

# Jian Wei Tay

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## CURRENT POSITION

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### Research Associate

August 2019 - Present

Advanced Light Microscopy Core

BioFrontiers Institute, University of Colorado Boulder

### Key projects in progress

- *CyAn: A cyanobacteria imaging and data analysis platform*, with Dr. Kristin Moore, and Prof. Jeffrey Cameron. Manuscript in progress, to be submitted early 2020.
- *A high-throughput E. coli genetic screening platform*, with Caleb Penner and Prof. Joel Kralj. Data collection and analysis in progress.
- *Studying photodamage of cyanobacteria cells*, with Prof. Jeffrey Cameron. Data collection and analysis in progress.
- *Registration of mouse brain slices with the Allen Institute Brain Atlas*, with Prof. David Root. Preliminary work to demonstrate proof of principle is underway.

## EDUCATION

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### PhD in Physics

July 2011

University of Otago, New Zealand

Thesis: *Optical Motion Detection*

Thesis committee: Jevon J. Longdell, Warwick P. Bowen, Igor Meglinski

### BSc (Hons. I) in Physics

December 2006

University of Otago, New Zealand

Thesis: *High finesse optical cavities in single atom detection*

Thesis advisor: Murray D. Barrett

## RESEARCH AND TEACHING INTERESTS

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- Optics, imaging, and microscopy
- Image processing and analysis
- Computational modelling
- Analysis and visualization of large, multi-dimensional datasets
- Machine learning and neural networks for image and data classification
- Research design and methodology

## ACADEMIC EMPLOYMENT

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**Professional Research Assistant** 2016 - 2019

BioFrontiers Institute and RASEI Institute, University of Colorado Boulder  
Advisors: Jeffrey Cameron, Amy Palmer, Joseph Dragavon, Joel Kralj

**Research Associate (Postdoctoral)** 2014 - 2016

Department of Electrical Engineering, University of Colorado Boulder  
Advisor: Rafael Piestun

**Postdoctoral Research Associate** 2011 - 2014

Department of Biomedical Engineering, Washington University in St Louis  
Advisor: Lihong V. Wang

## RESEARCH EXPERIENCE

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**Summer Research Assistant** 2006

Department of Physics, University of Otago, New Zealand  
Advisor: Warwick P. Bowen

**Summer Research Assistant** 2005

Department of Physics, University of Otago, New Zealand  
Advisor: Murray D. Barrett

## TEACHING EXPERIENCE

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**University of Colorado Boulder** **Boulder, CO**

Lecturer, Quantitative Optical Imaging Fall 2019  
Teaching Assistant, Interdisciplinary Quantitative Biology Lab Fall 2016 - 2019

**University of Otago** **Dunedin, New Zealand**

Teaching Assistant, Electromagnetism and Optics Semester 2 2009, 2010  
Teaching Assistant, Quantum and Thermal Physics Semester 1 2009  
Teaching Assistant, Fundamentals of Modern Physics Semester 2 2008, 2009  
Teaching Assistant, Physical Law and its Applications Semester 1 2008, 2009  
Teaching Assistant, Quanta and Uncertainty Semester 1 2007  
Teaching Assistant, Biological Physics Full Year 2005, 2007  
Undergraduate Tutor, Physics, Aquinas College Semester 1 2004

## AWARDS AND HONORS

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**Seno Medical Best Paper Award** 2014

*Focusing light in scattering media by ultrasonically encoded wavefront shaping (SEWS)*  
SPIE Photonics West (BiOS), San Francisco

**PhD Scholarship** 2007 - 2010

Jack-Dodd Centre for Quantum Technology, University of Otago, New Zealand

**Bursary in Physics** 2004 - 2006

Beverly Trust Fund, University of Otago, New Zealand

## PUBLICATIONS

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### JOURNAL ARTICLES (\* Equal first authors)

