

Peter L. McMahon

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Education

- Jun 2010 – **Ph.D.**, *Stanford University*, Electrical Engineering.
Sep 2014 Minor: Physics
- Sep 2008 – **M.S.**, *Stanford University*, Electrical Engineering.
Jun 2010 Concentration: Quantum Electronics
- Feb 2003 – **B.Sc. (Eng); M.Sc. (Eng); M.Sc.**, *University of Cape Town*, Electrical and
Aug 2008 Computer Engineering; Electrical Engineering; Computer Science.

Research Experience

- Oct 2014 – **Postdoctoral Research Fellow**, *Stanford University*, Applied Physics.
present Experimental quantum optics and feedback, in the groups of Prof. Hideo Mabuchi and Prof. Yoshihisa Yamamoto, and continued work on quantum dots with the group of Prof. Jelena Vučković. Highlights:
- Demonstrated a new class of physical annealing machine using optical parametric oscillators for solving combinatorial optimization problems (*Science*, 2016).
 - Demonstrated coherent control of a spin in a site-controlled quantum dot (manuscript in preparation).
- Jun 2009 – **Research Assistant**, *Stanford University*, Electrical Engineering.
Sep 2014 Experimental semiconductor quantum optics, in the group of Prof. Yoshihisa Yamamoto. Highlights:
- Achieved a world-record fidelity for spin-photon entanglement using a solid-state system (*Nature*, 2012; *Nature Communications*, 2013).
 - Demonstrated quantum-dot-quantum-well coupling, and the successful coexistence of charged quantum dots with quantum-well exciton-polaritons.
- Sep 2008 – **Research Assistant**, *Stanford University*, Electrical Engineering.
May 2009 Deep Belief Net (neural network) acceleration using FPGAs, in the group of Prof. Kunle Olukotun. Participated in prototype system development and measurement. Special-purpose hardware accelerators (FPGAs and ASICs) of neural network inference have subsequently been deployed in production systems at Google and Microsoft.
- May 2007 – **Visiting Research Student**, *University of California, Berkeley*, Space Sciences Laboratory and Berkeley Wireless Research Center.
Apr 2008 Instrumentation development for radio telescopes including the Allen Telescope Array (CA), the Parkes Radio Telescope (Australia) and the Nançay Radio Telescope (France), in the groups of Dr. Dan Werthimer and Prof. Don Backer. Highlights:
- Designed and built spectrometer for Parkes that was used to discover a planet made of diamond, *cf.* M. Bailes, *et al.*, *Science* **333**, 6050 pp. 1717 – 1720 (2011).

Publications

First-Author and Co-First-Author Papers

- K. G. Lagoudakis*, **P. L. McMahon***, *et al.* “Complete coherent control of a spin qubit in a site-controlled quantum dot.” *In preparation.*
- K. G. Lagoudakis*, **P. L. McMahon***, C. Dory*, K. A. Fischer, K. Müller, V. Borish, D. Dalacu, P. J. Poole, M. E. Reimer, V. Zwiller, Y. Yamamoto and J. Vučković “Ultrafast Coherent Manipulation of Trions in Site-Controlled Nanowire Quantum Dots.” *Optica* **3**, 12, 1430 – 1435 (2016). doi:10.1364/OPTICA.3.001430
- **P. L. McMahon***, A. Marandi*, Y. Haribara, R. Hamerly, C. Langrock, S. Tamate, T. Inagaki, H. Takesue, S. Utsunomiya, K. Aihara, R. L. Byer, M. M. Fejer, H. Mabuchi and Y. Yamamoto. “A fully programmable 100-spin coherent Ising machine with all-to-all connections.” *Science* **354**, No. 6312, 614 – 617 (2016). doi:10.1126/science.aah5178
- K. G. Lagoudakis*, **P. L. McMahon***, K. A. Fischer, S. Puri, K. Müller, D. Dalacu, P. J. Poole, M. E. Reimer, V. Zwiller, Y. Yamamoto and J. Vučković. “Initialization of a spin qubit in a site-controlled nanowire quantum dot.” *New Journal of Physics* **18** 053024 (2016). doi:10.1088/1367-2630/18/5/053024
- **P. L. McMahon** and K. De Greve. “Towards Quantum Repeaters with Solid-State Qubits: Spin-Photon Entanglement Generation using Self-Assembled Quantum Dots.” Invited chapter in *Engineering the Atom-Photon Interaction*, Springer-Verlag (2015). doi:10.1007/978-3-319-19231-4_14
- S. Puri*, **P. L. McMahon*** and Y. Yamamoto. “Single-Shot Quantum Non-Demolition Measurement of a Quantum Dot Electron Spin, using Cavity Exciton-Polaritons.” *Physical Review B* **90**, 155421 (2014). doi:10.1103/PhysRevB.90.155421
- K. De Greve*, **P. L. McMahon***, L. Yu, J. S. Pelc, C. Jones, C. M. Natarajan, N. Y. Kim, E. Abe, S. Maier, C. Schneider, M. Kamp, S. Höfling, R. H. Hadfield, A. Forchel, M. M. Fejer and Y. Yamamoto. “Complete tomography of a high-fidelity solid-state entangled spin-photon qubit pair.” *Nature Communications* **4**, 2228 (2013). doi:10.1038/ncomms3228

