



Brendan Patrick Marsh

Ph.D. Student in Applied Physics, admitted Autumn 2018

Bio

BIO

Brendan Marsh is a Ph.D. candidate in Professor Benjamin Lev's research group at Stanford University. He investigates light-matter interactions in many-body quantum systems and explores their use as a computational resource. His work more generally includes experimental quantum optics and theoretical methods to describe open quantum systems. He received a master's degree in applied mathematics and theoretical physics from the University of Cambridge in 2018 and a B.S. in physics and mathematics from the University of Missouri in 2017.

Besides quantum optics and computation, Brendan has worked on problems in the philosophy of quantum theory (with Jeremy Butterfield at the University of Cambridge) and single molecule biophysics (with Gavin King at the University of Missouri). Along with Gavin King, he invented the Hessian blob algorithm, a general-purpose machine vision algorithm which is finding applications in fields ranging from scanning probe microscopy to medical imaging.

HONORS AND AWARDS

- Q-FARM Fellowship, Stanford University (2021)
- 2018 Mark Twain Fellow, University of Missouri (2018)
- NSF Graduate Research Fellowship, National Science Foundation (2017)
- German DAAD RISE Scholar, DAAD (2016)
- Barry M. Goldwater National Scholarship, Barry Goldwater Foundation (2015)
- NSF Research Experience for Undergraduates, SRI International (2015)
- Discovery Fellow, University of Missouri Honor's College (2013-2014)

EDUCATION AND CERTIFICATIONS

- Part III Mathematical Tripos, University of Cambridge , Applied Mathematics and Theoretical Physics (2018)
- BS in Physics and Mathematics, University of Missouri , Double Major in Physics and Mathematics; Minor in Computer Science (2017)

PATENTS

- Brendan Marsh, Gavin King. "United States Patent Application: 62/793,596 Hessian Blob Algorithm", University of Missouri

LINKS

- Hessian Blob Paper: <https://www.nature.com/articles/s41598-018-19379-x>
- Hessian Blob Software: <http://web.missouri.edu/~kinggm/research.htm>
- Google Scholar: <https://scholar.google.com/citations?hl=en&user=BYhXhRoAAAAJ>
- Research Gate: https://www.researchgate.net/profile/Brendan_Marsh3

Research & Scholarship

LAB AFFILIATIONS

- Benjamin Lev, Lev Lab (9/1/2018)

Professional

WORK EXPERIENCE

- Visiting Scholar - University of Missouri (7/1/2018 - 9/7/2018)

Publications

PUBLICATIONS

- **Entanglement and Replica Symmetry Breaking in a Driven-Dissipative Quantum Spin Glass** *PHYSICAL REVIEW X*
Marsh, B. P., Kroeze, R. M., Ganguli, S., Gopalakrishnan, S., Keeling, J., Lev, B. L.
2024; 14 (1)
- **High Cooperativity Using a Confocal-Cavity-QED Microscope** *PRX QUANTUM*
Kroeze, R. M., Marsh, B. P., Lin, K., Keeling, J., Lev, B. L.
2023; 4 (2)
- **An optical lattice with sound.** *Nature*
Guo, Y., Kroeze, R. M., Marsh, B. P., Gopalakrishnan, S., Keeling, J., Lev, B. L.
2021; 599 (7884): 211-215
- **Enhancing Associative Memory Recall and Storage Capacity Using Confocal Cavity QED** *PHYSICAL REVIEW X*
Marsh, B. P., Guo, Y., Kroeze, R. M., Gopalakrishnan, S., Ganguli, S., Keeling, J., Lev, B. L.
2021; 11 (2)
- **Precision Analysis of Drug-Induced Conformational Changes of P-Glycoprotein Observed in AFM**
Schaefer, K. G., Marsh, B. P., Mensah, G. K., Roberts, A. G., King, G. M.
CELL PRESS.2021: 303A
- **Atomic Force Microscopy Reveals Membrane Protein Activity at the Single Molecule Level.** *Methods in molecular biology (Clifton, N.J.)*
Chattrakun, K., Schaefer, K. G., Chandler, L. S., Marsh, B. P., King, G. M.
2021; 2302: 81–99
- **Direct visualization of the E. coli Sec translocase engaging precursor proteins in lipid bilayers.** *Science advances*
Sanganna Gari, R. R., Chattrakun, K. n., Marsh, B. P., Mao, C. n., Chada, N. n., Randall, L. L., King, G. M.
2019; 5 (6): eaav9404
- **Non-locality and quasiclassical reality in Kent's formulation of relativistic quantum theory** *Journal of Physics: Conference Series*
Butterfield, J., Marsh, B.
2019
- **Single-molecule observation of nucleotide induced conformational changes in basal SecA-ATP hydrolysis** *SCIENCE ADVANCES*
Chada, N., Chattrakun, K., Marsh, B. P., Mao, C., Bariya, P., King, G. M.
2018; 4 (10): eaat8797
- **The conformation and dynamics of P-glycoprotein in a lipid bilayer investigated by atomic force microscopy.** *Biochemical pharmacology*
Sigdel, K. P., Wilt, L. A., Marsh, B. P., Roberts, A. G., King, G. M.
2018
- **Conformations and Dynamic Transitions of a Melittin Derivative That Forms Macromolecule-Sized Pores in Lipid Bilayers** *LANGMUIR*
Pittman, A. E., Marsh, B. P., King, G. M.
2018; 34 (28): 8393–99

