

Keisuke Goda

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CITIZENSHIP Japan

RESEARCH INTERESTS Optoelectronics for biomedical and defense applications

EDUCATION **Massachusetts Institute of Technology**, Cambridge, MA

Ph.D., Physics, August 2007

- Thesis: Development of techniques for quantum-enhanced laser-interferometric gravitational-wave detectors
- Advisor: Professor Nergis Mavalvala
- Area of Study: Quantum optics, optical engineering, astrophysics

University of California, Berkeley, Berkeley, CA

B.S., Physics, May 2001

- *Summa cum Laude*, With the Highest Honors in Physics
- GPA: 4.0

De Anza College, Cupertino, CA

A.S., Physics, June 1999

- *Summa cum Laude*, With the Highest Honors in Physics
- GPA: 4.0

AWARDS

- Gravitational Wave International Committee Thesis Award, 2008
- Optical Society of America's New Focus/Bookham Award Finalist, 2007
- SPIE (International Society for Optical Engineering)'s Laser Technology, Engineering, and Applications Scholarship from Forum for Military Applications of Directed Energy, 2005
- JAXA (Japan Aerospace Exploration Agency) Satellite Design Contest Grand Prize, 2002
- MIT Graduate Research Poster Competition Award, 2002
- Watters Scholarship from UC Berkeley, 2000
- Pomerants Scholarship from UC Berkeley, 2000
- Centuria of Excellence from Undergraduate Merit Award Program, 2000
- Robert DeHart Memorial Scholarship from De Anza College, 1999
- FODARA Scholarship from De Anza College, 1999
- AMATEC Mathematics Award, 1999

PROFESSIONAL EXPERIENCE **Photonics Laboratory, University of California, Los Angeles**, Los Angeles, CA
Postdoctoral Fellow **December 2007 to Present**

- Developed a novel ultrafast imaging technology known as serial time-encoded amplified imaging
- Developed a novel technique that enables simultaneous imaging and laser surgery without mechanical scanning
- Developed a theory of amplified dispersive Fourier transformation
- Developed a novel ultrafast optical reflectometer
- Developed a novel ultrafast barcode reader
- Developed a novel ultrafast displacement sensor
- Wrote grant proposals for National Science Foundation (NSF), National Institute of Health (NIH), Defense Advanced Research Projects Agency (NSF), and Department of Defense
- Supervised graduate and undergraduate students
- Initiated collaboration with private companies and UCLA Medical School

LIGO Laboratory, California Institute of Technology, Pasadena, CA

Visiting Scientist

January 2006 to August 2007

- Formed a collaboration team between MIT and Caltech
- Demonstrated the generation of squeezed states using a new type of crystal
- Demonstrated quantum enhancement in a prototype laser-interferometric gravitational wave detector

LIGO Laboratory, Massachusetts Institute of Technology, Cambridge, MA

Research Assistant

September 2001 to August 2007

- Participated in the development of laser-interferometric gravitational-wave detectors in the Laser Interferometer Gravitational-Wave Observatory (LIGO) group
- Developed techniques to enhance the quantum noise limited sensitivity of laser-interferometric gravitational wave detectors
- Developed improved techniques to generate squeezed states of light
- Demonstrated quantum enhancement in a prototype laser-interferometric gravitational wave detector in collaboration with Caltech
- Developed a novel frequency-resolving spatiotemporal wavefront sensor
- Installed a frequency-resolving spatiotemporal wavefront sensor in one of the LIGO detectors
- Developed a theory of displacement-noise-free interferometers for gravitational-wave detection

Spectroscopy Laboratory, Massachusetts Institute of Technology, Cambridge, MA

Visiting Scientist

June 2005 to November 2006

- Participated in the development of a novel Hilbert phase microscope in MIT Spectroscopy Laboratory
- Implemented a feedback control system into the Hilbert phase microscope to improve its sensitivity

TECHNICAL SKILLS Extensive hardware and software experience in both experimental and theoretical physics and engineering

Instrumentation: development of optical and electrical instruments including lasers and detectors for imaging, spectroscopy, and high-precision measurement

