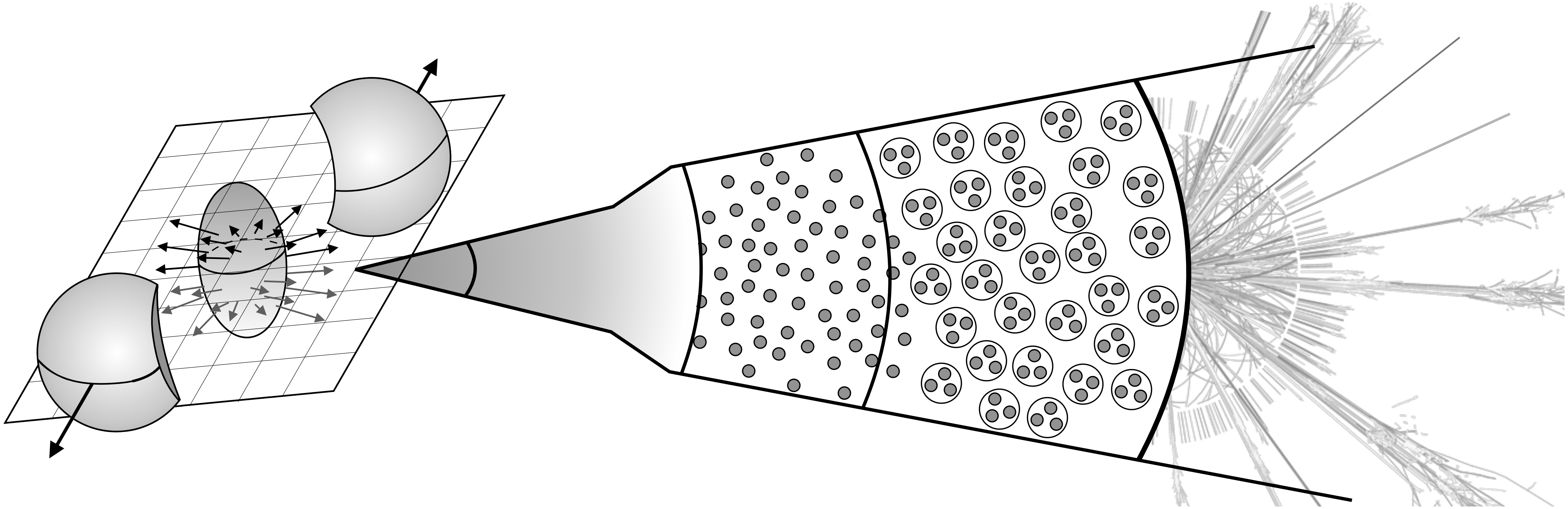
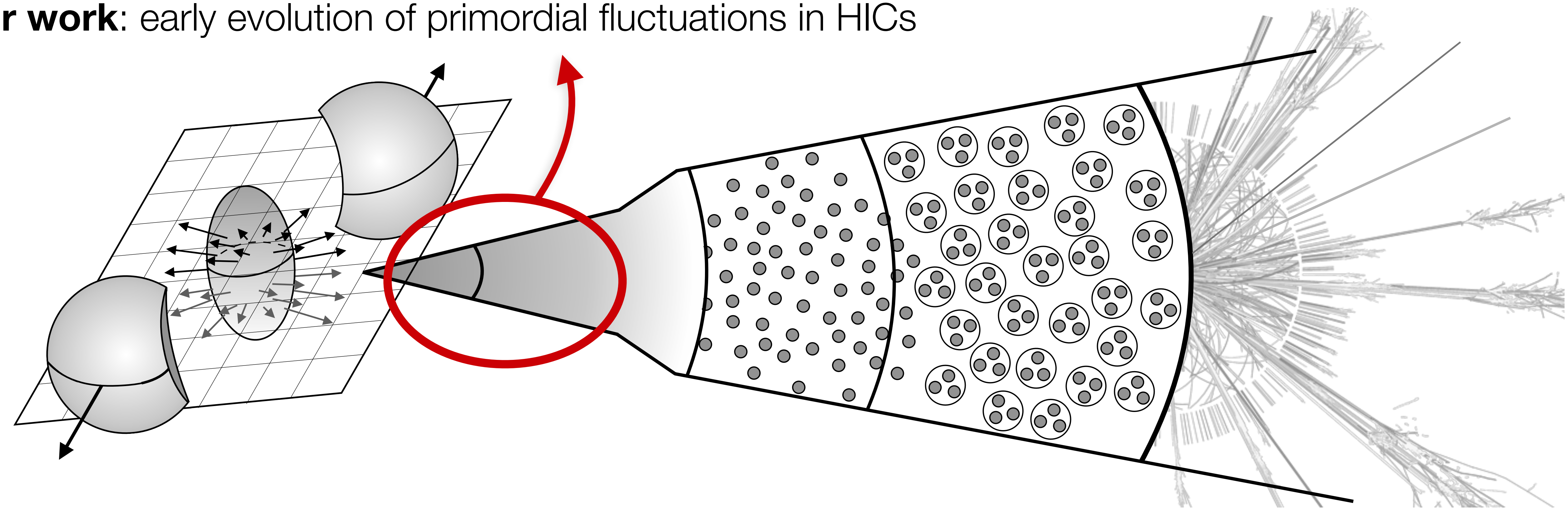
Primordial Fluctuations



