FFD and FHCal comparison for flow analysis in the MPD experiment

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Cross-PWG meeting in MPD

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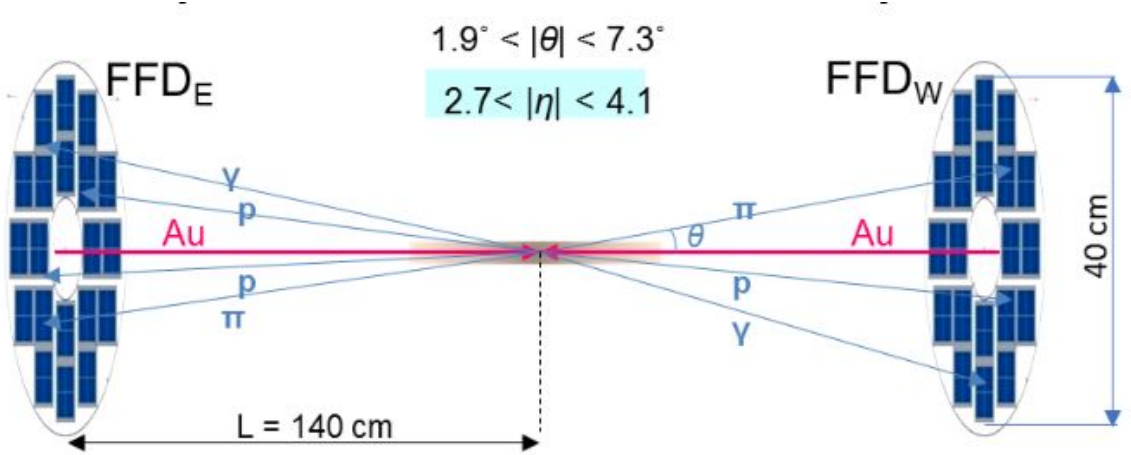
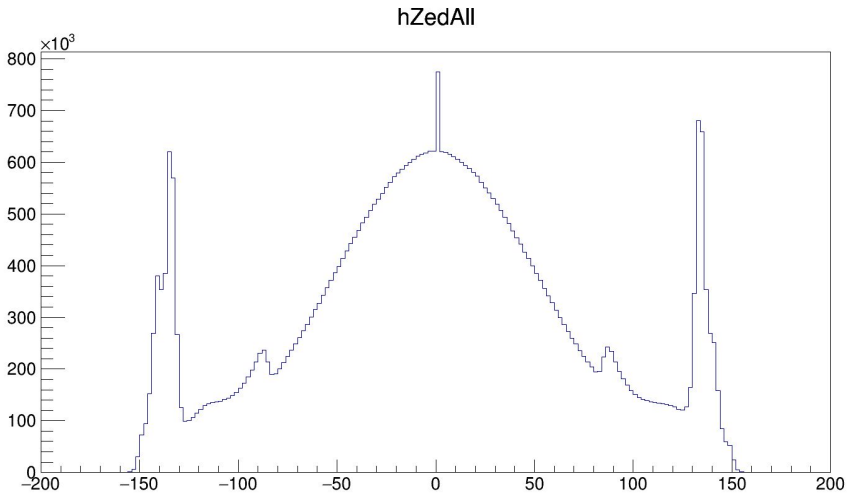
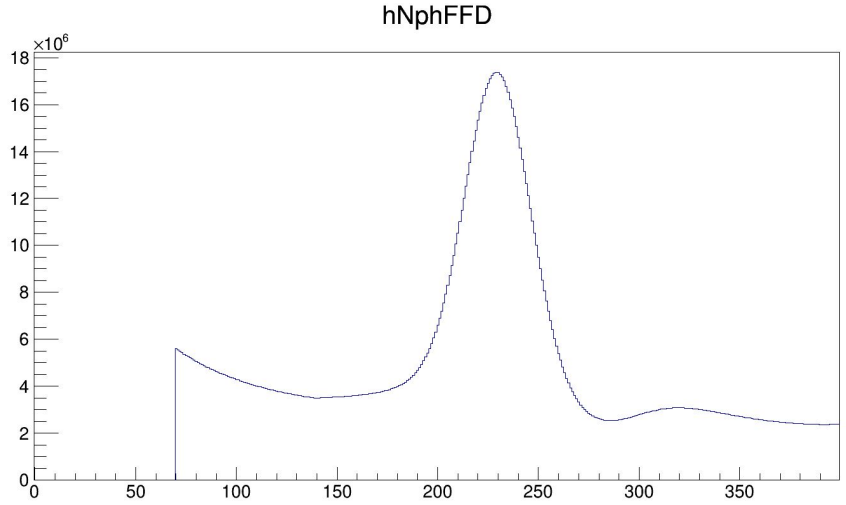
FFD detector



The FFD consists of two sets of Cherenkov counters located at ±140 cm from the nominal interaction point. Each set has 20 physical detectors with 4 read-out channels each. As a result, the total number of read-out channels is 2 sides 80 channels = 160 channels.

FFD QA





- To reduce impact of vertexZ, set cut |vtxZ|<50 cm and remove peak in vtxZ=0
- Number of photons in FFD is used as the weight

Dataset: Request 25 BiBi@9.2AGeV UrQMD 50m events

u_n, Q_n vectors formalism for flow measurements

- Unit vector of a particle $u_n(\text{centrality}, \text{pid}, p_T, y)$:

$$u_n = e^{in\varphi} = \begin{cases} u_{n,x} \equiv x_n = \cos n\varphi \\ u_{n,y} \equiv y_n = \sin n\varphi \end{cases}$$

