

# Lightening-like interactions in nuclear collisions at CERN large hadron collider

**Part I: Results of proton+Pb at  $\sqrt{s_{NN}} = 5.02$  TeV**

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# Contents

- ❑ HIJING code.
- ❑ Parameters of HIJING code.
- ❑ The improved HIJING code.
- ❑ Results of the improved HIJING code in non-single diffractive  $p + p$  collisions at  $\sqrt{s_{NN}} = 0.9, 2.36$  and 7 TeV.
- ❑ Results of the improved HIJING code in non-single diffractive  $p + Pb$  collisions at  $\sqrt{s_{NN}} = 5.02$  TeV.

# HIJING code

## HIJING: Heavy Ion Jet Interaction Generator

Xin-Nian Wang and Miklos Gyulassy, Physical Rev. D 44, 3501(1991)

- it is a hadronic cascade model
- the interaction is considered as a set of binary nucleon-nucleon collisions
- In each collision
  - Jet (Gluon) Production ( $p_T > p_0$ ) (Main source of hadrons at LHC energies)
    - Jet cross section ( $\sigma_{jet}$ )
  - string interactions
    - soft parton cross section ( $\sigma_{soft}$ )

## HIJING uses

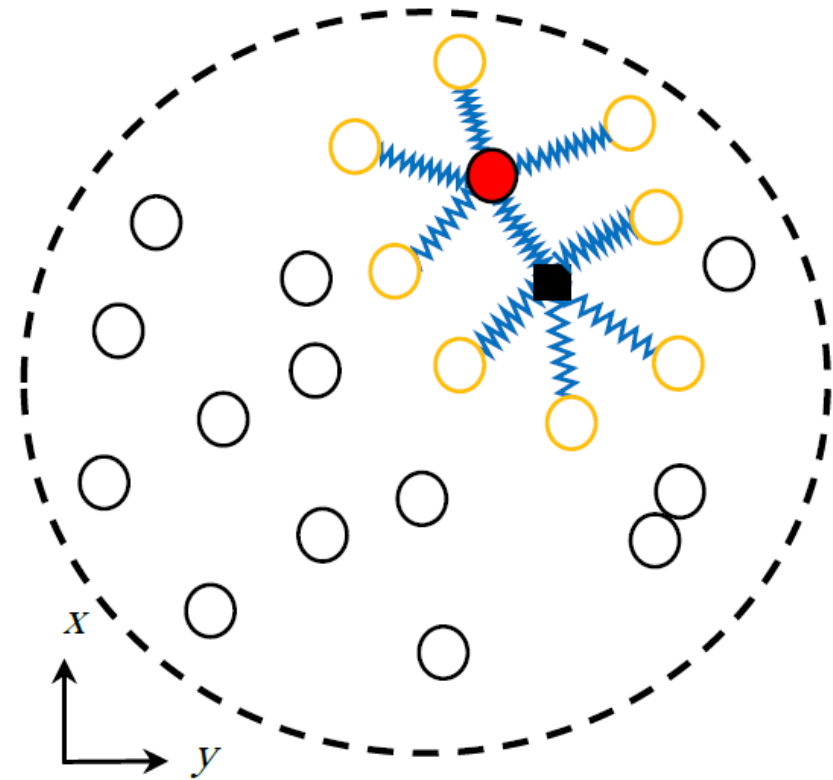
- Eikonal formalism to determine the number of wounded nucleons
- PYTHIA 5.3 to generate kinetic variables for each hard scattering (high  $p_T$ ).
- JETSET 7.2 for jet fragmentation.

# Parameters of HIJING code

- The jet cross section  $\sigma_{jet}$ .
    - cut off parameter  $p_0$ .
    - Parton Distribution function (**PDF**)
  - The soft parton cross section  $\sigma_{soft}$ .
  - Parton ( $\alpha_{g(q)}$ )Shadowing.
- $\sigma_{soft}$ ,  $p_0$  and **PDF** are determined by fitting  $p + p(\bar{p})$  collisions
  - For  $p + A$  and  $A + A$  collisions, we need to adjust  $p_0$  and  $\alpha_{g(q)}$

# The Improved HIJING code

- The Duke-Owen (1984) parameterizations of parton distribution functions are replaced by the Martin-Stirling-Throne-Watt (2009) ones.
- Parton Shadowing is replaced by Nucleon shadowing.