- **Quaternary Structure of Small Amino Acids Transporter OprG of *Pseudomonas aeruginosa***
Gari, R., Seelheim, P., Marsh, B., Kiessling, V., Creutz, C., Tamm, L.
CELL PRESS.2018: 236A–237A
- **The Hessian Blob Algorithm: Precise Particle Detection in Atomic Force Microscopy Imagery** *SCIENTIFIC REPORTS*
Marsh, B. P., Chada, N., Gari, R., Sigdel, K. P., King, G. M.
2018; 8: 978
- **Depictions of Quantum Reality in Kent's Interpretation of Quantum Theory**
Marsh, B.
PhilSci Archive.
2018
- **Single-Molecule Peptide-Lipid Affinity Assay Reveals Interplay between Solution Structure and Partitioning** *LANGMUIR*
Matin, T. R., Sigdel, K. P., Utjesanovic, M., Marsh, B. P., Gallazzi, F., Smith, V. F., Kosztin, I., King, G. M.
2017; 33 (16): 4057–65
- **Transient Collagen Triple Helix Binding to a Key Metalloproteinase in Invasion and Development** *STRUCTURE*
Zhao, Y., Marcink, T. C., Gari, R., Marsh, B. P., King, G. M., Stawikowska, R., Fields, G. B., Van Doren, S. R.
2015; 23 (2): 257–69
- **Glass: A Multi-Platform Specimen Supporting Substrate for Precision Single Molecule Studies of Membrane Proteins**
Chada, N., Sigdel, K. P., Reddy, R., Gari, S., Matin, T. R., Mao, C., Marsh, B., Randall, L. L., King, G. M.
CELL PRESS.2015: 170A
- **Atomic Force Microscopy of Protein Translocation Machinery in Supported Lipid Bilayers**
Gari, R., Frey, N., Marsh, B., Mao, C., Randall, L., King, G.
CELL PRESS.2015: 168A

PRESENTATIONS

- Quantum optical neural networks improve models of pattern recognition - University of St. Andrews weekly theory seminar (9/26/2019)
- Photon-mediated spin interactions and associative memory in multimode cavity QED - Quantum simulation subgroup at NTT PHI Research Laboratories (5/13/2019)
- Machine Learning Analysis of the Fully Hadronic VBF Higgs Boson Decay - University of Gottingen (August 5, 2016)
- Combating Tumor Cells Through Single Molecule Algorithms - Missouri Senate (March 15, 2016)
- Algorithmic Advances in Single Molecule Studies - Gulf Coast Undergraduate Research Symposium (10/20/2015)