

Mankei Tsang

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EDUCATION

- ◇ **Ph.D.** in Electrical Engineering, 2006
M.S. in Electrical Engineering, 2004
California Institute of Technology, USA (Sep 2002–Jun 2006)
 - Advisor: Prof. Demetri Psaltis
 - Ph.D. Thesis Title: Classical and Quantum Nonlinear Optical Information Processing
- ◇ **B.S.** in Electrical Engineering, 2002
B.S. in Physics, 2002 (double major)
University of California - Los Angeles, USA (Oct 1998–Jun 2002)
 - Summa Cum Laude

RESEARCH INTERESTS

- ◇ Quantum Measurement Theory, Quantum Metrology, Quantum Optics, Sensing and Imaging, Superresolution

RESEARCH AND TEACHING EXPERIENCE

- ◇ **Associate Professor** (with tenure, Jul 2017–present)
Assistant Professor (Aug 2011–Jun 2017)
Department of Electrical and Computer Engineering (joint appointment with Department of Physics), National University of Singapore, Singapore
 - Taught courses:
 - * EE2012 Analytic Methods in ECE (Tutorials, 2019–present)
 - * EE6440 Advanced Topics in Photonics (Part II, 2018–present)
 - * EE5517 Optical Engineering (Part I, 2012–present)
 - * MA2501 Differential Equations and Systems (Part II, 2017–2018)
 - * PC2232 Physics for Electrical Engineers (2015–2017)
 - Supervised graduate students:
 - * Kenneth Y. W. Ng (EE Ph.D. program, co-supervised with Aaron Danner, Jan 2019–present)
 - * Eric J. H. Cheung (EE Ph.D. program, co-supervised with Aaron Danner, Aug 2015–present)
 - * Shilin Ng (Ph.D. in Physics, Jan 2013–May 2017)
 - * Shan Zheng Ang (Ph.D. in EE, Aug 2012–Dec 2016)
 - * Soham Sataparno Saha (M.Eng. in EE, co-supervised with Aaron Danner, Jan 2014–Aug 2015)
 - * Dan Li (M.Sc. in Physics, Aug 2013–Aug 2015)
 - Supervised postdoctoral fellows: Luo Qi (co-supervised with Aaron Danner and Minghui Hong, 2019–present), Lianwei Chen (co-supervised with Minghui Hong and Aaron Danner, 2019–present), Wei Wang (co-supervised with Pakorn Kanchanawong, 2020–present), Samuel Barnett (co-supervised with Pakorn Kanchanawong, 2019), Ranjith Nair (2012–2018), Brent Yen (2012), Andy Chia (2012), Adam Zaman Chaudhry (2013–2014), Davide Girolami (2013–2014), Sumei Huang (2013–2015), Jun Deng (2014–2015), Alexander Crosse (2014–2015), Cong Son Ho (co-supervised with Mansoor B. A. Jalil, 2014–2016), Xiao-Ming Lu (2014–2016), and Shibdas Roy (2015–2016).
- ◇ **Adjunct Research Professor** (Oct 2010–Aug 2011)
Postdoctoral Fellow (Jan 2010–Aug 2011)
Center for Quantum Information and Control (CQuIC), Department of Physics and Astronomy, University of New Mexico, USA

- Advisor: Prof. Carlton M. Caves
 - Investigated fundamental problems concerning estimation, control, and limits in quantum sensing.
 - Organized the CQuIC seminar series.
- ◇ **Postdoctoral Fellow** (Jan 2008–Dec 2009)
Keck Foundation Center for Extreme Quantum Information Theory (xQIT), Research Laboratory of Electronics, Massachusetts Institute of Technology, USA
- Advisors: Prof. Seth Lloyd and Prof. Jeffrey H. Shapiro
 - Developed estimation techniques for quantum sensing and imaging.
- ◇ **Postdoctoral Scholar** (Jul 2006–Dec 2007)
Graduate Researcher (Sep 2002–Jun 2006)
Optical Information Processing Group, Department of Electrical Engineering, California Institute of Technology, USA
- Advisor: Prof. Demetri Psaltis
 - performed fundamental and applied research in quantum optics, nano-optics, and nonlinear optics.
 - gave lectures for the *Electromagnetic Engineering* course.
- ◇ **Teaching Assistant** (Sep 2002–Jun 2003)
Department of Electrical Engineering, California Institute of Technology, USA
- gave review lectures, answered students' questions, and graded homeworks for the courses *Fourier Optics*, *Electromagnetic Engineering*, and *Optics in Nano-structures*.
- ◇ **Undergraduate Researcher** (Jun 2001–Jun 2002)
Electro-Physical Integration Group, Electrical Engineering Department, University of California - Los Angeles, USA
- Advisor: Prof. Elliott R. Brown
 - performed analytic modeling and numerical analysis for the Acoustic Dental Imaging Project.

