

CURRICULUM VITAE

NAME: Paul Sebastian Julienne

ADDRESS: 100 Bureau Drive, Stop 8423
Atomic Physics Division and Joint Quantum Institute
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

BORN: May 8, 1944, Spartanburg, S. C.

MARRIED: August 31, 1968, to Marietta Grace Leneer

CHILDREN: Marianne Elizabeth, October 2, 1970
Alicia Katherine, November 3, 1973

EDUCATION: June 1965, B. S. in Chemistry from Wofford College,
Spartanburg, S. C.

August 1969, Ph. D. in Physical Chemistry from the
University of North Carolina at Chapel Hill

National Science Foundation Predoctoral Fellow, 1965-1969
Thesis: "A Theoretical Study of Excited Electronic States
in Dilute and Concentrated Mixed Molecular Crystals" with
Sang-il Choi.

PROFESSIONAL SOCIETIES: Fellow, American Physical Society
American Geophysical Union

EMPLOYMENT: NIST Fellow, 2003-present
1995 - 2003 - Group Leader, Quantum Processes Group
Atomic Physics Division
Molecular Physics Division (1976-95)
Physical Chemistry Division (1974-1976)
National Bureau of Standards(changed to National
Institute of Standards and Technology)

1973 - 1974 - Research physicist, Plasma Physics Division
Naval Research Laboratory, Washington, D. C.

1971 - 1973 - Research chemist, Physical Chemistry Division
National Bureau of Standards

1969 - 1971 - National Research Council Postdoctoral
Research Associate, Physical Chemistry
Division, National Bureau of Standards

- OTHER:
- August - September, 1986, Visiting Professor, Fachbereich Physik, Universtat Kaiserslautern, Kaiserslautern, FRG
 - July, 1987, Visiting scientist, Observatoire de Paris, Meudon, France
 - March - April, 1989, Visiting Professor, Ecole Normale Superieure, Paris, France
 - July, 1993, Visiting Professor, Laboratoire des Collisions Atomiques et Moleculaires, Orsay, France
 - March-April, 1995, Visiting Professor, Ben-Gurion University, Israel.
 - November, 2002, Visiting Professor, University of Innsbruck, Austria
- HONORS:
- 1992, Department of Commerce Silver Medal
 - 1998, Department of Commerce Gold Medal
 - 2004, Davisson-Germer Prize of the American Physical Society, Citation: For his pioneering studies of the theory of ultracold atomic collisions, and its applications to precision metrology and quantum gas dynamics.
 - 2004, NIST Samuel Wesley Stratton Award for outstanding scientific or engineering achievements in support of NIST objectives. Citation: For world leading theoretical physics research in ultracold collisions fundamental to the laser cooling of atoms and Bose-Einstein condensation
 - 2005, Washington Academy of Sciences Annual Award for Work of Merit and Distinction in the Physical Sciences Citation: For pioneering studies of the theory of ultracold atomic collisions and its numerous applications that continue to impact forefront research from Bose-Einstein condensation to atomic clocks.
- COMMITTEES:
- 1994-1998, National Research Council Committee on Atomic, Molecular, and Optical Science (CAMOS)
 - 2005-2007, Advisory Board for the Institute for Atomic and Molecular Physics (ITAMP).

Research Interest

My general area of interest has been in theoretical molecular spectroscopy and atomic collision processes, in particular, in the application of theoretical techniques, including state-of-the-art *ab initio* calculations, to obtain a better understanding of basic atomic and molecular phenomena. Most of this work has been directed to understand various experimental observations or to make predictions that can be tested by new experiments.

Most of this work in the 1970's involved applications to atmospheric and astrophysical problems. This included *ab initio* calculations of nonadiabatic couplings in molecular hydrogen and other molecules of astrophysical interest, predissociation of molecular oxygen, and collisional-radiative recombination of atomic oxygen plasmas. The work on molecular oxygen not only elucidated some complex fundamental molecular physics but also has proved to be important to the understanding the penetration of solar radiation into the stratosphere.

