

## William A. Schwalm

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### Education:

1978 Ph.D., Physics, Montana State University (J. C. Hermanson)  
1969 B.Sc., Physics, University of New Hampshire

### Employment history:

1978-80 Post Doctoral Research Associate and Teaching Fellow, University of Utah  
1980 Instructor of Physics, University of Utah  
1980-83 Assistant Professor Physics, University of North Dakota  
1983-90 Associate Professor of Physics, University of North Dakota  
1990-present Professor of Physics, University of North Dakota

### Awards:

1. University of Utah Department of Physics Award for Outstanding Instructor (1980)
2. University of North Dakota Foundation McDermott Award for Individual Excellence in Teaching (1988)
3. University of North Dakota Summer Research Professorship (1995)
4. University of North Dakota Summer Instructional Development Professorship (1997)
5. University of North Dakota Summer Instructional Development Prof. (shared 2000, 2001)

- @ Summer Visiting Scientist, University of Minnesota (Minneapolis), Physics 1983-85
- @ Visiting Scientist, Montana State University, Physics 1990-91
- @ Visiting Professor, University of Rome, "La Sapienza," summer 1998
- @ NATO Visiting Scholar, Univ. of Rome, "La Sapienza," Chemical Engineering, summer 1996, 1999
- @ Member, Scientific Committee of Second International Conference on Disordered Structures, Fractals and Chaos, Sept. 2-5, University of Rome, "La Sapienza," 1996, Session Chair
- @ Session Chair, Fractals, Am. Phys. Soc. March meeting (San Jose, 1995)
- @ Session Chair, FRACTAL 97, Denver 1997
- @ Semi-plenary speaker, Workshop on geometric integration theory, Foundations of Computational Mathematics 2002, Minneapolis.
- @ Organizing Committee, Midwest Geometry Conference (UND, April 26-28, 2002)
- @ Co-editor of special issue, *Intl. J. Modern Phys. B*, proceedings for 48<sup>th</sup> Midwest Solid State Conference, and the *Midwest Solid State Theory Symposium*, Vol. 15, Nos. 24 & 25, October, 2001.
- @ Participant, Park City Mathematics Institute (summer 2001)
- @ Regular Reviewer, Physical Review B, Physical Review E and Physical Review Letters

### Research:

Condensed matter theory, localization, dynamics of fractal and disordered structures, transport processes, Lie groups and renormalization, topological formalism for lattice models of physical processes.

### Membership:

American Physical Society; Mathematical Association of America, Sigma Xi

**University faculty administrative experience:**

1. Chair of College of Arts and Sciences Curriculum Committee
2. Chair of Arts and Sciences Committee on Tenure and Reappointment
3. Member University Curriculum Committee
4. Member General Education Requirement Committee
5. Dean's *Ad hoc* committee to update mission statement of College of Arts and Sciences
6. Member taskforce to revise general education requirements
7. Advisor of Society of Physics Students
8. Departmental Undergraduate and Library committees
9. At-large member of program evaluation panel for Computer Science undergraduate programs

**Teaching:**

1. Member of Forum on Physics Education of the American Physical Society.
2. Teaching awards from two different universities (see above).
3. Completed 1-week NSF short course on introductory physics teaching (U. Dayton, OH, 1994).
4. Participated in 3-week PCMI workshop on teaching differential equations (Salt Lake, UT, 2001).
5. Developed and taught for three semesters a Nuclear Weapons course.
6. Developed public lectures on Einstein's theory of relativity.
7. Developed and taught course in special relativity as Physics for Poets.
8. Developed and taught a course on *Mathematica* computer language.
9. Wrote *Physics Introductory Laboratory Manual I*, (Wiley, 2000) 135 pages, ISBN 0-471-41371-2.
10. Wrote *Physics Introductory Laboratory Manual II*, (Wiley, 2001) 120 pages, ISBN 0-471-21550-3.
11. Wrote *Short Course in Mathematica*, 41 pages, for summer course 2002.
12. Taught several IVN Physics courses (Interactive Video Network).
13. Have taught a number of interdisciplinary courses and seminars each time with one other faculty member. These have included faculty from Philosophy, English, History, Chemical Engineering and (several times) Math.
14. Compiled complete volumes of lecture notes (type set using TeX) for graduate physics courses: Analytical Mechanics, first semester each of Electromagnetism and Methods of Theoretical Physics. Second volumes of the latter two are in progress.

**Teaching experience:**

General Physics (with and without calculus), Physics for Poets, Solid State Physics, Thermal Physics, Nuclear Physics, Special Relativity, Computational Physics, Methods of Theoretical Physics, Quantum Mechanics, Classical Mechanics, Statistical Physics, Digital Electronics Lab, Nuclear Weapons.

