

Swati Singh

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CURRENT RESEARCH INTERESTS Hybrid quantum systems,
Quantum thermodynamics,
Quantum sensors

EMPLOYMENT **Assistant Professor**, July 2016–Present,
Department of Physics,
Williams College, Williamstown, MA.
Postdoctoral Research Associate, October 2015–June 2016,
College of Optical Sciences, University of Arizona, Tucson, AZ, and
Advisor: Prof. Pierre Meystre
ITAMP Postdoctoral Fellow, October 2012–September 2015,
Institute for Theoretical Atomic, Molecular, and Optical Physics (ITAMP),
Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, and
Department of Physics, Harvard University, Cambridge, MA.
Advisors: Prof. Hossein Sadeghpour, Prof. Susanne Yelin

EDUCATION **Ph.D. in Physics**, August 2007–May 2012,
Department of Physics, University of Arizona, Tucson, AZ.
Advisor: Prof. Pierre Meystre
Thesis: *Hybrid atomic-optomechanical systems: observing quantum effects in macroscopic oscillators.*
M.Sc. in Physics, September 2004–May 2007,
University of British Columbia, Vancouver, BC, Canada.
Advisor: Prof. Kirk Madison
Thesis: *Production of ultra-cold ensembles of lithium and rubidium.*
Hons. B.Sc. in Physics, September 2000–May 2004,
McMaster University, Hamilton, ON, Canada.
Advisors: Prof. Brian King and Prof. Joseph Thywissen
Senior Thesis: *Design, construction and evaluation of an atomic source of potassium-40 for degenerate Fermi gas experiments.*

SELECTED AWARDS AND HONORS ◇ KITP Scholar Award, 2018.
Awarded annually to 6-8 people doing theoretical physics at non-PhD granting institutions
◇ ITAMP Postdoctoral Fellowship, 2012.
Awarded annually to 1-2 people in theoretical atomic physics
◇ University of Arizona College of Science Award for Excellence in Scholarship, 2011.
Awarded annually to one graduate student in College of Science
◇ Best presentation award for the UA Physics Students Colloquium series, Spring 2010.
Awarded annually to two graduate students in the Physics Department

- ◇ Ontario Graduate Fellowship (declined due to studying out of province), 2004.
- ◇ Dean's Honour List at McMaster University for academic standing, 2000-2004.
- ◇ 2nd Prize: Best presentation at the 39th Canadian Undergraduate Physics Conference, 2003.
- ◇ NSERC Undergraduate Student Research Award
May -Aug. 2003 at University of Toronto, May -Aug. 2002 and 2001 at McMaster University.
- ◇ McMaster University Senate Scholarship, August 2001.

GRANT SUPPORT Army Research Office Conference Grant Award for the “2014 Mechanical Systems in the Quantum Regime GRS”, PI, February 2014, \$5000.

