Nuclear fragmentation at high energies in Geant4: QGSC versus QGSP model

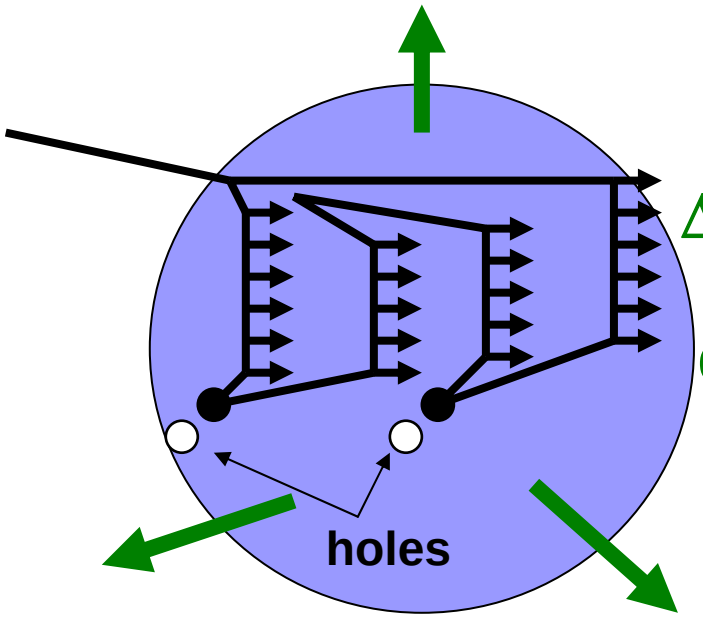
Mikhail Kosov, Physics Validation, October 2006

Plan

- Difference of QGSC and QGSP algorithms
  - Intranuclear String vs. Particle-Hole excitation
- Tuning of QGSC parameters (preliminary)
  - Nuclear dE/dx parameter (string tension)
  - Minimum density for the Quasmon excitation
  - Energy Flow vs. Individual Hadron algorithm
- Comparison with Agababyan (NA22) data
  - π^+(250 GeV) + (Al,Au) => positive, negative
  - K^+(250 GeV) + (Al,Au) => positive, negative