Programming: C, Matlab, LabView, Mathematica

PROFESSIONAL
OUTREACH

IEEE Photonics Society Los Angeles Chapter, Los Angeles, CA

Co-Chair

December 2007 to Present

- Provided opportunities for information exchange and continuing education on timely topics
- Sponsored special events and supported student activities

Southern California Science Network @ UCLA, Los Angeles, CA

Chair

December 2007 to Present

- Provided opportunities for information exchange and continuing education in science, engineering, and medicine
- Sponsored special events

PUBLICATIONS

- K. Goda, K. K. Tsia, and B. Jalali, "Serial time-encoded amplified imaging for real-time observation of fast dynamic phenomena," *Nature* 458, 1145 (2009)
- K. Goda, the LIGO Collaboration, and the VIRGO Collaboration, "An upper limit on the stochastic gravitational-wave background of cosmological origin," *Nature* 460, 990 (2009)
- K. K. Tsia, K. Goda, D. Capewell, and B. Jalali, "Simultaneous mechanical-scan-free confocal microscopy and laser microsurgery," *Optics Letters* 34, 2099 (2009)
- K. Goda and the LIGO Collaboration, "All-sky LIGO search for periodic gravitational waves in the early fifth-science-run data," *Physical Review Letters* 102, 111102 (2009)
- K. Goda and the LIGO Collaboration, "LIGO: the laser interferometer gravitational-wave observatory," *Reports on Progress in Physics* 72, 076901 (2009)
- K. Goda and the LIGO Collaboration, "Einstein@Home search for periodic gravitational waves in LIGO S4 data," *Physical Review D* 79, 022001 (2009)
- K. Goda and the LIGO Collaboration, "Einstein@Home search for periodic gravitational waves in early S5 LIGO data," *Physical Review D* 80, 042003 (2009)
- K. Goda and the LIGO Collaboration, "Search for gravitational waves from low mass binary coalescences in the first year of LIGOs S5 data," *Physical Review D* 79, 122001 (2009)
- K. Goda and the LIGO Collaboration, "Stacked search for gravitational waves from the 2006 SGR 1900+14 storm," *Astrophysical Journal Letters* 701, L68 (2009)
- K. Goda and the LIGO Collaboration, "Observation of a kilogram-scale oscillator near its quantum ground state," *New Journal of Physics* 11, 073032 (2009)
- K. Goda, K. K. Tsia, and B. Jalali, "Amplified dispersive Fourier-transform imaging for ultrafast displacement sensing and barcode reading," *Applied Physics Letters* 93, 131109 (2008)
- K. Goda, D. R. Solli, and B. Jalali, "Real-time optical reflectometry enabled by amplified dispersive Fourier transformation," *Applied Physics Letters* 93, 031106 (2008)
- K. Goda, O. Miyakawa, E. E. Mikhailov, S. Saraf, R. Adhikari, K. McKenzie, R. Ward, S. Vass, A. J. Weinstein, and N. Mavalvala, "A quantum-enhanced prototype gravitational-wave detector," *Nature Physics* 4, 472 (2008)
- K. Goda, E. E. Mikhailov, O. Miyakawa, S. Saraf, S. Vass, A. J. Weinstein, and N. Mavalvala, "Generation of a stable low-frequency squeezed vacuum field with periodically-poled KTiOPO4 at 1064 nm," *Optics Letters* 33, 92 (2008)
- K. Goda and the LIGO Collaboration, "Search for gravitational-wave bursts from soft gamma repeaters," *Physical Review Letters* 101, 211102 (2008)

