

Eugene R. Marshalek

Department of Physics
University of Notre Dame

Present Position

Emeritus Professor of Physics

Main Research Specialty

Theoretical nuclear physics - in particular, microscopic theories of collective motion.

Education

- B.S., 1957, Queens College, New York.
- Ph.D., 1962, University of California, Berkeley.

Professional Positions - Regular Appointments

- Teaching Assistant, University of California, Berkeley, 1957-1958.
- Research Assistant, Lawrence Berkeley Laboratory, 1958-1962.
- N.S.F. Postdoctoral Fellow, Niels Bohr Institute, Copenhagen, 1962-1963.
- Postdoctoral Research Associate, Brookhaven National Laboratory, 1963-1965.
- Assistant Professor of Physics, University of Notre Dame, 1965-1969.
- Associate Professor of Physics, University of Notre Dame, 1969-1978.
- Professor of Physics, University of Notre Dame, 1978-present.

Sabbatical Positions

- Guest Professor, Technische Universität München, 1971-1972.
- Visiting Physicist, Niels Bohr Institute, Copenhagen, Fall 1977.
- Visiting Physicist, Kernforschungsanlage (KFA), Jülich, Spring-Summer 1978.
- Visiting Professor, Technische Universität München, Spring 1985.
- Senior Alexander von Humboldt Fellow, Universität Frankfurt, Summer-Fall 1985.
- Senior Alexander von Humboldt Fellow, Universität Frankfurt, Fall 1987.

- Visiting Physicist, Institute for Nuclear Theory, University of Washington, Seattle, Fall 1992.
- Visiting Physicist, Institute for Nuclear Theory, University of Washington, Seattle, Fall 1995.

Temporary Summer Positions

- A.B. Atomenergi, Studsvik, Sweden, 1963.
- NSF Summer Institute, University of Wisconsin, Madison, 1967.
- Lawrence Berkeley Laboratory, 1968.
- Brookhaven National Laboratory, 1968.
- Tandem Laboratory, University of Montreal, 1970.
- Niels Bohr Institute, Copenhagen, 1972.
- Department of Physics, University of Coimbra, Portugal, 1972.
- Niels Bohr Institute, Copenhagen, 1973.
- Lawrence Berkeley Laboratory, 1974.
- Lawrence Berkeley Laboratory, 1975.
- Oak Ridge National Laboratory, 1976.
- Niels Bohr Institute, Copenhagen, 1978.
- Niels Bohr Institute, Copenhagen, 1979.
- Lawrence Berkeley Laboratory, 1980.
- Niels Bohr Institute, Copenhagen, 1981.
- Department of Physics, University of Kyoto, Japan, 1982.
- Niels Bohr Institute, Copenhagen, 1985.
- Niels Bohr Institute, Copenhagen, 1989.
- Niels Bohr Institute, Copenhagen, 1991.

Academic Honors

- New York State Scholarship, 1953-1957.
- Phi Beta Kappa, Queens College, 1956.
- Summa Cum Laude, Queens College, 1957.
- Sigma Xi, UC Berkeley, 1960.
- NSF Postdoctoral Fellowship, 1962-1963.
- U.S. Senior Scientist Award, Alexander von Humboldt Foundation, 1985.
- Fellow of the American Physical Society, 1997.

Professional Society Affiliations

American Physical Society, Sigma Xi, American Association for the Advancement of Science, Alexander von Humboldt Association of America

Referee for Journals

Physical Review C, Physical Review Letters, Nuclear Physics A, Physics Letters B, Journal of Physics G, Annals of Physics, Journal of Mathematical Physics, International Journal of Modern Physics E.

