Comparison of the γ_{112} and γ_{123} correlators in 200 GeV Au+Au collision via Decomposition

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Outline

- Introduction
- Results
- To-do List

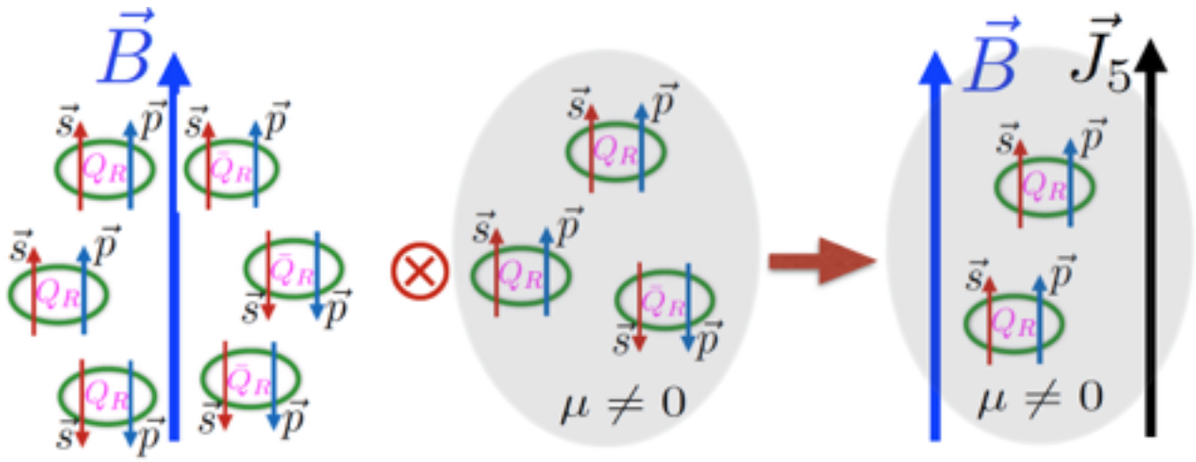
Introduction to CME

- CME physics: In the magnetic field the current will be generated due to the unbalance of chiral quarks(right-handed or left-handed)
- Gamma and delta definiton:

$$\gamma \equiv \langle \cos(\phi_1 + \phi_2 - 2\Psi_{\mathrm{RP}}) \rangle = \langle \cos(\phi_1 - \Psi_{\mathrm{RP}}) \cos(\phi_2 - \Psi_{\mathrm{RP}}) \rangle$$

$$- \langle \sin(\phi_1 - \Psi_{\mathrm{RP}}) \sin(\phi_2 - \Psi_{\mathrm{RP}}) \rangle = \cos\cos - \sin\sin$$

$$\delta = \langle \cos(\phi_\alpha - \phi_\beta) \rangle$$



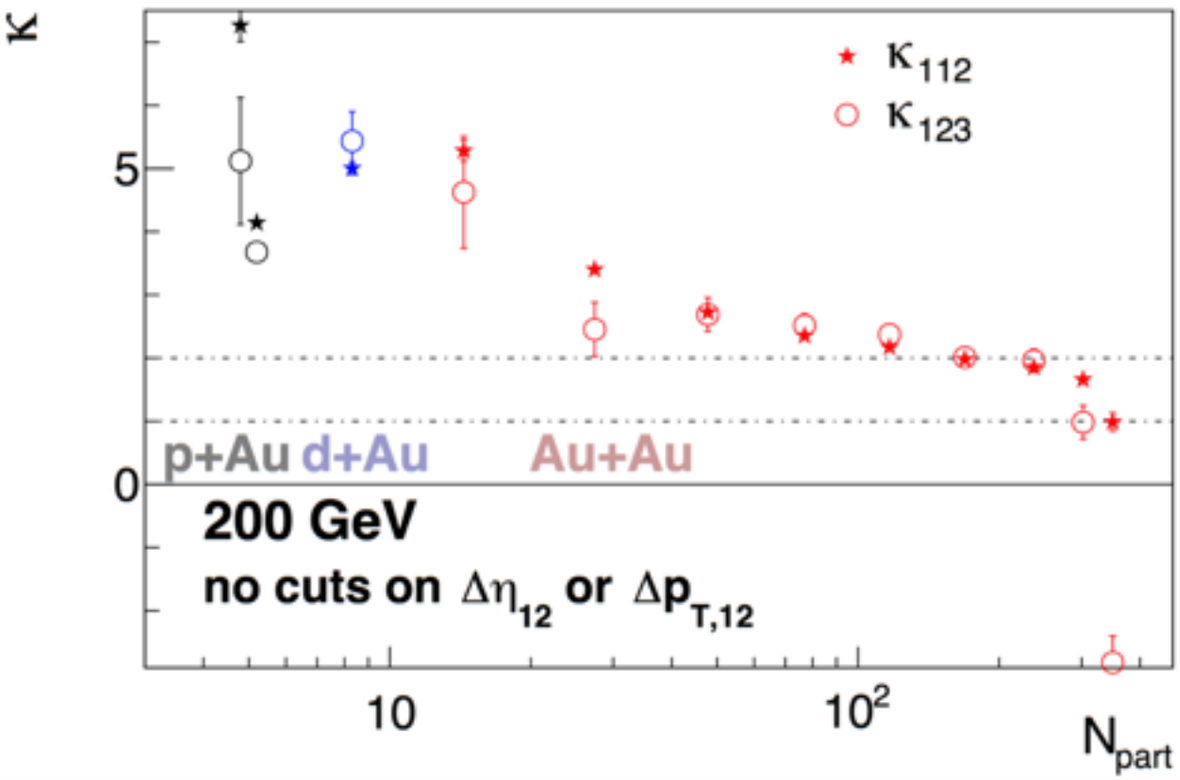
Physical Quantities

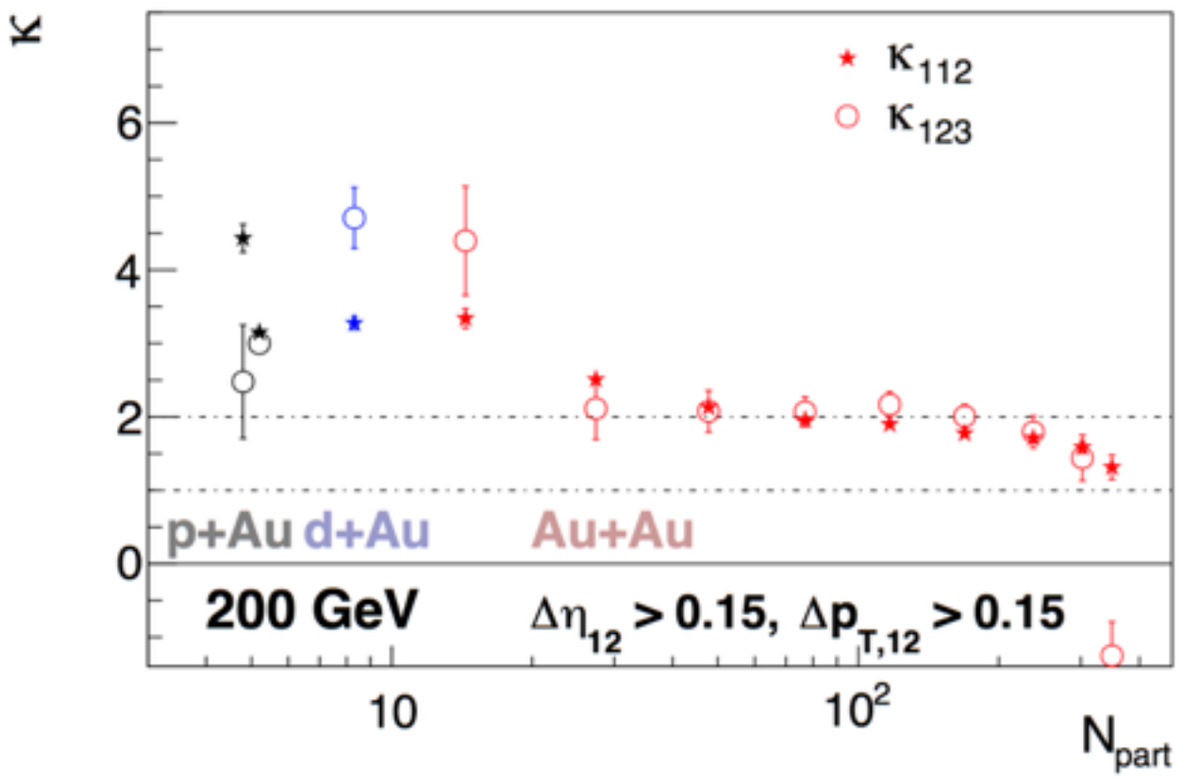
$$\gamma_{1,n-1,n} = \frac{\langle \cos(\phi\alpha + (n-1)\phi_\beta - n\phi_{Ep}) \rangle}{res_{Ep}}$$

$$= \kappa_{1,n-1,n}\, \delta\, v_{n,\beta}$$

- $\kappa_{1,n-1,n}$: the Kappa parameter
- α and β: Measured at mid-rapidity
- Ep: Event Plane

Motivation





- With or without very-short-range correlations,the two kappa values are close to each other in most centralities.