Primordial Fluctuations

Our work: early evolution of primordial fluctuations in HICs



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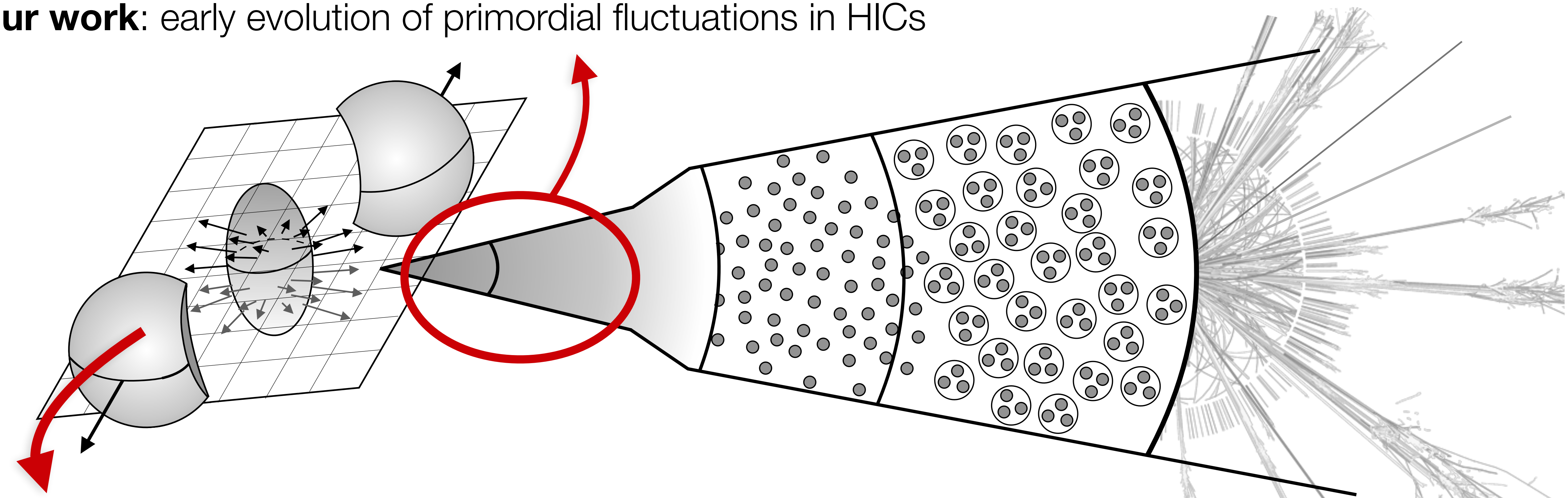
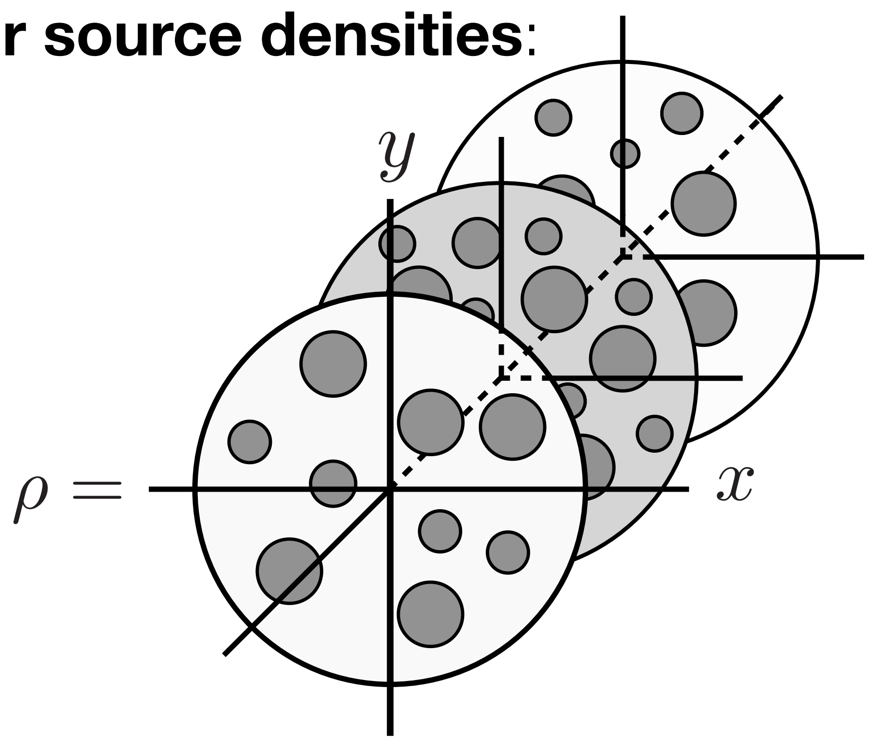


