Physical Review Workshop on

Quantum Materials for Modern Magnetism & Spintronics (Q3MS)

July 11-14, Hefei, China (Onsite & Online Hybrid)
Venue: Gaosu Hall C, 5F, Gaosu Kaiyuan International Hotel

Program

	Day 1 -- July 12
8:30~8:50	Welcome & Opening Remarks Chair: Prof. Zhenyu Zhang (USTC) Dr. Michael Thoennessen (Editor-In-Chief, APS) Prof. Xincheng Xie (Peking Univ & Associate Director, NSFC) Prof. Xiaodong Xu (Workshop Co-chair, Univ of Washington, USA)
Session I	Fundamental Concepts and Enabling Materials Chair: Prof. Xiangrong Wang (HKUST, Hong Kong SAR)
8:50~9:25	**Geometric Picture of Electronic Systems in Solids** Naoto Nagaosa (+1) (RIKEN & University of Tokyo, Japan)
9:25~10:00	**Thermopower and Thermoelectricity Enhanced by Spin Degrees of Freedom in Dirac Materials** Xianhui Chen (USTC, China)
10:00~10:25	**Photo Time & Coffee Break**
Session II	2D Quantum Magnets Chair: Prof. Shiwei Wu (Fudan Univ)
10:25~11:00	**Stacking Dependent Magnetism in Van der Waals Magnets** Di Xiao (-12) (Carnegie Mellon University, USA)
11:00~11:35	**2D Quantum Magnets and Its Heterostructures** Xiang Zhang (University of Hong Kong, Hong Kong SAR)
11:35~12:10	**Electrical Control of a Canted-antiferromagnetic Chern Insulator** Xiaodong Xu (-15) (University of Washington, USA)
Session III	Topology and Technology Frontiers in Magnetics Chair: Prof. Tai Min (Xi'an Jiaotong Univ)
14:00~14:35	**Emergent Electromagnetic Responses from Spin Helices, Skyrmions, and Hedgehogs** Yoshinori Tokura (+1) (RIKEN & University of Tokyo, Japan)
14:35~15:10	**Topological Spin Textures** Stuart Parkin (-6) (Max Planck Institute of Microstructure Physics, Germany)

15:10~15:45	**Spin Transport in Quantum Spin Systems** Eiji Saitoh (+1) (University of Tokyo, Japan)
15:45~16:20	**Electrical Manipulation of Skyrmionic Spin Textures in Chiral Magnets** Haifeng Du (The High Magnetic Field Laboratory, CAS, China)
16:20~16:40	**Coffee Break**
Session IV	Zoo of Hall Effects I Chair: Prof. Ke Xia (Beijing Computational Science Research Center)
16:40~17:15	**Magnetic Topological Insulators** Laurens W Molenkamp (-6) (Würzburg University, Germany)
17:15~17:50	**Flat Band, Magnetism and Topological Properties of Kagome Lattices** Changgan Zeng (USTC, China)
18:00~	**Banquet**

Day 2 -- July 13	
Session V	Orbital Magnetization Chair: Prof. Xincheng Xie (Peking Univ)
8:30~9:05	**Theory of Orbital Magnetization in 2D Materials** Allan MacDonald (-13) (University of Texas at Austin, USA)
9:05~9:40	**Orbital Magnetism and Other Surprises in Graphene-based Moires** David Goldhaber-Gordon (-15) (Stanford University, USA)
9:40~10:15	**Orbital Chern Insulators in Flat-band Graphene Moiré Systems** Gregory Polshyn (-15) (University of California, Santa Barbara, USA)
10:15~10:35	**Coffee Break**
Session VI	From Single Spin to Spin Liquids Chair: Prof. Jianxin Li (Nanjing Univ)
10:35~11:10	**Quantum Information Based on Single Spins** David Awschalom (-13) (University of Chicago, USA)
11:10~11:45	**Unveiling a Nematic Spin-orbital Liquid State on the Triangular Lattice** Yi Zhou (Institute of Physics, CAS, China)
Session VII	Zoo of Hall Effects II Chair: Xiangang Wan (Nanjing Univ)
14:00~14:35	**Quantum Anomalous Hall Effect in an Intrinsic Magnetic Topological Insulator** Yuanbo Zhang (Fudan University, China)
14:35~15:10	**Transport Studies of Axion Insulator and Chern Insulator Phases in $MnBi_2Te_4$** Jinsong Zhang (Tsinghua University, China)