Nucleon shadowing

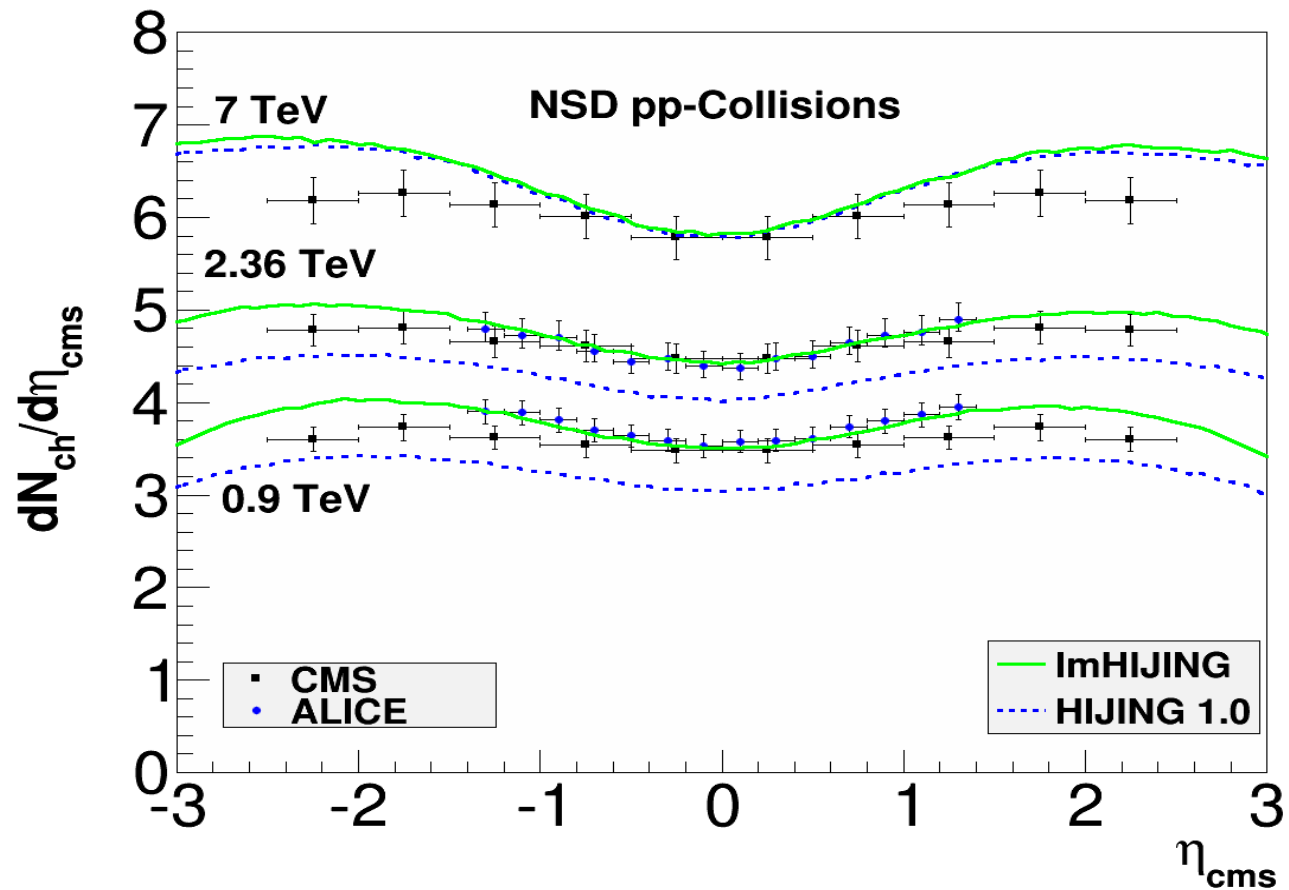
# The main improvement

- Lightening-like interactions at LHC energies!



