FY 2025 Annual Report

Unit Name

Quantum Machines Unit

Professor Jason M Twamley

Collaborations

Masaki Ando, University of Tokyo, Japan, Vibration isolation for low frequencies

Fedor Jelezko, University of Ulm, Germany, Spin systems in diamond for quantum sensors

Kentaro Somiya, Institute of Science Tokyo, Japan, Magnetic Levitation for Gravity Wave Detection

Takeshi Ohshima, Institute of Quantum Science and Technology, Japan, Diamond quantum science and technologies

Gerard Milburn, University of Sussex, United Kingdom, Quantum Machine Learning and nonlinear dissipative quantum systems

James Downes, Macquarie University, Australia, Magnetic Levitation

Jingbo Wang, University of Western Australia, Australia, Algorithms for quantum sensing

Mutsuko Hatano, Institute of Science Tokyo, Japan, Diamond quantum science and technologies

Research Personnel

Jinjin Du, Staff Scientist

Anil Kumar, Staff Scientist

Anshuman Nayak, PhD Student

Andrii Yakymenko, PhD Student

Alexander Henry Hodges, PhD Student

Tatiana Iakovleva, PhD Student

Daehee Kim, PhD Student

Kalle Eemeli Pakarinen, Research Intern

Miu Nakano, Research Intern

Scholarly Contributions and Creative Productions (by Faculty)

Journal Article

1. Hodges, A.; Du, J.; Tian, S.; Twamley, J.
   Cooling a levitated milligram mirror to the ground state using Pound-Drever-Hall locking
   Physical Review A 113, 03358 (2026)
2. Twamley, J.; Quijandria Diaz, I.F; Nayak, A.
   Quantum error correction system and process for quantum error correction
   USA Patent filing, 19101328, Jan 15 2026
3. Chauhan, A.K.; Twamley, J.
   Cluster states of multiple ferrimagnetic spheres in cavity magnonics,
   Phys. Rev. Res. 8, 013011 (2025)
4. Kumar, C., Anil; Kani, A.; Twamley, J.

Enhancing Macroscopic Multimode Entanglement through Many-Body Interactions in Cavity Magnomechanics.
Phys. Rev. A 2025, 111, 033505.

5. Kani, A.; Hatifi, M.; Twamley, J.
Magnomechanical rotational Schrodingers cat
Applied Physics Letters Quantum 2, 046104 (2025)
6. Raman, N., Sarath; Tian, S.; Brennen, G. K.; Bose, S.; Twamley, J.
Massive Quantum Superpositions Using Magnetomechanics
Phys. Rev. Appl. 2025, 24, 024061.
7. Kim, D.; Tian, S.; Calderoni, B.; Sastre Jachimska C.; Downes, J.; Twamley, J.
A magnetically levitated conducting rotor with ultra-low rotational damping circumventing eddy loss
Commun. Phys. 8, 381 (2025)
8. Hatifi, M.; Nayak, A.; Twamley, J. M.
Spin-Mechanical Thermal Machines
Physical Review Research 2025, 7, 043338.
9. Bose, S.; *et al*,
A spin-based pathway to testing the quantum nature of gravity
Preprint: arXiv: https://arxiv.org/pdf/2509.01586

Scholarly Contributions (by Unit Members)

Name of Unit Member	Type	Title	Outlet	Publisher	Year Pub
Sanket Das	Journal Article	Unconventional photon blockade in cavity QED with parametric amplification	Phys. Rev. A	APS	2026
Anshuman Nayak	Journal Article	Spin-Mechanical Thermal Machines	Physical Review Research	American Physical Society	2025
Mitchell Owen de Vries	Journal Article	The Nitrogen-Vacancy-Nitrogen Color Center: A Ubiquitous Visible and Near-Infrared-II Quantum Emitter in Nitrogen-Doped Diamond	ACS Nano	American Chemical Society	2025
Resmi Manoharan	Journal Article	Polarization dependence of fluorescence photons from quantum dots coupled to an optical nanofiber tip	Physica Scripta	Institute of Physics	2025
Jinjin Du	Journal Article	Imaging a Chain of Rydberg Superatoms Enabled by Forster-Resonance-Enhanced Interaction	Optica	Optica	2025
Mitchell Owen de Vries	Journal Article	A fluorescent color center in meteoritic Lonsdaleite	arXiV	arXiV	2025
Jinjin Du	Journal Article	Strong microwave-induced cross-Kerr effect with Rydberg atoms at telecommunication wavelength	Phys. Rev. Appl.	APS	2025
Fernando Quijandría	Journal Article	Experimental realization of deterministic and selective photon addition in a bosonic mode assisted by an ancillary qubit	Quantum Science and Technology	Institute of Physics	2025
Mohamed Hatifi	Journal Article	Quantum Gravity Without Metric Quantization: From Hidden Variables to Hidden Spacetime Curvatures	Nature Communications	Nature	