PUBLICATIONS **Journal Articles (18 Published, 3 In progress)**

- 21) E. Bauch, J. Lee, **S. Singh**, C. Hart, J. Schloss, M. Turner, J. F. Barry, L. Pham, N. Bar-Gill, and R. Walsworth, *Quantum coherence of NV center ensembles in diamond*, In preparation (2018).
- 20) M. Soltani, **S. Singh** and A. Singh, *Using higher-order statistics to infer random forces driving a harmonic oscillator*, In preparation (2018). Draft available upon request.
- 19) **S. Singh**, M. Goldman, Y. Chu, A. Pick, A. Aspect, M. Lukin, and S. F. Yelin, *Probing nuclear spin dynamics near quantum emitters via photon statistics*, In preparation (2018). Draft available upon request.
- 18) E. Bauch, C. A. Hart, J. M. Schloss, M. J. Turner, J. F. Barry, P. Kehayias, **S. Singh**, and R. L. Walsworth, *Ultralong dephasing times in solid-state spin ensembles via quantum control*, Phys. Rev. X **8** (3), 031025 (2018).
- 17) **S. Singh**, L.A. DeLorenzo, I. Pikovski, and K.C. Schwab, *Detecting continuous gravitational waves with superfluid ^4He* , New J. Phys. **19**, 073023 (2017).
- 16) Q. Song, **S. Singh**, K. Zhang, W. Zhang, and P. Meystre, *One qubit and one photon: The simplest polaritonic heat engine*, Phys. Rev. A **94**, 063852 (2016).
- 15) F. Bariani, H Seok, **S. Singh**, M Vengalattore, P Meystre, *Atom-based coherent quantum-noise cancellation in optomechanics*, Phys. Rev. A **92**, 043817 (2015). (**Editors' Suggestion**)
- 14) **S. Singh**, Y. Chu, M. Lukin, and S. F. Yelin, *Coherent Population Trapping, Nuclear Spin Cooling, and Lévy Flights in Solid-State Atom-Like Systems*, Adv. Atom. Mol. Opt. Phys. **64**, 273 (2015).
- 13) F. Bariani*, **S. Singh***, L.F. Buchmann, M. Vengalattore, P. Meystre, *Hybrid optomechanical cooling by atomic Λ systems*, Phys. Rev. A **90**, 033838 (2014). *co-first author.
- 12) S. K. Steinke, **S. Singh**, P. Meystre, K. C. Schwab, and M. Vengalattore. *Quantum back-action in spinor condensate magnetometry*, Phys. Rev. A **88**, 063809 (2013).
- 11) H. Seok, L. F. Buchmann, **S. Singh**, and P. Meystre. *Optically mediated nonlinear quantum optomechanics*, Phys. Rev. A **86**, 063829 (2012).
- 10) E. M. Wright, M. Mazilu, **S. Singh**, K. Dholakia, and P. Meystre. *Theory and simulation of an Optical Spring Mirror*, Proc. SPIE **8458**, “Optical Trapping and Optical Micromanipulation IX”, 84580A-1, doi 10.1117/12.929281 (2012).
- 9) **S. Singh**, H. Jing, E. M. Wright, and P. Meystre. *Quantum state transfer between a Bose-Einstein condensate and an optomechanical mirror*, Phys. Rev. A **86**, 021801(R) (2012).
- 8) H. Seok, L. F. Buchmann, **S. Singh**, S. K. Steinke, and P. Meystre. *Generation of mechanical squeezing via magnetic dipoles on cantilevers*, Phys. Rev. A **85**, 033822 (2012).
- 7) S. K. Steinke, **S. Singh**, M. E. Tasgin, P. Meystre, K. C. Schwab, and M. Vengalattore. *Quantum-measurement backaction from a Bose-Einstein condensate coupled to a mechanical oscillator*, Phys. Rev. A **84**, 023841 (2011).

- 6) **S. Singh**, G. A. Phelps, D. S. Goldbaum, E. M. Wright, and P. Meystre. *All-Optical Optomechanics: An Optical Spring Mirror*, Phys. Rev. Lett. **105**, 213602 (2010).
- 5) M. Bhattacharya, **S. Singh**, P. L. Giscard, and P. Meystre. *Optomechanical control of atoms and molecules*, Laser Physics **20**, 57 (2010).
- 4) **S. Singh**, and P. Meystre. *Atomic probe Wigner tomography of a nanomechanical system*, Phys. Rev. A **81**, 041804(R) (2010).
- 3) **S. Singh**, M. Bhattacharya, O. Dutta, and P. Meystre. *Coupling Nanomechanical Cantilevers to Dipolar Molecules*, Phys. Rev. Lett. **101**, 263603 (2008).
Also in the January 2009 issue of Virtual Journal of Quantum Information and January 2009 issue of Virtual Journal of Nanoscale Science & Technology
- 2) Z. Li, **S. Singh**, T. V. Tscherbul, and K. W. Madison. *Feshbach resonances in ultracold 85Rb - 87Rb and 6Li - 87Rb mixtures*, Phys. Rev. A **78**, 022710 (2008). Also in the September 2008 issue of Virtual Journal of Quantum Information.
- 1) S. Aubin, M. Extavour, S. Myrskog, L. LeBlanc, J. Esteve, **S. Singh**, P. Scrutton, D. McKay, R. McKenzie, I. Leroux, A. Stummer, and J. H. Thywissen. *Trapping Fermionic ^{40}K and Bosonic ^{87}Rb on a Chip*, J. Low Temp. Phys. **140**, 377 (2005).