Difference between QGSP and QGSC

QGSP (QGSM):
Only Evaporation



Quark(anti-quark) **Di-quark**

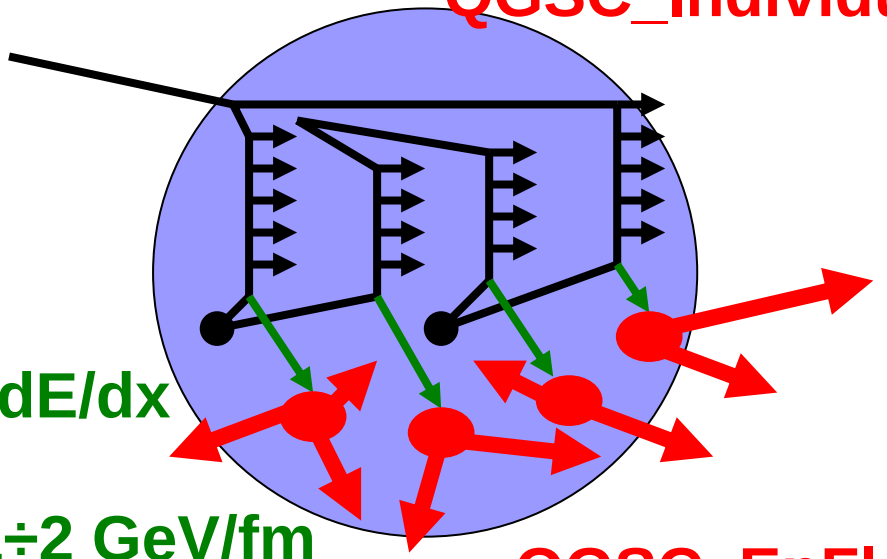
Meson **Baryon**

Quark(anti-quark) **Anti-quark**

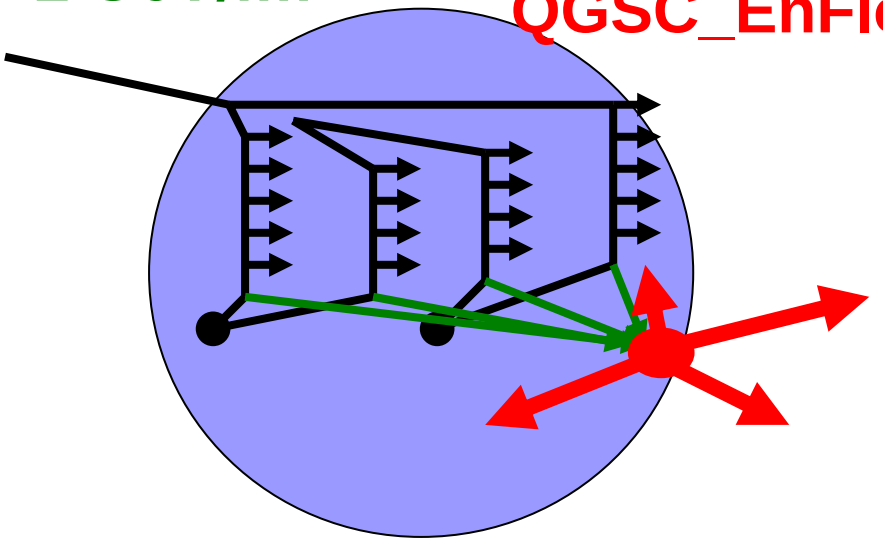
$\Delta E = T(b) \cdot dE/dx$

$dE/dx = 1 \div 2$ GeV/fm

QGSC_Individual

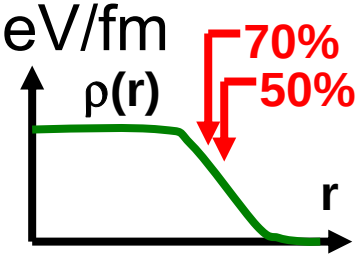


QGSC_EnFlow

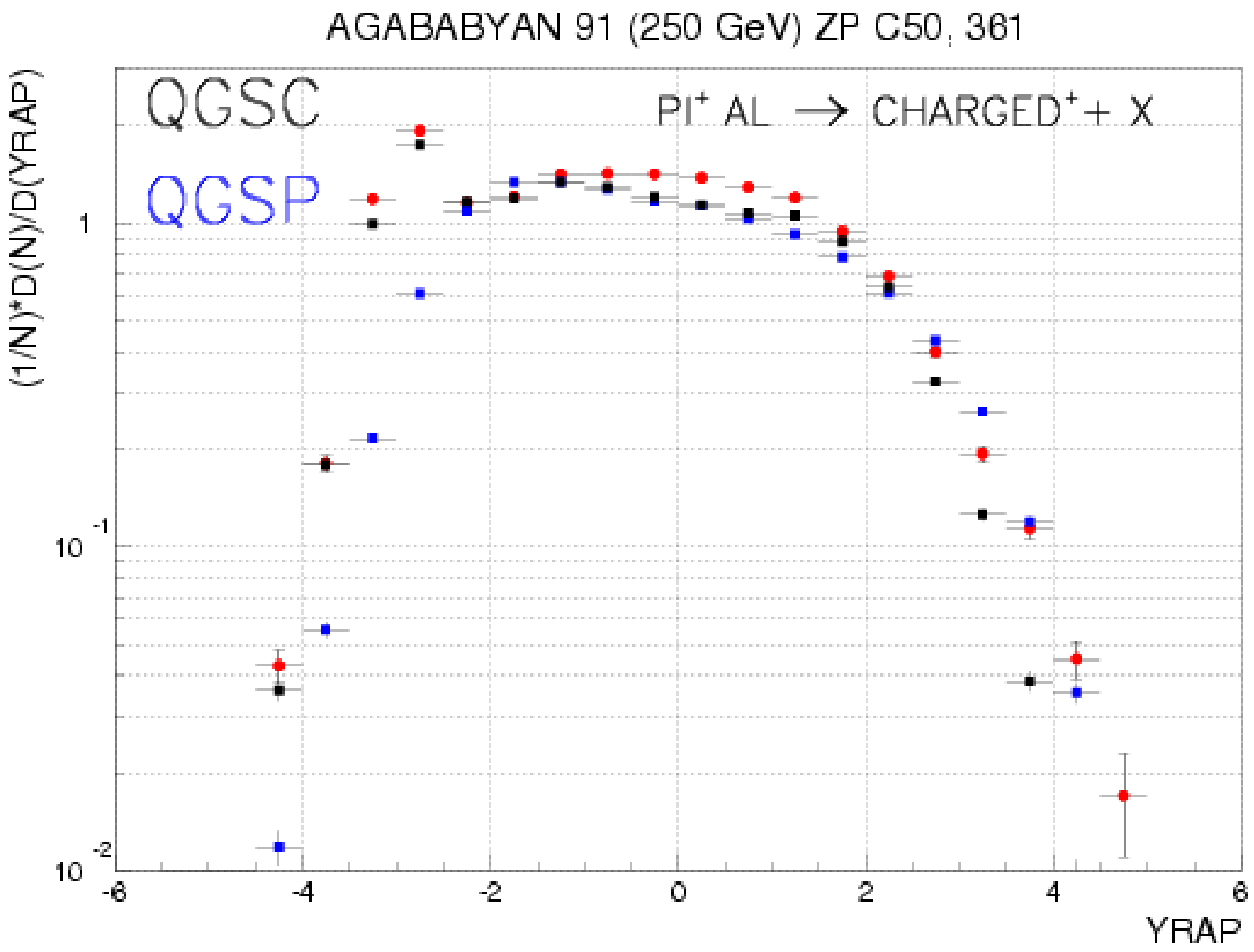


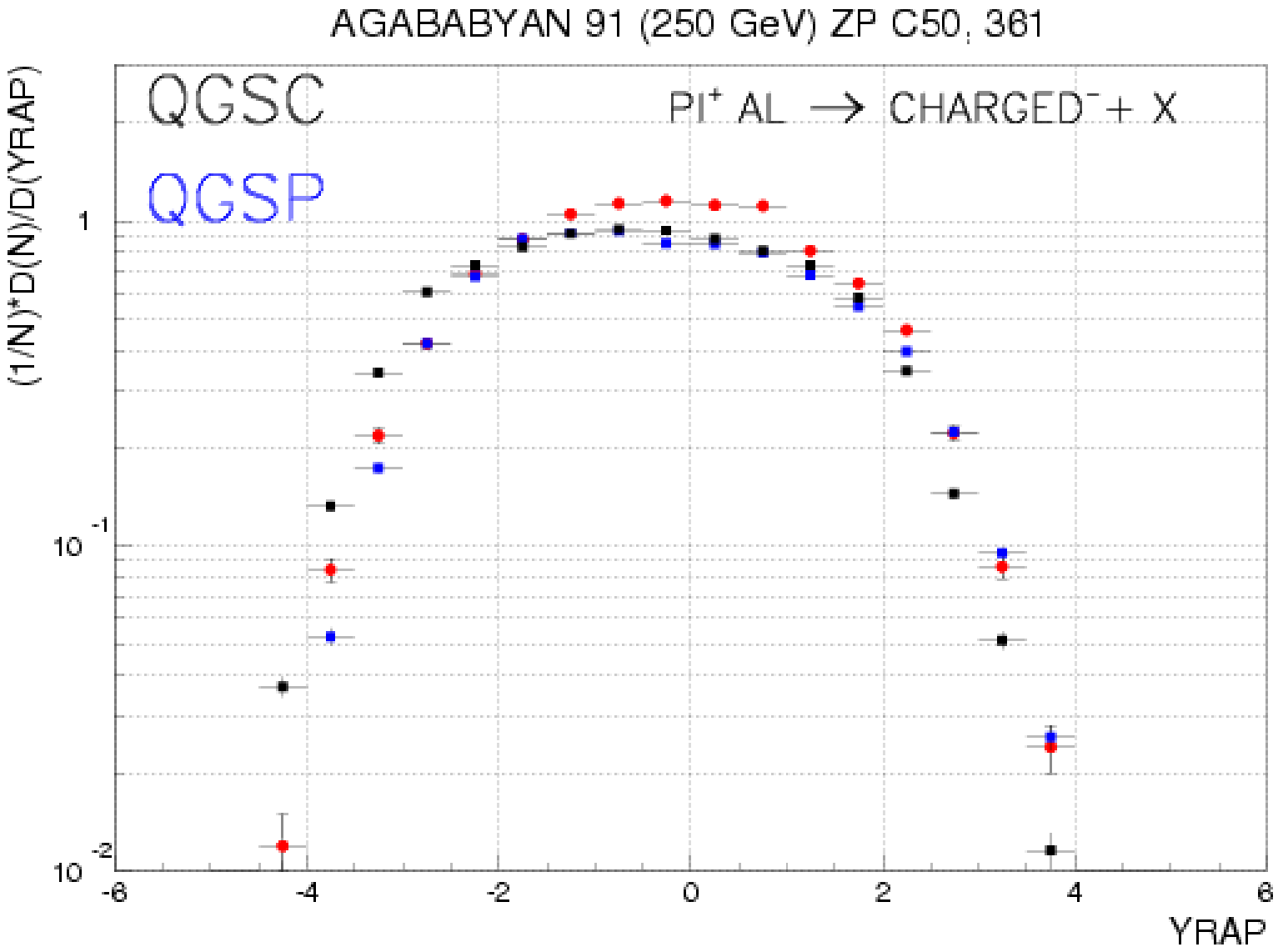
Nuclear fragmentation in QGSC model

- QGS with CHIPS nuclear fragmentation is QGSC
  - Nuclear stopping power: 1 GeV/fm → 1.5 GeV/fm
  - Absorption (% of max density): 50% →70%
  - 1 Quasmon for total energy flow instead of a separate Quasmons for each low rapidity QGS particle



- NA22 experiment (Red) cuts $P_p < 0.2$ GeV/c protons
  - Probably similar cut must be applied to mesons
- QGSC produces a lot of nuclear protons but a soft part of them is cut off by NA22 acceptance
- Important: NA22 experiment cuts off diffraction part, while QGS includes the diffraction (no special cuts!)