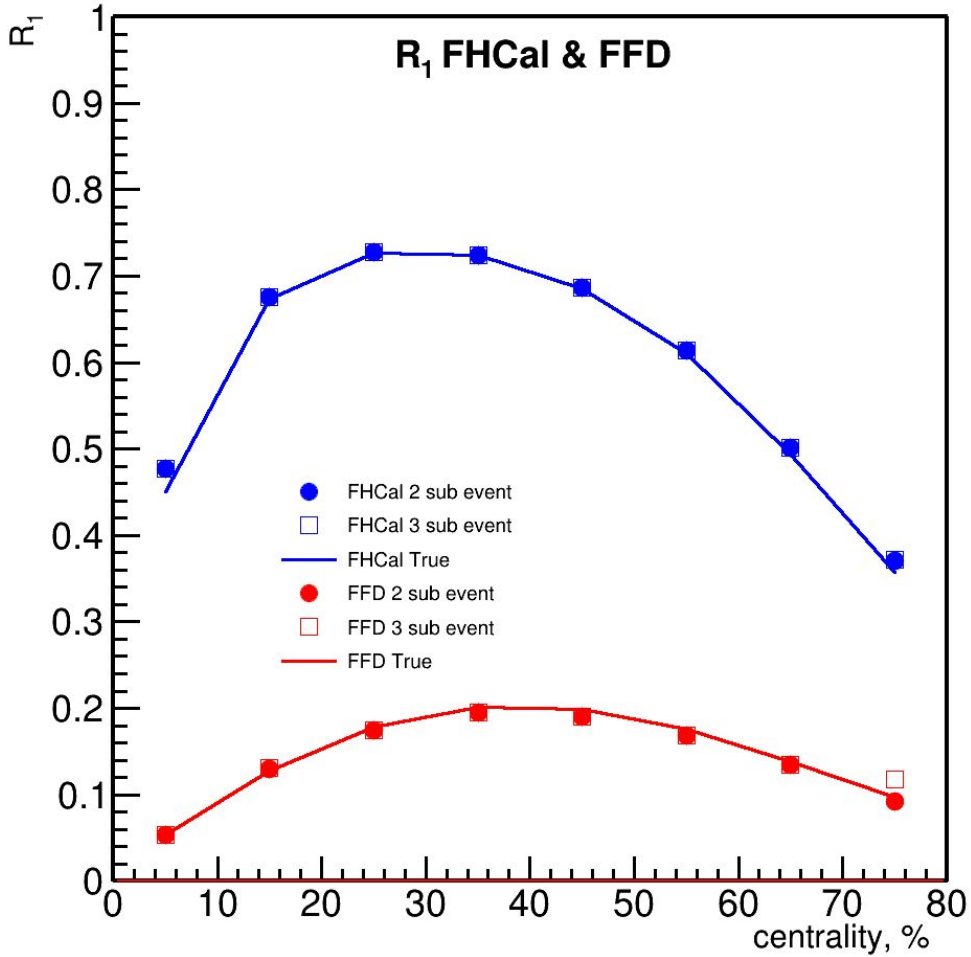
- Event flow vector $Q_n(\text{centrality})$:

$$Q_n = \sum_{k=1}^{M} \omega_n^k u_n^k \equiv |Q_n| e^{in\Psi_n} = \begin{cases} Q_{n,x} \equiv X_n = |Q_n| \cos n\Psi_n \\ Q_{n,y} \equiv Y_n = |Q_n| \sin n\Psi_n \end{cases}$$

  - φ – azimuthal angle of the produced particle
  - ω – weight of the Q_n vector (for example, $\omega = 1$ for participant plane and $\omega = E$ for spectator plane)
  - Ψ_n – event plane angle

More information:
https://inspirehep.net/literature/757158

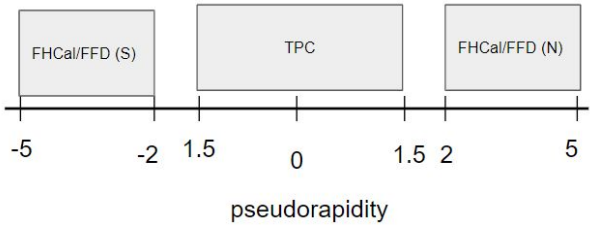
Request 25 FHCal & FFD event plane Resolution



