中国高能核物理网络论坛
HIGH ENERGY NUCLEAR PHYSICS IN CHINA

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The 173rd HENPIC seminar

Quantum Simulation for Heavy Ion Collisions

Speaker: Dr. Xiaojun Yao, University of Washington

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ABSTRACT:

The scientific objective of heavy ion collision experiments is to study the properties of the quark-gluon plasma (QGP), a hot and dense phase of nuclear matter. Perturbative calculations and nonperturbative methods such as the lattice method and the holography at finite temperature have led to many interesting results regarding the QGP properties. However, there are still many open questions that cannot be fully addressed by traditional methods, especially those related to finite baryon chemical potentials and the real-time dynamics.

With the rapid development of quantum technology recently, it may be possible that we can use quantum computing to solve some difficult problems in our understanding of QCD at finite temperature and density in the near future. In this talk, I will discuss two examples in which quantum computing may help to deepen our understanding. The first example is the non-unitary and non-equilibrium dynamics of open quantum systems. The open quantum system framework has been used to describe the transport of heavy quarks and quarkonia in the QGP, but current studies are limited to a small number of degrees of freedom. Quantum computers may help to overcome this problem. I will explain the quantum simulation of the non-unitary dynamics of a two-level system and the U(1) gauge theory in 1+1-dimension, also known as the Schwinger model, embedded in a thermal environment. The second example is jet quenching. I will show a framework for the quantum simulation of the light-front Hamiltonian dynamics of QCD, which can be used to study the Landau-Pomeranchuk-Migdal effect in jet quenching beyond the current methods' scope.

ABOUT THE SPEAKER:

Xiaojun Yao obtained his B. Sc. at Shandong University in 2013 and his Ph.D at Duke University in 2019. He then worked at the the Center for Theoretical Physics of Massachusetts Institute of Technology as a postdoctoral associate from 2019 to 2022. Now he is a research assistant professor at the University of Washington. His interest includes effective field theory, physics in heavy ion and electron ion collisions and applications of quantum computing in nuclear and particle physics.

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