- K. Goda and the LIGO Collaboration, "Search for S3 LIGO data for gravitational wave signals from spinning black hole and neutron star binary inspirals," *Physical Review D* 78, 042002 (2008)
- K. Goda and the LIGO Collaboration, "Search for gravitational waves from binary inspirals in S3 and S4 LIGO data," *Physical Review D* 77, 062002 (2008)
- K. Goda and the LIGO Collaboration, "Search for gravitational waves associated with 39 gamma-ray bursts using data from the second, third, and fourth LIGO runs," *Physical Review D* 77, 062004 (2008)
- K. Goda and the LIGO Collaboration, "First cross-correlation analysis of interferometric and resonant-bar gravitational-wave data for stochastic backgrounds," *Physical Review D* 77, 022001 (2008)
- K. Goda and the LIGO Collaboration, "Implications for the origin of GRB 070201 from LIGO observations," *Astrophysical Journal* 681, 1419 (2008)
- K. Goda and the LIGO Collaboration, "Beating the spin-down limit on gravitational wave emission from the Crab Pulsar" *Astrophysical Journal Letters* 683, L45 (2008)
- K. Goda and the LIGO Collaboration, "A joint search for gravitational wave bursts with AURIGA and LIGO," *Classical and Quantum Gravity* 25, 095004 (2008)
- K. Goda and the LIGO Collaboration, "First joint search for gravitational-wave bursts in LIGO and GEO 600 data," *Classical and Quantum Gravity* 25, 245008 (2008)
- K. Somiya, K. Goda, Y. Chen, and E. E. Mikhailov, "Utility investigation of artificial time delay in displacement-noise-free interferometers," *Physical Review D* 76, 022002 (2007)
- K. Goda and the LIGO Collaboration, "Searches for periodic gravitational waves from unknown isolated sources and Scorpius X-1: results from the second LIGO science run," *Physical Review D* 76, 082001 (2007)
- K. Goda and the LIGO Collaboration, "Search for gravitational wave radiation associated with the pulsating tail of the SGR 1806-20 hyperflare of 27 December 2004 using LIGO," *Physical Review D* 76, 062003 (2007)
- K. Goda and the LIGO Collaboration, "Upper limits on gravitational wave emission from 78 radio pulsars," *Physical Review D* 76, 042001 (2007)
- K. Goda and the LIGO Collaboration, "Upper limit map of a background of gravitational waves," *Physical Review D* 76, 082003 (2007)
- K. Goda and the LIGO Collaboration, "First cross-correlation analysis of interferometric and resonant-bar gravitational-wave data for stochastic backgrounds," *Physical Review D* 76, 022001 (2007)
- K. Goda and the LIGO Collaboration, "Search for gravitational-wave bursts in LIGO data from the fourth science run," *Classical and Quantum Gravity* 24, 5343 (2007)
- K. Goda and the LIGO Collaboration, "Searching for a stochastic background of gravitational waves with LIGO," *Astrophysical Journal* 659, 918 (2007)
- G. Popescu, T. Ikeda, K. Goda, C. A. Best, M. Laposata, S. Manley, R. R. Dasari, K. Badizadegan, and M. Feld, "Optical measurement of cell membrane tension," *Physical Review Letters* 97, 218101 (2006)
- Y. Chen, A. Pai, K. Somiya, S. Kawamura, S. Sato, K. Kokeyama, R. L. Ward, K. Goda, and E. E. Mikhailov, "Interferometers for displacement-noise-free gravitational-wave detection," *Physical Review Letters* 97, 151103 (2006)
- E. E. Mikhailov, K. Goda, and N. Mavalvala, "Noninvasive measurements of cavity parameters by use of squeezed vacuum," *Physical Review A* 74, 033817 (2006)
- E. E. Mikhailov, K. Goda, T. Corbitt, and N. Mavalvala, "Frequency-dependent squeeze-amplitude attenuation and squeeze-angle rotation by electromagnetically induced transparency for gravitational-wave interferometers," *Physical Review A* 73, 053810 (2006)
- K. Goda and the LIGO Collaboration, "Joint LIGO and TAMA300 search for gravitational waves from inspiralling neutron star binaries," *Physical Review D* 73, 102002

(2006)

