Event-by-Event correlations and fluctuations with strongly intensive quantities in heavy-ion collisions with ALICE

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QM22- QUARK MATTER
Kraków, 04 – 10 April, 2022
Introduction: Why do we study strongly intensive quantities?

- The forward-backward (FB) correlation coefficient $b_{\text{corr}}$ is largely influenced by geometrical (volume) fluctuations.

- Strongly Intensive quantities do not depend on system volume nor system volume fluctuations.

**STRONGLY INTENSIVE QUANTITY $\Sigma$:**

$$
\Sigma = \frac{\langle n_F \rangle \omega_B + \langle n_B \rangle \omega_F - 2 \text{Cov}(n_F, n_B)}{\langle n_F \rangle + \langle n_B \rangle}
$$

- For a symmetric collision: $\Sigma \approx \omega(1-b_{\text{corr}})$. 

$\Sigma \rightarrow$ gives direct information about characteristics of the single source distribution!
Results: $\Sigma$ as a function of centrality

- Values of $\Sigma$ increase with energy and increase with decreasing centrality in experimental data, contrary behavior noted for HIJING results.
- AMPT and EPOS reproduce dependence on centrality qualitatively but not quantitatively.
- The AMPT results show that $\Sigma$ is sensitive to the initial conditions.
Results: $\Sigma$ as a function of $\Delta\eta$

- Increase with $\Delta\eta$;
- **Pb-Pb**: decrease of $\Sigma$ with increasing centrality class;
- **pp**: $\Sigma$ grows with the increase of forward event multiplicity; contrary to Pb-Pb collisions.

Different ordering of $\Sigma$ with centrality for Pb-Pb and pp collisions.

\[ \eta_{sep} = \Delta\eta + 0.2 \]
Summary

- New results for measurement of the FB correlation with the strongly intensive quantity $\Sigma$ have been presented.

- $\Sigma$ increases with collision energy, and with decreasing centrality in experimental data, contrary behavior noted for HIJING and for experimental pp collisions.

- Removal of resonances does not change the dependence of $\Sigma$ on centrality.

- AMPT and EPOS reproduce the dependence on centrality qualitatively, but not quantitatively.

- In AMPT, $\Sigma$ is sensitive to the initial conditions (string melting).

- The comparison of centrality ordering in A-A reactions versus theoretical models, and experimental pp data, may provide new insight into the underlying dynamics of the collision.

- What model can reproduce $\Sigma$ behavior?