

# CARLOS R. HANDY

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<b>EDUCATION</b>	<b>Ph. D., Theoretical Physics</b> <i>Columbia University, New York</i>	October 1978
	<b>M. Ph.D., Theoretical Physics</b> <i>Columbia University, New York</i>	May 1976
	<b>M. A., Physics</b> <i>Columbia University, New York</i>	May 1975
	<b>B. A., Physics, Minor in Mathematics</b> <i>Columbia College, New York</i>	May 1972
<b>RESEARCH INTERESTS</b>	Mathematical physics as applied to quantum systems, fractals, transform methods, and nonlinear systems. Semidefinite Programming with application to quantum operator theory.	
<b>APPOINTMENTS</b>	Professor and Chair of the Physics Department Texas Southern University, Houston, TX.	2005 to present
	Co-Director, Center for Theoretical Studies of Physical Systems Clark Atlanta University, Atlanta, GA.	1991 - 2005
	Professor of Physics Clark Atlanta University, Atlanta, GA.	1983 - 2005
	Research Scientist, AMAF Ind., Inc. Columbia, MD.	1981 - 1983
	Postdoctoral Fellow, Los Alamos National Laboratory Los Alamos, NM.	1978 - 1981
<b>VISITING APPOINTMENTS</b>	Visiting Professor, Theoretical Physics Group of the Centre d'Etudes Nuclaires, Saclay, France	July - Sep. 1988, Dec. 1989 Aug. 1990, Aug. 1991, Aug. 1992
	Visiting Professor, Theoretical Fusion Energy Group Oak Ridge National Laboratory	Jun - Aug 1989
	Visiting Professor, Department of Applied Mathematics University of Waterloo, Waterloo, Canada	Aug. 1987
	Visiting Professor, Free Electron Laser Laboratory AT & T Research Laboratory, Murray Hill, N.J.	Jun - Aug 1984
	Visiting Professor, Theoretical Fusion Energy Group Oak Ridge National Laboratory	Jun - Aug 1983
<b>HONORS</b>	First Recipient (and graduate), Bell Telephone Laboratory's Cooperative Research Fellowship	1972 - 1978
	Academic Scholarship Columbia University, New York City	1968 - 1972
	New York Regents Scholarship	1968 - 1972
<b>AFFILIATIONS</b>	The American Physical Society	
	APS Committee on Minorities	1996 - 1999
	Chair of the APS Committee on Minorities	1997 - 1998
	APS- Bouchet Award Sub Committee	1997 - 1999

National Society of Black Physicists

**STUDENT  
ADVISEMENT**

**Masters:** Robert M. Williams, 1986; Jin Qun Pei, 1987; J. B. Gibbons, 1988; Patricia Lee, 1991 (subsequently received Ph.D. in Health Physics from Georgia Tech, 1998); Julian Niles, 1991 (subsequently received Ph.D. in Physics from Georgia Tech, 1998); Grabiell Ndow, 1991 (pursuing Ph.D. at Howard U.); Leticia Atterberry, 1995; Asmerom Y. Ogbazghi, 1998 (pursuing Ph.D. at Georgia Tech), Zhenyu Yan, 2002 (pursuing Ph.D. at Boston University); Damien Khan, 2002 (pursuing Ph.D. at U. Michigan).

**Bachelors:** John Maweu, CAU (1994 - 1997); Henry Hayes, CAU (1994); Kojo Appiah, Morehouse (1994); Jami Joshua, Morehouse (1993); Sonya Summerour, Spelman (1993); Dawn Stephens, CAU (1994).

