

VITA

NAME: Deborah Kay Watson

EDUCATION:

1977 Ph.D. Harvard University, Cambridge, Massachusetts
1977-1981 Postdoctoral Research Fellow, Caltech

PROFESSIONAL EXPERIENCE:

2020– Fellow of American Physical Society,
2016– Professor Emeritus,
2004– Edith Kinney Gaylord Presidential Professor,
Department of Physics and Astronomy,
University of Oklahoma, Norman, OK
1993– Professor, Department of Physics and Astronomy,
University of Oklahoma, Norman, OK
1987-1988 National Science Foundation Visiting Professorships for Women Fellow,
Harvard University, Cambridge, Massachusetts
1987-1993 Associate Professor, Department of Physics and Astronomy,
University of Oklahoma, Norman, OK
1981–1987 Assistant Professor, Department of Physics and Astronomy,
University of Oklahoma, Norman, OK
1980–1981 Research Physicist, Space Science Laboratory, Aerospace
Corporation, Los Angeles, CA
1979–1983 Consultant, Advanced Quantum Electronics Program, Y Division,
Lawrence Livermore Laboratories
1978–1980 Postdoctoral Research Fellow, California Institute of Technology,
1977–1978 NSF Postdoctoral Research Fellow, California Institute of Technology,
1977 Center for Astrophysics Postdoctoral Fellow

SCHOLARSHIPS AND HONORS:

American Physical Society Fellow 2020-
Edith Kinney Gaylord Presidential Professorship 2004-
Bunting Institute Award 1988
Regents Award for Superior Research 1988
OU Distinguished Lectureship Award 1986-1987
OU Distinguished Lectureship Award 1985-1986
Outstanding Research Award of the National Honor Society 1984
National Science Foundation Postdoctoral Fellow 1977-1978
Center for Astrophysics Postdoctoral Fellow 1977
I.B.M. Fellow 1975-1976
National Science Foundation Predoctoral Fellow 1972-1975

AREAS OF EXPERTISE:

Theoretical Atomic and Molecular Physics
The Pauli principle
Manybody systems
Ultracold Fermions
Group theoretic methods

PROFESSIONAL SOCIETY MEMBERSHIPS AND ACTIVITIES:

American Physical Society
Division of Atomic, Molecular and Optical Physics
Sigma Xi
Program Committee 13th Annual Meeting of the Division of Electron and
Atomic Physics New York City, New York (December 1981)
Co-Chairman, Theoretical Workshop, 16th Annual Meeting of the Division
of Electron and Atomic Physics Norman, Oklahoma (May 1985)
Member of the Physics Advisory Committee to the National Science Foundation,
term 1987-1990
Member of the Board of Directors, Harvard-Smithsonian Institute for
Theoretical Atomic and Molecular Physics, term 1989-1992
Member of NSF Committee to select Young Presidential Investigators
1993-1994

Member of the DAMOP Thesis Prize Committee

1999-2002, Chair 2000-2002

Member of the Few Body Topical Group Nominating Committee

2000-2002

Member of the National Academies' National Research Council NIST Panel

2004-2010

Chair of the Theoretical Atomic, Molecular and Optical Physics Community
(TAMOC) committee 2005-2007

Member of the Nominations Committee for the Division of Atomic, Molecular,
and Optical Physics 2009-2010

PUBLICATIONS

G. Fraenkel and D. Watson, "Alkoxide Adduct of an Amide, Mean Lifetime of an Intimate Ion Pair," *JACS* **97**, 231 (1975)

D. K. Watson and S. V. O'Neill, "1/Z-Expansion Study of the $1s^2 2s^2 1S$, $1s^2 2s 2p^1 P$, and $1s^2 2p^2 1S$ States of the Beryllium Isoelectronic Sequence," *Phys. Rev. A* **12**, 729 (1975)

R. F. Stewart, D. K. Watson and A. Dalgarno, "Variational Time-Dependent Hartree-Fock Calculations: I. Applications to Four-Electron Atomic and Molecular Systems," *J. Chem. Phys.* **63**, 3222 (1975)

D. K. Watson, R. F. Stewart and A. Dalgarno, "Variational Time-Dependent Hartree-Fock Calculations: II. Applications to Six-Electron Molecular Systems," *J. Chem. Phys.* **64**, 4995 (1976)

R. F. Stewart, D. K. Watson and A. Dalgarno, "Variational Time-Dependent Hartree-Fock Calculations: III. Potential Curves for Two-Electron Molecular Systems," *J. Chem. Phys.* **65**, 2104 (1976)