Research Support

<u>Principal Investigator</u>	<u>Funding Agency</u>	<u>Dates</u>
Charles Mullin	Atomic Energy Commission	1965-1971
E. Marshalek, Paul Shanley	National Science Foundation	1972-1978
E. Marshalek	National Science Foundation	1978-1990
E. Marshalek	Yamada Science Foundation	1982
E. Marshalek	Department of Energy	1991-1996

Invited Conference Talks

1. "Lectures on the Many-Body Problem," at A.B. Atomenergie, summer of 1963 (notes unpublished).
2. "Introduction to the Collective Model of Atomic Nuclei," and "Recent Developments in the Collective Model," in *Advanced Course on Nuclear Physics with Thermal Neutrons*, at the Netherlands-Norwegian Reactor School, Instituttet for Atomenergie, Kjeller, Norway, September 1962 (see Ref. 4).
3. "Nuclear Rotation," Chicago American Physical Society meeting, February 1974 [recorded in Bull. Am. Phys. Soc., Ser. II, **19**, 13 (1974), unpublished talk].
4. "Boson Expansions and the Cranking Model," at the *Conference on Problems of Vibrational Nuclei*, Zagreb, Yugoslavia, September 24-27, 1974 (see Ref. 26).
5. "Pathologies of the Cranking Model - Diagnosis and Remedies," at the *Tenth Masurian Summer School*, Mikolajki, Poland, August 29-September 11, 1977 (see Ref. 36).
6. "How Microscopic Boson Models Work," at the *International Conference on Band Structure and Nuclear Dynamics*, Tulane University, New Orleans, February 28-March 1, 1980 (see Ref. 42).
7. "Restoration of Broken Symmetries in the Perturbative Boson Expansion Formalism" at the *1982 INS International Symposium on Dynamics of Nuclear Collective Motion-High-Spin States and Transitional Nuclei*, Mt. Fuji, Japan, July 6-10, 1982 (see Ref. 48).
8. "Boson-Fermion Expansions," at the *Fifth Kyoto Summer Institute on Microscopic Theories of Nuclear Collective Motions*, Kyoto, Japan, July 12-16, 1982 (see Ref. 49).
9. "Mixed Alignment in the Os-Ir Region," at the *Workshop on High and Medium Spin States in Nuclei*, Lawrence Berkeley Laboratory, Berkeley, CA, October 13, 1986 (unpublished).

10. "Tipsy Rotators," at the *Symposium on Contemporary Physics*, Drexel University, Philadelphia, PA, October 31 - November 1, 1991 (see Ref. 64).
11. "Reconstructing Symmetries from Deformed Boson Expansions," at the *Workshop on Nuclear Structure Models*, Oak Ridge National Laboratory, Oak Ridge, TN, March 15-25, 1992 (see Ref. 65).
12. "New Perspectives on the Cranking Model," at the *Rapidly Rotating Nuclei 1992 - 21st INS International Symposium*, Tokyo, Japan, October 26-30, 1992 (see Ref. 67).
13. "Bifurcations in the Cranking Model," at the *Belyaev Symposium*, Drexel University, Philadelphia, PA, May 9-11, 1994 (see Ref. 70).
14. "The Cranking Approximation Applied to Multiphonon Anharmonic Vibrations," at the *INT Workshop on Nuclei Under Extreme Conditions*, University of Washington, Seattle, WA, November 22, 1995 (unpublished).

External Departmental Seminars (since 1977)

1. "The Random-Phase Approximation at High Spin," Niels Bohr Institute, Copenhagen, Denmark, November 1977.
2. "The Random-Phase Approximation at High Spin," KFA, Jülich, Germany, March 1978.
3. "Quantization of Time-Dependent Self-Consistent Fields," Physik Department, Technische Universität München, Garching, Germany, June 1978.
4. "How Boson Expansions Work," Nuclear Science Division, Lawrence Berkeley Laboratory, July 1980.
5. "Restoration of Broken Symmetries in the Perturbative Boson-Expansion Formalism", Drexel University, Philadelphia, June 8, 1982.
6. "Restoration of Broken Symmetries in the Perturbative Boson-Expansion Formalism," Nagoya University, Nagoya, Japan, July 23, 1982.
7. "Nonadiabatic Corrections for Systems with Broken Symmetry," Physik Department, Technische Universität München, Garching, Germany, series of 3 lectures, June 1985.
8. "New Vistas in the Cranking Model," Yukawa Institute, University of Kyoto, Kyoto, Japan, October 20, 1992.
9. "Cranking Anharmonic Collective Oscillations," Department of Physics, University of Washington, Seattle, November 20, 1992.
10. "Angular-Momentum Cranking Applied to Anharmonic Collective Vibrations," INT, University of Washington, Seattle, October 27, 1993.