**GRANTS  
AWARDED**

1. PI-TSU for Nuclear Regulatory Commission (NRC) grant , **\$449,351**, "Continued Development of a New Curricula in Environmental Nuclear Protection", 2007 -2010, NRC-38-07-495.
2. PI-TSU for Nuclear Regulatory Commission (NRC), **\$100,000**, "Faculty Development Grant", 2008 -2011, NRC-38-08-973.
3. PI-TSU for Scholarship Sub-award Grant from UT-Austin and the Office of Naval Research, Acquiring Nuclear Science Emphasis at Texas Southern University, **\$180,000**, 2009 – 2012. Prime Award number: N00014-08-1-1183, Sub-award number: UTA09-000083.
4. Co-director of the \$10,000,000 National Science Foundation center at Clark Atlanta University, Center for Theoretical Studies of Physical Systems (1991 - 2001).
5. Project Director of CAU component within the Army Federated Laboratory Consortium (spearheaded by Lockheed-Martin), \$2.5 million, Jan., 1996 - Jan., 2001.
6. Project Director of \$300,000 Ballistic Missile Defense Organization grant, July, 1995 – 1997.
7. Project Director of \$900K ARPA grant on Automatic Target Recognition and Detection (1993 - 1996).
8. Project Director of High Performance Computing Equipment Grant from the Office of Naval Research in support of a CRAY-J9164 \$354,000, July 1, 1995.
9. Project Director of \$5 K grant from the State of Georgia impacting science education at Frederick Douglass H.S. (GSAMS program).
10. Principal Investigator of \$25K grant from Naval Weapons, Chinalake, CA on Fourier Image Compression (1992 - 1993).
11. Project Director on \$500K NASA grant in experimental surface physics, together with Professor C. Papageorgopoulos, 1993 - 1996.
12. Principal Investigator of the Physics portion of the PRISM-D award from ONR (Dr. Melvin Webb, project director), 1989 - 1994. This allowed us acquire the first IBM RISC workstation (IBM 530), support Dr. Papageorgopoulos in building a surface physics lab at CAU, and configure the first computer/physics demonstration laboratory (McPheeters Dennis Room 143) impacting pre-college summer students and CAU undergraduates. Total grant \$5,000,000.
13. Principal Investigator of a \$60K NSF grant in theoretical physics (1989 - 1991).
14. Principal Investigator of an NSF-RIMI grant, \$300K, 1986 - 1989, renewed for another \$300K, 1989 - 1992.
15. Principal Investigator of an NSF-MRI grant, plus creativity extension for \$300 K (1983 - 1988).

**PUBLICATIONS**

1. C. R. Handy, "Diagrammatics of Gauge Transformations for General Gauge Theories," Phys. Rev. D19, 585 (1979).
2. C. R. Handy, "Strong Coupling Singular Perturbation Theory and the Moments Problem," Phys. Rev. D 24, 378 (1981).
3. C. R. Handy, "Lattice Multiscale Singular Perturbation Theory," Proceedings of the International Conference on Differential Equations, edited by Ian W. Knowles and Roger T. Lewis, North Holland, 279 (1984).
4. C. R. Handy and S. P. Hirshman, "Accelerated Convergence of the Steepest Descent Method for Magnetohydrodynamic Equilibria," J. Comp. Physics 60, 338 (1985).
5. C. R. Handy, "Combining the Methods of Harmonic Balance and Kryloff-Bogoliuboff," J. Sound and Vibration, 102, 243 (1985).
6. C. R. Handy, "Harmonic Balance Methods and the Theory of Generalized Pade Approximants,"