From the late 1970s through the 1980s, applications centered on issues relating to the development of high-energy lasers and collisions in light fields. This resulted in the study of molecular excimers, and the development of general theoretical methods for calculating the effect of light on atomic collisions. Other work in collaboration with Frederick Mies established a generalized analytic framework known as multichannel quantum defect theory to characterize the bound states, quasi-bound resonances, and scattering properties of atomic collisions. These theories were applied to atomic line broadening, the collisional redistribution of light, energy transfer collisions, molecular photodissociation, and excimer spectra.

For the last 20 years, since the development of laser cooling in the mid 1980s, I have concentrated on phenomena associated with ultracold trapped atoms. The very first paper I wrote concerning ultracold atoms, done in conjunction with Prof. John Weiner at the University of Maryland and a graduate student, Helen Thorsheim, proposed high resolution photoassociation spectroscopy as a tool for probing ground and excited state interactions of cold atoms. This has turned out to be a very fruitful avenue of experimental investigation, pioneered at NIST. Since this first paper in 1987, I have published over 100 articles directed towards understanding cooled and trapped bosonic or fermionic atoms, their interactions and control, especially for quantum degenerate gases or lattices. I have also worked on the nonlinear dynamics of Bose-Einstein condensates, including proposing an experiment successfully carried out by Bill Phillips' group at NIST demonstrating four-wave mixing of matter waves.

My current research is directed in two areas. The first is to provide simplified quantitative models for understanding and calculating the properties of magnetically tunable Feshbach resonances, which have been very successfully used to make cold molecules and to control atom interactions in quantum degenerate atomic gases or optical lattices. This work is being extended to calculating the properties of optically tunable resonances. The second area involves the study of closed shell S-state atoms such as Ca, Sr, and Yb. These species can be laser cooled, have both bosonic and fermionic isotopes, and have good prospects for use in ultraprecise optical clocks, as new kinds of quantum degenerate gases or lattices, or for quantum information applications.

PUBLICATION LIST (183)

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2. Julienne, P. S., and Choi, Sang-II, "Impurity states in a linear molecular Crystal," *J. Chem. Phys.* **49**, 3704 (1968).
3. Julienne, P. S., and Choi, Sang-II, "Electronic states of a disordered polymer," *J. Chem. Phys.* **53**, 2726 (1970).
4. Julienne, P. S., "Predissociation of the $H_2 D^1\Pi_u$ state," *Chem. Phys. Lett.* **8**, 27 (1971).
5. Waynant, R. W., Ali, A. W., and Julienne, P. S., "Experimental observations and calculated band strengths for the D_2 Lyman band laser," *J. Appl. Phys.* **42**, 3406 (1971).
6. Julienne, P. S., Neumann, D., and Krauss, M., "Calculation of the temperature dependence for absorption of CO_2 in the 1720-1200 Å region," *J. Atmos. Sci.* **28**, 833 (1971).
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INVITED TALKS AFTER 1996

