KANG-KUEN NI

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Departments of Chemistry and Chemical Biology ⋄ Harvard University

RESEARCH

Kang-Kuen Ni pursues new approaches to create and gain quantum control of ultracold molecules for studies of chemical reactions, quantum information processing, and quantum many-body physics. Notable recent achievements include building single molecules in movable optical tweezers, studying collisions in a new paradigm with exactly known numbers of collision partners and products, and theoretical investigation of a novel quantum computing scheme with molecules.

EMPLOYMENT

Harvard University *Cambridge, MA*
Assistant Professor *July 2013 - Present*
Department of Chemistry and Chemical Biology
Harvard-MIT Center for Utracold Atoms

JILA *Boulder, CO*
National Research Council Postdoctoral Fellow *December 2011 - June 2013*
Advisor: Prof. Eric Cornell

California Institute of Technology *Pasadena, CA*
Center for Physics of Information Postdoctoral Fellow *November 2009 - September 2011*
Advisor: Prof. Jeff Kimble

EDUCATION

University of Colorado, Boulder *August 2003 - December 2009*
Ph.D., Physics
Thesis advisor: Prof. Deborah Jin
JILA, the National Institute of Standards and Technology and the University of Colorado, Boulder
A quantum gas of polar molecules

University of California, Santa Barbara *September 2000 - June 2003*
B.S. with Highest Honors

AWARDS AND HONORS

- American Physical Society I.I. Rabi Prize in Atomic, Molecular, and Optical Physics, 2019
- DOE Young Investigator Award, 2018
- Camille Dreyfus Teacher-Scholar Award, 2018
- Packard Fellowship for Science and Engineering, 2016
- Beckman Young Investigator Award, 2015
- Alfred P. Sloan Research Fellow in Physics, 2015
- AFOSR Young Investigator Award, 2015

- The International Organization of Chinese Physicists and Astronomers Outstanding Young Researcher Award (Macronix Prize), 2014
- National Research Council Postdoctoral Fellowship, NIST, 2011 - 2013
- American Physical Society Division of Atomic, Molecular, and Optical Physics (DAMOP) Thesis Prize, 2010
- Center for Physics of Information Postdoctoral Fellowship, Caltech, 2009 - 2011
- National Science Foundation Graduate Fellowship, 2004 - 2007
- University of California Leadership Excellence through Advanced Degrees scholar, 2001 - 2003

PUBLICATIONS

[1] L. R. Liu, J. D. Hood, Y. Yu, J. T. Zhang, K. Wang, Y.-W. Lin, T. Rosenband, and **K.-K. Ni**†. Ground State Cooling and Transport of Single Atoms for Ultracold Molecular Assembly. *arXiv:1902.03935*, February 2019.

[2] L. Anderegg, L. W. Cheuk, Y. Bao, S. Burchesky, W. Ketterle, **K.-K. Ni**, and J. M. Doyle. An Optical Tweezer Array of Ultracold Molecules. *arXiv:1902.00497*, February 2019.

[3] **K.-K. Ni**†, T. Rosenband, and D. D. Grimes. Dipolar exchange quantum logic gate with polar molecules. *Chem. Sci.*, 9:6830–6838, 2018.

[4] T. Rosenband, D. D. Grimes, and **K.-K. Ni**. Elliptical polarization for molecular stark shift compensation in deep optical traps. *Opt. Express*, 26(16):19821–19825, Aug 2018.

[5] L. R. Liu, J. D. Hood, Y. Yu, J. T. Zhang, N. R. Hutzler, T. Rosenband, and **K.-K. Ni**†. Building one molecule from a reservoir of two atoms. *Science*, 360(6391):900–903, 2018.

[6] Y. Yu, N. R. Hutzler, J. T. Zhang, L. R. Liu, J. D. Hood, T. Rosenband, and **K.-K. Ni**†. Motional-ground-state cooling outside the lamb-dicke regime. *Phys. Rev. A*, 97:063423, June 2018.

[7] L. R. Liu, J. T. Zhang, Y. Yu, N. R. Hutzler, Y. Liu, T. Rosenband, and **K.-K. Ni**†. Ultracold Molecular Assembly. *ArXiv:1701.03121*, January 2017.

