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A LIGHT-FRONT AdS/QCD QUARK-DIQUARK NUCLEON MODEL IN PROTON-PROTON AND HEAVY-ION COLLISIONS

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This work discusses a phenomenological quark-diquark nucleon model based on light-front soft-wall AdS/QCD holography able to be used in particle collision simulations.
The light-front holography has predicted two particle bound state wave function inside nucleons which can not be derived simply from a picture of valence quarks, namely diquarks [1]. In this framework, from the construction of phenomenological diquark Parton Distribution Functions based on light-front QCD and soft-wall AdS/QCD [2, 3] matched to data from NNPDF2.3 QCD+QED NNLO [4, 5]; as well as, due to consequences of the color gauge $SU(3)_c$ in QCD, we have armed a nucleon model and implemented it into the PYTHIA simulation package.
The quark-diquark nucleon model contains both scalar (isoscalar-scalar diquark singlet) state and axial-vector (isoscalar-vector diquark and isovector-vector diquark) state as participating in hard-scattering process alongside quarks and gluons in particle collisions.

Thanks to the hadronization machinery already existing in PYTHIA, we were able to to compare the model in the proton-to-pion ratio in proton-proton collisions at transverse momentum region $0 \leq p_T \leq 20$ GeV at $\sqrt{s} = 13$ TeV with default PYTHIA processes and experimental data from ALICE experiment [6]. The quark-diquark model shows an enhancement of baryon production in the region $2 \leq p_T \leq 4$ GeV, being in better agreement with experimental data than default PYTHIA models, which only consider quarks and gluons in hard processes.
On the side of heavy-ions, we compared the quark-diquark nucleon model to data from PHENIX experiment in HeAu collisions at $\sqrt{s} = 200$ GeV [7], obtaining a better agreement in the p/π^+ ratio than the default models in PYTHIA in the region $0 \leq p_T \leq 3$ GeV.
In general terms, as expected from a quark-diquark nucleon model with interacting valence diquarks in hard-processes, the studied systems of collisions showed a subtle increase of production of proton over pions not observed in models without diquark hard-processes. It is proposed to generalize and use the model in phenomena where diquark degrees of freedom may play a role.

References:

1. Stanley J. Brodsky, Guy F. de Teramond, Phys. Rev. Lett. **96**, 201601 (2006)
2. T. Gutsche, V. E. Lyubovitskij, I. Schmidt and A. Vega, Phys. Rev. D **89** 5, 054033 (2014), Phys. Rev. D **92** 1, 019902 (2015) (erratum)
3. Tanmay Maji, Dipankar Chakrabati, Phys. Rev. D **94** 9, 094020 (2016)
4. Richard D. Ball et al., Nucl. Phys. B **877**, 290-320 (2013)
5. B. Rodriguez-Aguilar, Ya. A. Berdnikov, e-Print: 2105.05884 [hep-ph]
6. Shreyasi Acharya et al., Eur. Phys. J.C **81** 3, 256 (2021)
7. D. Larionova, et al. Nucleus-2021

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