Teaney Yan correlation

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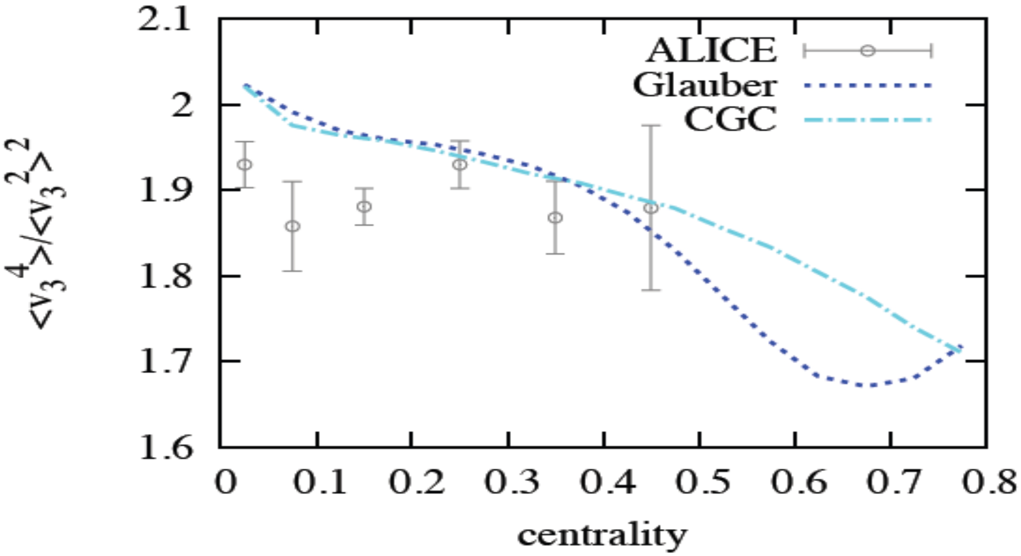
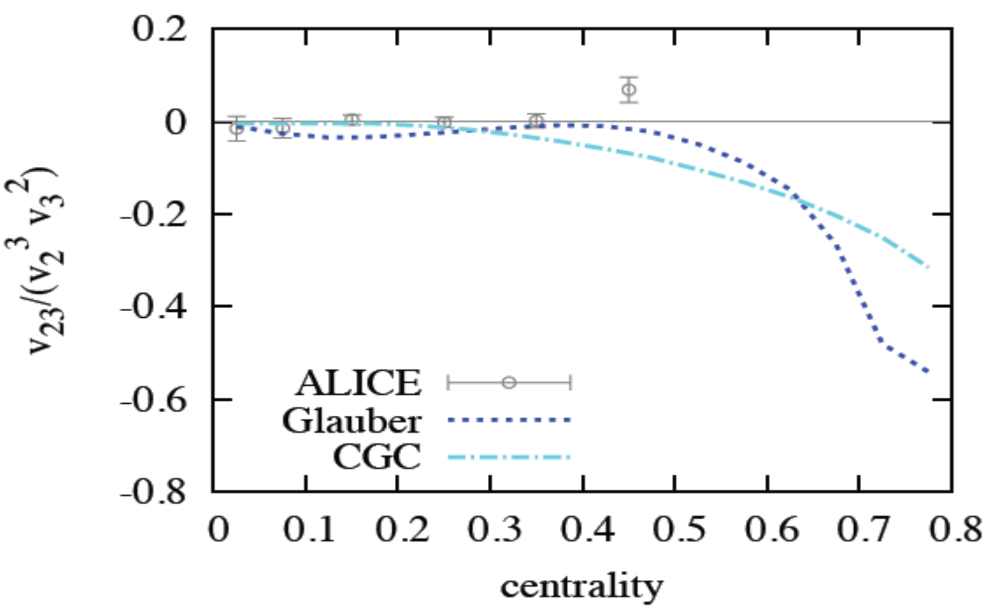
V_3を含むcorrelation



