

AKIO KAWASAKI

Address: 382 Via Pueblo Mall, Rm. 136
Stanford, CA 94305, USA

E-mail: akiok@stanford.edu

Tel: +1-650-725-2342

Professional Experience:

02/2018- **William M. and Jane D. Fairbank Postdoctoral Fellow**

W. W. Hansen Experimental Physics Laboratory and Department of Physics, Stanford University, Stanford, CA, USA

08/2017 **Postdoctoral scholar**, Department of Physics, Stanford University, Stanford, CA, USA
-01/2018

Education:

09/2010 **Massachusetts Institute of Technology (MIT)**, Cambridge, MA, USA

-08/2017 Ph.D. in physics

04/2010 **the University of Tokyo**, Tokyo, Japan

-08/2010 Temporarily belonged to the master course at Department of Physics, Graduate School of Science

04/2006 **the University of Tokyo**, Tokyo, Japan

-03/2010 Bachelor of Science, Physics

Research experience:

08/2017- **Search for Non-Newtonian Gravity with Optically Levitated Microsphere**

Supervisor: Giorgio Gratta

Stanford University, Stanford, CA

Numerically calculated the amount of the expected signal. Analyzed data to estimate the amount of the background in the main measurement. Suggested an optimal way to separate signal and background. Designed and constructed an optics system and a vacuum chamber for a new trap. Precisely aligned the optics system with parabolic mirrors that generates 3.3 μm waist limited by diffraction. Trapped microspheres in the trap at the pressure of $\sim 10^{-6}$ mbar with feedback cooling, with a force sensitivity of 1×10^{-17} N/ $\sqrt{\text{Hz}}$. Performed preliminary measurements and established one of the three different methods of analysis to obtain the preliminary constraint on the non-Newtonian gravity from the preliminary measurements. Supervised 2 junior postdocs, 3 junior graduate students, and 2 undergraduate students.

Skills: optics, analog circuit designing and building, vacuum, optical path length stabilization, numerical calculation and data analysis with C++, ROOT, Python, and Mathematica. Optics design with Zemax, CAD designing by SolidWorks.

06/2011- **Spin Squeezed Yb Atomic Clock**

08/2017 Supervisor: Vladan Vuletić

Massachusetts Institute of Technology, Cambridge, MA

Designed a new lab, an optical cavity, and a vacuum chamber for the experiment. Built the lab, including arranging all the devices in the lab, setting up seven laser systems, building the vacuum chamber, and setting up the data acquisition system. Narrowed the linewidth of the clock laser down to < 1 kHz and optimized the locking of the trap laser and the in-vacuum cavity by improving electronics circuits to control lasers. Achieved a mirror magneto-optical trap for ytterbium atoms in the new setup, loaded them into an optical lattice, optically pumped them, and performed cavity QED measurement through a high finesse optical cavity. Observed measurement based spin squeezing of 2.1 dB. Performed unitary cavity feedback squeezing of 8.6 dB, which eventually led to 12.9 dB

