

Curriculum Vitae

Harris J. Silverstone

Department of Chemistry
The Johns Hopkins University
3400 N. Charles Street
Baltimore, Maryland 21218

100 Cedarcroft Road
Baltimore, Maryland 21212

voice: (410) 516-7431
email: hjsilverstone@jhu.edu
fax: (410) 516-7452

(410) 435-3582

Born 18 September 1939, New York, NY
United States citizen

Education

| | | |
|------------------------------------|------|---|
| Harvard College | 1960 | A.B., Chemistry, (magna cum laude with highest honors); $\phi\beta\kappa$ |
| California Institute of Technology | 1964 | Ph.D., Chemistry |

Professional Experience

| | | |
|--------------------------------|--------------|---|
| Yale University | 1964 | Postdoctoral Fellow |
| The Johns Hopkins University | 1965-68 | Assistant Professor of Chemistry |
| The Johns Hopkins University | 1968-71 | Associate Professor of Chemistry |
| The Johns Hopkins University | 1971-present | Professor of Chemistry |
| University of Modena, Italy | 1982 | Visiting Professor |
| University of Waterloo, Canada | 1984 | Visiting Research Professor |
| Cambridge University, England | 1995 | Exponential Asymptotics Programme, Isaac Newton Institute |
| Kyoto University, Kyoto, Japan | 2007 | Visiting Professor |

Fellowships

| | |
|---|---------------------------|
| National Science Foundation Graduate Fellowship | 1960-61, 1961-62, 1962-63 |
| National Science Foundation Postdoctoral Fellowship | 1964 |
| Alfred P. Sloan Research Fellowship | 1969-73 |

HARRIS J. SILVERSTONE

Publications

1. *A theoretical study of the electron spin resonance spectra of cycloheptatrienyl*
Harris Julian Silverstone
Ph.D. Thesis, California Institute of Technology, 1964, (University Microfilms, Inc., Ann Arbor, Michigan, No. 65-6532).
2. *Study of molecular orbital degeneracy in C_7H_7*
H. J. Silverstone, D. E. Wood and H. M. McConnell
J. Chem. Phys. **41**, 2311-2323 (1964).
3. *Electron Correlation in nonclosed shell systems*
Harris J. Silverstone and Oktay Sinanoğlu
in *Modern Quantum Chemistry - Istanbul Lectures, Part II*, O. Sinanoğlu, editor,
(Academic Press, Inc., New York, 1965), pp. 99-121.
4. *Energy differences and Parr's Integral Hellmann-Feynman Theorem*
Harris J. Silverstone
J. Chem. Phys. **43**, 4537-4539 (1965).
5. *Toward a better $2p\pi$ -atomic orbital for π -electron theory*
Harris J. Silverstone, Hubert W. Joy and Malcolm K. Orloff
J. Am. Chem. Soc. **88**, 1325-1327 (1966).
6. *Many-electron theory of nonclosed-shell atoms and molecules. I. Orbital wavefunction and perturbation theory*
Harris J. Silverstone and Oktay Sinanoğlu
J. Chem. Phys. **44**, 1899-1907 (1966).
7. *Many-electron theory of nonclosed-shell atoms and molecules. II. Variational theory*
Harris J. Silverstone and Oktay Sinanoğlu
J. Chem. Phys. **44**, 3608-3617 (1966).
8. *On the evaluation of two-center overlap and coulomb integrals with non-integer- n Slater type orbitals*
Harris J. Silverstone
J. Chem. Phys. **45**, 4337-4341 (1966).
9. *Symmetry properties of one- and two-electron correlation functions in the many-electron theory of atoms and molecules*
Harris J. Silverstone and Oktay Sinanoğlu
J. Chem. Phys. **46**, 854-859 (1967).