V_3のfluctuation
➔ ALICEのtrack数なら
e-b-e v3 も測れるか？

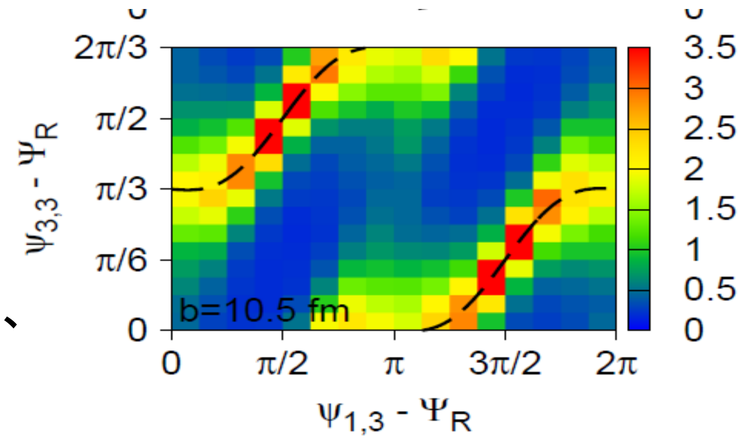


Mixed harmonics correlation
$<V_2^3 V_3^2 \cos(6(\Psi_2-\Psi_3))>/V_2^3 V_3^2$

Teaney Yan CorrelationのIntro

Initial fluctuationの議論で予想されるcorrelation。
V_1 は$\varepsilon_1 \sim \langle r^3\cos\phi\rangle$　由来のη-even V_1 。
簡単にいうと次の式であらわされるcorrelation。

$$\psi_{1,3}^{\mathrm{mp}} = 3\psi_{3,3} - 2\Psi_{PP} - \pi\,.$$

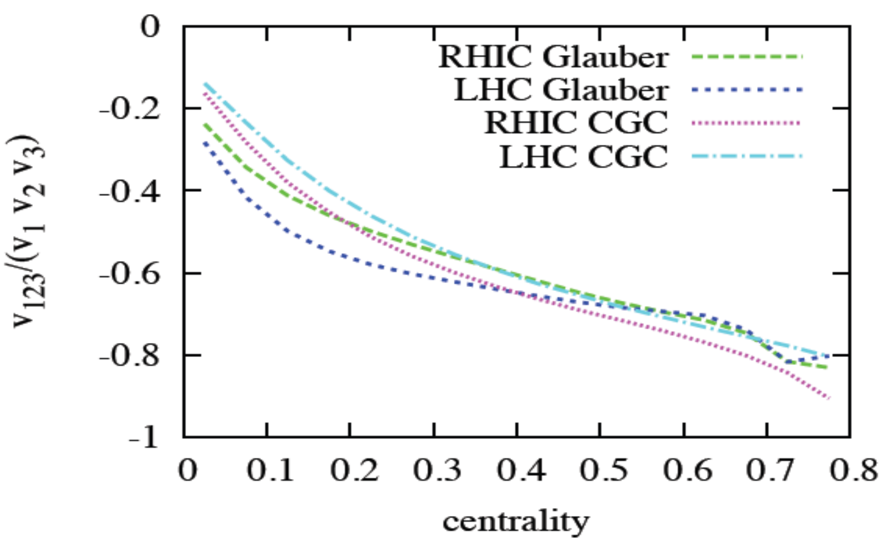


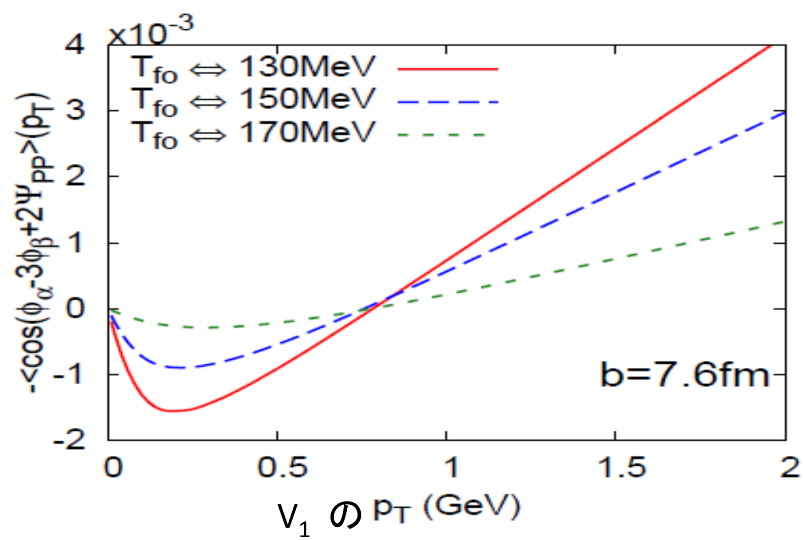
3p correlationのうえ、少なくともO(v1v2v3)なので、
統計的に難しいが、

