Dynamical Initialization with Core-corona Picture in Small Colliding Systems #640

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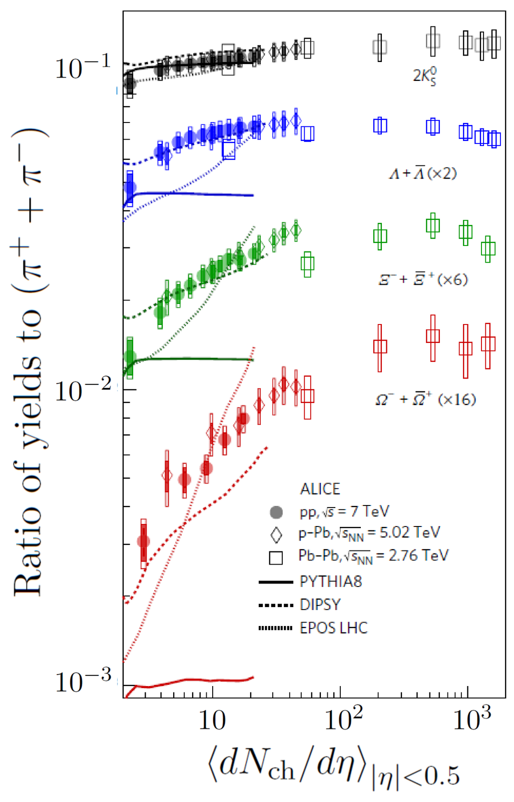
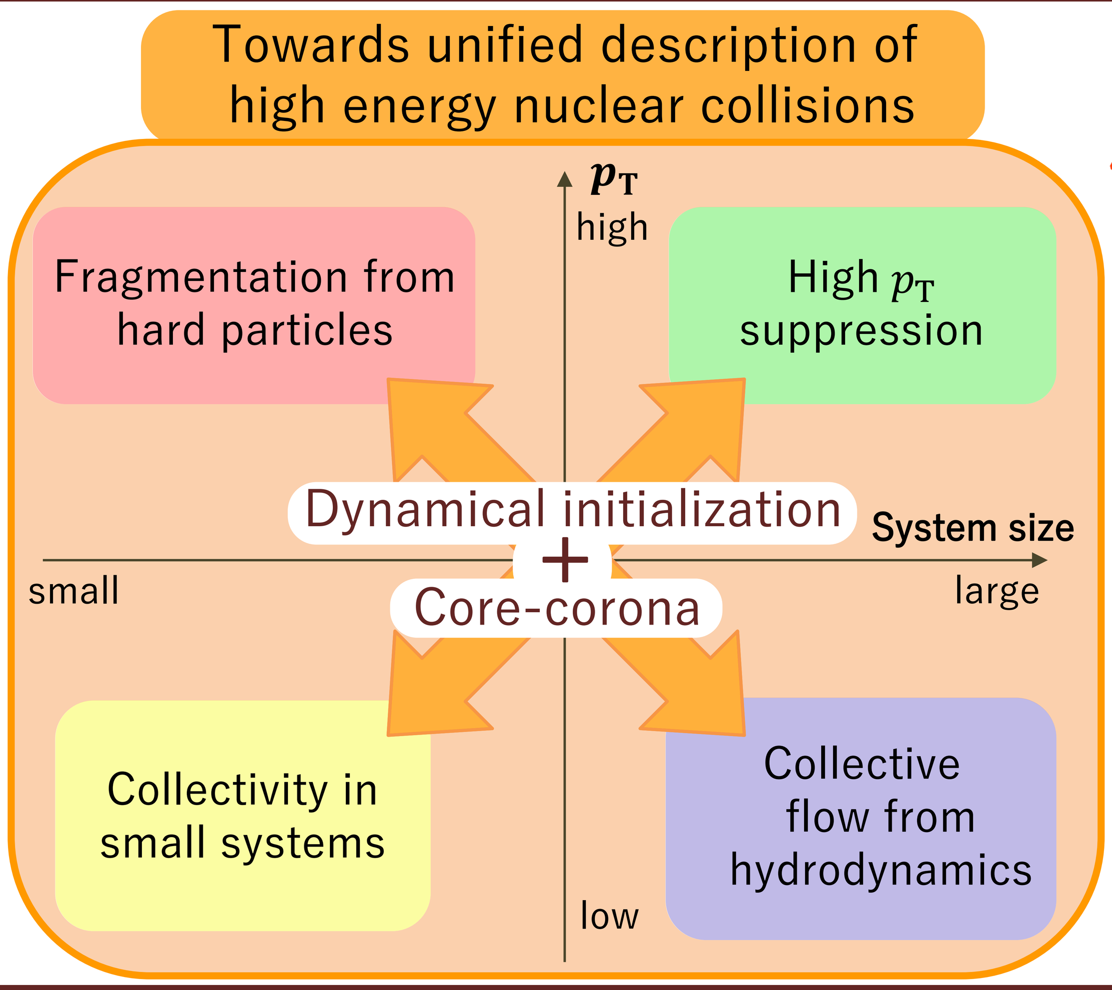
1. Introduction



