

Hongzhen Chen

Assistant Professor
College of Physics and Optoelectronic Engineering
Shenzhen University

RESEARCH INTEREST

- Quantum physics, including Quantum metrology, Quantum measurement and Quantum foundations
- Quantum information, including Quantum error correction and Quantum control

EMPLOYMENT

Shenzhen University
Assistant Professor

March 2024 - Present
Shenzhen, P.R. China

- Theoretical research on multiparameter quantum estimation.
- Experimental research on quantum magnetometry, quantum gyroscope, etc.

The Chinese University of Hong Kong
Research Associate

March 2021 - February 2024
Hong Kong SAR, P.R. China

- Theoretical research on incompatibility measures and ultimate precision in multiparameter quantum estimation, and its applications in quantum radar, quantum magnetometry, quantum imaging, etc.
- Theoretical analysis on simultaneous measurement of multiple noncommutative observables and its relation with quantum metrology, which is one of the fundamental questions in quantum physics.

EDUCATION

The Chinese University of Hong Kong
Ph.D in Mechanical and Automation Engineering

August 2016 - November 2020
Hong Kong SAR, P.R. China

- Supervisor: Haidong Yuan
- Thesis: Ultimate Precision for Quantum Enhanced Parameter Estimation

Nanjing University
Bachelor in Physics

September 2012 - June 2016
Nanjing, P.R. China

- Department: Kuang Yaming Honors School
- Major in Theoretical Physics, GPA: 4.57/5

FEATURED RESEARCH

Incompatibility measures and ultimate precision in multiparameter quantum estimation

We derive a set of analytical bounds on the difference between the quantum and classical Fisher information metric under collective quantum measurements. The results can be directly transformed to the precision limit in multiparameter quantum estimation, which is a central topic in quantum metrology. The framework also provides a coherent picture for several famous results by including them as extreme cases.

Related publications: [Physical Review Letters, 128 \(25\), 250502.](#) & [Physical Review A, 105 \(6\), 062442.](#)

Ultimate precision limit of multiparameter quantum magnetometry

We provide an approach to characterize the minimal tradeoff among the precisions of multiple parameters that arise from the incompatibility of the optimal probe states, which leads to the identification of the ultimate precision limit for the estimation of all three components of a magnetic field under the parallel scheme. The optimal probe state that achieves the ultimate precision is also explicitly constructed. The

obtained precision sets a benchmark on the precision of the multiparameter quantum magnetometry under the parallel scheme, which is of fundamental interest and importance in quantum metrology.

Related publication: *Physical Review Letters*, 125 (2), 020501.

PUBLICATIONS

* equal contribution, † corresponding author

Peer-Reviewed

- 2022 **H. Chen**, Y. Chen and H. Yuan[†].
“Information Geometry under Hierarchical Quantum Measurement.”
Physical Review Letters, 128 (25), 250502.
- 2022 **H. Chen**, Y. Chen and H. Yuan[†].
“Incompatibility measures in multiparameter quantum estimation under hierarchical quantum measurements.”
Physical Review A, 105 (6), 062442.
- 2022 J. Liu[†], M. Zhang, **H. Chen**, L. Wang and H. Yuan[†].
“Optimal scheme for quantum metrology.”
Advanced Quantum Technologies, 5 (1), 2100080.
- 2021 Z. Hou, Y. Jin, **H. Chen**, J.-F. Tang, C.-J. Huang, H. Yuan[†], G.-Y. Xiang[†], C.-F. Li and G.-C. Guo.
“‘Super-Heisenberg’ and Heisenberg Scalings Achieved Simultaneously in the Estimation of a Rotating Field.”
Physical Review Letters, 126 (7), 070503.
- 2021 Z. Hou, J.-F. Tang, **H. Chen**, H. Yuan[†], G.-Y. Xiang[†], C.-F. Li and G.-C. Guo.
“Zero-trade-off multiparameter quantum estimation via simultaneously saturating multiple Heisenberg uncertainty relations.”
Science Advances, 7 (1): eabd2986.
- 2020 Z. Hou*, **H. Chen***, L. Liu*, Z. Zhang, G.-Y. Xiang[†], C.-F. Li, G.-C. Guo and H. Yuan[†].
“Minimal Tradeoff and Ultimate Precision Limit of Multiparameter Quantum Magnetometry under the Parallel Scheme.”
Physical Review Letters, 125 (2), 020501.
- 2019 **H. Chen** and H. Yuan[†].
“Optimal joint estimation of multiple Rabi frequencies.”
Physical Review A, 99 (3), 032122.

In preparation

- 2024 **H. Chen**[†] and H. Yuan[†].
“Approximate measurement of multiple observables and tradeoff in multiparameter quantum estimation”.
- 2024 L. Wang[†], **H. Chen**[†] and H. Yuan[†].
“Minimal tradeoff and optimal measurement for multi-parameter quantum estimation”.

Preprints

- 2020 Y. Chen*, **H. Chen***, J. Liu, Z. Miao and H. Yuan.
“Fluctuation-enhanced quantum metrology”.
arXiv preprint, arXiv:2003.13010.

PROFESSIONAL SKILLS

- Native in Chinese, Proficient in English.
- Proficient in Python, Mathematica, Matlab and L^AT_EX.