- [7] Megan Yamoah, Boris Braverman, Edwin Pedrozo-Peñafiel, [Akio Kawasaki](#), Bojan Zlatković, Vladan Vuletić: Robust kHz-linewidth distributed Bragg reflector laser with optoelectronic feedback, *Opt. Exp.* **27**, 37714 (2019)
- [8] Charles P. Blakemore, Alexander D. Rider, Sandip Roy, Alexander Fieguth, [Akio Kawasaki](#), Nadav Priel, Giorgio Gratta: Precision mass and density measurement of individual optically-levitated microspheres, *Phys. Rev. Applied* **12**, 024037 (2019)
- [9] Boris Braverman*, [Akio Kawasaki](#)*, Edwin Pedrozo-Peñafiel*, Simone Colombo, Chi Shu, Zeyang Li, Enrique Mendez, Megan Yamoah, Leonardo Salvi, Daisuke Akamatsu, Yanhong Xiao, Vladan Vuletić: Near-Unitary Spin Squeezing in ^{171}Yb , *Phys. Rev. Lett.* **122**, 223203 (2019)
- [10] Alexander D. Rider, Charles P. Blakemore, [Akio Kawasaki](#), Nadav Priel, Sandip Roy, Giorgio Gratta: Electrically driven, optically levitated microscopic rotors, *Phys. Rev. A* **99**, 041802(R) (2019)
- [11] Charles P. Blakemore, Alexander D. Rider, Sandip Roy, Qidong Wang, [Akio Kawasaki](#), Giorgio Gratta: Three-dimensional force-field microscopy with optically levitated microspheres, *Phys. Rev. A* **99**, 023816 (2019) —selected as Editor’s Suggestion
- [12] [Akio Kawasaki](#)*, Boris Braverman*, Edwin Pedrozo-Peñafiel, Chi Shu, Simone Colombo, Zeyang Li, Özge Özel, Wenlan Chen, Leonardo Salvi, André Heinz, David Levonian, Daisuke Akamatsu, Yanhong Xiao, Vladan Vuletić: Geometrically asymmetric optical cavity for strong atom-photon coupling, *Phys. Rev. A* **99**, 013437 (2019) —selected as Editor’s Suggestion
- [13] [Akio Kawasaki](#): Search for gram-scale dark matter with precision displacement sensors, *Phys. Rev. D* **99**, 023005 (2019)
- [14] Boris Braverman, [Akio Kawasaki](#), Vladan Vuletić: Impact of Non-Unitary Spin Squeezing on Atomic Clock Performance, *New J. Phys.* **20**, 103019 (2018)
- [15] C. M. Adhikari, [A. Kawasaki](#), and U. D. Jentschura: Magic wavelength for the hydrogen 1S-2S transition: Contribution of the continuum and the reduced-mass correction, *Phys. Rev. A* **94**, 032510 (2016)
- [16] Grace H. Zhang, Boris Braverman, [Akio Kawasaki](#), Vladan Vuletić: Fast Compact Laser Shutter Using a Direct Current Motor and 3D Printing, *Rev. Sci. Instrum.* **86**, 126105 (2015)
- [17] [Akio Kawasaki](#): Magic Wavelength for the Hydrogen 1S-2S Transition, *Phys. Rev. A* **92**, 042507 (2015)
- [18] [Akio Kawasaki](#), Satoshi Itoh, Kunihiro Shima, Kenichi Kato, Haruhiko Ohashi, Tetsuya Ishikawa, Toshimitsu Yamazaki: Observation of Rapid Change of Crystalline Structure during the Phase Transition of the Palladium-Hydrogen System, *Phys. Chem. Chem. Phys.* **17**, 24783 - 24790 (2015)
- [19] [Akio Kawasaki](#), Boris Braverman, QinQin Yu, Vladan Vuletić: Two-Color Magneto-Optical Trap with Small Magnetic Field for Ytterbium, *J. Phys. B: At. Mol. Opt. Phys.* **48**, 155302 (2015) —selected as Highlights of 2015
- [20] Polnop Samutpraphoot, Sophie Weber, Qian Lin, Dorian Gangloff, Alexei Bylinskii, Boris Braverman, [Akio Kawasaki](#), Christoph Raab, Wilhelm Kaenders, Vladan Vuletić: Passive intrinsic-linewidth narrowing of ultraviolet extended-cavity diode laser by weak optical feedback, *Opt. Exp.* **22**, 11592-11599 (2014)
- [21] [Akio Kawasaki](#), Satoshi Itoh, Kunihiro Shima, Toshimitsu Yamazaki: Anomalous Deformation of Palladium Plates by a Small Gravitational Force during Hydrogen Absorption and Desorption, *Mat. Sci. Eng. A* **551**, 231-235 (2012)
- Note: authors with * had equal contribution to the paper.