Event-by-event fluctuations of
color source densities:



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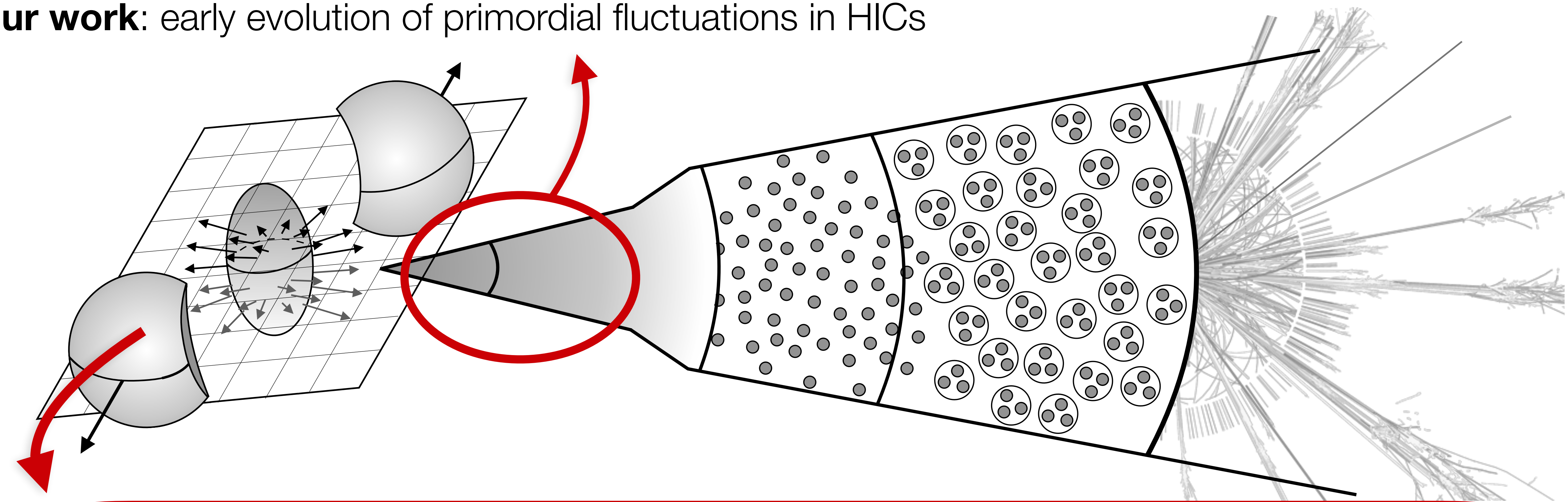