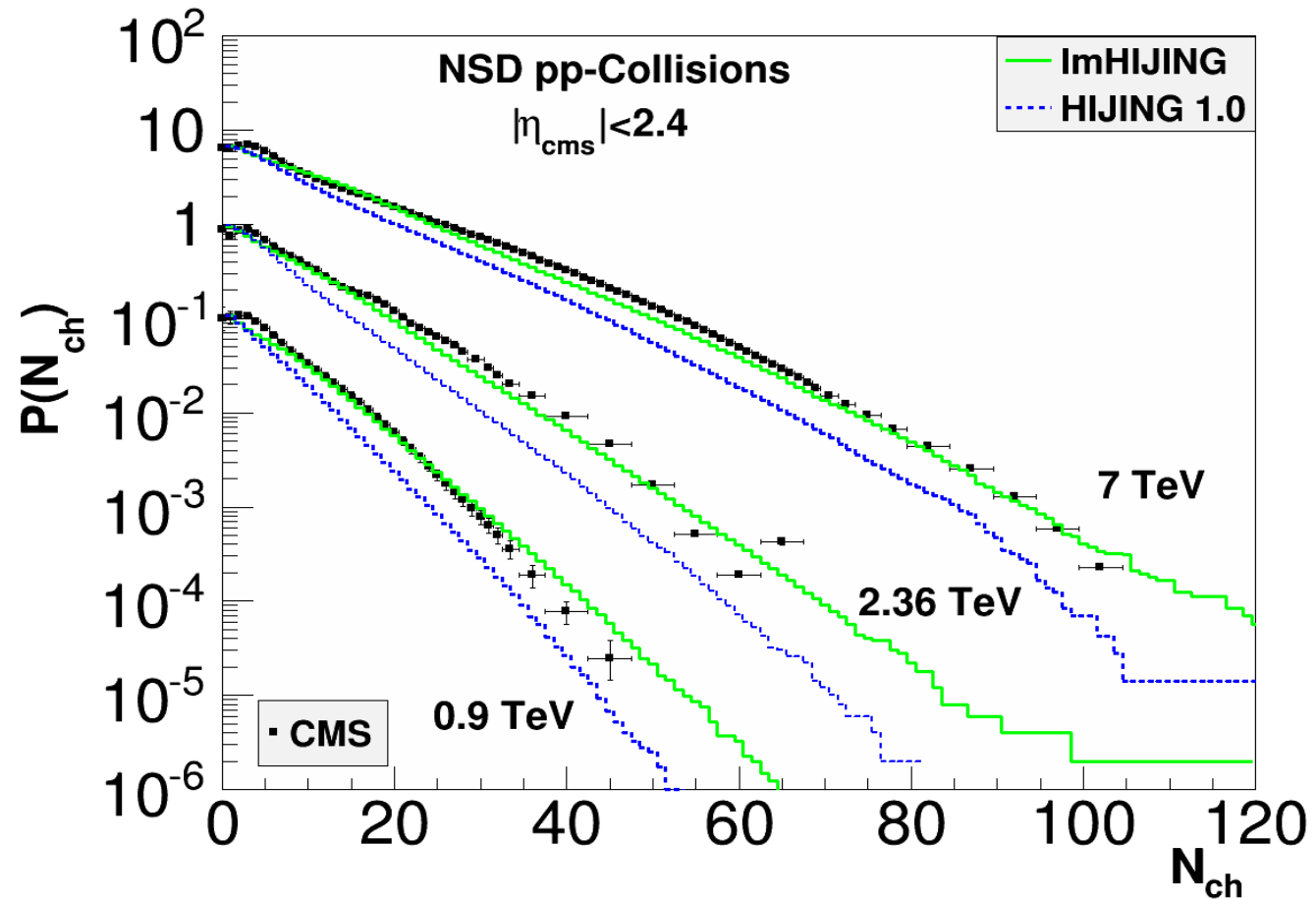
The results of the improved and standard HIJING codes in non-single diffractive  $p + p$  collisions

