世纪物理情·系列讲座

Quantum computing with atoms

【摘要】

Atoms are natural qubits for their fundamental property of being identical, and the consequent convenience in achieving scalable quantum control of large number of qubits. The atomic platform becomes particularly attractive with recent developments of optical tweezers, that allow quantum control of individual atoms. This talk will present several protocols to perform quantum optimization and digital quantum simulations of finite-temperature quantum many-body physics. I will describe an atom-cavity based quantum optimization architecture, which has optimal scaling at encoding complexity for 3-SAT and vertex cover problems. It also encodes generic quadratic unconstrained binary optimization with arbitrary connectivity at quadratic cost in the atom number. Then I will present a quantum kernel function expansion algorithm, for digital quantum simulations of finite-temperature quantum many-body physics. In this algorithm, the temperature dependence of observables is expanded in terms of complete basis functions, and the expansion moments are obtained through Rydberg blockaded quantum dynamics. Our theoretical results indicate atomic quantum computing is promising to demonstrate practical quantum advantage in near-term.

【报告人简介】

Xiaopeng Li is professor of physics in the Physics Department of Fudan University, China, jointly employed by Shanghai Qi Zhi Institute. He is active in quantum information science and condensed-matter theories, with his primary research interests in exploiting the quantum computation power of various quantum simulation platforms. He received his Ph.D. in physics from the University of Pittsburgh in 2013 and joined Fudan University as a faculty member in 2016 after three years at the University of Maryland, supported by a Joint Quantum Institute theoretical postdoctoral fellowship. He has been a full professor since 2019.

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