

## CONFERENCE AGENDA

Silicon Quantum Electronics Workshop 2015

Monday, 3 August

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|---------------|---|
| 07:30 – 8:40  | Registration  |
| 08:45 – 09:00 | Opening   |
|               | Session I: Single donor qubits  |
| 09:00 – 09:20 | I-1 D. R. Luhman (Sandia National Laboratories, USA)<br>"Electron spin resonance of a phosphorous donor qubit in enriched silicon"  |
| 09:20 – 09:40 | I-2 G. Tosi (University of New South Wales, Australia)<br>"Electric drive and long-distance coupling of Si:P qubits"  |
| 09:40 – 10:00 | I-3 M. G. House (University of New South Wales, Australia)<br>"Radio frequency reflectometry measurement singlet-triplet states in Si:P quantum dots"                     |
| 10:00 – 10:20 | I-4 T. F. Watson (University of New South Wales, Australia)<br>"Long spin lifetimes and high fidelity readout of electrons bound to single and few-donor dots in silicon" |
| 10:20 – 10:40 | Break   |
|               | Session II: Ensemble donor/acceptor qubits  |
| 10:40 – 11:00 | II-1 M. L. W. Thewalt (Simon Fraser University, Canada)<br>"Zero-field magnetic resonance of $^{31}\text{P}$ in $^{28}\text{Si}$ using donor bound exciton transitions"   |
| 11:00 – 11:20 | II-2 P. Ross (University College London, UK)<br>"Hybrid optical-electrical detection of donor electron spins with bound excitons in silicon"                              |
| 11:20 – 11:40 | II-3 B. J. Willis (University College London, UK)<br>"Coherent creation and destruction of orbital wavepackets in Si:P with electrical and optical read-out"              |
| 11:40 – 12:00 | II-4 A. J. Sigillito (Princeton University, USA)<br>"Electron spin coherence of donors in germanium"  |
| 12:00 – 13:30 | Lunch   |
| 13:30 – 13:50 | II-5 C. D. Hill (University of Melbourne, Australia)<br>"A surface code quantum computer in silicon"  |
| 13:50 – 14:10 | II-6 P. A. Mortemousque (Keio University, Japan)<br>"Quadrupole shift of nuclear magnetic resonance of donors in silicon at low magnetic field"                           |
| 14:10 – 14:30 | II-7 D. P. Franke (Technical University of Munich, Germany)<br>"Mechanical tuning of arsenic donors in silicon"   |
| 14:30 – 14:50 | II-8 J. van der Heijden (University of New South Wales, Australia)<br>"Double acceptor singlet-triplet relaxation"  |
| 14:50 – 15:20 | Break   |

Session III: P-type qubits and nanowires

- 15:20 – 15:40 III-1 S. V. Amitonov (University of Twente, The Netherlands)  
"Single-charge occupation in single-hole transistors with implanted boron atoms"
- 15:40 – 16:00 III-2 R. Maurand (University Grenoble-Alpes and CEA, France)  
"Hole nanowire MOSFET: g-factor anisotropy, Pauli spin blockade and dispersive readout"
- 16:00 – 16:20 III-3 J. Ridderbos (University of Twente, The Netherlands)  
"G-factor anisotropy in Ge/Si core/shell nanowires quantum dots"
- 16:20 – 16:40 III-4 C. Kloeffel (University of Basel, Switzerland)  
"Spin-orbit interaction in silicon nanowires"
- 16:40 – 18:40 Poster Session
- 19:00 – 21:00 Banquet

Tuesday, 4 August

Session IV: Optically/MW coupled qubits

- 08:20 – 08:40 IV-1 M. J. Gullans (National Institute of Standards and Technology, USA)  
"Interfacing semiconductor spin qubits with photons"
- 08:40 – 09:00 IV-2 X. Hu (University at Buffalo, USA)  
"Decoherence of a driven spin qubit"
- 09:00 – 09:20 IV-3 J. Pla (University College London, UK)  
"Cavity-enhanced electron spin relaxation"
- 09:20 – 09:40 IV-4 A. Laucht (University of New South Wales, Australia)  
"A dressed spin qubit in silicon"
- 09:40 – 10:00 Break

Session V: Si qubits

- 10:00 – 10:20 V-1 C. H. Yang (University of New South Wales, Australia)  
"A two qubit logic gate in silicon"
- 10:20 – 10:40 V-2 M. A. Fogarty (University of New South Wales, Australia)  
"Non-exponential fidelity decay in randomized benchmarking with low-frequency noise"
- 10:40 – 11:00 V-3 T. Ferrus (Hitachi Cambridge Laboratory, UK)  
"Wireless manipulation of quantum states in silicon isolated double quantum dots"
- 11:00 – 11:20 V-4 J. K. Gamble (Sandia National Laboratories, USA)  
"Predicting the valley physics of silicon quantum dots directly from a device layout"
- 11:20 – 11:40 Break