## PUBLICATIONS

- J. of Sound and Vibration, 102, 247 (1985).
7. C. R. Handy, "Multiple-Turning Point Problems and Lattice Multiscale Singular Perturbation," Phys. Rev. D. 3168 (1985).
  8. C. R. Handy and D. Bessis, "Rapidly Convergent Lower Bounds for the Schrodinger Equation Ground State Energy," Phys. Rev. Lett. 55, 931 (1985).
  9. C. R. Handy, "Hankel-Hadamard Analysis of Quantum Potential  $\lambda x^2 + \{1+gx^2\}$ ," J. Phys. A: Math. Gen. 18, 3593 (1985).
  10. C. R. Handy, "Polya-Pade Fourier Resonance Reconstruction and Singular Perturbation Theory," J. of Nonlinear Analysis, Theory, Methods & Applications, 10, 391 (1986).
  11. D. Bessis and C. R. Handy, "Systematic Construction of Upper and Lower Bounds to the Ground State Energy of the Schrodinger Equation," International Journal of Quantum Chemistry: Quantum Chemistry Symposium 20, 21 (John Wiley & Sons, INc. 1986).
  12. D. Bessis, E. R. Vrscay, and C. R. Handy, "Hydrogenic Atoms in the External Potential  $V(r) = g r + \lambda r^2$ : Exact Solutions and Ground State Eigenvalue Bounds Using Moment Methods," J. Phys. A: Math. Gen. 20, 419 (1987).
  13. C. R. Handy and R. M. Williams, "Rapid Wavefunction Reconstruction through Hankel-Hadamard Moments Analysis," J. Phys. A: Math. Gen. 20, 2315 (1987).
  14. C. R. Handy, "Moment Method Quantization of a Linear Differential Eigenvalue Equation for  $|\Psi|^2$ ," Phys. Rev. A 36, 4411 (1987).
  15. C. R. Handy, "Nonnegativity and Moment Quantization for  $|\Psi|^2$ ," Phys. Lett. A 124, 308 (1987).
  16. C. R. Handy, "A Solution to the One-Dimensional Missing Moment Problem," J. Math. Phys. 29, 32 (1988).
  17. C. R. Handy, D. Bessis, and R. M. Williams, "Moment Problem Formulation of the Simplified Ideal Magnetohydrodynamic Ballooning Equation," J. Math. Phys. 29, 717 (1988).
  18. C. R. Handy, D. Bessis, and T. R. Morley, "Generating Quantum Energy Bounds by the Moment Method: A Linear Programming Approach," Phys. Rev. A 37, 4557 (1988).
  19. C. R. Handy, D. Bessis, G. Sigismondi, and T. D. Morley, "Rapidly Converging Bounds for the Ground State Energy of Hydrogenic Atoms in Superstrong Magnetic Fields," Phys. Rev. Lett. 60, 253 (1988).
  20. C. R. Handy, L. Luo, G. Mantica, and A. Z. Msezane, "Exact Bounds to One Dimensional Potential Scattering Amplitudes Through the Classical Theory of Moments," Phys. Rev. A 38, 490 (1988).
  21. A. Z. Msezane, C. R. Handy, G. Mantica, and J. Lee, "Close Coupling Analysis of Electron Impact Excitation of Na(4s)," Phys. Rev. A 38, 1604 (1988).
  22. C. R. Handy and J. Q. Pei, "Moment Method Analysis of the Ground State of Discretized Bosonic Systems," Phys. Rev. A 38, 3175 (1988).
  23. C. R. Handy, "Positivity and the Quantization of Singular Strongly Coupled Physical Systems: An Operations Research Approach to Modern Physics," Proceedings of the First Edward Bouchet International Conference on Physics and Technology, Trieste, Italy (1988).
  24. C. R. Handy, G. Mantica, and J. B. Gibbons, "Quantization of Lattice Schrodinger Operators via the Trigonometric Moment Problem," Phys. Rev. A 39, 3256 (1988).
  25. E. R. Vrscay and C. R. Handy, "The Perturbed Two Dimensional Oscillator: Eigenvalues and Infinite Field Limits via Continued Fractions, Renormalized Perturbation Theory and Moment Method," J. Phys. A: Math. Gen. 22, 823 (1989).
  26. C. R. Handy and D. Bessis, Response to Comments by Rech, Gallas, and Gallas, Phys. Rev. Lett. 62, 2199 (1989).
  27. C. R. Handy and G. Mantica, "Inverse Problems in Fractal Construction: Moment Method Solution," Physica D 43, 17 (1990).
  28. C. R. Handy and P. Lee, "Positivity and the Quantization of Physical Systems: The C-Shift Moment Method," J. Phys. A: Math. Gen. 24, 1565 (1991).
  29. C. R. Handy, B. G. Giraud, and D. Bessis, "A Dynamical System Formulation of the Eigenvalue Moment Method," Phys. Rev. A 44, 1505 (1991).
  30. C. R. Handy and G. L. Ndow "Euclidean Time Formulation of the Eigenvalue Moment Method: A Moment Problem-Convexity Analysis of Barnsley's Theorem", J. of Phys. A: Math. and Gen. 25, 2669-2681 (1992).
  31. C. R. Handy, "Application of the Eigenvalue Moment Method to the Quartic Anharmonic Double Well Oscillator", Phys. Rev. A 46, 1663 (1992).
  32. C. R. Handy, "An Eigenvalue Moment Method Analysis of the  $V(x) = \frac{\omega^2}{2} x^2 + \alpha x^3 + \beta x^4$  Anharmonic Oscillator," Molecular Physics, 76, 1235 (1992).

