Contribution ID: **39** Type: **oral**

Relativistic corrections to the vector meson light front wave function

Wednesday 13 January 2021 15:30 (20 minutes)

Exclusive vector meson production is a powerful process to probe the gluonic structure of protons and nuclei at small Bjorken-x, and it also makes it possible to study the geometry of the nuclei in the transverse plane. An accurate description of the process requires us to use a vector meson light front wave function that correctly represents the meson. Currently, the light front wave function is not fully understood and for heavy vector mesons the used light front wave functions are mostly either phenomenological or fully nonrelativistic.

We present our recent work [1] where we develop a new method to compute a light front wave function for heavy vector mesons based on long distance matrix elements constrained by decay width analyses in the Non Relativistic QCD framework. Our approach provides a systematic expansion of the wave function in quark velocity. The first relativistic correction included in our calculation is found to be significant, and crucial for a good description of the HERA exclusive J/Ψ-production data. When looking at cross section ratios between nuclear and proton targets, the wave function dependence does not cancel out exactly. In particular, the fully nonrelativistic limit is found not to be a reliable approximation even in this ratio. The important role of the Melosh rotation to express the rest frame wave function on the light front is illustrated.

[1] T. Lappi, H. Mäntysaari and J. Penttala, arXiv:2006.02830 [hep-ph], accepted for publication in Phys. Rev. D

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Session Classification: CGC

Track Classification: Physics at low-x and gluon saturation