## Pseudorapidity density of charged particles

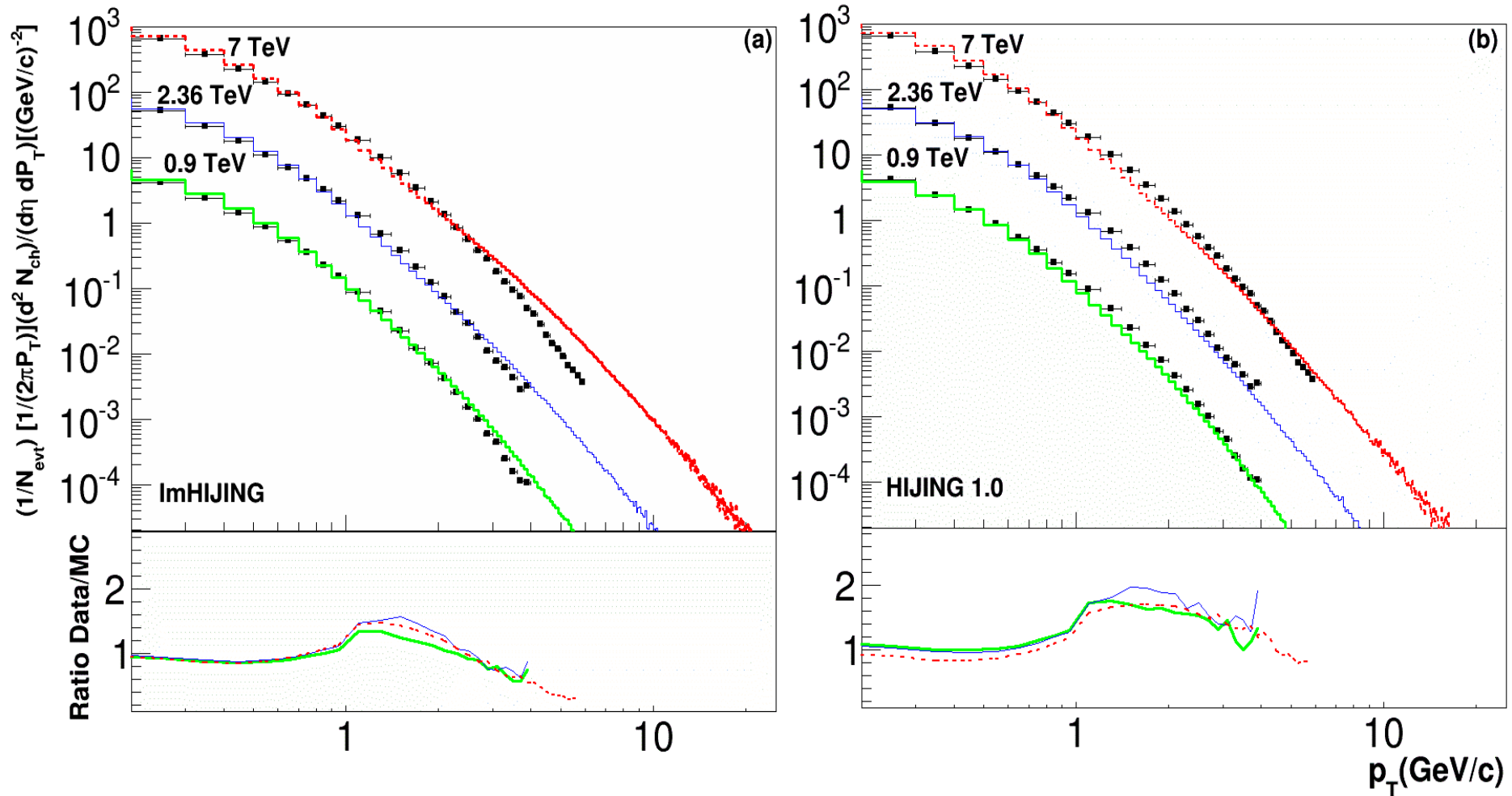




# Multiplicity distributions of