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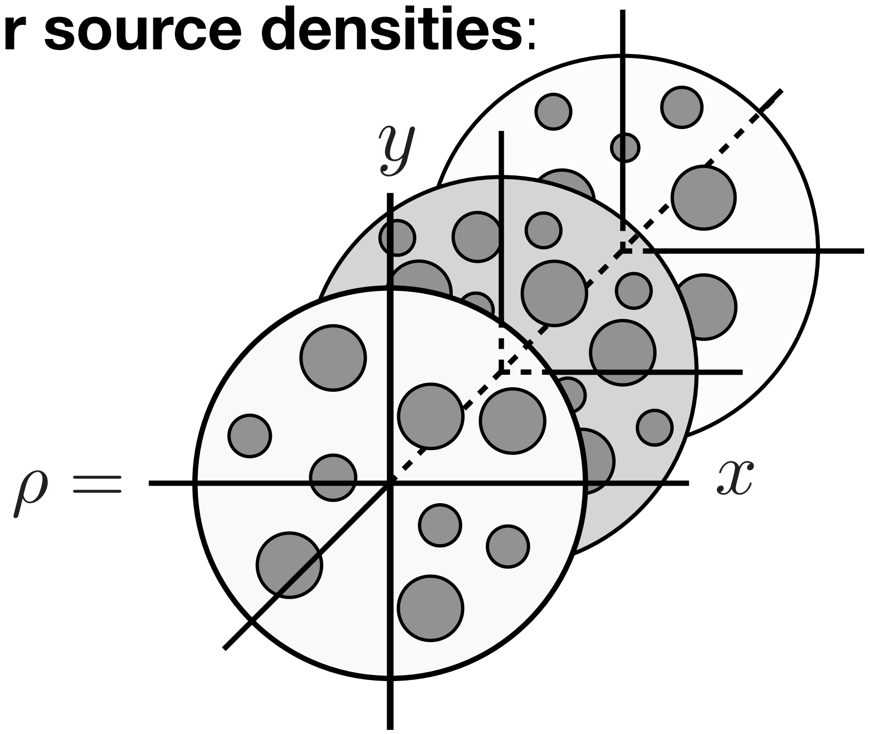
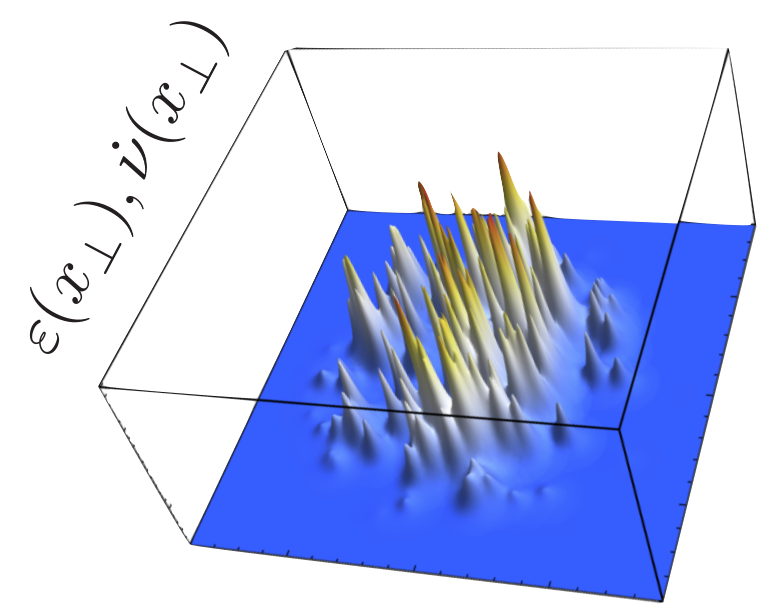
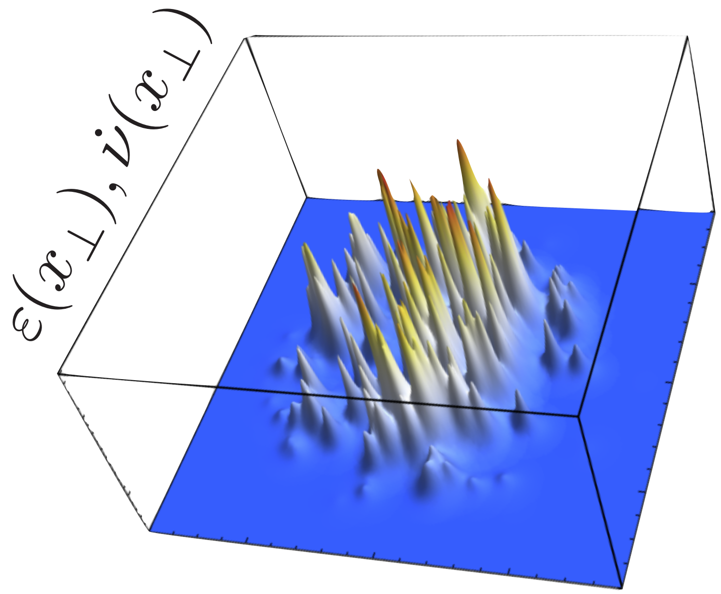


Fluctuating distributions of **energy density** and **axial charge**



CGC correlators

Fluctuating distributions of **energy density** and **axial charge** characterized by the following **correlators**:



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$\langle \dot{\nu}(x_\perp) \rangle$

} Average/ Expectation value

$\langle \varepsilon(x_\perp) \varepsilon(y_\perp) \rangle$

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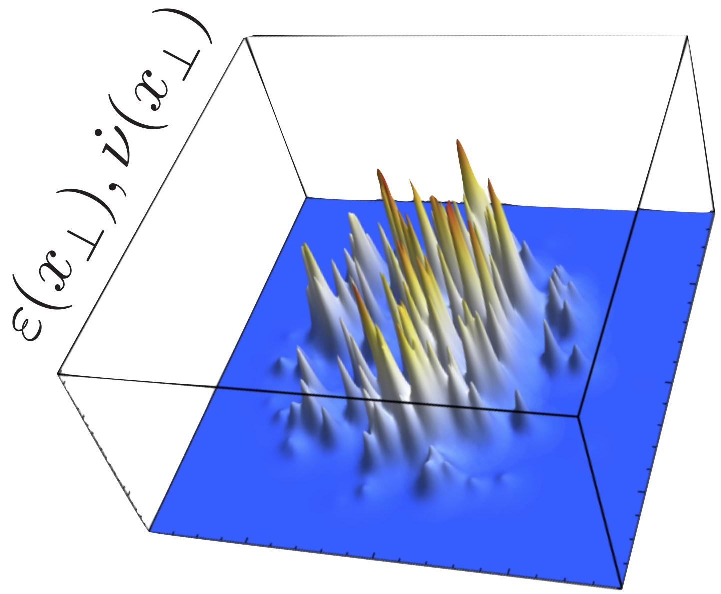

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Color Glass Condensate: appropriate theoretical framework to compute these correlators in HICs

$$\langle \rho(x_\perp) \rho(y_\perp) \rangle \propto \delta(x_\perp - y_\perp)$$

Gaussian density correlations (MV model)