15:10~15:45	**Observation of 3D Quantum Hall Effects** Liyuan Zhang (Southern University of Science & Technology, China)
15:45~16:05	**Coffee Break**
Session VIII	Magnetism at Single-Spin Resolution Chair: Prof. Ying Jiang (Peking Univ)
16:05~16:40	**Single-Spin Imaging & Spectroscopy** Jiangfeng Du (USTC, China)
16:40~17:15	**Quantum Nonlinear Spectroscopy Using a Spin Sensor** Renbao Liu (Chinese University of Hong Kong, Hong Kong SAR)
17:15~17:50	**Seeing Nanoscale Magnetism with Single Spin Sensors** Joerg Wrachtrup (-6) (University of Stuttgart, Germany)
18:00~19:30	**Dinner Reception**
20:00~22:00	**Special Event Night:** **"Quantum Entangling" with Physical Review Editors** Chair: Prof. Yuao Chen (Dean of School of Physics, USTC) Editors Online: Dr. Michael Thoennessen, Editor in Chief, APS Editors from PRL: Dr. Hugues Chate, Dr. Sami Mitra. Dr. Reiny Schuhmann, Dr. Mu Wang Editors from PRX: Dr. Yun Li, Dr. Paul Snijders, Dr. Yiming Xu Editors from PRB: Dr. Ashot Melikyan, Dr. Paul Snijders Editors from PRM: Dr. Mu Wang Editors from PRApplied: Dr. Matt Eager, Dr. Qiao Qiao

Day 3 -- July 14	
Session IX	Flat Bands & Beyond Chair: Prof. Jianxin Zhong (Xiangtan Univ)
8:30~9:05	**Unification of Orbital-active Honeycomb Materials** Congjun Wu (Westlake University, China)
9:05~9:40	**Unconventional Correlated States in Moire & Kagome Lattices** Leon Balents (-15) (University of California, Santa Barbara, USA)
9:40~10:15	**Tuning the Chern Number in Quantum Anomalous Hall Insulators** Cui-Zu Chang (-12) (Penn State University, USA)
10:15~10:35	**Coffee Break**
Session X	X-tronics Chair: Dr. Mu Wang (APS)
10:35~11:10	**Twistronics** Stephen Carr (-12) (Brown University, USA)
11:10~11:45	**Valleytronics** Qian Niu (-13) (University of Texas at Austin, USA)

Session XI	Chiral Antiferromagnetism Chair: Prof. Jian Shen (Fudan Univ)
14:00~14:35	**Topological Magnetic Semimetals and Manipulation of their Giant Responses** Satoru Nakatsuji (+1) (University of Tokyo, Japan)
14:35~15:10	**Emergent Antiferromagnetic Spintronics: from Dirac Quasiparticles to Non-relativistic Novel Magnetic Classes** Jairo Sinova (-6) (Johannes Gutenberg University Mainz, Germany)
15:10~15:45	**Ultrafast Pure Spin Current Generation from an Antiferromagnetic Insulator** Di Wu (Nanjing University, China)
15:45~16:05	**Coffee Break**
Session XII	Magnetic/Superconducting Hybriding for Majoranas Chair: Prof. Donglai Feng (USTC)
16:05~16:40	**Discovery of Segmented Fermi Surface and Spin Current from MZM** Jinfeng Jia (Shanghai Jiao Tong University, China)
16:40~17:15	**Topological Superconductivity in a Van Der Waals Heterostructure** Peter Liljeroth (-5) (Aalto University, Finland)
17:15~	Concluding Remarks Chair: Prof. Zhenyu Zhang (USTC) Prof. Fuchun Zhang (Univ of CAS) Dr. Mu Wang (APS)
18:00~	**Dinner Reception**

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Quantum Materials for Modern Magnetism & Spintronics (Q3MS)

Dates: July 11-14, 2021
Format: Hybrid (both onsite & online)
Onsite Location: Gaosu Kaiyuan International Hotel, Hefei, China

Organizing Committee

Co-Chairs:

Prof. Zhenyu Zhang (University of Science and Technology of China)
Prof. Xiaodong Xu (University of Washington, U.S.A.)

