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Jet evolution in a quantum computer: quark and gluon dynamics

Quantum Chromodynamics allows the discovery of new states and phases of matter, among which is the Quark-Gluon Plasma (QGP). Jets are one of the most common QGP probes that are not only produced inside the QGP medium but also their behavior in the vacuum is well-understood, despite their complexity. Moreover, jets'properties are modified due to the interaction with the medium, which is commonly known as the jet quenching phenomenon. Over the past decades, jet quenching has been extensively studied, driving the development of simulation techniques forward to provide new insights into QGP properties.

Following Feynman's simulation ideas, the quantum nature of the jets and the QGP make the study of jet quenching a prime candidate to benefit from quantum computing. Due to the jets'complexity and the state of the current quantum computers, the full simulation of jets is still a long-term challenge. As a precursor to this, the propagation of SU(3) partons in a QGP media using quantum simulation algorithms is studied. Both quarks and gluons cases are analyzed and compared with analytical solutions. Results obtained from quantum simulators demonstrate that the algorithm successfully models parton propagation, yielding outcomes consistent with classical predictions. This work lays the groundwork for future quantum simulations of jet evolution in QGP.

Email Address of submitter

maria.oliveira@nbi.ku.dk

Short summary

Authors: Dr MILHANO, Guilherme (LIP-Lisbon & CERN TH); OLIVEIRA, Maria Gabriela (Niels Bohr Institute); CASTRO, Nuno (LIP and University of Minho)

Presenter: OLIVEIRA, Maria Gabriela (Niels Bohr Institute)

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