Conference Sessions Chaired

1. *Workshop on Nuclear Physics*, Drexel University, Philadelphia, September 1-3 1980, Session V [proceedings published as *Contemporary Research Topics in Nuclear Physics*, edited by D.H. Feng, M. Vallieres, M.W. Guidry and L.L. Riedinger (Plenum, New York, 1982)].
2. APS Nuclear Division Meeting, University of Notre Dame, October 13-15, 1983, Session AE.
3. *Notre Dame Workshop on Giant Resonances*, University of Notre Dame, Notre Dame, IN, Oct. 21-23, 1991.
4. *Workshop on Spurious States in Boson Mappings*, Department of Physics, Drexel University, November 2, 1991.
5. *International Seminar on the Frontier of Nuclear Spectroscopy*, Kyoto, Japan, October 23-24, 1992, Morning Session I.
6. *Rapidly Rotating Nuclei 1992 - 21st INS International Symposium*, Tokyo, Japan, October 26-30, 1992, Session 13.
7. *INT Workshop on Nuclei Under Extreme Conditions*, University of Washington, Seattle, November 22, 1995.

List of Scientific Publications

1. "Theory of Collective Vibrations of Even-Even Spheroidal Nuclei," E.R. Marshalek, Thesis 1962, University of California at Berkeley [Distributed by the UC Radiational Laboratory (Lawrence Berkeley Laboratory) as UCRL-10046, 1962].
2. "Collective Vibrations of Spheroidal Even Nuclei," E.R. Marshalek and J.O. Rasmussen, Nucl. Phys. **43**, 438-471 (1963).
3. "Systematics of Deformations of Atomic Nuclei," E.R. Marshalek, L.W. Person, and R.J. Sheline, Rev. Mod. Phys. **35**, 108-117 (1963).
4. "Introduction to the Collective Model of Atomic Nuclei," and "Recent Developments in the Collective Model," in *Advanced Course on Nuclear Physics with Thermal Neutrons*, Organized by the Netherlands-Norwegian Reactor School at the Institutt for Atomenergie, Kjeller, Norway, September 1962 (distributed as Kjeller Report No. Kr-64, Secs VI, VIII).
5. "Self-Consistent Perturbation of Hartree-Fock-Bogoliubov Equations and Nuclear Rotational Spectra. I.," E.R. Marshalek, Phys. Rev. **139**, B770-B789 (1965).
6. " $I^2(I+1)^2$ Corrections to Nuclear Rotational Spectra," E.R. Marshalek and J.B. Milazzo, Phys. Rev. Lett. **16**, 190-194 (1966).
7. "Self-Consistent Perturbation of the Hartree-Fock-Bogoliubov Equations and Nuclear Rotational Spectra II.," E.R. Marshalek, Phys. Rev. **158**, 993-1010 (1967).
8. "Isomer Shifts and the Self-Consistent Cranking Model," E.R. Marshalek, Phys. Rev. Lett. **20**, 214-217 (1968).
9. "Nuclear Rotation and the Random-Phase Approximation," E.R. Marshalek and J. Weneser, Ann. Phys. (N. Y.) **53**, 569-624 (1969).
10. "Nuclear Rotation and Boson Expansions," E.R. Marshalek and J. Weneser, Phys. Rev. C **2**, 1682-1714 (1970).
11. "Gauge Fields in the Many-Body Problem and Superfluidity," H.J. Lee, P.C. DeCelles, and E.R. Marshalek, Nuovo Cimento Lett. **4**, 1033-1036 (1970).
12. "Microscopic Description of Quasirotational Bands," E.R. Marshalek, Phys. Rev. C **3**, 1710-1715 (1971).
13. "On the Relation Between Beliaev-Zelevinsky and Marumori Boson Expansions," E.R. Marshalek, Nucl. Phys. A **161**, 401-409 (1971).
14. "Static Quadrupole Moments of Vibrational States of Spherical Nuclei in the Self-Consistent Cranking Approximation," E.R. Marshalek and M. Sabato, Phys. Rev. C **4**, 1006-1009 (1971).
15. "Problems with Perturbative Treatments of Anharmonic Nuclear Oscillations," E.R. Marshalek and M. Sabato, Phys. Rev. C **5**, 1130-1134 (1972).
16. "Backward Bending in Spherical Nuclei," E.R. Marshalek, Phys. Letters B **38**, 367-? (1972).
17. "Calculation of Static Quadrupole Moments and Anharmonicity Parameters of Even Tin and Tellurium Isotopes," E.R. Marshalek, Nuovo Cimento Lett. **4**, 631-636 (1972).