2 sub event

$$R_{1,i} = \sqrt{\langle Q^N_{1,i} Q^S_{1,i} \rangle}, i = x, y$$

$$R^{True}_{1,i} = \langle Q_{1,i} \Psi_{RP} \rangle$$

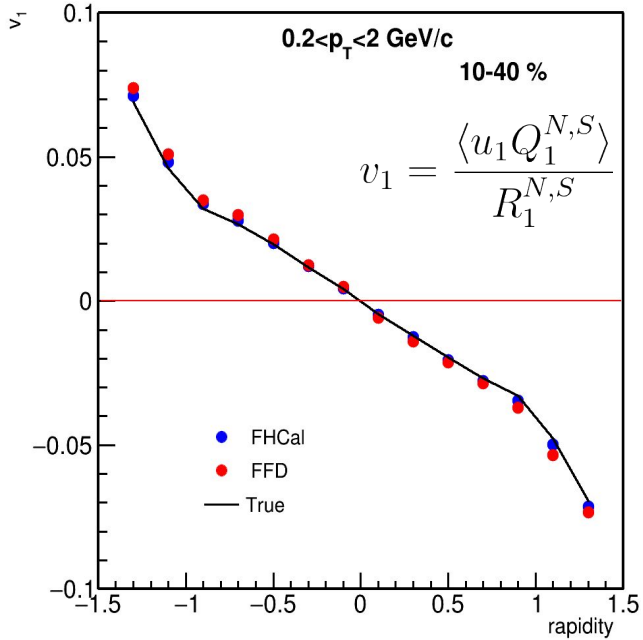


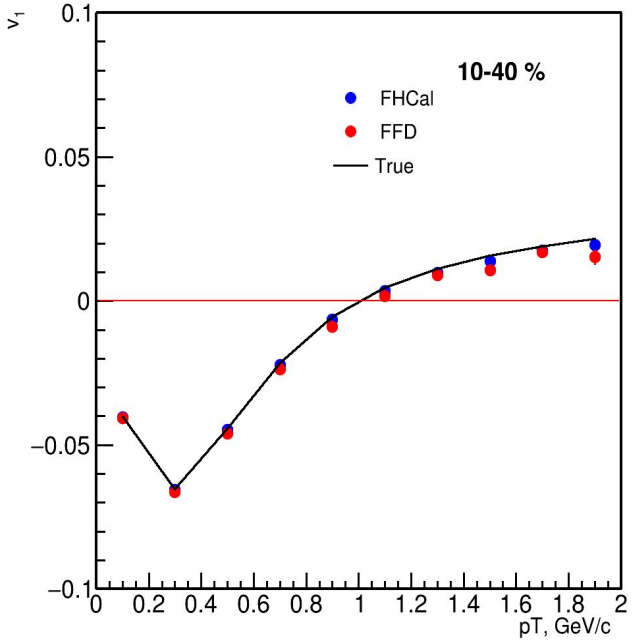
3 sub event

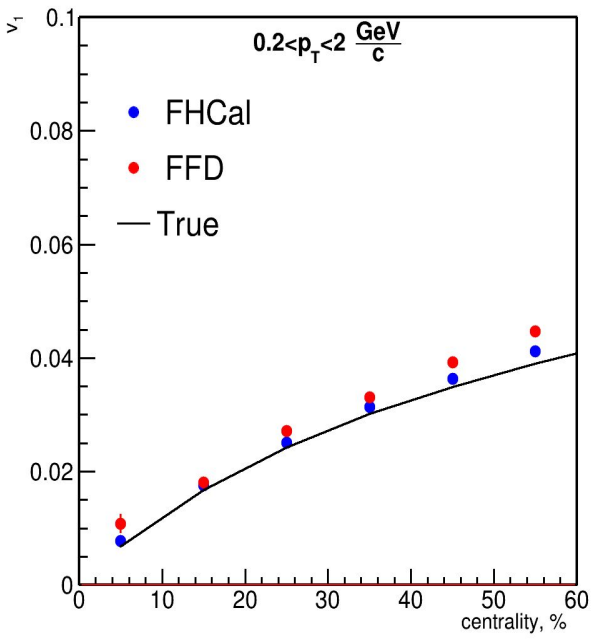
$$R^N_{1,i} = \sqrt{\frac{2\langle Q^N_{1,i} Q^S_{1,i} \rangle \langle Q^S_{1,i} Q^{TPC}_{1,i} \rangle}{\langle Q^N_{1,i} Q^{TPC}_{1,i} \rangle}}$$

- FFD resolution are smaller than FHCal
- 2 and 3 sub event has good agreement with True Resolution

