Yuimaru KUBO

Ph.D., Group Leader

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Education

March 2009 **Ph.D. in Engineering**, *Doctoral Program in Materials Science and Engineering, National Institute for Materials Science (NIMS) and University of Tsukuba*, Japan.
*Selected as an **honored Ph.D. student***

March 2006 **M.Sc. in Engineering**, *Institute of Materials Science, University of Tsukuba*, Japan.

March 2004 **B.Sc. in Engineering**, *College of Engineering Science, University of Tsukuba*, Japan.

Ph.D. Dissertation

Title *"Macroscopic Quantum Phenomena in Intrinsic Josephson Junctions"*

Supervisors Dr. Takahide YAMAGUCHI and Prof. Yoshihiko TAKANO

*Selected for an **excellent Ph.D. thesis prize***

Master Thesis

Title *"Dynamics of Josephson Vortices in Mesoscopic $Bi_2Sr_2CaCu_2O_{8+\delta}$ Single Crystals"*

Supervisors Dr. Itsuhiro KAKEYA and Prof. Kazuo KADOWAKI

Research Experience

Dec 2015–Present **Group Leader**, *Quantum Dynamics Unit, OIST (Okinawa Institute of Science and Technology)*, Japan.
"Coherent bidirectional conversion between optical-microwave photons with electron spins in solids"
"Ultra-sensitive electron spin resonance using superconducting quantum technologies"

July 2014–Dec 2015 **Research Engineer**, *Quantronics Group, SPEC (Department of Solid State Physics), CEA (Atomic Energy and Alternative Energies Commission) Saclay*, France.
"Microwave Detection of a Single Spin with a Superconducting Resonator"
(Advised by Dr. Patrice BERTET and Prof. Daniel ESTEVE)

2012–July 2014 **JSPS Postdoctoral Research Fellow**, *Quantronics Group, SPEC (Department of Solid State Physics), CEA (Atomic Energy and Alternative Energies Commission) Saclay*, France.
"Hybrid Quantum Devices with Superconductors and Spins"
(Advised by Dr. Patrice BERTET and Prof. Daniel ESTEVE)

2009–2012 **Postdoctoral Researcher**, *Quantronics Group, SPEC, CEA Saclay*, France.
"Hybrid Quantum Circuit with Superconducting Qubits and Spins"
(Advised by Dr. Patrice BERTET and Prof. Daniel ESTEVE)

2009 **Research Assosiate**, *Institute of Physics, University of Tsukuba*, Japan.
"Quantum Effects in Intrinsic Josephson Junction Stacks and Break Junctions"
(Advised by Prof. Youiti OOTUKA)

2007–2009 **Ph.D. Researcher**, *Doctoral Program in Materials Science and Engineering, NIMS and University of Tsukuba*, Japan.
"Macroscopic Quantum Phenomena in Intrinsic Josephson Junction Stacks"
(Advised by Dr. Takahide YAMAGUCHI and Prof. Yoshihiko TAKANO)

2004–2006 **Master Student**, *Institute of Materials Science, University of Tsukuba*, Japan.
"Study of Dynamical Josephson Vortex States in High-Tc Superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$"
(Advised by Dr. Itsuhiro KAKEYA and Prof. Kazuo KADOWAKI)

2004 **Undergraduate Student**, *College of Engineering Science, University of Tsukuba*, Japan.
"Single Crystal Growth of High-Tc Superconductor $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$"
(Advised by Prof. Kazuo KADOWAKI)

Research Interests

- Hybrid quantum systems
- Solid state quantum devices/systems (such as superconducting qubits and spins in crystals)
- Quantum state transfer among different quantum systems
- Cavity and circuit quantum electrodynamics
- Quantum optics

Research Skills

- Microwave engineering: vector network analyzer, spectrum analyzer, designing and assembling custom microwave circuit with various components (IQ mixers, couplers, circulators, amplifiers, etc.), cable assembling in a cryogenic environment, etc.
- Optics: confocal microscopy, optical cavity (Fabry-Pérot)
- EM analysis and simulations: SONNET, COMSOL, CST, SPICE
- Ultra low noise DC transport measurements: switching currents of Josephson junctions at sub-Kelvin temperatures
- Nano fabrication: Optical lithography, electron beam lithography, metal evaporation and spattering, focused ion beam etch, argon ion mill, reactive ion etch, wet etch, etc.
- Analog electronics: assembling pre-amplifiers, current-ramp generator, and designing customized feed-back circuit for measuring switching currents of Josephson junctions, etc.
- Scientific software: Igor Pro, Matlab, LabVIEW, Mathematica, AutoCAD, Origin PRO
- Cryogenic operation: $^4He/^3He$ dilution refrigerator, ^4He or ^3He refrigerator, superconducting magnet, PID temperature control, etc.
- Single crystal growth with an image furnace: high-Tc cuprates (Bi-Sr-Ca-Cu-O and La-Sr-Ca-O), transition metal oxides (e.g., TiO_2, Al_2O_3)

