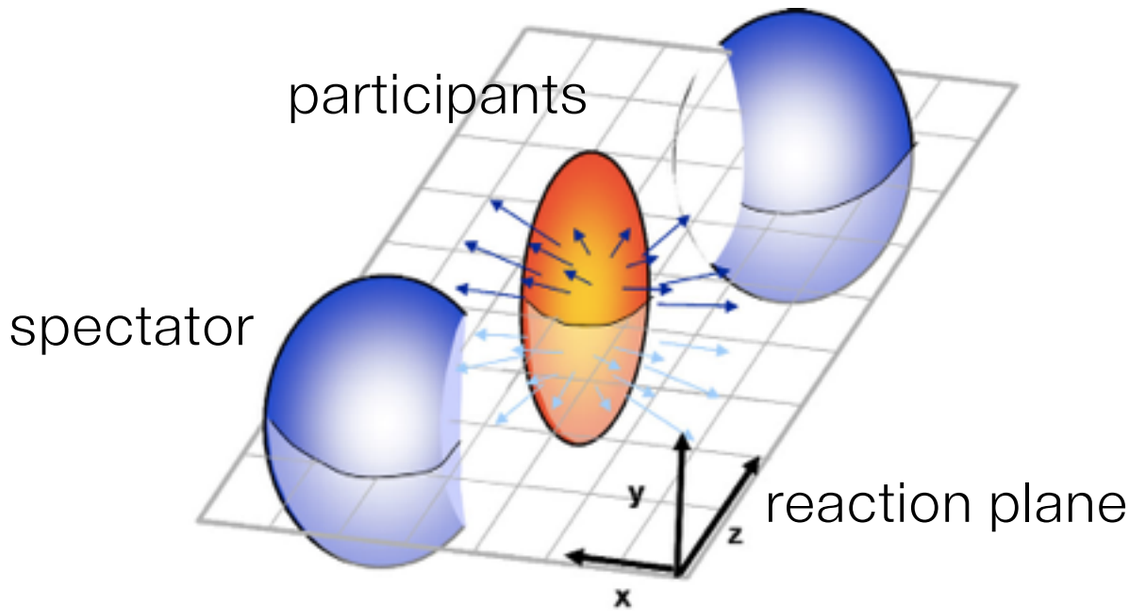
MuonChamber
(DT, RPC)

Inner Tracker
(silicon Strip & Pixel)

Muon Chamber
(CSC, RPC)

motivation

- Quarkonia are expected to carry out information on the initial state and the medium effects



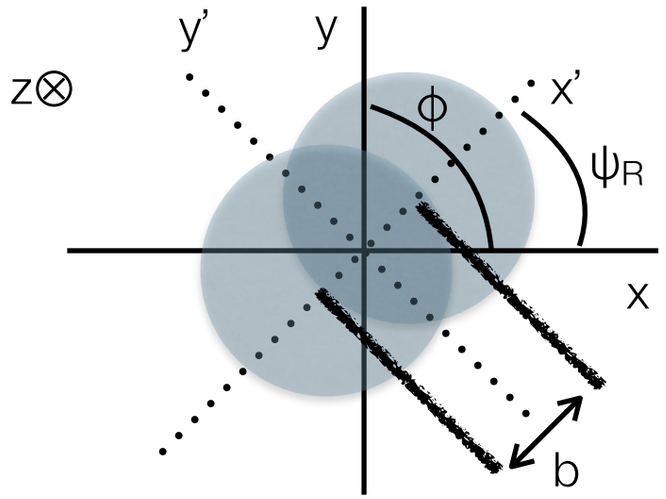
- participants of the collision are distributed in an almond shape region

- Due to the length and pressure difference, spatial anisotropy converted into a momentum anisotropy

- this anisotropy is strong evidence for the existence of QGP

flow

- azimuthal anisotropy can be described using Fourier series



$$E\frac{d^3N}{dp^3} = \frac{1}{2\pi}\frac{d^2N}{p_t dp_t dy}\left(1+\sum_{n=1}^{\infty} 2v_n \cos[n(\phi-\Psi_R)]\right)$$