Directed flow of charged hadrons with FHCal and FFD

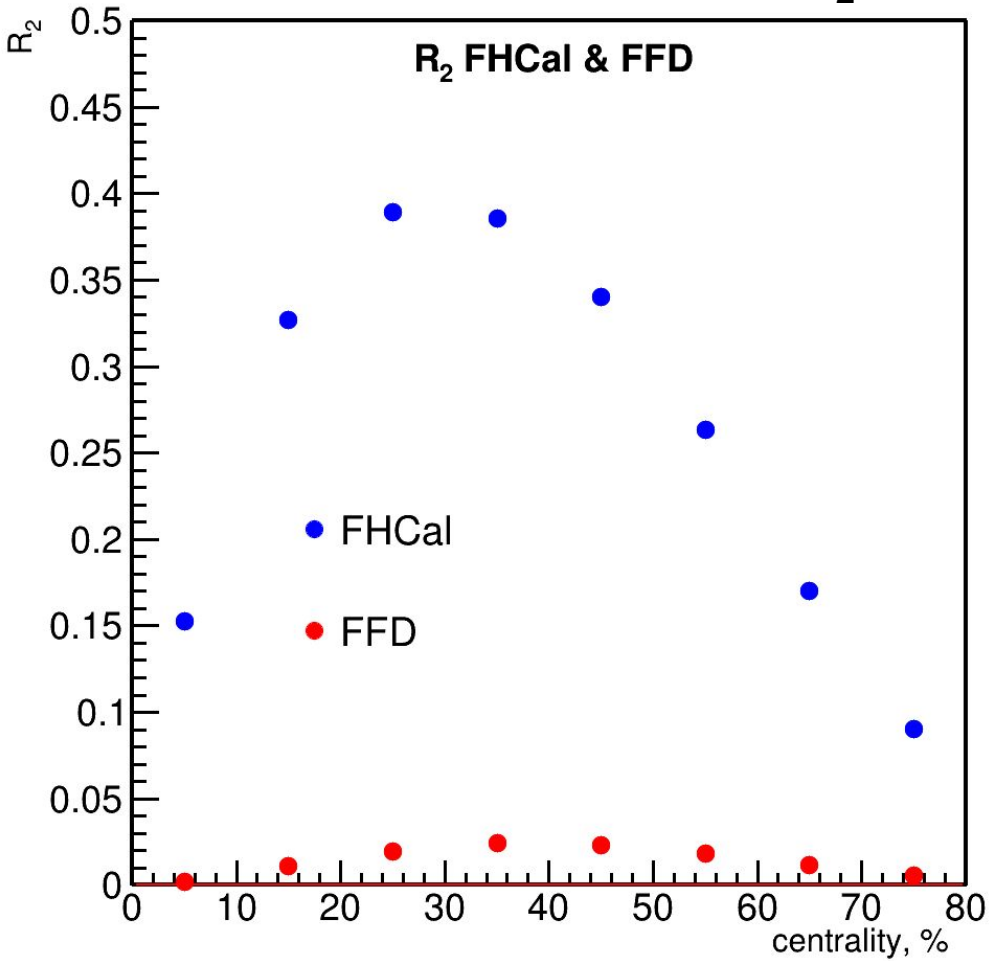




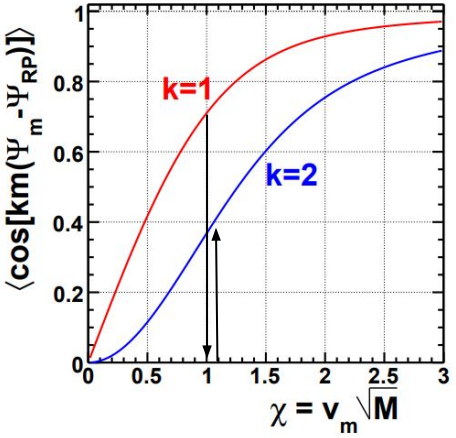


FHCal is better than FFD for directed flow measurements

Request 25 FHCal & FFD R_2

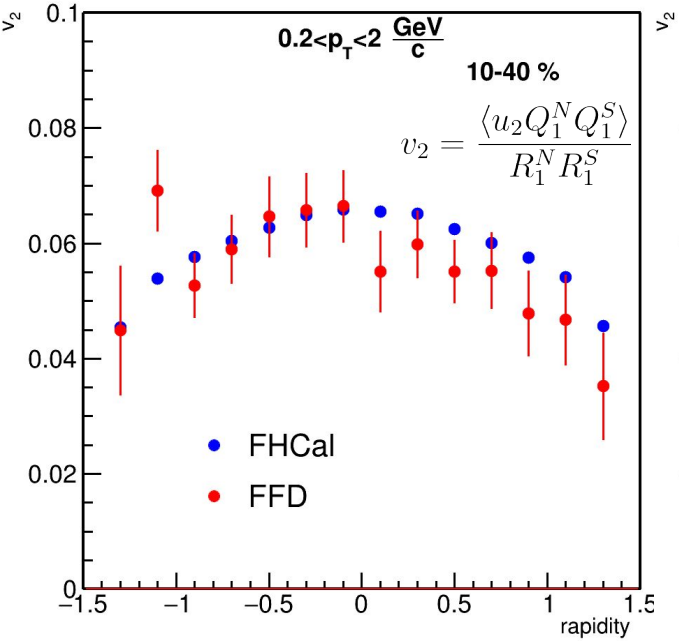


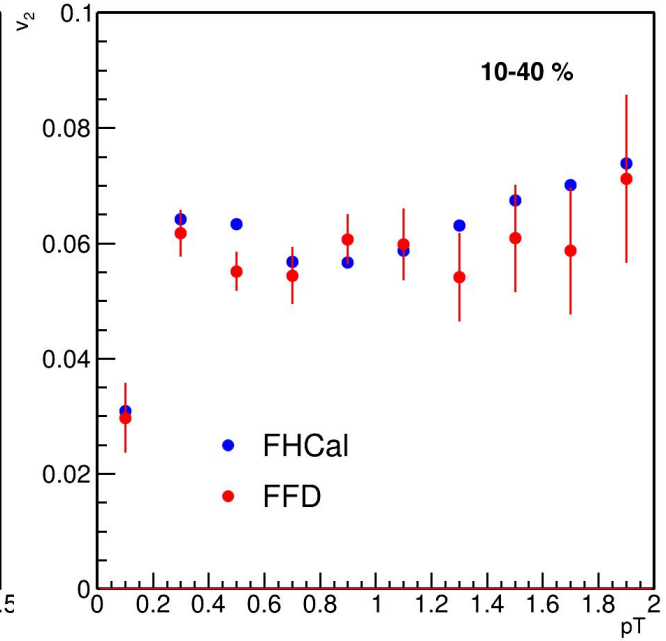
Ollitro extrapolation to obtain R_2

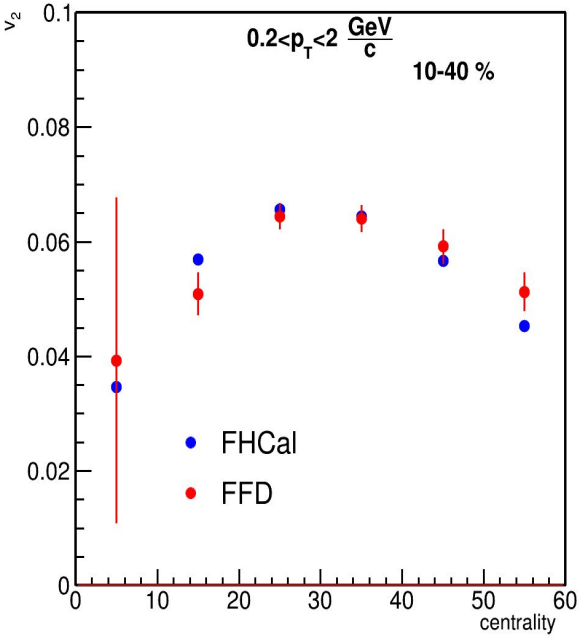


- FFD resolution is extremely small.