Other Papers

- K. G. Lagoudakis, K. A. Fischer, T. Sarmiento, **P. L. McMahon**, M. Radulaski, J. L. Zhang, Y. Kelaita, C. Dory, K. Müller and J. Vučković. “Observation of Mollow Triplets with Tunable Interactions in Double Lambda Systems of Individual Hole Spins.” *Physical Review Letters* **118**, 013602 (2017). doi:10.1103/PhysRevLett.118.013602
- T. Inagaki, Y. Haribara, K. Igarashi, T. Sonobe, S. Tamate, T. Honjo, A. Marandi, **P. L. McMahon**, T. Umeki, K. Enbutsu, O. Tadanaga, H. Takenouchi, K. Aihara, K. Kawarabayashi, K. Inoue, S. Utsunomiya and H. Takesue. “A coherent Ising machine for 2000-node optimization problems.” *Science* **354**, No. 6312, 603 – 606 (2016). doi:10.1126/science.aah4243

- K. De Greve, D. Press, **P. L. McMahon** and Y. Yamamoto. “Ultrafast optical control of individual quantum dot spin qubits.” *Reports on Progress in Physics* **76**, 092501 (2013). doi:10.1088/0034-4885/76/9/092501
- K. De Greve, L. Yu*, **P. L. McMahon***, J. S. Pelc*, C. M. Natarajan, N. Y. Kim, E. Abe, S. Maier, C. Schneider, M. Kamp, S. Höfling, R. H. Hadfield, A. Forchel, M. M. Fejer and Y. Yamamoto. “Quantum-dot spin-photon entanglement via frequency downconversion to telecom wavelength.” *Nature* **491**, 421 – 425 (2012). doi:10.1038/nature11577
- J. S. Pelc, L. Yu*, K. De Greve*, **P. L. McMahon***, C. M. Natarajan, V. Esfandyarpour, S. Maier, C. Schneider, M. Kamp, S. Hoefling, R. H. Hadfield, A. Forchel, Y. Yamamoto, M. M. Fejer. “Downconversion quantum interface for a single quantum dot spin and 1550-nm single-photon channel.” *Optics Express* **20**, 25, 27510 – 27519 (2012). doi:10.1364/OE.20.027510
- N. C. Jones, R. Van Meter, A. G. Fowler, **P. L. McMahon**, J. Kim, T. D. Ladd and Y. Yamamoto. “Layered Architecture for Quantum Computing.” *Physical Review X* **2**, 031007 (2012). doi:10.1103/PhysRevX.2.031007
- N. C. Jones, J. D. Whitfield, **P. L. McMahon**, M.-H. Yung, R. Van Meter, A. Aspuru-Guzik and Y. Yamamoto. “Faster quantum chemistry simulation on fault-tolerant quantum computers.” *New Journal of Physics* **14**, 115023 (2012). doi:10.1088/1367-2630/14/11/115023
- A. P. V. Siemion, G. C. Bower, G. Foster, **P. L. McMahon**, M. I. Wagner, D. Werthimer, D. Backer, J. Cordes and J. van Leeuwen. “The Allen Telescope Array Fly’s Eye Survey for Fast Radio Transients.” *Astrophysical Journal*, **744**, 109 (2012). doi:10.1088/0004-637X/744/2/109
- K. De Greve, **P. L. McMahon**, D. Press, T. D. Ladd, D. Bisping, C. Schneider, M. Kamp, L. Worschech, S. Höfling, A. Forchel and Y. Yamamoto. “Coherent control and suppressed nuclear feedback of a single quantum dot hole qubit.” *Nature Physics* **7**, 872 – 878 (2011). doi:10.1038/nphys2078
- H.-H. Kuo, J.-H. Chu, S. C. Riggs, L. Yu, **P. L. McMahon**, K. De Greve, Y. Yamamoto, J. G. Analytis, and I. R. Fisher. “Possible origin of the nonmonotonic doping dependence of the in-plane resistivity anisotropy of $\text{Ba}(\text{Fe}_{1-x}\text{T}_x)_2\text{As}_2$ ($T=\text{Co}$, Ni and Cu).” *Physical Review B*, **84**, 054540 (2011). doi:10.1103/PhysRevB.84.054540
- T. D. Ladd, D. Press, K. De Greve, **P. L. McMahon**, B. Frieß, C. Schneider, M. Kamp, S. Höfling, A. Forchel and Y. Yamamoto. “Pulsed Nuclear Pumping and Spin Diffusion in a Single Charged Quantum Dot.” *Physical Review Letters*, **105**, 107401 (2010). doi:10.1103/PhysRevLett.105.107401
- J.-H. Chu, J. G. Analytis, K. De Greve, **P. L. McMahon**, Z. Islam, Y. Yamamoto and I. R. Fisher. “In-Plane Resistivity Anisotropy in an Underdoped Iron Arsenide Superconductor.” *Science*, **329**, No. 5993, 824 – 826 (2010). doi:10.1126/science.1190482