Computer Skills

- Programming: Python, C++, Java Scripts
- Desktop Publishing: Adobe Illustrator, Adobe Photoshop, Adobe Flush
- Documentation: LaTeX, Microsoft Word
- General Software: Microsoft Office, Open Office, Apple iWorks

Grants, Fellowships, and Awards

2018 – 2021 **Grants-in-Aid for Scientific Research B (KAKENHI KIBAN-B)**, *"Ultra-sensitive electron spin resonance based on superconducting quantum technologies"*, by JSPS, 18 Million JPY.

2018 – 2020 **Grant-in-Aid for Scientific Research on Innovative Areas (KAKENHI Shin-Gakujutsu)**, *"Three-dimensional hybrid quantum system with superconductors and diamonds"*, by JSPS, 9 Million JPY.

2018 – 2019 **Research Support for Young Scientists**, *"Quantum information transducer with spins in diamond"*, by The Nakajima Foundation, 2 Million JPY.

2016 – 2019 **PRESTO (Precursory Research for Embryonic Science and Technology)**, *"Coherent bidirectional conversion between optical-microwave photons with electron spins in solids"*, by JST (Japan Science and Technology Agency), 43 Million JPY.

2012 – 2014 **JSPS Research Fellowship**, *"Building a Hybrid Quantum Circuit with Superconductors and Spins"*, by JSPS (Japan Society for the Promotion of Science).

July 2009 **Fuji-Television Award**, *High-Technology Paper Awards by Fuji-Sankei Business i Group*, Tokyo, Japan.

March 2009 **Ph.D. Thesis Award**, *Graduate School of Pure and Applied Sciences, University of Tsukuba*, Tsukuba, Japan.

July 2008 **Best Presentation Award**, *The 5th NIMS/MANA - IRC - UCLA/CNSI Nanotechnology Students' Summer School*, Tsukuba, Japan.
http://www.nims.go.jp/mana/news/2008/t363dl00000005xn.html

March 2007 **Golden Prize**, *Poster session in the 4th FIMS International Symposium*, Tsukuba, Japan.

February 2007 **Golden Prize**, *The 3rd Young Power Symposium by "Promotion of Creative Interdisciplinary Materials Science for Novel Functions"*, Tsukuba, Japan.

Teaching Experience

2017 November **Lecture**, *University of the Ryukyus*.
"Quantum information and technologies with hybrid systems"

2016 November **Invited Lecture**, *Kyoto University*.
"Quantum information and technologies with hybrid systems"

2016 March **OIST Skill Pills**, *Okinawa Institute of Science and Technologies (OIST)*.
"CAD with SOLIDWORKS"

2006–2007 **Teaching Assistant**, *College of Engineering Science, University of Tsukuba*.
"Single crystal growth of oxides with an image furnace"

2005–2006 **Teaching Assistant**, *College of Engineering Science, University of Tsukuba*.
"Logic circuit"

2004–2005 **Teaching Assistant**, *College of Engineering Science, University of Tsukuba*.
"Fundamentals of C++ programming"

2004 **Personal Tutor**, *International Student Center, University of Tsukuba*.
Mentor and tutor for newly-arrived international students

Selected Publications

[1] "Controlling Spin Relaxation with a Cavity"
A. Bienfait, J.J. Pla, **Y. Kubo**, X. Zhou, M. Stern, C.C. Lo, C.D. Weis, T. Schenkel, D.

Vion, D. Esteve, J.J.L. Morton, and P. Bertet,
Nature **531**, 74 (2016). (38 times cited)

[2] "Reaching the quantum limit of sensitivity in electron spin resonance"
A. Bienfait, J. J. Pla, **Y. Kubo**, M. Stern, X. Zhou, C. C. Lo, C. D. Weis, T. Schenkel, M. L. W. Thewalt, D. Vion, D. Esteve, B. Julsgaard, K. Moelmer, J. J. L. Morton, and P. Bertet,
Nature Nanotechnologies **11**, 253 (2016). (48 times cited)

[3] "Multimode Storage and Retrieval of Microwave Fields in a Spin Ensemble"
C. Grezes, B. Julsgaard, **Y. Kubo**, M. Stern, T. Umeda, J. Isoya, H. Sumiya, H. Abe, S. Onoda, T. Ohshima, V. Jacques, J. Esteve, D. Vion, D. Esteve, K. Mølmer, P. Bertet,
Phys. Rev. X **4**, 021049 (2014). (66 times cited)