測定量　$V_{123} = \langle\langle \cos(\phi_\alpha - 3\phi_\beta + 2\phi_\gamma)\rangle\rangle$

$= \langle\langle \cos((\phi_\alpha - \Psi_1) - 3(\phi_\beta - \Psi_3) + 2(\phi_\gamma - \Psi_{PP}) + (\Psi_1 - 3\Psi_3 + 2\Psi_{PP}))\rangle\rangle$

$\sim (V_1(p_T \text{ or } \eta) V_2 V_3)/(\varepsilon_1\varepsilon_2\varepsilon_3) \times \langle\langle \varepsilon_1\varepsilon_2\varepsilon_3 \cos(\Psi_1 - 3\Psi_3 + 2\Psi_{PP})\rangle\rangle$



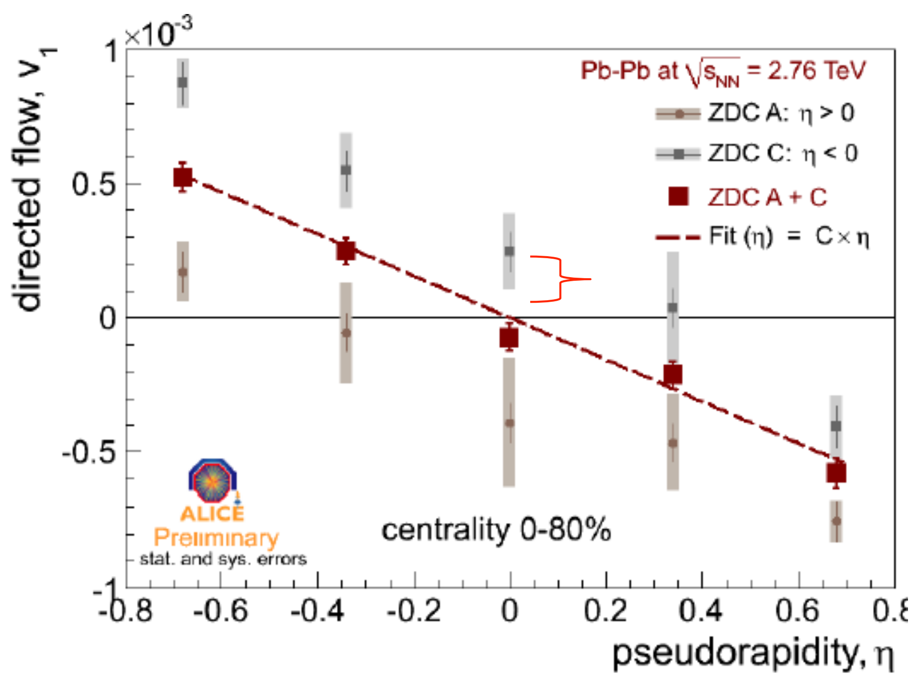


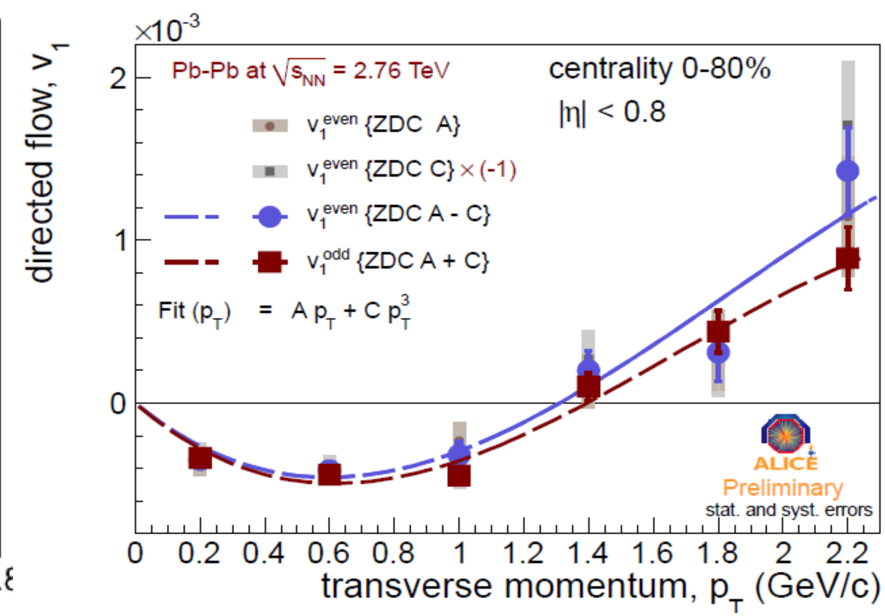
STAR(QM poster by Jim Thomas)、ALICE(not yet preliminary)ではsignalらしいものが見えている