10. *Nonempirical evaluation of π -electron charge density dependence of proton isotropic hyperfine coupling constants. An application of the valence state model*
Kenneth G. Kay and Harris J. Silverstone
J. Chem. Phys. **46**, 2854-2855 (1967).
11. *Series expansion for two-center noninteger- n overlap integrals*
Harris J. Silverstone
J. Chem. Phys. **46**, 4368-4376 (1967).
12. *Series expansion for two-center noninteger- n coulomb integrals*
Harris J. Silverstone
J. Chem. Phys. **46**, 4377-4380 (1967).
13. *Analytical evaluation of three- and four-center integrals of r_{12}^{-1} with Slater-type orbitals*
Harris J. Silverstone
Proc. Natl. Acad. Sci. U.S. **58**, 34-36 (1967).
14. *Expansion about an arbitrary point of three-dimensional functions involving spherical harmonics by the Fourier transform convolution theorem*
Harris J. Silverstone
J. Chem. Phys. **47**, 537-540 (1967).
15. *Valence states of carbon in π -electron systems. I. Alternant hydrocarbon ground states*
Harris J. Silverstone
J. Chem. Phys. **47**, 1384-1392 (1967).
16. *Valence states of carbon in π -electron system. II. Excited states and ions*
Hubert W. Joy and Harris J. Silverstone
Molec. Phys. **13**, 149-156 (1967).
17. *Energy calculation by the method of local moments*
Harris J. Silverstone, Moon-Lung Yin and R. L. Somorjai
J. Chem. Phys. **47**, 4824-4827 (1967).
18. *Analytical evaluation of multicenter integrals of r_{12}^{-1} with Slater-type atomic orbitals. I. (1-2)-type three-center integrals*
Harris J. Silverstone
J. Chem. Phys. **48**, 4098-4106 (1968).
19. *Analytical evaluation of multicenter integrals of r_{12}^{-1} with Slater-type atomic orbitals. II. Three-center nuclear attraction integrals*
Harris J. Silverstone
J. Chem. Phys. **48**, 4106-4108 (1968).

20. *Analytical evaluation of multicenter integrals of r_{12}^{-1} with Slater-type atomic orbitals. III. (2-2)-type three-center integrals*
Harris J. Silverstone and Kenneth G. Kay
J. Chem. Phys. **48**, 4108-4115 (1968).
21. *Modified perturbation theory for atoms and molecules based on a Hartree-Fock ϕ_0*
Harris J. Silverstone and Moon-Lung Yin
J. Chem. Phys. **49**, 2026-2030 (1968).
22. *Some aspects of electron correlation in open-shell states. 2^1P and 2^3P helium*
Moon-Lung Yin and Harris J. Silverstone
J. Chem. Phys. **49**, 3160-3164 (1968).
23. *Long-range behavior of Hartree-Fock orbitals*
Nicholas C. Handy, Michael T. Marron, and Harris J. Silverstone
Phys. Rev. **180**, 45-48 (1969).
24. *Convergence properties of certain formulas for multicenter electron repulsion integrals obtained from the bipolar expansion of r_{12}^{-1}*
Harris J. Silverstone and Kenneth G. Kay
J. Chem. Phys. **50**, 5045-5047 (1969).
25. *Analytical evaluation of multicenter integrals of r_{12}^{-1} with Slater-type atomic orbitals. IV. Four-center integrals by Taylor series method*
Kenneth G. Kay and Harris J. Silverstone
J. Chem. Phys. **51**, 956-961 (1969).
26. *Dirac delta functions in the Laplace-type expansion of $r^n Y_l^m(\theta, \phi)$*
Kenneth G. Kay, H. David Todd, and Harris J. Silverstone
J. Chem. Phys. **51**, 2359-2362 (1969).
27. *Bipolar expansion for $r^n Y_l^m(\theta, \phi)$*
Kenneth G. Kay, H. David Todd, and Harris J. Silverstone
J. Chem. Phys. **51**, 2363-2367 (1969).
28. *Method of local configuration interaction applied to electronic systems. Hydrogen atom and hydrogen molecule ion*
Stuart M. Rothstein, James E. Welsch, and Harris J. Silverstone
J. Chem. Phys. **51**, 2932-2936 (1969).
29. *Analytical evaluation of multicenter integrals of r_{12}^{-1} with Slater-type atomic orbitals. V. Four-center integrals by Fourier-transform method*
Kenneth G. Kay and Harris J. Silverstone
J. Chem. Phys. **51**, 4287-4304 (1969).