- K. Goda and the LIGO Collaboration, "Search for gravitational waves from binary black hole inspirals in LIGO data," *Physical Review D* 72, 062001 (2006)
- K. Goda and the LIGO Collaboration, "Search for gravitational-wave bursts in LIGOs third science run," *Classical and Quantum Gravity* 23, S29 (2006)
- K. McKenzie, E. E. Mikhailov, K. Goda, P. K. Lam, N. Grosse, M. B. Gray, N. Mavalvala, and D. E. McClelland, "Quantum noise locking," *Journal of Optics B: Quantum and Semiclassical Optics* 7, S421 (2005)
- K. Goda, K. McKenzie, E. E. Mikhailov, P. K. Lam, D. E. McClelland, and N. Mavalvala, "Photothermal fluctuations as a fundamental limit to low-frequency squeezing in a degenerate optical parametric oscillator," *Physical Review A* 72, 043819 (2005)
- K. Goda and the LIGO Collaboration, "Upper limits on a stochastic background of gravitational waves," *Physical Review Letters* 95, 221101 (2005)
- K. Goda and the LIGO Collaboration, "Limits on gravitational-wave emission from selected pulsars using LIGO data," *Physical Review Letters* 94, 181103 (2005)
- K. Goda and the LIGO Collaboration, "Search for gravitational waves associated with the gamma ray burst GRB030329 using the LIGO detectors," *Physical Review D* 72, 042002 (2005)
- K. Goda and the LIGO Collaboration, "Upper limits on gravitational wave bursts in LIGOs second science run," *Physical Review D* 72, 062001 (2005)
- K. Goda and the LIGO Collaboration, "Upper limits from the LIGO and TAMA detectors on the rate of gravitational-wave bursts," *Physical Review D* 72, 122004 (2005)
- K. Goda and the LIGO Collaboration, "Search for gravitational waves from galactic and extra-galactic binary neutron stars," *Physical Review D* 72, 082001 (2005)
- K. Goda and the LIGO Collaboration, "Search for gravitational waves from primordial black hole binary coalescences in the galactic halo," *Physical Review D* 72, 082002 (2005)
- K. Goda and the LIGO Collaboration, "First all-sky upper limits from LIGO on the strength of periodic gravitational waves using the Hough transform," *Physical Review D* 72, 102004 (2005)
- K. Goda, D. Ottaway, B. Connelly, R. Adhikari, N. Mavalvala, and A. Gretarsson, "Frequency resolving spatiotemporal wavefront sensor," *Optics Letters* 29, 1452 (2004)
- K. Goda and the LIGO Collaboration, "First upper limits from LIGO on gravitational wave bursts," *Physical Review D* 69, 102001 (2004)
- K. Goda and the LIGO Collaboration, "Analysis of LIGO data for gravitational waves from binary neutron stars," *Physical Review D* 69, 122001 (2004)
- K. Goda and the LIGO Collaboration, "Setting upper limits on the strength of periodic gravitational waves from PSR J1939+2134 using the first science data from the GEO 600 and LIGO detectors," *Physical Review D* 69, 082004 (2004)
- K. Goda and the LIGO Collaboration, "Analysis of first LIGO science data for stochastic gravitational waves," *Physical Review D* 69, 122004 (2004)
- K. Goda and the LIGO Collaboration, "Detector description and performance for the first coincidence observations between LIGO and GEO," *Nuclear Instruments and Methods in Physics Research Section A* 517, 154 (2004)

PATENTS

- Apparatus and method for multiple-pulse impulsive stimulated Raman spectroscopy, UC2010-116 (UC Provisional), 2009
- Apparatus and method for dispersive Fourier-transform imaging, UC09-045 (UC Provisional), 2008
- Apparatus and method for optically amplified serial imaging, UC09-280 (UC Provisional), 2008

- Apparatus and method for optically amplified multi-dimensional spectrally encoded imaging, UC09-275 (UC Provisional), 2008