Name of Unit Member	Type	Title	Outlet	Publisher	Year Pub
Mitchell Owen de Vries	Journal Article	Nitrogen-vacancy centres in lonsdaleite: a novel nanoscale sensor?	Physical Chemistry Chemical Physics	Royal Society of Chemistry	2025
Mojtaba Moshkani	Poster Presentation at Conference	Teaching tool for quantum technology diamond NV	1st Aspire ECR workshop, Japan		2025
Mojtaba Moshkani	Poster Presentation at Conference	Tunable Lens using Magnetically Engineered Liquids	PIERS 2025 in Chiba, Japan		2025
Alexander Hodges	Poster Presentation at Conference	Macroscopic Diamagnetic Levitated Optomechanics: Feedback Cooling towards the Ground State	PIERS in Chiba, Japan		2025
Alexander Hodges	Poster Presentation at Conference	Macroscopic diamagnetic levitated optomechanics: feedback cooling towards the ground state	Quantum Optics XI, Poland		2025
Mitchell Owen de Vries	Poster Presentation at Conference	Teaching Tool for Quantum Technology Diamond NV	1st ASPIRE ECR Workshop, Japan	ASPIRE	2025
Anshuman Nayak	Presentation at Conference	Spin-Mechanical Thermal Machines	Quantum Optics XI, Poland		2025
Mojtaba Moshkani	Presentation at Conference	Diamond laser etching	1st Aspire meeting, Ulm, Germany		2025

Honors, Awards & Fellowships [By Unit Members Only]

Term 3 2025 - Term 3 2025	Alexander Hodges, Poster Award, ポスター賞, 2025, Quantum Optics XI, N/A [Fiscal Year: 2025-09-05]
Term 2 2025 - Ongoing	Alexander Hodges, JSPS DC1 Fellow, JSPS DC1 Fellow, 2025, JSPS, N/A [Fiscal Year: 2025-04-01]
Term 2 2025 - Term 1 2026	Alexander Hodges, JSPS DC1 Fellowship, 2025年度 特別研究員-DC1 , 2025, JSPS, 3 year fellowship with stipend [Fiscal Year: 2025-04-01]

Other Institutional Service

Term 3 2025 - Term 3 2025	International Conference on Quantum Information Science and Technology (ICQIST), 2025, (University) [Fiscal Year: 2025-12-01]
Term 2 2025 - Term 2 2025	Science Festival OIST, (Twamley - Quantum Machines Unit) [Fiscal Year: 2025-02-01]
Term 2 2025 - Term 2 2025	Science Challenge 2025, (University) [Fiscal Year: 2025-03-01]

Outreach Activities [For Unit Members Only]

Term 2 2026	Alexander Hodges, Career panel for Kings College London, OIST [Fiscal Year: 2026-01-21]
Term 2 2026	Alexander Hodges, Science Workshop for Kagoshima High School Students, OIST [Fiscal Year: 2026-02-19]
Term 2 2026	Alexander Hodges, Science Workshop for local High School Students, OIST [Fiscal Year: 2026-01-19]

Term 2 2026	Alexander Hodges, Science challenge hands-on session, OIST [Fiscal Year: 2026-03-11]
Term 2 2026	Alexander Hodges, Science Workshop for DoDEA High School Students, OIST [Fiscal Year: 2026-02-24]
Term 1 2025	Alexander Hodges, Poster feedback session for Yokohama high school students, OIST [Fiscal Year: 2025-10-22]
Term 3 2025	Mitchell Owen de Vries, Presentation of career pathway to OIST, OIST [Fiscal Year: 2025-10-03]
Term 3 2025	Alexander Hodges, Science Workshop for Atsugi High School Students, OIST [Fiscal Year: 2025-07-23]
Term 3 2025	Alexander Hodges, Poster feedback session for Saga high school students, OIST [Fiscal Year: 2025-07-02]
Term 2 2025	Alexander Hodges, Career talk for Nanao High School, OIST [Fiscal Year: 2025-02-12]
Term 2 2025	Daehee Kim, OIST Science Festival 2025, OIST [Fiscal Year: 2025-02-02]
Term 2 2025	Alexander Hodges, Science Workshop for Odawara High School Students, OIST [Fiscal Year: 2025-10-09]

Workshops and Seminars [Organized and Hosted by Faculty/Units]

Speaker Name(s)	Title	Location	Date
Dr Marion Cromb	[Seminar] (Quantum) Physics in Rotating Frames	OIST	2025-12-16
Dr Kentaro Komori	[Seminar] Synergy between gravitational wave detectors and macroscopic optomechanics	OIST	2025-07-23
Prof Michael R. Vanner	[Seminar] Towards quantum science and technology with Brillouin-Mandelstam scattering	OIST	2025-07-22
Dr Alexander Wood	[Seminar] Classical Rotation of Quantum Spins and Quantum Rotations of Classical Particles	OIST	2025-05-20
Mr. Yohei Nishino	[Seminar] Toward Quantum-Enhanced Metrology for Gravitational Wave Detection	OIST	2025-04-15
Dr. Rejjak Laskar	[Seminar] Quantum Heat Engines: Exploring Thermodynamics with Vibrating Nanomirrors	OIST	2025-03-13