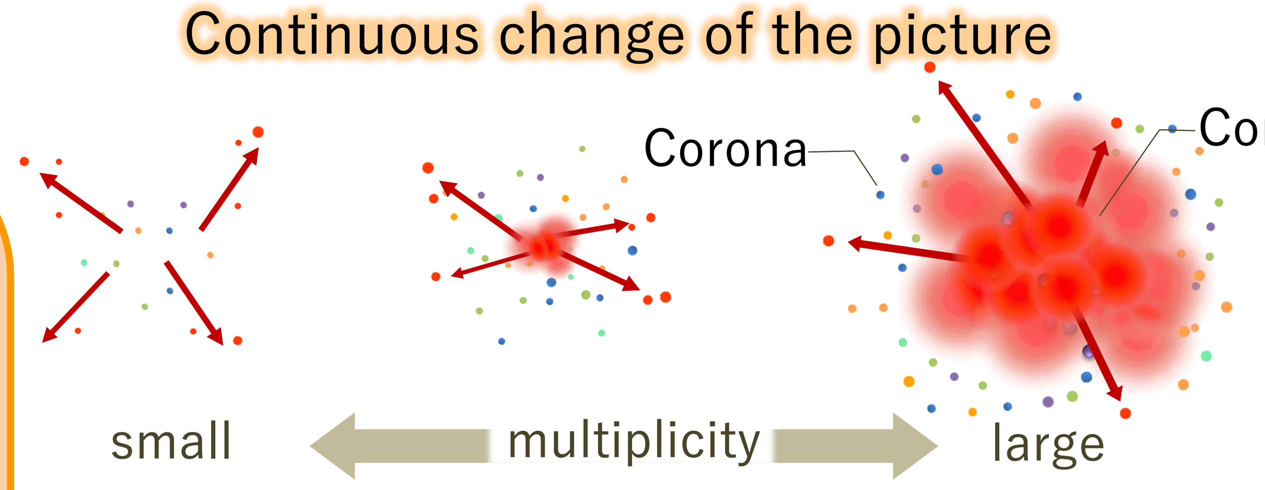
ALICE Collaboration. Nat. Phys. 13, (2017) 535.

Strangeness enhancement in small systems

Need of continuous change from fragmentation to chemical-equilibrated matter as increasing multiplicity



Continuous change of the picture



Purpose of this study

Construct a model to describe dynamics from low to high p_T regardless of system size.

Interpretation of strangeness enhancement for each system in one unified framework

2. Model

Parton generation with PYTHIA 8.230 → Dynamical initialization with core-corona

- Surviving partons → Traversing QGP fluids → String fragmentation with PYTHIA 8.230
- Fluids → Hydrodynamic evolution of QGP fluids → Particlization from fluids at T_{ch}

T. Sjöstrand *et al.*, Comput. Phys. Commun. 191, 159 (2015).
C. Bierlich *et al.*, JHEP 1610 (2016) 139.

i) Dynamical initialization

M. Okai *et al.* PRC 95, 054914 (2017).

$$\partial_\mu T^{\mu\nu} = J^\nu,$$

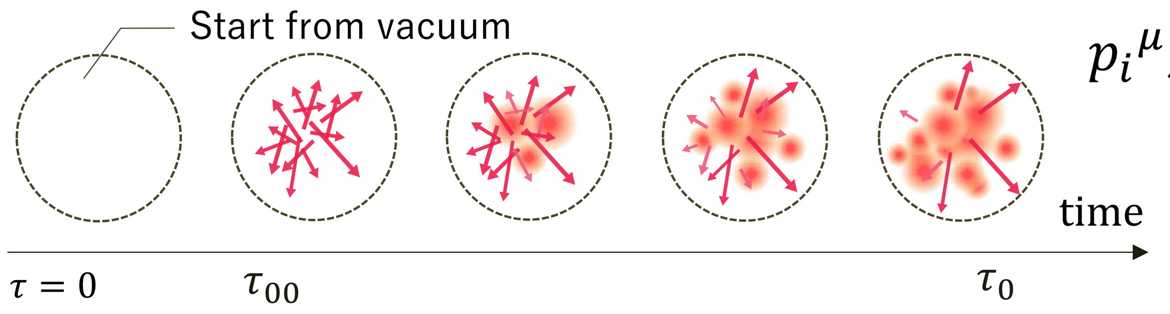
$$J^\mu = -\sum_i \frac{dp_i^{\mu}}{dt} G(\boldsymbol{x} - \boldsymbol{x}_i(t))$$