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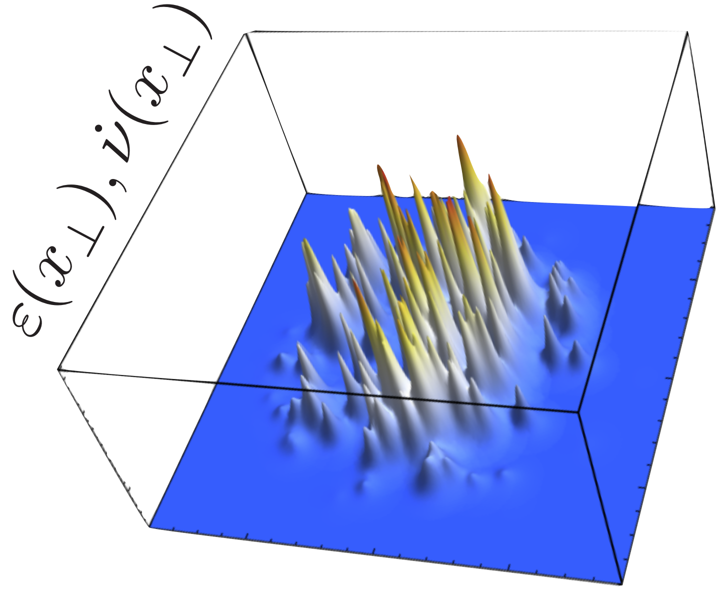

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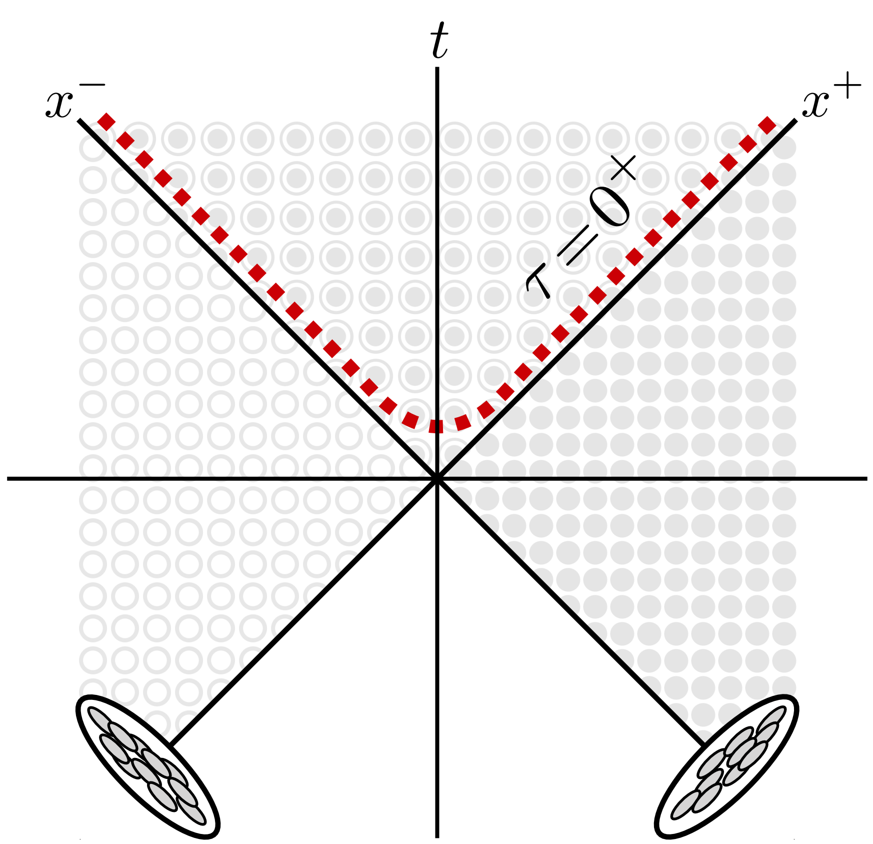

Analytical calculations performed for the instant **right after the collision**

$\langle \varepsilon(\tau = 0^+, x_\perp) \rangle$ $\quad$ $\langle \varepsilon(\tau = 0^+, x_\perp)\varepsilon(\tau = 0^+, y_\perp) \rangle$
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(J.L.Albacete, Cyrille Marquet and PGR, JHEP 1901 (2019) 073)
(PGR, JHEP 1908 (2019) 026)
(T.Lappi and S.Schlichting, Phys.Rev.D97 (2018) 3 034034)

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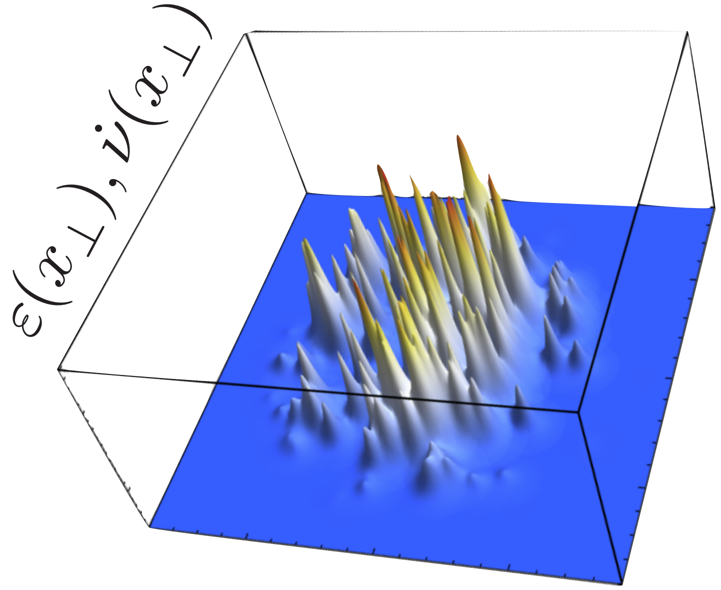