1997

1. "Atomic Interactions and Bose-Einstein Condensation," Physics Colloquium, University of Toledo, Toledo, OH, January 1997.
2. "Collisional Stability of Dual Bose-Einstein Condensates," ARO-ONR Workshop on Atom Lasers, Optical Sciences Center, University of Arizona, Tuscon, AZ, January, 1997.
3. "Atomic Interactions and Bose-Einstein Condensation," Physics Seminar, Ben-Gurion University, Beer-Sheva, Israel, February, 1997.
4. "Atomic Interactions and Bose-Einstein Condensation," Physics Seminar, Oersted Institute, Copenhagen University, Copenhagen, Denmark, March, 1997.
5. "Atomic Interactions and Bose-Einstein Condensation," Workshop on Bose-Einstein Condensation," University of Helsinki, Helsinki, Finland, March, 1997.
6. "Photoassociation Spectroscopy: Progress in Theory for a New Precision Measurement Tool," Symposium on New Challenges in Precision Atomic Physics, DAMOP Meeting, American Physical Society, April, 1997.
7. "Atomic Collisions and Bose-Einstein Condensation," Joint University of Connecticut, Wesleyan University, and Yale University Physics Chemical Physics Colliquium Series, Storrs, CT, April, 1997.
8. "High Precision Molecular Spectra by Photoassociation of Ultracold Trapped Atoms," International Symposium on Molecular Spectroscopy, Ohio State University, Columbus, OH, June 1997.
9. "Theory of Ultracold Atomic Collisions," International Conference on Electron and Atomic Collisions, Vienna, Austria, July, 1997.
10. "Atomic Interactions and Bose-Einstein Condensation," Gordon Conference on Electronic Spectra, Queens College, Oxford, England, September, 1997.
11. "Quantitative Collision Rates for Ultracold Collisions," Gaseous Electronics Conference, Madison, WI, October, 1997.
12. "Atomic interactions and Bose-Einstein Condensation," Physics Colloquium, Temple University, Philadelphia, PA, November, 1997
13. "Photoassociation Spectroscopy and Bose-Einstein Condensation," Workshop on Collisions of Cold, Trapped Atoms, JILA, Boulder, CO, November, 1997.

1998

1. Collisions of Cooled and Trapped atoms: 3 lectures, "Introduction to Cold Collisions: Basic concepts," "Photo-induced collisions," "Collisions and Bose-Einstein Condensation", School on Nonlinear and Quantum Optics, 1998, Sao Carlos, Brazil, January 5-16, 1998.
2. "Progress in Cold Collision Studies for Bose-Einstein Condensation," Mini-workshop on Bose-Einstein Condensation, Niels Bohr Institute, Copenhagen, Denmark, January 24, 1998.
3. "Collisions in a Cold Atomic Gas," Euroconference on Slow Collisions between Laser Manipulated Systems, Rust, Austria, April 1-5, 1998.
4. "Cold Molecule Formation in Bose-Einstein Condensates and Optical Lattices," Center for Advanced Studies Workshop on Quantum Control of Atomic Motion II, University of New Mexico, Albuquerque, New Mexico, June 1-2, 1998
5. "Atomic Collisions in the Quantum Limit," Symposium honoring Bill Phillips, NIST, June 17-19, 1998.
- 6 "Lineshape Issues in Cold Atomic Collisions." International Conference on Spectral Line Shapes, Pennsylvania State University, State College, PA, June 22-26, 1998.
7. "Atoms, Molecules, Bose-Einstein Condensates, and Light," Gordon Conference on Atomic and Molecular Interactions, New London, NH, June 28-July 3, 1998
8. "Ultracold Atomic Collisions," International Conference on Atomic Physics, Windsor, Ontario, Canada, Aug. 3-7, 1998.
9. "Atoms, Light, and Bose-Einstein Condensates: the Story of Cooling and Trapping," Physics Seminar, George Mason University, Fairfax, Virginia, Oct. 9, 1998.
10. "Cold Atomic Collisions: 9 lectures," Master Class on Laser Cooling, Cold Collisions, and Bose-Einstein Condensation, Niels Bohr Institute, Copenhagen, Denmark, Dec. 2-9, 1998.

1999

1. "Photoassociation Spectroscopy: Past, Present, and Future," Workshop on Formation of Cold Molecules," Les Houches, France, March 1-5, 1999.
2. "Atoms, Light, and Bose-Einstein Condensates: the Success of Cooling and Trapping," Physics Colloquium, University of Maryland Baltimore County, April 9, 1999.
3. "Atomic Collisions in Optical Lattices," Southwestern Quantum Information Network Workshop, Albuquerque, NM, April 30-May 1, 1999.