PRESENTATIONS

- Serial time-encoded amplified microscopy (STEAM) for detection of rogue events, Department of Pediatrics, UCLA, Los Angeles, California, 2009 (invited)
- Serial time-encoded amplified microscopy (STEAM) toward high-throughput identification and enumeration of rare cells, Conference on Lasers and Electro Optics (CLEO), Munich, Germany, 2009
- Serial time-encoded amplified microscopy (STEAM), Optical Society of America's Novel Techniques in Microscopy (NTM) Conference, Vancouver, Canada, 2009
- Mechanical-scan-free laser microsurgery with simultaneous spectrally-encoded confocal microscopy, Optical Society of America's Novel Techniques in Microscopy (NTM) Conference, Vancouver, Canada, 2009
- Research activities at UCLA Photonics Laboratory, Olympus Corporation, Tokyo, Japan, 2008 (invited)
- Amplified dispersive Fourier-transform imaging for ultrafast displacement sensing and barcode reading, IEEE Photonics Society Annual Meeting, Newport, California, 2008
- Quantum enhancement in laser-interferometric gravitational wave detectors, NASA Jet Propulsion Laboratory, Pasadena, California, 2007 (invited)
- Laser Interferometer Gravitational-Wave Observatory (LIGO), Hamamatsu Photonics, Shizuoka, Japan, 2007 (invited)
- Toward first experimental demonstration of squeezing-enhanced gravitational wave interferometry, 40m Squeezing Informative Session, Caltech, Pasadena, California, 2006
- Development of a stable low-frequency squeezed vacuum source for gravitational wave interferometers, Caltech Special LIGO Seminar, Caltech, Pasadena, California, 2005 (invited)
- Development of a stable low-frequency squeezed vacuum source for gravitational wave interferometers, National Astronomical Observatory, Tokyo, Japan, 2005
- Development of a stable low-frequency squeezed vacuum source for gravitational wave interferometers, SPIE Fluctuations and Noise, Austin, Texas, 2005
- How to squeeze in 60 days, LIGO at MIT, Cambridge, Massachusetts, 2004
- Quantum noise in LIGO, Astrograd Lunch Talk at MIT, Cambridge, Massachusetts, 2003
- Generation of squeezed light and measurement schemes, LIGO at MIT, Cambridge, Massachusetts, 2002

PRESS COVERAGE

- Photonics Spectra - "Two tools in one – Technique enables simultaneous imaging and laser surgery without mechanical scanning," 2009
- Nature News - "World's fastest camera," 2009
- BBC News - "Debut for world's fastest camera," 2009
- Wired Magazine - "Fastest camera ever built uses lasers," 2009
- Discover Magazine - "World's fastest camera snaps 6 million pictures in a single ...," 2009
- UCLA Newsroom - "World's fastest camera relies on an entirely new type of imaging," 2009
- Nature Abstractions - "First author," 2009
- PhysicsWorld - "New camera 1000 times faster than competitors," 2009
- gurdian.co.uk - "Meet the world's fastest camera," 2009
- PhysOrg - "World's fastest camera relies on new type of imaging, takes 6 million ...," 2009

2009

- Jiji.com - "World's fastest camera developed at UCLA," 2009
- Yahoo Japan Headline News - "World's fastest camera developed at UCLA," 2009
- Livedoor News - "World's fastest camera developed at UCLA," 2009
- Gizmodo - "World's fastest camera uses lasers to boost images," 2009
- Inovacao Tecnologica - "Camera mais rapida do mundo usa lasers e nao tem CCD," 2009
- Romandie News - "Six millions d'images par seconde pour filmer des ..," 2009
- Slashdot - "Scientists build world's fastest camera," 2009
- LaserFocusWorld - "World's fastest camera uses new type of imaging to capture ..," 2009
- Amateur Photographer - "Fastest camera could help fight cancer ..," 2009
- techradar.com - "World's fastest camera shoots 6 million fps," 2009
- American Scientist - "Debut for world's fastest camera," 2009
- redOrbit - "Researchers unveil world's fastest camera," 2009
- ScienceDaily - "World's fastest camera relies on entirely new type of imaging," 2009
- ePHOTOzine - "World's fastest camera," 2009
- e! Science News - "World's fastest camera relies on an entirely new type of ..," 2009
- azo optics - "Novel continuously running camera that captures images roughly ..," 2009
- California NanoSystems Institute - "World's fastest camera developed by team ..," 2009
- Science Centric - "World's fastest camera relies on an entirely new type of imaging," 2009
- nanowerk - "World's fastest camera relies on new type of imaging," 2009
- Buzz7 - "World's fastest camera can capture 6 million snaps in a second," 2009
- LabSpaces - "World's fastest camera relies on an entirely new type of imaging," 2009
- Gizmo Watch - "Fastest camera in the world developed with STEAM," 2009
- current.com - "World's fastest camera," 2009
- msn.com - "World's fastest camera shoots 6 million fps," 2009
- TopNews.in - "World's fastest camera can capture 6 milion snaps in a second," 2009
- Wired Vision - "World's fastest camera developed by Keisuke Goda at UCLA," 2009
- Livedoor News - "Realization of world's fastest camera," 2009
- Goo Business EX - "Realization of world's fastest camera," 2009
- optics.org - "Camera snaps at record speed," 2009
- Zeenews - "World's fastest camera captures 6 million pics a sec," 2009
- MailOnline - "Quick as a flash: world's fastest camera takes six million images ..," 2009
- photonics.com - "Imaging at 6 million fps," 2009
- Nanotechnology Now - "World's fastest camera relies on an entirely new type of ..," 2009
- UC Newsroom - "World's fastest camera relies on new type of imaging," 2009
- innovations report - "World's fastest camera relies on an entirely new type of ..," 2009
- cnet news - "Crazy-fast camera shoots at 6.1 million frames per second," 2009
- R&D Magazine - "World's fastest camera grabs 6 million frames per second," 2009
- nanotechwire.com - "World's fastest camera relies on an entirely new type of ..," 2009
- Imaging & Microscopy - "New type of imaging: fastest camera," 2009
- Galicia-Hoxe.com - "Steam, a mellora do sistema CCD das camaras," 2009
- Wicked Magazine - "La camara mas rapida de la historia," 2009
- china.com - "World's fastest camera," 2009
- California Chronicle - "Fastest camera ever built uses lasers," 2009
- The British Journal of Photography - "Full steam ahead for light fast camera," 2009