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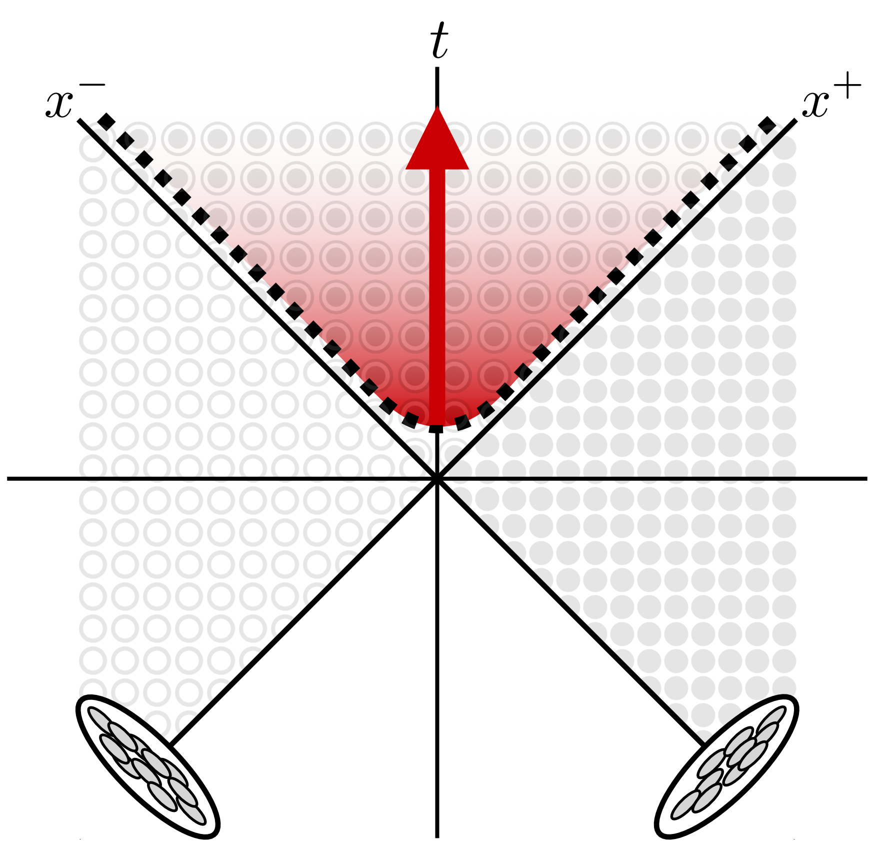

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Our approach

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Analytical approximation: **linearizing Yang-Mills equations**

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In previous approaches: **weak field limit / dilute-dense regime**

$$U(x_\perp) = 1 + igA(x_\perp)$$

Wilson lines correponding to weak source are expanded

(A. Kovner, L.McLerran, H.Weigert, Phys.Rev.D52 (1995) 6231-6237)

(L. McLerran, V.Skokov, 10.1016/j.nuclphysa.2016.12.011)

(A. Dumitru, L. McLerran, Nucl.Phys.A700:492-508,2002)

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- Good approximation for **UV-dominated quantities** such as:

$$\varepsilon(\tau, x_\perp) = \mathrm{Tr}\{E^\eta E^\eta + B^\eta B^\eta + E^i E^i + B^i B^i\}$$
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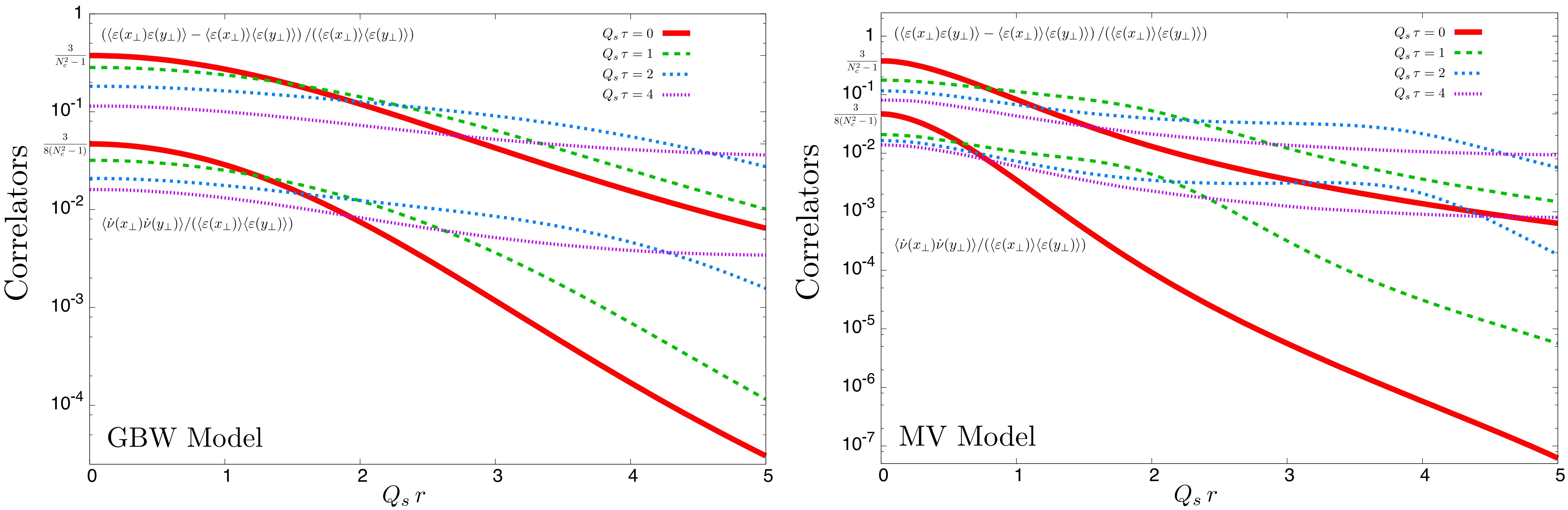
- Our approach is equivalent to a resummation of the contributions of high momentum modes that would make a power series expansion in proper time divergent.