4. "Cold Collisions in Traps: Condensates, Resonances, and Molecules," ITAMP Workshop on Cold Molecules, Harvard-Smithsonian Center for Astrophysics, July 1-3, 1999.
5. "Collisions and the Dynamics of Cold Atomic Gases," International Conference on the Dynamics of Molecular Collisions, Split Rock, PA, July 18-22, 1999
6. "Coherence and Dynamics of Matter Waves from Bose-Einstein Condensate Sources," Grodon Conference on Quantum Control of Matter, Plymouth, NH, Aug. 1-5, 1999.
7. "Photoassociation Spectroscopy: Past, Present, and Future," Workshop on Collisions in Laser Fields, Torun, Poland, Sept. 1-3, 1999.
8. "Condensates, Collisions, and Quantum Control," Physics Seminar, Yale Univeristy, New Haven, CT, Nov. 6, 1999.

2000

1. "Scattering resonances and the formation of cold molecules," Division of Atomic, Molecular, and Optical Physics Annual Meeting, Storrs, CT, June 16, 2000.
2. "Nonlinear phenomena in Bose-Einstein condensate wavepacket dynamics," Gordon Conference on Multiphoton Processes, Tilton, NH, June 22, 2000.
3. "Survey of molecule formation processes from ultracold atoms," American Chemical Society National Meeting, Symposium on Low Temperature Spectroscopy and Dynamics, Washington, DC, August 22, 2000.
4. "Group II Atoms: A Cornucopia of Cold Collision Physics," Workshop on Group II Atoms, Institute for Theoretical Atomic and Molecular Physics, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, Sept. 9, 2000.
5. "Threshold Resonances: a key to cold collision phenomena," Physics Seminar, State University of New York, Stony Brook, NY, September 25, 2000.
6. "Threshold Resonances: a key to cold collision phenomena," Department of Energy Basic Energy Sciences Annual Meeting on Atomic, Molecular, and Optical Physics, Warrenton, VA, September 28, 2000.

2001

1. "Threshold resonances: A key to cold collision physics", Physics Seminar, University of Texas at Austin, Austin, TX, March 2001.
2. "Threshold resonances: A key to cold collision physics", Seminar, Center for Ultracold Atoms, Harvard/MIT, Cambridge, MA, May 2001.

3. "Threshold resonances: A key to cold collision physics", International Conference on Laser Spectroscopy, Snowbird, UT, June 2001.
4. "Collisions of Cold Group II Atoms," Workshop on Cold Atoms and Ultra-precise Atomic Clocks, Sandbjerg, Denmark, September 2001.

2002

1. "Quantum encounters of the cold kind," Physics Seminar, European Laboratory for Nonlinear Spectroscopy, Florence, Italy, February, 2002.
2. "Theory of photoassociation at ultra low temperatures," Workshop on Cold Molecules, Les Houches, France, march 2002.
3. " Quantum encounters of the cold kind," Physics Colloquium, Old Dominion University, Norfolk, VA, April 2002.
4. "Collisions, Condensates, and Optical Lattices," Conference on Cold Atoms in Traps, Sandbjerg, Denmark, April 2002.
5. "Collisions, Condensates, and Optical Lattices," Nordic Institute for Theoretical Physics, Copenhagen, Denmark, April 2002.
6. "Collisions, Condensates, and Optical Lattices," Physics Seminar, Institute for Quantum Optics, University of Hannover, Hannover, Germany, April 2002.
7. "Threshold resonances: a key to cold collision physics," Workshop on Cold Molecules, University of Durham, Durham, UK, September 2002.
8. "Quantum encounters of the cold kind," Seminar, University of Maryland, College Park, Md, , October, 2002.
9. "Cold collision basics: Threshold phenomena", tutorial lecture, Institute for Experimental Physics, University of Innsbruck, Innsbruck, Austria, November, 2002.
10. "Quantum Encounters of the Cold Kind," Physics Seminar, University of Innsbruck, Innsbruck, Austria, November, 2002.
11. "Photoassociation in a Bose-Einstein condensate", tutorial lecture, Institute for Experimental Physics, University of Innsbruck, Innsbruck, Austria, November, 2002.