V_1がすべてη-odd V_1 だったら

$$V_{123} = \langle\langle \cos(\phi_\alpha - 3\phi_\beta + 2\phi_\gamma) \rangle\rangle$$
$$= \langle\langle \cos((\phi_\alpha - \Psi_1) - 3(\phi_\beta - \Psi_3) + 2(\phi_\gamma - \Psi_{PP}) + (\Psi_1 - 3\Psi_3 + 2\Psi_{PP})) \rangle\rangle$$
$$= \langle\langle \cos(\phi_\alpha - \Psi_1) \rangle\rangle \times \langle\langle \cos 3(\phi_\beta - \Psi_3) \rangle\rangle \times \langle\langle \cos 2(\phi_\gamma - \Psi_{PP}) \rangle\rangle \times \langle\langle \cos(\Psi_1 - 3\Psi_3 + 2\Psi_{PP}) \rangle\rangle$$
$$= V_1 V_2 V_3 \times \langle\langle \cos(\Psi_{PP} + \pi/2 - 3\Psi_3 + 2\Psi_{PP}) \rangle\rangle \sim 0$$ (η-odd なΨ_1 はΨ_{PP}とfully correlate)

ではALICEでは、η-even な V_1 と Ψ_1
η-odd な V_1 と Ψ_1
はどれくらいの大きさをもつのか？ (ilyaというひとのQM talk)
この二つはSame order で 10^{-3} くらい。 POI (ϕ_α) の η の範囲を変えた測定が必要！！