SERVICES

- ◇ **Manuscript Referee** for Nature Photonics, Nature Physics, Physical Review Letters, Physical Review A, Physical Review B, Physical Review E, Physical Review X, Quantum, Annalen der Physik, New Journal of Physics, The Astrophysical Journal, Optica, Optics Letters, Optics Express, Journal of the Optical Society of America B, Optics Communications, Journal of Optics, Optics and Laser Technology, EPJ Quantum Technology, Journal of Electromagnetic Waves and Applications, and IEEE Transactions on Automatic Control.
- ◇ **Proposal Referee** for the Austrian Science Fund in 2014, the UK Royal Society in 2010, and the US National Science Foundation in 2009, 2007, and 2006.
- ◇ **Advisory Editorial Board** member for Quantum Measurements and Quantum Metrology (<http://www.degruyter.com/view/j/qmetro>) (April 2012–present)
- ◇ **Program Committee** member for PRACQSYS 2019 (Hong Kong, China, Dec 2019) and SPIE/COS Photonics Asia (Beijing, China, Oct 2016, Oct 2014).
- ◇ **Presider** for QCMC (Baton Rouge, Louisiana, USA, Mar 2018), PQE (Snowbird, Utah, USA, Jan 2017), PRACQSYS (Sydney, Australia, Jul 2015; Tokyo, Japan, Sep 2012), SPIE/COS Photonics Asia (Beijing, China, Oct 2014), APS March Meeting (Denver, Colorado, USA, Mar 2014), Croucher Advanced Study Institute (Hong Kong, China, Dec 2011), and CLEO/IQEC (Baltimore, Maryland, USA, Jun 2009).

GRANTS

- ◇ Quantum Engineering Programme, Singapore National Research Foundation (Apr 2019–Mar 2024)
- Project title: “Quantum Photonics for Superresolution Confocal Fluorescence Microscopy”
 - Total direct cost: SGD 2,137,700

- Lead PI (co-PIs: Aaron Danner, Minghui Hong, Pakorn Kanchanawong, Alexander Ling)
- ◇ Academic Research Fund Tier 1 Grant, Singapore Ministry of Education (Mar 2016–Feb 2019)
 - Project title: “Optimal Quantum Photonics for Imaging and Spectroscopy”
 - Total direct cost: SGD 170,000
 - Sole PI
- ◇ Singapore National Research Foundation Fellowship (Aug 2011–Aug 2016)
 - Project title: “General Theory of Quantum Sensors: Estimation, Control, and Fundamental Limit”
 - Total direct cost: SGD 2,818,000
 - Sole PI

JOURNAL PUBLICATIONS

Invited

3. Mankei Tsang,
“Resolving starlight: a quantum perspective,”
Contemporary Physics **60**, 279–298 (2019).
2. Mankei Tsang,
“Microwave photonics: Optomechanics sets the beat,”
Nature Physics **10**, 245–246 (2014).
 - ◇ News & Views article.
1. Mankei Tsang,
“Testing quantum mechanics: a statistical approach,”
Quantum Measurements and Quantum Metrology **1**, 84–109 (2013).