charged particles



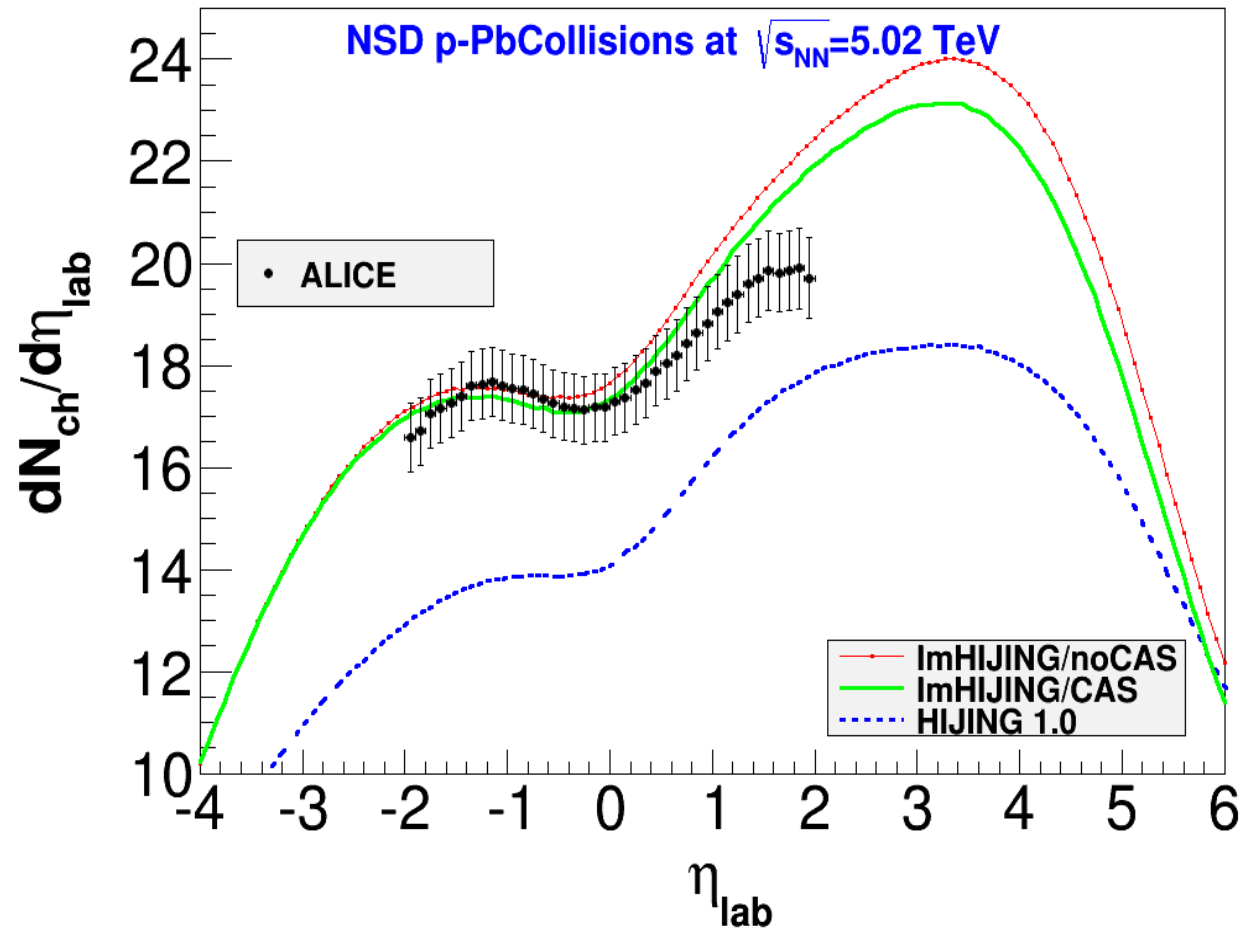
# Transverse momentum distributions of charged particles