## PUBLICATIONS

33. C. R. Handy, H. Hayes, D. Stephens, J. Joshua, and S. Summerour "Application of the Eigenvalue Moment Method to Important One Dimensional Quantum Systems", *J. Phys. A* 26, 2635 (1993).
34. C. R. Handy, K. Appiah, and D. Bessis "Moment-Problem Formulation of a Minimax Quantization Procedure", *Phys. Rev. A* 50, 988 (1994).
35. C. R. Handy, "Extension of a Moment Problem Mini-Max Quantization Procedure to Anharmonic Potentials", *Phys. Rev. A* 52, 3468 (1995).
36. C. R. Handy, J. Maweu, and L. Atterberry, "Variational Formulation of a Moment Problem Quantization Method", *J. Math. Phys.* 37, 1182 (1996).
37. C. R. Handy, "Ground-State Energy Bounds of Singular Potentials", *Physics Letters A* 216, 15 (1996).
38. C. R. Handy "A Moment Equation Reformulation of Rayleigh-Ritz Theory", *J. Phys. A: Math. & Gen.* 29, 4093 (1996).
39. C. R. Handy and R. Murenzi, "Continuous Wavelet Transform Analysis of One Dimensional Quantum Bound States from First Principles," *Phys. Rev. A* 54, 3754 (1996).
40. C. R. Handy and R. Murenzi, "Continuous Wavelet Transform Analysis of One Dimensional Quantum Ground States," CRM Proceedings and Lecture Notes: Spline Functions and the Theory of Wavelets, American Mathematical Society, Providence, Rhode Island, Eds. S. Dubuc and G. Deslauriers,(1999). (1996 Workshop, at the Centre de Recherches Mathematiques, University of Montreal, Quebec, Canada)
41. C. R. Handy and R. Murenzi, "Continuous Wavelet Transform Analysis of Quantum Systems with Rational Potentials," *J. Phys. A* 30, 4709 (1997).
42. C. J. Tymczak, G. S. Japaridze, C. R. Handy, and Xiao-Qian Wang, "New Perspective on Inner Product Quantization," *Phys. Rev. Lett.* 80, 3673 (1998).
43. C. J. Tymczak, G. S. Japaridze, C. R. Handy, and Xiao-Qian Wang, "Iterative Solutions to Quantum Mechanical Problems," *Phys. Rev. A* 58, 2708 (1998).
44. C. R. Handy and R. Murenzi, "Moment-Wavelet Quantization: A First Principles Analysis of Quantum Mechanics through continuous Wavelet Transform Theory," *Phys. Lett. A* 248, 7 (1998).
45. C. R. Handy and R. Murenzi, "On the Equivalence of Moment Quantization and Continuous Wavelet Transform Analysis," *J. Phys. A: Math. Gen.* 31, 9897 (1998).
46. C. R. Handy and R. Murenzi, "Moment Quantization and (A-adic) Discrete Continuous Wavelet Transform Theory," *J. Phys. A: Math. Gen.* 32, 8111 (1999).
47. C. R. Handy and R. Murenzi, "Moment-Wavelet Quantization of Schrodinger Operators," Proceedings of the International Conference: Perspective in Mathematical Physics, Conference in the honor of Alexander Grossmann (Marseille- Luminy , July 28 - August 1, 1997 France). CPT-98/P.3748, CNRS-UPR 7061 - CPT, edited by M. Holschneider and G. Saracco.
48. C. R. Handy, R. Murenzi, K. Bouyoucef, and H. A. Brooks, "Moment-wavelet quantization and (complex) multiple turning point contributions," *J. Phys. A: Math. Gen.* 33, 2151 (2000).
49. C. R. Handy and H. A. Brooks "Scalets, Wavelets, and (Complex) Turning Point Quantization," *J. Phys. A: Math. Gen.* 34, 3577 (2001).
50. C. R. Handy, "New Perspectives in Moment-Wavelet Analysis from Quantum Operator Theory: Scalets and Local Quantization," Proceedings of the Council for African-American Researchers in the Mathematical Sciences, Contemporary Mathematics, Vol. 284, edited by G. M. N'Guerekata, (American Mathematical Society, Providence, R.I. (2001)).
51. C. R. Handy, "Turning Point Quantization and Scalet-Wavelet Analysis," Chapter 6 in Computational Chemistry: Review of Current Trends, Vol. 6 edited by J. Leszczynski (World Scientific, Singapore (2001)).
52. C. R. Handy, "Generating Converging Eigenenergy Bounds for the Discrete States of the  $-ix^3$  non-Hermitian Potential", *J. Phys. A: Math. Gen.* 34, L271 (2001).
53. C. R. Handy and X. Q. Wang, "Extension of a Spectral Bounding Method to Complex Rotated Hamiltonians, with Application to  $P^2 - iX^3$ ," *J. Phys. A: Math. Gen.* 34, 8297 (2001).
54. C. R. Handy, "Generating Converging Bounds to the (Complex) Discrete States of the  $P^2 + iX^3 + iaX$  Hamiltonian," *J. Phys. A: Math. Gen.* 34, 5065 (2001).
55. C. R. Handy, D. Khan, X. Q. Wang, and C. J. Tymczak, "Multiscale Reference Function Analysis of the PT Symmetry Breaking Solutions for the  $P^2 + iX^3 + iaX$  Hamiltonian," *J. Phys. A: Math. Gen.* 34, 5593 (2001).
56. Z. Yan and C. R. Handy, "Extension of a Spectral Bounding Method to the PT-Invariant States of the  $-(iX)^N$  non-Hermitian Potential," *J. Phys. A: Math. Gen.* 34, 9907 (2001).
57. C. R. Handy and A. Z. Msezane, "Generation of Converging Regge-Pole Bounds: A New Formulation of Complex Rotation Quantization," *J. Phys. A: Math. Gen.* 34, L531 (2001).
58. C. R. Handy, C. Trallero-Giner, and A. H. Rodriguez, "Generating Bounds for the Discrete State Energy Values of the Infinite Quantum Lens Potential," *J. Phys. A: Math. Gen.* 34, 10991 (2001).