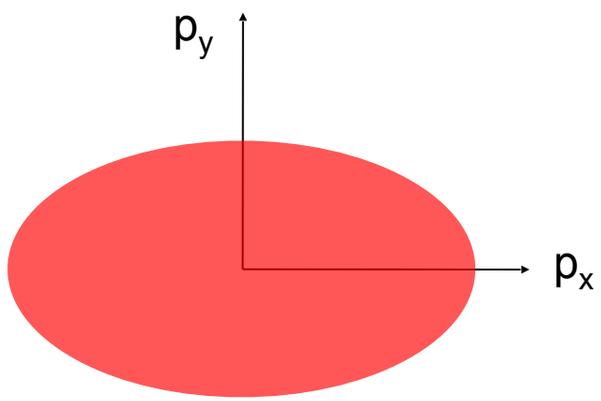
Ψ_R: angle of reaction plane

- reaction plane is defined by the impact parameter b and the beam axis z

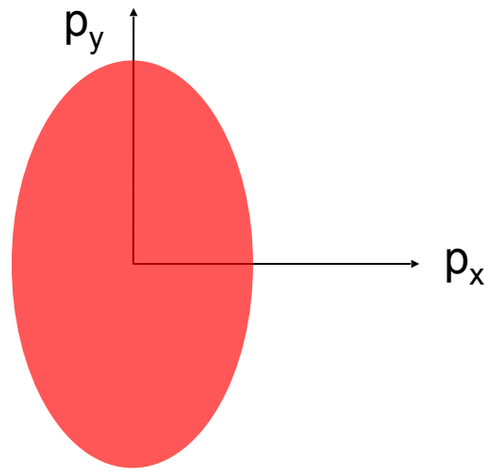
- v_1: direct flow, v_2: elliptic flow, v_3: triangular flow and so on

elliptic flow

- how the flow is not uniform in all detections when viewed along the beam-line
- directly reflects the initial spatial anisotropy
- in-plane elliptic flow due to pressure gradient
- out-of-plane elliptic flow due to spectator blocking



$v_2 > 0$: in-plane



$v_2 < 0$: out-of-plane

Prompt J/ψ extraction

- CMS collected 150 μb^{-1} in 2011 2.76 TeV PbPb collision
- J/ψ are reconstructed from $\mu^+\mu^-$ pair
- non-prompt J/ψ excluded by 2-D fit

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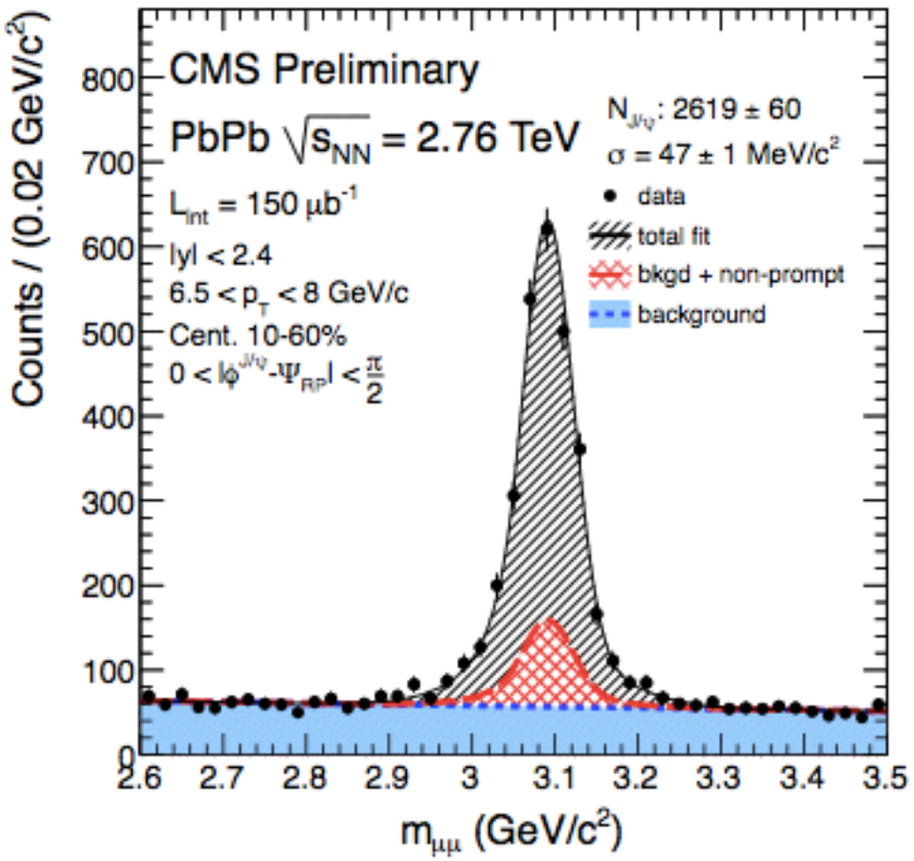