Elliptic flow of charged hadrons with FHCal and FFD







FFD need more statistics than FHCal

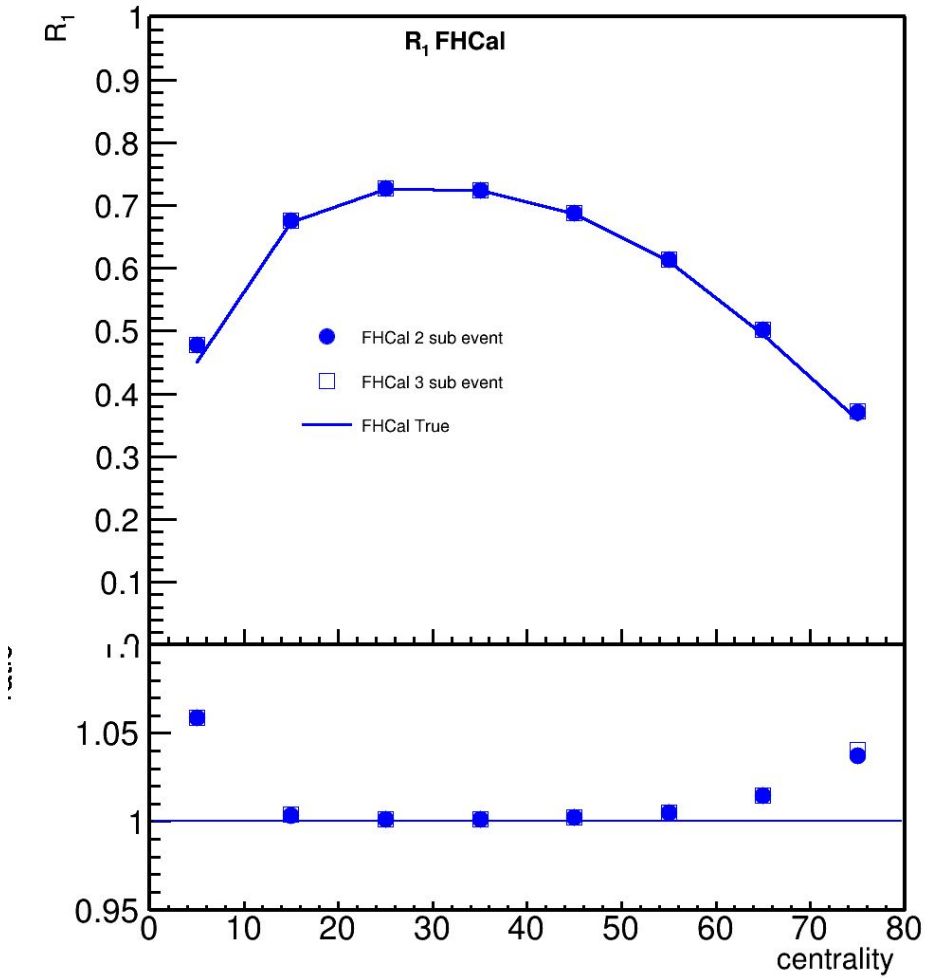
Results

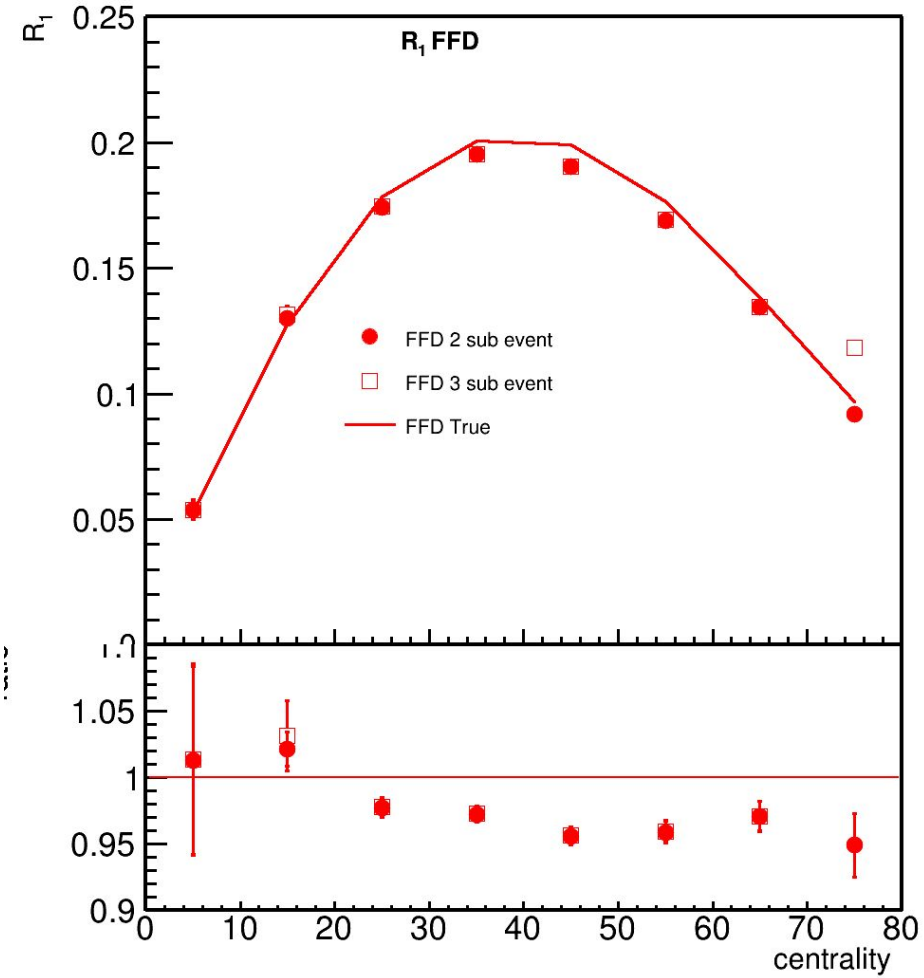
- Event plane Resolution of FFD is much more smaller than FHCal resolution;
- Good agreement for 2 and 3 sub event methods
- FFD has extremely small Resolution for 2-nd harmonic
- FFD needs more statistics than FHCal for flow measurements
- FHCal are better than FFD for flow measurements

Question:

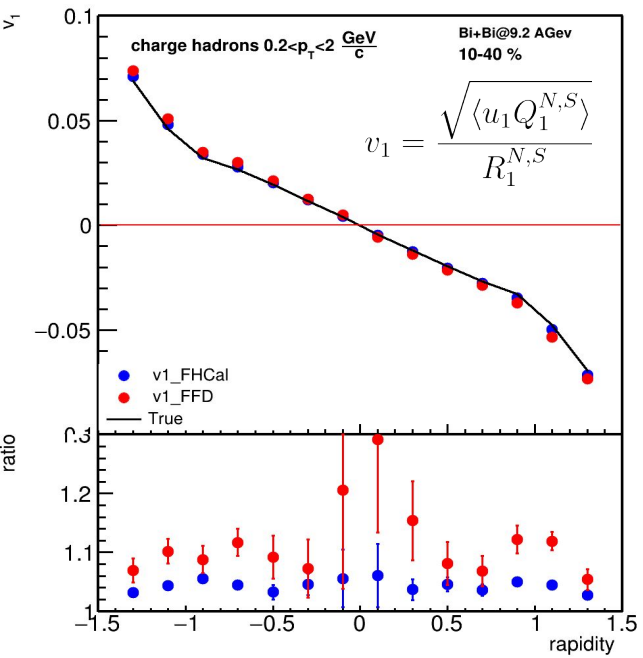
- Which parameter will be available in the experiment?(number of photons, energy, something else)