AGABABYAN 91 (250 GeV) ZP C50, 361
QGSC
QGSP
PI+ AL → CHARGED+ + X
(1/N)*D(N)/D(YRAP)
1
10-1
10-2
-6
-4
-2
0
2
4
6
YRAP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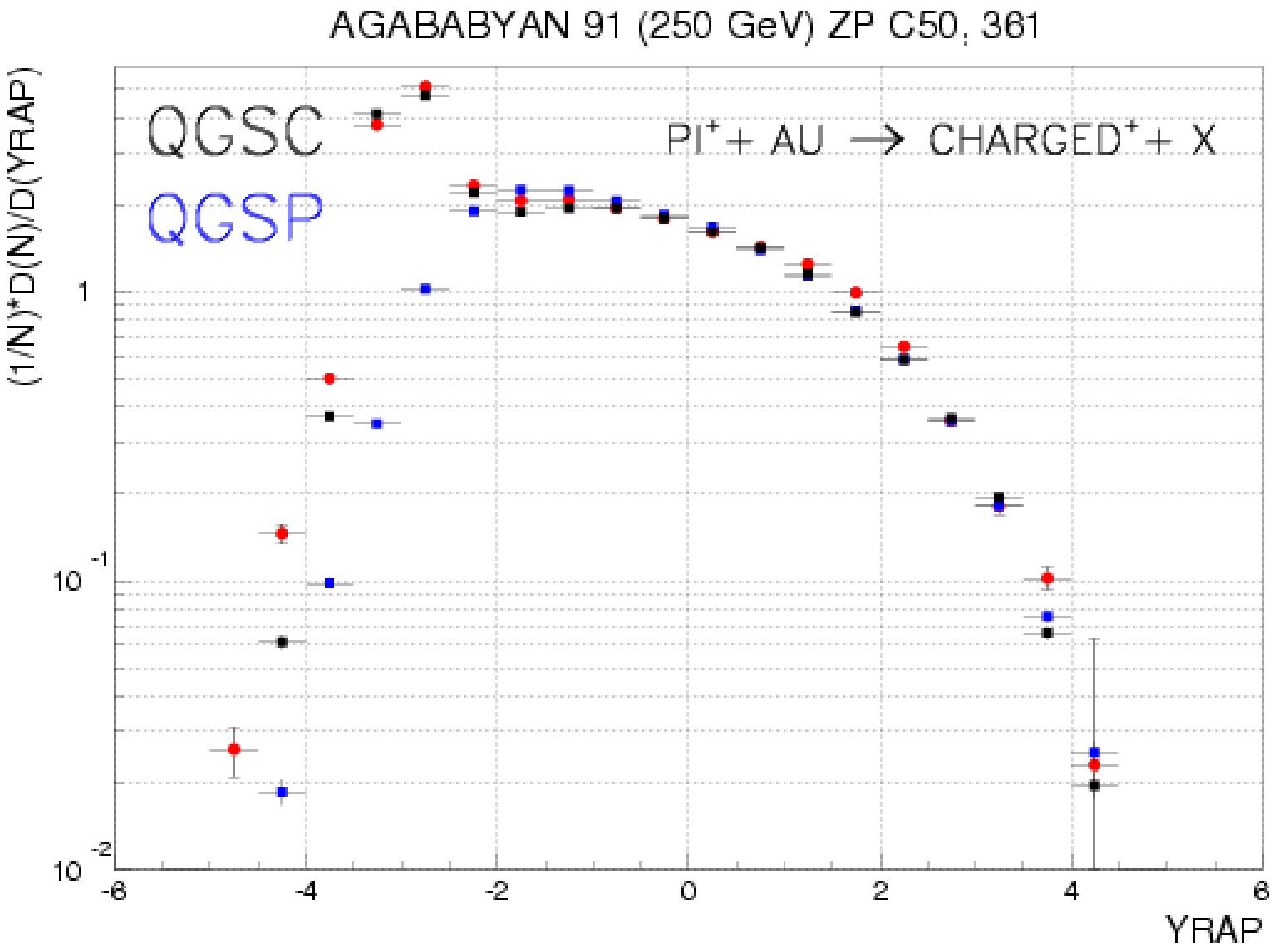