1. Hill, N. C., **Tay, J. W.**, Altus, S., Bortz, D. M., and Cameron, J. C. *Lifecycle of a cyanobacterial carboxysome*. *Sci. Adv.* 6, eaba1269 (2020). doi:[10.1126/sciadv.aba1269](https://doi.org/10.1126/sciadv.aba1269)
2. Moore, K. A., Altus, S., **Tay, J. W.**, Fox, J., Johnson, E. B., Bortz, D. M. and Cameron, J. C. *Mechanical regulation of photosynthesis in cyanobacteria*. *Nat. Microbiol.* 5, 757-767 (2020). doi:[10.1038/s41564-020-0684-2](https://doi.org/10.1038/s41564-020-0684-2)
3. Lo, M., Damon, L. J., **Tay, J. W.**, and Palmer, A. E. *Single cell analysis reveals multiple requirements for zinc in the mammalian cell cycle*. *eLife* 9, e51107 (2020). doi:[10.7554/eLife.51107](https://doi.org/10.7554/eLife.51107)
4. Mahadevan, J., Rudolph, J., Jha, A., **Tay, J. W.**, Dragavon, J., Grumstrup, E. M., and Luger, K. *Q-FADD: A mechanistic approach for modeling the accumulation of proteins at sites of DNA damage*. *Biophys. J* 116, 2224 - 2233 (2019). doi:[10.1016/j.bpj.2019.04.032](https://doi.org/10.1016/j.bpj.2019.04.032)
5. Connacher, M. K., **Tay, J. W.**, and Ahn, N. G. *Rear-polarized Wnt5a-receptor-actin-myosin-polarity (WRAMP) structures promote the speed and persistence of directional cell migration*. *Mol. Biol. Cell.* 28, 1924-1936 (2017). doi:[10.1091/mbc.e16-12-0875](https://doi.org/10.1091/mbc.e16-12-0875)
6. Hemphill, A. S., **Tay, J. W.**, and Wang, L. V. *Hybridized wavefront shaping for high-speed, high-efficiency focusing through dynamic diffusive media*. *J. Biomedical Optics* 21, 121502 (2016). doi: [10.1117/1.JBO.21.12.121502](https://doi.org/10.1117/1.JBO.21.12.121502)
7. Lai, P. \*, Wang, L. \*, **Tay, J. W. \***, and Wang, L. V. *Photoacoustically guided wavefront shaping for enhanced optical focusing in scattering media*. *N. Photon.* 9, 126-132 (2015). doi: [10.1038/nphoton.2014.322](https://doi.org/10.1038/nphoton.2014.322)
8. **Tay, J. W. \***, Liang, J. Y. \*, and Wang, L. V. *Amplitude-masked photoacoustic wavefront shaping and application in flowmetry*. *Opt. Lett.* 39, 5499-5502 (2014). doi: [10.1364/OL.39.005499](https://doi.org/10.1364/OL.39.005499)
9. Suzuki, Y., **Tay, J. W.**, Yang, Q. and Wang, L. V. *Continuous scanning of the time-reversed ultrasonically encoded optical focus by reflection-mode digital phase conjugation*. *Opt. Lett.* 39, 3441-3444 (2014). doi: [10.1364/OL.39.003441](https://doi.org/10.1364/OL.39.003441)
10. **Tay, J. W. \***, Lai, P., Suzuki\*, Y., and Wang, L. V. *Ultrasonically encoded wavefront shaping for focusing into random media*. *Sci. Rep.* 4, 3918 (2014). doi: [10.1038/srep03918](https://doi.org/10.1038/srep03918)
11. **Tay, J. W.**, Farr, W. G., Ledingham, P. M., Korystov, D., and Longdell, J. J. *Hybrid optical and electronic laser locking using slow light due to spectral holes*. *Phys. Rev. A.* 87, 063824 (2013). doi: [10.1103/PhysRevA.87.063824](https://doi.org/10.1103/PhysRevA.87.063824)
12. **Tay, J. W.**, Ledingham, P. M., and Longdell, J. J. *Coherent optical ultrasound detection with rare-earth ion dopants*. *Appl. Opt.* 49, 4331-4334 (2010). doi: [10.1364/AO.49.004331](https://doi.org/10.1364/AO.49.004331)
13. **Tay, J. W.**, Hsu, M. T. L., and Bowen, W. P. *Quantum limited particle sensing in optical tweezers*. *Phys. Rev. A.* 80, 063806 (2009). doi: [10.1103/PhysRevA.80.063806](https://doi.org/10.1103/PhysRevA.80.063806)
14. **Tay, J. W.**, Taylor, M. A., and Bowen, W. P. *Sagnac-interferometer-based characterization of spatial light modulators*. *Appl. Opt.* 48, 2236-2242 (2009). doi: [10.1364/AO.48.002236](https://doi.org/10.1364/AO.48.002236)

