北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Quantum metric-based optical selection rules and -induced magneto-optical effects

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Time: 3:00 pm, March 30, 2026 (Monday)

时间：2026年3月30日（周一）下午3:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Quantum geometry is the source of many novel effects and new quantum states. The real and imaginary parts of the quantum geometry tensor correspond to the quantum metric and Berry curvature, respectively. Berry curvature has been well studied over the past four decades, while the exploration of quantum metric is just beginning. In this report, I will introduce some of the progress we have made in the study of quantum metric. In the first part of the report, we propose quantum metric-based optical selection rules [1]. We unveil a universal quantum metric and oscillator strength correspondence for linear polarization of light and establish valley-contrasted optical selection rules that lock orthogonal linear polarizations to distinct valleys. Part II, we propose quantum metric as a new mechanism for magneto-optical effects (MOEs) beyond the Berry curvature paradigm [2,3]. We develop new general MOE formulas that incorporate the whole quantum geometry, namely both Berry curvature and quantum metric. Based on our formulas, we predict quantum metric-induced MOEs in space-time inversion (PT)-symmetric antiferromagnets and unconventional MOEs, that is, quantum metric–dominated MOEs, in altermagnets.

1. Quantum-Metric-Based Optical Selection Rules, Y. Li, and C.-C. Liu*, PRL 136, 046901 (2026).
2. Quantum metric induced magneto-optical effects in PT-symmetric antiferromagnets, Y. Li, Y. Liu, C.-C. Liu*, arXiv:2503.04312v1 (2025).
3. Unconventional Magneto-Optical Effects in Altermagnets, Y. Li, Y. Liu, C.-C. Liu*, arXiv:2512.03435v1 (2025).

About the speaker

刘铖铖，北京理工大学物理学院教授，从事凝聚态计算物理研究，围绕材料中量子几何效应，通过方法和理论创新，在硅烯、新奇磁性、莫尔体系、磁光效应等方向取得了原创性成果，多个理论预言被实验证实，所提理论模型被冠名，部分成果写进了专著。共发表论文60余篇，包括15篇PRL，总引用1.2万次，连续六年入选Elsevier中国高被引学者（物理学）。获国家自然科学奖二等奖[排名2]和NJP Early Career Award。