CHEN Hongzhen

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Education

PhD in Mechanical and Automation Engineering, The Chinese University of Hong Kong, 2020
Concentrations: Quantum Metrology, Quantum Control, Quantum Information
Thesis: *Ultimate Precision for Quantum Enhanced Parameter Estimation*
Thesis Advisor: Prof. YUAN Haidong

BA in Physics, Nanjing University, 2016
Concentrations: Theoretical Physics, Quantum Information
Thesis: *Quantum Metrology in a Spin-Magnetic Resonance System*
Thesis Advisor: Prof. WU Shengjun

Working Experience

Research Associate, The Chinese University of Hong Kong, 2021.03 - present

- Design novel schemes for improving the precision limit in multi-parameter quantum estimation.
- Explore the applications of quantum control and quantum error correction in quantum metrology.

Teaching Assistant, The Chinese University of Hong Kong, 2016.08 - 2019.06

- Courses: Quantum Computation and Quantum Control, Modern Control Systems Analysis and Design, Engineering Physics

Research Experience

Research Associate, The Chinese University of Hong Kong, 2021.3 – present
Multi-parameter quantum estimation under p-local measurements, 2021-present

- Provide a systematical way to bound the difference between the quantum Fisher information metric and the classical Fisher information metric under general p-local measurements.
- The bounds can be directly transformed to the bounds on the tradeoff among the precision limits of multiple parameters.

PhD student, The Chinese University of Hong Kong, 2016.08 - 2020.12
Optimal joint estimation of multiple Rabi frequencies, 2017-2019

- Study the joint estimation of multiple Rabi frequencies in a multilevel system and analytically identify the optimal probe state, the optimal measurement, and the highest precision.
- Adding additional adaptive quantum controls to establish the all-time improvement of the joint estimation over the separate estimation.

Fluctuation enhanced quantum metrology, 2018-2020

- Use the fluctuation to improve the precision limits in quantum metrology for the estimation of various parameters. The achieved precisions can even surpass the highest precision achievable under the unitary dynamics, which have been widely taken as the ultimate limit.
- For the estimation of the direction and rotating frequency of a field, explicit protocols were provided, which employs the adaptive quantum error correction.

Ultimate precision limit of multiparameter quantum magnetometry, 2019-2020

- Provide an approach to characterize the minimal tradeoff among the precisions of multiple parameters of a magnetic field.
- Explicitly construct an optimal entangled probe state and the optimal measurement that can achieve the ultimate precision.

Publications and Preprints

Peer-Reviewed

- **Chen, H.**, Chen, Y., & Yuan, H. (2022). Incompatibility measures in multiparameter quantum estimation under hierarchical quantum measurements. *Physical Review A*, 105(6), 062442.
- **Chen, H.**, Chen, Y., & Yuan, H. (2022). Information Geometry under Hierarchical Quantum Measurement. *Physical Review Letters*, 128(25), 250502.
- Liu, J., Zhang, M., **Chen, H.**, Wang, L., & Yuan, H. (2022). Optimal Scheme for Quantum Metrology. *Advanced Quantum Technologies*, *5*(1), 2100080.
- Hou, Z., Jin, Y., **Chen, H.**, Tang, J. F., Huang, C. J., Yuan, H., ... & Guo, G. C. (2021). "Super-Heisenberg" and Heisenberg Scalings Achieved Simultaneously in the Estimation of a Rotating Field. *Physical Review Letters*, *126*(7), 070503.
- Hou, Z., Tang, J. F., **Chen, H.**, Yuan, H., Xiang, G. Y., Li, C. F., & Guo, G. C. (2021). Zero–trade-off multiparameter quantum estimation via simultaneously saturating multiple Heisenberg uncertainty relations. *Science Advances*, 7(1), eabd2986.
- Hou, Z., **Chen, H. (co-first author)**, Liu, L., Zhang, Z., Xiang, G. Y., Li, C. F., ... & Yuan, H. (2020). Minimal tradeoff and ultimate precision limit of multiparameter quantum magnetometry under the parallel scheme. *Physical Review Letters*, 125(2), 020501.
- **Chen, H.**, & Yuan, H. (2019). Optimal joint estimation of multiple Rabi frequencies. *Physical Review A*, 99(3), 032122.

Preprints

- Chen, Y., **Chen, H.**, Liu, J., Miao, Z., & Yuan, H. (2020). Fluctuation-enhanced quantum metrology. *arXiv preprint,* arXiv:2003.13010.

Research Skills

- Programming ability in Python and MATLAB
- Extensive knowledge of Mathematica and LaTeX

Awards and Honors

- Outstanding Graduates, Nanjing University, 2016
- Scholarship of Chinese Academy of Sciences (DICP), 2015
- Scholarship for Outstanding Students,1st prize, Nanjing University, 2014