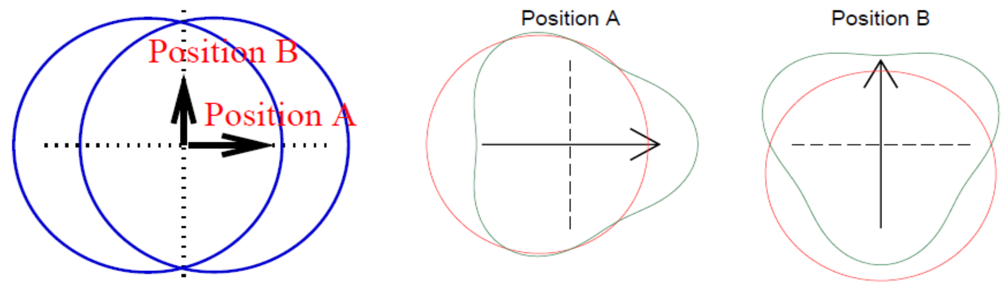




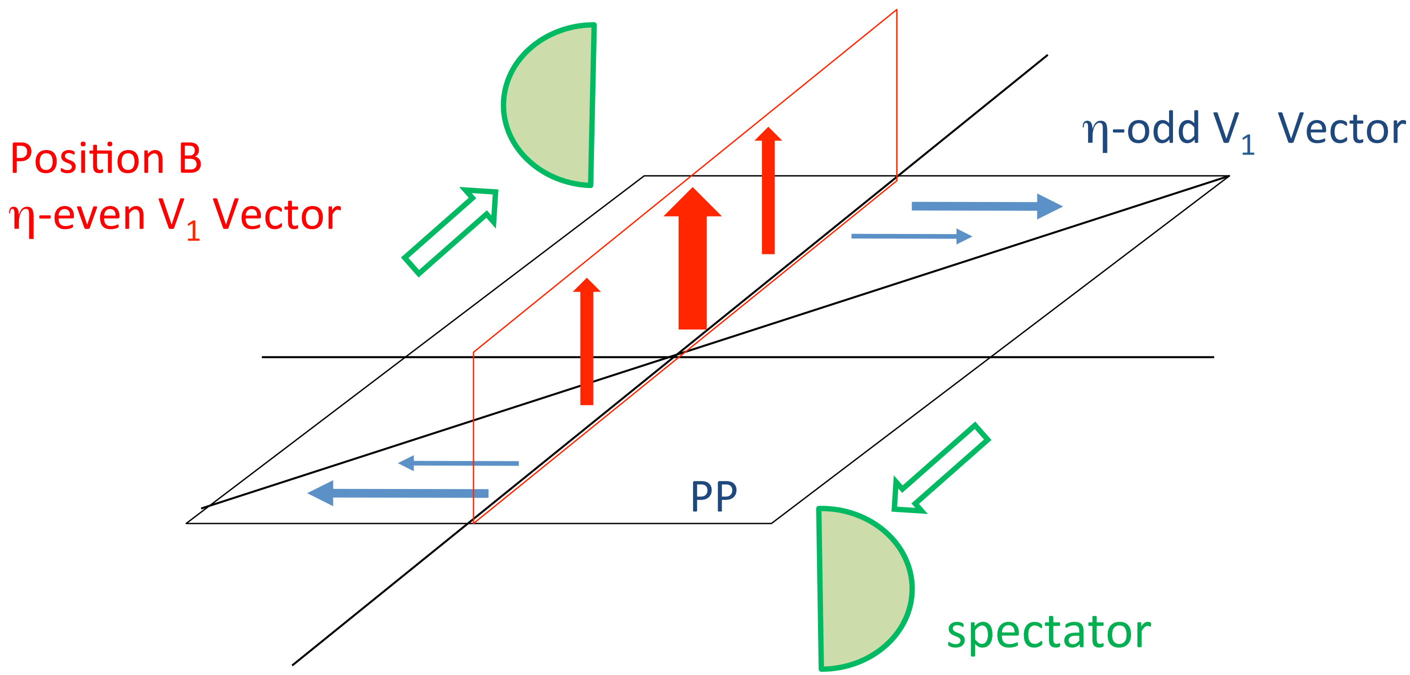
Dipole direction with respect to direction of PP is uniform, but

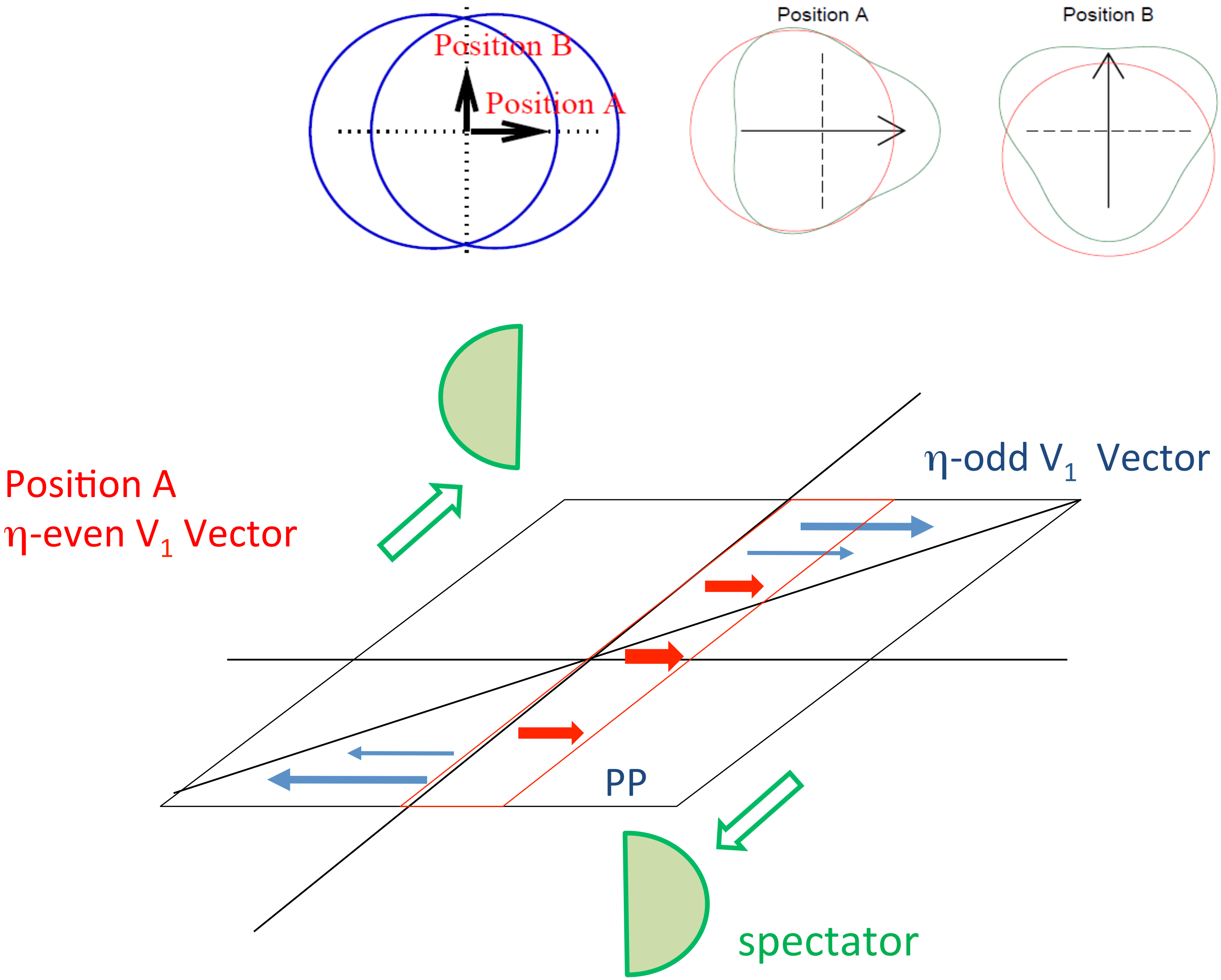
Position A (dipole = in-plane) triangle direction = dipole