- D. Press, K. De Greve, **P. L. McMahon**, T.D. Ladd, B. Frieß, C. Schneider, M. Kamp, S. Höfling, A. Forchel and Y. Yamamoto. “Ultrafast optical spin echo in a single quantum dot.” *Nature Photonics*, **4**, 367 – 370 (2010). doi:10.1038/nphoton.2010.83
- M. J. Keith, A. Jameson, W. Van Straten, M. Bailes, S. Johnston, M. Kramer, A. Possenti, S. D. Bates, N. D. R. Bhat, M. Burgay, S. Burke-Spolaor, N. D’Amico, L. Levin, **P. L. McMahon**, S. Milia and B. W. Stappers. “The High Time Resolution Universe Pulsar Survey – I. System configuration and initial discoveries.” *Monthly Notices of the Royal Astronomical Society*, **409**, 2, 619 – 627 (2010). doi:10.1111/j.1365-2966.2010.17325.x
- A. Siemion, J. Von Korff, **P. McMahon**, E. Korpela, D. Werthimer, D. Anderson, G. Bower, J. Cobb, G. Foster, M. Lebofsky, J. van Leeuwen, W. Mallard and M. Wagner. “New SETI Sky Surveys for Radio Pulses.” *Acta Astronautica*, **67**, 11 – 12 (2010). doi:10.1016/j.actaastro.2010.01.016
- K. Stevens, H. Chen, T. Filiba, **P. McMahon** and Y.S. Song. “SeqHive: A Reconfigurable Computer Cluster for Genome Re-sequencing.” *Proceedings of the IEEE Conference on Field Programmable Logic and Applications (FPL)*, 31 August – 2 September 2010. doi:10.1109/FPL.2010.121
- S.K. Kim, **P. L. McMahon** and K. Olukotun. “A Large-scale Architecture for Restricted Boltzmann Machines.” *Proceedings of the IEEE Symposium on Field-Programmable Custom Computing Machines (FCCM)*, 2 – 4 May 2010. [Acceptance rate: 18%] doi:10.1109/FCCM.2010.38
- S.K. Kim, L. McAfee, **P. L. McMahon** and K. Olukotun. “A Highly Scalable Restricted Boltzmann Machine FPGA Implementation.” *Proceedings of the IEEE Conference on Field Programmable Logic and Applications (FPL)*, 31 August – 2 September 2009. [Acceptance rate: 25%] doi:10.1109/FPL.2009.5272262
- A. Parsons, D. Backer, H. Chen, P. Droz, T. Filiba, D. MacMahon, J. Manley, **P. McMahon**, A. Parsa, A. Siemion, D. Werthimer and M. Wright. “A Scalable Correlator Architecture Based on Modular FPGA Hardware, Reuseable Gateway, and Data Packetization.” *The Publications of the Astronomical Society of the Pacific*, **120**, 873, 1207 – 1221 (2008). doi:10.1086/593053