Peer-Reviewed

59. Mankei Tsang,
“Physics-inspired forms of the Bayesian Cramér-Rao bound,”
Physical Review A **102**, 062217 (2020).
 - ◇ Editors’ Suggestion [1].
58. Mankei Tsang, Francesco Albarelli, and Animesh Datta,
“Quantum Semiparametric Estimation,”
Physical Review X **10**, 031023 (2020).
57. Mankei Tsang,
“Semiparametric estimation for incoherent optical imaging,”
Physical Review Research **1**, 033006 (2019).
56. Mankei Tsang and Ranjith Nair,
“Resurgence of Rayleigh’s curse in the presence of partial coherence: comment,”
Optica **6**, 400 (2019).
55. Mankei Tsang,
“Quantum limit to subdiffraction incoherent optical imaging,”
Physical Review A **99**, 012305 (2019).
 - ◇ Editors’ Suggestion [1].
 - ◇ Covered by the APS *Physics Buzz* website [2].
54. Mankei Tsang,
“Subdiffraction incoherent optical imaging via spatial-mode demultiplexing: Semiclassical treatment,”
Physical Review A **97**, 023830 (2018).

53. Mankei Tsang,
“Quantum limits on the time-bandwidth product of an optical resonator,”
Optics Letters **43**, 150 (2018).
52. Fan Yang, Ranjith Nair, Mankei Tsang, Christoph Simon, and Alexander I. Lvovsky,
“Fisher information for far-field linear optical superresolution via homodyne or heterodyne detection in a higher-order local oscillator mode,”
Physical Review A **96**, 063829 (2017).
51. Mankei Tsang,
“Conservative classical and quantum resolution limits for incoherent imaging,”
Journal of Modern Optics **65**, 1385–1391 (2018).
 - ◇ Special issue for the 47th Winter Colloquium on the Physics of Quantum Electronics (PQE).
50. Shan Zheng Ang, Ranjith Nair, and Mankei Tsang,
“Quantum limit for two-dimensional resolution of two incoherent optical point sources,”
Physical Review A **95**, 063847 (2017).
49. Mankei Tsang,
“Subdiffraction incoherent optical imaging via spatial-mode demultiplexing,”
New Journal of Physics **19**, 023054 (2017).
48. Ranjith Nair and Mankei Tsang,
“Far-field Superresolution of Thermal Electromagnetic Sources at the Quantum Limit,”
Physical Review Letters **117**, 190801 (2016).
 - ◇ Editors’ Suggestion [3].
47. Mankei Tsang, Ranjith Nair, and Xiao-Ming Lu,
“Quantum Theory of Superresolution for Two Incoherent Optical Point Sources,”
Physical Review X **6**, 031033 (2016).
 - ◇ Selected for a Viewpoint article on the APS *Physics* website [4, 5].
 - ◇ Covered by the APS *Physics Buzz* website [6], the IoP *Physics World* website [7], and the *Phys.org* website [8].
 - ◇ Mentioned by news articles on the OSA *Optics & Photonics News* website [9] and the AAAS *EurekAlert!* website [10].
 - ◇ Chosen as #2 of top physics breakthroughs of 2016 by the Foundational Questions Institute (FQXi) podcast [11].
46. Xiao-Ming Lu and Mankei Tsang,
“Quantum Weiss-Weinstein bounds for quantum metrology,”
Quantum Science and Technology **1**, 015002 (2016).
45. Shilin Ng, Shan Zheng Ang, Trevor A. Wheatley, Hidehiro Yonezawa, Akira Furusawa, Elanor H. Huntington, and Mankei Tsang,
“Spectrum analysis with quantum dynamical systems,”
Physical Review A **93**, 042121 (2016).
44. Ranjith Nair and Mankei Tsang,
“Interferometric superlocalization of two incoherent optical point sources,”
Optics Express, **24**, 3684 (2016).
 - ◇ Covered by a news article in the *Laser Focus World* magazine [12].
43. Shawn Y. Siew, Soham S. Saha, Mankei Tsang, and Aaron J. Danner,
“Rib Microring Resonators in Lithium Niobate on Insulator,”
IEEE Photonics Technology Letters **28**, 573 (2016).
42. Mankei Tsang,
“Volterra filters for quantum estimation and detection,”
Physical Review A **92**, 062119 (2015).