- We want to further remove the short-range correlations

Method of analysis

- Study the γ correlator with four independent parts: OS:cos*cos; SS:cos*cos; OS:sin*sin and SS:sin*sin; then fit each part with 3 gaussian functions plus a constant：

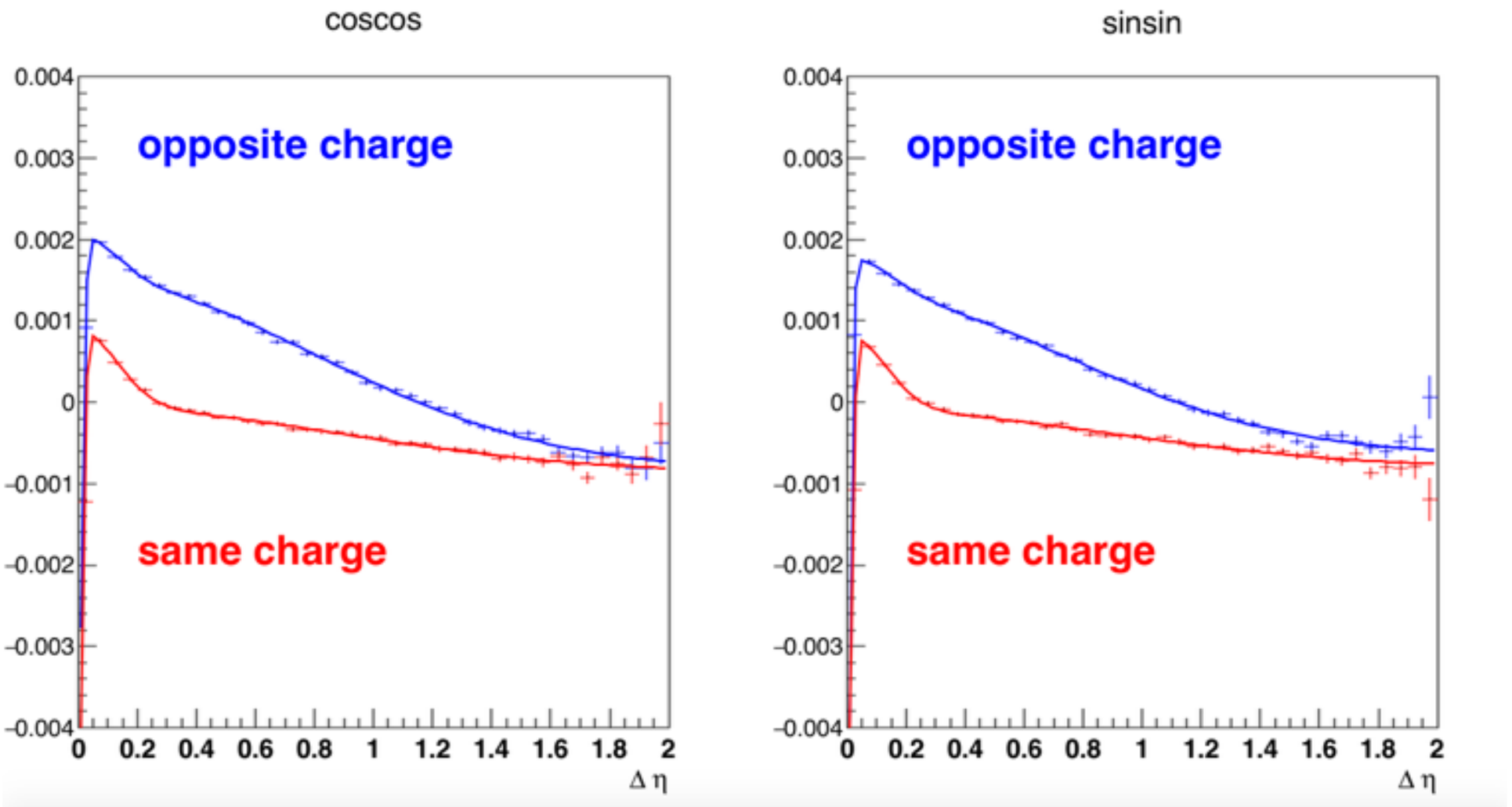
$$f(\Delta\eta) = A_{\mathrm{VSR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{VSR}}} + A_{\mathrm{SR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{SR}}} + A_{\mathrm{IR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{IR}}} + A_{\mathrm{LR}}$$

- Make comparison of the amplitude and peak width between γ_{112} and γ_{123} correlator

