Study of the criticality for QGP formation in *AA* and *pp* collisions

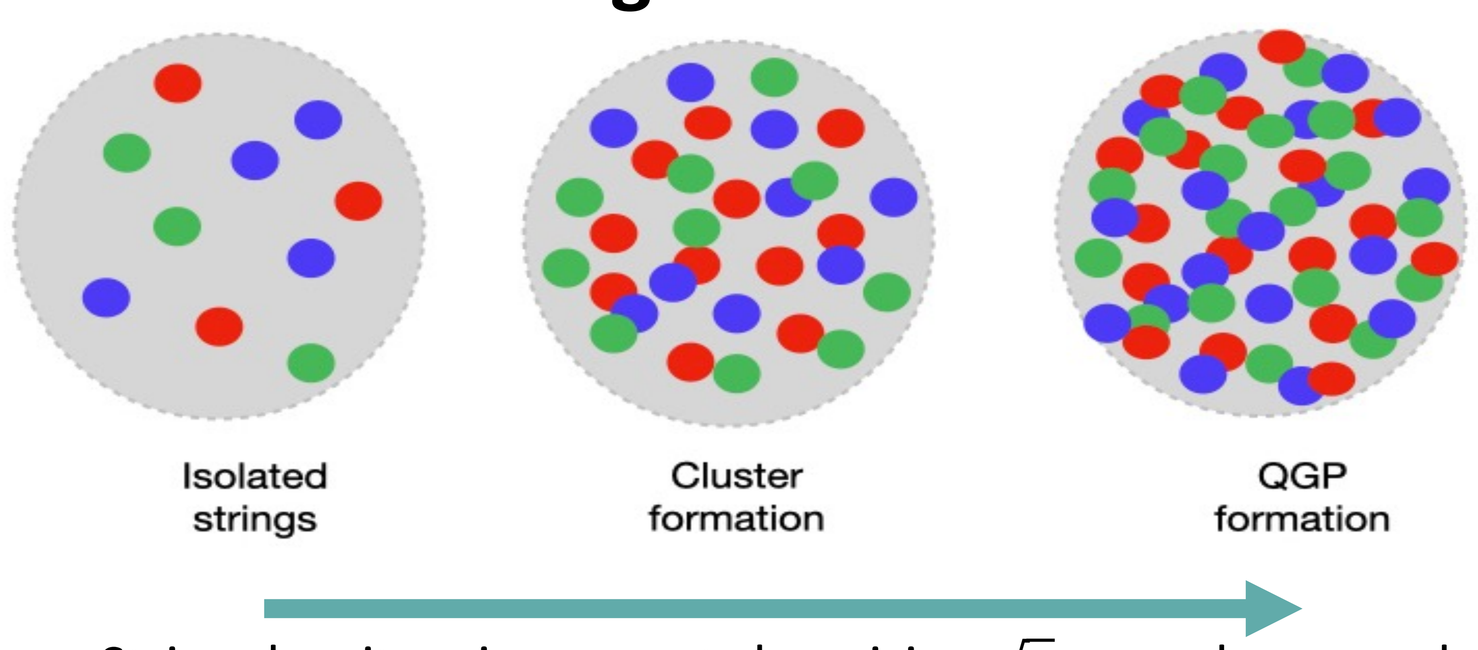
Diana Rosales Herrera[a,*] , Arturo Fernández Téllez[a, ⁕] ,J. Ricardo Alvarado García[a,†] ,Jhony E. Ramírez Cancino[b, +]

[a] Facultad de Ciencias Físico Matemáticas, Benemérita Universidad Autónoma de Puebla

[b] Instituto de Ciencias, Benemérita Universidad Autónoma de Puebla

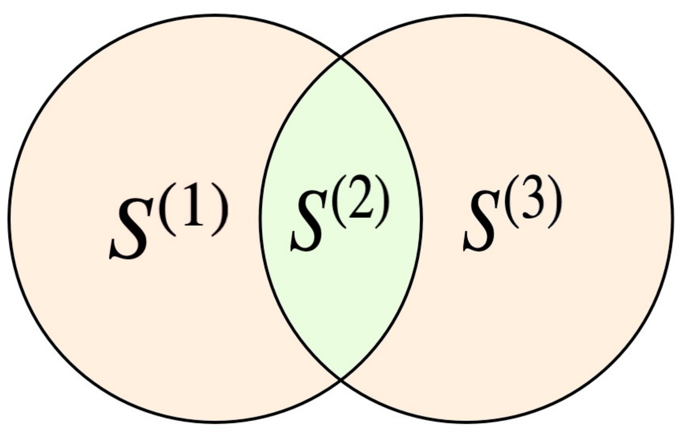
[*] diana.rosales.herrera@cern.ch, [⁕] Arturo.Fernandez.Tellez@cern.ch,[†]j.ricardo.alvarado@cern.ch, [+]jhony.eredi.ramirez.cancino@cern.ch