Session VI: Si/SiGe qubits

- 11:40 – 12:00 VI-1 B. Thorggrimsson (University of Wisconsin-Madison, USA)  
"Increasing the coherence times for an ac-gated hybrid quantum dot qubit"

- 12:00 – 12:20 VI-2 D. Kim (Yonsei University, South Korea)  
 “Conditional coherent oscillations in capacitively coupled Si/SiGe quantum dot charge qubits”
- 12:20 – 13:50 Lunch
- 13:50 – 14:10 VI-3 P. Scarlino (TU Delft, The Netherlands)  
 “High gate fidelity and second harmonic coherent driving of an electron spin in Si/SiGe quantum dot”
- 14:10 – 14:30 VI-4 T. D. Ladd (HRL Laboratories, LLC, USA)  
 “Control of exchange-coupled Si/SiGe dots”
- 14:30 – 14:50 VI-5 D. M. Zajac (Princeton University, USA)  
 “A reconfigurable gate architecture for Si/SiGe quantum dots”
- 14:50 – 15:10 VI-6 K. Takeda (RIKEN, Japan)  
 “A fast addressable single-spin qubit in a Si/SiGe double quantum dot with a micro-magnet”
- 15:10 – 15:40 Break
- Session VII: Si nanodevices
- 15:40 – 16:00 VII-1 A. Rossi (University of New South Wales, Australia)  
 “Direct current measurements and electron counting in a silicon quantum dot pump”
- 16:00 – 16:20 VII-2 G. Yamahata (NTT Basic Research Laboratories, Japan)  
 “Ultrafast single-charge transfer in silicon up to 8 GHz”
- 16:20 – 16:40 VII-3 M. Tabe (Shizuoka University, Japan)  
 “Dopant-cluster-assisted tunnelling in Si nanodevices”
- 16:40 – 17:00 VII-4 K. Ono (RIKEN, Japan)  
 “Room-temperature single-electron transistor based on tunnel field-effect transistor (TFET) and deep level”
- 17:00 – 17:20 VII-5 M. F. Gonzalez-Zalba (Hitachi Cambridge Laboratory, UK)  
 “Dispersive spin readout of silicon double quantum dots”
- 17:20 – 17:40 VII-6 A. Chatterjee (University College London, UK)  
 “Charge dynamics and spin blockade in a hybrid double quantum dot in silicon”
- 17:40 Closing

## Poster session: Monday 3 August 16:40 – 18:40

- P-01 *Influence of strain and electric fields on hyperfine couplings of shallow donors in silicon*  
M. Usman, C. D. Hill, R. Rahman, G. Klimeck, M. Y. Simmons, S. Rogge, and L. C. L. Hollenberg
- P-02 *Computational challenges in modeling silicon quantum information processing devices*  
A. D. Baczewski, J. K. Gamble, N. T. Jacobson, R. P. Muller, and E. Nielsen
- P-03 *Modeling open quantum system device operation with multi-valley effective mass theory*  
T. Jacobson, A. D. Baczewski, J. K. Gamble, R. P. Muller, E. Nielsen, M. Rudolph, P. Harvey-Collard, and M. Carroll
- P-04 *Designing a large scale quantum computer with classical and quantum simulations*  
F. A. Mohiyaddin, R. Rahman, R. Kalra, A. Laucht, G. Klimeck, A. S. Dzurak, and A. Morello
- P-05 *Multi-scale 4D modelling of Si qubit states*  
A. Andreev and D.A. Williams
- P-06 *Valley dependent spin splitting and spin relaxation in a silicon quantum dot*  
R. Ferdous, M. Veldhorst, Y.-L. Hsueh, C. H. Yang, F. A. Mohiyaddin, G. Klimeck, A. S. Dzurak, R. Rahman
- P-07 *Theory of g-factors in silicon quantum dots and other interesting quantum dot physics*  
R. Ruskov and C. Tahan
- P-08 *Atomistic modelling of metallic conduction limits in quasi 1-D silicon wires*  
Y.-H. M. Tan, H. Ryu, B. Weber, M. Y. Simmons, and G. Klimeck
- P-09 *Electrical characterization of a gate-defined double quantum dot in a Si/SiGe nanomembrane*  
T. J. Knapp, R. T. Mohr, Y. S. Li, B. Thorgrimsson, R. H. Foote, X. Wu, D. R. Ward, D. E. Savage, M. G. Lagally, M. Friesen, S. N. Coppersmith, and M. A. Eriksson
- P-10 *Transport through an impurity tunnel-coupled to a Si/SiGe quantum dot*  
R. H. Foote, D. R. Ward, J. R. Prance, J. K. Gamble, E. Nielsen, B. Thorgrimsson, D. E. Savage, A. L. Saraiva, M. Friesen, S. N. Coppersmith, and M. A. Eriksson
- P-11 *Fabrication and characterization of gate-defined small Si-MOS quantum dot device*  
J. Yoneda, T. Honda, K. Takeda, M. Marx, T. Otsuka, T. Nakajima, M. R. Delbecq, S. Amaha, G. Allison, T. Koderu, S. Oda, and S. Tarucha
- P-12 *A Si-MOS multi-quantum-dot device for two-qubit tomography experiments*  
J. C. C. Hwang, M. Veldhorst, C. H. Yang, C. M. Cheng, K. M. Itoh, A. Morello, and A. S. Dzurak
- P-13 *Dispersive readout of Si-MOS double quantum dot*  
C. M. Cheng, C. H. Yang, J. C. C. Hwang, M. Veldhorst, F. E. Hudson, K. M. Itoh, A. S. Dzurak, and C. G. Smith
- P-14 *Pb centers in ambipolar silicon planar quantum dots*  
P. C. Spruijtenburg, F. Mueller, S. V. Amitonov, W. G. van der Wiel, and F. A. Zwanenburg
- P-15 *Physically-defined quantum dots fabricated on silicon-on-insulator substrate*  
T. Koderu, K. Horibe, K. Yamada, S. Ihara, T. Kambara, A. Andreev, D. A. Williams, Y. Arakawa, and S. Oda
- P-16 *Towards single-electron pumping with 3 driving signals*  
R. Zhao, A. Rossi, and A. S. Dzurak
- P-17 *Device modelling for electron counting experiments in silicon single-electron pumps*  
Y. Sun, A. Rossi, and A. S. Dzurak