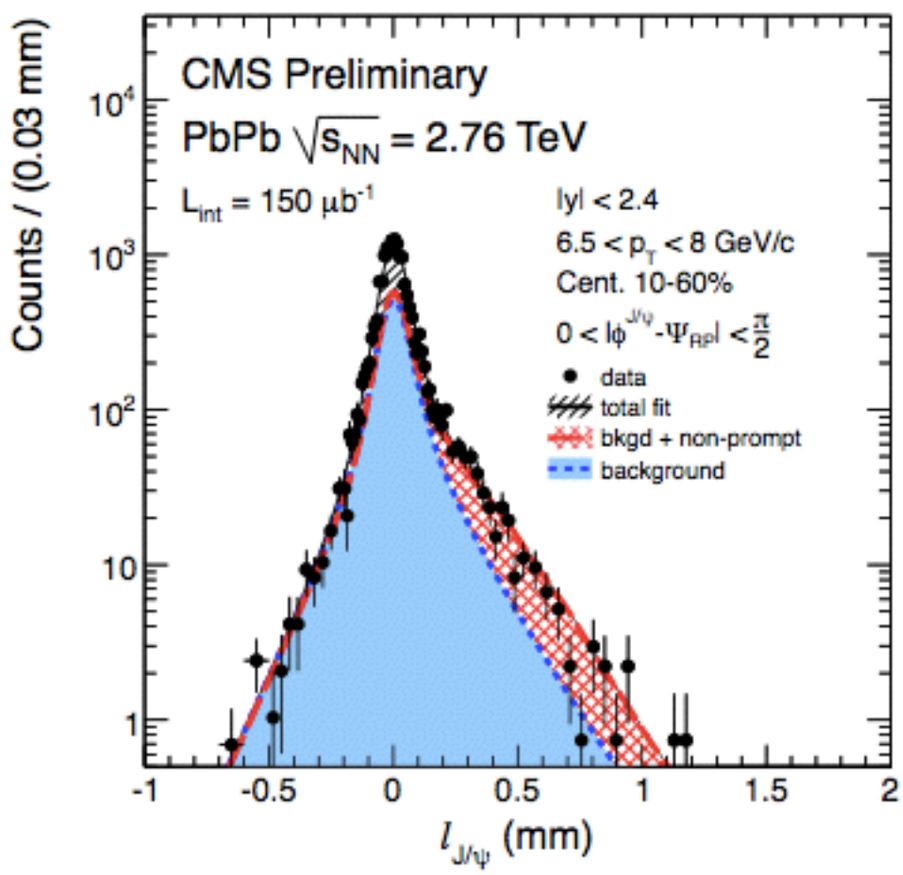

$l_{J/\psi}$: pseudo-proper decay length

v_2 calculation

- use prompt J/ψ yields in each rapidity, p_T, centrality, Δϕ

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