



Distinguished Special Seminar

Quantum Simulation, Quantum Learning, and Inverse Design with Programmable Atomic Systems

Prof. Peter Zoller

*University of Innsbruck and IQOQI, Austrian
Academy of Sciences*

Time: 3: 00 pm, July. 03, 2026 (Friday)

时间: 2026年7月03日 (周五) 下午3:00

Venue: Room W301, Physics building, Peking University

地点: 北京大学物理楼, 西301思源多功能厅



Abstract

Programmable atomic systems offer a powerful route to quantum simulation of strongly correlated many-body dynamics beyond the reach of classical computation. I will begin with a few remarks on implementing lattice gauge theories, where atomic, ionic, and Rydberg platforms enable the controlled study of gauge-invariant dynamics, constrained Hilbert spaces, string formation and string breaking, and real-time non-equilibrium phenomena. As these systems scale, two central questions arise: How do we trust what the device is doing? and how can we use it to actively design new quantum matter? I will address these questions through bounded-error quantum simulation, combining experimental data with Hamiltonian and Lindbladian learning to place quantitative confidence bounds on implemented dynamics and observables, and through inverse quantum simulation, where programmable devices are used as machine-learning-assisted design engines to identify many-body states with desired properties and reconstruct Hamiltonians that realize them. I will conclude with an outlook toward quantum networks, where programmable many-body systems may operate as non-local quantum sensors, for example through entangled atomic ensembles implementing network-based Ramsey interferometry and probing the gravity-quantum interface

About the speaker

Peter Zoller教授是量子物理领域享誉世界的著名学者。他目前担任奥地利因斯布鲁克大学理论物理学教授, 曾担任奥地利科学院量子光学与量子信息研究所(IQOQI)科学主任。作为量子信息领域的先驱, Zoller教授率先提出了离子阱量子计算、超冷原子量子模拟以及长距离量子通信中的量子中继器等核心概念, 为相关前沿领域的发展奠定了坚实的理论与实验基础。此外, 他还是经典专著《量子噪声》(Quantum Noise)的合著者。因为在量子光学、量子计算及量子模拟等领域的卓越成就, Zoller教授获得了众多国际顶级荣誉, 包括普朗克奖(2005年)、狄拉克奖(2006年)、富兰克林奖(2010年)、沃尔夫物理学奖(2013年)、墨子量子奖(2018年)、拉姆齐奖(2018年)等, 并当选为奥地利科学院院士、美国国家科学院外籍院士、荷兰皇家艺术与科学院外籍院士、西班牙皇家科学院外籍院士、德国国家科学院院士、欧洲科学院院士、英国皇家学会院士, 以及中国科学院外籍院士等。