$T^{\mu\nu}$: Energy-momentum tensor

J^μ: Source term from partons to the QGP fluids

$G(\boldsymbol{x} - \boldsymbol{x}_i)$: Smearing Gaussian function

$p_i^{\mu}, \boldsymbol{x}_i$: Four momentum and position of the i-th parton



ii) Fluidization with core-corona

Fluidization rate

$$\frac{dp_i^{\mu}(t)}{dt} = -a_0 \frac{\rho_i(x_i(t))}{p_{T,i}^{\,2}(t)} p_i^{\mu}(t)$$

$$\rho_i(\boldsymbol{x})d^3x = \sum_{j \neq i} G\left(\boldsymbol{x} - \boldsymbol{x}_j(t)\right) d^3x$$

$\rho_i(\boldsymbol{x})$: Density distribution seen from the i-th parton

G: Gaussian distribution

$p_{T,i}$: Transverse momentum of the i-th parton

a_0: Core-corona parameter

Dynamical core-corona initialization
→ Interface between two pictures, partons and fluids

3. Results

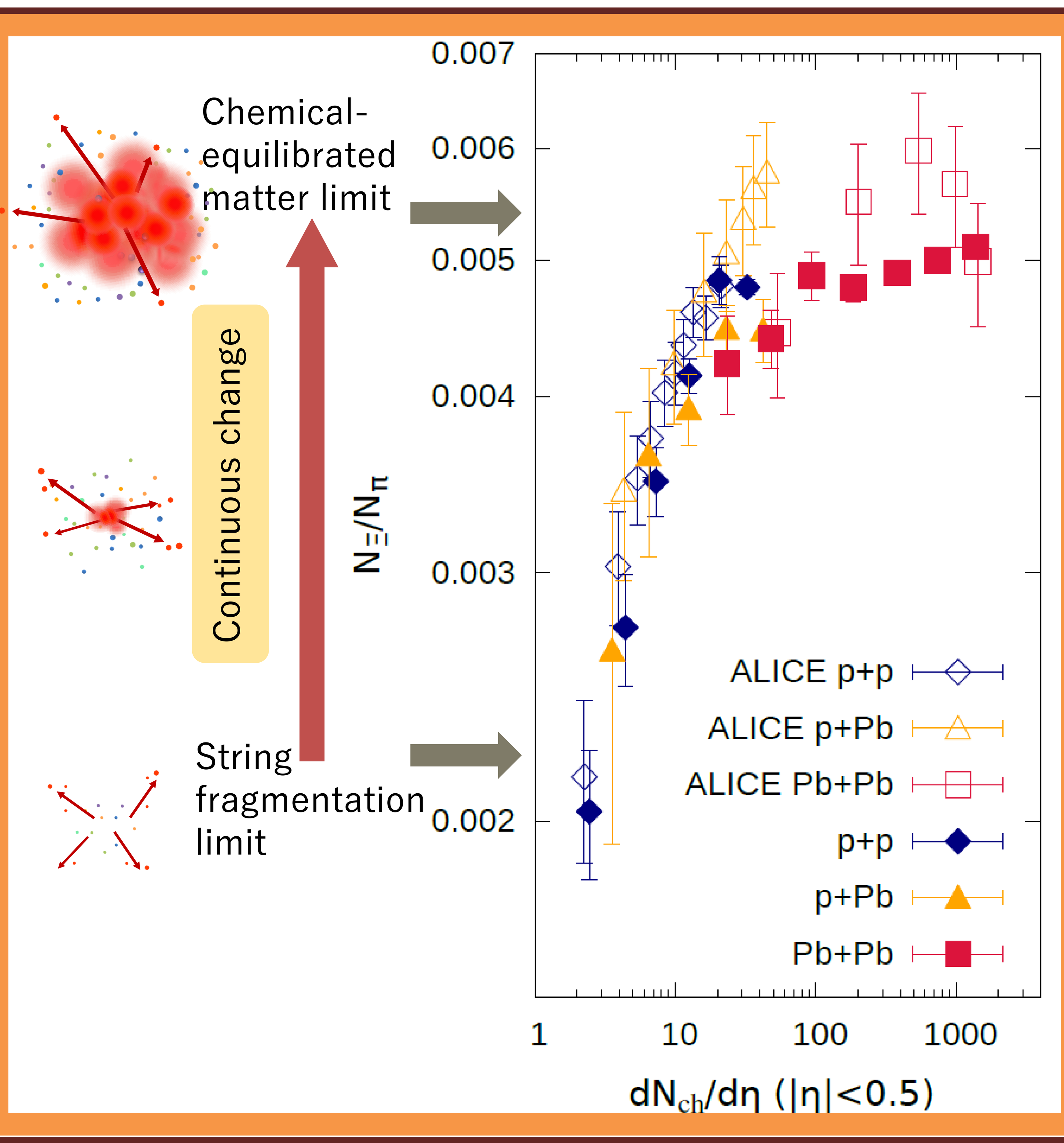
i) Strangeness enhancement

Pb+Pb: $\sqrt{s_{NN}} = 2.76$TeV
p+Pb: $\sqrt{s_{NN}} = 5.02$TeV
p+p: $\sqrt{s_{NN}} = 7$TeV

