DEPARTMENT OF PHYSICS
THE UNIVERSITY OF HONG KONG

Physics Colloquium

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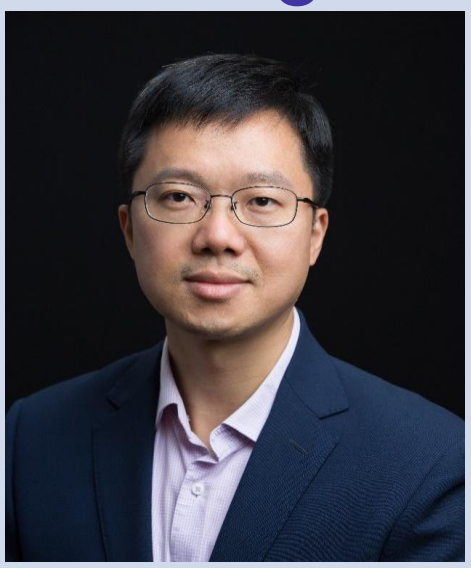
Can AI Turn a Physics Paper into a Validated Scientific Program?

Lessons from Quantum Many-Body Programming

September 23, 2026 (Wednesday)

3:30 p.m.

MB237, 2/F, Main Building,
Main Campus, HKU



Prof. Yi ZHOU

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Abstract:

Can an AI read a physics paper and turn it into trustworthy research code? In quantum many-body physics, papers often leave implicit the index ordering, gauge choices, fermionic signs, truncation rules, contraction strategy, and scaling decisions that determine whether an implementation is correct.

In this colloquium, I will present a human-in-the-loop "Paper-to-Program Many-Body" workflow that externalizes this hidden knowledge before coding. A virtual research group of AI agents extracts the theory, reviews an implementation-ready specification, and generates code tested by physics oracles and production-scale checks.

Two case studies show promise and limits. For DMRG, specification-guided implementations succeeded in 16 of 16 tested pairings, versus 6 of 13 direct attempts. For the sign-sensitive Pfaffian conversion of paired-fermion states to matrix product states, the workflow produced 11 validated passes among 26 audited runs, versus none under direct prompting after provenance and scale auditing. The remaining failures expose a second bottleneck: even with a good specification, current agents differ in their ability to reason, debug, and construct scalable scientific software.
The broader lesson is that reliable AI-assisted science requires more than better code generation. It requires explicit knowledge externalization, expert review, and validation protocols that make both successes and failures auditable.

Biography:

Yi Zhou is a professor of theoretical condensed matter physics at the Institute of Physics, Chinese Academy of Sciences. He received his B.S. and Ph.D. in physics from Tsinghua University and held postdoctoral positions at the Max Planck Institute for the Physics of Complex Systems and universities in Hong Kong before joining Zhejiang University in 2009. He moved to the Institute of Physics in 2019. His research develops analytical and numerical approaches to correlated and topological quantum matter, spanning quantum spin liquids, unconventional superconductivity, topological phases, and tensor-network methods. His publications include the Reviews of Modern Physics article "Quantum Spin Liquid States," as well as research articles in Science and Physical Review Letters.

Anyone interested is welcome to attend.

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