Color String Percolation Model



String density η increments by raising $\sqrt{s}$ or nucleon number

Color suppresion factor $F(\eta)$ and CSPM observables



Overlaped color strings

1.- $F(\eta)$ reflects the effects on the interaction between strings

2.- Since $F(\eta)$ is a decreassing function

$\mu = NF(\eta)\mu_1$ decreases , and

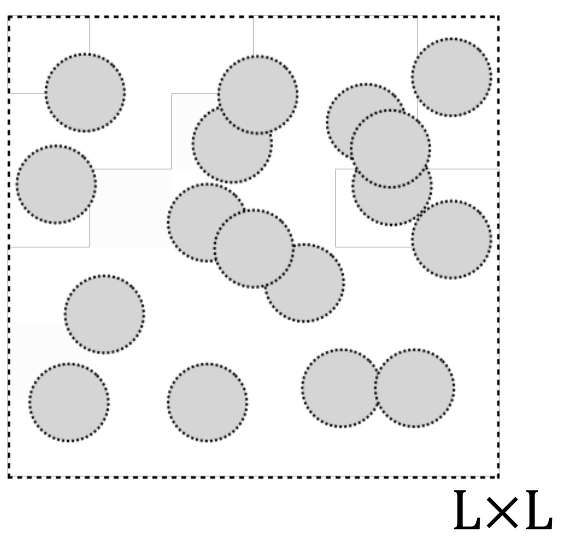
$\langle p_T^2 \rangle = \langle p_T^2 \rangle_1 / F(\eta)$ is enhanced.

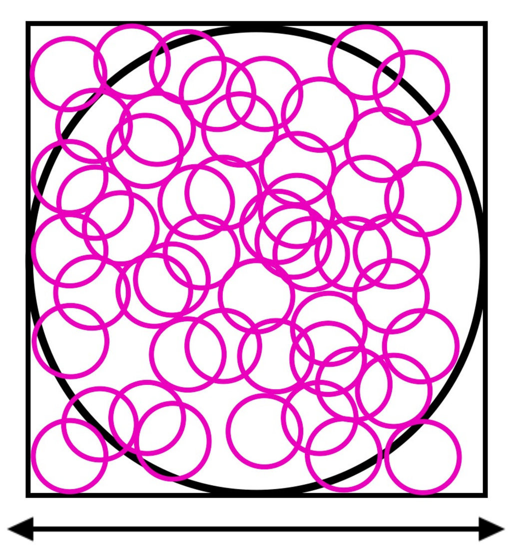
Finite Size Effects

Percolation theory	Ultrarelativistic collisions
Thermodynamic limit L → ∞	PbPb, AuAu collision

How can we include pp collisions?