## PREPRINTS

1. **Tay, J. W.**, and Cameron, J. C. *CyAn: A MATLAB toolbox for image and data analysis of cyanobacteria*. bioRxiv doi: [10.1101/2020.07.28.225219](https://doi.org/10.1101/2020.07.28.225219).
2. Moore, K. A., **Tay, J. W.**, and Cameron, J. C. *Multi-generational analysis and manipulation of chromosomes in a polyploid cyanobacterium*. bioRxiv doi: [10.1101/661256](https://doi.org/10.1101/661256).

## PROCEEDINGS (\* Equal first authors)

1. Lai, P.\*, **Tay, J. W.\***, Wang, L.\* & Wang, L. V. *Optical focusing in scattering media with photoacoustic wavefront shaping (PAWS)*, Proc. SPIE 8943, 894318, (2014). doi: [10.1117/12.2036510](https://doi.org/10.1117/12.2036510)
2. **Tay, J. W.**, Lai, P., Suzuki, Y. & Wang, L. V. *Focusing light in scattering media by ultrasonically encoded wavefront shaping (SEWS)*. Proc. SPIE 8943, 89434P (2014). doi: [10.1117/12.2037037](https://doi.org/10.1117/12.2037037)
3. Suzuki, Y., **Tay, J. W.**, Yang, Q., & Wang, L. V. *Digital reflection-mode time-reversed ultrasonically encoded (TRUE) optical focusing*. Proc. SPIE 8943, 89431B (2014). doi: [10.1117/12.2037952](https://doi.org/10.1117/12.2037952)
4. Liang, J.\*, **Tay, J. W.\***, Hemphill, A. S., & Wang, L. V. *Amplitude-masked photoacoustic wavefront shaping: theory and application in flowmetry*, Proc. SPIE 9323, 932310 (2015). doi: [10.1117/12.2081693](https://doi.org/10.1117/12.2081693)
5. **Tay, J. W.**, Ledingham P. M., and Longdell, J. J. *Coherent detection of ultrasound using dispersion due to spectral holes*. Proc. SPIE 7948, 794809, Feb 11 (2011). doi: [10.1117/12.875605](https://doi.org/10.1117/12.875605)
6. Tay, J. W., Ledingham, P. M., and Longdell, J. J. *Ultrasound detection using dispersion due to spectral holes* in Frontiers in Optics 2010/Laser Science XXVI, FThP2 (2010). doi: [10.1364/FIO.2010.FThP2](https://doi.org/10.1364/FIO.2010.FThP2)
7. **Tay, J. W.**, Jiang, X., and Bowen, W. P. *On shotnoise and Brownian motion limits to the accuracy of particle positioning with optical tweezers*. Proc. SPIE 6801, 68010Z (2008). doi: [10.1117/12.769285](https://doi.org/10.1117/12.769285)

## BOOK CHAPTERS

- Bowen, W. P., Hsu, M. T. L., and **Tay, J. W.** *Fundamentals and Applications of Quantum Limited Optical Imaging*. In Costa, N., and Cartaxo, A. (Eds.), *Advances in Lasers and Electro Optics* (pp. 633- 654). Croatia: INTECH (2010).