Honors and Awards

- Stanford Nano- and Quantum Science and Engineering Postdoctoral Fellowship (2015 – 2017) *Awarded to one applicant annually, across the Departments of Physics, Electrical Engineering, Applied Physics, and Materials Science and Engineering.*
- Stanford Graduate Fellowship (2008 – 2011) *Awarded to ~100 Ph.D. students annually across all science and engineering disciplines.*
- UCT Engineering Faculty selection for *Best Masters Thesis* (2008)
- UCT Department of Electrical Engineering Siemens Prize for *Best Undergraduate Thesis*, and Electrical and Computer Engineering Medal for top-ranked graduate (2006)

- South African National Science Expo Gold Medal (1999)

Invited Talks

- “Computing using networks of optical parametric oscillators.” *Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, 27 February, 2017.*
- “Computing using networks of optical parametric oscillators.” *Los Alamos National Laboratory, Los Alamos, NM, 9 February, 2017.*
- “Computing using networks of optical parametric oscillators.” *Institute for Molecular Engineering, University of Chicago, Chicago, IL, 24 January, 2017.*
- “Combinatorial optimization using networks of optical parametric oscillators: present (bulk) and future (on-chip).” *47th Winter Colloquium on the Physics of Quantum Electronics (PQE), Snowbird, UT, 8 – 13 January, 2017.*
- “Physical computing using networks of optical parametric oscillators: solving Ising problems using optical-electronic machines.” *SystemX Alliance Fall Conference, Stanford, CA, 15 – 17 November, 2016.*
- “Combinatorial Optimization with Coherent Ising Machines based on Degenerate Optical Parametric Oscillators.” *Frontiers in Optics / Laser Science (FiO/LS), Rochester, NY, 17 – 21 October, 2016.*
- “Explorations with a New Qubit System: Hybrid Quantum Dot and Quantum Well Exciton-Polariton Devices.” *American Physical Society March Meeting, San Antonio, TX, 5 March, 2015.*
- “Tomography of a high-fidelity entangled spin-photon qubit pair.” *MSS-16: 16th International Conference on Modulated Semiconductor Structures, Wrocław, Poland, 1 – 5 July, 2013.*

Selected Other Conference Presentations and Talks

- “A fully-programmable measurement-feedback OPO Ising machine with all-to-all connectivity.” *AQC 5: Adiabatic Quantum Computing, Venice, CA, 27 – 30 June, 2016.*
- “Coherent optical Ising machines based on networks of optical parametric oscillators.” *AQC 4: Adiabatic Quantum Computing, Zurich, Switzerland, 29 June – 2 July, 2015.*
- “Coupling Quantum Dots to Quantum-Well Exciton-Polaritons: A Path Towards Scalable Two-Qubit Interactions.” *Department of Physics Seminar, Harvard University, Cambridge, MA, 17 April, 2015.*
- “Towards Quantum Repeaters using Quantum Dot Spin Qubits.” *Research Laboratory of Electronics Seminar, Massachusetts Institute of Technology, Cambridge, MA, 16 April, 2015.*
- “Exchange Interaction between a Quantum Dot Electron Spin Qubit and an Exciton-Polariton Gas.” *QD 2014: 8th International Conference on Quantum Dots, Pisa, Italy, 11 – 16 May, 2014.*