[8] N. R. Hutzler, L. R. Liu, Y. Yu, and **K.-K. Ni**†. Eliminating light shifts for single atom trapping. *New Journal of Physics*, 19(2):023007, 2017.

[9] W. G. Tobias, J. S. Rosenberg, N. R. Hutzler, and **K.-K. Ni**†. A low-temperature external cavity diode laser for broad wavelength tuning. *Review of Scientific Instruments*, 87(11):113104, 2016.

[10] **K.-K. Ni**, H. Loh, M. Grau, K. C. Cossel, J. Ye, and E. A. Cornell. State-specific detection of trapped HfF^+ by photodissociation. *Journal of Molecular Spectroscopy*, 300:12–15, 2014.

[11] H. Loh, K. C. Cossel, M. C. Grau, **K.-K. Ni**, E. R. Meyer, J. L. Bohn, J. Ye, and E. A. Cornell. Precision spectroscopy of polarized molecules in an ion trap. *Science*, 342(6163):1220–1222, 2013.

[12] **K.-K. Ni**, R. Norte, D. J. Wilson, J. D. Hood, D. E. Chang, O. Painter, and H. J. Kimble. Enhancement of Mechanical Q Factors by Optical Trapping. *Physical Review Letters*, 108(21):214302, May 2012.

[13] D. E. Chang, **K.-K. Ni**, O. Painter, and H. J. Kimble. Ultrahigh-Q mechanical oscillators through optical trapping. *New Journal of Physics*, 14(4):045002, April 2012.

[14] Y. Zhao, D. J. Wilson, **K.-K. Ni**, and H. J. Kimble. Suppression of extraneous thermal noise in cavity optomechanics. *Optics Express*, 20:3586, February 2012.

[15] D. Wang, B. Neyenhuis, M. H. G. de Miranda, **K.-K. Ni**, S. Ospelkaus, D. S. Jin, and J. Ye. Direct absorption imaging of ultracold polar molecules. *Physical Review A*, 81(6):061404, June 2010.

[16] **K.-K. Ni**, S. Ospelkaus, D. Wang, G. Quéméner, B. Neyenhuis, M. H. G. de Miranda, J. L. Bohn, J. Ye, and D. S. Jin. Dipolar collisions of polar molecules in the quantum regime. *Nature*, 464:1324–1328, April 2010.

[17] S. Ospelkaus, **K.-K. Ni**, D. Wang, M. H. G. de Miranda, B. Neyenhuis, G. Quéméner, P. S. Julienne, J. L. Bohn, D. S. Jin, and J. Ye. Quantum-State Controlled Chemical Reactions of Ultracold Potassium-Rubidium Molecules. *Science*, 327:853, February 2010.

[18] S. Ospelkaus, **K.-K. Ni**, G. Quéméner, B. Neyenhuis, D. Wang, M. H. G. de Miranda, J. L. Bohn, J. Ye, and D. S. Jin. Controlling the Hyperfine State of Rovibronic Ground-State Polar Molecules. *Physical Review Letters*, 104(3):030402, January 2010.

[19] S. Ospelkaus, **K.-K. Ni**, M. H. G. de Miranda, B. Neyenhuis, D. Wang, S. Kotochigova, P. S. Julienne, D. S. Jin, and J. Ye. Ultracold polar molecules near quantum degeneracy. *Faraday Discussions*, 142:351, 2009.

[20] **K.-K. Ni**, S. Ospelkaus, D. J. Nesbitt, J. Ye, and D. S. Jin. A dipolar gas of ultracold molecules. *Physical Chemistry Chemical Physics*, 11:9626, 2009.

[21] **K.-K. Ni**, S. Ospelkaus, M. H. G. de Miranda, A. Pe'er, B. Neyenhuis, J. J. Zirbel, S. Kotochigova, P. S. Julienne, D. S. Jin, and J. Ye. A High Phase-Space-Density Gas of Polar Molecules. *Science*, 322:231, October 2008.

[22] S. Ospelkaus, A. Pe'er, **K.-K. Ni**, J. J. Zirbel, B. Neyenhuis, S. Kotochigova, P. S. Julienne, J. Ye, and D. S. Jin. Efficient state transfer in an ultracold dense gas of heteronuclear molecules. *Nat. Phys.*, 4(8):622–626, 2008.