Mertens-Moore algorithm	Density is an intensive quantity





$$L = \frac{R_A}{r_0} = \frac{r_o^* A_M^{1/3}}{r_0} \sim 5A_M^{1/3}$$

Scaling laws

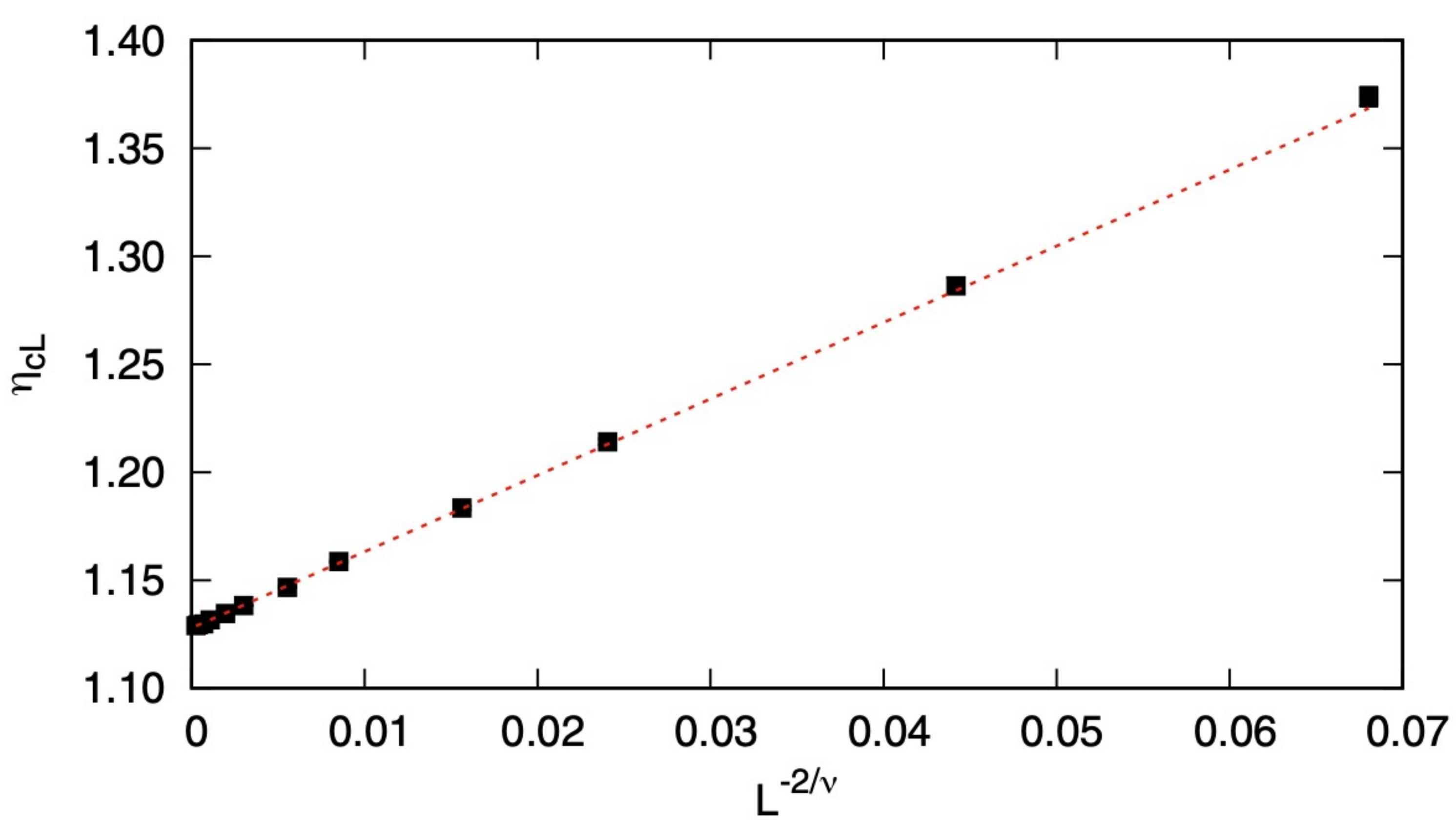
$$X_c - X_{cL} \propto L^{z}$$

Observable's estimation in the thermodynamic limit

Observable's estimation depending on the system size

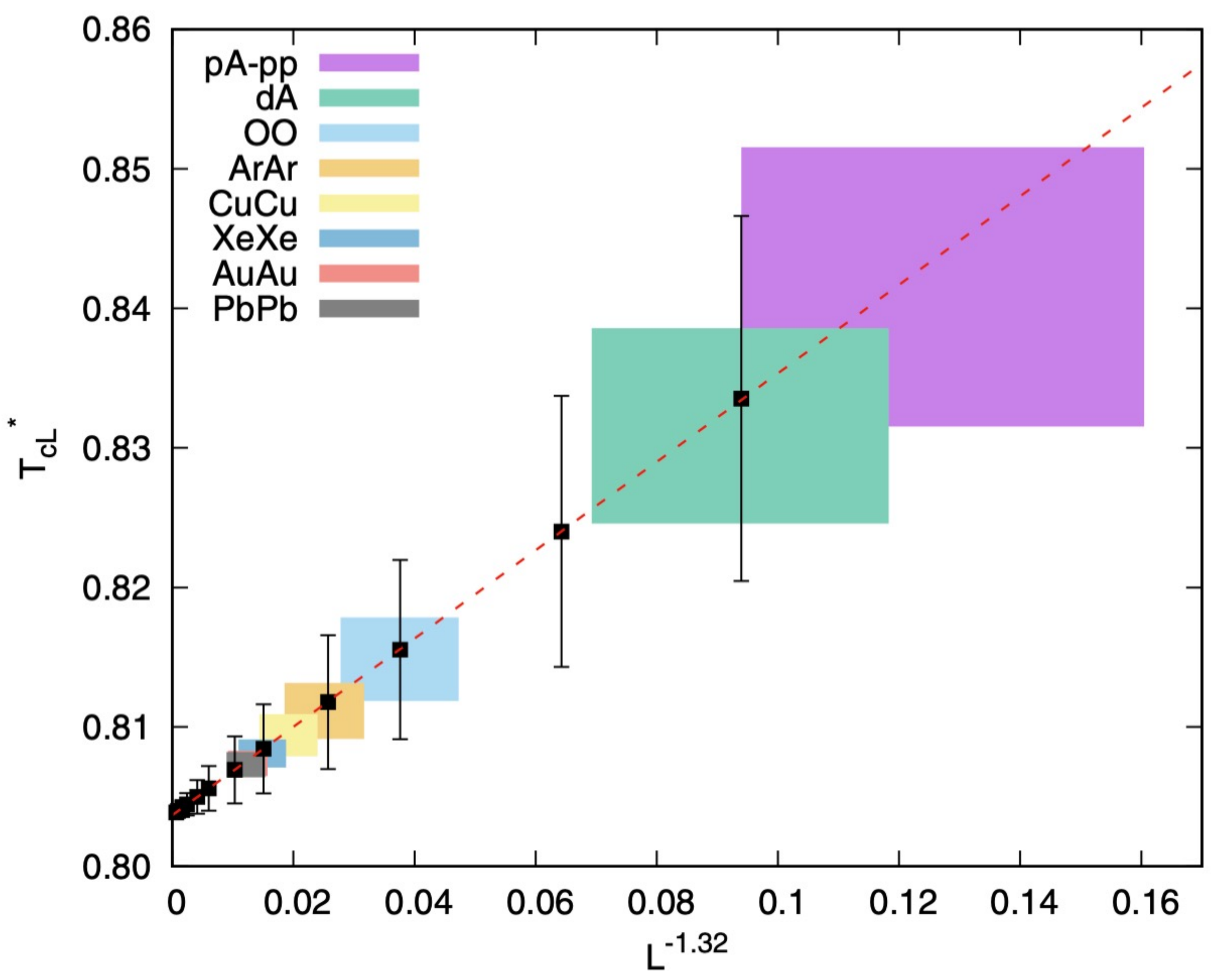
$$X_c - X_{cL} \propto (5A_M)^{\frac{z}{3}}$$

The observable can be scaled by the nucleon number !!



$\eta_c = 1.1279$ is the estimation in the thermodynamic limit

Temperature-like parameter in the CSPM



$$T = \sqrt{\frac{\langle p_T^2 \rangle_1}{2F(\eta)}}$$

$$T^* = \langle p_T^2 \rangle_1^{-1/2} T$$

Dimensionless temperature

Dimensionless transition temperature associated with the QGP formation is defined by $T^*(\eta_c)$.

For CSPM we estimate $T^*_c = 0.80365$ in the thermodynamic limit.