[4] "Electron Spin Resonance Detected by a Superconducting Qubit"
Y. Kubo, I. Diniz, C. Grezes, T. Umeda, J. Isoya, H. Sumiya, T. Yamamoto, H. Abe, S. Onoda, T. Ohshima, V. Jacques, A. Dréau, J.-F. Roch, A. Auffeves, D. Vion, D. Esteve and P. Bertet,
Phys. Rev. B **86** 064514 (2012). (18 times cited)

[5] "Hybrid Quantum Circuit with a Superconducting Qubit Coupled to a Spin Ensemble"
Y. Kubo, C. Grezes, A. Dewes, T. Umeda, J. Isoya, H. Sumiya, N. Morishita, H. Abe, S. Onoda, T. Ohshima, V. Jacques, A. Dréau, J.-F. Roch, I. Diniz, A. Auffeves, D. Vion, D. Esteve and P. Bertet,
Phys. Rev. Lett. **107** 220501 (2011). (208 times cited, Selected for "Editor's Suggestion")

[6] "Strong Coupling of a Spin Ensemble to a Superconducting Resonator"
Y. Kubo, F.R. Ong, P. Bertet, D. Vion, V. Jacques, D. Zheng, A. Dréau, J.-F. Roch, A. Auffeves, F. Jelezko, J. Wrachtrup, M.F. Barthe, P. Bergonzo and D. Esteve,
Phys. Rev. Lett. **105** 140502 (2010). (320 times cited)
[Selected for "Editor's Suggestion" and "ViewPoint" in Physics: Physics **3**, 80 (2010), and highlighted in "Research News and Views" in Nature: Nature **468**, 44 (2010).]

Invited Talks

1. "Ultra-sensitive spin resonance using superconducting quantum technologies"
The 66th Japan Society of Applied Physics (JSAP) Spring Meeting, Tokyo, Japan, March 2016.

2. "Quantum information and technologies with hybrid systems"
The 3rd Photonics Workshop, JSAP Photonics Division, OIST, Japan, December 2018.

3. "Magnetic Resonance at the Quantum Limit"
The 73rd Japan Physical Society (JPS) Annual Meeting, Noda, Japan, March 2018.

4. "Hybrid quantum systems with spins and superconductors (and photons)"
The 7th Summer School on Semiconductor/Superconducting Quantum Coherence Effect and Quantum Information, Shuzenji, Japan, August 2017.

5. "Reaching the quantum limit of sensitivity in electron spin resonance"
JSAP international workshop, National Institute of Information (NII), Tokyo, March 2017.

6. "Magnetic Resonance at the Quantum Limit
   The Society of Electron Spin Sceince and Technology (SEST), Osaka, Japan, November, 2016.

7. "Circuit-QED and Spins"
   The 63th Japan Society of Applied Physics (JSAP) Spring Meeting, Tokyo, Japan, March 2016.

8. "Hybrid Quantum Systems with Superconductors and NV centers in Diamond"
   The 71st Japan Physical Society (JPS) Annual Meeting, Sendai, Japan, March 2016.

9. "Magnetic Resonance at the Quantum Limit
   The International Symposium on Nanoscale Transport and Technology (ISNTT2015), Atsugi, Japan, November, 2015.

10. "Electron Spin Resonance Detected by a Superconducting Qubit"
    Workshop for Quantum Simulations of Open Quantum Systems, Freiburg, Germany, November, 2013.

11. "Hybrid Quantum Circuit with a Supeconducting Qubit and an Electron Spin Ensemble"
    iQIT workshop, Corfu, Greece, Septempber, 2013.

12. "Hybrid Quantum Circuit with a Supeconducting Qubit coupled to an Electron Spin Ensemble"
    Coherent Control in Complex Quantum Systems, OIST, Okinawa, Japan, May 2013.

13. "Hybrid Quantum Circuit with a Supeconducting Qubit coupled to an Electron Spin Ensemble"
    DPG Spring Meeting, Regensburg, Germany, March 2013.

14. "Hybrid Quantum Circuit with a Supeconducting Qubit coupled to an Electron Spin Ensemble"
    GDR, Physique Quantique Mesoscopique, Aussois, France, December 2011.

15. "Strong Coupling of a Spin Ensemble to a Superconducting Resonator: Towards Superconducting Hybrid Quantum Circuits"
    GDR Information Quantique, Nice, France, March 2011.

16. "Strong Coupling of a Spin Ensemble to a Superconducting Resonator"
    Hasselt Diamond Workshop 2011 (SBDD XVI), Hasselt, Belgium, Feburary 2011.