## PATENTS

1. Cameron JC, Hill NC, **Tay JW**, Altus S, Bortz DM, inventors; University of Colorado Boulder, assignee. *Methods for Measuring and Optimizing the Structure, Location, and Activity of Natural and Engineered Microcompartments, Organelles, and Macromolecules*. United States provisional patent 62/935,738. 2019 November 15.
2. Cameron JC, Moore KM, Johnson EB, **Tay JW**, Meehl JB, Altus S, Bortz DM, inventors; University of Colorado Boulder, assignee. *Methods and Systems for the Use of Photosynthetic Microbes as Mechanical Transducers and Sensors*. United States provisional patent 16/036,645. 2018 July 16.

3. Wang, L. V., Wang, L., Zhang, C., Lai, P., **Tay, J. W.** *Systems and methods of Grueneisen-relaxation photoacoustic microscopy and photoacoustic wavefront shaping*. Publication number: 20160305914. Filed 19 November 2014. Issued 20 October 2016.
4. Longdell, J.J., and **Tay, J. W.** *Method and apparatus for detection of ultrasound*. Publication number: 2011068417. Filed 30 November 2010. Issued 9 June 2011.

## PRESENTATIONS

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### CONFERENCES

1. **Tay, J. W.**, & Cameron, J. C. *CyAn: A cyanobacteria image analysis toolbox*. 13th Workshop on Cyanobacteria, University of Colorado Boulder, June 6-9 (2019).
2. **Tay, J. W.**, Lai, P., Suzuki, Y. & Wang, L. V. *Focusing light in scattering media by ultrasonically encoded wavefront shaping (SEWS)*. SPIE BiOS 8943-42, San Francisco, CA, Feb 3 (2014).
3. Lai, P., **Tay, J. W.**, Wang, L. & Wang, L. V. Optical wavefront shaping-enhanced photoacoustic microscopy, SPIE BiOS 8943-167, San Francisco, CA, Feb 3 (2014).
4. **Tay, J. W.**, Ledingham P. M., and Longdell, J. J. Coherent detection of ultrasound using dispersion due to spectral holes. *Frontiers in Optics*, Rochester, NY, October 24-28, (2010).
5. **Tay, J. W.**, Farr, W. G., Korystov, D., Ledingham P. M., and Longdell, J. J. Hybrid laser stabilisation using spectral hole burning. Jack-Dodd Centre Student Symposium, Dunedin, New Zealand, December (2009).
6. **Tay, J. W.**, and Bowen, W. P. Towards determining the classical resolution limit of optical tweezers. KOALA student conference, Brisbane, Australia, December (2008).
7. **Tay, J. W.**, Jiang, X., and Bowen, W. P. The classical resolution limit of optical tweezers. SPIE: Microelectronics, MEMS and Nanotechnology, Canberra, Australia, December 4-7, (2007).
8. **Tay, J. W.**, Jiang, X., and Bowen, W. P. Classical Resolution Limit of Optical Tweezers. New Zealand Institute of Physics (NZIP), Dunedin, New Zealand, July 4, (2007).

### DEPARTMENTAL TALKS

1. **Tay, J. W.** *Computational toolboxes for single cell microscopy*. SCR Single Cell Single Molecule supergroup. University of Colorado Boulder. February 17 (2020).
2. **Tay, J. W.** *An Introduction to Neural Networks for Image Classification*. Quantitative Optical Imaging supergroup. University of Colorado Boulder. October 1 (2018).
3. **Tay, J. W.** *Introduction to Biophotonics*. Short course at IONS-KOALA student conference, Dunedin, New Zealand, November 28-December 3 (2010).
4. **Tay, J. W.**, Farr, W. G., Korystov, D., Ledingham P. M., and Longdell, J. J. *Hybrid laser stabilisation using spectral hole burning*. Jack-Dodd Centre Student Symposium, Dunedin, New Zealand, December (2009).
5. **Tay, J. W.**, and Bowen, W. P. *Towards determining the classical resolution limit of optical tweezers*. KOALA student conference, Brisbane, Australia, December (2008).

## **PROFESSIONAL SERVICE**

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- Reviewer, Optical Society of America
- Reviewer, AIP Advances