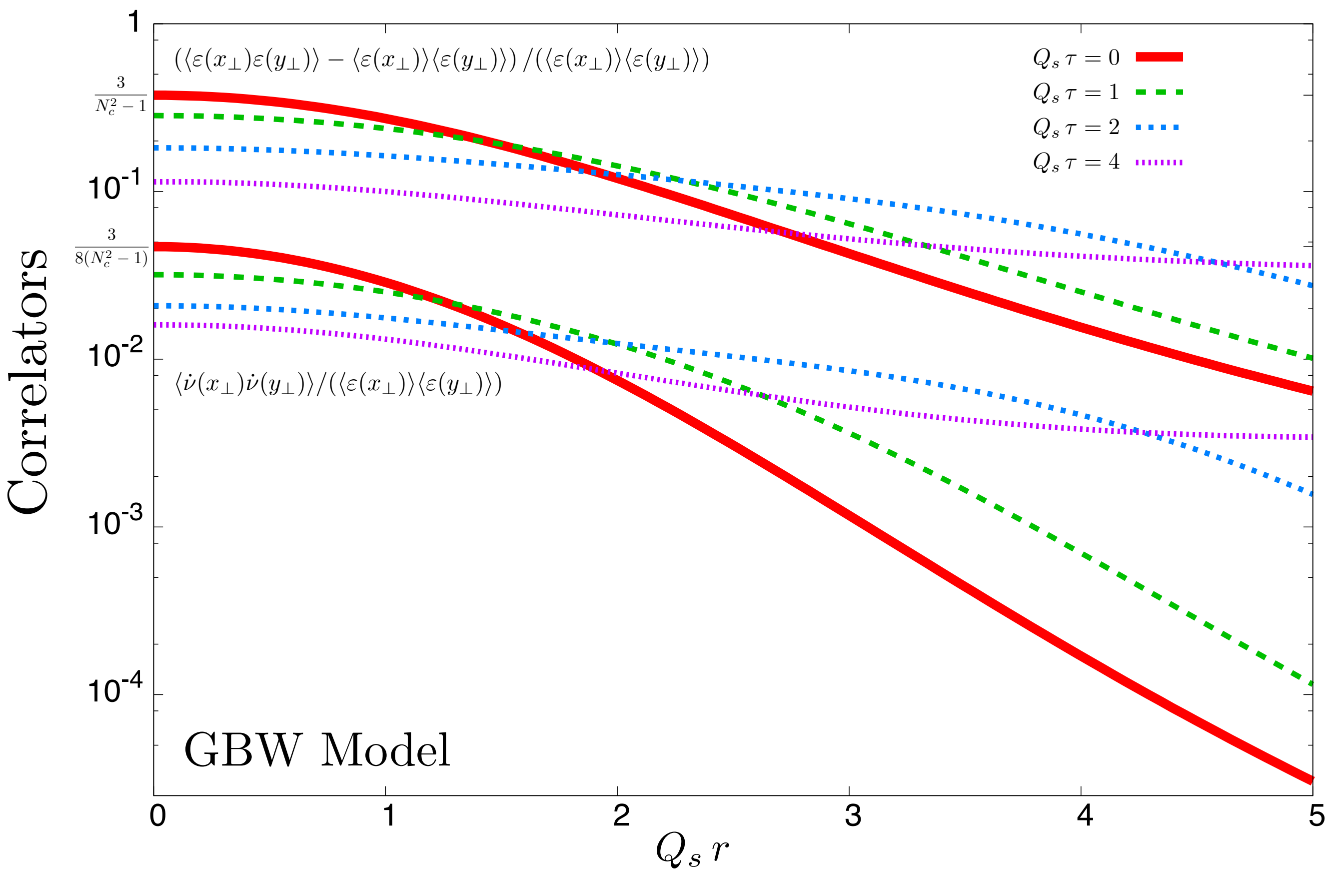
$$A(\tau, \vec{x}_\perp) = \sum_{n=0}^{\infty}\tau^n A_{(n)}(\vec{x}_\perp), \qquad A^i_\perp(\tau, \vec{x}_\perp) = \sum_{n=0}^{\infty}\tau^n A^i_{\perp(n)}(\vec{x}_\perp),$$