59. C. R. Handy, A. Z. Msezane, and Z. Yan, "Generation of Converging Regge Pole Bounds for Arbitrary Rational Fraction Scattering Potentials," *J. Phys. A: Math. Gen.* 35, 6359 (2002).
60. A. Rodriguez, C. R. Handy, and C. Trallero-Giner, "Excited States in the Infinite Quantum Lens Potential: Conformal Mapping and Moment Quantization Methods," *J. Phys.: Condensed Matter* 15, 8465 (2003).
61. C. R. Handy, C. J. Tymczak, and A. Z. Msezane, "High Precision Regge-Pole and Residues for Singular Scattering Potentials," *Phys. Rev. A* 66, 050701 (R) (2002).
62. C. R. Handy, D. Khan, S. Okbagabir, and T. Yarahmad "Moment Problem Quantization within A Generalized Scalet-Wigner (Auto-Scaling) Transform Representation," *J. Phys. A: Math. Gen.* 36, 1623 (2003).
63. C. R. Handy and X. Q. Wang, "Spectral Bounds for the PT-breaking Hamiltonian  $p^2 + x^4 + iax$ ," *J. Phys. A: Math. & Gen.* 36, 11513 (2003).
64. C. R. Handy "Positivity Representations for non-Hermitian Hamiltonians," *Czechoslovak J. of Physics* 54, 57 (2004).
65. A. Rodriguez, C. R. Handy, and C. Trallero-Giner, Reply to Comment on "Excited States in the Infinite Quantum Lens Potential: Conformal Mapping and Moment Quantization Methods," *J. Phys.: Condensed Matter* 16, 2945 (2004).
66. C. R. Handy "(Quasi)-convexification of Barta's (multi-extrema) bounding theorem", *J. Phys. A: Math. Gen.* 39, 3425 (2006)
67. Handy C R and Vrinceanu D, "Orthogonal Polynomial Projection Quantization: A New Hill Determinant Method". *J. Phys. A: Math. Theor.* 46: 135202, 2013.
68. Handy C R and Vrinceanu D, "Rapidly Converging Bound State Eigenenergies for the Two Dimensional Quantum Dipole". *J. Phys. B: At. Mol. Opt. Phys.* 46: 115002, 2013.
69. Handy C R, Vrinceanu D, and Gupta R, "A Moments' Analysis of Quasi-Exactly Solvable Systems: A New Perspective on the Sextic Potential  $gx^6+bx^4+mx^2+\beta/x^2$ ". *J. Phys. A: Math.Theor.* 47: 295203, 2014