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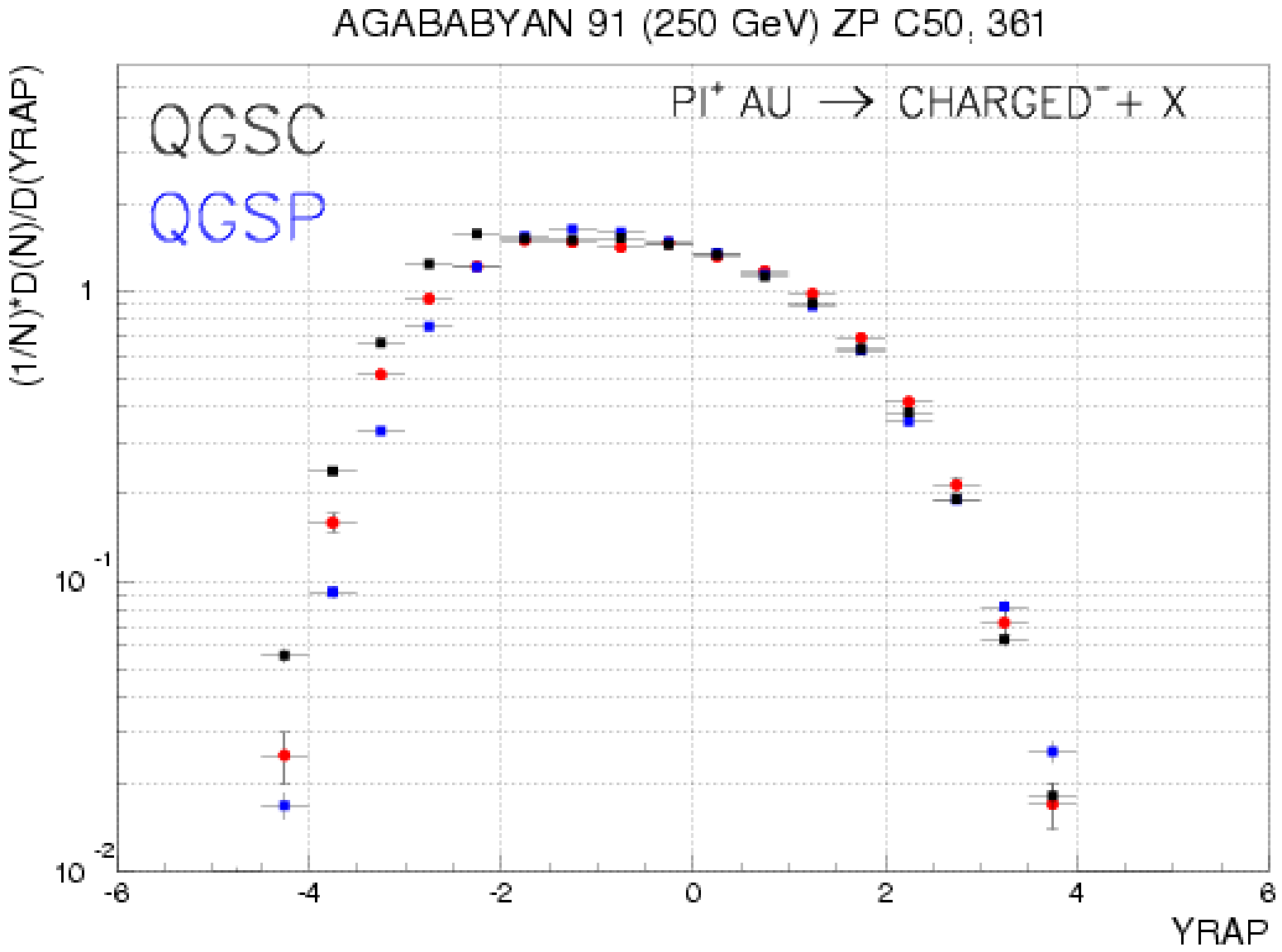
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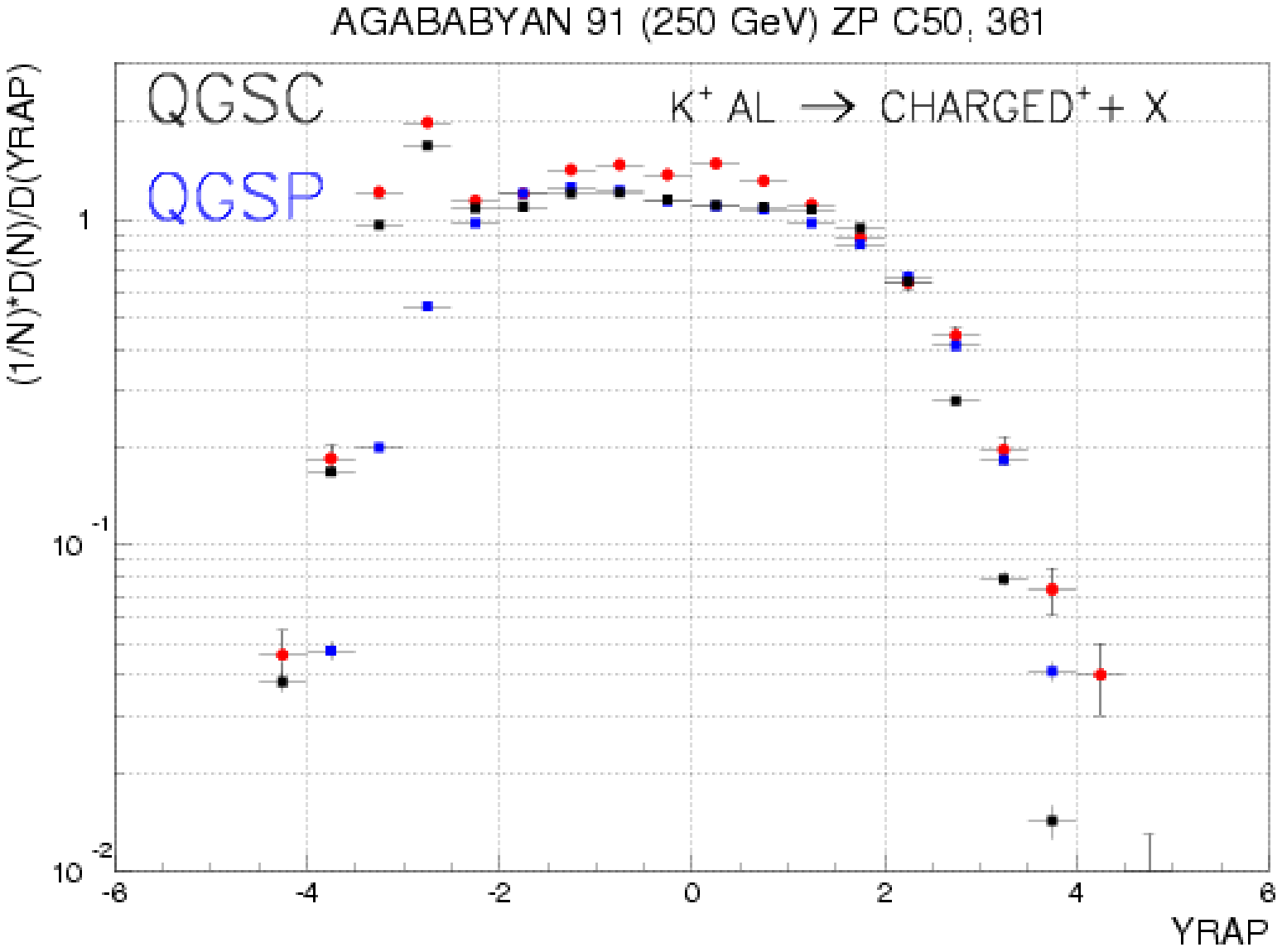
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