41. Dominic W. Berry, Mankei Tsang, Michael J. W. Hall, and Howard M. Wiseman,
“The quantum Bell-Ziv-Zakai bounds and Heisenberg limits for waveform estimation,”
Physical Review X **5**, 031018 (2015).
40. Ranjith Nair and Mankei Tsang,
“Quantum Optimality of Photon Counting for Temperature Measurement of Thermal Astronomical Sources,”
The Astrophysical Journal **808**, 125 (2015).
39. Mankei Tsang,
“Quantum limits to optical point-source localization,”
Optica **2**, 646 (2015).
38. Trevor A. Wheatley, Mankei Tsang, Ian R. Petersen, and Elanor H. Huntington,
“Improved mirror position estimation using resonant quantum smoothing,”
EPJ Quantum Technology **2**, 13 (2015).
37. Shilin Ng and Mankei Tsang,
“Optimal signal processing for continuous qubit readout,”
Physical Review A **90**, 022325 (2014).
36. Shan Zheng Ang, Glen I. Harris, Warwick P. Bowen, and Mankei Tsang,
“Optomechanical parameter estimation,”
New Journal of Physics **15**, 103028 (2013).
35. Kohjiro Iwasawa, Kenzo Makino, Hidehiro Yonezawa, Mankei Tsang, Aleksandar Davidovic, Elanor Huntington,
and Akira Furusawa,
“Quantum-Limited Mirror-Motion Estimation,”
Physical Review Letters **111**, 163602 (2013).
34. Mankei Tsang,
“Quantum transition-edge detectors,”
Physical Review A **88**, 021801(R) (2013).
 ◇ Rapid Communication.
33. Mankei Tsang,
“Quantum metrology with open dynamical systems,”
New Journal of Physics **15**, 073005 (2013).
32. Mankei Tsang and Ranjith Nair,
“Fundamental quantum limits to waveform detection,”
Physical Review A **86**, 042115 (2012).
31. Mankei Tsang and Carlton M. Caves,
“Evading Quantum Mechanics: Engineering a Classical Subsystem within a Quantum Environment,”
Physical Review X **2**, 031016 (2012).
 ◇ Covered by an article on the *Ars Technica* website [13].
30. Mankei Tsang,
“Ziv-Zakai Error Bounds for Quantum Parameter Estimation,”
Physical Review Letters **108**, 230401 (2012).
29. Mankei Tsang,
“Continuous Quantum Hypothesis Testing,”
Physical Review Letters **108**, 170502 (2012).
 ◇ Editors’ Suggestion [3].
 ◇ Selected for a Synopsis on the APS *Physics* website [5, 14].
28. Mankei Tsang,
“Quantum Nonlocality in Weak-Thermal-Light Interferometry,”
Physical Review Letters **107**, 270402 (2011).
27. Mankei Tsang,
“Cavity quantum electro-optics. II. Input-output relations between traveling optical and microwave fields,”
Physical Review A **84**, 043845 (2011).