Patent

- [1] Vladan Vuletić, Boris Braverman, [Akio Kawasaki](#), Megan Yamoah, Edwin Eduardo Pedrozo-Peñafiel: Semiconductor laser with intra-cavity electro-optic modulator, U.S. Patent 10,418,783 (September 17, 2019)

Invited talks

- 06/17/2020 Precision Measurements with Ytterbium for Searches for Physics beyond the Standard Model, TRIUMF
- 03/26/2020 Precision Measurements with Ytterbium for Searches for Physics beyond the Standard Model, Precision Probes of the Standard Model, Heidelberg University
- 02/02/2020 Search for non-Newtonian gravity with optically-levitated microspheres, Photonics West 2020
- 11/19/2019 Search for non-Newtonian Gravity with Optically-Levitated Microspheres, Purdue University Joint PQSEI/Particle Physics Seminar
- 09/27/2019 Precision Measurements with Ytterbium: from a Spin Squeezed Atomic Clock to an Isotope Shift Measurement for a Search for Physics beyond Standard Model, Meson Science Seminar, RIKEN
- 02/04/2019 Towards a search for non-Newtonian gravity with optically-levitated microspheres, 1st Arizona Workshop on Precision Search for Fundamental Physics
- 12/19/2017 Towards Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, AIST
- 01/25/2017 Spin Squeezed ^{171}Yb atomic Clock beyond the Standard Quantum Limit, Stanford University
- 01/09/2017 Spin Squeezed ^{171}Yb atomic Clock beyond the Standard Quantum Limit, TRIUMF
- 08/01/2016 Progress towards a Spin Squeezed Atomic Clock, Korea Research Institute of Standards and Science

Conference presentations

- 08/26/2020 Denzal Martin, Charles P. Blakemore, Alex Fieguth, Akio Kawasaki, Nadav Priel, Giorgio Gratta: Search for non-Newtonian gravity with optically levitated microspheres, Optical Trapping and Optical Micromanipulation XVII (Online presentation, presentation is delivered by Akio Kawasaki on behalf of Denzal Martin)
- 06/05/2020 Charles Blakemore, Denzal martin, Alexander Fieguth, Akio Kawasaki, Nadav Priel, Alexander Rider, Giorgio Gratta: An optically-levitated, spinning-rotor vacuum gauge, 51st Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (Online meeting)
- 06/05/2020 Denzal Martin, Charles P. Blakemore, Akio Kawasaki, Alexander Fieguth, Nadav Priel, Alexander D. Rider, Giorgio Gratta: Librational cooling of electrically-driven and optically-levitated microscopic rotors, 51st Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (Online meeting)
- 06/04/2020 Chi Shu, Edwin Pedrozo, Simone Colombo, Albert Adiyatullin, Zeyang Li, Enrique Mendez, Akio Kawasaki, Boris Braverman, Vladan Vuletic: Building Spin-Squeezed Optical Lattice Clock, 51st Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (Online meeting)
- 06/03/2020 Akio Kawasaki, Charles P. Blakemore, Alexander Fieguth, Denzal Martin, Nadav Priel, Alexander D. Rider, Giorgio Gratta: Search for non-Newtonian gravity with optically-levitated microspheres, 51st Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics (Online meeting)
- 04/20/2020 Akio Kawasaki, Charles P. Blakemore, Alexander Fieguth, Denzal Martin, Nadav Priel, Alexander D. Rider, Giorgio Gratta: Search for non-Newtonian gravity with optically-levitated microspheres, APS April Meeting 2020 (Online meeting)
- 02/01/2020 Boris Braverman, Akio Kawasaki, Edwin Pedrozo-Peñafiel, Simone Colombo, Chi Shu, Zeyang Li, Enrique Mendez, Megan Yamoah, Leonardo Salvi, Daisuke Akamatsu, Yanhong Xiao, Vladan Vuletic: Near-unitary spin squeezing with ytterbium, Photonics West 2020
- 10/28/2019 J. Hasi, N. Priel, J. D. Segal, G. Gratta, C. J. Kenney, C. P. Blakemore, A. D. Rider, A. Kawasaki, A. Fieguth: High Quantum Efficiency, Near Infrared Imaging Array for Micron-scale Gravity Studies, 2019 IEEE Nuclear Science Symposium & Medical Imaging Conference
- 09/17/2019 Akio Kawasaki, Alexander D. Rider, Charles P. Blakemore, Nadav Priel, Alexander Fieguth, Denzal Martin, Giorgio Gratta: Search for non-Newtonian gravity with optically-levitated microspheres, 2019 Autumn Meeting, The Physical Society of Japan
- 09/10/2019 Akio Kawasaki, Alexander D. Rider, Charles P. Blakemore, Nadav Priel, Alexander Fieguth, Denzal Martin,

