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Multi particle production in proton-nucleus collisions

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Using the formalism of the light-cone wave function in perturbative QCD together with the hybrid factorization, we compute the cross-section for three particle production at forward rapidities in proton-nucleus collisions. In this picture, the three produced partons — a quark accompanied by a gluon pair, or two quarks plus one antiquark — are all generated via two successive splittings of a quark from the incoming proton, that was originally collinear with the latter. The three partons are put on-shell by their scattering off the nuclear target, described as Lorentz-contracted “shockwave”. We explicitly compute the three-parton Fock space components of the light-cone wave function of the incoming quark and also the “production” state, which describes the scattering between this dressed quark state and the shockwave for the purposes of computing particle production. This “production” state is also an ingredient for other interesting calculations, like the next-to-leading order correction to the cross-section for the production of a pair of jets.

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