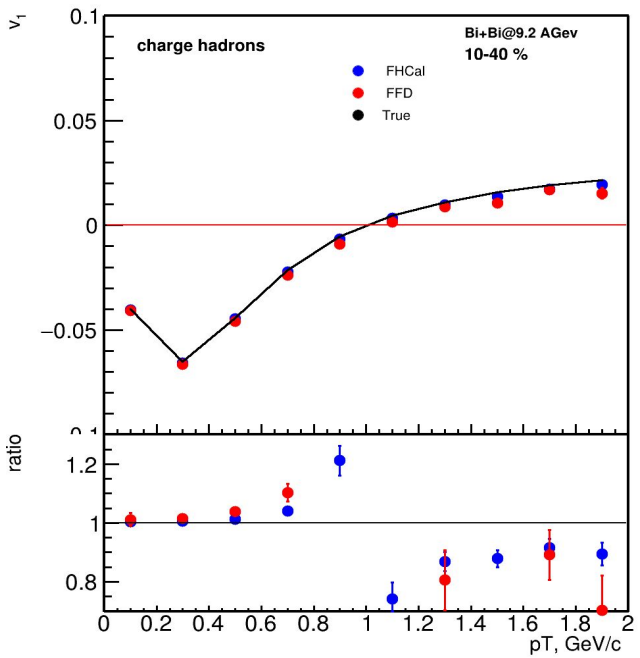
BACKUP

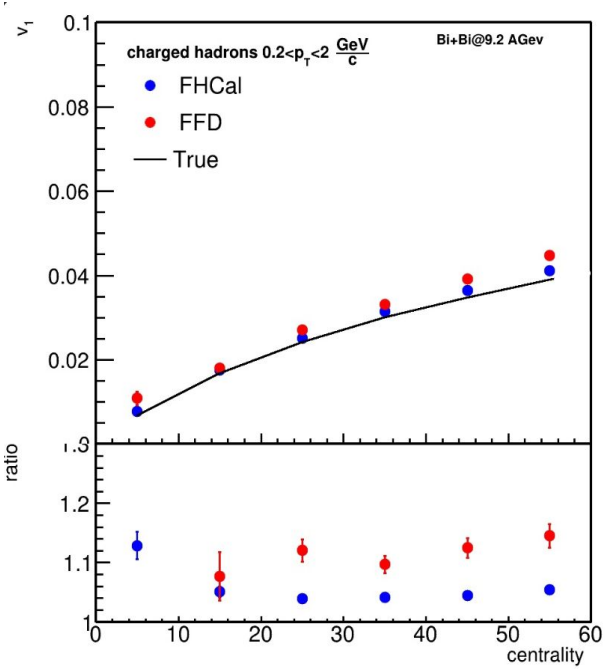

R1 FHCal
R1
FHCal 2 sub event
FHCal 3 sub event
FHCal True
centrality


R1 FFD
R1
FFD 2 sub event
FFD 3 sub event
FFD True
centrality

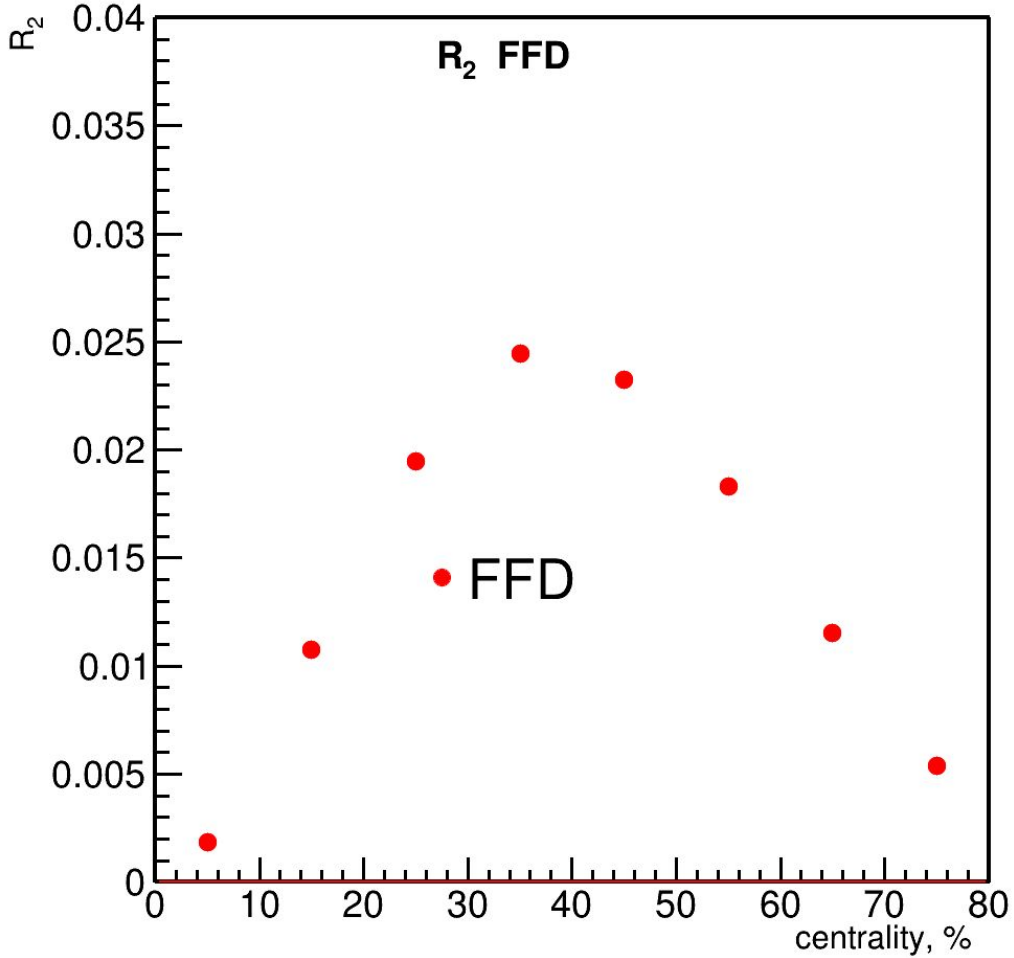
Directed flow of charged hadrons with FHCal and FFD



