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Towards a Hamiltonian first principle approach for baryons

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Basis light-front quantization (BLFQ), as a fully relativistic and nonperturbative approach based on a light-front quantized Hamiltonian with Quantum Chromodynamics (QCD) input, has the potential to achieve the first principle calculation. For QCD applications in limited Fock spaces, we implement a form of confinement based on light-front holography and additional longitudinal confinement in our Hamiltonian. Consequently, BLFQ results agree with the global fitting and experimental data. Recent developments include expanding the Fock spaces to the five-particle Fock sectors, such as the five-quark and three-quark-two-gluon Fock sectors, and implementing the relevant QCD interaction to replace the effective confining potential. Using the light-front wave functions produced by BLFQ, one can calculate observables such as parton distribution functions (PDFs) of the gluon and sea quarks at a low-resolution scale and implement QCD-evolved to higher scales for comparison with experiments. At the end of this talk, I also discuss prospects for future developments.

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