D. K. Watson, R. F. Stewart and A. Dalgarno, "Variational Time-Dependent Hartree-Fock Calculations: IV. A Pseudopotential Study of the Alkali Hydrides," *Mol. Phys.* **32**, 1661 (1976)

D. K. Watson, C. J. Cerjan, S. Guberman and A. Dalgarno, "Potential Energy Curves for Li_2 ," *Chem. Phys. Lett.* **50**, 181 (1977)

D. K. Watson, "Theoretical Radiative Lifetimes for the $A^1\Sigma_u^+ - X^1\Sigma_g^+$ Band System of Li_2 ," *Chem. Phys. Lett.* **51**, 513 (1977)

D. K. Watson, A. Dalgarno and R. F. Stewart, "Inner-shell Photoionization of the Be Isoelectronic Sequence," *Phys. Rev. A* **17**, 1928 (1978)

T. Uzer, D. K. Watson, and A. Dalgarno, "Radiative Lifetimes of the

$B^1\Pi_u$ States of Li_2 ,” *Chem. Phys. Lett* **55**, 6 (1978)

D. K. Watson and V. McKoy, “Discrete Basis Function Approach to Electron-Molecule Scattering,” *Phys. Rev. A* **20**, 1474 (1979)

D. K. Watson, R. R. Lucchese, V. McKoy and T. N. Rescigno, “The Schwinger Variational Principle for Electron-Molecule Scattering: Applications to Electron-Hydrogen Scattering,” *Phys. Rev. A* **21**, 738 (1980)

R. R. Lucchese, D. K. Watson and V. McKoy, “An Iterative Schwinger Variational Procedure: Application to Electron-Hydrogen Scattering,” *Phys. Rev. A* **22**, 421 (1980)

D. K. Watson, T. N. Rescigno, and V. McKoy, “Schwinger Variational Calculations for Electron Scattering by Polar Molecules,” *J. Phys. B*, **14**, 1875 (1981)

R. R. Lucchese, K. Takatsuka, D. K. Watson and V. McKoy, “The Schwinger Variational Principle: An Approach to Electron Molecule Collisions,” *Proc. Symp. Electron-Atom and Molecular Collisions*, Universitat Bielefeld, ZIF Bielefeld, Germany, May 5-14, 1980 (Plenum Press, London, New York), 1981

D. K. Watson, “*Ab Initio* Determination of Quantum Defects by Calculation of the Poles of the Schwinger T Matrix,” *Phys. Rev. A* **28**, 40 (1983)

D. K. Watson, “Direct Calculation of Resonance Energies and Widths from the Poles of the Multi-channel T Matrix,” *Phys. Rev. A* **29**, 558 (1984)

G. Snitchler and D. K. Watson, “Determination of Accurate Quantum Defects and Wave Functions for Alkali Rydberg States with High Principal Quantum Numbers,” *J. Phys. B* **19**, 259 (1986).

D. K. Watson, “Determination of Partial Widths Using Properly Normalized

Resonance Wavefunctions,” *J. Phys. B* **19**, 293 (1986).

D. K. Watson, “Partial Widths and Resonance Normalization,”
Phys. Rev. A **34**, 1016 (1986).

T.L. Goforth, G. L. Snitchler, and D. K. Watson, “Determination of Quantum Defects from a Negative Energy Reaction Matrix,” *Phys. Rev. A* **35**, 904 (1987).

G. L. Snitchler and D. K. Watson, “Ab initio Determination of Quantum Defects for Beryllium I from the Poles of the Multichannel T Matrix,”
Phys. Rev. A **36**, 1533 (1987).

D.K. Watson, “The Schwinger Variational Method,” *Adv. At. Mol. Phys.* **25**, 221 (1988).

Dudley R. Herschbach, John G. Loeser, and Deborah K. Watson, “Pseudomolecular Atoms: Geometry of Two-Electron Intrashell Excited States,” *Z. Phys. D - Atoms Molecules and Clusters* **10**, 195 (1988).

D.Z. Goodson, D.K. Watson, J.G. Loeser, and D.R. Herschbach, “Energies of Doubly Excited Two-Electron Atoms from Interdimensional Degeneracies,” *Phys. Rev. A* **44**, 97 (1991).

T.L. Goforth and D.K. Watson, “Multichannel Quantum Defect Calculations Using a Smooth Reaction Matrix,” *Phys. Rev. A* **46**, 1239 (1992).