- Giorgio Gratta: Search for non-Newtonian gravity with optically-levitated microspheres, 16th International Conference on Topics in Astroparticle and Underground Physics
- 06/12/2019 Edwin Pedrozo-Peñañiel, Boris Braverman, [Akio Kawasaki](#), Simone Colombo, Chi Shu, Zeyang Li, Enrique Mendez, Megan Yamoah, Leonardo Salvi, Daisuke Akamatsu, Yanhong Xiao, Vladan Vuletić: Near-Unitary Spin Squeezing in ^{171}Yb : Toward Spin Squeezing on an Optical Clock Transition, Gordon Research Conference on Atomic Physics (Poster Session)
- 06/12/2019 Chi Shu, Enrique Mendez, Albert Adiyatullin, Edwin Pedrozo, Simone Colombo, Zeyang Li, [Akio Kawasaki](#), Boris Braverman, Vladan Vuletić: Building Optical Lattice Clock Beyond Standard Quantum Limit, Gordon Research Conference on Atomic Physics (Poster Session)
- 06/10/2019 [Akio Kawasaki](#), Charles P. Blakemore, Alexander Fieguth, Denzal Martin, Nadav Priel, Alexander D. Rider, Giorgio Gratta: Towards a search for non-Newtonian gravity with optically-levitated microspheres, Gordon Research Conference on Atomic Physics (Poster Session)
- 06/10/2019 Charles P. Blakemore, Alex Fieguth, [Akio Kawasaki](#), Denzal Martin, Nadav Priel, Alexander D. Rider, Giorgio Gratta: Opto-mechanical Control and Characterization of Levitated Microspheres as Precision Force Sensors, Gordon Research Conference on Atomic Physics (Poster Session)
- 05/30/2019 [Akio Kawasaki](#), Alexander D. Rider, Charles P. Blakemore, Nadav Priel, Alexander Fieguth, Sandip Roy, Giorgio Gratta: Characterization of precision force sensing by optically-levitated microspheres, 50th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics APS Meeting
- 05/30/2019 Nadav Priel, Alexander D. Rider, Charles P. Blakemore, [Akio Kawasaki](#), Alexander Fieguth, Sandip Roy, Giorgio Gratta: Spinning optically-levitated microspheres by rotating electric fields, 50th Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics APS Meeting
- 04/13/2019 Charles P. Blakemore, Alexander D. Rider, [Akio Kawasaki](#), Nadav Priel, Alexander Fieguth, Sandip Roy, Giorgio Gratta: Towards a search for non-Newtonian gravity with optically-levitated microspheres, APS April Meeting 2019
- 08/20/2018 Charles P. Blakemore, Alexander D. Rider, [Akio Kawasaki](#), Giorgio Gratta: Single-beam dielectric-microsphere trapping with optical heterodyne detection: investigating torsional optomechanics and testing fundamental physics, Optical Trapping and Optical Micromanipulation XV
- 07/26/2018 E. Pedrozo, B. Braverman, [Akio Kawasaki](#), S. Colombo, C. Shu, Z. Li, V. Vuletić: A geometrically asymmetric optical cavity for a spin squeezed ^{171}Yb optical atomic clock, The 26th International Conference on Atomic Physics (Poster Session)
- 07/24/2018 S. Colombo, B. Braverman, [Akio Kawasaki](#), E. Pedrozo, C. Shu, Z. Li, V. Vuletić: Near-Unitary Spin-Squeezing for Optical Clocks, The 26th International Conference on Atomic Physics (Poster Session)
- 07/07/2018 [Akio Kawasaki](#), Alex Rider, Charles Blakemore, Giorgio Gratta: Limits on non-Newtonian gravity at $10\ \mu\text{m}$ scale by precision force measurements with optically-levitated microspheres, XXXIX International Conference on High Energy Physics
- 06/01/2018 Boris Braverman, [Akio Kawasaki](#), Edwin Pedrozo, Chi Shu, Simone Colombo, Zeyang Li, Vladan Vuletić: Toward Unitary Spin Squeezing for Atomic Clocks, 49th Annual Meeting of the APS DAMOP
- 06/14/2017 Boris Braverman, [Akio Kawasaki](#), Edwin Pedrozo, Yanhong Xiao, Vladan Vuletić: Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, Gordon Research Conference on Atomic Physics (Poster Session)
- 07/28/2016 [Akio Kawasaki](#), Boris Braverman, Leonardo Salvi, Bojan Zlatković, Vladan Vuletić: Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, 25th International Conference on Atomic Physics (Poster Session)
- 05/26/2016 Boris Braverman, [Akio Kawasaki](#), Vladan Vuletić: Generating and probing entangled states for optical atomic clocks, 47th Annual Meeting of the APS DAMOP
- 05/24/2016 [Akio Kawasaki](#): Magic Wavelength for the Hydrogen 1S-2S Transition, 47th Annual Meeting of the APS