18. "Boson Expansions and Hartree-Bogoliubov Theory," E.R. Marshalek and G. Holzwarth, Nucl. Phys. A **191**, 438-448 (1972).
19. "A New Boson Expansion for Odd-Particle Systems," E.R. Marshalek, Phys. Lett. B **44**, 5-8 (1973).
20. "Sum Rules, Random-Phase-Approximation, and Constrained Self-Consistent Fields," E.R. Marshalek and J. da Providencia, Phys. Rev. C **7**, 2281-2293 (1973).
21. "Beliaev-Zelevinsky-Type Boson Expansion About the Hartree-Fock Minimum," E.R. Marshalek and J. da Providencia, Nuovo Cimento **14B**, 32-38 (1973).
22. "A Solvable Model for Describing Quasi-Rotational Bands in Transitional Nuclei," J. Krumlinde and E.R. Marshalek, Nuovo Cimento Lett. **7**, 679-684 (1973).
23. "Perturbative Boson Expansions to All Orders for Even and Odd Nuclei, I. Formal Properties," E.R. Marshalek, Nucl. Phys. A **224**, 221-244 (1974).
24. "Perturbative Boson Expansions to All Orders for Even and Odd Nuclei, II. Illustrative Applications," E.R. Marshalek, Nucl. Phys. A **224**, 245-261 (1974).
25. "Test of Cranking Plus RPA on an Exactly Soluble Backbending Model," Sudesh Bose, J. Krumlinde, E.R. Marshalek, Phys. Letters B **53**, 136-140 (1974).
26. "Boson Expansions and the Cranking Model," E.R. Marshalek in *Problems of Vibrational Nuclei*, Zagreb, Yugoslavia, September 24-27, 1974, edited by G. Alaga, V. Paar, and L. Sips (North Holland, Amsterdam, 1975) p. 108-127.
27. "Boson Representation for the Quantized Rotator," E.R. Marshalek, Phys. Rev. C **11**, 1426-1431 (1975).
28. "Test of Many-Body Methods on an Exactly Soluble Model with Backbending and Gapless Superconductivity," S.Y. Chu, E.R. Marshalek, P. Ring, J. Krumlinde and J.O. Rasmussen, Phys. Rev. C **12**, 1017-1034 (1975).
29. "Boson Factorization Approximation for Anharmonic Nuclear Vibrations," E.R. Marshalek, Phys. Lett. **B 62**, 5-8 (1976).
30. "Large-Amplitude Collective Motion in the Lipkin Model," E.R. Marshalek, Phys. Rev. C **14**, 342-344 (1976).
31. "Self-Consistent Cranking Plus RPA Method for High-Spin States," E.R. Marshalek, Nucl. Phys. A **266**, 317-336 (1976).
32. "Negative-Parity Bands and Gapless Superconductivity in an Exactly Solvable Model," J. Krumlinde and E.R. Marshalek, Nucl. Phys. A **275**, 395-415 (1977).
33. "RPA at High Spin and Conservation Laws," E. R. Marshalek, Nucl. Phys. A **275**, 416-444 (1977).
34. "Pairing Interaction at High Spin," E.R. Marshalek. Phys. Rev. C **15**, 1574-1576 (1977).
35. "Band Crossing Anomalies in the Cranking Model," E.R. Marshalek and A. Goodman, Nucl. Phys. A **294**, 92-128 (1978).
36. "Pathologies of the Cranking Model - Diagnosis and Remedies," E.R. Marshalek, Nukleonika **23**, 409-458 (1978).