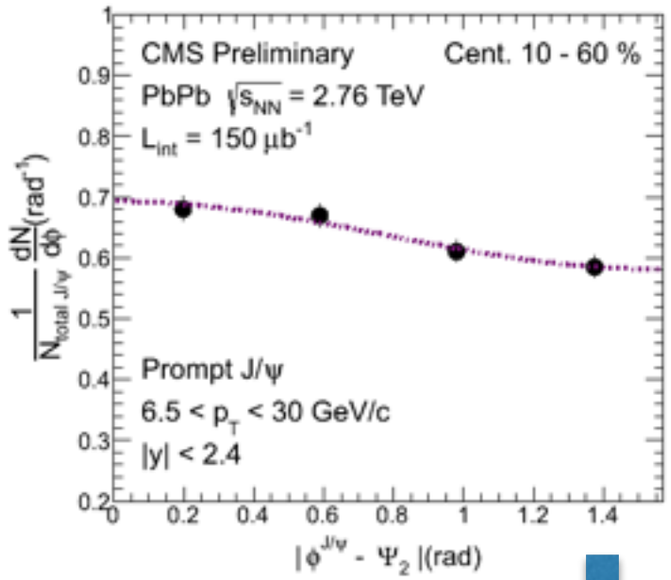
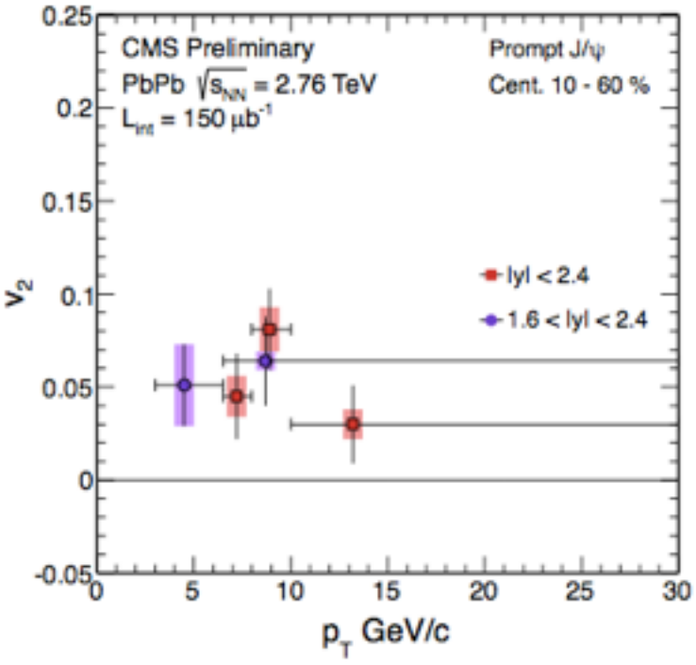
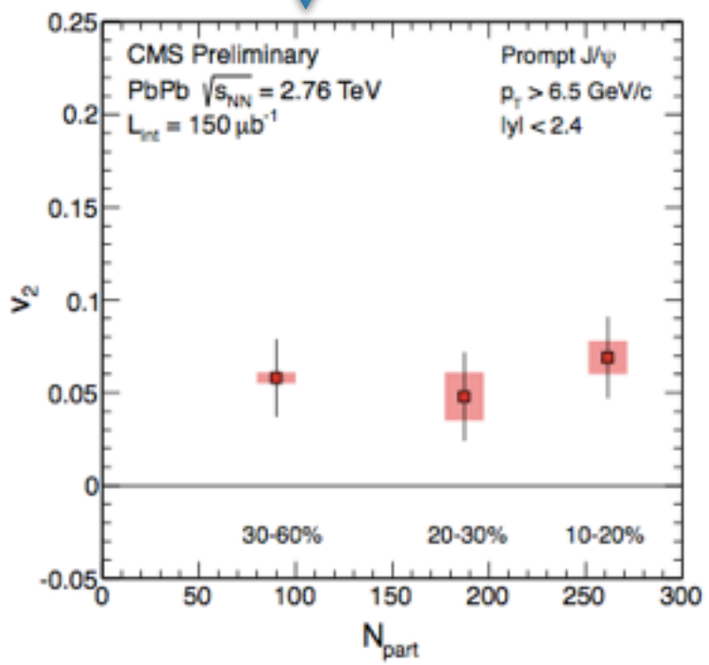
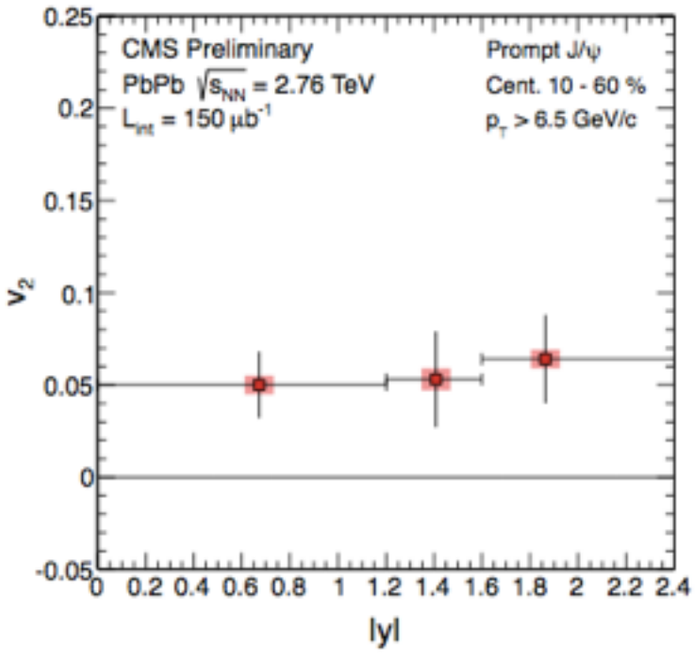
$$1+2v_2\cos(2\Delta\phi)$$