26. Mankei Tsang, Howard M. Wiseman, and Carlton M. Caves,
“Fundamental Quantum Limit to Waveform Estimation,”
Physical Review Letters **106**, 090401 (2011).
25. Laura Waller, Mankei Tsang, Sameera Ponda, Se Young Yang, and George Barbastathis,
“Phase and amplitude imaging from noisy images by Kalman filtering,”
Optics Express **19**, 2805 (2011).
24. Mankei Tsang and Carlton M. Caves,
“Coherent Quantum-Noise Cancellation for Optomechanical Sensors,”
Physical Review Letters **105**, 123601 (2010).
 - ◇ Featured in the “Editors’ Choice” section of the *Science* magazine [15].
23. Mankei Tsang,
“Cavity quantum electro-optics,”
Physical Review A **81**, 063837 (2010).
22. Mankei Tsang,
“Optimal waveform estimation for classical and quantum systems via time-symmetric smoothing. II. Applications to atomic magnetometry and Hardy’s paradox,”
Physical Review A **81**, 013824 (2010).
21. Mankei Tsang,
“Optimal waveform estimation for classical and quantum systems via time-symmetric smoothing,”
Physical Review A **80**, 033840 (2009).
20. Mankei Tsang,
“Time-Symmetric Quantum Theory of Smoothing,”
Physical Review Letters **102**, 250403 (2009).
19. Mankei Tsang,
“Quantum Imaging beyond the Diffraction Limit by Optical Centroid Measurements,”
Physical Review Letters **102**, 253601 (2009).
 - ◇ Editors’ Suggestion [3].
 - ◇ Selected for a Viewpoint article on the APS *Physics* website [5, 16].
18. Mankei Tsang, Jeffrey H. Shapiro, and Seth Lloyd,
“Quantum theory of optical temporal phase and instantaneous frequency. II. Continuous time limit and state-variable approach to phase-locked loop design,”
Physical Review A **79**, 053843 (2009).
17. Mankei Tsang, Jeffrey H. Shapiro, and Seth Lloyd,
“Quantum theory of optical temporal phase and instantaneous frequency,”
Physical Review A **78**, 053820 (2008).
16. Mankei Tsang,
“Fundamental Quantum Limit to Multiphoton Absorption Rate for Monochromatic Light,”
Physical Review Letters **101**, 033602 (2008).
15. Mankei Tsang and Demetri Psaltis,
“Magnifying perfect lens and superlens design by coordinate transformation,”
Physical Review B **77**, 035122 (2008).
14. Ye Pu, Jie Wu, Mankei Tsang, and Demetri Psaltis,
“Optical parametric generation in periodically poled KTiOPO_4 via extended phase matching,”
Applied Physics Letters **91**, 131120 (2007).
13. Mankei Tsang and Demetri Psaltis,
“Theory of resonantly enhanced near-field imaging,”
Optics Express **15**, 11959 (2007).
12. Mankei Tsang,
“Decoherence of quantum-enhanced timing accuracy,”
Physical Review A **75**, 063809 (2007).

11. Mankei Tsang,
“Relationship between resolution enhancement and multiphoton absorption rate in quantum lithography,”
Physical Review A **75**, 043813 (2007).
10. Mankei Tsang and Demetri Psaltis,
“Reflectionless evanescent wave amplification via two dielectric planar waveguides,”
Optics Letters **31**, 2741 (2006); Erratum: **32**, 86 (2007).
9. Mankei Tsang,
“Quantum Temporal Correlations and Entanglement via Adiabatic Control of Vector Solitons,”
Physical Review Letters **97**, 023902 (2006); Erratum: **99**, 049901(E) (2007).
8. Mankei Tsang,
“Spectral phase conjugation via extended phase matching,”
Journal of the Optical Society of America B **23**, 861 (2006).
7. Mankei Tsang and Demetri Psaltis,
“Propagation of temporal entanglement,”
Physical Review A **73**, 013822 (2006).
6. Martin Centurion, Ye Pu, Mankei Tsang, and Demetri Psaltis,
“Dynamics of filament formation in a Kerr medium,”
Physical Review A **71**, 063811 (2005); Erratum: **74**, 069902(E) (2006).
5. Mankei Tsang and Demetri Psaltis,
“Spontaneous spectral phase conjugation for coincident frequency entanglement,”
Physical Review A **71**, 043806 (2005).
4. Mankei Tsang and Demetri Psaltis,
“Spectral phase conjugation by quasi-phase-matched three-wave mixing,”
Optics Communications **242**, 659 (2004).
3. Mankei Tsang and Demetri Psaltis,
“Spectral phase conjugation with cross-phase modulation compensation,”
Optics Express **12**, 2207 (2004).
2. Mankei Tsang, Demetri Psaltis, and Fiorenzo G. Omenetto,
“Reverse propagation of femtosecond pulses in optical fibers,”
Optics Letters **28**, 1873 (2003).
1. Mankei Tsang and Demetri Psaltis,
“Dispersion and nonlinearity compensation by spectral phase conjugation,”
Optics Letters **28**, 1558 (2003).