30. *Rational function approximation for atomic and molecular wavefunctions*
Gail Wilson and Harris J. Silverstone
Int. J. Quantum Chem **3**, 1067-1068 (1969).
31. *Explicit formulas for the n th order wavefunction and energy in nondegenerate Rayleigh-Schrödinger perturbation theory*
Harris J. Silverstone and Thomas T. Holloway
J. Chem. Phys. **52**, 1472-1475 (1970).
32. *Solution of the Hartree-Fock problem by expansion onto nested bases*
Michael T. Marron, Nicholas C. Handy, Robert G. Parr, and Harris J. Silverstone
Int. J. Quantum Chem. **4**, 245-255 (1970).
33. *Analytical evaluation of three-center one-electron integrals of $r^n Y_l^m(\theta, \phi)$ with Slater-type atomic orbitals*
Harris J. Silverstone and H. David Todd
Int. J. Quantum Chem Symposium **4**, 371-383 (1971).
34. *Unified treatment of two-center overlap, coulomb, and kinetic-energy integrals*
H. David Todd, Kenneth G. Kay, and Harris J. Silverstone
J. Chem. Phys. **53**, 3951-3956 (1970).
35. *Comment on "The evaluation of three-center nuclear attraction integrals"*
Kenneth G. Kay, Harris J. Silverstone, and B. Kleinman
J. Chem. Phys. **53**, 2545-2546 (1970).
36. *Analytical evaluation of multicenter integrals of r_{12}^{-1} with Slater-type atomic orbitals. VI. Asymptotic expansions for large internuclear distances*
Kenneth G. Kay and Harris J. Silverstone
J. Chem. Phys. **53**, 4269-4285(1970).
37. *Explicit solution for the wavefunction and energy in degenerate Rayleigh-Schrödinger perturbation theory*
Harris J. Silverstone
J. Chem. Phys. **54**, 2325-2335 (1971).
38. *Kinetic energy expectation values with discontinuous approximate wave functions*
Harris J. Silverstone and Edward W. Stuebing
Phys. Rev. A **5**, 1092-1093 (1972).
39. *Explicit formulas in degenerate Rayleigh-Schrödinger perturbation theory for the energy and wavefunction, based on a formula of Lagrange*
Harris J. Silverstone and Thomas T. Holloway
Phys. Rev A **4**, 2191-2199 (1971).

40. *Complex variable theory*
Harris J. Silverstone
Chapter 3 in *Physical Chemistry, An Advanced Treatise*, Vol. XI, *Mathematical Methods*,
Edited by Douglas Henderson (Academic Press, Inc., New York, 1975), pp. 151-260.
41. *Piecewise polynomial electronic wavefunctions*
Jose Luis Gazquez and Harris J. Silverstone
J. Chem. Phys. **67**, 1887-1898 (1977).
42. *Hartree-Fock equations for open shell states*
Harris J. Silverstone
J. Chem. Phys. **67**, 4172-4180 (1977).
43. *Perturbation theory of resonant states induced by an electrostatic field: one-dimensional model*
Tokio Yamabe, Akitomo Tachibana and Harris J. Silverstone
J. Phys. B **10**, 2083-2100 (1977).
44. *Theory of the ionization of the hydrogen atom by an external electrostatic field*
Tokio Yamabe, Akitomo Tachibana and Harris J. Silverstone
Phys. Rev. A **16**, 877-890 (1977).
45. *Expansion of a function about a displaced center*
Harris J. Silverstone and Richard K. Moats
Phys. Rev. A **16**, 1731-1732 (1977).
46. *Piecewise polynomial basis functions for configuration interaction and many-body perturbation theory calculations. The radial limit of helium*
Harris J. Silverstone, Dennis P. Carroll, and David M. Silver
J. Chem. Phys. **68**, 616-618 (1978).
47. *Perturbation theory of the Stark effect in hydrogen to arbitrarily high order*
Harris J. Silverstone
Phys. Rev. A **18**, 1853-1864 (1978).
48. *Piecewise polynomial configuration interaction natural orbital study of $1s^2$ helium*
Dennis P. Carroll, Harris J. Silverstone, and Robert Melville Metzger
J. Chem. Phys. **71**, 4142-4163 (1979).
49. *Pseudo-eigenvalue equation for natural orbitals of two-electron systems and long-range behavior*
Harris J. Silverstone, Dennis P. Carroll, and Robert Melville Metzger
J. Chem. Phys. **70**, 5919 (1979).