[23] J. J. Zirbel, **K.-K. Ni**, S. Ospelkaus, T. L. Nicholson, M. L. Olsen, P. S. Julienne, C. E. Wieman, J. Ye, and D. S. Jin. Heteronuclear molecules in an optical dipole trap. *Physical Review A*, 78(1):013416, July 2008.

[24] J. J. Zirbel, **K.-K. Ni**, S. Ospelkaus, J. P. D'Incao, C. E. Wieman, J. Ye, and D. S. Jin. Collisional Stability of Fermionic Feshbach Molecules. *Physical Review Letters*, 100(14):143201, April 2008.

[25] D.K. Wood, **K.-K. Ni**, D.R. Schmidt, and A.N. Cleland. Submicron giant magnetoresistive sensors for biological applications. *Sensors and Actuators A: Physical*, 120(1):1 – 6, 2005.

† Principal Investigator

MENTORING

Postdoctoral Fellows:

Dr. David Grimes (2017 - Present), Dr. Yen-Wei Lin (2017 - Present), Dr. Jonathan Hood (2016 - Present), Dr. Ming-Guang Hu (2016 - Present).

Dr. Nicholas R. Hutzler (2014 - 2017), Harvard Quantum Optics Center Prized Postdoctoral Fellow. Next position: Assistant Professor at the Department of Physics at Caltech

Dr. Alexandros Gerakis (2014). Next position: Associate Research Physicist at Princeton University

Graduate Students:

Lee R. Liu (2014 - present), Yichao Yu (2014 - present), Yu Liu (2014 - present), Jessie T. Zhang (2015 - present), Kenneth Wang (2017 - present), Lewis Picard (2018 - present), Eliot Fenton (2018 - present), Andrei Gheorghe (2016 - 2018)

Visiting Students:

Remy Vatre (2017 - 2018), Frederic Condin (2016 - 2017)

Undergraduate Students:

Camilo Castellanos Sanchez (2019 - present), Urshella Hishaam (2018), William Fu (2018), Constantin Arnscheidt (2017 - 2018, currently: graduate student at MIT), Colin MacGinnitie (summer 2016, from University of Chicago), Eugene O'friel (2015), William Tobias (2014 - 2016, currently: graduate student at University of Colorado/JILA), Saahil Mehta (2014 - 2015), Jason Rosenberg (2015 - 2017, currently: graduate student at Princeton), Trevor Chistolini (2015), Enes Aybar (summer 2014, from Bilkent University)

High School Students:

Ilona Demler (summer 2016, currently: undergraduate student at Harvard)

TEACHING

Chem 242 (2013 and 2014), Graduate-Level Quantum Mechanics for Physical Chemistry

Chem 160 (2015, 2016, 2017, 2018), Undergraduate-Level Quantum Mechanics for Physical Chemistry

SERVICE

Referees for Physical Review Letters, Review of Scientific Instruments, Science, Science Advances, Nature Physics, Journal of New Physics, ChemPhysChem

CONFERENCE ORGANIZING

ITAMP workshop on "New Frontier of Cold Molecules", Cambridge, MA, May 21-24, 2019, co-organizer

ACS Spring Meeting, Symposium on "Cold Molecules for Chemistry", New Orleans, LA, March 18-20, 2018, lead organizer

IST/ITAMP workshop on Controllable Quantum Impurities in Physics and Chemistry, Austria (2017), co-organizer

Cold and Controlled Molecules and Ions Conference, Athens, GA (2018), member of advisory panel

INVITED TALKS

Boston University, Physical Chemistry seminar, "Ultracold Molecules for Chemistry and Physics", February 6, 2019

Rice University, Atomic, Molecular, Optical physics seminar, "Ultracold Molecules for Chemistry and Physics", January 31, 2019

MIT-Harvard Center for Ultracold Atoms, seminar, "Ultracold Molecules for Chemistry and Physics", December 11, 2018

University of Toledo, Physics Colloquium, "Ultracold Molecules for Chemistry and Physics", October 18, 2018

