Event-by-event investigation of pion source in heavy-ion collisions with the EPOS model

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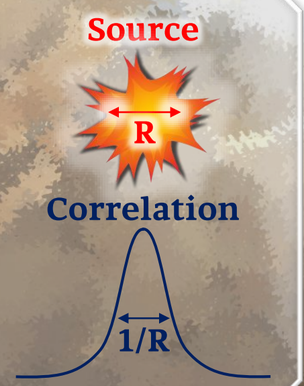
1. Femtoscopy

- Momentum correlations of identical boson pairs
- Information about the geometry of the source
- Correlation function: $C(Q) = \int D(r)\left|\psi_Q(r)\right|^2 dr$
- Pair-source: $D(r,K) = \int d^4\rho S\left(\rho + \frac{r}{2}, K\right) S\left(\rho - \frac{r}{2}, K\right)$

Q - relative pair momentum; r – relative pair coordinate; K – average pair momentum
$\psi_Q(r)$ - symmetrized pair wave function; S(x,p) – single-particle source distribution

- Experiments – information about D(r) through C(Q)
- Event generator models – direct access to pair-source!



2. The EPOS model

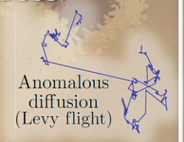
- heavy-ion event generator model
- Theoretical framework: parton based Gribov Regge theory
- Main parts:

1. Core-Corona division (based on dE /dx of string segments)
2. vHLLE 3D+1 viscous hydrodynamics
3. Hadronic rescattering (UrQMD)

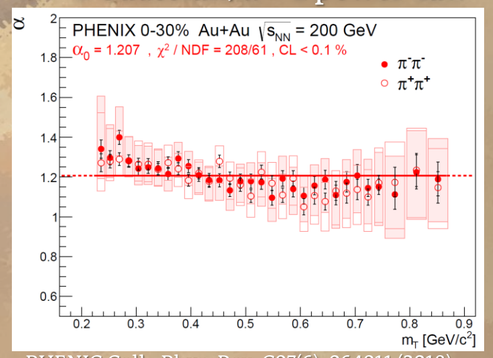
Werner, K. et al., Phys. Rev.C82, 044904 (2010)

3. Lévy-type sources

- Possible reasons for the appearance of such sources:
  - Critical behavior
  - Anomalous diffusion
  - Jet fragmentation



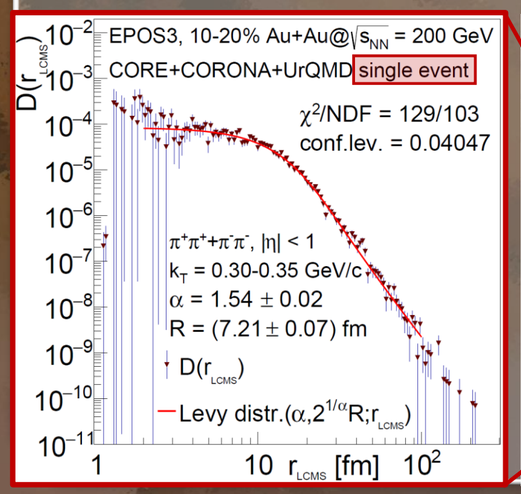
- Symmetric Lévy-stable distr.:
  $\mathcal{L}(\alpha, R; r) = \frac{1}{(2\pi)^3}\int d^3q e^{iqr} e^{-\frac{1}{2}|qR|^\alpha}$
- $\alpha = 2$ Gaussian, $\alpha < 2$ power-law

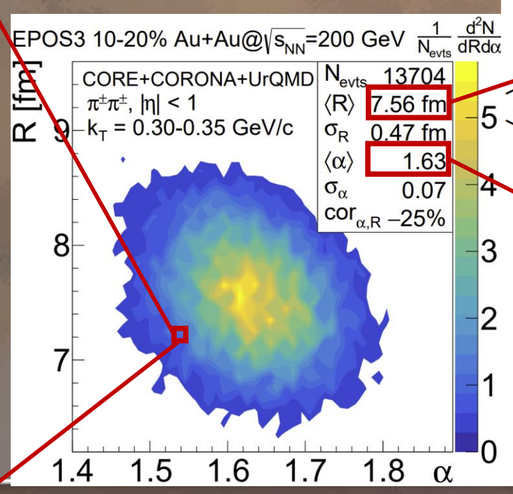


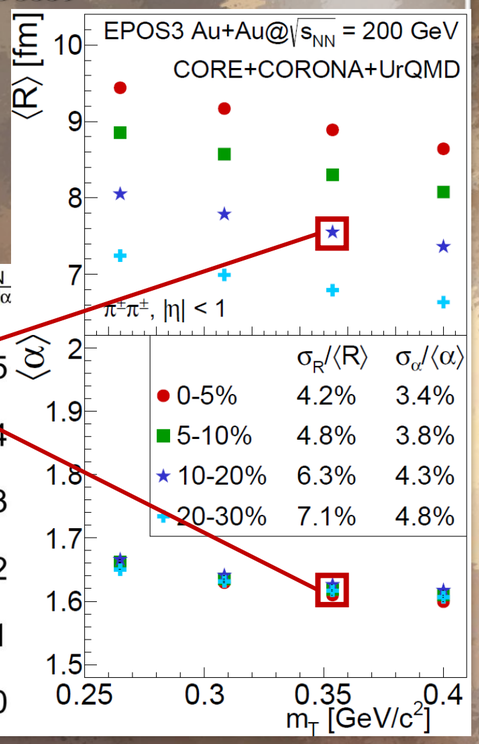
PHENIC Coll., Phys. Rev. C97(6), 064911 (2018)
Csörgő, Hegyi, Zajc , Eur.Phys.J . C36
Csörgő, Hegyi, Novák, Zajc, AIP Conf.Proc. 828
Metzler, Klafter, Physics Reports 339 (2000) 1-77
Csörgő, Hegyi, Novák, Zajc, Acta Phys.Polon. B36

4. Results

- $\sqrt{s_{NN}}$ = 200 GeV Au+Au collisions generated by EPOS359
- Angle-averaged radial pair-source distribution of pions
- $D(r_{1,2}^{LCMS}) = \int d\Omega dt D(r)$; $r_{1,2}^{LCMS} = \sqrt{(x_1-x_2)^2 + (y_1-y_2)^2 + (\Delta z_{LCMS})^2}$,
- Fitting D(r) **event by event** with a Lévy-stable distribution
- Extracted α and R parameters described with a normal distr.
- Similar trends as observed in experiments, higher α values







5. Summary

- pion pair-source investigated in EPOS
- Lévy-distribution describes source D(r)
- **event by event non-Gaussianity** – not because of averaging
- normal distribution of dN/dR and dN/dα in given kT & cent.
- **Lévy-scale R:** trend and magnitude agrees with meas.
- **Lévy-exponent α:** Magnitude higher than in measurements