50. *Calculation of Stark effect energy shifts by Padé approximants of Rayleigh-Schrödinger perturbation theory*
Harris J. Silverstone and Peter M. Koch
J. Phys. B **12**, L537-L541 (1979).
51. *Stark effect in hydrogen: dispersion relation, asymptotic formulas, and calculation of the ionization rate via high-order perturbation theory*
Harris J. Silverstone, Barry G. Adams, Jiří Čížek, and Peter Otto
Phys. Rev. Lett. **43**, 1498-1501 (1979).
52. *Bender-Wu formulas for degenerate eigenvalues*
B. G. Adams, J. E. Avron, J. Čížek, P. Otto J. Paldus, R. K. Moats, and Harris J. Silverstone
Phys. Rev. A **21**, 1914-1916 (1980).
53. *Asymptotic behavior of atomic Hartree-Fock orbitals*
George S. Handler, Darwin W. Smith, and Harris J. Silverstone
J. Chem. Phys. **73**, 3936-3939 (1980).
54. *Practical recursive solution of degenerate Rayleigh-Schrödinger perturbation theory and application to high-order calculations of the Zeeman effect in hydrogen*
Harris J. Silverstone and Richard K. Moats
Phys. Rev. A **23**, 1645-1654 (1981).
55. *Long-range behavior of electronic wavefunctions; generalized Carlson-Keller expansion*
Harris J. Silverstone
Phys. Rev. A **23**, 1030-1037 (1981).
56. *High-order perturbation theory of the imaginary part of the resonance eigenvalues of the Stark effect in hydrogen and of the anharmonic oscillator with negative anharmonicity*
Harris J. Silverstone, Evans Harrell, and Christina Grot
Phys. Rev. A **24**, 1925-1934 (1981).
57. *Unified derivation of the perturbation series for the real and imaginary parts of the energy of hydrogen in the Stark effect and of the negatively anharmonic oscillator*
Harris J. Silverstone
Int. J. Quantum Chem. **21**, 125-131 (1982).
58. *Recent progress on three-center integrals using Fourier-transform-based analytical formulas*
H. David Todd, Kenneth C. Daiker, Robert D. Cloney, S. J., Richard K. Moats, and Harris J. Silverstone
in *ETO Multicenter Molecular Integrals*, Charles A. Weatherford and Herbert W. Jones, editors, (D. Reidel Publishing Company, Boston, 1982), pp. 73-89.

59. *1/R Expansion for H_2^+ : analyticity, summability, asymptotics, and calculation of exponentially small terms*
Robert J. Damburg, Rafail Kh. Propin, Sandro Graffi, Vincenzo Grecchi, Evans M. Harrell II, Jiří Čížek, Josef Paldus, and Harris J. Silverstone
Phys. Rev. Lett. **52**, 1112-1115 (1984).
60. *On definitions of L convergence of atomic correlation energies*
Karol Jankowski, Daniel W. Zaharevitz, and Harris J. Silverstone
J. Chem. Phys. **82**, 1969-1972 (1985).
61. *Resonances and convergence of perturbation theory for N -body atomic systems in external AC-electric field*
S. Graffi, V. Grecchi, and H. J. Silverstone
Ann. Inst. Henri. Poincaré (A) **42**, 215-234 (1985).
62. *Complex energies from real perturbation series for the LoSurdo-Stark effect in hydrogen by Borel-Padé approximants*
Valter Franceschini, Vincenzo Grecchi, and Harris J. Silverstone
Phys. Rev. A **32**, 1338-1340 (1985).
63. *Observations on the summability of confluent hypergeometric functions and on semiclassical quantum mechanics*
Harris J. Silverstone, Sachiko Nakai, and Jonathan G. Harris
Phys. Rev. A **32**, 1341-1345 (1985).
64. *Asymptotics of high-order perturbation theory for the one-dimensional anharmonic oscillator by quasisemiclassical methods*
Harris J. Silverstone, Jonathan G. Harris, Jiří Čížek, and Josef Paldus
Phys. Rev. A **32**, 1965-1980 (1985).
65. *1/R Expansion for H_2^+ : analyticity, summability, and asymptotics*
S. Graffi, V. Grecchi, E. M. Harrell II, and H. J. Silverstone
Ann. Phys. (NY) **165**, 441-483 (1985).
66. *Piecewise polynomial Hylleraas configuration interaction wavefunctions for helium*
D. W. Zaharevitz, H. J. Silverstone, and D. M. Silver
in *Supercomputer Applications*, Proceedings of the Supercomputer Applications Symposium cosponsored by the Purdue University Computing Center, the Purdue Center of Parallel and Vector Computing, and Control Data, held October 31 - November 1, 1984, in West Lafayette, Indiana, edited by R. W. Numrich (Plenum Press, New York, 1985), pp. 263-271.