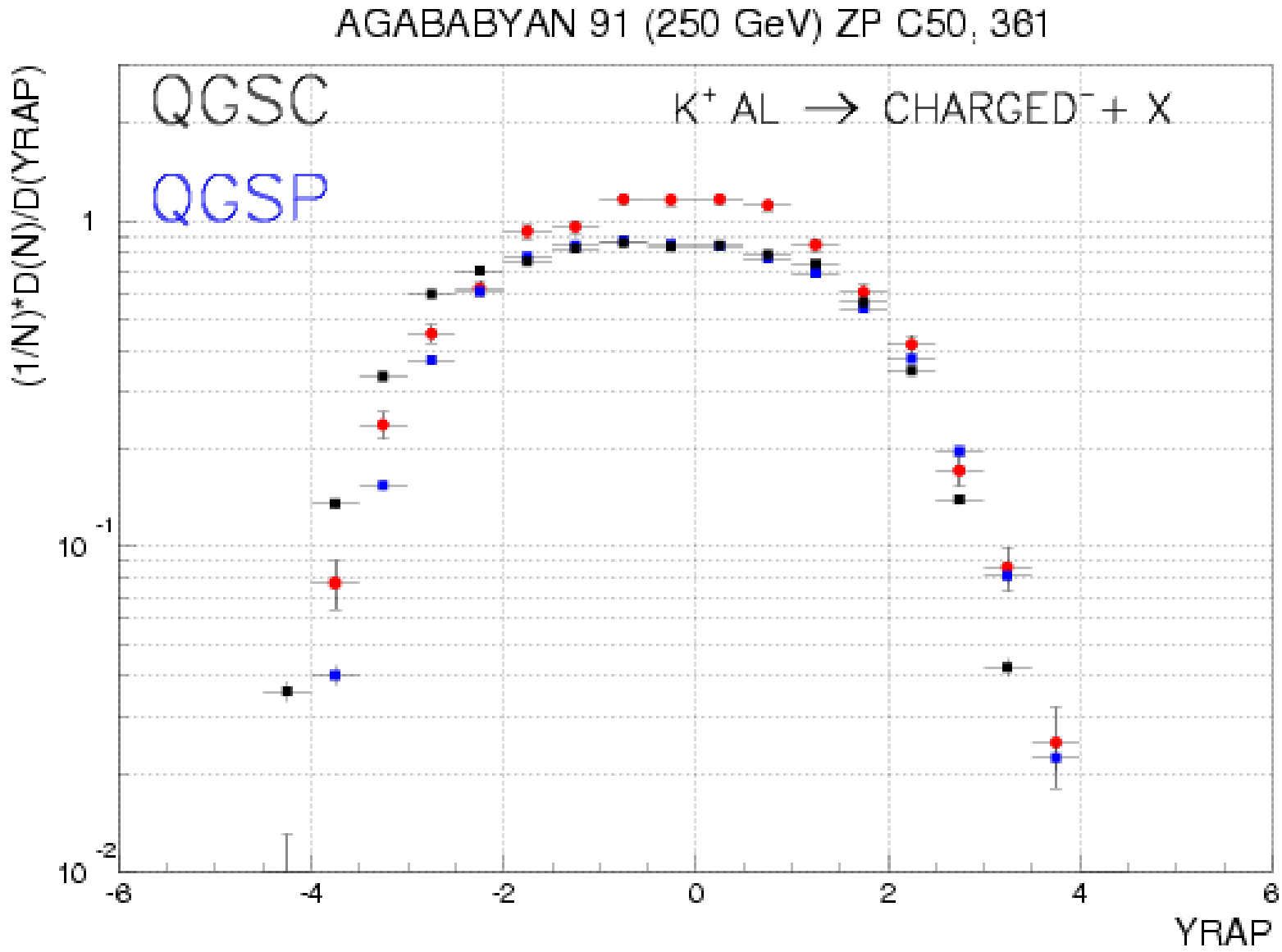
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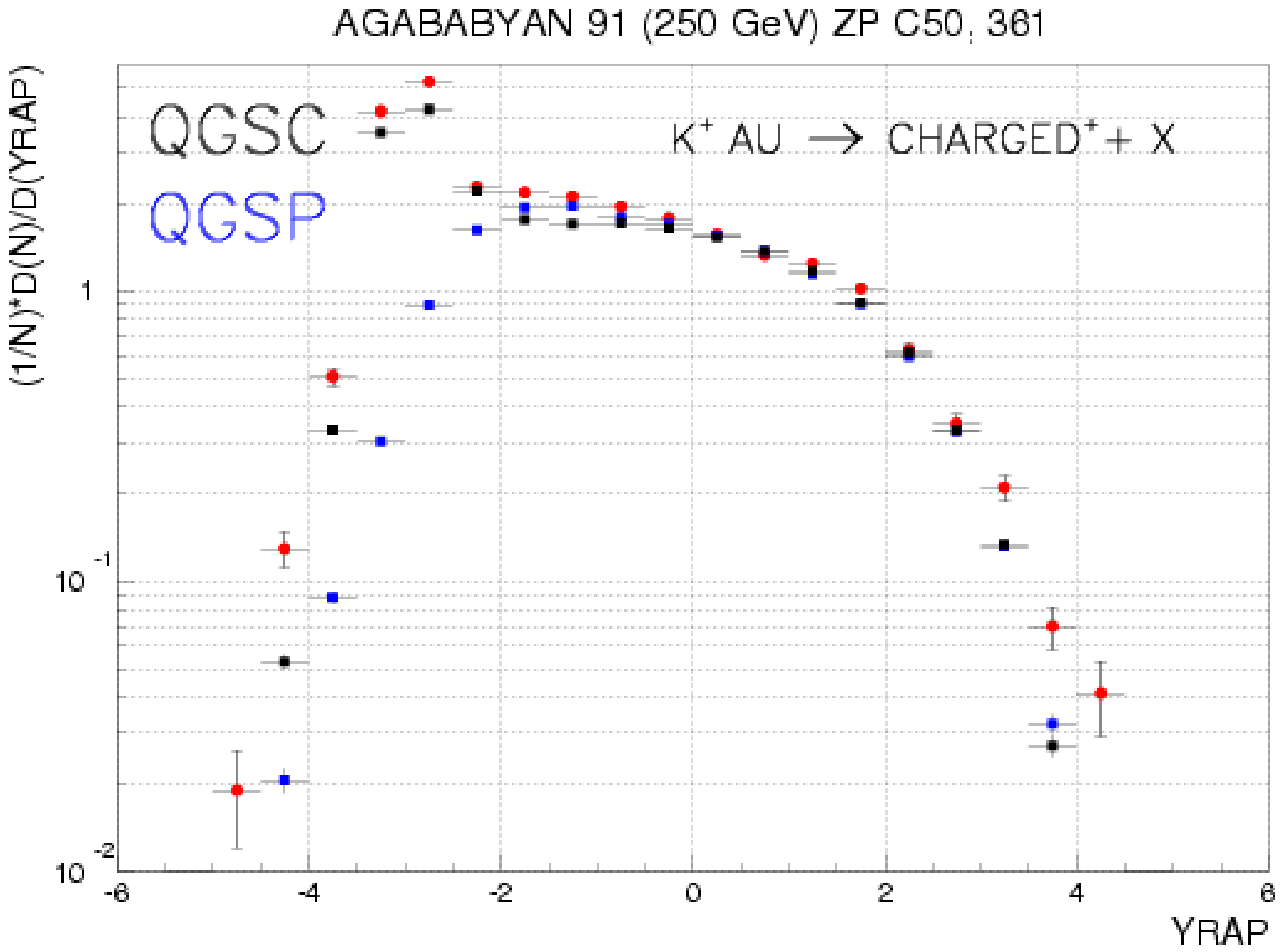
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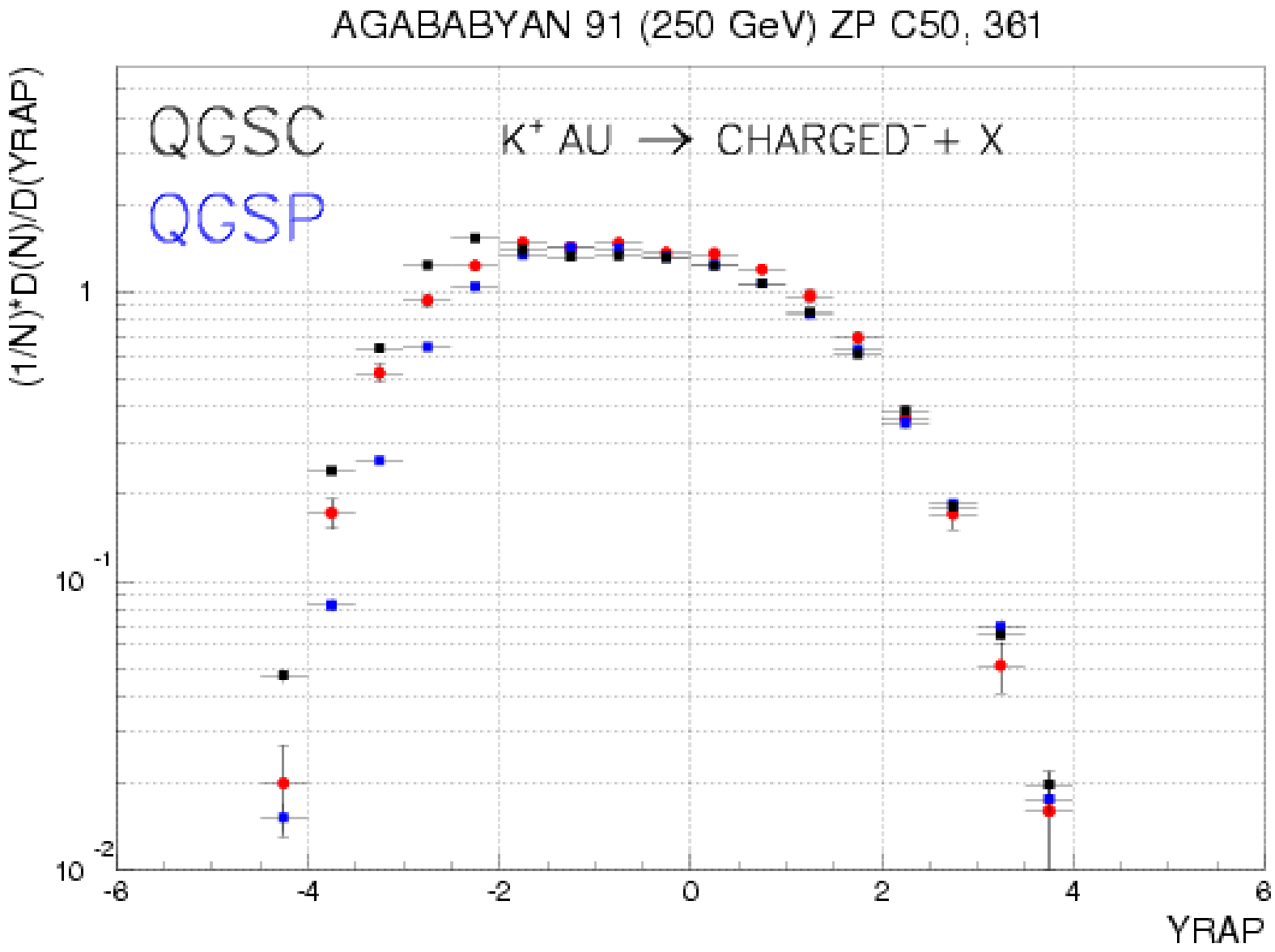
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Conclusion

- QGSC (with respect to QGSP) fits the nuclear fragmentation region better.
- It is necessary to make one Quasmon per interacting nuclear nucleon (cluster). For that CHIPS_QGS model is made in a similar way to the old Geant4 QGS model (must be tuned)
- CHIPS_QGS is based on the CHIPS classes and covers interactions of all SU(3) hadrons (there is no heavy quarks!) as projectiles.