Position B (dipole=out-plane) triangle direction = opposite of dipole



Measured V_1 vector = (η-even V_1 vector) + (η-odd V_1 vector)





Position B
Position A
Position A
Position B
Position A
η-even V1 Vector
η-odd V1 Vector
PP
spectator

How to reduce non-flow contribution?

Teaney Yan correlation　に対して non-flow contribution　の寄与がどのくらいあるか。

1) Large eta gap (1 nest loop)
   use forward detector for ϕ_γ in $\langle\langle\cos(\phi_\alpha - 3\phi_\beta + 2\phi_\gamma)\rangle\rangle$

2) 4p correlation (1 nest loop) → large eta gap + multi-correlation
   $V_{1311} = \langle\langle\cos(\phi_\alpha - 3\phi_\beta + \phi_\gamma + \phi_\delta)\rangle\rangle$
   $= \langle\langle\cos((\phi_\alpha - \Psi_1) -3(\phi_\beta - \Psi_3) + (\phi_\gamma - \Psi_1`) + (\phi_\delta - \Psi_1`) + (\Psi_1 - 3\Psi_3 + 2\Psi_1`))\rangle\rangle$
   use forward detector for ϕ_γ and ϕ_δ, then $\Psi_1`$ is η-odd and fully correlated to Ψ_{PP}
   $= V_1 V_2 V_1` V_1` \times \langle\langle\cos(\Psi_1 - 3\Psi_3 + 2\Psi_{PP})\rangle\rangle$

3) 6p correlation (5 nest loop → QC method must be used)
   $V_{123123} = \langle\langle\cos(\phi_\alpha - 3\phi_\beta + 2\phi_\gamma + \phi_\delta - 3\phi_\sigma + 2\phi_\zeta)\rangle\rangle$
   $= \langle\langle\cos((\phi_\alpha - \Psi_1) -3(\phi_\beta - \Psi_3) + 2(\phi_\gamma - \Psi_{PP}) + (\phi_\delta - \Psi_1) -3(\phi_\sigma - \Psi_3) + 2(\phi_\zeta - \Psi_{PP})$
   $+ 2(\Psi_1 - 3\Psi_3 + 2\Psi_{PP}))\rangle\rangle$
   $= V_1 V_2 V_3 V_1 V_2 V_3 \times \langle\langle\cos 2(\Psi_1 - 3\Psi_3 + 2\Psi_{PP})\rangle\rangle$
   $= V_1 V_2 V_3 V_1 V_2 V_3 \times (2\langle\langle\cos(\Psi_1 - 3\Psi_3 + 2\Psi_{PP})\rangle\rangle^2 - 1)$

Results of quick analysis(far from preliminary)

3p correlation with QC method

$$\left\langle e^{\psi_1 - 3\phi_2 + 2\phi_3} \right\rangle = \frac{p_n Q_{2n} Q_{3n}^* - p_n Q_n^* - q_{2n}^* Q_{2n} - q_{3n} Q_{3n}^* + 2m_q}{(m_p M - 2m_q)(M-1)}$$

