ACCOUNTING OF ENERGY LOSSES IN THE FRAMEWORK OF THE MODIFIED MONTE CARLO GLAUBER MODEL

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PLAN

1 Motivation

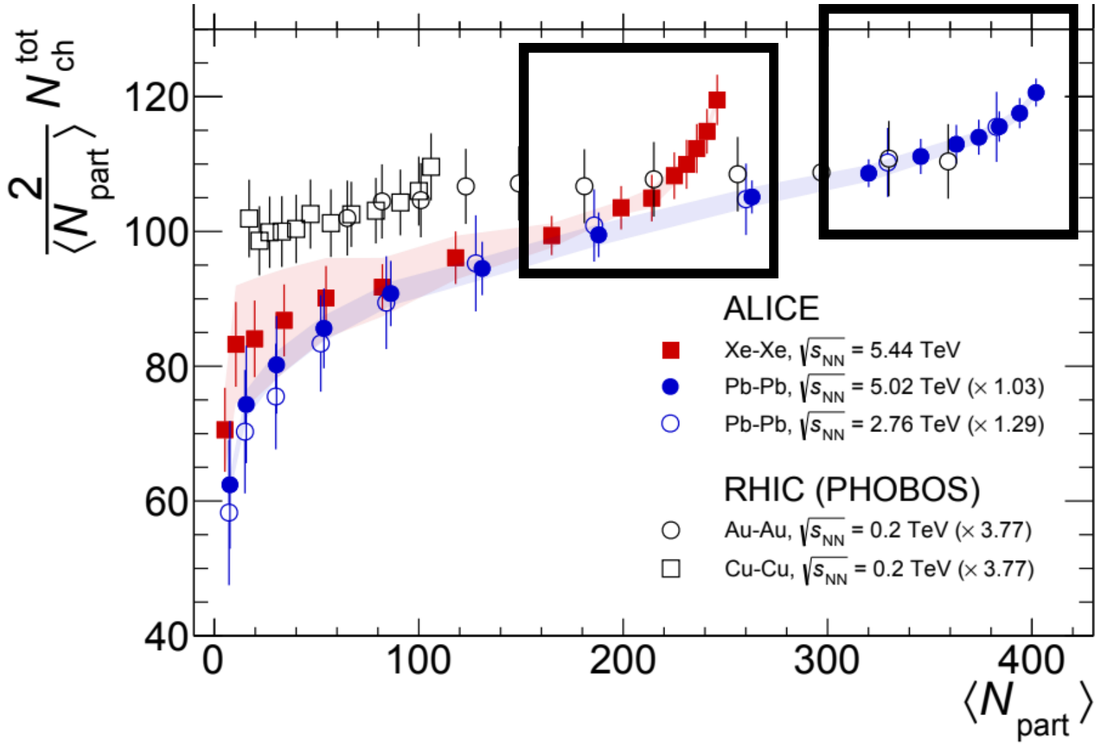
2 Core generation

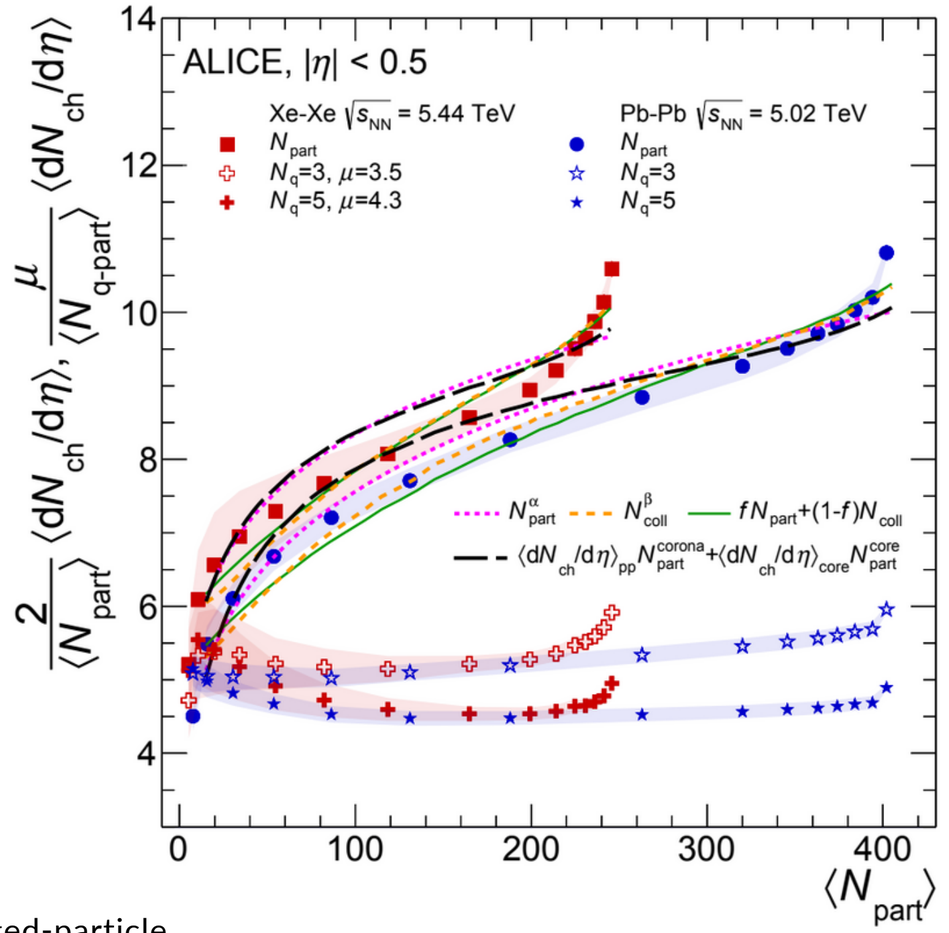
3 Collisions calculation

4 Charged particle calculation

5 Results

MOTIVATION





ALICE Collaboration, Centrality and pseudorapidity dependence of the charged-particle multiplicity density in Xe–Xe collisions at √sNN = 5.44 TeV