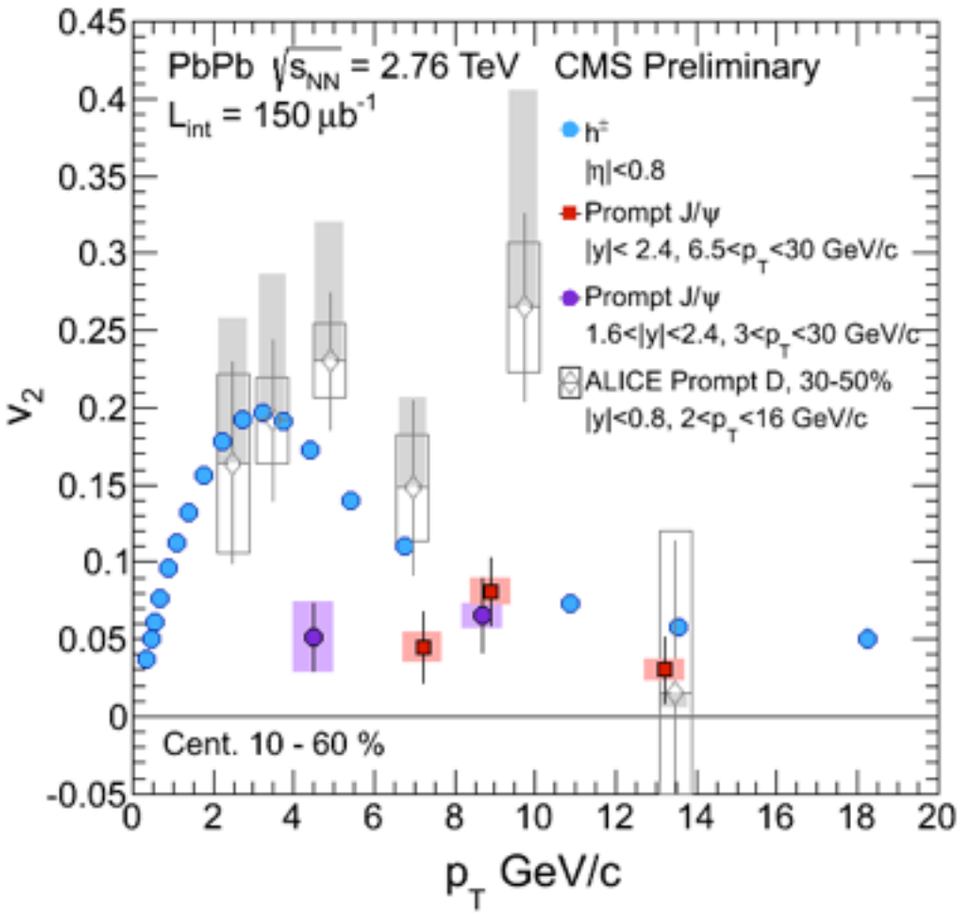






- no significant centrality or rapidity dependence

comparison with other experiments



- at high p_T, v_2 looks matches with other experiments
- but at low p_T, v_2 are not
- prompt J/ψ contains information of early state before QGP make

summary

- CMS measured elliptic flow of prompt J/ψ at 2.76 TeV PbPb collision in 2011

- The measured prompt J/ψ v_2, for 10-60 % event centrality, integrated over $6.5 < p_T < 30$ GeV/c and $|y| < 2.4$ is

- $0.054 \pm 0.013(\text{stat}) \pm 0.006(\text{syst})$

- a non-zero v_2 is measured in all the kinematic bins studied

- the observed anisotropy shows no significant centrality or rapidity dependence when integrated over rapidity and centrality, respectively

back up

event plane method