- Make comparison of the contributions of peak between these two correlators

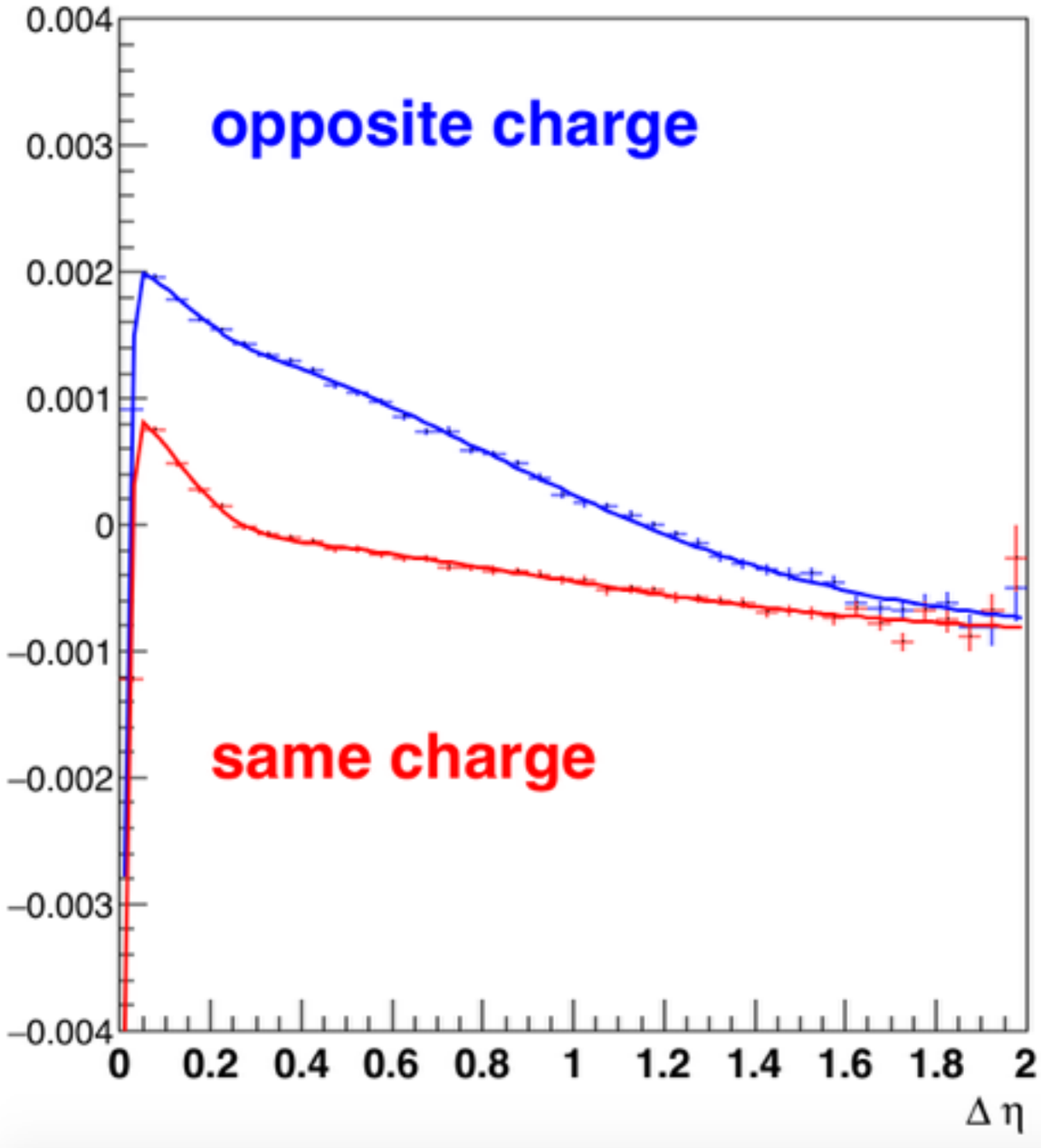
Fit Example

- Decompose the γ correlator in 4 parts and fit independently

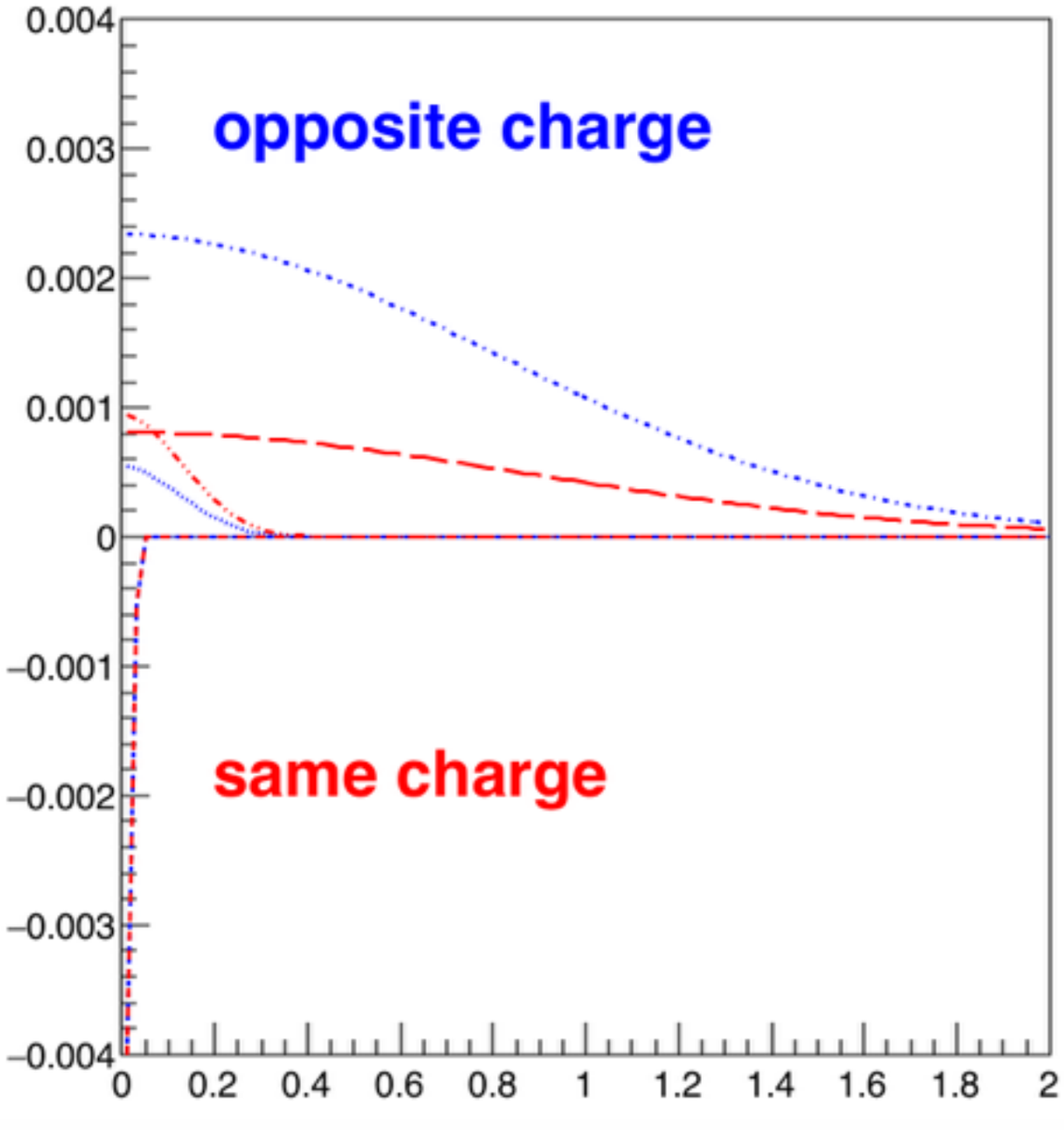


γ_{123} 40%-50% fit result

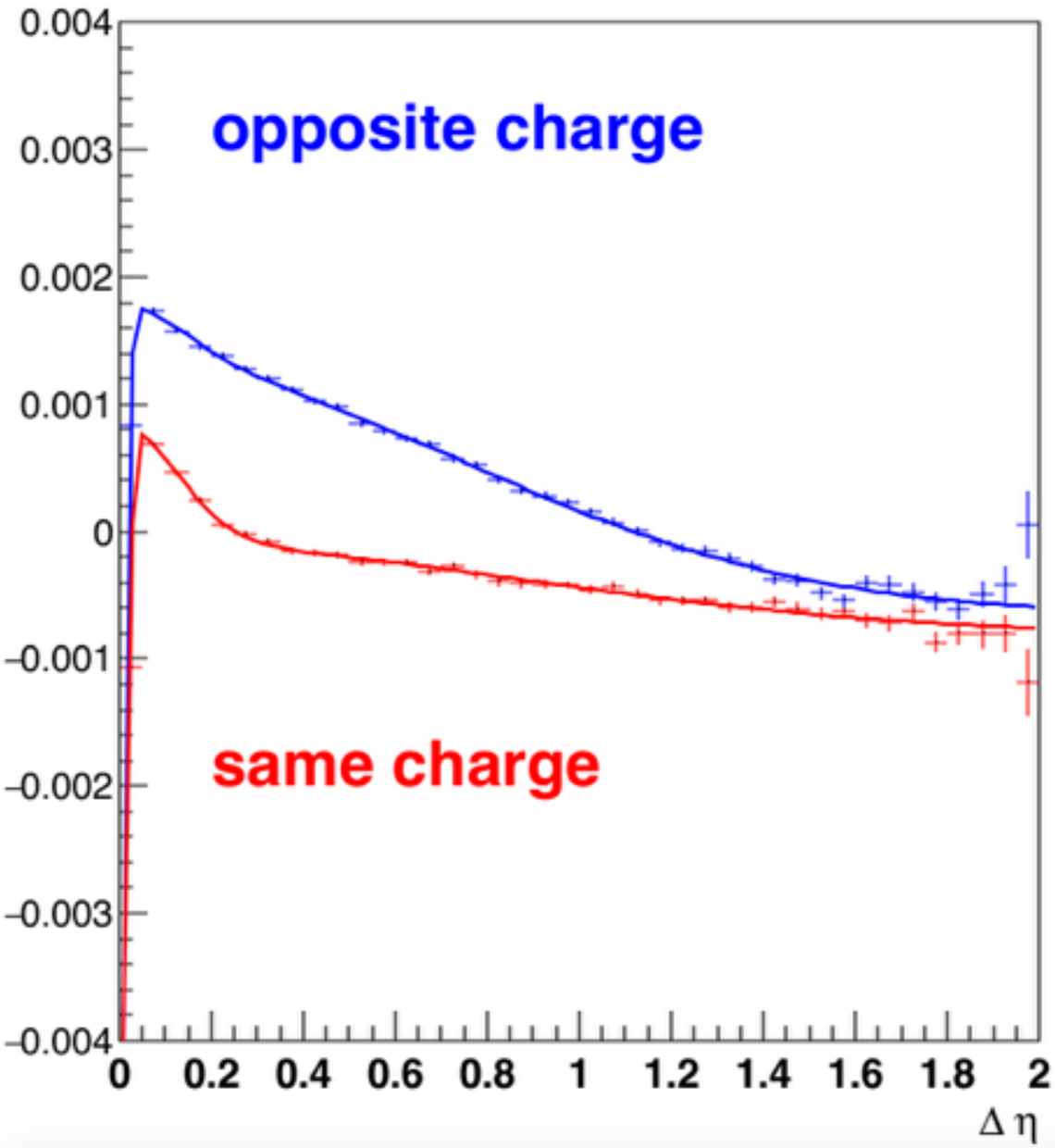
coscos



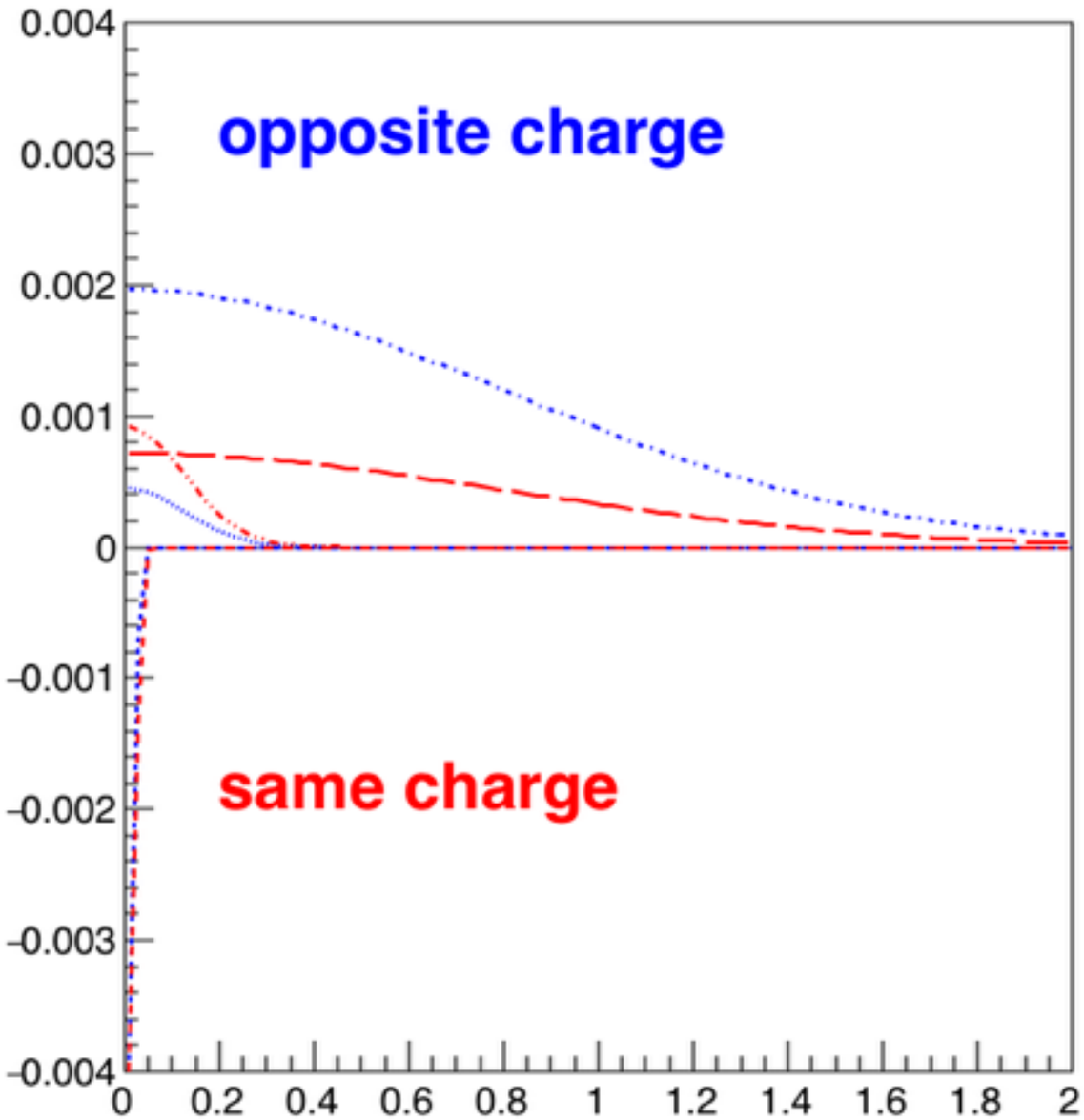
coscos:indenpent gaussian



sinsin



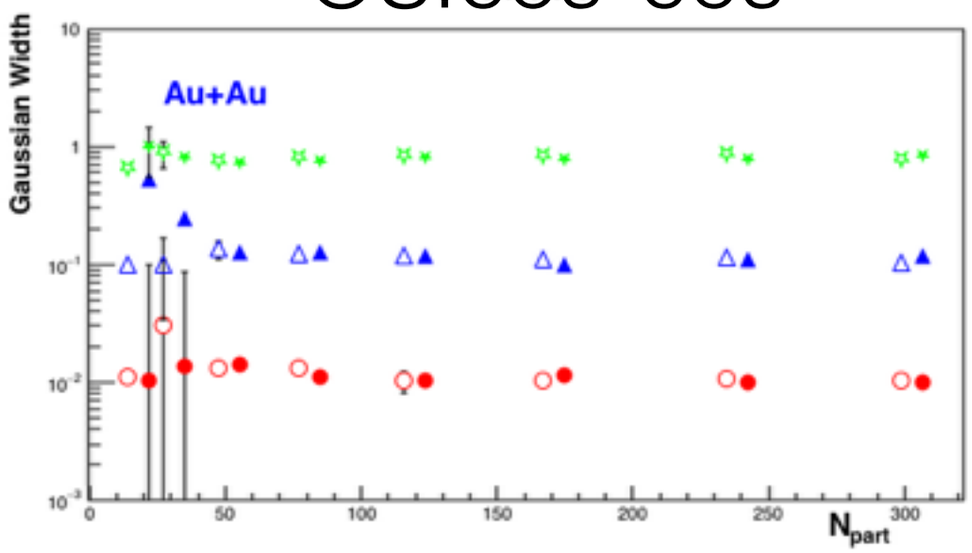
sinsin:indenpent gaussian



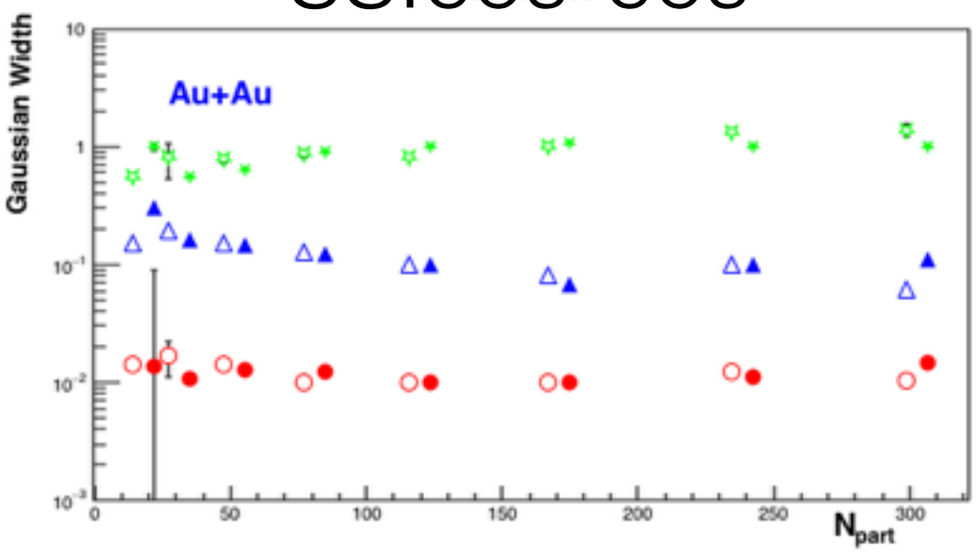
Gaussian peak width vs centrality