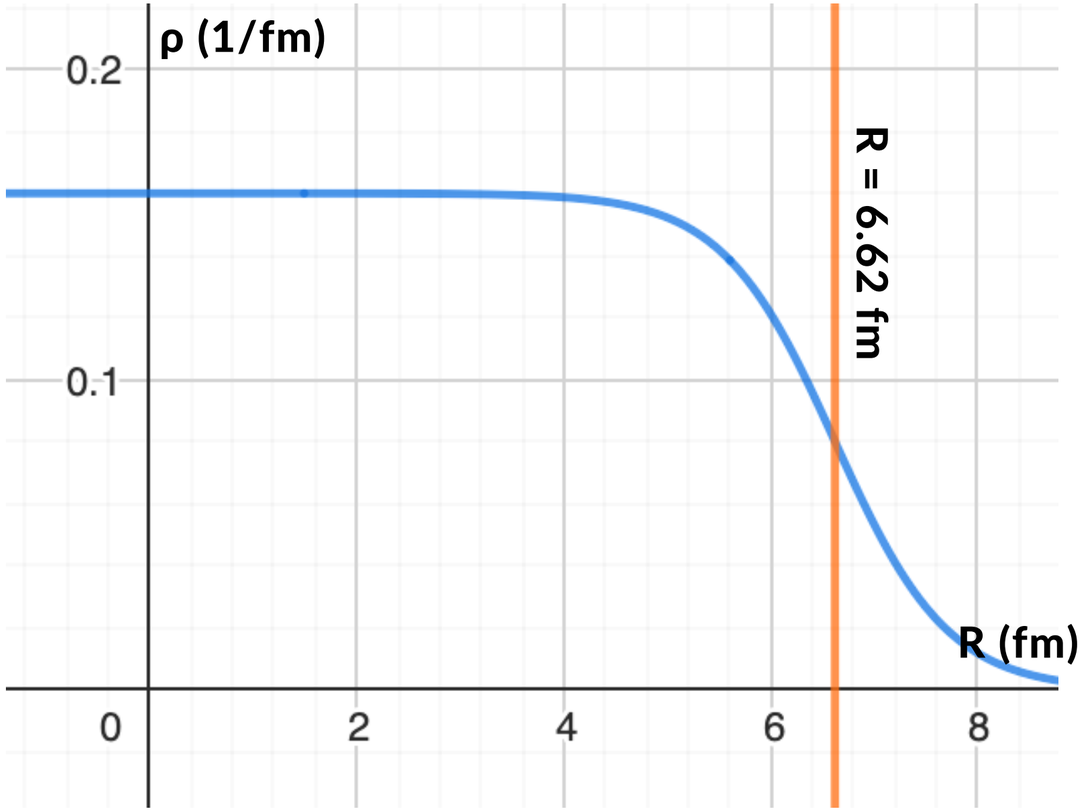
CORE GENERATION

Nucleon density distribution for Pb-208

Two-parameter Fermi model:

$$\rho(r) = \rho_0 \frac{1}{1 + exp(\frac{r - R}{a})}$$

a = 0.546 fm
R = 6.62 fm



H. DE VRIES, C. W. DE JAGER, and C. DE VRIES,
ATOMIC DATA AND NUCLEAR DATA TABLES
36,495536 (1987)

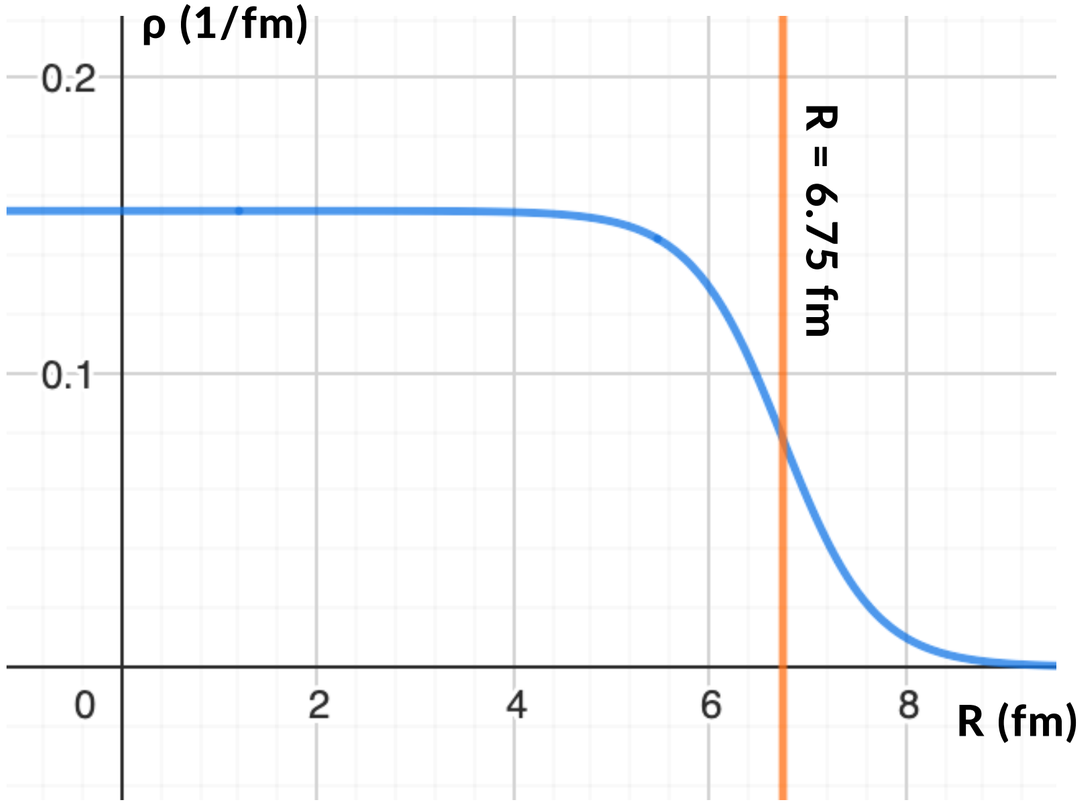
CORE GENERATION

Nucleon density distribution for Bi-209

Two-parameter Fermi model:

$$\rho(r) = \rho_0 \frac{1}{1 + exp(\frac{r - R}{a})}$$

a = 0.468 fm
R = 6.75 fm



H. DE VRIES, C. W. DE JAGER, and C. DE VRIES,
ATOMIC DATA AND NUCLEAR DATA TABLES
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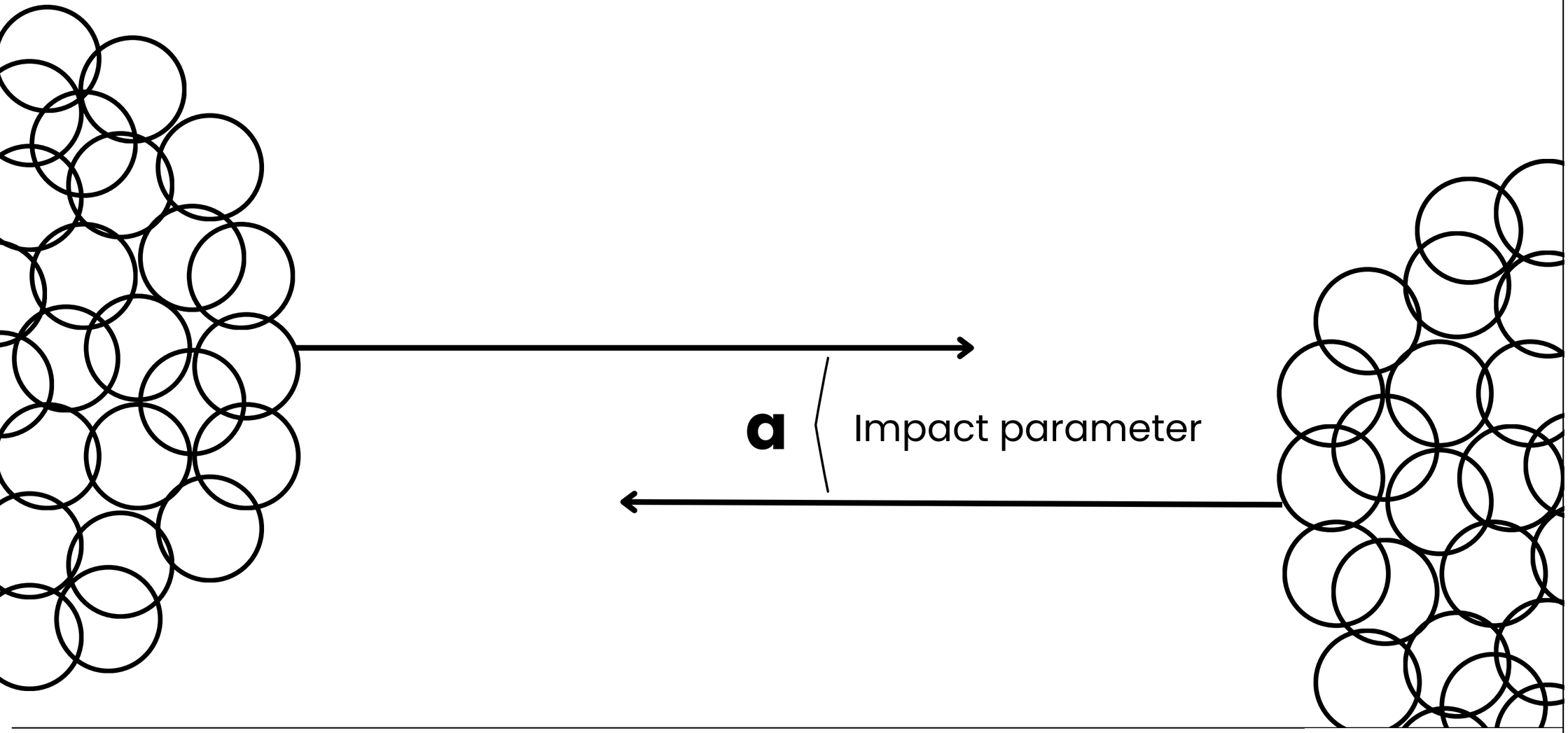
COLLISIONS CALCULATION SGM

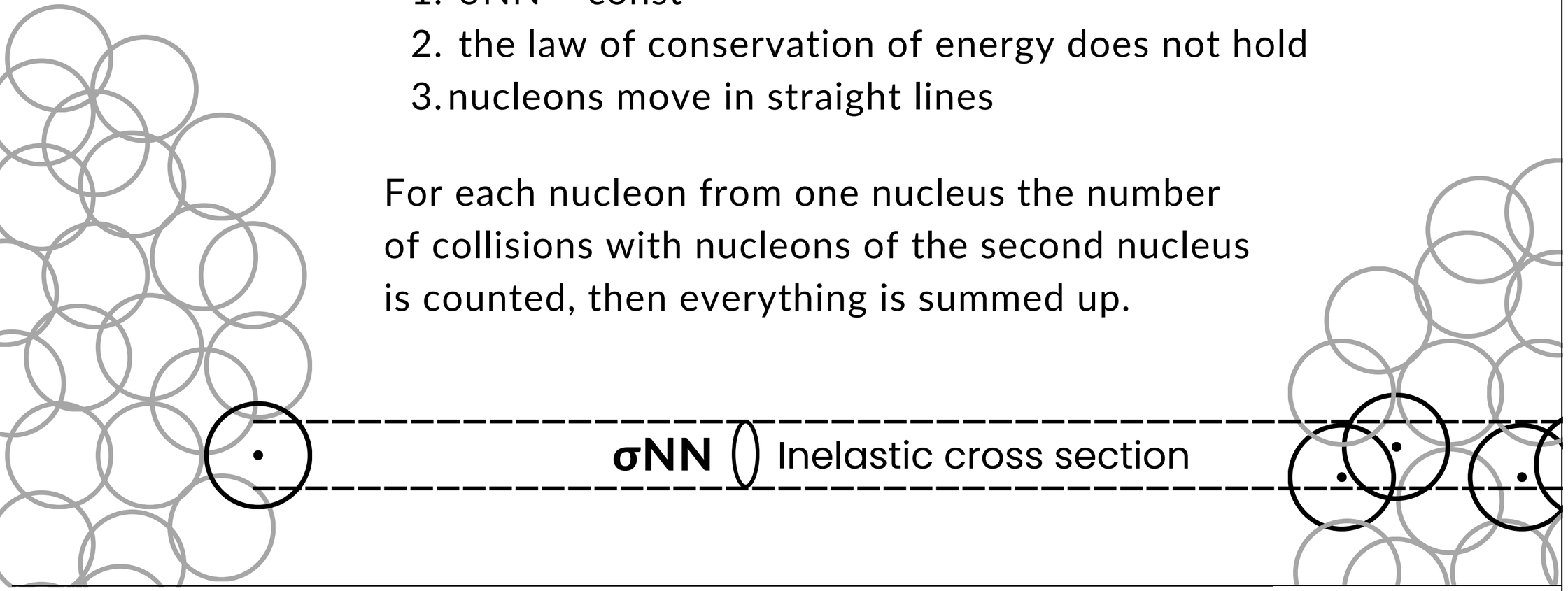


COLLISIONS CALCULATION SGM

SGM:

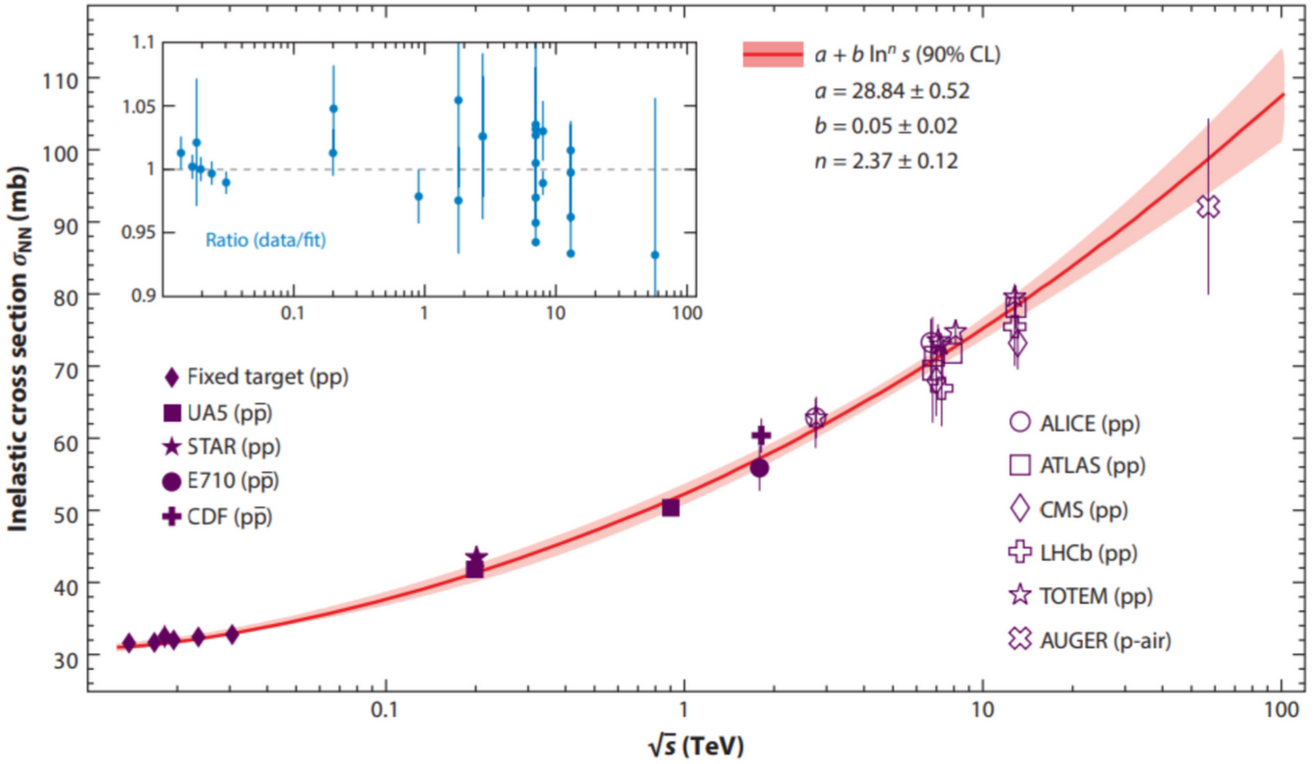
1. σNN = const
2. the law of conservation of energy does not hold
3. nucleons move in straight lines

For each nucleon from one nucleus the number of collisions with nucleons of the second nucleus is counted, then everything is summed up.



σNN Inelastic cross section

INELASTIC CROSS SECTION



DAVID D'ENTERRIA AND CONSTANTIN LOIZIDES, ANNUAL REVIEW OF NUCLEAR AND PARTICLE SCIENCE: PROGRESS IN THE GLAUBER MODEL AT COLLIDER ENERGIES

Two nucleons are said to collide if their impact parameter b is satisfied:

$$b < \sqrt{\frac{\sigma_{NN}}{10\pi}}$$

COLLISIONS CALCULATION MGM

Before collision: $P_1 = -P_2 = \sqrt{(\frac{\sqrt{S}}{2})^2 - m^2}$

After collision: $P_1' = k \cdot P_1, P_2' = k \cdot P_2$

COLLISIONS CALCULATION MGM

In next collisions:

Nucleon energies: $E_1 = \sqrt{(P_1')^2 + m^2}\,, \quad E_2 = \sqrt{(P_2')^2 + m^2}$

Energy per nucleon pair in the center-of-mass system: $\sqrt{S} = \sqrt{(E_1 + E_2)^2 - (P_1' + P_2')^2}$

Energy and momentum of the nucleon in the center-of-mass system: $E_{CM} = \dfrac{\sqrt{S}}{2}\,, \quad P_{CM} = \sqrt{E_{CM}^2 - m^2}$