M. Dunn and D. K. Watson, “Wrong Parity States and the Molecular Orbital Description of Doubly-Excited Two-Electron Atoms in D Dimensions,”
J. Phys. Chem. **97**, 2457 (1993).

D. Z. Goodson and D. K. Watson, “Dimensional Expansions for Excited States,” in *Dimensional Scaling in Chemical Physics*, edited by D. R. Herschbach, O. Goscinski and J. Avery (Kluwer Academic, Dordrecht, Holland, p. 359).

M. Dunn and D. K. Watson, "Analytic Continuation of Higher Angular Momentum States to D Dimensions and Interdimensional Degeneracies," in *Dimensional Scaling in Chemical Physics*, edited by D. R. Herschbach, O. Goscinski and J. Avery (Kluwer Academic, Dordrecht, Holland, p. 375).

D. Z. Goodson and D. K. Watson, "Dimensional Perturbation Theory for Excited States of Two-Electron Atoms," *Phys. Rev. A* **48**, 2668(1993).

M. Dunn, T. C. Germann, C. A. Traynor, D. Z. Goodson, J. D. Morgan III, D. K. Watson and D. R. Herschbach, "A Linear Algebraic Method for Exact Computation of the Coefficients of the $1/D$ Expansion", *J. Chem. Phys.* **101**, 5987(1994).

T. C. Germann, D. R. Herschbach, M. Dunn and D. K. Watson, "Circular Rydberg States of the Hydrogen Atom in a Magnetic Field", *Phys. Rev. Lett.* **74**, 658(1994).

D. K. Watson and D. Z. Goodson, "Dimensional perturbation theory for weakly bound systems", *Phys. Rev. A* **51**, R5(1995).

D. K. Watson, M. Dunn, T. C. Germann, D. R. Herschbach, D. Z. Goodson and J. R. Walkup, "Dimensional Expansions for Atomic Systems", *New Methods in Quantum Theory*, edited by C. A. Tsipis, V. S. Popov, D. R. Herschbach, and J. Avery, NATO Conference Book, Vol. 8. (Kluwer Academic, Dordrecht, Holland, p. 83).

M. Dunn and D. K. Watson, "Continuation of the Wavefunction of Higher Angular Momentum States to D Dimensions I. The Generalized Schwartz Expansion," *Ann. Phys.* **251**, 266(1996).

M. Dunn and D. K. Watson, "Continuation of the Wavefunction of Higher Angular Momentum States to D Dimensions II. Elimination of Linear Dependencies from the Generalized Schwartz Expansion for the Wavefunction in D Dimensions," *Ann. Phys.* **251**, 319(1996).

M. Dunn and D. K. Watson, "Continuation of the Schrödinger Equation for Higher Angular Momentum States to D Dimensions and Interdimensional Degeneracies," *Few Body Systems* **21**, 187(1996).

M. Dunn, D. K. Watson, J. R. Walkup and T. C. Germann, "On the Behavior of Padè Approximants in the Vicinity of Avoided Crossings", *J. Chem. Phys.* **104**, 9870(1996).

M.O. Elout, D.Z. Goodson, C.D. Elliston, S-W Huang, A. V. Sergeev and D.K. Watson, "Improving the convergence and estimating the accuracy of summation approximants of $1/D$ expansions for Coulombic systems", *J. Math. Phys.* **39**, 5112(1998).

M. Dunn and D. K. Watson, "The Large Dimension Limit of Higher Angular Momentum States", *Phys. Rev. A* **59**, 1109(1999).

J.C. Carzoli, M. Dunn, D.K. Watson, "Singly and Doubly Excited States of the D-Dimensional Helium Atom", *Phys. Rev. A* **59**, 182(1999).

J.R. Walkup, M. Dunn, T.C. Germann and D.K. Watson, "Avoided Crossings of Diamagnetic Hydrogen as Functions of Magnetic Field Strength and Angular Momentum", *Phys. Rev. A* **58** 4668(1998).

D.K. Watson and B.A. McKinney, "An improved large N limit for Bose-Einstein condensates from perturbation theory", *Phys. Rev. A* **59**, 4091(1999).

M. Dunn and D.K. Watson, "On the Origin of the Exact Interdimensional Degeneracies", in preparation.

M. Dunn, D.K. Watson, J.R. Walkup and T.C. Germann, "Branch Point Structure and the Energy Level Characterization of Avoided Crossings", *J. Math. Phys.* **41**, 218(2000).