$$f(\Delta\eta) = A_{\mathrm{VSR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{VSR}}} + A_{\mathrm{SR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{SR}}} + A_{\mathrm{IR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{IR}}} + A_{\mathrm{LR}}$$

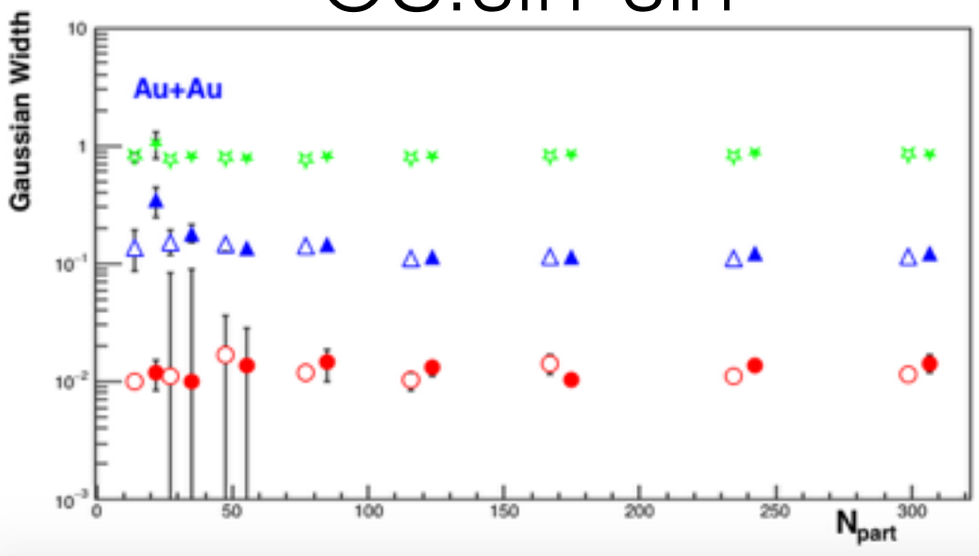
OS:cos*cos



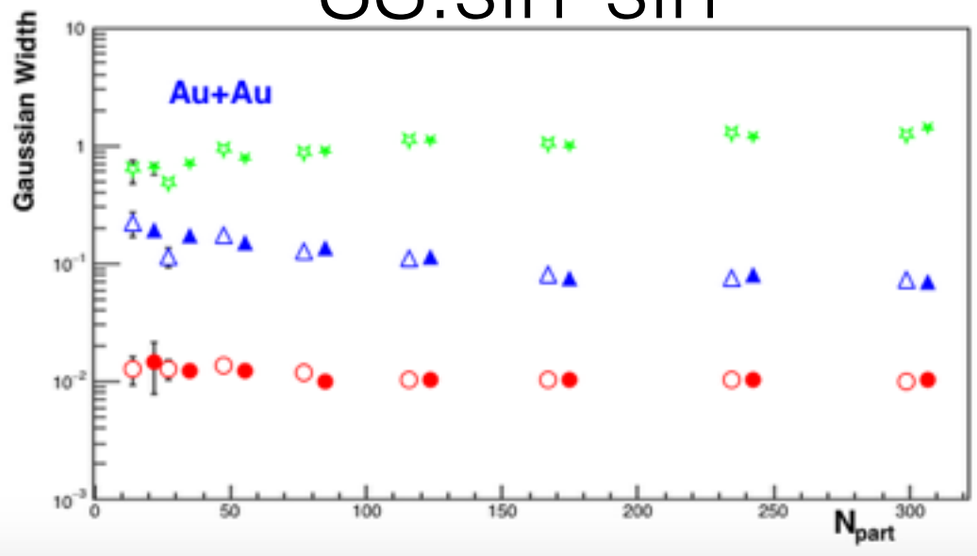
SS:cos*cos



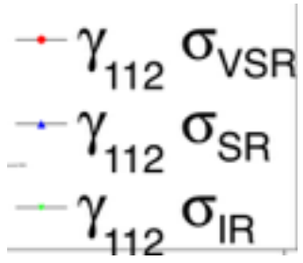
OS:sin*sin

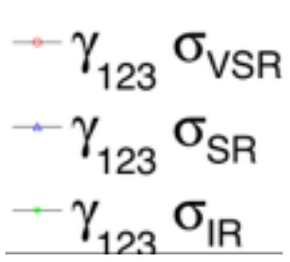


SS:sin*sin



(γ_{112} points shift to right)