67. *1/R Expansion for H_2^+ : calculation of exponentially small terms and asymptotics*
Jiří Čížek, Robert J. Damburg, Sandro Graffi, Vincenzo Grecchi, Evans M. Harrell II, Jonathan G. Harris, Sachiko Nakai, Josef Paldus, Rafail Kh. Propin, and Harris J. Silverstone
Phys. Rev. A **33**, 12-54 (1986).
68. *Reality and complexity in asymptotic expansions for eigenvalues and eigenfunctions, with application to the JWKB connection-formula problem*
Harris J. Silverstone
Int. J. Quantum Chem. **29**, 261-272 (1986).
69. *JWKB connection-formula problem revisited via Borel summation*
Harris J. Silverstone
Phys. Rev. Lett. **55**, 2523-2526 (1985).
70. *LoSurdo-Stark effect for a hydrogenic impurity in a thin layer: Two-dimensional model*
Kazuyoshi Tanaka, Masahiro Kobashi, Tokushige Shichiri, Tokio Yamabe, David M. Silver, and Harris J. Silverstone
Phys. Rev. B **35**, 2513-2516 (1987).
71. *Classical resonance overlapping and quantum avoided crossings*
Sandro Graffi, Thierry Paul, and Harris J. Silverstone
Phys. Rev. Lett. **59**, 255-258 (1987).
72. *On the use of asymptotic expansions*
Modris Gailitis and Harris J. Silverstone
Theor. Chim. Acta **73**, 105-114 (1988).
73. *Resonance overlapping in classical mechanics and avoided crossings in quantum mechanics*
S. Graffi, T. Paul, and H. J. Silverstone
Phys. Rev. A **37**, 2214-2219 (1988).
74. *Transition from classical to quantum mechanics: x^4 perturbed harmonic oscillator*
Gabriel Alvarez, Sandro Graffi, and Harris J. Silverstone
Phys. Rev. A **38**, 1687-1696 (1988).
75. *Resonance Contributions to the Photoionization Spectrum of Atomic Hydrogen in an Electric Field*
Gabriel Alvarez and Harris J. Silverstone
Phys. Rev. Lett. **63**, 1364-1367 (1989).
76. *Photoionization cross section: exact expansion over resonances and natural line shape*
Gabriel Alvarez and Harris J. Silverstone
Phys. Rev. A **40**, 3690-3697 (1989).