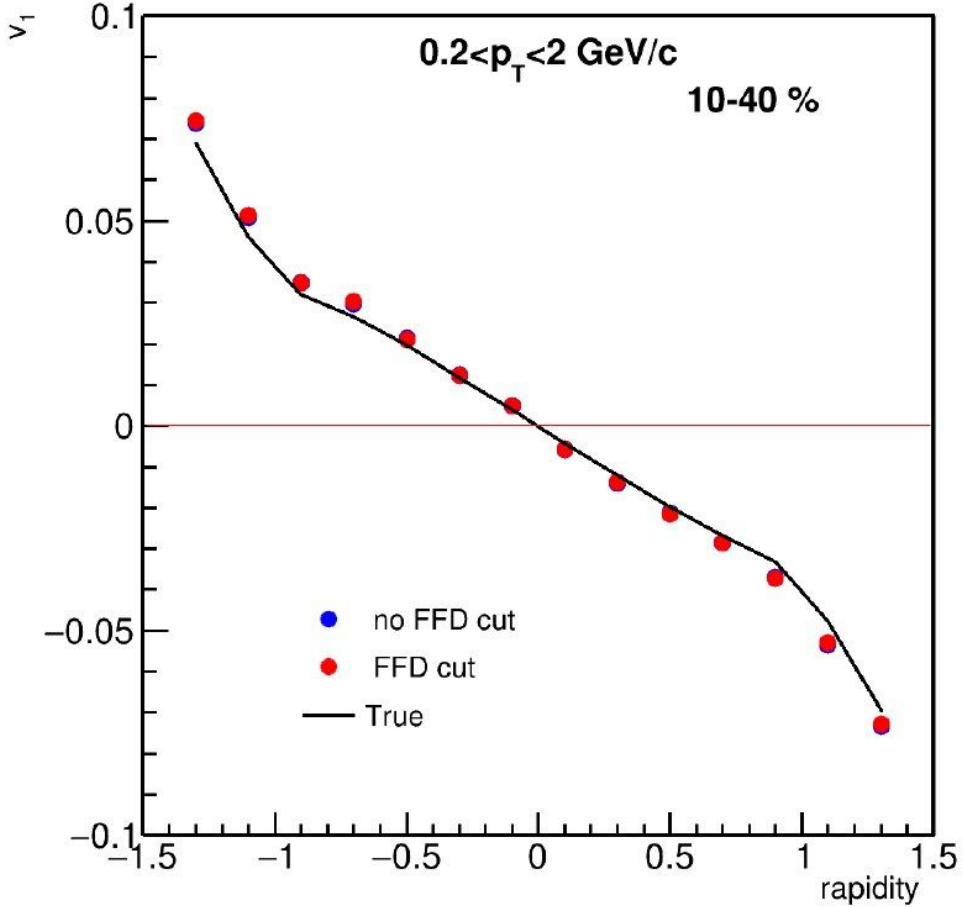


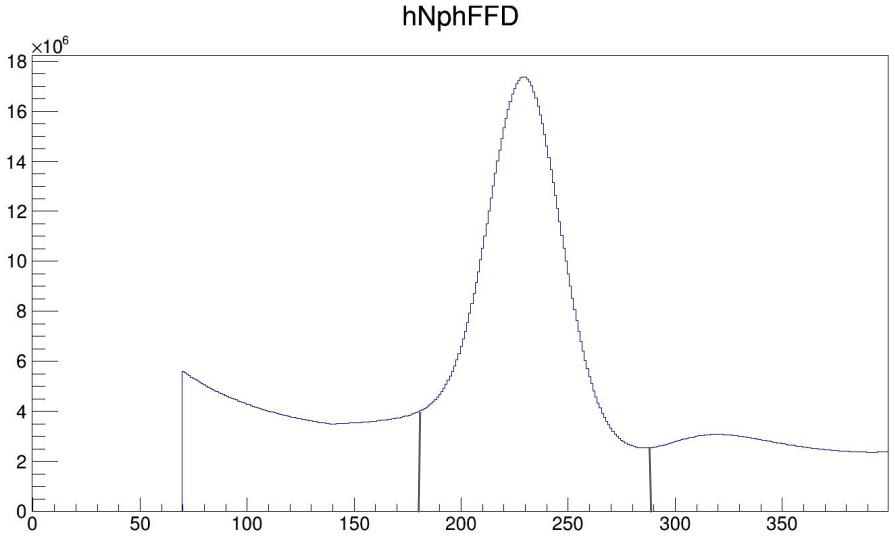


FHCal are better than FFD for directed flow measurements

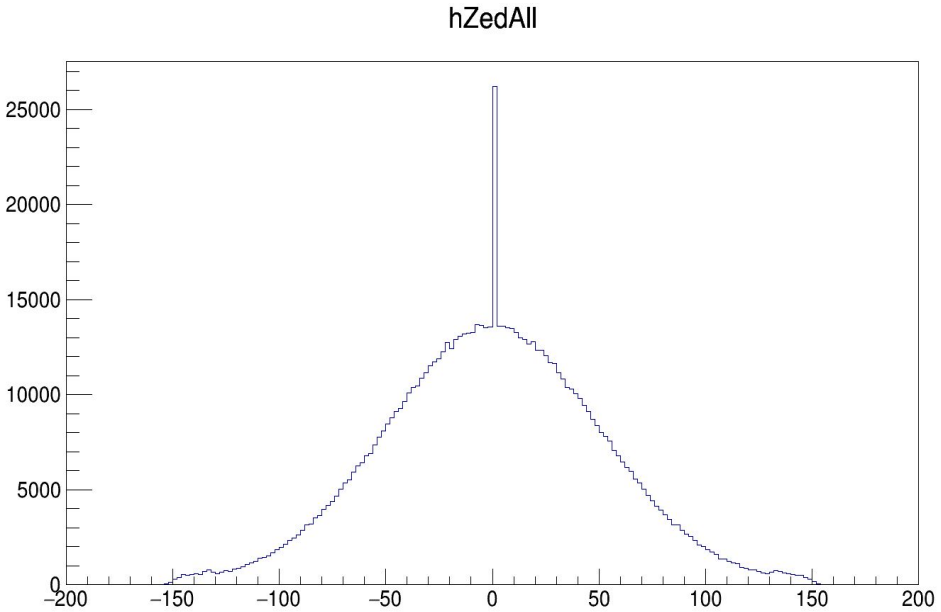

R_2 FFD
R_2
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
10
20
30
40
50
60
70
80
centrality, %
FFD

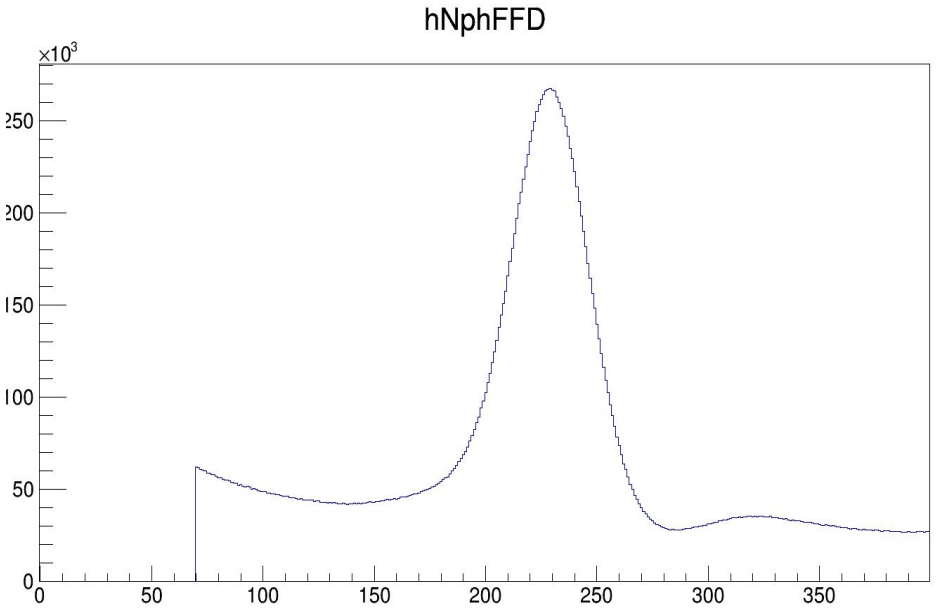
Effects of FFD cut on number of photons [180;290]



