

1. Femtoscopy and correlation functions

- Investigation of the correlation function of identical boson pairs

$$C_2(q) = \frac{\int d^4x D(x, K) |\psi_q(x)|^2}{\int d^4x D(x, K)}$$

- The pair source distribution:

$$D(x, K) = \int d^4X S\left(X + \frac{x}{2}, K\right) S\left(X - \frac{x}{2}, K\right)$$

- $C(q, K)$ can be measured in experiments
- The $D(x, K)$ function can be reconstructed in event generators

2. Lévy-type source function

- General form of the function:

$$\mathcal{L}(r, R_x, R_y, R_z, \alpha) = \frac{1}{(2\pi)^3} \int d^3q e^{iqr} e^{-\frac{1}{2} |q_x^2 R_x^2 + q_y^2 R_y^2 + q_z^2 R_z^2|^\alpha}$$

- 1 dimensional case:

$$\mathcal{L}(r, R, \alpha) = \frac{1}{\pi} \int_0^\infty dq \cos qr e^{-\frac{1}{2} qR}$$

- Lévy exponent: $\alpha < 2$ power-law, $\alpha = 2$ Gaussian
- Lévy-scale: R , geometric properties

$$S(r) = \mathcal{L}(r, R, \alpha) \Rightarrow D(r) = \mathcal{L}(r, 2^{\frac{1}{\alpha}} R, \alpha)$$

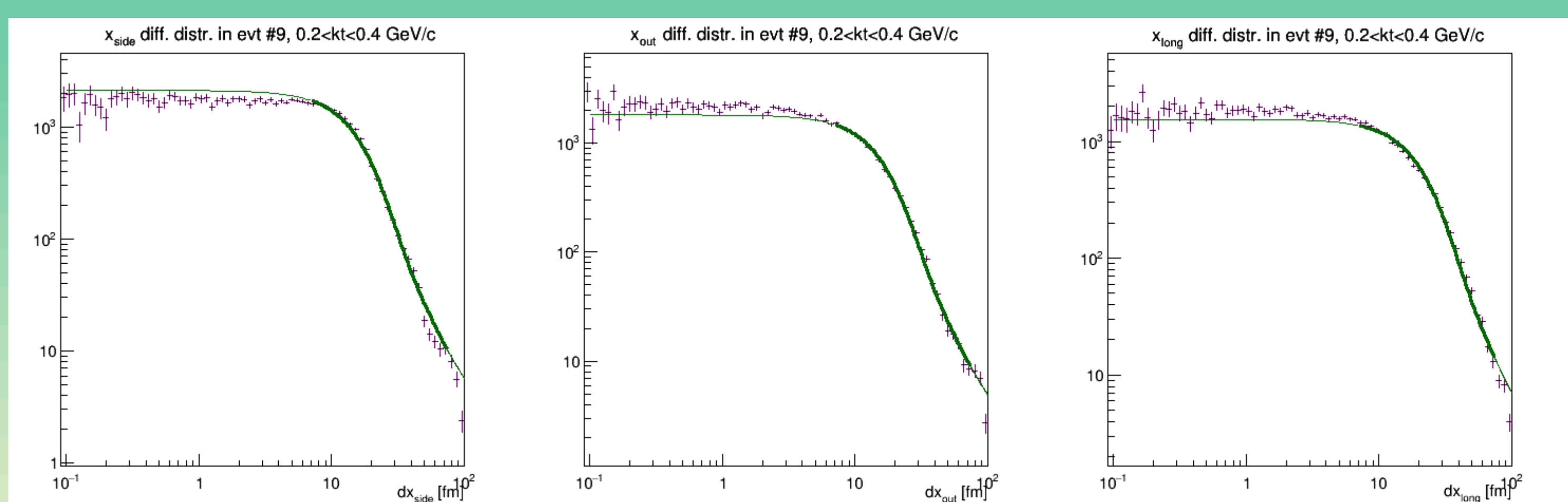
3. EPOS

- Event-generator of heavy-ion collisions
- Phenomenological model based on Monte Carlo techniques