77. *High-order perturbation theory and its application to atoms in strong fields*
Harris J. Silverstone
in *Atoms in Strong Fields*, edited by C. A. Nicolaides, C. W. Clark, and M. H. Nayfeh,
(Plenum, New York, 1990), pp. 295–307.
78. *Photoionization of Atomic Hydrogen in an Electric Field*
Gabriel Alvarez, Robert J. Damburg, and Harris J. Silverstone
Phys. Rev. A **44**, 3060-3082 (1991).
79. *EPR Spectroscopy of Interdoublet Transitions in High-Spin Iron: Applications to Transferrin Oxalate*
Kutbuddin S. Doctor, B. J. Gaffney, Gabriel Alvarez, and Harris J. Silverstone
J. Phys. Chem. **97**, 3028-3033 (1993).
80. *Simulation of the EMR Spectra of High-Spin Iron in Proteins*
Betty J. Gaffney and Harris J. Silverstone
Chapter 1 of *Biological Magnetic Resonance, Volume 13: EMR of Paramagnetic Molecules*, edited by Lawrence J. Berliner and Jacques Reuben (Plenum, New York, 1993), pp. 1-57.
81. *Large-field behavior of the LoSurdo-Stark resonances in atomic hydrogen*
Gabriel Alvarez and Harris J. Silverstone
Phys. Rev. A **50**, 4679-4699 (1994).
82. *Exact expansion methods for atomic hydrogen in an external electrostatic field: divergent perturbation series, Borel summability, semiclassical approximation, and expansion of photoionization cross-section over resonance eigenvalues*
Harris J. Silverstone
Chapter 10 of *Modern Electronic Structure Theory*, edited by David R. Yarkony (World Scientific Publishing Co., Singapore, 1995).
83. *Simulation methods for looping transitions*
Betty J. Gaffney and Harris J. Silverstone
J. Magn. Reson. **134**, 57-66 (1998).
84. *On the summations involving Wigner rotation matrix elements*
Shan-Tao Lai, Pancracio Palting, Ying-Nan Chiu, and Harris J. Silverstone
J. Math. Chem. **24**, 123-132 (1998).
85. *Connection formula, hyperasymptotics, and Schrödinger eigenvalues: dispersive hyperasymptotics and the anharmonic oscillator*
Gabriel Álvarez, Christopher J. Howls, and Harris J. Silverstone
in *Toward the Exact WKB Analysis of Differential Equations, Linear or Non-Linear*, edited by Christopher J. Howls, Takahiro Kawai, and Yoshitsugu Takei (Kyoto University Press, Kyoto, 2000), pp. 121-134.

86. *Anharmonic oscillator discontinuity formulae up to second-exponentially-small order*
Gabriel Álvarez, Christopher J. Howls, and Harris J. Silverstone
J. Phys. A **35**, 4003-4016 (2002).
87. *Dispersive hyperasymptotics and the anharmonic oscillator*
Gabriel Álvarez, Christopher J. Howls, and Harris J. Silverstone
J. Phys. A **35**, 4017-4042 (2002).
88. *JWKB method as an exact technique*
Hujun Shen and Harris J. Silverstone
Int. J. Quantum Chem. **99**, 336-352 (2004)
DOI: 10.1002/qua.20029.
89. *On the computation of (2-2)-three-center Slater-type-orbital integrals of $1/r_{12}$ using Fourier-transform-based analytical formulas*
Danko Antolovic and Harris J. Silverstone
Int. J. Quantum Chem. **100**, 146-154 (2004).
DOI: 10.1002/qua.20123
90. *On the bidirectionality of the JWKB connection-formula at a linear turning point*
Hujun Shen and Harris J. Silverstone
Collect. Czech. Chem. Commun. (Collection of Czechoslovak Chemical Communications) **70**, 740-754 (2005).
DOI: 10.1135/cccc20050740
91. *Observations on the JWKB treatment of the quadratic barrier*
Hujun Shen and Harris J. Silverstone
in *Algebraic Analysis of Differential Equations: from Microlocal Analysis to Exponential Asymptotics*, Festschrift in Honor of Takahiro Kawai, edited by T. Aoki, H. Majima, Y. Takei, and N. Tose (Springer-Verlag, 2008), pp. 237-250.
92. *Rereading Langer's influential 1937 JWKB paper: the unnecessary Langer transformation; the two \hbar 's*
Tatsuya Koike and Harris J. Silverstone
J. Phys. A: Math. Theor. **42** (2009) 495206 (11pp).
DOI: 10.1088/1751-8113/42/49/495206
93. *On the convergence of the interpenetrating bipolar expansion for the Coulomb Potential*
Harris J. Silverstone
Adv. Quantum Chem. **68**, 3-17 (2014).
DOI: 10.1016/B978-0-12-800536-1.00001-0
94. *Convergence of the bipolar expansion for the Coulomb Potential*
Harris J. Silverstone
Int. J. Quantum Chem. **2014**, *114*, 1073–1078. DOI: 10.1002/qua.24630
(article first published online: 19 Feb 2014).

95. *Two-Center Noninteger- n Overlap, Coulomb, and Kinetic Energy Integrals by Numerical Contour Integration*
Harris J. Silverstone
J. Phys. Chem. A **2014**, *118*, 11971–11974. DOI: 10.1021/jp5070159
(article first published online: 21 August 2014).