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- 06/15/2015 Akio Kawasaki, Boris Braverman, David Levonian, André Heinz, Daisuke Akamatsu, Vladan Vuletić: Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, Gordon Research Conference on Atomic Physics (Poster Session)
- 06/11/2015 Boris Braverman, Akio Kawasaki, Vladan Vuletić: Progress toward a spin squeezed optical atomic clock beyond the standard quantum limit, 46th Annual Meeting of the APS DAMOP
- 08/05/2014 Boris Braverman, Akio Kawasaki, Vladan Vuletić: Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, The 24th International Conference on Atomic Physics (Poster Session)
- 06/24/2013 Akio Kawasaki, Boris Braverman, Özge Özel, Tailin Wu, Vladan Vuletić: Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, Gordon Research Conference on Atomic Physics (Poster Session)
- 04/10/2013 Akio Kawasaki, Boris Braverman, Özge Özel, Tailin Wu, Vladan Vuletić: Spin Squeezed ^{171}Yb Atomic Clock beyond the Standard Quantum Limit, The 11th US-Japan Joint Seminar on Quantum Electronics and Laser Spectroscopy (Poster Session)
- 07/08/2010 Shingo Kazama, Akio Kawasaki, Toshio, Shoji Asai, Tomio Kobayashi: Search for weak-coupling scalar particle X with positronium, 47th Isotope Conference
- 03/23/2010 Shingo Kazama, Akio Kawasaki, Toshio Namba, Shoji Asai, Tomio Kobayashi: Search for weak-coupling scalar particles with positronium, 65th Annual Meeting, The Physical Society of Japan

Teaching experience

- 02/2014 **Teaching Assistant of 8.421 Atomic and Optical Physics I class at MIT**
- 05/2014 Assisted making an online homework system, held recitations and office hours, and graded midterm exam and term papers.
- 04/2010 **Teaching Assistant of Junior Experiment Class at the University of Tokyo**
- 07/2010 Taught at a junior experiment class on the gamma ray detection by scintillation counters.

Prize & Awards:

- 02/2018- William M. and Jane D. Fairbank Postdoctoral Fellowship
- 04/2013 Open House Poster Session Prize First Prize
- 03/2009 Elite Science Students Visit Abroad Program Dean's Award
- 03/2006 Nezu Prize (a prize for 2 highest-achieving students at the graduation of my high school)
- 07/2005 37th International Chemistry Olympiad Silver Medal
- 11/2004 High School Chemistry Grand Prix 2004 (domestic chemistry olympiad) Highest Award
- 07/2004 36th International Chemistry Olympiad Gold Medal
- 11/2003 High School Chemistry Grand Prix 2003 Silver Award

Professional memberships:

APS (2012-), SPIE (2020-)

Language skill:

Japanese (native), English (advanced), Korean (advanced)