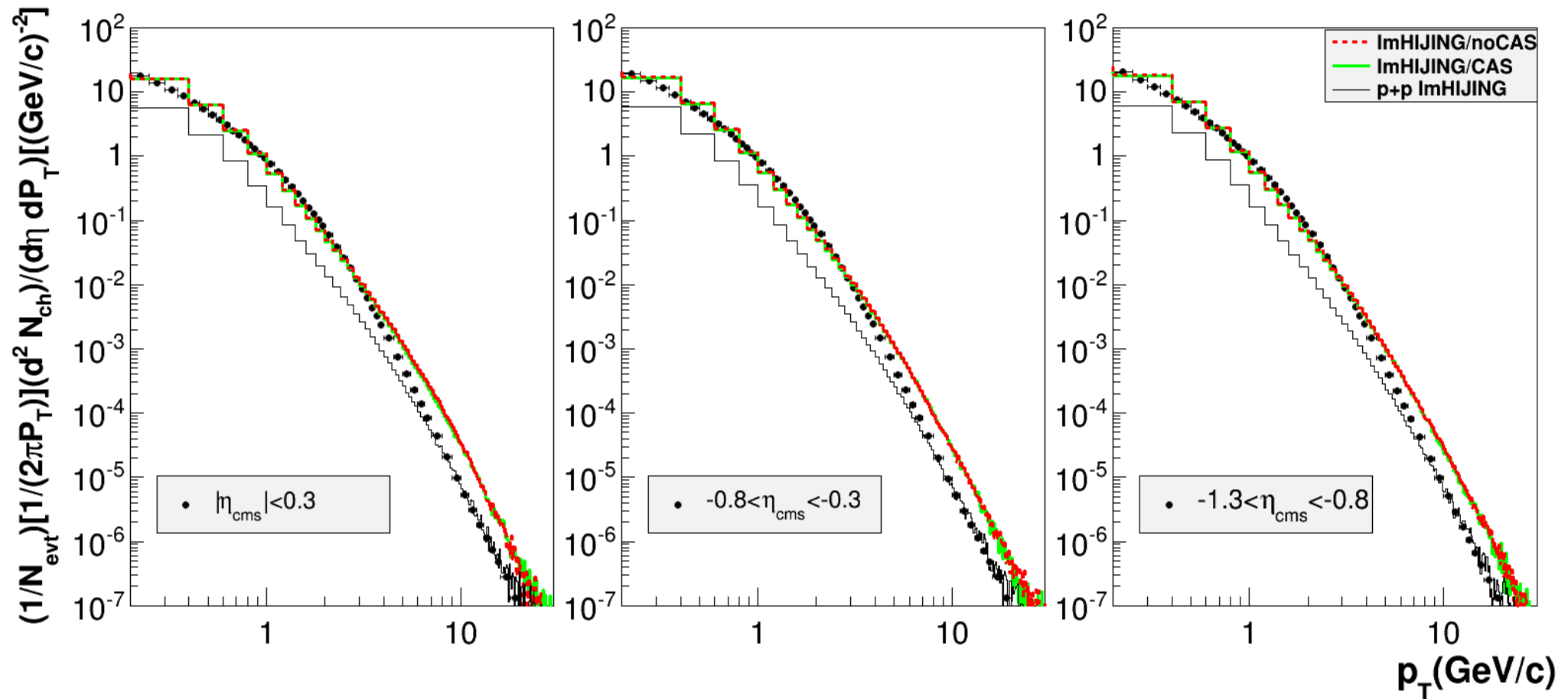
The results of the improved and standard HIJING codes in non-single diffractive  $p + Pb$  collisions at  $\sqrt{S_{NN}} = 5.02$  TeV