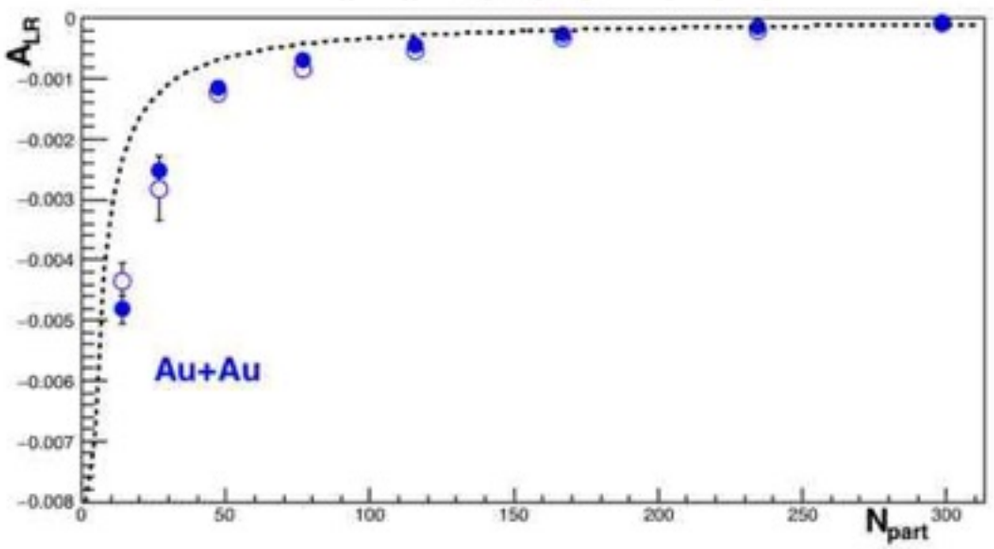




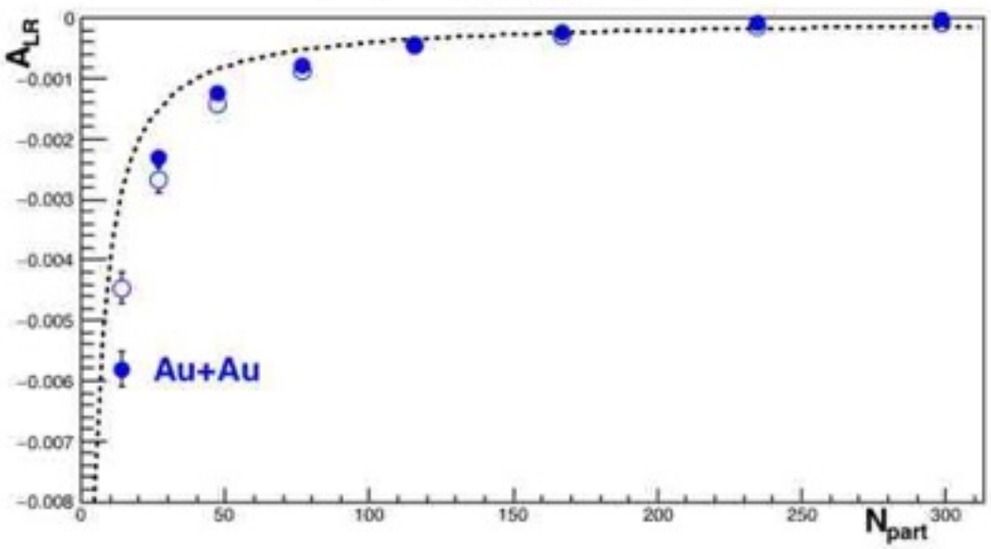
constant via centrality

$$f(\Delta\eta) = A_{\mathrm{VSR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{VSR}}} + A_{\mathrm{SR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{SR}}} + A_{\mathrm{IR}} e^{-(\Delta\eta)^2/2\sigma^2_{\mathrm{IR}}} + A_{\mathrm{LR}}$$