37. "Boson Expansions and Quantization of Time-Dependent Self-Consistent Fields, I.," J.P. Blaizot and E.R. Marshalek, Nucl. Phys. A **309**, 422-452 (1978).
38. "Boson Expansions and Quantization of Time-Dependent Self-Consistent Fields, II.," J.P. Blaizot and E.R. Marshalek, Nucl. A **309**, 453-476 (1978).
39. "Quantization of Time-Dependent Self-Consistent Fields and Finite Boson Representations for Many-Fermion System," J.P. Blaizot and E.R. Marshalek, Phys. Letts. B **79**, 1-4 (1978).
40. "Nuclear Wobbling Motion," E.R. Marshalek. Nucl. Phys. A **331**, 429-463 (1979).
41. "Microscopic Foundation for the Particle-Vibrator Model," E.R. Marshalek, Phys. Letts. B **92**, 245-248 (1980).
42. "How Microscopic Boson Models Work," E.R. Marshalek, Nucl. Phys. A **347**, 253-271 (1980).
43. "Chimerical Boson Expansions," E.R. Marshalek, Phys. Lett. B **95**, 337-343 (1980).
44. "Microscopic Particle-Vibrator Model," E.R. Marshalek, Nucl. Phys. A **357**, 398-428 (1981).
45. "Quantization in the High-Spin RPA," E.R. Marshalek, Nucl. Phys. A **381**, 240-252 (1982).
46. "Approximate Solutions of the Particle-Rotor Model for Decoupled Bands," E.R. Marshalek, Phys. Rev. C **26**, 1678-1691 (1982).
47. "Boson Expansions and Broken Symmetry," E.R. Marshalek, Ann. Phys. (NY) **143**, 191-238 (1982).
48. "Restoration of Broken Symmetry in the Perturbative Boson Expansion Formalism," E.R. Marshalek, *Proceedings of the 1982 International Symposium on Dynamics of Nuclear Collective Motion-High Spin States and Transitional Nuclei*, Mt. Fuji, Japan, edited by K. Ogawa and K. Tanabe (University of Tokyo, 1982) p. 343-351.
49. "Boson-Fermion Expansions," E.R. Marshalek, Suppl. Prog. Theor. Phys. **74 & 75**, 89-114 (1983).
50. "Volume Conservation in the Nilsson Model and Effective Many-Body Forces," E.R. Marshalek, Phys. Rev. Lett. **51**, 1534-1537 (1983).
51. "Constant Volume Constraint and Many-Body Forces in the Nilsson Model," E.R. Marshalek, Phys. Rev. C **29**, 640-646 (1984).
52. "Backbending in the 1/2-[541] Band in ^{181}Ir ," U. Garg, E.R. Marshalek, A. Chaudhury, E.G. Funk, R. Kaczarowski, J.W. Mihelich, D. Frekers, R.V.F. Janssens, D. Radford, and A.M. Van Den Berg, Phys. Lett. B **151**, 335-338 (1985).
53. "Mixed Alignment in the Osmium-Iridium Region," E.R. Marshalek and R. Blümel, Phys. Rev. Lett. **55**, 370-373 (1985).
54. "Reconstituting Rotational Band Structure from Deformed Boson Expansions: Generic Treatment," E.R. Marshalek, Phys. Rev. C **35**, 1900-1921 (1987).
55. "Reconstituting Rotational Band Structure from Deformed Boson Expansions: Model Test," E.R. Marshalek, Phys. Rev. C **36**, 2538-2554 (1987).