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- [1] PRA Editors’ Suggestions are “a small number of papers published in *Physical Review A* that the editors and referees find of particular interest, importance, or clarity;” see <http://doi.org/10.1103/PhysRevA.88.020001>.
 - [2] K. Redmond, “We’re Nowhere Near the Limit on Telescope Resolution, According to New Physics,” APS Physics Central – Physics Buzz Blog (2018), <http://physicsbuzz.physicscentral.com/2018/12/were-nowhere-near-limit-on-telescope.html>.
 - [3] To promote reading across fields, the editors of *Physical Review Letters* offer “Suggestions” each week of papers that they hope will lead readers to explore other areas of physics; see <http://doi.org/10.1103/PhysRevLett.118.030001>.
 - [4] G. Durkin, “Viewpoint: Unlocking the hidden information in starlight,” *Physics* **9**, 100 (2016), <http://dx.doi.org/10.1103/Physics.9.100>.
 - [5] *Physics* is an online American Physical Society publication that “spotlights exceptional research;” see <http://physics.aps.org/> and <http://journals.aps.org/edannounce/PhysRevLett.101.120001>.
 - [6] K. Redmond, “Resolving Starlight with Quantum Technology,” APS Physics Central – Physics Buzz Blog (2016), <http://physicsbuzz.physicscentral.com/2016/08/resolving-starlight-with-quantum.html>.
 - [7] E. Cartlidge, “Tapping into light’s hidden information to push fundamental diffraction limit,” IoP Physics World and nanotechweb.org (2016), <https://physicsworld.com/a/tapping-into-lights-hidden-information-to-push-fundamental-diffraction-limit/>.
 - [8] B. Yirka, “Quantum mechanics technique allows for pushing past ‘Rayleigh’s curse,’” *Phys.org* (2016), <http://phys.org/news/2016-09-quantum-mechanics-technique-rayleigh-curse.html>.
 - [9] P. Daukantas, “Beating Rayleigh with quantum mechanics,” OSA Optics & Photonics News (2016), <http://www.osa-opn.org/news/rayleigh-limit/>.

- [10] University of Toronto, “Physicists harness neglected properties of light,” AAAS EurekAlert! (2017), https://www.eurekalert.org/pub_releases/2017-02/uot-uot021517.php.
- [11] The Foundational Questions Institute (FQXi), “December 31, 2016 Podcast – 2016 Countdown Part 2,” Online (2016), <https://fqxi.org/community/podcast/2016.12.31>.
- [12] J. Wallace, “SLIVER to determine separation of two sources closer than Rayleigh limit,” *Laser Focus World* **52** (2016), <http://www.laserfocusworld.com/articles/print/volume-52/issue-01/newsbreaks/sliver-to-determine-separation-of-two-sources-closer-than-rayleigh-limit.html>.
- [13] C. Lee, “Demolishing Heisenberg with clever math and experiments,” *Ars Technica* (2012), <http://arstechnica.com/science/2012/09/demolishing-heisenberg-with-clever-math-and-experiments/>.
- [14] D. Voss, “Synopsis: Quantum Testing,” *Physics* (2012), <http://physics.aps.org/synopsis-for/10.1103/PhysRevLett.108.170502>.
- [15] I. S. Osborne, “Calling for a Quantum Hush,” *Science* **330**, 13 (2010), <http://science.sciencemag.org/content/330/6000/twil>.
- [16] P. M. Anisimov and J. P. Dowling, “Viewpoint: Super resolution with superposition,” *Physics* **2**, 52 (2009), <http://dx.doi.org/10.1103/Physics.2.52>.

CONFERENCES ¹

Invited

33. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Resolving starlight: a quantum perspective,”
Oral Presentation, the First Quantum Science, Engineering and Technology Conference (qSET), Canberra, Australia, Apr 9, 2019.
32. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum-inspired measurements for subdiffraction incoherent optical imaging,”
Oral Presentation, the Fifth Workshop on Scalable Information Processing with Quantum Nano-Photonics (SIPQNP), Tucson, Arizona, USA, Mar 26, 2019.
31. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum metrology for subdiffraction incoherent optical imaging,”
Oral Presentation, Symposium on Novel Perspectives in Quantum Metrology, German Physical Society (DPG) Spring Meeting, Rostock, Germany, Mar 15, 2019, SYQM 1.1.
30. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Seize the moments: enhancing moment estimation for subdiffraction incoherent imaging,”
Oral Presentation, the Fourteenth Singapore-China Physics Frontier Symposium, Shanghai, China, Sep 26, 2018.
29. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Seize the moments: enhancing moment estimation for subdiffraction incoherent imaging,”
Oral Presentation, the Twelfth International Workshop on Principles and Applications of Control in Quantum Systems (PRACQSYS), Paris, France, Jul 5, 2018.
28. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Seize the moments: enhancing moment estimation for subdiffraction incoherent imaging,”
Oral Presentation, the Fourteenth International Conference on Quantum Communication, Measurement and Computing (QCMC), Baton Rouge, Louisiana, USA, Mar 15, 2018.
27. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Subdiffraction incoherent imaging: statistical and quantum approaches,”
Oral Presentation, the 39th Progress in Electromagnetics Research Symposium (PIERS), Singapore, Nov 21, 2017.
26. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum information kills Rayleigh’s criterion,”
Oral Presentation, Conference on Quantum Information and Quantum Control VII, Toronto, Canada, Aug 29, 2017.
25. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum information kills Rayleigh’s criterion,”
Oral Presentation, the 26th Annual International Laser Physics Workshop (LPHYS), Kazan, Russia, Jul 19, 2017.