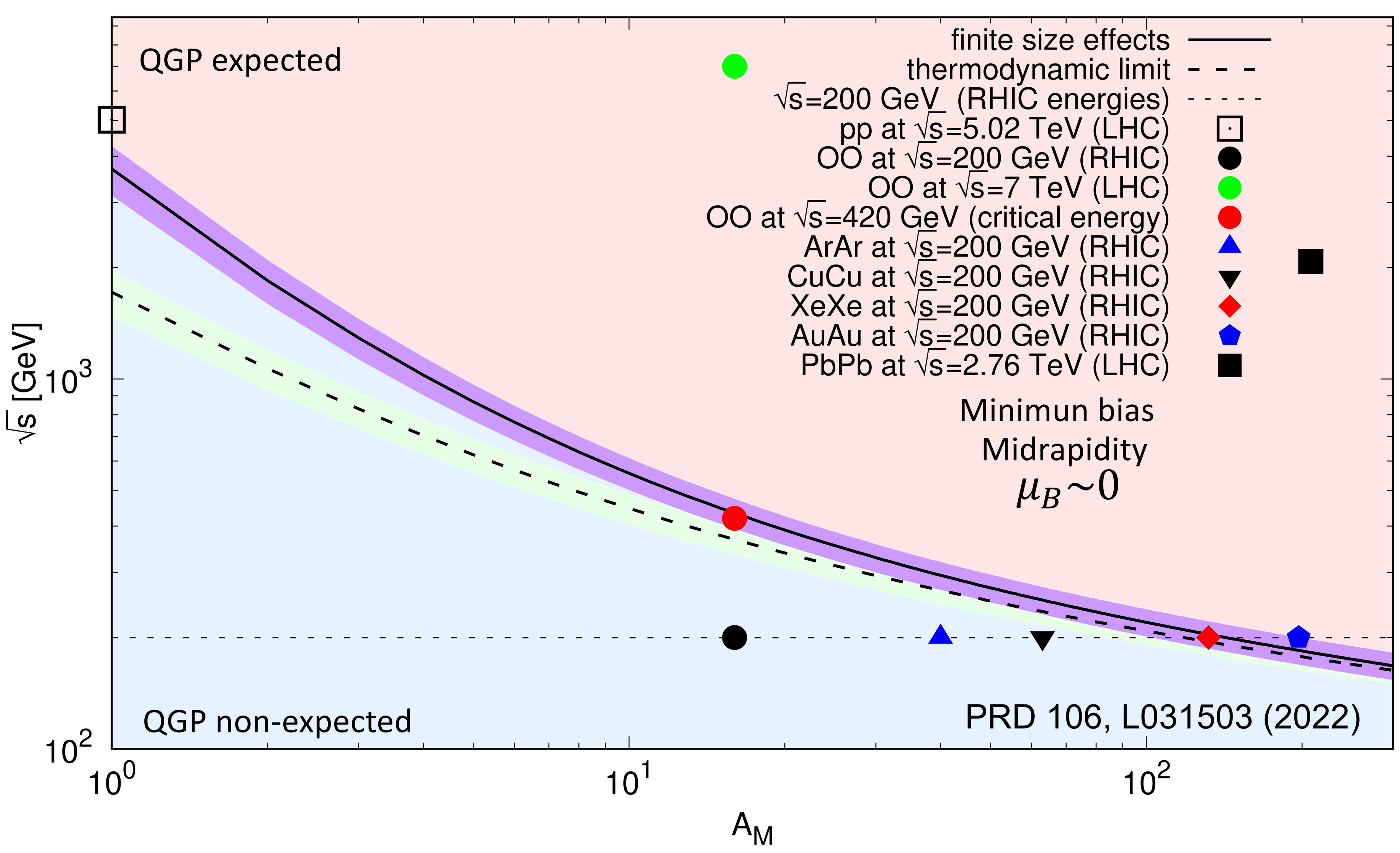
Minimal center of mass energy needed for QGP formation

We express string density for pp and AA collisions as function of $\sqrt{s}$ through

$$\eta^{pp}(\sqrt{s}) = \frac{\pi}{25}\left[2 + 4\left(\frac{r_0}{R_p}\right)^2 \left(\frac{\sqrt{s}}{m_p}\right)^{2\lambda}\right] \quad \text{and} \quad \eta^{AA}(\sqrt{s}) = \eta^{pp}(\sqrt{s}) A_M^{\alpha(\sqrt{s})}.$$

We estimate the critical $\sqrt{s}$ by solving $\eta^{AA}(\sqrt{s}) = \eta^{AA}_{cL}$

Collision	A_M	$\sqrt{s}_{cL}$ GeV	η^{AA}_{cL}
pp	1	3700	1.444
OO	16	420	1.2057
ArAr	40	290	1.1768
CuCu	63	246	1.1668
XeXe	132	201	1.1547
AuAu	197	184	1.1497
PbPb	208	182	1.1491



Conclusions

- CSPM presents finite size effects that can be express in terms of A_M
- Transition temperature is higher for small systems than for large ones.
- Small systems requiere higher energy or higher multiplicity.
- Our estimation of $\sqrt{s}$ for QGP formation is consistent with those reported in literature.

References

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