Songbo Xie

PhD Candidate, University of Rochester
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EDUCATION

University of Rochester *2017 - Present*
PhD Candidate in Physics GPA: 3.97/4
Master of Arts in Physics

Shanghai Jiao Tong University *2013 - 2017*
Bachelor of Science in Physics Major GPA: 3.9/4.3

RESEARCH INTERESTS

Quantum Entanglement, Quantum Information, Quantum Computation, Quantum Field Theory, Quantum Foundation, Quantum Optics.

TECHNICAL STRENGTHS

Programming Mathematica (Proficient), Latex (Proficient), Matlab, Python, C/C++
Language Chinese (Native), English (Proficient), French (5 years' study).

RESEARCH EXPERIENCE

University of Rochester *Aug. 2018 - Present*
Graduate Research Assistant under J. H. Eberly Rochester, NY

- "Consistent Histories" is a new interpretation of the quantum mechanics. We study a three-state paradox by comparing the two different interpretations of quantum mechanics: Copenhagen and Consistent Histories.
- By applying the Poisson summation formula, the dynamical behavior of the inversion of a two-level atom subject to a single-mode quantized external field is calculated analytically up to the third order. We obtain results with better precision compared to the results using previous methods.
- We find a surprising phenomenon, where the entanglement of a two qubit system subject to a single-mode cavity can abruptly remain constant for finite time in a periodic fashion, which we call "entanglement sudden freezing and sudden thawing".
- We solve the three-qubit genuine entanglement problem by proposing an entanglement measure via geometric approach. The measure is called "concurrence Fill". The measure is then used to further study three-qubit ESD problem, mixed state problem, and so on. The extension to four-qubit is on its way.

Shanghai Jiao Tong University *Jul. 2015 - Aug. 2017*
Undergraduate Researcher under Z. Lv Shanghai, China

- Numerical research (with Mathematica) on the dynamical properties of two-level quantum systems in the presence of asymmetric driving field.
- Develop the Counter-rotating Hybridized Rotating Wave (CHRW) method to provide analytical solutions of the dynamics of two-level systems subject to asymmetric driving field.
- Research on dynamical properties of two-level systems by comparing the results of different methods: numerical method, the Floquet method, previous analytic method, and the new CHRW method.

University of Michigan *Oct. 2016 - Dec. 2016*
Undergraduate Researcher under H. Deng Ann Arbor, MI

- Study the dipole-dipole interaction of multi-atoms in a quantized cavity. Study the collective radiation modes for atomic ensembles.
- Extend previous analytic results for one- and two-atom systems on emission rates and fluorescence spectra. Numerical research (with Python) on multi-atom resonance fluorescence with the external field both 1-dimensional and 2-dimensional.

Shanghai Jiao Tong University *Oct. 2015 - Dec. 2015*
Undergraduate Researcher under L. Li Shanghai, China

- Research on specific processes of particle collision, particle emission and detection of new particles by Circular Electron-Positron Collider (CEPC) with numerical simulations.

PUBLICATIONS

JOURNAL ARTICLES

Estimating Lower and Upper Bounds of Entanglement
S. Xie, Y.-Y. Zhao, C. Zhang, Y.-F. Huang, C.-F. Li, G.-C. Guo, J. H. Eberly, arXiv:2207.07584 [quant-ph] (2022).

Managing the three-party entanglement challenge
S. Xie and J. H. Eberly, Contemp. Phys. **62**, 189 (2022).

Entanglement on Orbits
S. Xie, arXiv:2202.11799 [math-ph] (2022).

Triangle Measure of Tripartite Entanglement
S. Xie and J. H. Eberly, Phys. Rev. Lett. **127**, 040403 (2021).

Sudden freezing and thawing of entanglement sharing in a shrunken volume
Y. Ding, **S. Xie**, and J. H. Eberly, Phys. Rev. A **103**, 032418 (2021).

CONFERENCE PROCEEDINGS

Multi-Photonic Entanglement, A Geometric Approach
S. Xie and J. H. Eberly, Frontiers in Optics, FTh6D. 6 (2021).

Sudden Freezing and Sudden Thawing of Entanglement in Multi-Party Jaynes-Cummings Dynamics
Y. Ding, **S. Xie**, and J. H. Eberly, Frontiers in Optics, FW1B. 7 (2020).

SEMINARS AND POSTERS

What Does Entanglement Sudden Death Require? (Poster) Toronto, CA
The 27th International Conference on Atomic Physics *Jul. 18 2022*

Multi-Photonic Entanglement, A Geometric Approach Online (Zoom)
Frontiers in Optics + Laser Science *Nov. 4 2021*

Triangle Measure of Genuine Tripartite Entanglement (Poster) Online (Zoom)
23rd Annual SQuInT Workshop *Oct. 14 2021*

Newly discovered triangle measure for tripartite entanglement Warsaw, Poland (Zoom)
40 years celebration of Centrum Fizyki Teoretycznej PAN *Aug. 31 2021*

Geometric Power: A Triangle For Genuine Entanglement (Poster) Geneva, Switzerland (Zoom)
International Congress on Mathematical Physics, Poster Session *Aug. 2 2021*

Newly discovered measures for quantum entanglement that are genuine University of Rochester
Graduate Research Seminar *Apr. 23 2021*

Stories about Ghost Imaging University of Rochester
Center for Coherence and Quantum Optics Seminar *Jun. 13 2019*

Entanglement restriction and sharing in multi-qubit systems University of Rochester
Center for Coherence and Quantum Optics Seminar *Apr. 4 2019*

TEACHING

PHYS 521 Condensed Matter I University of Rochester
Graduate Teaching Assistant *Fall 2022*
TA for the advanced graduate course. Grade homeworks and hold office hours.

PHYS 415 Electromagnetic Theory I University of Rochester
Graduate Teaching Assistant *Fall 2022*
TA for the graduate course. Grade homeworks, grade exams, and hold office hours.

PHYS 532 Quantum Optics of Electromagnetic Field University of Rochester
Graduate Teaching Assistant *Spring 2022*
TA for the advanced graduate course. Design homeworks, grade homeworks, and hold office hours.

PHYS 121 Mechanics University of Rochester
Graduate Teaching Assistant *Spring 2018 & Fall 2018*
Head TA for the undergraduate Mechanics lab course. Design blackboard writings, give lectures, and grade lab works.

PHYS 122 Electromagnetic field University of Rochester
Graduate Teaching Assistant *Fall 2017*
Head TA for the undergraduate E&M lab course. Give lectures and grade lab works.

AWARDS AND HONORS

Scholarship for Outstanding Undergraduate Students at Zhiyuan College *2016*

Scholarship for Outstanding Undergraduate Students at Zhiyuan College *2015*

President of the Band League at Shanghai Jiao Tong University, *2015*

Second Prize of China Undergraduate Mathematical Contest in Model *2015*

Scholarship for Outstanding Undergraduate Students at Zhiyuan College *2014*

Vice president of Student Union at Zhiyuan College of Shanghai Jiao Tong University *2013*

Bronze Medal of Chinese Physics Olympiad, grand final *2012*

First Prize of Chinese Physics Olympiad, Liaoning Province *2012*