- Product Design & Development - "Fast camera relies on new type of imaging," 2009
- 2Physics - "World's fastest continuously running camera," 2009
- Optics & Photonics News (OPN) - "Ultrafast imaging captures fleeting phenomena," 2009
- LaserFocusWorld - "World's fastest camera images with time-domain data ..," 2009
- CAPA - "A Japanese scientist at UCLA invents the world's fastest camera," 2009
- Nature News - "Gravity waves around the corner," 2009
- NSF Press Release - "LIGO listens for gravitational echoes of the birth of the ..," 2009
- Yahoo News - "Lack of gravity waves puts limits on exotic cosmology theories," 2009
- MSNBC - "Lack of gravity waves limits cosmology theories," 2009
- Caltech Media Relations - "LIGO listens for gravitational echoes of the birth of the ..," 2009
- PhysOrg - "Listening for gravitational echoes of the universe's birth," 2009
- Wired Magazine - "New improved bar code readers, now 1000 times faster," 2008
- ABC7, "Ultra-fast bar code reader at UCLA," 2008
- PhysOrg - "Researchers develop world's fastest bar code reader," 2008
- Nature - The Great Beyond - "World's fastest barcode reader," 2008
- Barcode.com - "UCLA creates the fastest barcode scanner in the world," 2008
- UCLA Today - "Researchers develop world's fastest bar code reader," 2008
- UCLA Newsroom - "UCLA researchers develop world's fastest bar code reader," 2008
- KTLA - "World's fastest bar code reader invented," 2008
- Daily Bruin - "UCLA develops fastest barcode reader," 2008
- Channel 42 - "World's fastest barcode reader," 2008
- PhysicsWorld - "Prototype gravitational-wave detector uses squeezed light," 2008
- 2Physics - "Beating the quantum limit in gravitational wave detectors," 2008
- Nature Physics News and Views - "Gravitational wave detectors: squeezing up ..," 2008
- PhysOrg - "Squeezed light may improve gravitational wave detectors," 2008
- Universe Today - "Can light be squeezed to improve sensitivity of ..?," 2008
- R&D Magazine - "Putting the squeeze on light for unheard-of accuracy," 2008
- Gravitational Wave International Committee - "2007 GWIC Thesis Prize," 2008
- Lighthouse - "Working in the US," 2008
- MIT News - "MIT technique reveals inner lives of red blood cells," 2006
- nanotechwire.com - "MIT technique reveals inner lives of red blood cells," 2006
- R&D Magazine - "Unlocking a cell's inner secrets," 2006
- PhysOrg - "MIT technique reveals inner lives of red blood cells," 2006