- P-18 *Tunable coupling capacitance of double quantum dot by an electric field*  
T. Uchida, H. Sato, A. Tsurumaki-Fukuchi, M. Arita, A. Fujiwara, and Y. Takahashi
- P-19 *Characterization of physically-defined double quantum dots on highly-doped silicon substrate*  
Y. Yamaoka, S. Oda, and T. Kodera
- P-20 *Detection of electronic states in doped silicon double quantum dot*  
T.-Y. Yang, Y. Yamaoka, A. Andreev, T. Ferrus, D. A. Williams, T. Kodera, and S. Oda
- P-21 *Unusually asymmetric bias triangles measured on a silicon double quantum dot*  
M. D. Stewart Jr., J. K. Perron, and N. M. Zimmerman
- P-22 *Optimizing charge qubit oscillations in double dot systems to unitary amplitude*  
J. Mosakowski, T. Ferrus, D. Williams, E. Owen, M. Dean, and C. Barnes
- P-23 *Physically-defined silicon triple quantum dots in metal-oxide-semiconductor structures*  
S. Hiraoka, K. Horibe, R. Mizokuchi, T. Kodera, and S. Oda
- P-24 *High fidelity AC gate operation of the quantum dot hybrid qubit*  
C. Wong, S. Coppersmith, and M. Friesen
- P-25 *Nanocavity-enhanced spontaneous emission from isoelectronic centers in silicon*  
H. Sumikura, E. Kuramochi, H. Taniyama, and M. Notomi
- P-26 *Optical pumping and readout of bismuth hyperfine states in silicon for atomic clock applications*  
K. Saeedi, M. Szech, P. Dluhy, J. Z. Salvail, K. J. Morse, H. Riemann, N. V. Abrosimov, N. Nötzel, K. L. Litvinenko, B. N. Murdin, and M. L. W. Thewalt
- P-27 *Addressing allowed vs. forbidden clock transition of  $^{209}\text{Bi}$  donors in Si with circularly polarized microwaves*  
T. Yasukawa, A. J. Sigillito, B. C. Rose, A. M. Tyryshkin, and S. A. Lyon
- P-28 *Pulsed electron spin resonance in the strong coupling regime*  
H. Huebl, C. W. Zollitsch, K. Müller, S. T. B. Goennenwein, R. Gross, and M. S. Brandt
- P-29 *Electron spin resonance spectroscopy of the defects in annealed  $\gamma$ -irradiated silicon*  
H. Saito, Y. Kusano, M. P. Vlasenko, L. S. Vlasenko, and K. M. Itoh
- P-30 *Reflectometry observation of inter-donor coupling*  
T. Kobayashi, J. van der Heijden, M. G. House, S. J. Hile, S. Barraud, R. Lavieville, M. Y. Simmons, and S. Rogge
- P-31 *Extracting inter-dot tunnel couplings between few donor quantum dots in silicon*  
S. K. Gorman, M. A. Broome, J. G. Keizer, T. F. Watson, S. J. Hile, W. J. Baker, and M. Y. Simmons
- P-32 *Engineering inter-qubit exchange coupling between donor bound electrons in silicon*  
Y. Wang, A. Tankasala, L. C. L. Hollenberg, G. Klimeck, M. Y. Simmons, and R. Rahman
- P-33 *Control of two-electron spin correlations on precision-placed donors in Si*  
M. A. Broome, M. G. House, S. Hile, S. K. Gorman, J. Keizer, W. J. Baker, and M. Y. Simmons
- P-34 *Digital STM lithography for P-in-Si qubit devices*  
J. H. G. Owen, J. Ballard, E. Fuchs, C. Delgado, J. N. Randall, and J. R. Von Ehr
- P-35 *Progress towards the characterisation and fabrication of atomic and nanoscale donor devices in silicon*  
N. J. Curson, K. Sinthiptharakoon, V. Brázdová, T. Lim, A. Kölker, H. S. Solanki, J. Li, G. Aeppli, D. R. Bowler, A. J. Fisher, and S. R. Schofield
- P-36 *The impact of dopant segregation on the carrier density in Si:P delta- and multi-layers*  
J. G. Keizer, S. R. McKibbin, S. Kölling, P. M. Koenraad, and M. Y. Simmons