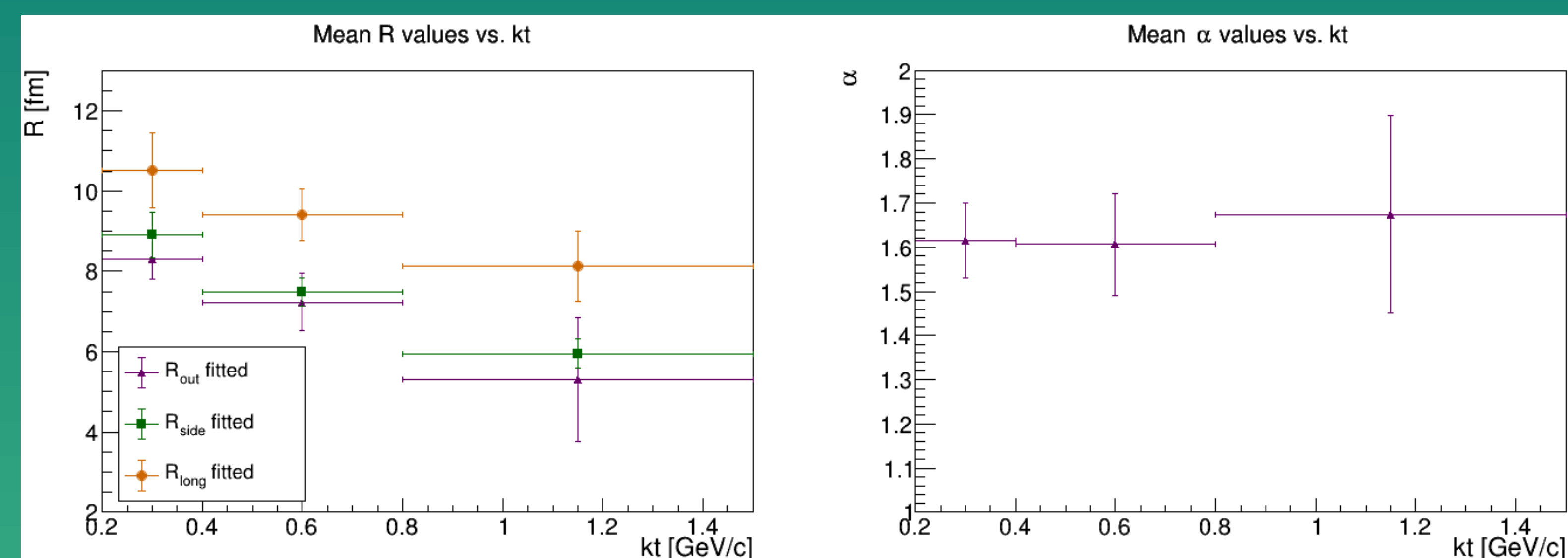
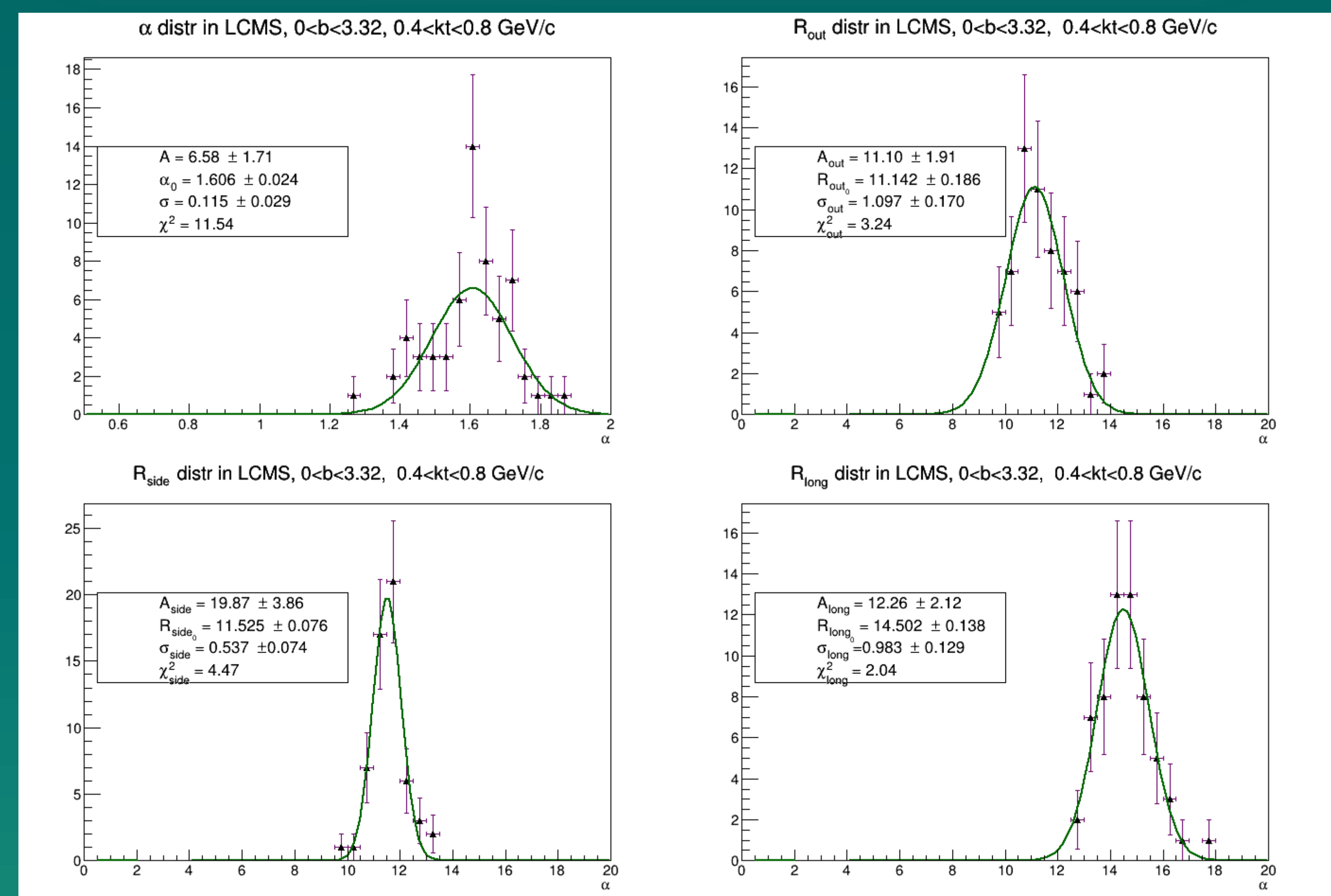
4. Methods