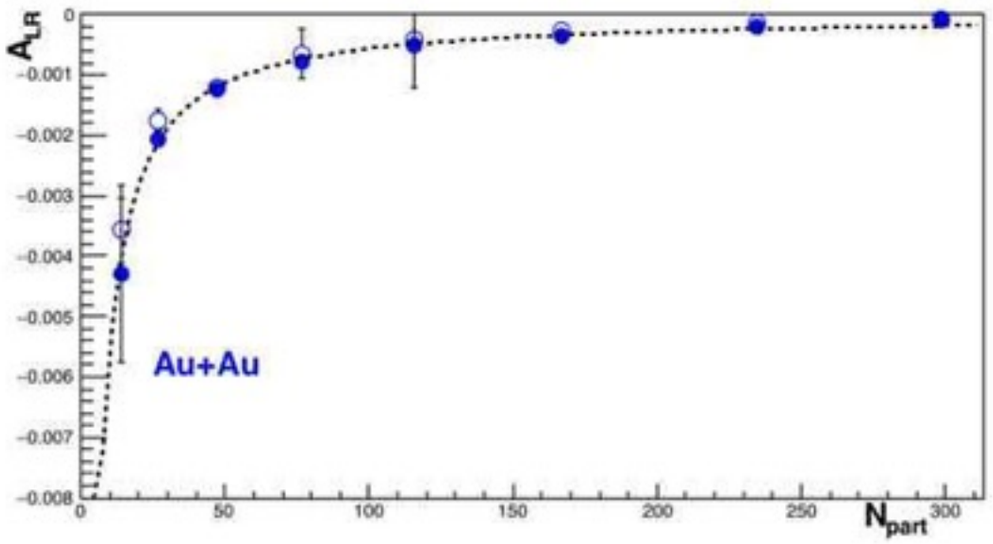
OS:cos*cos



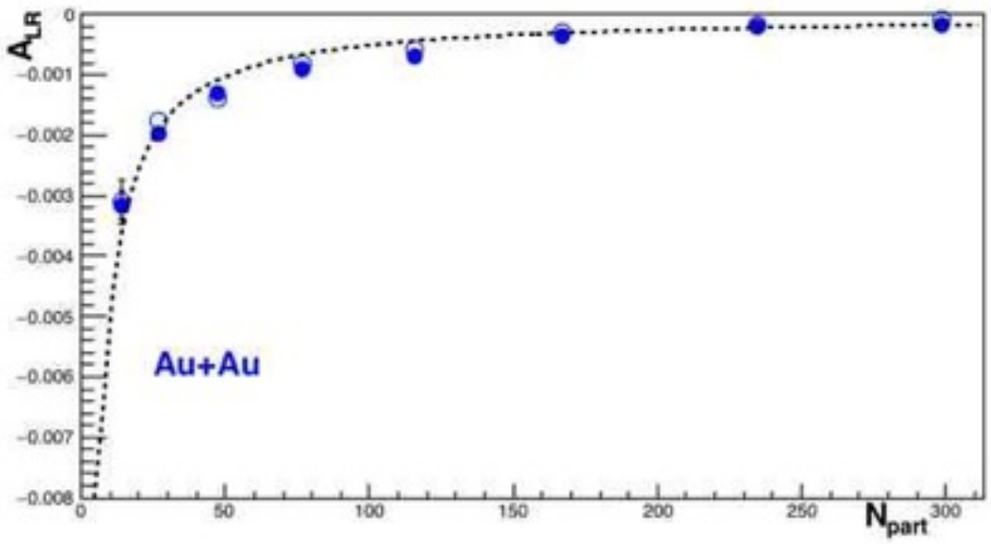
SS:cos*cos

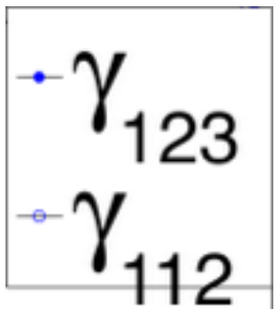


OS:sin*sin



SS:sin*sin

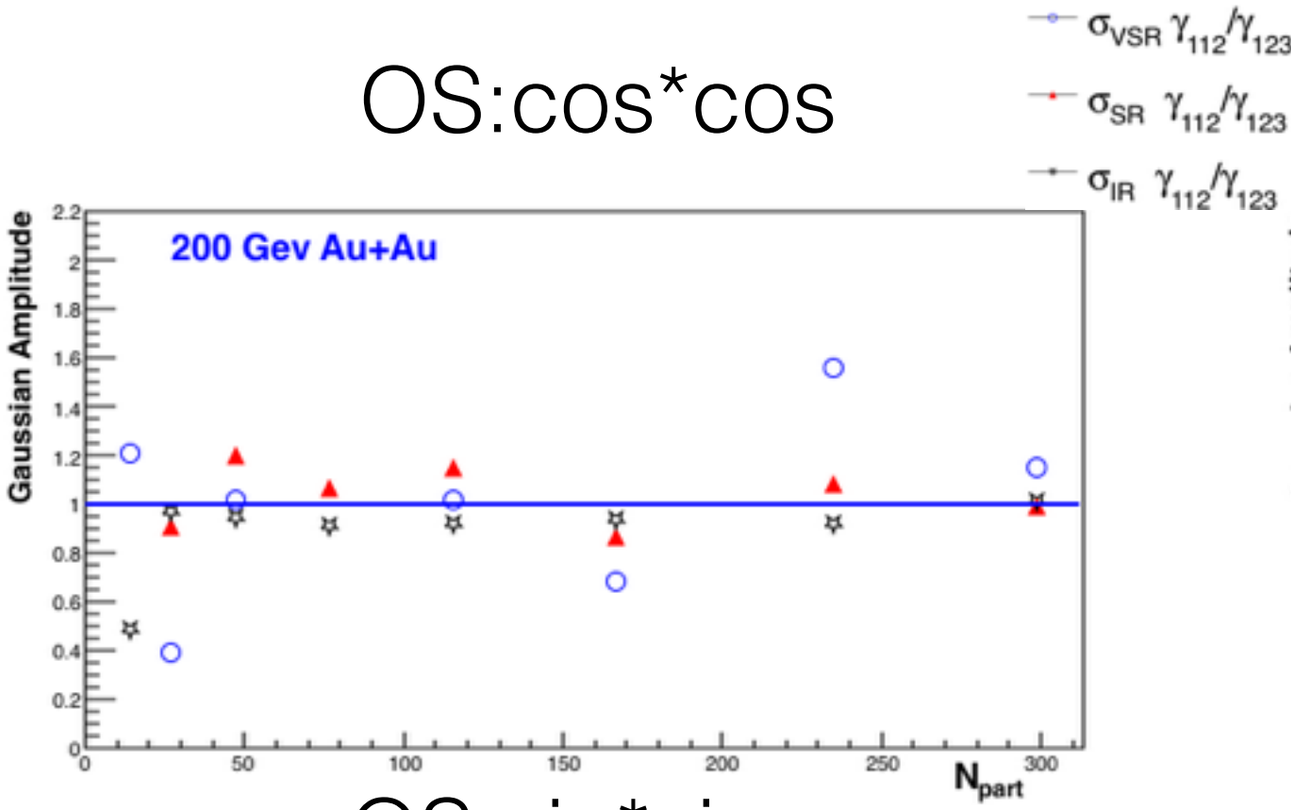




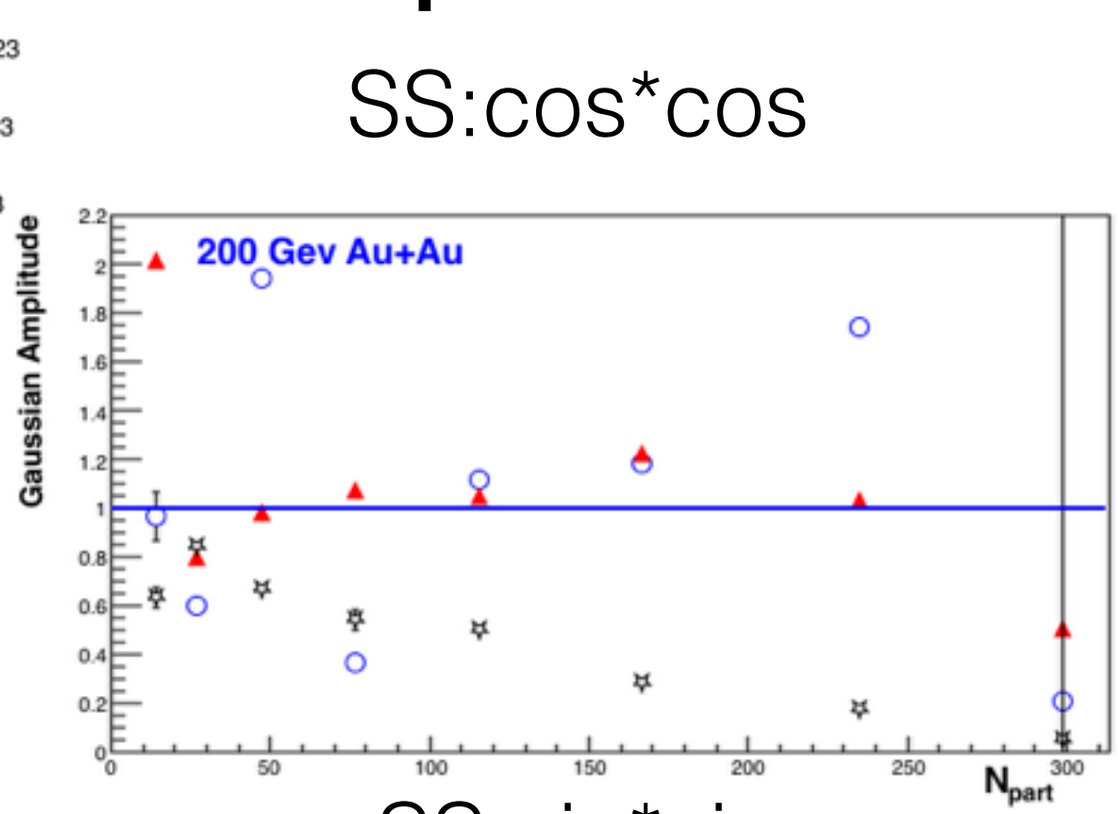
Fit with -sqrt(1/x) due to the conservation of momentum