# Pseudorapidity density of charged particles in the Lab. system



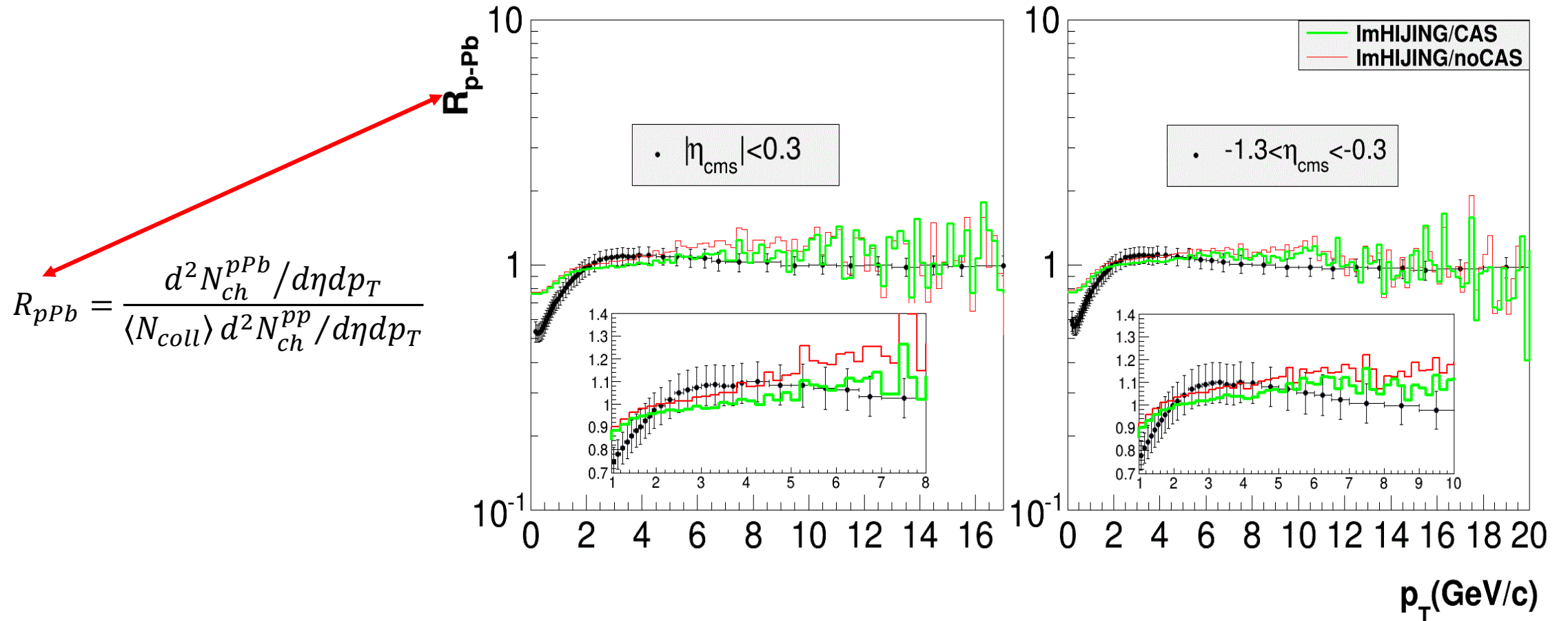
# The transverse momentum distribution of charged particles

NSD p-Pb Collisions at  $\sqrt{s_{NN}}=5.02$  TeV



# The transverse momentum dependence of nuclear modification factor

NSD p-Pb Collisions at  $\sqrt{s_{NN}}=5.02$  TeV



# Conclusions

- ✓ HIJING code is improved
  - **Tabulated Martin-Stirling-Throne-Watt (2009) parton distribution functions.**
  - **Nucleon shadowing.**
- ✓ Non-single Diffractive  $p + p$  collisions data at  $\sqrt{s_{NN}} = 0.9, 2.36$  and 7 TeV are well reproduced.
- ✓ Non-single Diffractive  $p + Pb$  collisions data at  $\sqrt{s_{NN}} = 5.02$  TeV are described.



Thanks