$dN_{ch}/d\eta < \sim 100$
→ Competition between string fragmentation and chemical-equilibrated matter

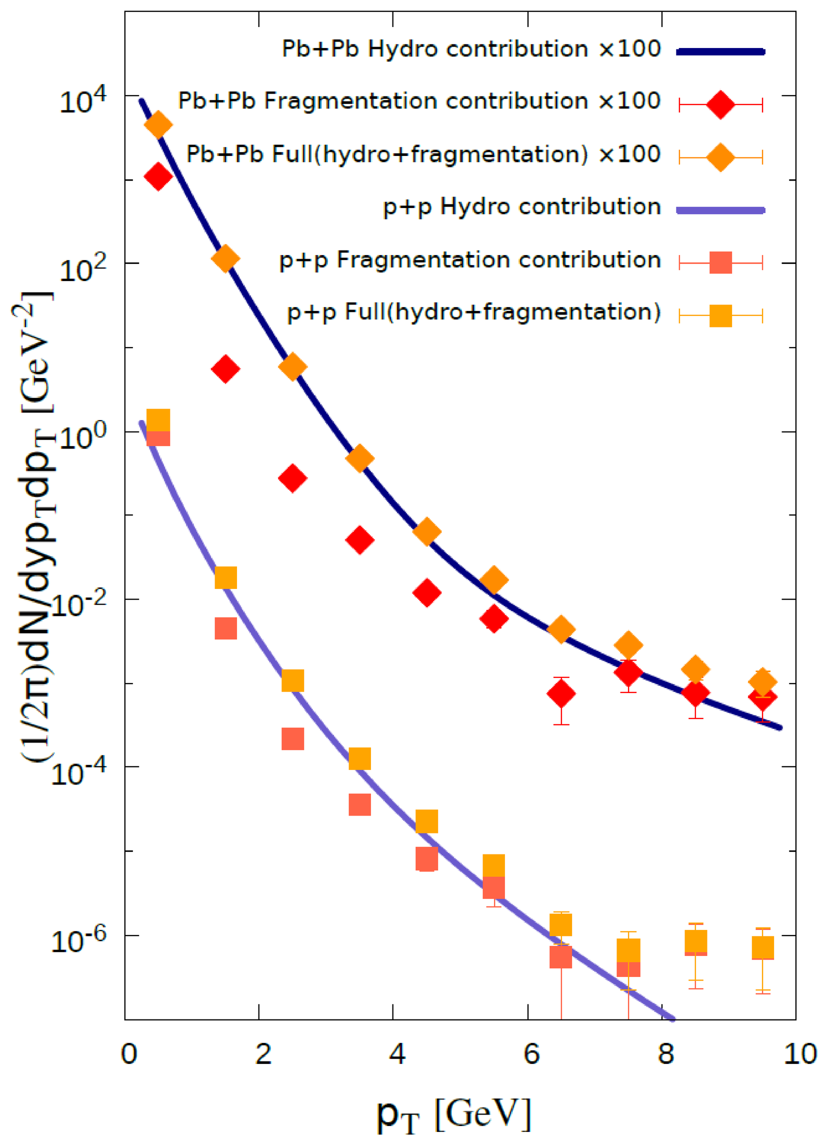
$dN_{ch}/d\eta \geq \sim 100$
→ Chemical-equilibrated matter dominance

Multiplicity dependence of strangeness enhancement well described in one framework



ii) p_T distribution

Pb+Pb: $\sqrt{s_{NN}} = 2.76$TeV
p+p: $\sqrt{s_{NN}} = 2.76$TeV
minimum bias $\pi^+ + \pi^-$



High p_T in p+p
→ Fragmentation dominance

Low p_T in Pb+Pb
→ hydro dominance

Continuous change from hydro to fragmentation as increasing p_T

Dependence of turning point on system size

4. Summary

- ✔ We developed a dynamical initialization model with core-corona picture based on string fragmentation and hydrodynamics.
- ✔ N_Ξ/N_π increases with $dN_{ch}/d\eta$ and saturates above $dN_{ch}/d\eta \sim 100$.

→ The QGP fluids are partly produced and their fraction increases with $dN_{ch}/d\eta$ in small systems at the LHC energies.

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