Mathematical & Physical Aspects of Information Sciences

程序册

哈尔滨工业大学数学研究院

2018 年 **1** 月 **5—7** 日

邀请报告专家：

陈泽乾（中科院武汉物理与数学研究所）

李传锋（中国科学技术大学）

骆顺龙（中科院数学与系统科学研究院）

邱道文（中山大学）

王向斌（清华大学）

武俊德（浙江大学）

薛　鹏（东南大学）

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会议地点： 哈尔滨工业大学格物楼 522 室

会议网址： http://im.hit.edu.cn

会议日程

1月6日

- **08:30-08:40　会议签到**
- **08:40-08:45　欢迎致辞（许全华）**

主持人：武俊德

- **08:45--09:30　骆顺龙**
- **09:35--10:20　陈泽乾**
- **10:20--10:40　茶歇**
- **10:40--11:25　薛鹏**
- **11:30--12:15　王向斌**

中餐

下午自由讨论、晚餐

1月7日

主持人：骆顺龙

- **08:50--09:35　李传锋**
- **09:40--10:25　武俊德**
- **10:25--10:45　茶歇**
- **10:45--11:30　邱道文**

中餐

报告题目与摘要

陈泽乾：中国科学院武汉物理与数学研究所

题目：量子系统的拓扑与几何 (Geometric phases for the observable)

摘要：：In this talk, we will report that the geometric phase can be introduced for the observable excerpt for the state. The phase is determined by the Heisenberg equation, contrary to the usual one by the Schrödinger equation. It is shown that the geometrical phases of the observable are connected with the geometry of the quantal observable space.

李传锋：中国科学技术大学

题目：量子网络与固态量子存储

摘要：量子纠缠网络是经典网络的升级和完善，包含量子节点和量子信道，各节点间可以通过量子信道共享量子纠缠。相比经典网络，量子网络可以完成更高效的信息处理和更安全的信息存储与传输。本报告简要介绍量子纠缠网络的近期研究进展，包括量子存储和量子界面等。然后介绍我们研究组在固态量子存储方向的研究进展。

骆顺龙：中国科学院数学与系统科学研究院

题目：Quantifying Coherence via Quantum Uncertainty

摘要：The notion of measurement is of both foundational and instrumental significance in quantum mechanics, and coherence destroyed by measurements (decoherence) lies at the very heart of quantum to classical transition. Qualitative aspects of this spirit have been widely recognized and analyzed ever since the inception of quantum theory. However, axiomatic and quantitative investigations of coherence are attracting great interests only quite recently with several figures of merit for coherence introduced [Baumgratz, Cramer, and Plenio, Phys. Rev. Lett. **113**, 140401, 2014]. While these resource theoretic approaches have many appealing and

intuitive features, they rely crucially on various notions of incoherent operations which are sophisticated, subtle, and not uniquely defined, as have been critically assessed [Chitamber and Gour, Phys. Rev. Lett. **117**, 030401, 2016]. In this talk, we elaborate on the idea that coherence and quantum uncertainty are dual viewpoints of the same quantum substrate, and address coherence quantification by identifying coherence of a state (w.r.t a measurement) with quantum uncertainty of a measurement (w.r.t a state). Consequently, coherence measures may be set into correspondence with measures of quantum uncertainty. In particular, we take average quantum Fisher information as a measure of quantum uncertainty, and introduce the corresponding measure of coherence which are demonstrated to exhibit desirable properties. Implications for interpreting quantum purity as maximal coherence, and quantum discord as minimal coherence, are illustrated.

邱道文：中山大学

题目：Characterizations of symmetric partial Boolean functions with exact quantum query complexity

摘要：In this talk, I would like to report a recent work regarding:

1. an optimal exact quantum query algorithm for generalized Deutsch-Jozsa problem;

2. the characterization of all partial symmetric Boolean functions with exact quantum 1-query complexity.

王向斌：清华大学

题目：不完美单光子源量子操控理论与诱骗态量子密钥分发

摘要：将综述分析不完美单光子源，通道与探测损耗等对实际量子密钥分发系统安全性的威胁。介绍解决办法。采用诱骗态方法可以解决不完美单光子源问题。然而对现实条件，诱骗态方法假定的精确控制光源强度并不成立。我们将介绍抗强度涨落诱骗态方法及其实际应用情况。通道及探测损耗是另外一个安全威胁。我们介绍实际可执行的高效测量器件无关量子密钥分发理论及其实验证实情况。

武俊德： 浙江大学

题目： 量子网络理论及相关数学问题

摘要： 基于著名的 Choi-Jamiolkowski 同构而建立起来的量子网络理论是近年来发展起来的一个重要研究方向。该理论在量子信息处理、量子层析技术、量子变换的学习等方面有巨大的应用潜力。我们将介绍这方面的研究进展和与张量网络之间的密切联系。

薛鹏： 东南大学

题目： Directly detecting topological invariants in non-unitary discrete-time quantum walks

摘要： The investigation of topological phases of matter is one of the major endeavors in modern physics. The various remarkable properties of topological matter are typically associated with topological edge states, which are in turn dictated by topological invariants through the bulk-edge correspondence. For conventional topological phases in non-dissipative settings, the topological invariants are typically well studied and well classified. However, characterization of topological phases and topological invariants in dissipative systems remains an open question and has stimulated much theoretical discussion of late.

In this paper, we report the first experimental detection of bulk topological invariants in non-unitary discrete-time quantum walks with single photons. The non-unitarity of the quantum dynamics is enforced by periodically performing partial measurements on the polarization of the walker photon, which effectively introduces loss to the quantum dynamics. The topological invariant is probed by measuring the average displacement of the walker through the photon loss. We confirm the topological properties of the system by observing localized edge states at the boundary of regions with different topological invariants, and further demonstrate the robustness of both the topological properties and the measurement scheme of the topological invariants against disorder. By combining dissipation, topology and discrete-time quantum walks, our work opens up the avenue of exploring topological features in discrete-time quantum dynamics governed by non-unitary Floquet operators.