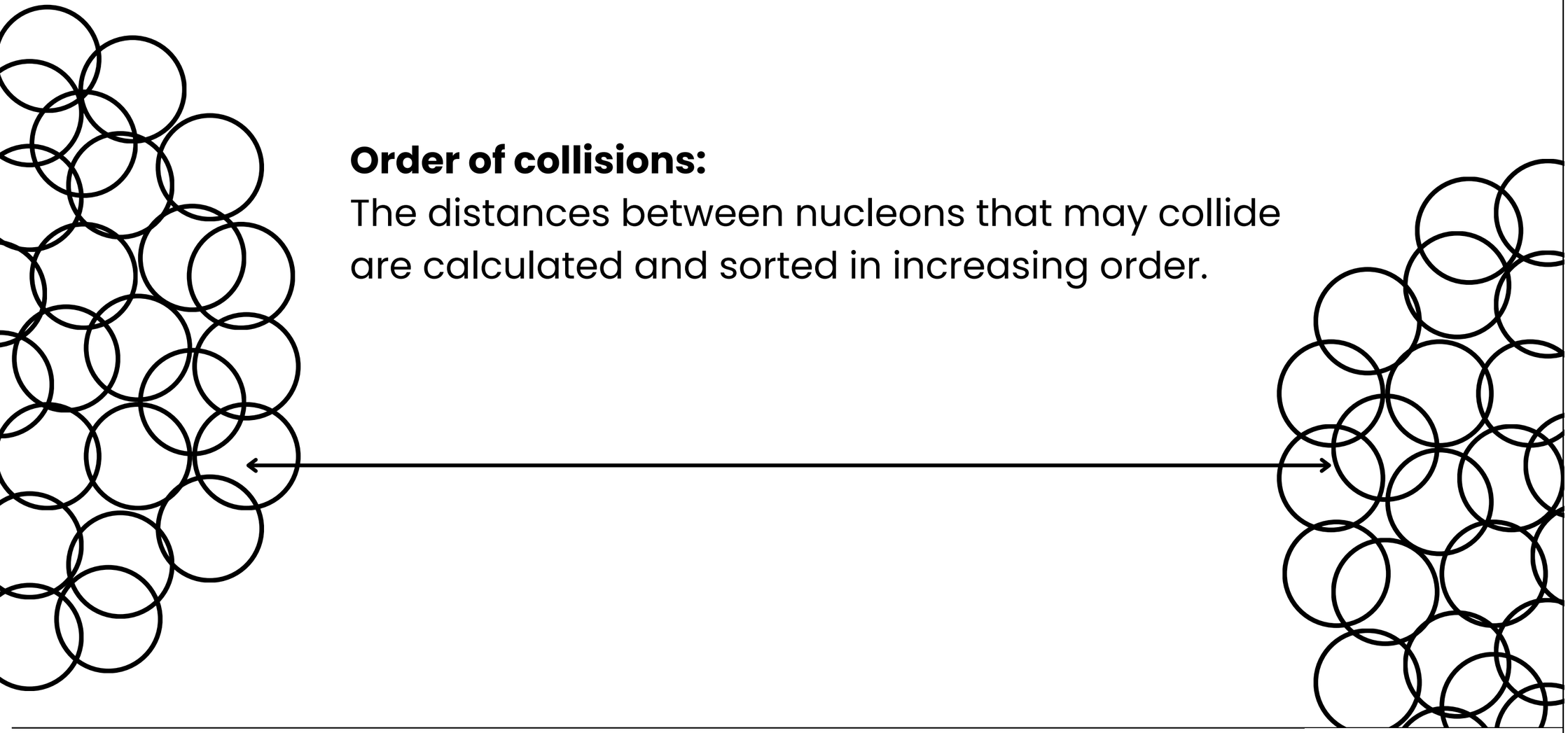
Lorenz boost: $\beta = \dfrac{P_{CM} \cdot E_1 - E_{CM} \cdot P_1}{P_{CM} \cdot P_1 - E_{CM} \cdot E_1}$

Momentum and energy after collision: $P_{CM}^{new} = k \cdot P_{CM}, E_{CM}^{new} = \sqrt{(P_{CM}^{new})^2 + m^2}$

Reverse Lorenz boost: $P_1^{new} = \dfrac{P_{CM}^{new} + \beta \cdot E_{CM}^{new}}{\sqrt{1 - \beta^2}}, P_2^{new} = \dfrac{-1 \cdot P_{CM}^{new} + \beta \cdot E_{CM}^{new}}{\sqrt{1 - \beta^2}}$

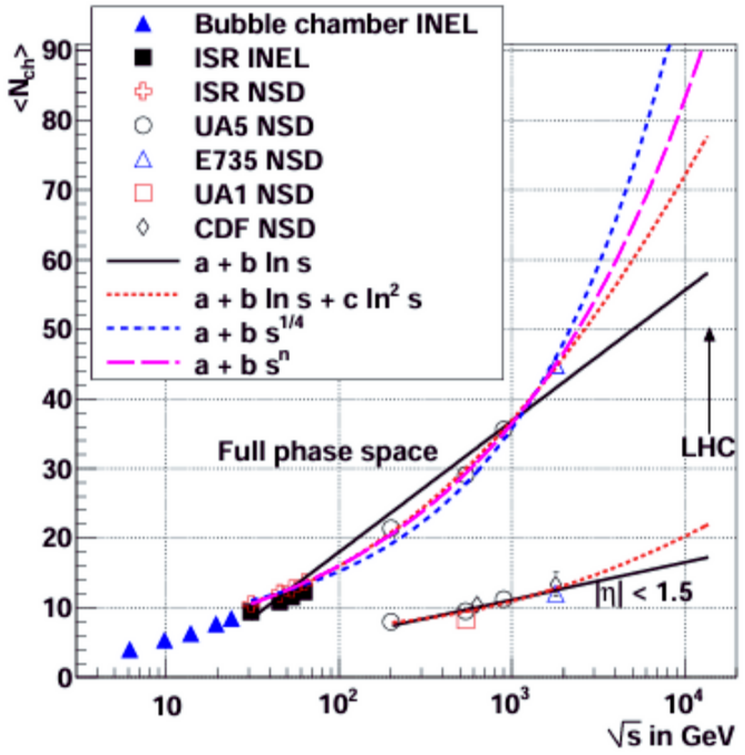
COLLISIONS CALCULATION MGM

Order of collisions:
The distances between nucleons that may collide are calculated and sorted in increasing order.



COLLISIONS CALCULATION MGM

In each collision number of produced charged particles (N_ch) is calculated.



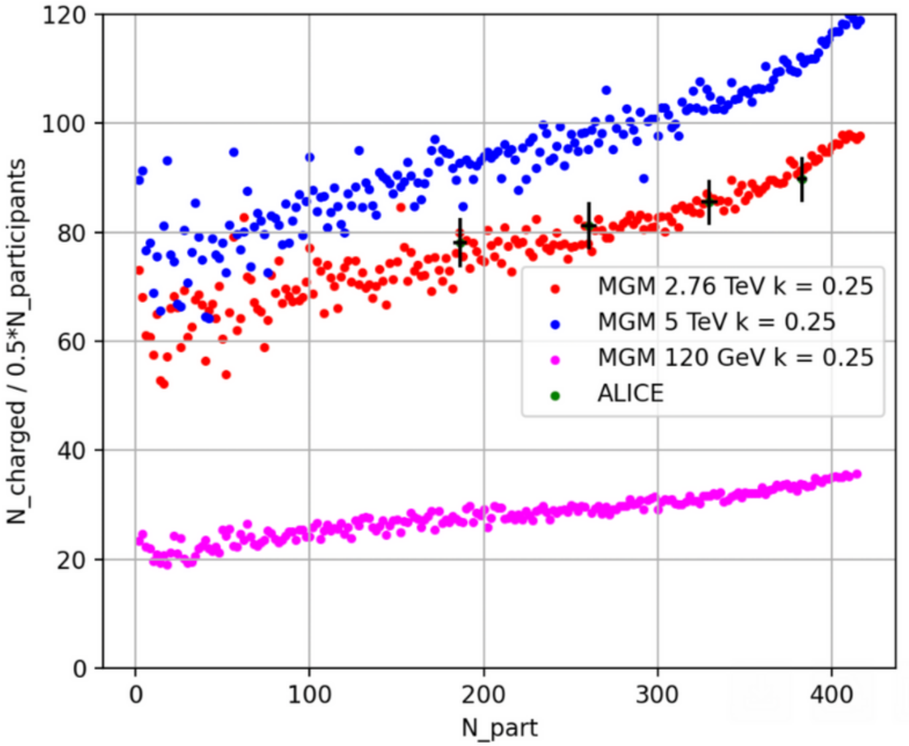
$$N_{ch}^{pp} = a + b \cdot ln(S) + c \cdot ln^2(S)$$

