



Contribution ID: 32

Type: **Invited**

## Quantum simulation of quark jet and gluon jet

*Thursday, 28 November 2024 10:00 (30 minutes)*

In this work, we demonstrate quantum advantage for simulating dynamics of multiple particles in the  $(3+1)$ -d QCD Hamiltonian on the light front, especially in the high-energy physics phenomena of an incoming quark jet or gluon jet scattered on the nuclear medium. Using quantum simulation with direct encoding, we provide an universal framework to simulate jet particles, and it is efficient in both Hamiltonian operator and multiple gluon state representation. For the numerical results, we use quantum simulator to simulate on more than a hundred qubits and we observe jet momentum broadening and gluon radiation.

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**Session Classification:** Gary McCartor award