- P-37 *Fabrication and transport in counted donor devices using top-down ion implantation*  
E. Bielejec, J. L. Pacheco, M. Singh, D. R. Luhman, M. P. Lilly, and M. S. Carroll
- P-38 *Towards fabrication of isotopically-enriched strained  $^{28}\text{Si}$  layers*  
Y. Hoshi, S. Tanaka, K. Sawano, K. M. Itoh, and N. Usami
- P-39 *Device and material characterization of in situ enriched  $^{28}\text{Si}$  films*  
K. J. Dwyer, H. S. Kim, D. S. Simons, A. N. Ramanayaka, and J. M. Pomeroy
- P-40 *Are Ge hut-wires candidates for spin qubits?*  
H. Watzinger, L. Vukušić, E. Lausecker, R. Kirchschlager, A. Truhlar, J. Kukučka, V. Sessi, M. Glaser, A. Rastelli, F. Schäffler, and G. Katsaros
- P-41 *Towards in-situ STM capacitance detection of buried nanostructures in silicon*  
H.-S. Kim, K. Dwyer, and J. Pomeroy
- P-42 *Deep level transient spectroscopy studies of quantumrelated test devices*  
B. C. Johnson, F. Hudson, and J. C. McCallum
- P-43 *Single photon emitting diode in silicon carbide*  
A. Lohrmann, N. Iwamoto, Z. Bodrog, S. Castelletto, T. Ohshima, T. J. Karle, S. Prawer, J. C. McCallum, A. Gali, and B. C. Johnson
- P-44 *withdrawn*
- P-45 *Dynamic nuclear polarization of bismuth donor nuclear spins in silicon induced by spin dependent recombination of electrons*  
P. A. Mortemousque, T. Sekiguchi, S. Rosenius, A. Truong, M. P. Vlasenko, L. S. Vlasenko, R. G. Elliman, and K. M. Itoh
- P-46 *Error detection and correction of single-electron transfer*  
H. Tanaka, G. Yamahata, K. Nishiguchi, and A. Fujiwara
- P-47 *Clock transitions in electrically controlled Si:P spin qubits*  
G. Tosi, F. A. Mohiyaddin, S. Tenberg, and A. Morello
- P-48 *Quantum memory in a single nucleus in silicon*  
S. Freer, S. S. Simmons, A. Laucht, F. A. Mohiyaddin, F. Hudson, K. M. Itoh, J. C. McCallum, D. Jamieson, A. Dzurak, and A. Morello
- P-49 *Improved design and fabrication for Si/SiGe quantum dots with increased valley-splitting*  
M. Marx, K. Takeda, J. Yoneda, G. Allison, T. Honda, M. Delbecq, T. Otsuka, T. Nakajima, S. Amaha, T. Kodera, and S. Oda
- P-50 *Spatially resolving coupled donor states in silicon*  
J. Bocquel, B. Voisin, J. Salfi, M. Usman, A. Tankasala, R. Rahman, G. Klimeck, M. Y. Simmons, L. C. L. Hollenberg, and S. Rogge
- P-51 *Mixing of crystal field levels of individual erbium ions in silicon*  
G. de Boo, Q. Zhang, C. Yin, M. Rancic, B. Johnson, J. C. McCallum, M. J. Sellars, and S. Rogge