- Event-by-event distributions of pion pairs
- Separated the measurements into centrality and k_T classes
- 3 dimensional pair-distribution \Rightarrow 1 dimensional projections according Bertsch-Pratt-coordinates
- Fitting 1 dimensional Lévy-functions to the projections
- For the 3 projection of a 3 D distribution: fitting simultaneously with same Lévy exponent but different Lévy scales

5. Examples of the fitted event by event distribution for the three projections



6. Example of the distribution of α and R parameters



Summary

- EPOS pion pair source function fitted with Lévy distribution
- Lévy-exponent: $\alpha \approx 1.6 - 1.7$, not Gaussian ($\alpha \neq 2$)
- Lévy-scale: different values for the different projections (with the same α -s)
- Lévy shape is not the result of event-averaging or direction averaging
- Results agree with 1D analysis of Ref. [4]
- Next step: azimuthally sensitive (w.r.t. reaction plane) refinement of analysis

References

- [1] T. Csorgo, S. Hegyi and W. A. Zajc, Eur. Phys. J. C 36 (2004), 67-78
- [2] T. Csorgo, S. Hegyi, T. Novak and W. A. Zajc, AIP Conf. Proc. 828 (2006) no.1, 525-532
- [3] A. Adare et al. [PHENIX], Phys. Rev. C 97 (2018) no.6, 064911
- [4] D. Kincses, M. Stefaniak and M. Csanád, Entropy 24 (2022) no.3, 308
- [5] S. Afanasiev et al. [PHENIX], Phys. Rev. Lett. 100 (2008), 232301