If use FMD for ϕ_γ

$< \exp (\phi_\alpha - 3\phi_\beta + 2\phi_\gamma) > = < \exp (\phi_\alpha - 3\phi_\beta) > \times < \exp (2\phi_\gamma) >^{FMD}$

$= (p_n Q_{3n}^* - q_{2n}^*)/(m_p M - m_q) \times Q_{2n}^{FMD} / M^{FMD}$

Calculation of 6p correlation

Use FMD A side track for ϕ_γ and FMD C side track for ϕ_ζ

Use central track for ϕ_α, ϕ_β, ϕ_δ, ϕ_σ → 3 next loop

$V_{123123} = \langle\langle \cos(\phi_\alpha - 3\phi_\beta + 2\phi_\gamma + \phi_\delta - 3\phi_\sigma + 2\phi_\zeta) \rangle\rangle$

$= Q_{2n}^{FMD\ C} / M^{FMD\ C} \times Q_{2n}^{FMD\ A} / M^{FMD\ A}$

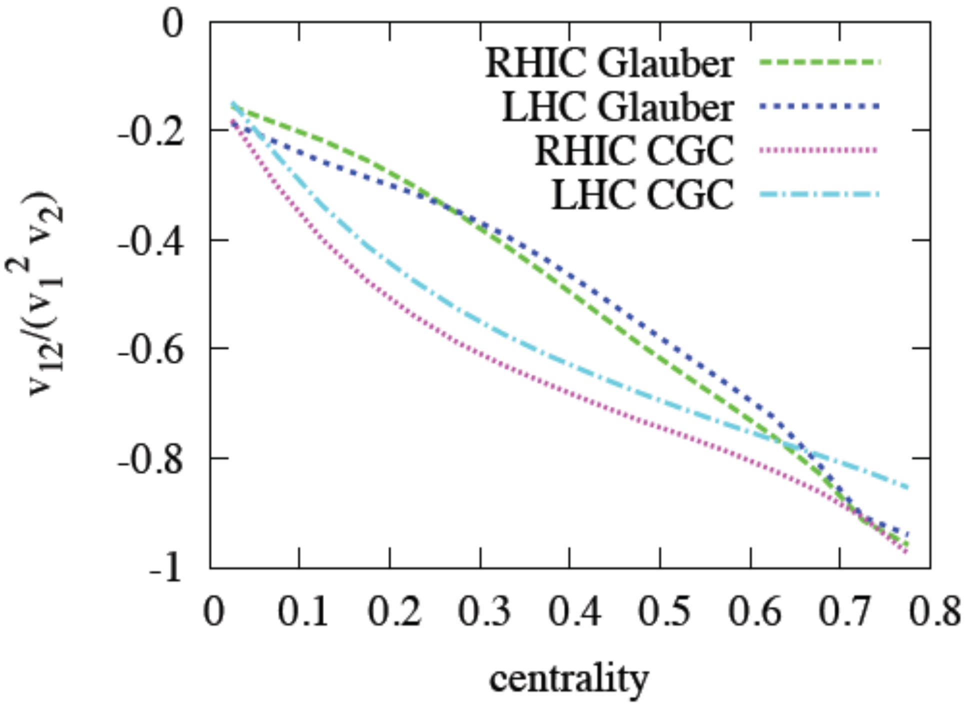
$\times (p_{1n}^2 (Q_{3n}^*)^2 - p_{1n}^2 Q_{6n}^* - q_{2n} (Q_{3n}^*)^2 - 4q_{2n}^* p_{1n} Q_{3n}^*$

$- 2(q_{2n}^*)^2 + 4q_{2n}^* p_{2n}^* + 4q_{5n}^* p_{1n} + 4q_{1n}^* Q_{3n}^* - 5q_{4n}^*)$

$/ (m_p^2 M^2 – 2m_p M^2 - 4m_p m_q M + 4m_p m_q + 4m_q M + m_p M - 5m_q)$

V_1を含むcorrelation

$\langle V_1^2 V_2 \cos(2(\Psi_1-\Psi_2))\rangle / V_1^2 V_2$



$\langle V_1^3 V_3^1 \cos(3(\Psi_1-\Psi_3))\rangle / V_1^3 V_3$