PRESS
COVERAGE

The article “Detecting continuous gravitational waves with superfluid ^4He ” was reported in:

- ◇ <http://physicsworld.com/cws/article/news/2017/jul/24/how-to-detect-gravitational-waves-using-superfluid-liquid-helium>
- ◇ http://www.realclearscience.com/2017/07/25/superfluid_helium_can_detect_gravitational_waves_277304.html

RECENT
CONFERENCE
ABSTRACTS

- 17) *Detecting continuous gravitational waves with superfluid helium*,
S. Singh, L. DeLorenzo, I. Pikovski and K. C. Schwab.
Currents trends in open and non-equilibrium quantum optical systems workshop, MPL Erlangen, Germany, June 2018. (Oral Presentation)
- 16) *Detecting continuous gravitational waves with superfluid helium*,
S. Singh, L. DeLorenzo, I. Pikovski and K. C. Schwab.
APS March Meeting, Los Angeles, CA, March 2018. (Oral Presentation)
- 15) *Detecting gravitational waves with superfluid ^4He* ,
S. Singh, L. DeLorenzo, A. Pearlman, I. Pikovski and K. C. Schwab.
Gordon Research Conference on Mechanical Systems in Quantum Regime, Ventura, CA, March 2018. (Poster Presentation)
- 14) *Detecting continuous gravitational waves with superfluid helium*,
S. Singh, L. DeLorenzo, I. Pikovski and K. C. Schwab.
SQuInT workshop, Santa Fe, NM, Feb 2018. (Oral Presentation)
- 13) *Detecting continuous gravitational waves with superfluid helium*,
S. Singh, L. DeLorenzo, I. Pikovski and K. C. Schwab.
DAMOP Meeting, Sacramento, CA, May 2017. (Oral Presentation)
- 12) *Detecting gravitational waves with superfluid ^4He* ,
S. Singh, L. DeLorenzo, A. Pearlman, I. Pikovski and K. C. Schwab.
Gordon Research Conference on Quantum Science, Stonehill College Easton, MA, August 2016. (Poster Presentation)
- 11) *Detecting gravitational waves with superfluid ^4He* ,
S. Singh, L. DeLorenzo, A. Pearlman, I. Pikovski and K. C. Schwab.
DAMOP Meeting, Providence, RI, May 2016. (Oral Presentation)
- 10) *Probing an NV Center’s Nuclear Spin Environment with Coherent Population Trapping*,
D. Levonian, M. Goldman, **S. Singh**, M. Markham, D. Twitchen and M. Lukin.
DAMOP Meeting, Providence, RI, May 2016. (Poster Presentation)

- 9) *Spin noise in mixed Spin Systems*,
E. Bauch, P. Junghyun, **S. Singh**, T. Devakul, A. Feguin, C. Hart and R. Walsworth.
DAMOP Meeting, Providence, RI, May 2016. (Oral Presentation)
- 8) *Detecting continuous gravitational waves with a jug of superfluid*,
S. Singh, L. DeLorenzo, A. Pearlman, I. Pikovski, M. Blencowe and K. C. Schwab.
APS March Meeting, Baltimore, MD, March 2016. (Oral Presentation)
- 7) *Probing nuclear spin dynamics near solid-state atom-like systems via photon statistics*,
S. Singh, Y. Chu, A. Pick, A. Aspect, M. Lukin and S. F. Yelin.
DAMOP Meeting, Columbus, OH, June 2015. (Oral Presentation)
- 6) *Spin-mediated Hybrid Quantum Optomechanics*,
A. Shaffer, L. Chang, Y. S. Patil, F. Bariani, **S. Singh**, A. Date, S. Chakram, K. C. Schwab,
P. Meystre and M. Vengalattore.
DAMOP Meeting, Columbus, OH, June 2015. (Oral Presentation)
- 5) *Sensing of mechanical motion at the quantum level via a hybrid atom-optomechanical setup*,
H. Seok, F. Bariani, **S. Singh**, M. Vengalattore and P. Meystre.
DAMOP Meeting, Columbus, OH, June 2015. (Oral Presentation)
- 4) *Suppression of Spin Noise in Diamond for improved Sensing and Imaging*,
E. Bauch, J. Lee, **S. Singh**, M. L. Pham, K. Arai and R. Walsworth.
DAMOP Meeting, Columbus, OH, June 2015. (Poster Presentation)
- 3) *Lévy flights in laser cooling of nuclear spins*,
S. Singh, Y. Chu, A. Pick, A. Aspect, M. Lukin and S. F. Yelin.
DAMOP Meeting, Madison, WI, June 2014. (Oral Presentation)
- 2) *Atom mediated sensing in a hybrid optomechanical system*,
S. Steinke, F. Bariani, **S. Singh**, P. Meystre and M. Vengalattore.
DAMOP Meeting, Madison, WI, June 2014. (Oral Presentation)
- 1) *Cooling of Nuclear Spins in Diamond via Dark State Spectroscopy*,
S. Singh, A. Pick, A. Aspect, M. Lukin and S. F. Yelin.
DAMOP Meeting, Quebec City, QC, Canada June 2013. (Oral Presentation)