Ratio of Peak Amplitude

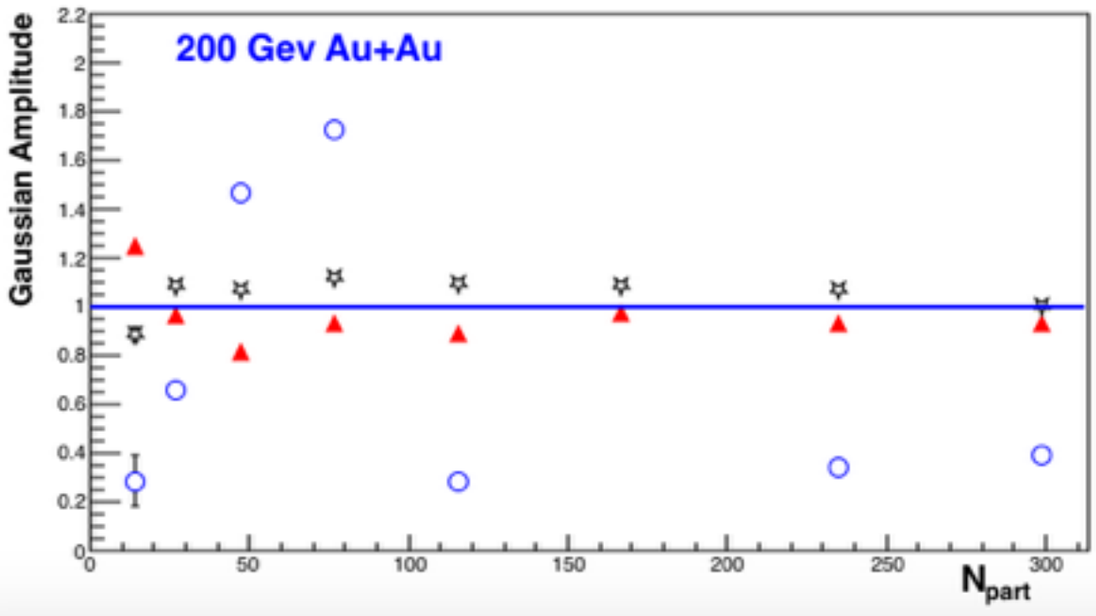
OS:cos*cos



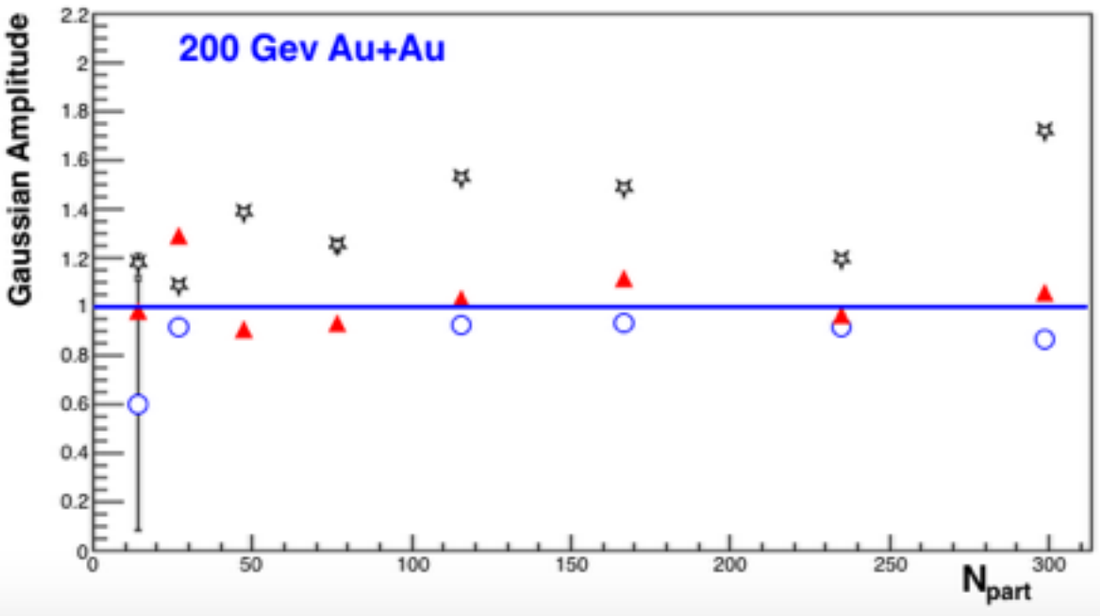
SS:cos*cos



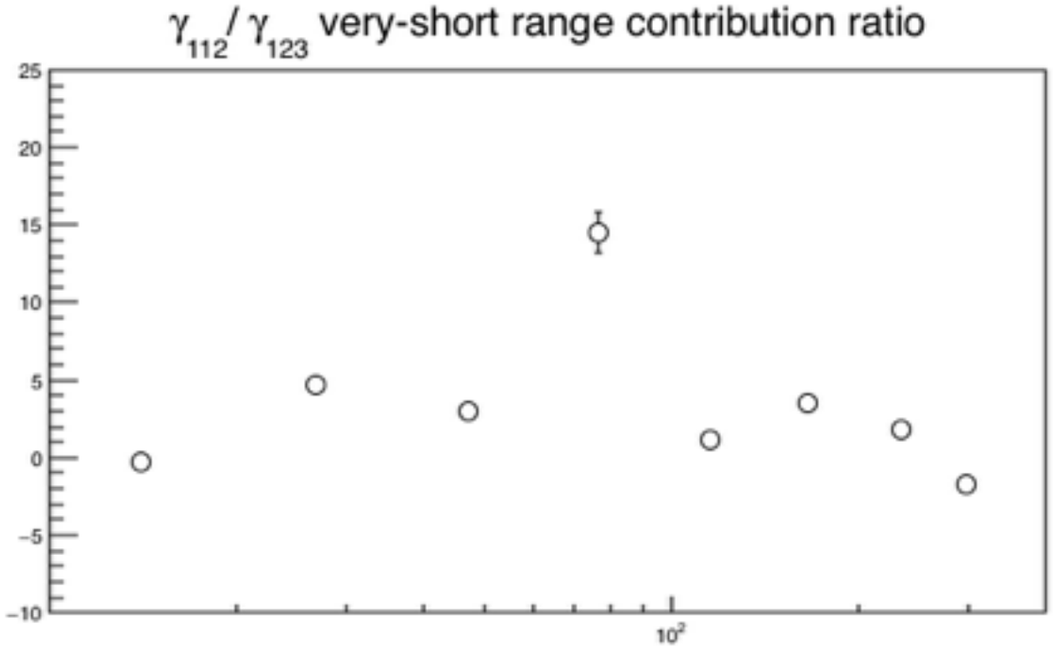
OS:sin*sin

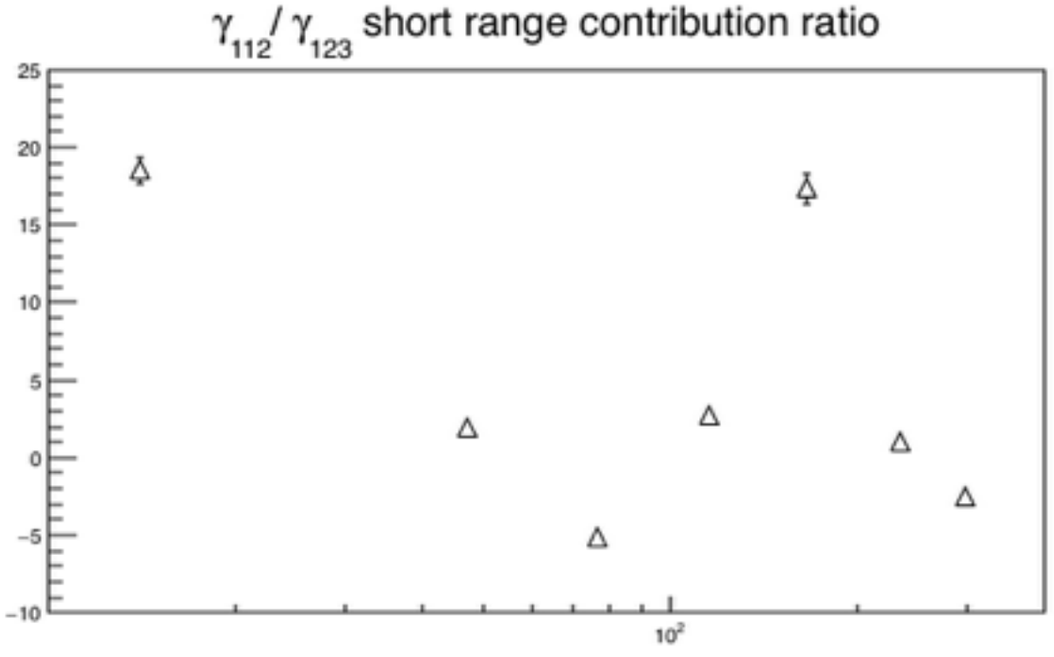


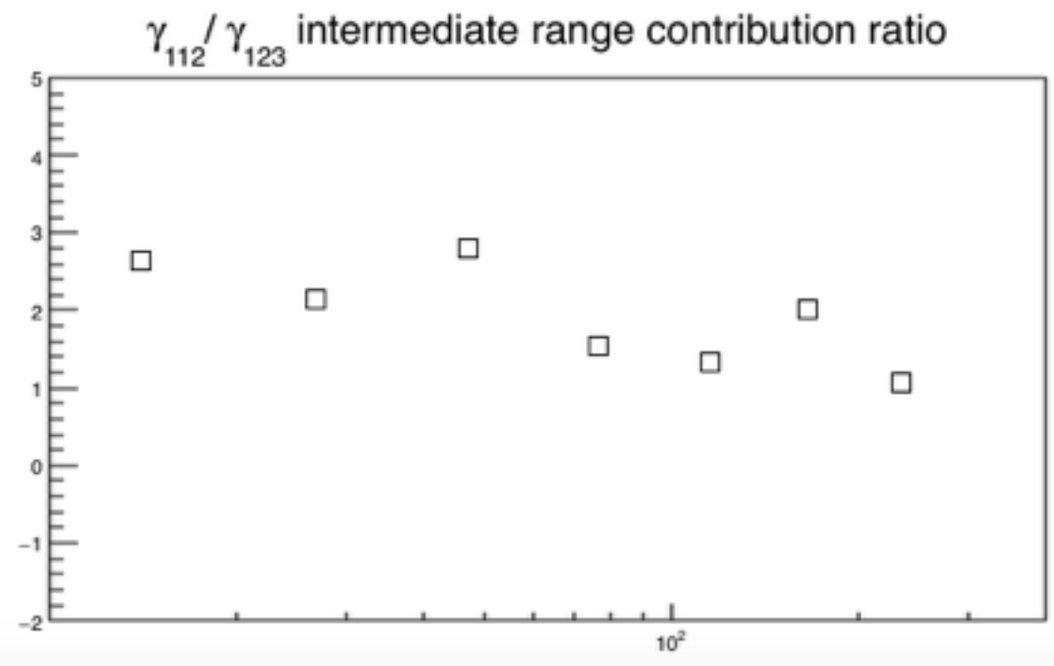
SS:sin*sin

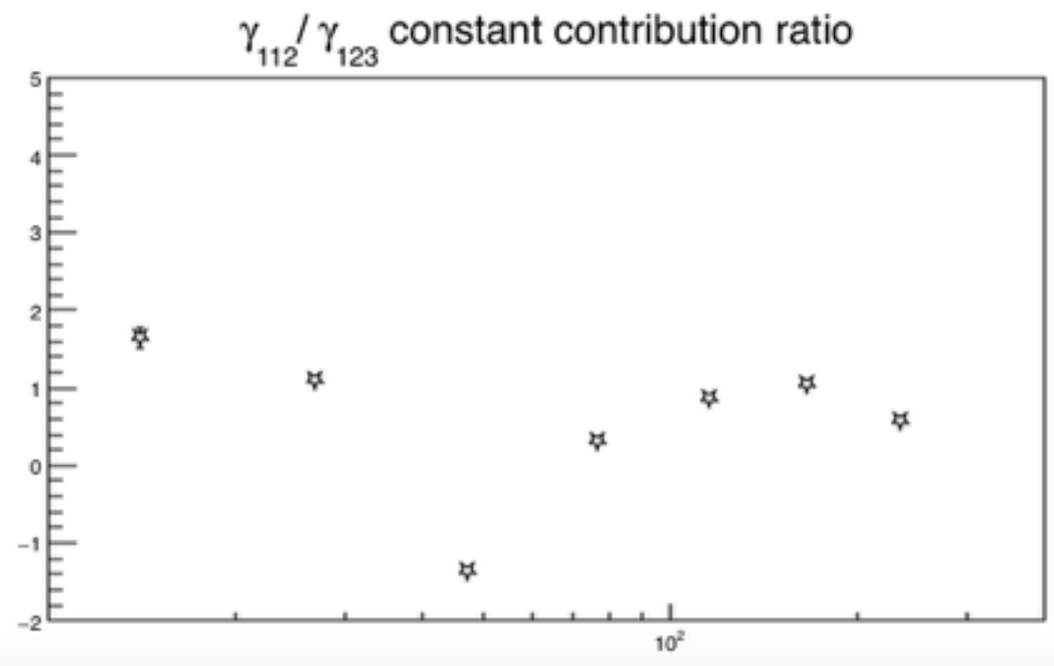


Analysis of Peak Contribution



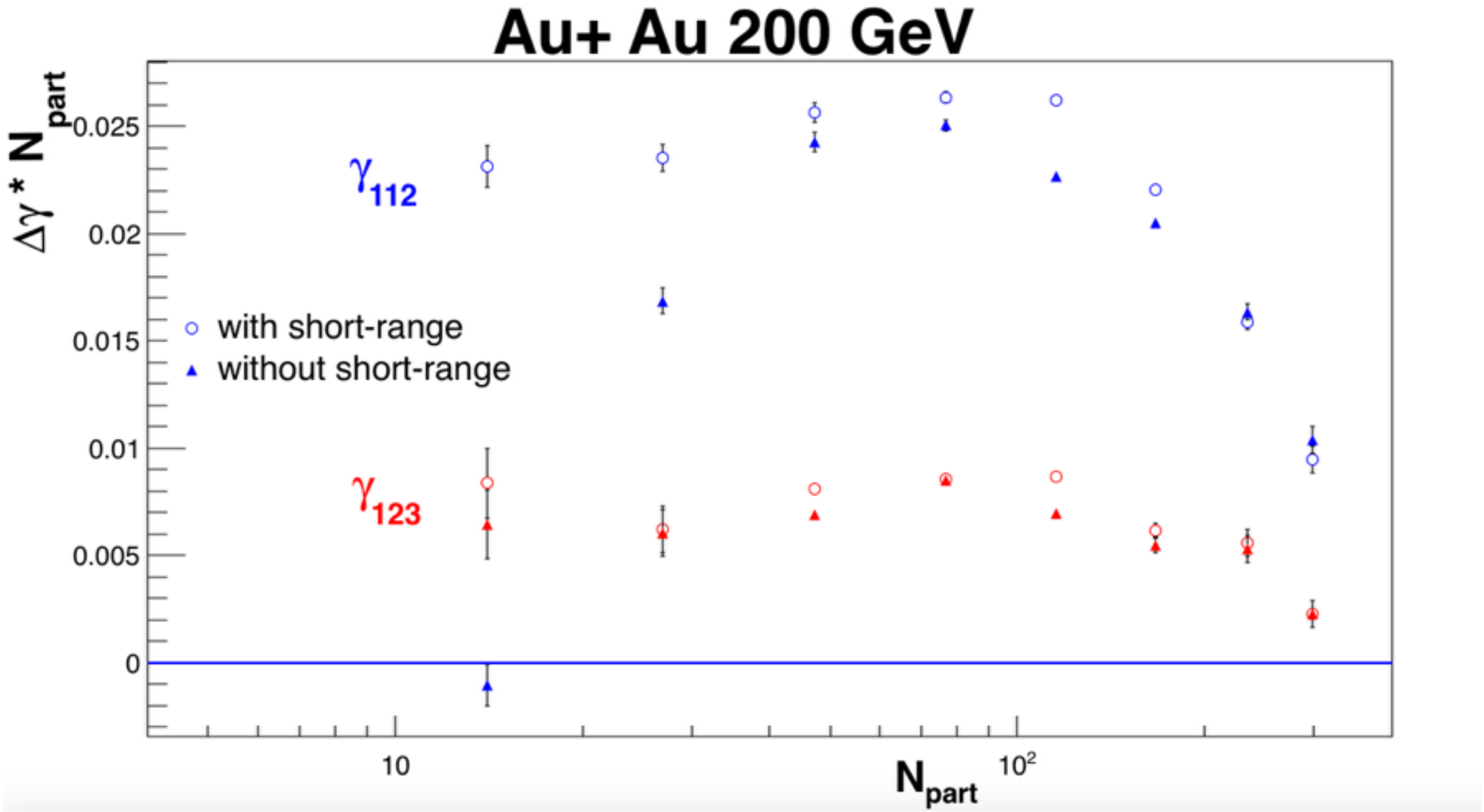




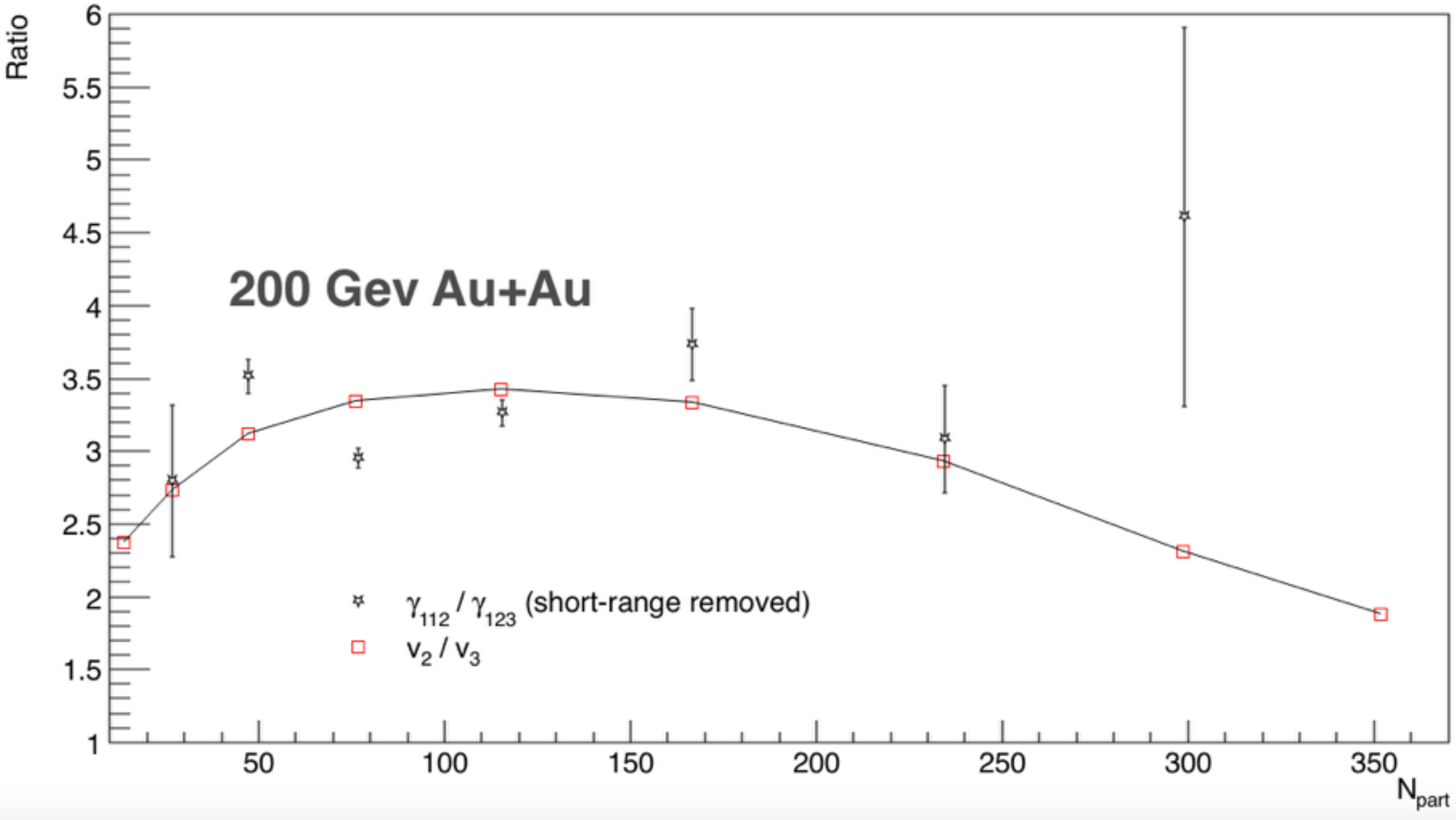


Results

Original vs Short range removal



Analysis of Peak Contribution



Conclusion

- The 3 gaussian peak widths are very similar between γ_{112} and γ_{123} correlator, for each independent part. The constant is described by the function -sqrt(1/x).

- For the peak amplitude, the short-range gaussian function peak amplitudes are also similar between γ_{112} and γ_{123} correlator