¹ **bold names** denote presenters.

24. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum theory of superresolution for incoherent optical imaging,”
Oral Presentation, American Physical Society March Meeting 2017, New Orleans, Louisiana, USA, Mar 17, 2017,
abstract X51.00001.
23. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum theory of superresolution for incoherent optical imaging,”
Oral Presentation, WE-Heraeus Seminar on Quantum-Limited Metrology and Sensing, Bad Honnef, Germany, Feb
7, 2017.
22. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum theory of superresolution for incoherent optical imaging,”
Plenary Talk, the 47th Winter Colloquium on the Physics of Quantum Electronics, Snowbird, Utah, USA, Jan 12,
2017.
21. **Mankei Tsang**, Ranjith Nair, and Xiao-Ming Lu,
“Quantum information for semiclassical optics,”
Oral Presentation, Quantum and Nonlinear Optics IV Conference, SPIE/COS Photonics Asia 2016, Beijing, China,
Oct 12, 2016.

 - ◇ Invited paper in Proc. SPIE **10029**, Quantum and Nonlinear Optics IV, 1002903 (2016).
20. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum metrology kills Rayleigh’s criterion,”
Oral Presentation, the Fourth Biennial China-Australia Quantum Control Workshop, Hefei, China, Sep 28, 2016.
19. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum metrology kills Rayleigh’s criterion,”
Oral Presentation, Advances in Optical Metrology Symposium, Nottingham, UK, Jun 14, 2016.
18. Ranjith Nair, Xiao-Ming Lu, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum metrology kills Rayleigh’s criterion,”
Oral Presentation, Recent Advances in Quantum Metrology Workshop, Warsaw, Poland, Mar 4, 2016.
17. Shilin Ng, Shan Zheng Ang, and **Mankei Tsang**,
“Quantum spectroscopy,”
Oral Presentation, the Tenth International Workshop on Principles and Applications of Control in Quantum Systems
(PRACQSYS), Sydney, Australia, Jul 20, 2015.
16. **Mankei Tsang**,
“Evading quantum mechanics,”
Oral Presentation, EQuS Optomechanics Incubator, Sydney, Australia, Dec 3, 2014.
15. **Mankei Tsang**,
“Quantum theory of optical sensing: estimation, control, and fundamental limits,”
Oral Presentation, Quantum and Nonlinear Optics III Conference, SPIE/COS Photonics Asia 2014, Beijing, China,
Oct 9, 2014.
14. **Mankei Tsang**,
“Continuous quantum hypothesis testing,”
Keynote Talk, the Third Biennial China-Australia Quantum Control Workshop, Brisbane, Australia, Sep 30, 2014.
13. **Mankei Tsang**,
“Quantum transition-edge detectors,”
Oral Presentation, the Eighth International Workshop on Principles and Applications of Control in Quantum Sys-
tems (PRACQSYS), Monterey, California, USA, Aug 23, 2013.
12. **Mankei Tsang**,
“Quantum Waveform Detection Theory,”
“Quantum Waveform Estimation Theory,”
“Quantum Microwave Photonics,”
Oral Presentations, the Seventh Winter School on Quantum Information Science, National Cheng Kung University,
Taiwan, Republic of China, Feb 28–Mar 2, 2013.