56. "A New Derivation of the Marshalek-Okubo Realization of the Shell-Model Algebra $SO(2\nu + 1)$ For Even and Odd Systems with ν Single-Particle Levels," A. Klein and E.R. Marshalek, *Z. Phys. A* **329**, 441-449 (1988).
57. "Finite Hermitian Alternatives to the Dyson Hamiltonian," E.R. Marshalek, *Phys. Rev. C* **38**, 2961-2963 (1988).
58. "On the Boson-Quasifermion Realization of the Particle-Hole $SO(2\Omega + 1)$ Algebra," A. Klein and E.R. Marshalek, *J. Math. Phys.* **30**, 219-232 (1989).
59. "Berry's Phase in a Quantized Path: An Example From Nuclear Physics," R.S. Nikam, P. Ring, Y. Sun and E.R. Marshalek, *Phys. Lett. B* **235**, 215-220 (1990).
60. "Translationally Invariant Volume-Conserving Effective Interaction," E.R. Marshalek, *Phys. Lett. B* **244**, 1-4 (1990).
61. "Boson Realization of Lie Algebras With Applications to Nuclear Physics," A. Klein and E.R. Marshalek, *Rev. Mod. Phys.* **63**, 375-558 (1991).
62. "Boson Realization of Lie Algebras With Applications to Nuclear Physics," A. Klein and E.R. Marshalek in *Understanding the Variety of Nuclear Excitations*, 3rd International Spring Seminar in Nuclear Physics, Ischia, Italy, May 21-25, 1990, edited by A. Coviello (World Scientific, Singapore, 1991) p. 265-281.
63. "A New Boson Realization for the Three-Dimensional Isotropic Oscillator," E.R. Marshalek, *J. Math. Phys.* **33**, 2972-2983 (1992).
64. "Tippy Rotators," E.R. Marshalek, in *Symposium on Contemporary Physics*, Drexel University, Oct. 31-Nov. 1, 1991, edited by M. Vallières and D.H. Feng (World Scientific, Singapore, 1993) p. 191-208.
65. "Reconstructing Broken Symmetries From Deformed Bason Expansions," E.R. Marshalek, in *International Workshop on Nuclear Structure Models*, Oak Ridge, Tennessee, March 16-25, 1992, edited by R. Bengtsson, J. Draayer, and W. Nazarewicz (World Scientific, Singapore, 1992) p. 387-427.
66. "Cranking Anharmonic Gamma Vibrations," E.R. Marshalek and R.G. Nazmitdinov, *Phys. Lett. B* **300**, 199-204 (1993).
67. "New Perspectives on the Cranking Model," E.R. Marshalek, *Nucl. Phys. A* **559**, 291c-300c (1993).
68. "Anharmonic Gamma Vibrations in a Simple Model," E.R. Marshalek, R.G. Nazmitdinov and I. Ragnarsson, *Izv. Akad. Nauk., Ser. Fiz.* **57**, 54-60 (1993) (in Russian); English translation in *Bull. Acad. Sci. USSR, Phys. Ser.* **57**, 1709-1714 (1993).
69. "On the Alleged Contra-Rotation of Neutrons and Protons," E.R. Marshalek, *Phys. Rev. C* **50**, R5-R-6 (1994).
70. "Bifurcations in the Cranking Model," E.R. Marshalek, *Phys. Rep.* **264**, 279-295 (1996).
71. "Angular-Momentum Cranking Applied to Multiphonon Anharmonic Collective Vibrations: Cranked Bifurcation Theory," E.R. Marshalek, *Phys. Rev. C* **54**, 159-175 (1996).
72. "An Overlooked Figure of Equilibrium of a Rotating Ellipsoidal Self-Gravitating Fluid and the Riemann Theorem," E.R. Marshalek, *Phys. Fluids* **8**, 3414-3422 (1996).

73. "Selective bosonization of the many-fermion problem in a model framework," E.R. Marshalek and Y. Miyanishi, Phys. Rev. C **63**, 064314 (2001).
74. "Bifurcations of the self-consistent cranked harmonic oscillator," E.R. Marshalek, Phys. Rev. C **68**, 064308 (2003).
75. "Commentary on self-consistent cranking plus RPA," E.R. Marshalek, J. Phys. G: Nucl. Part. Phys. **30**, 1861-1891 (2004).
76. "Intrinsic quadrupole tensor in the geometric interpretation of the interacting boson approximation (IBA-1)," Eugene R. Marshalek, Phys. Rev. C **74**, 044307 (2006).