2003

1. "Time-dependent Feshbach Resonance Ramps and Molecules in a BEC," QIBEC Seminar, NIST, January, 2003.
2. "Quantum Encounters of the Cold Kind: Fundamentals of Cold Collision Physics," Tutorial Lecture, Student Symposium, DAMOP, Boulder, May, 2003.
3. "Making Cold Molecules by tunable Scattering Resonances," Quantum Challenges Colloquium, Warsaw, Poland, September, 2003
4. "High intensity Photoassociation Spectra," Workshop on Cold Alkaline Earth Atoms, Copenhagen, Denmark, September, 2003.

2004

1. "Making Ultracold Molecules" Joint Institute for Coherent Quantum Phenomena Workshop, U. Maryland, January, 2004
2. "Making cold molecules using tunable scattering resonances", March APS Meeting, Montreal, March 22, 2004
3. "Making cold molecules using tunable scattering resonances", Conference on Bose-Einstein Condensation: from Atoms to Molecules, University of Durham, UK, March, 2004
4. "Making cold molecules using tunable scattering resonances", Plenary Prize Session, DAMOP, Tucson, AZ, May, 2004
5. "Making cold molecules using tunable scattering resonances", Symposium on Ultracold Molecules, American Chemical Society National Meeting, Philadelphia, August, 2004.

2005

1. "Tunable scattering resonances: What are they like?" Conference on Mesoscopic Phenomena in Ultracold Matter: From Single Atoms to Coherent Ensembles, Dresden, Germany, October 2004.
2. "The molecular physics of bound and unbound Feshbach resonance states," Workshop on Ultracold Molecules, Telluride, CO, July 2005.
3. "Quantum Encounters of the Cold Kind," Telluride Public Town Talk, Telluride, CO, July 2005.
4. "What you really want to know about Feshbach resonances," NIST QIBEC Seminar, July 2005.

5. "Properties of Bound and Unbound Feshbach Resonance States," Seminar, Institute for Experimental Physics, University of Innsbruck, Innsbruck, Austria, August 2005.
6. "Feshbach Resonances and the Formation of Polar Molecules," Workshop on Quantum Computing with Polar Molecules, Arlington, VA, Sept. 2005.
7. "Scattering resonances and molecules in ultracold atomic gases," James Franck Institute, University of Chicago, Chicago, IL, October, 2005.
8. "Scattering resonances and molecules in ultracold atomic gases," Atomic Physics Seminar, NIST, Nov. 2005.

2006

1. "Scattering resonances and molecules in ultracold atomic gases," James Franck Institute, University of Chicago, Chicago, IL, October, 2005.
2. "Scattering resonances and molecules in ultracold atomic gases," Atomic Physics Seminar, NIST, Nov. 2005.
3. "Scattering resonances and molecules in ultracold atomic gases," Physics Seminar, Ohio State University, Columbus, Ohio, Feb. 2006.
4. "Resonant control of collisions in atomic gases," Center for Advanced Studies Seminar, University of New Mexico, Albuquerque, New Mexico, March, 2006.
5. Three lectures at the ICAP Summer School, Innsbruck, Austria, July 10-14, 2006, on "Cold atomic and molecular collisions:" (1) "Basics," (2) "Feshbach resonances," (3) "Photoassociation."
6. "Simple theoretical models for resonant cold atom interactions", International Conference on Atomic Physics (ICAP), Innsbruck.
7. "Resonant control of cold atom collisions," Physics seminar, University of Durham, Durham, UK, July 2006.
8. "Cold molecular collisions: challenges and opportunities", Wilhelm und Else Heraeus-Seminar on Cold Molecules, Bad Honnef, Germany, October 2007.