11. **Mankei Tsang**,
“Fundamental quantum limits to waveform sensing,”
Oral Presentation, the Fourth Workshop on Quantum Information Science, Hong Kong, China, Dec 28, 2012.
10. **Mankei Tsang**,
“Fundamental quantum limits to waveform sensing,”
Oral Presentation, the Seventh International Workshop on Principles and Applications of Control in Quantum Systems (PRACQSYS), Tokyo, Japan, Sep 13, 2012.
9. **Mankei Tsang**,
“Quantum limits on sensing and imaging,”
Oral Presentation, the Keck Institute for Space Studies (KISS) Workshop on Quantum Communication, Sensing and Measurement in Space, Pasadena, California, USA, Jun 28, 2012.
8. **Mankei Tsang**,
“Quantum limit to waveform estimation,”
Oral Presentation, MIT Center for Extreme Quantum Information Theory Conference 2011, Cambridge, Massachusetts, USA, May 3, 2011.
7. **Mankei Tsang** and Carlton M. Caves,
“Coherent quantum noise cancellation for opto-mechanical sensors,”
Oral Presentation, Los Alamos National Laboratory Quantum Workshop 2010, Los Alamos, New Mexico, USA, Apr 28, 2010.
6. **Mankei Tsang**,
“Quantum sensing and imaging,”
Oral Presentation, Office of Naval Research Conference on Entanglement beyond the Optical Regime, Anaheim, California, USA, Feb 8, 2010.
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27. “Resolving Starlight: A Quantum Perspective,”
AP 483 Seminar, Stanford University, USA, Nov 16, 2020.
26. “Resolving Starlight: A Quantum Perspective,”
Special Lecture, College of Optical Sciences, University of Arizona, USA, Mar 28, 2019.
25. “Seize the Moments: Enhancing Moment Estimation for Subdiffraction Incoherent Imaging,”
Seminar, Kastler Brossel Laboratory, Paris, France, Jul 3, 2018.
24. “Seize the Moments: Enhancing Moment Estimation for Subdiffraction Incoherent Imaging,”
Seminar, Department of Physics, University of Toronto, Canada, Sep 5, 2017.
23. “Quantum Metrology Kills Rayleigh’s Criterion,”
Seminar, Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology, Chengdu, China, Sep 28, 2016.
22. “Quantum Theory of Superresolution for Incoherent Optical Imaging,”
Seminar, Department of Mathematics, National University of Singapore, Singapore, Sep 14, 2016.
21. “Introduction to Quantum Metrology,”
Lecture, University of Nottingham, UK, Jun 13, 2016.
20. “Killing Rayleigh’s Criterion by Farfield Linear Photonics,”
Seminar, Department of EECS, University of California - Berkeley, USA, Jun 2, 2016.
19. “Killing Rayleigh’s Criterion by Quantum Measurements,”
Seminar, Centre for Quantum Technologies, Singapore, Nov 18, 2015.
18. “Resonantly Enhanced Microwave Photonics: Coupling Microwave Circuits and Optics via Cavity Electro-Optic Modulators,”
Seminar, Institute of Modern Optics, Peking University, Beijing, China, Oct 12, 2014.
17. “Quantum Metrology for Dynamical Systems,”
Seminar, Center for Quantum Information and Control, University of New Mexico, USA, Feb 27, 2014.
16. “Quantum Microwave Photonics,”
“Quantum Waveform Detection Theory,”
“Quantum Waveform Estimation Theory,”
Seminars, RIKEN Institute, Wako, Japan, Feb 14, 21, 25, 2013.
15. “Continuous Quantum Hypothesis Testing,”
Colloquium, Department of Applied Mathematics, the Hong Kong Polytechnic University, China, Jan 7, 2013.
14. “Quantum Microwave Photonics,”
Seminar, A*STAR Data Storage Institute, Singapore, Apr 20, 2012.
13. “Theory of Quantum Sensing: Fundamental Limits, Estimation, and Control,”
Seminar, Centre for Quantum Technologies, Singapore, Oct 18, 2011.
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6. “Theory of Quantum Sensing: Fundamental Limits, Estimation, and Control,”
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5. “Estimation, Control, and Fundamental Limit of Quantum Sensing,”
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4. “Fundamental Quantum Limit to Waveform Estimation,”
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