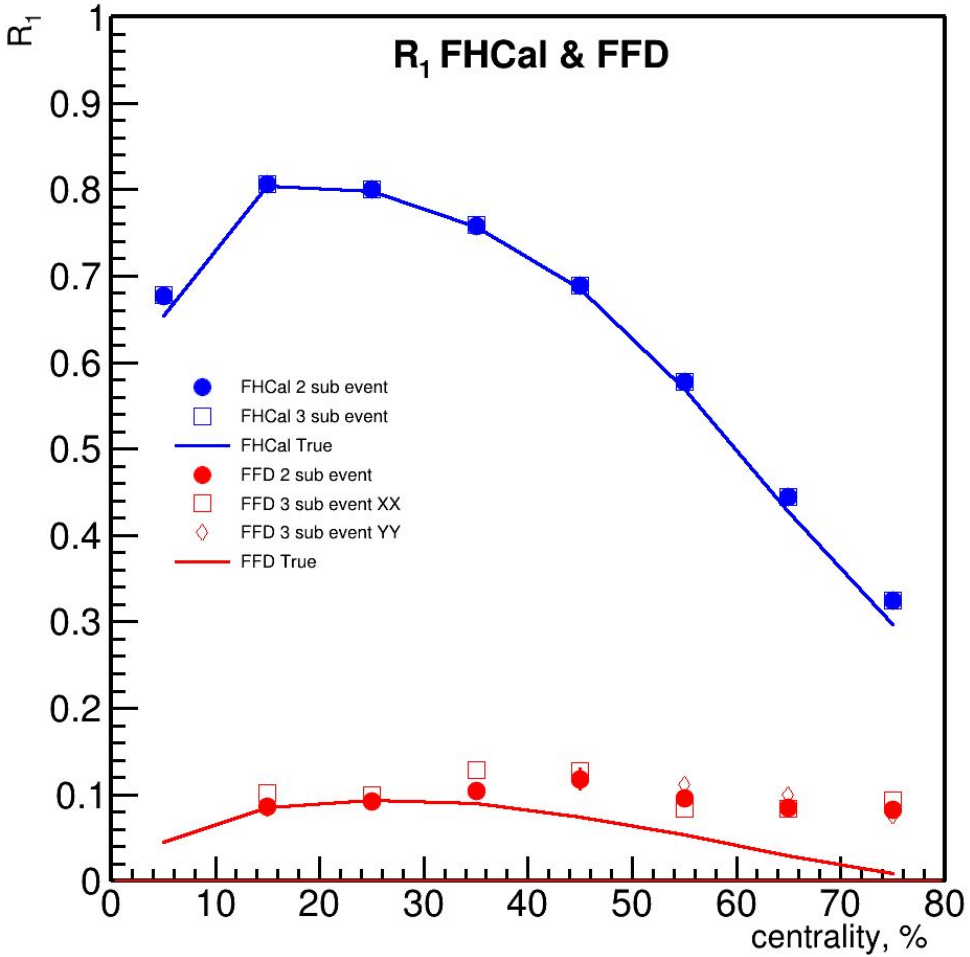


Request 26 FFD QA



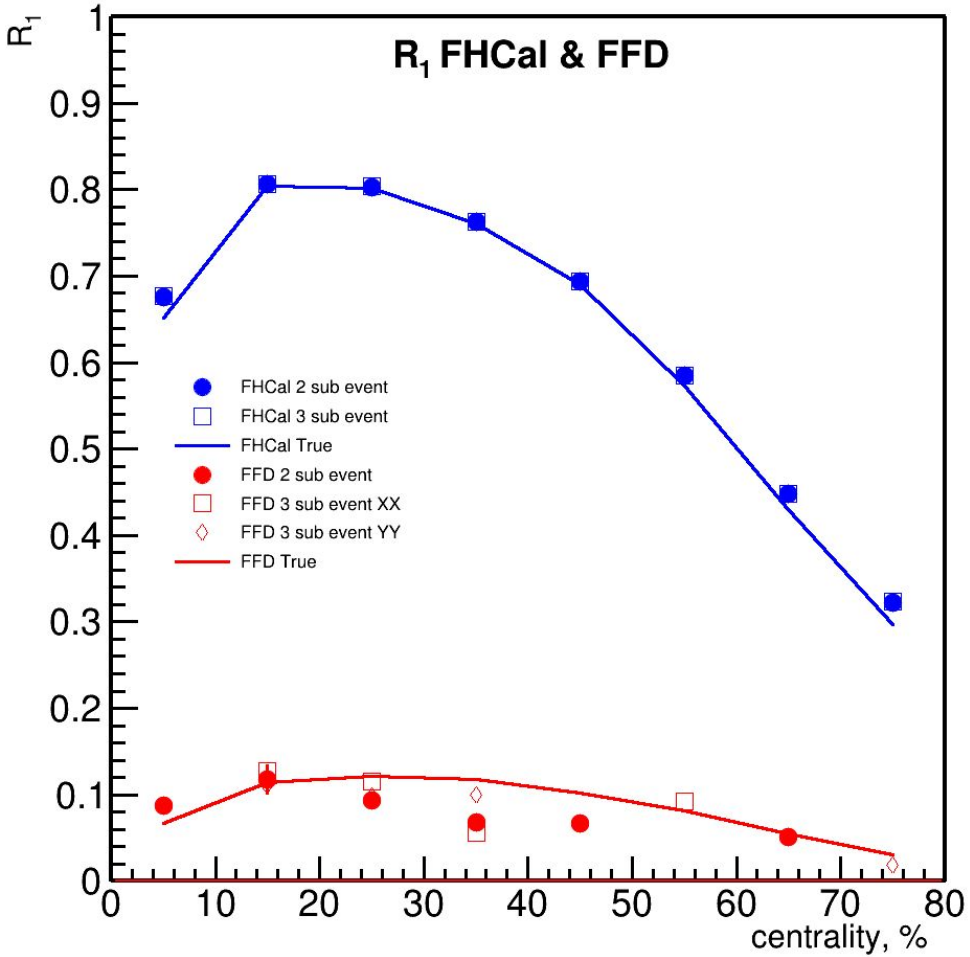


Request 26 FHCal & FFD event plane Resolution



- In this data set we don't have an agreement with True Resolution for FFD

Request 26 FHCal & FFD event plane Resolution:vtxZ cut



- vtxZ cut: |vtxZ|< 50 cm
- Here we have better agreement than in case of full vtxZ