Probing flow fluctuation through factorization breaking in heavy-ion collision

- based on P. Bozek, R. Samanta, PRC 105, 034904 (2022)

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NCN grant : 2019/35/O/ST2/00357

Dec 8, 2022

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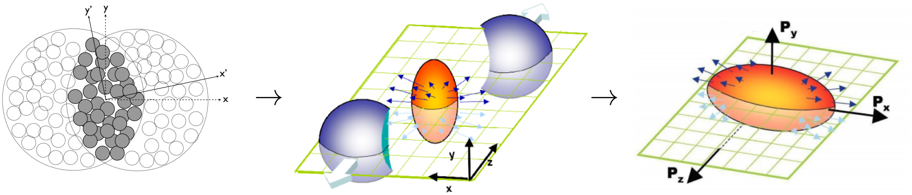
Fluctuation of collective flow in HI Collisions

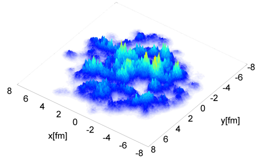


Asymmetry in initial source distribution ⟶ Hydrodynamic evolution of the fireball ⟶ Final state momentum anisotropy

Momentum anisotropy : Harmonic flow

$$\frac{dN}{dp\,d\phi} = \frac{dN}{2\pi dp}\left(1 + 2\sum_{n=1}^{\infty} V_n(p)e^{in\phi}\right)$$

- Flow vector, $V_n = |V_n|\ e^{i\ n\Psi_n}$
  $|V_n| \rightarrow$ Flow magnitude & $\Psi_n \rightarrow$ Flow angle
- **Event by event fluctuation of initial state** $\Longrightarrow$ **event by event fluctuation of flow vectors** V_n**'s**



lumpy structure of the initial density

Mapping flow fluctuation by factorization-breaking coefficients

- **Flow fluctuation** $\longrightarrow$ **decorrelation between two flow vectors in two momentum bins** $\longrightarrow$ **includes both flow magnitude and flow angle decorrelation** $\longrightarrow$ *factorization-breaking coefficients* .
- **Flow magnitude and flow angle decorrelation require 2nd order correlations** $\longrightarrow$ one flow momentum dependent $(V_n(p))$ and other flow momentum averaged (V_n), removes experimental difficulty.
- The **flow vector square and flow magnitude square factorization coefficients** are constructed as,

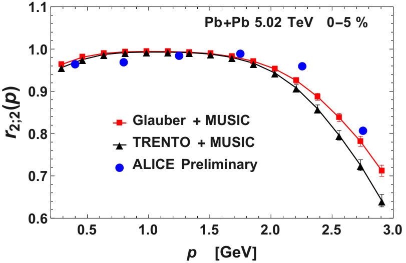
$$r_{n;2}(p) = \frac{\langle V_n^2 V_n^*(p)^2 \rangle}{\sqrt{\langle |V_n|^4 \rangle \ \langle |V_n(p)|^4 \rangle}} \quad \text{and} \quad r_n^{v_n^2}(p) = \frac{\langle |V_n|^2 |V_n(p)|^2 \rangle}{\sqrt{\langle |V_n|^4 \rangle \ \langle |V_n(p)|^4 \rangle}}$$

- The **flow angle decorrelation** is obtained from the **ratio of the flow vector and flow magnitude** factorization coefficients,

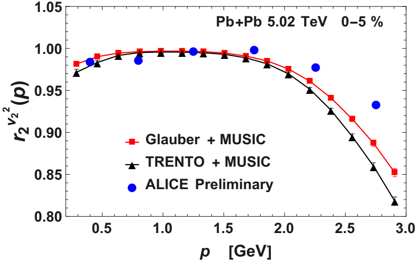
$$F_n(p) = \frac{\langle V_n^2 V_n^*(p)^2 \rangle}{\langle |V_n|^2 |V_n(p)|^2 \rangle} = \frac{\langle |V_n|^2 |V_n(p)|^2 \cos[2n(\Psi_n - \Psi_n(p))] \rangle}{\langle |V_n|^2 |V_n(p)|^2 \rangle} \simeq \frac{\langle |V_n|^4 \cos[2n(\Psi_n - \Psi_n(p))] \rangle}{\langle |V_n|^4 \rangle}$$

Model Results

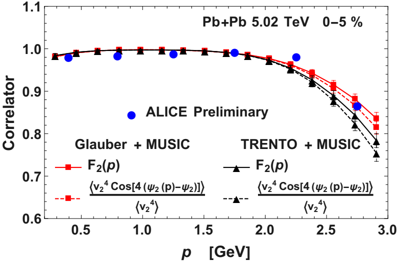
(flow vector)^2-(flow vector)^2



(flow magnitude)^2-(flow magnitude)^2



flow angle decor.



- **Similar momentum dependent correlations between mixed-flows e.g. $V_2^2 - V_4(p)$ and $V_2 V_3 - V_5(p)$** could be studied $\longrightarrow$ measure of **non-linear** medium response
- **For more detailed results and discussions, please follow the poster session.**