SELECTED
RECENT TALKS

- Special seminar, University of Vienna, Austria, July 2018.
- Theory seminar, MPQ, Garching, Germany, June 2018.
- Special seminar, Physics Department, University of Turin, Italy, June 2018. (**Invited**)
- Special seminar, INRiM, Turin, Italy, May 2018.
- CM seminar, Dartmouth College, April 2018. (**Invited**)
- Physics Department Colloquium, Wellesley College, April 2018. (**Invited**)
- Physics Department Colloquium, Miami University OH, March 2018. (**Invited**)
- ECE seminar, University of Delaware, December 2017. (**Invited**)
- Greylock Talk, Mt. Greylock High School, September 2017.
- Science Lunch Talk, Williams College, May 2017.
- Physics Department Colloquium, Amherst College, April 2017.
- ITAMP Lunch Seminar, Harvard University, Cambridge, MA, November 2016.
- Physics seminar, Williams College, Williamstown, MA, December 2015. (**Invited**)
- Physics seminar, Williams College, Williamstown, MA, October 2015. (**Invited**)
- DARPA Quasar Review Meeting, University of California, Santa Barbara, CA, October 2015.
- IQC seminar, University of Waterloo, Waterloo, ON, Canada, February 2015. (**Invited**)
- Harvard-MIT Center for Ultra Cold Atoms (CUA) Retreat, NH, January 2015.

CM Seminar, University of Delaware, Newark, DE, October 2014.(Invited)
AMO Seminar, Stony Brook University, Stony Brook, NY, September 2014.(Invited)
CUA student seminar series, Harvard University, Cambridge, MA, March 2014.
Department of Physics, University of Massachusetts, Boston, MA, September 2013.(Invited)

TEACHING EXPERIENCE ◇ **Assistant Professor**
PHYS 107 (Spacetime and Quanta): Modern Physics course for non-science majors (Fall 2017).

PHYS 302 (Thermodynamics and Statistical Mechanics): Required course for Junior/Senior Physics majors (Spring 2017, 2018).

◇ **Teaching Assistant**
Various freshman and sophomore Physics courses at University of Arizona (2007), University of British Columbia (2004-2007), and McMaster University (2001-2002).
Freshman Calculus at McMaster University (2001-2002).

STUDENTS Joshua Reynolds (Class of 2021), Research student (Winter Study 2018).
Derek Galvin (Class of 2018), Undergraduate Thesis student (2017-18).
Qiyuan Hu (Class of 2020), Summer Research student (Summer 2017).
Ashay Patel (Class of 2018), Independent Study student (Spring 2017).

SCHOOLS AND PROGRAMS ATTENDED **Many-Body Physics with Light**
October -November 2015, Kavli Institute for Theoretical Physics, UC Santa Barbara.
Les Houches Summer School on Quantum Optomechanics and Nanomechanics
August 2015, École de Physique, Les Houches.
ITAMP/B2 Institute Winter Graduate School on AMO Physics
January 2012, University of Arizona-Biosphere 2, Tucson, Arizona.

PROFESSIONAL SERVICE **Organizer**, Williams Physics Colloquium for 2017-18.
Panel member, Junior Faculty Panel
Physics Department at Harvard University, November 2016.
Panel member, Launching Your Career Symposium
Women in Physics and Women in Optics at the University of Arizona, April 2016.
Referee, National Science Foundation grants 2016.
Organizer, ITAMP topical seminars for 2014-15.
Chair, Gordon Research Seminar on Mechanical Systems in the Quantum Regime, 2014.
Reviewer, Physical Review Letters, Physical Review A and Physical Review E.
Member, American Physical Society.
Member, Optical Society of America.