International program committee:

Prof. David Awschalom (University of Chicago, USA)
Prof. Leon Balents (KITP, University of California, Santa Barbara, USA)
Prof. Xianhui Chen (University of Science and Technology of China)
Prof. Jiangfeng Du (University of Science and Technology of China)
Prof. Zhong Fang (Institute of Physics, Chinese Academy of Sciences, China)
Prof. David Goldhaber-Gordon (Stanford University, USA)
Prof. Allan MacDonald (University of Texas at Austin, USA)
Prof. Naoto Nagaosa (RIKEN Center for Emergent Matter Science (CEMS) & University of Tokyo, Japan)
Prof. Stuart Parkin (Max Planck Institute of Microstructure Physics, Germany)
Prof. Yoshinori Tokura (RIKEN Center for Emergent Matter Science (CEMS) & University of Tokyo, Japan)
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Mission and Presentations of the Workshop

The initiation of the Iron Age took place over several millennia ago, yet discoveries of magnetic materials, broadly defined, are still at the central stage of our present era in which the principles of quantum mechanics play a pivotal role. This vibrant field of modern magnetism and spintronics has further been immensely fueled by the recent discoveries of two-dimensional magnetic materials, offering unprecedented opportunities for a better fundamental understanding of magnetic phenomena at atomic-scale precision. The Physical Review Workshop on Quantum Materials for Modern Magnetism & Spintronics (Q3MS) will bring together world-leading experts in experimental and theoretical physics to address critical issues at the frontier of the field. Emphases will be given to the latest developments surrounding new systems and materials that integrate magnetic, topological, and superconducting properties, new experimental approaches and probes, and new theoretical mechanisms and formalisms that, collectively, point to potential new directions of scientific development and device applications (especially for information processing and storage in the quantum regime). Besides perspective reviews, the highly selective invited speakers will be strongly encouraged to present unpublished work to expand the overall scope of the workshop and expected dynamical discussions.

Overall, the workshop aims to bring together early, mid-career, and senior physicists to identify relevant theoretical and experimental issues to develop further. In addition, representative editors from the *Physical Review* journals will participate to assess editorial needs and challenges in these research directions.

Given the likely still very challenging situations surrounding the COVID-19 pandemic in the coming months, the workshop is planned to have a hybrid format, physically taking place in Hefei, China, but with the option to attend virtually.

Background of the Workshop

The *Physical Review Workshops* focus on topics that straddle traditional subject boundaries and new ones that are starting to "emerge from the noise". They are being developed as the expanded versions of the *Physics Next Workshops*. Since its launching in 2017, all the *Physics Next* workshops had taken place in scenic Eastern Long Island, not far from the location of the APS editorial offices. The *Physical Review Workshops* would be held far away from Long Island, but would still be well attended by the relevant *Physical Review* editors. The present workshop is a follow-up to the first *Physical Review Workshop* launched in Hefei, China on November 10-13, 2019, with the theme of "New Frontiers of Superconductivity" (see more meeting info at https://icqd.ustc.edu.cn/prworkshop/main.psp), but with the new theme of "Quantum Materials for Modern Magnetism & Spintronics (Q3MS)". Collectively, the goal of these workshops is to provide a setting to promote open and informal discussions and the exchange of information needed to help assess the promise and challenges of an emerging field. With this in mind, the workshops comprise only a limited number of presentations and leave considerable room for informal conversations, round-table discussions, and social activities.

Meeting Activities

Invited talks and overview presentations (onsite & online)
Extensive discussions
"Quantum Entangling" with Physical Review Editors