a = 16.65, b = -3.147, c = 0.334

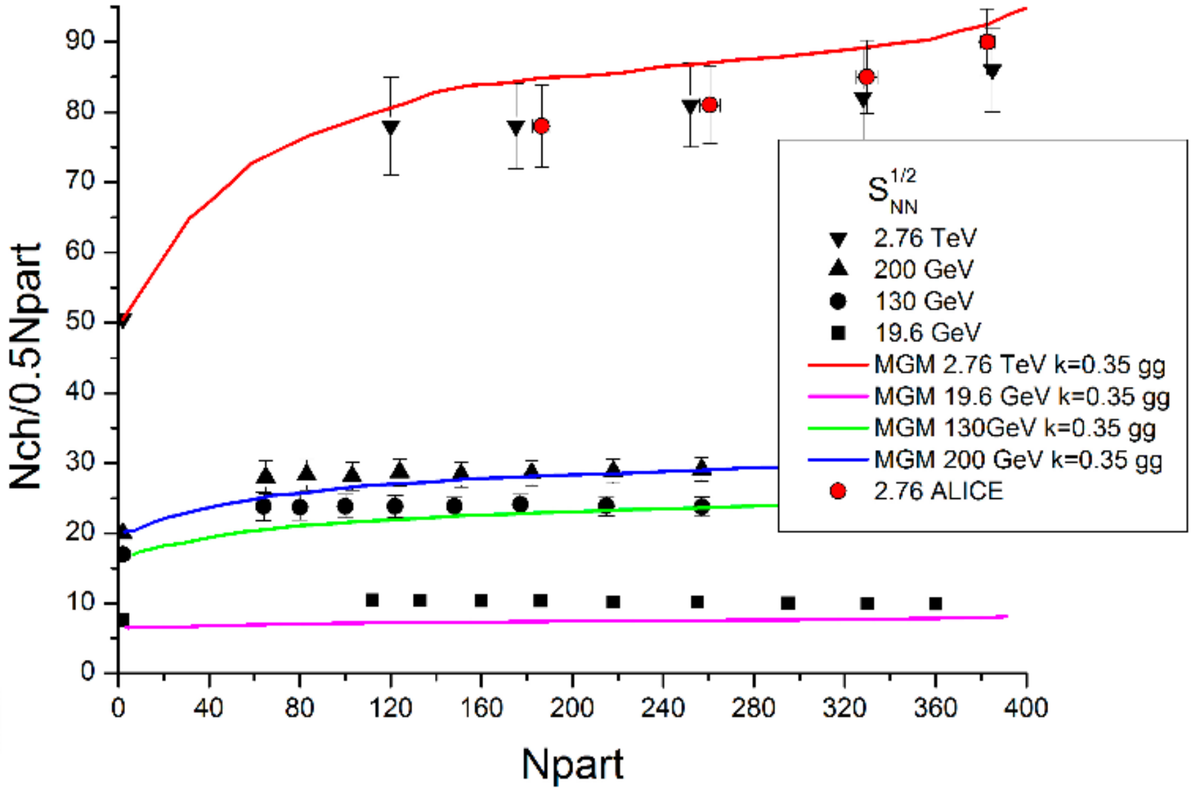
Jan Fiete Grosse-Oetringhaus, Klaus Reygers, arXiv:0912.0023

RESULTS

For Pb-Pb collisions:



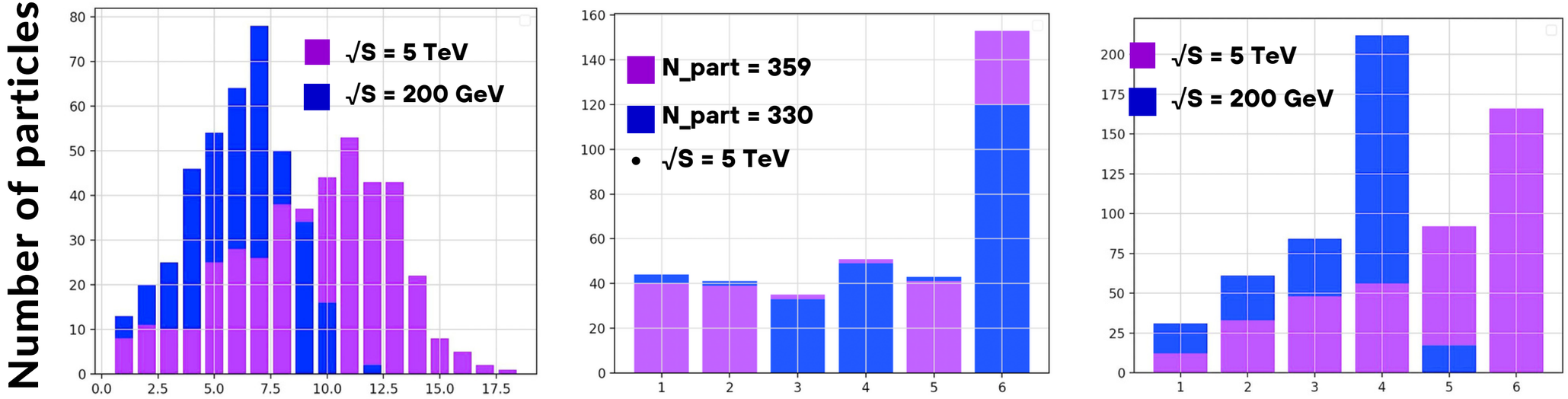
ALICE Collaboration, Centrality dependence of the pseudorapidity density distribution for charged particles in Pb–Pb collisions at √sNN = 2.76 TeV