- Peak contributions tell a different story, and if we focusing only on intermediate and constant contribution(i.e the short range removal part), the contribution is comparable to v_2/v_3.

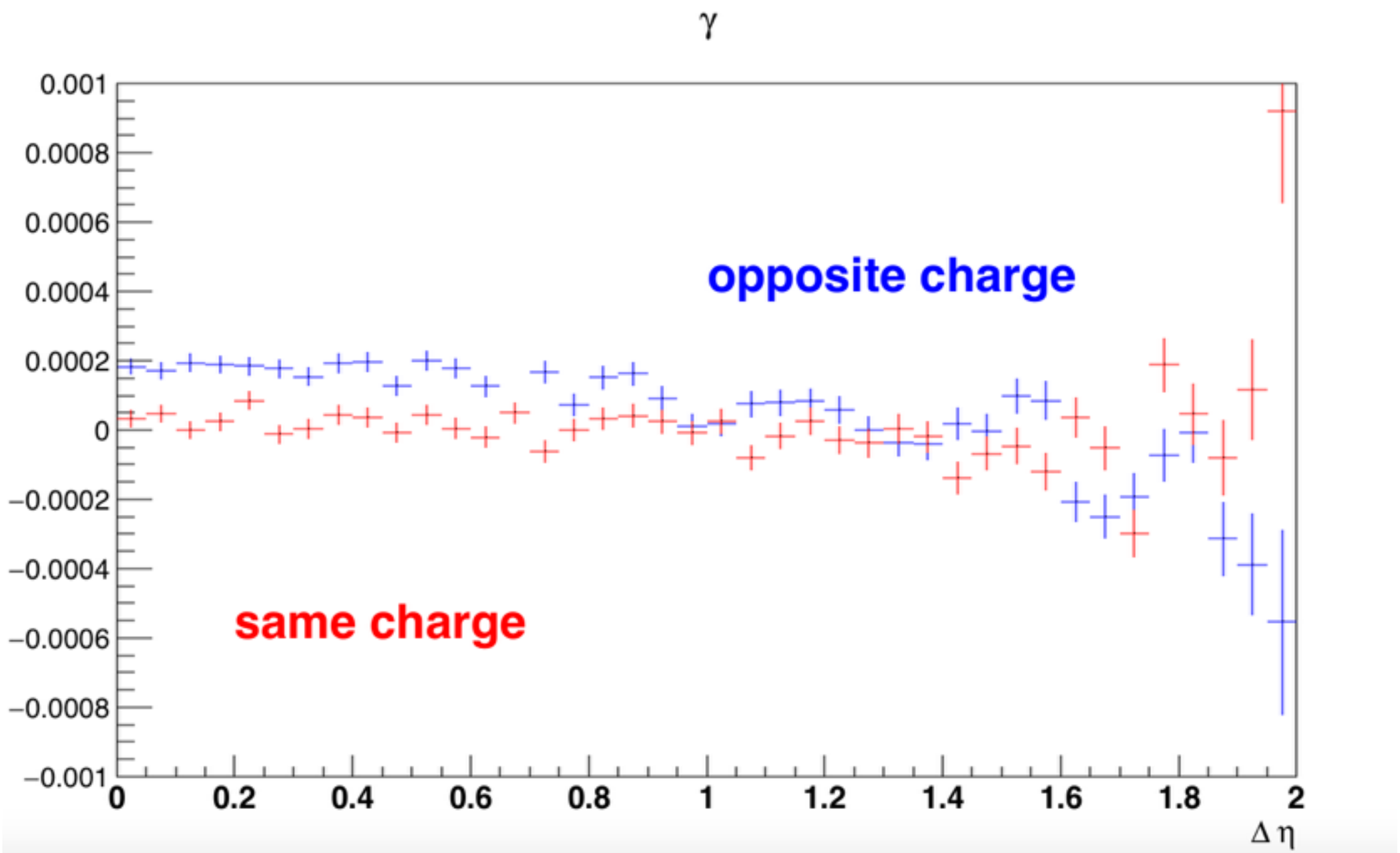
- γ_{112} and γ_{123} correlators could have the same origins or physical mechanism

To-do List

- The fit should be improved especially for the small systems and the very central one
- Further researches should be done to study the meaning of γ_{112} and $\gamma_{123,}$ similarity and difference
- High Δp_T case may also be studied with the same method to see whether there is a better result

Back slide

・ Resulted γ by removing the “very-short-range” and “short-range”



γ_{123} 40%-50%