## PUBLICATIONS

## PRESENTATIONS

- "Moment Problem Formulation of the Schrodinger Equation," presented by D. Bessis and C. R. Handy at the International Mathematical Congress on Extrapolation and Rational Approximation, Tenerife, Spain, January 13 - 17, 1992.
- "Important New Results from a Dynamical System's Perspective on the Eigenvalue Moment Method," by C. R. Handy, presented at the Georgia Tech - UAB International Conference on Differential Equations and Mathematical Physics, Georgia Tech, March 22 - 28, 1992.
- "Moment Problems in Physics," International Quantum Physics Conference, U. of Costa Rica, San Jose, Costa Rica, November 7 - 14, 1993.
- "Multi-Scale Moment Quantization and Wave Function Reconstruction," Mini-Colloquium on Wavelets and Quantum Mechanics, CTSPS, CAU, January 25 - 27, 1995.
- "Moment Problem Based Computational Strategies for Generating Converging Bounds to Quantum Energies," presented at the First International Conference on Neural, Parallel, and Scientific Computation, Atlanta, GA, May 28 - 31, 1995.
- "Moment Quantization and Continuous Wavelet Transform Theory", University of Havana, Cuba, October, 1995.
- Presentation at the GSAMS Conference, University of Georgia, Georgia Center for Continuing Education, Athens, GA, February 26, 1996.
- Presentation during the NSF Site visit for renewal of the Pittsburgh Supercomputing Center, Dedham, MA, December 4 - 6, 1996.
- "Exact Generation of Continuous Wavelet Transforms for Linear ODEs and PDEs and Wavefunction Reconstruction from First Principles," C. R. Handy and R. Murenzi, SPIE 11th Annual International Symposium on Aerospace/Defense Sensing, Simulation and Controls, Orlando, FL, April 20 - 25, 1997.
- "Continuous Wavelet Transform Analysis of One Dimensional Quantum Ground States," U. Montreal Workshop on Spline Functions and Wavelets, Montreal, Canada, March 25 - 29, 1996.
- "Equivalence of Moment Quantization and Continuous Wavelet Transform Analysis," 65th Anniversary Workshop Honoring Alex Grossmann, (Marseille, France, August, 1997)., University of San Jose, Costa Rica, August 5 - 19, 1997.
- "Moment-Wavelet Quantization," Seminar delivered at Center for Neurophysics, Havana, Cuba, October, 1997.
- NARCE Conference, University of Puerto Rico, Mayaguez, February 19 - 22, 1998.
- National Society of Black Physicists Conference, U. of Kentucky, March 4 - 7, 1998.

“Equivalence of Moment Quantization and Continuous Wavelet Transform Analysis,” Physics Dept., Indiana University, Feb. 9, 1998; Physics Dept., U. Florida, Gainesville, March 30, 1998.

“Wavelet Research at CTSPS,” APS-AAPT Conference, Columbus, OH, April 20, 1998.

“Moment-Wavelet Quantization,” joint ITAMP-CTSPS Wavelet Workshop, Harvard University, October 9 - 11, 1998.

“Moment-Wavelet Analysis and (Complex) Turning Point Quantization,” March Meeting of the APS Centennial Conference, Atlanta, GA, 1999.

“Positivity Representations for Non-hermitian Hamiltonians,” presented at the First International Workshop on Pseudo-Hermitian Hamiltonians in Quantum Physics, Prague, Czech Rep., June 16-17, 2003.

“Quasi-Convexification of Barta’s Bounding Theorem”, TSAPS, U. Houston, Oct. 2005

“Extension of Barta’s Theorem to Pseudo-Hermitian Systems,” U.T.-Arlington, Oct. 2006.

## **CONFERENCES**

Supercomputing Conference 2005, Seattle Washington.

Texas Section of the American Physical Society (TSAPS), Univ. of Houston, 2005

Texas Section of the American Physical Society, U.T.-Arlington, 2006

## **COMMUNITY INVOLVEMENT**

Member of the Gulf Coast Community Concert Band (trumpet)

## **PATENTS**