B.A. McKinney and D.K. Watson, "Semiclassical perturbation theory for two electrons in a D-dimensional quantum dot", *Phys. Rev B*

61, 4958(2000).

J.R. Walkup, M. Dunn, and D.K. Watson, “Local optimization of the summation of divergent power series”, *J. Math. Phys.* **41**, 56814(2000).

J.R. Walkup, M. Dunn and D.K. Watson, “Energy Calculations of Low $|m|$ Diamagnetic Hydrogen States with Dimensional Perturbation Theory”, *Phys. Rev. A* **63**, 025405-1(2001).

B.A. McKinney and D.K. Watson, “Bose-Einstein Condensation in Variable Dimensionality,” *Phys. Rev. A* **65**, 033604(2002).

B.A. McKinney, M. Dunn, D.K. Watson, and J.G. Loeser, “ N identical particles under quantum confinement: a many-body dimensional perturbation theory approach,” *Ann. Phys.* **310**, 56(2004).

B.A. McKinney, M. Dunn, D.K. Watson, “Beyond-mean-field results for atomic Bose-Einstein condensates at interaction strengths near Feshbach resonances: A many-body dimensional perturbation theory calculation,” *Phys. Rev. A* **69**, 053611(2004).

M. Dunn, D.K. Watson and J.G. Loeser, “Analytic, group theoretic wave functions for confined, correlated N -body systems with general two-body interactions,” *Ann. of Phys* **321**, 1939 (2006).

W.B. Laing, M. Dunn, and D.K. Watson, “Analytic, group-theoretic density profiles for confined, correlated N -body systems,” *Phys. Rev. A* **74**, 06360 (2006).

W.B. Laing, M. Dunn, and D.K. Watson, “On the Use of Group Theoretical and Graphical Techniques to solve the N -Body Problem with General Two-Body Interactions,” *J. of Math. Phys.***50**, 062105 (2009).

W.B. Laing, M. Dunn, and D.K. Watson,
“On Notation and the Use of Graphs in Higher-Order Dimensional Perturbation

Theory,” accepted to EPAPS (2007).

W.B. Laing, D.W. Kelle, M. Dunn, and D.K. Watson, “A Complete Basis for a Perturbation of the General N -Body Problem,” *J. Phys A* **42**, 205307 (2009).

M. Dunn, W. B. Laing, D. Toth, and D.K. Watson, “A Test of a New Interacting N -Body Wave Function,” *Phys. Rev A* **80**, 062108 (2009).

D.K. Watson and M. Dunn, “Rearranging the Exponential Wall for Large N -Body Systems,” *Phys. Rev. Lett.* **105**, 020402 (2010).

D.K. Watson and M. Dunn, “Analysis of the growth in complexity of a symmetry-invariant perturbation method for large N -body systems,” *J. Phys. B* **45**, 095002 (2012).

D.K. Watson, “A Manybody Formalism for Fermions: Applying the Pauli Principle on Paper,” *Phys. Rev. A* **92**, 013628 (2015).

D.K. Watson, “A Manybody Formalism for Fermions: Testing the Enforcement of the Pauli Principle,” *Phys. Rev. A* **93**, 023622 (2016).

D.K. Watson, “A Manybody Formalism for Fermions: The Partition Function,” *Phys. Rev. A* **96**, 033601 (2017).

T. T. Le, Z. Osman, D.K. Watson, M. Dunn and B.A. McKinney, ”Generalization of the Fermi pseudopotential,” *Phys. Scr.* **94**, 065203 (2019).

D.K. Watson, “Universal thermodynamics of a trapped Fermi gas in the unitary regime: the role of the Pauli principle,” *J. Phys. B* **52**, 205301(2019).

D.K. Watson, ”Normal modes for N identical particles: A study of collective behavior from few-body to many-body,” *Ann. Phys.* **419**, 168219 (2020).

D.K. Watson, ”Analytic-normal-mode frequencies for N identical particles: The microscopic dynamics underlying the emergence and stability of excitation gaps from BCS to unitarity,” *Phys. Rev. A* **104**, 033320 (2021).

D.K. Watson, "Exploring the transition from BCS to unitarity using normal modes: energies, entropies, critical temperatures and excitation frequencies, accepted *J. Low Temp. Phys.* (2023).

D.K. Watson, "The Pauli principle in collective motion: Reimagining and reinterpreting Cooper pairs, the Fermi sea, Pauli blocking and superfluidity," arXiv:2304.04696 (2023).