Andrey Seryakov, Grigory Feofilov, AIP Conference Proceedings 1701(1):070001

RESULTS

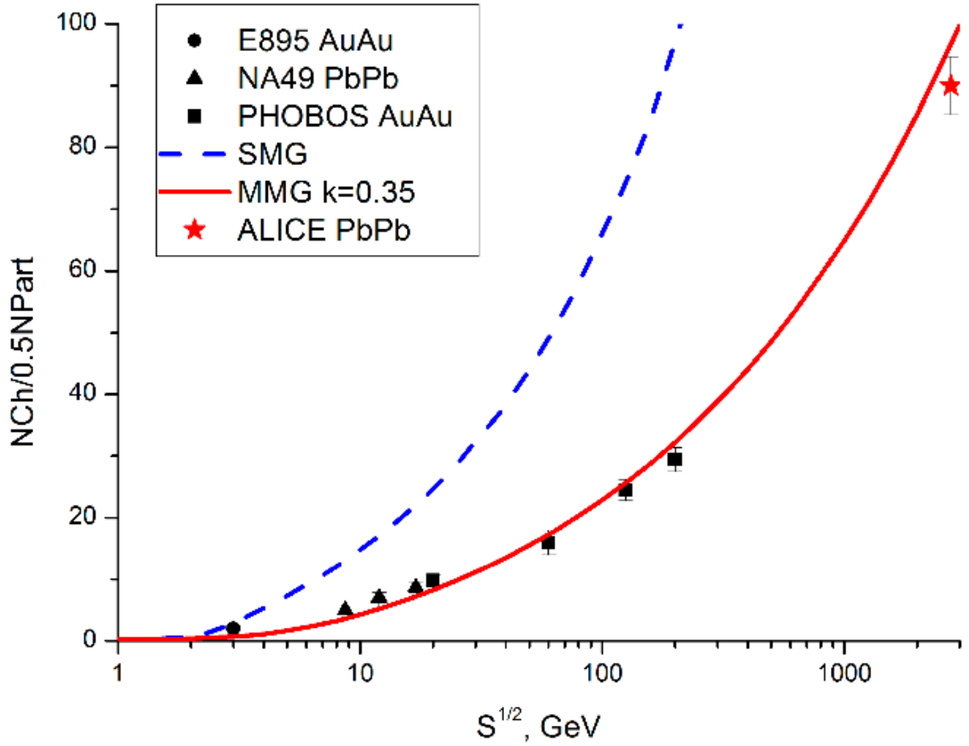
For Pb-Pb collisions:



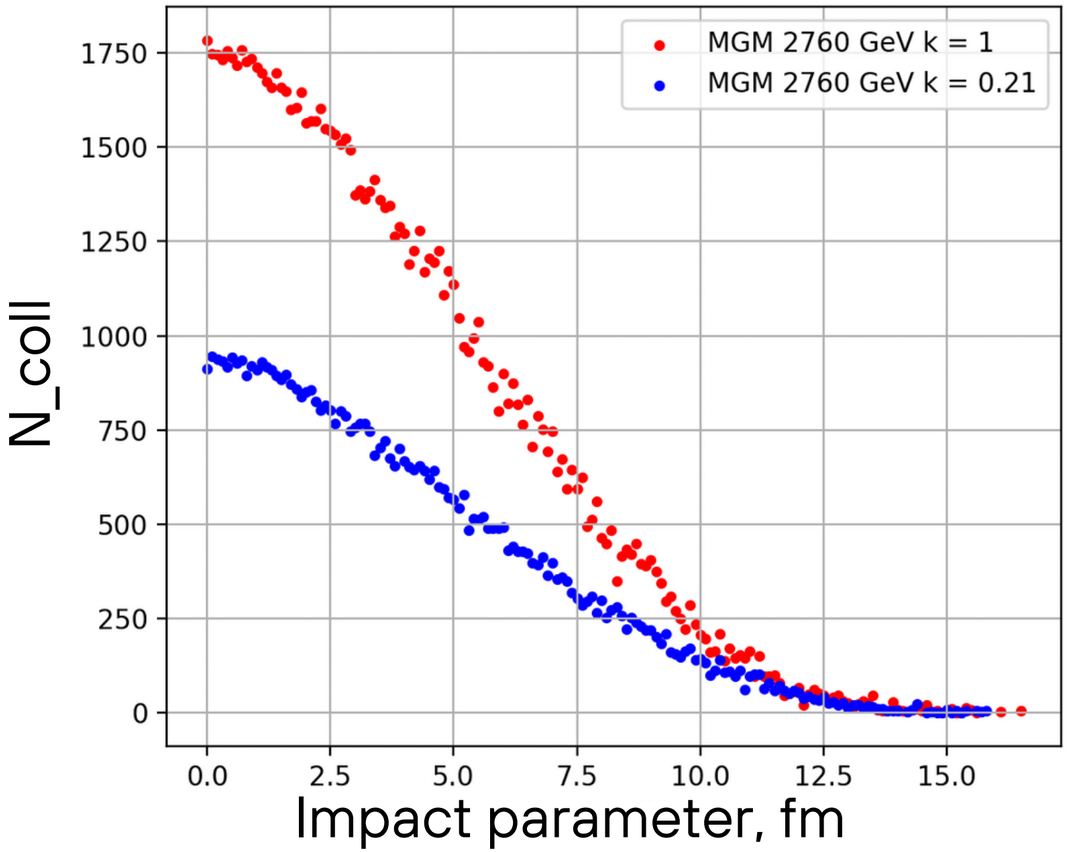
RESULTS

A **large difference** is observed between the values obtained by MGM and SGM, which is **extremely important** in the processing of experimental data.

For Pb–Pb collisions:

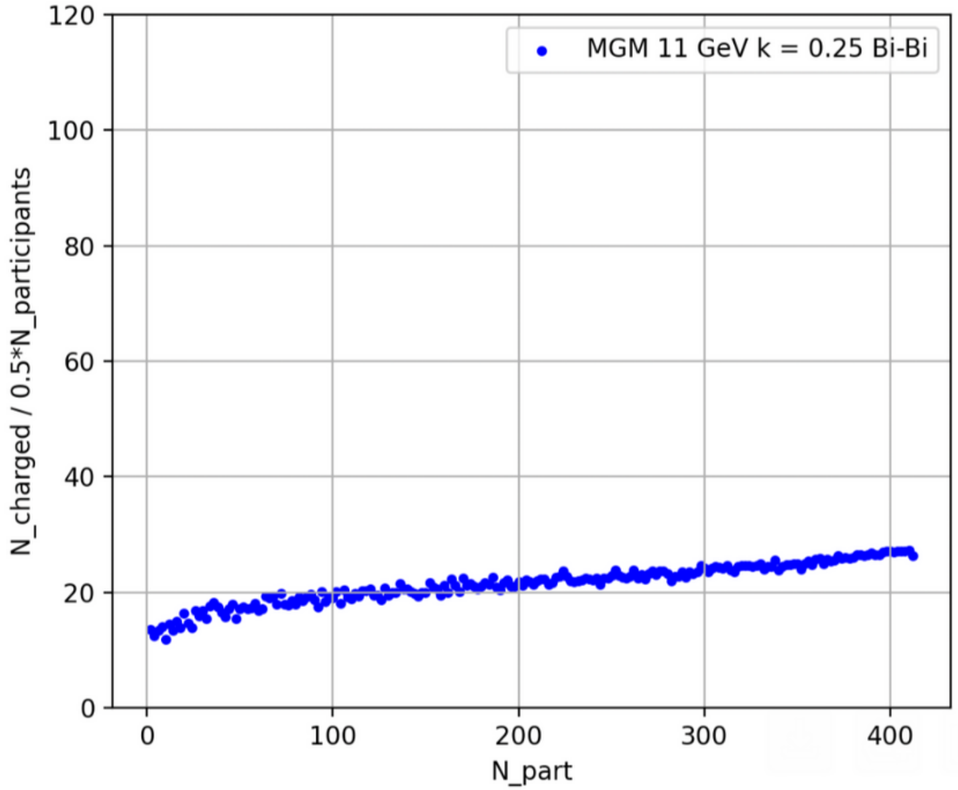


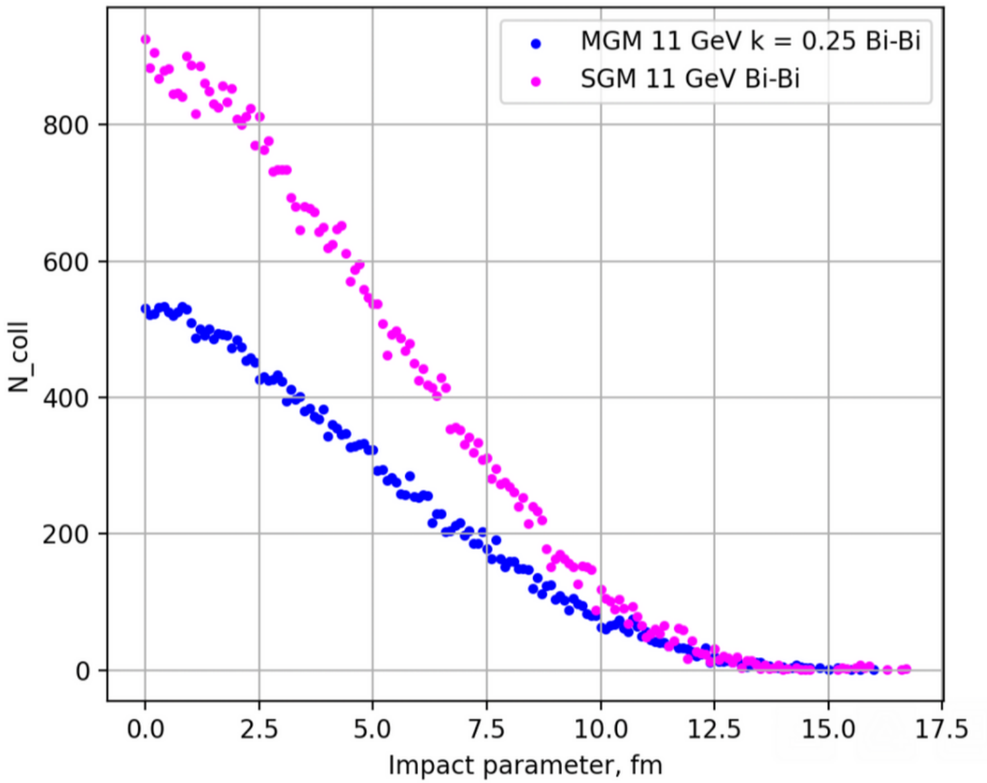
Andrey Seryakov, Grigory Feofilov, AIP Conference Proceedings 1701(1):070001



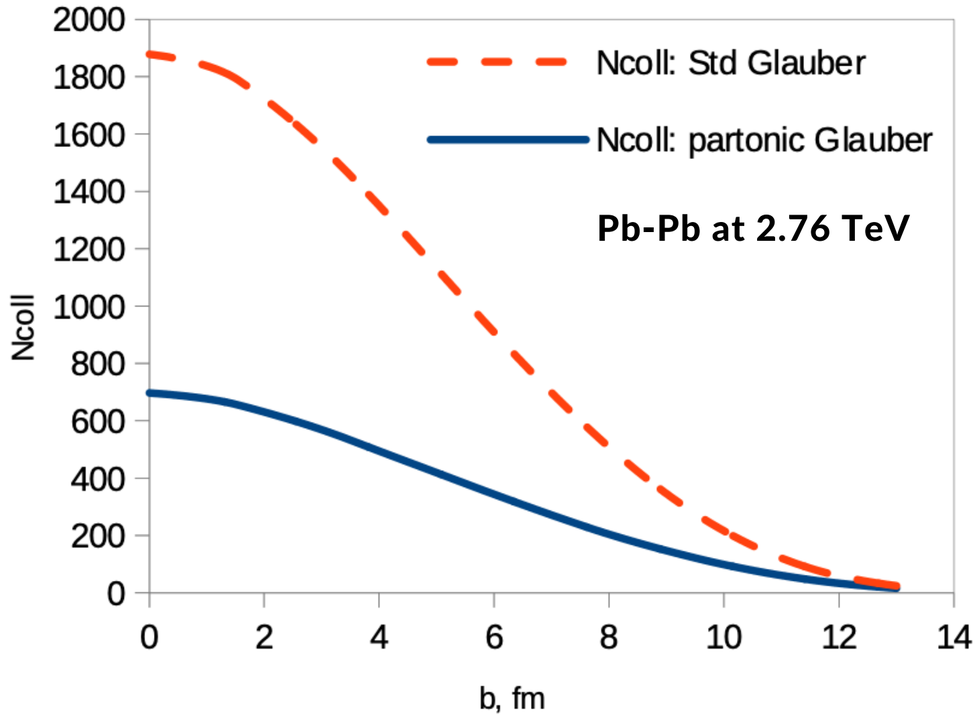
RESULTS

For Bi-Bi collisions:





BESIDES...



Vladimir Kovalenko, Glauber modeling hadron-nucleus collisions at the parton level, Scientific session of the nuclear physics section of the Division of Physical Sciences of the Russian Academy of Sciences, JINR, 2024

THANK YOU FOR YOUR ATTENTION!

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