- “Experimental Progress in Quantum Information Processing using Spins in Self-Assembled Quantum Dots.” *Institut für Festkörperphysik Seminar, Technische Universität Berlin*, Berlin, Germany, 8 May, 2014.
- “Experimental Progress in Quantum Information Processing using Spins in Self-Assembled Quantum Dots.” *Schottky Seminar, Walter Schottky Institut, Technische Universität München*, Munich, Germany, 6 May, 2014.
- “Experimental Progress in Quantum Information Processing using Spins in Self-Assembled Quantum Dots.” *Technische Physik Seminar, Universität Würzburg*, Würzburg, Germany, 5 May, 2014.
- “Experimental Progress in Quantum Information Processing using Spins in Self-Assembled Quantum Dots.” *Fachbereich Physik Sonderseminar, Universität Konstanz*, Konstanz, Germany, 28 April, 2014.
- “Tomography of a high-fidelity spin-photon entangled state.” *American Physical Society March Meeting*, Baltimore, MD, 18 March, 2013.
- “Entanglement between an electron’s spin and a photon: technology for quantum repeaters and long-distance quantum cryptography.” *School of Natural Sciences Seminar, University of California*, Merced, CA, 14 December, 2012.
- “Entanglement between a quantum dot spin and a single photon.” *NOEKS 11: 11th International Workshop on Nonlinear Optics and Excitation Kinetics in Semiconductors*, Stuttgart, Germany, 23 – 27 September, 2012.
- “Quantum Dot Quantum Information Processing: A Summary of Recent Results.” *Technische Physik Seminar, Universität Würzburg*, Würzburg, Germany, 19 September, 2012.
- “Spin-photon entanglement using ultrafast downconversion.” *Department of Physics, ETH-Zürich*, Switzerland, 17 September, 2012.
- “QND Measurement, Hole Spins and Entanglement Experiments.” *Technische Physik Seminar, Universität Würzburg*, Würzburg, Germany, 1 July, 2011.
- “Quantum Computing: Theory and Experiment.” *CASPER Seminar, Berkeley Wireless Research Center, University of California*, Berkeley, CA, 6 May, 2011.
- “Quantum Nondemolition Measurement of Single Spin Quantum Dot Qubits.” *Technische Physik Seminar, Universität Würzburg*, Würzburg, Germany, 6 September, 2010.
- “Pulsar and Transient Instrumentation using CASPER Technology.” *3rd Marie Curie SKADS Training School: Towards the SKA*, Observatoire de Paris, Paris, France, August 24 – 28, 2009.
- “Pulsar and Transient Instrumentation using CASPER Technology.” *CASPER-JPL Workshop, NASA Jet Propulsion Laboratory, Pasadena*, CA, June 11 – 12, 2009.
- “Pulsar Spectrometer Development using CASPER Technology.” *Center for Astronomy Signal Processing and Electronics Research Workshop*, University of California, Berkeley, CA, August 2 – 5, 2008.

Service

- Reviewer for *Nature Photonics* (2014, 2015, by proxy); *Optics Express* (2015); *Nature Communications* (2016); *Physical Review Letters* (2016); *Physical Review A* (2016); *Electronics Letters* (2016)
- Invited Abstract Sorter, American Physical Society March Meeting (2015)
- Member, Stanford Optical Society of America Student Chapter Executive Committee, including Outreach Subcommittee (2011 – 2012, 2012 – 2013)
- Member, IONS NA-3 2011 Conference Organizing Committee (2011)
- Co-founder and Member, Department of Electrical Engineering “Happy Hour” Social Committee, Stanford (2009 – 2011)
- Founder and Editor, “*Starting Over*” *EE Graduate Student Advice Guide*, Department of Electrical Engineering, Stanford (2009 – 2011)
- Member, Department of Electrical Engineering Graduate Student Orientation Panel, Stanford (2009)
- Writer (2003), Junior News Editor (2004), Chief Sub Editor (2005), and Business and Technology Editor (2006) at *Varsity Newspaper*, UCT.

Technical Skills

Experimental Physics	High-magnetic-field (10 T), low-temperature (1.5 K) experiments. High-frequency analog (1 GHz) and digital (10 GHz) circuit and electronic-system design. Linear and nonlinear optics (visible – IR). Optical spectroscopy.
Engineering Software	MATLAB, Simulink, NI LabView, Mentor Graphics, Xilinx ISE, Altera Quartus, Agilent ADS.
Programming	C/C++, Python, Julia, Java, MPI.