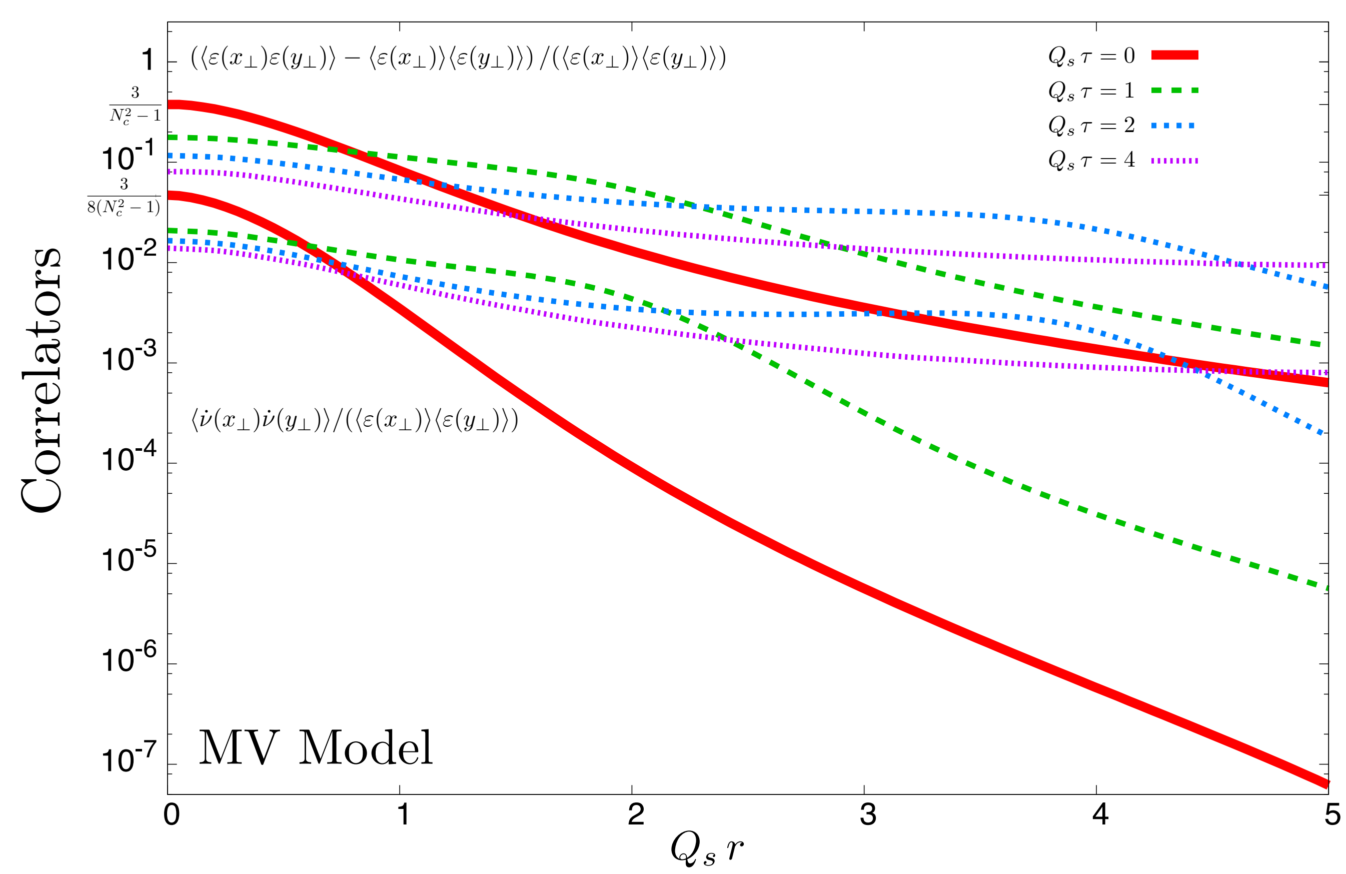
(G. Chen, R. J. Fries, J. I. Kapusta and Y. Li, Phys. Rev. C92 (2015) No.6 064912)

(H. Fujii, K. Fukushima and Y. Hidaka, Physical Review C 79 (Feb, 2009))



- "Correlation length" growth: sign of a system that is approaching the hydrodynamical regime
- Theoretical insight into thermalization phase of HICs (during classical regime)
- More refined calculations (i.e. beyond Glasma Graph approximation) needed for the description of IR-sensitive quantities like eccentricity fluctuations
- Potential application: saving computing time in models that rely on numerical solutions of Yang-Mills equations





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Thank you for your attention