University of California, Berkeley, Physical Chemistry seminar, "Ultracold Molecules for Chemistry and Physics", October 16, 2018

Jin Fest: A Celebration of Deborah Jin's Scientific Career, "Building single molecules," Boulder, CO, September 7-8, 2018

Stereodynamics 2018 Conference, "Building single molecules - collisions and reactions of two atoms," Arosa, Switzerland, September 2-7, 2018

The 26th International Conference on Atomic Physics, Hot Topics talk "Building single molecules," Barcelona, Spain, July 22-27, 2018

Cold Controlled Molecules and Ions Conference, "Building single molecules," Athens, GA, March 25 - 30, 2018

Max Planck Harvard Quantum Optics Center Inauguration Ceremony, "Fun with two atoms: a tale of collisions and reactions," Munich, Germany, January 11-12, 2018

WE-Heraeus-Seminar: Longrange interactions, "Photoassociation of single atoms," Bad Honnef, Germany, October 25-27, 2017

DAMOP 2017, "Making a molecular gas in the quantum regime," Sacramento, CA, June 5-9, 2017

University of California, Berkeley, Atomic, Molecular, Optical physics seminar, "Ultracold Molecular Assembler", April 12, 2017

ACS National Meeting, Symposium on "Physical Chemistry meets AMO," "Ultracold Molecular Assembler", August 21, 2016

University of California, Los Angeles, Physical Chemistry seminar, "Molecules and reactions at micro-Kelvin temperature," April 11, 2016

University of Waterloo, Canada, Physics Colloquium, "Molecular physics and chemistry at micro-Kelvin temperature," April 21, 2016

Northwestern University, Atomic, Molecular, Optical physics seminar, "Ultracold Molecular Assembler," May 10, 2016

Amherst College, Physics Colloquium, "Molecular physics and chemistry at micro-Kelvin temperature," March 22 2016

International Organization of Chinese Physicists and Astronomers 8th Conference, "Precision Spectroscopy of Polarized Molecules in an Ion Trap," Singapore, June 2014

Cornell University, “New prospect for cold molecular physics," Ithaca, NY, April 4th, 2013

Duke University, “New prospect for cold molecular physics,” March 6th, 2013

Columbia University, “New prospect for cold molecular physics,” New York, NY, March 5th, 2013

Hong Kong University of Science and Technology, “New prospect for cold molecular physics,” Hong Kong, February 28th.

University of Illinois at Urbana-Champaign, “New prospect for cold molecular physics", February 18, 2013

Harvard University, “New prospect for cold molecular chemistry and physics," Cambridge, MA, February 13, 2013

Joint Quantum Institute, “New prospect for cold molecular physics," College Park, MA, February 11, 2013

Cornell University, “New prospect for cold molecular physics," Ithaca, NY, February 5, 2013

Institute of Atomic and Molecular Sciences, “New prospect for cold molecular physics," Taipei, Taiwan, January 23, 2013

National Tsing Hua University, “New prospect for cold molecular physics," Hsinchu, Taiwan, January 21, 2013

Pennsylvania State University, “New prospect for cold molecular physics," State College, PA, January 15, 2013

Princeton University, “New prospect for cold molecular physics,” Princeton, NJ, December 13, 2012

Institute for Advanced Study, Tsinghua University, Beijing, “Looking for electron out-of-roundness below 10^{-28} centimeters”, September 6, 2012

UC Berkeley AMO Seminar, “Optical Trapping of Dielectric Membranes," Berkeley, CA, April 13, 2011

DAMOP 2010, Thesis Prize Finalist presentation, Houston, TX, May 26, 2010

Quantum Optics Conference 2010, “Ultracold Collisions of Polar Molecules," Obergurgl, Austria, Feb., 2010

Center for Ultracold Atoms Seminar 2009, “Ultracold Collisions of Polar Molecules," Cambridge, MA, Nov. 17, 2009

DAMOP 2009, “Ultracold Molecules” session, Charlottesville, VA, May 22, 2009

Workshop on “Ultracold atoms and molecules,” Hsinchu, Taiwan, March 28 and 29, 2009

Extreme Photonics, “Ultrafast meets Ultracol” Conference, Gamagori, Japan, Nov. 12, 2008