**Graduate students and thesis titles :**

1. Kurt Krouss, MS "Tight-binding band structure calculation for ordered models of  $\text{Bi}_2(\text{Te}_{1-x}\text{S}_x)_3$ ," (1988).
2. Kevin G. Rada, MS "Eigenstates of the Schrödinger equation on a well-connected hierarchical glass model with self-similarity dimension  $d=3$ ," (1989).
3. Lynn D. Reed, MS "Diffraction of waves by ordered fractals," (1989).

4. Bruce F. Sampson, MS “Properties of biased self avoiding walks on the 2D Sierpinski fractal,” (1990).
5. Christopher C. Reese, MS “Pencils of plane curves and exact orbits of Green function renormalization maps for hierarchical lattices,” (1994).
6. Brian Moritz, MS “Lie groups and the soliton of renormalizable lattice problems,” (1997).
7. Brian Moritz, Ph.D. “Vector difference calculus,” (2000).
8. Scott Crockett, MS “Topological model of an electron coupled to a classical polarization field,” (2001).

**Graduate Thesis Committee:**

1. Hai. Ni (Chemical Engineering MS)
2. Ken Pierce (Chemistry Ph. D.)
3. Kathleen Kuhler (Chemistry Ph. D)
4. Ryan Winburn (Chemistry Ph. D.)
5. Leon Nelson (D. Ed.)
6. Gong Liu (Physics Ph.D.)
7. Sean Stone (Physics MS)
8. Jai Sung (Chemistry Ph. D)
9. Tim Dudley (Chemistry Ph.D.)
10. Xiaochu Wang (Physics Ph.D. )
11. Udom Tepparah (Physics Ph.D.)
12. Hefeng Wang (Chemistry Ph.D.)

**Collaborators since 1990:**

1. Massimiliano Giona (University of Rome, “La Sapienza,” Italy) 1993-99
2. Alessandra Adrover (University of Rome, “La Sapienza,” Italy) 1994-99
3. Douglas K. Ludlow (University of North Dakota) 1992-96
4. George Tuthill (Montana State University ) 1990-91

**Research grants funded:**

1. “Infinitely ramified fractal lattices”, NSF/EPSCOR, Oct. 1992-June 1995, \$41,563.  
PI W. Schwalm, Co-PI M. Schwalm
2. “Diffusion on porous media”, NDEPSCoR, Sep. 1994- Aug. 1995, \$7,160  
PI D.K. Ludlow, Co-PI W. Schwalm
3. “Fractal isotherms, dynamic scaling in adsorption phenomena on microporous materials”, NATO Collaborative Research, June 1995-May 1997, \$7,000  
PI W. Schwalm, Co-PIs M. Giona and D. K. Ludlow
4. “Vector Difference Calculus,” NATO Collaborative Research Grant 1998-99 \$7,000, PI W. Schwalm, co-PI M. Giona.

**List of publications in refereed journals:**

1. “Density of States for Directional Photoemission Spectroscopy of W(001)”, J. Hermanson, M. Kawajiri and W. Schwalm, Solid State Commun. **21**, 327-329 (1977).
2. “Surface Density of states for Normal Photoemission from Mo(110) and W(111)”, M. Kawajiri, J. Hermanson and W. Schwalm, Solid State Commun. **25**, 303-305 (1978).
3. “Surface States on Unrelaxed GaAs(110) in the Bond-orbital Model”, W. Schwalm and J. Hermanson, Solid State Commun. **27**, 587-590 (1978).

4. "Hartree-Fock formalism for the calculation of total energies and charge densities of thin films", Frank H. Harris, Hendrik J. Monkhorst and William A. Schwalm, *J. Vac. Sci. Technol.* **16**, 1318-1322 (1979).
5. "Analytic continuation in exchange perturbation theory", B. Jeziorski, W. A. Schwalm and K. Szalewiwz, *J. Chem. Phys.* **73**, 6215-6224 (1980).
6. "Site-by-site Madelung energies in semi-infinite NaCl", William A. Schwalm, *Am. J. Phys.* **50**, 444-447 (1982).
7. "Electrostatics for periodic films of atoms", H. J. Monkhorst and W. A. Schwalm, *Phys. Rev. B* **23**, 1729-1742(1981).
8. "2D conductance and magnetoconductance in a thin crystal of  $\text{Bi}_{14}\text{Te}_{11}\text{S}_{10}$ ", H. H. Soonpaa and W. A. Schwalm, *Sol. St. Commun.* **42**, 201-204 (1982).
9. "Generating functions in physics", William A. Schwalm, *Am. J. Phys.* **51**, 230-235 (1983).
10. "Bridge between particle and fluid kinematics", William A. Schwalm and Mizuho K. Schwalm, *Am. J. Phys.* **53**, 421-428 (1985).
11. "Single-parameter scaling in thin crystals", H. H. Soonpaa and W. A. Schwalm, *Phys. Lett.* **98A**, 122-124 (1983).
12. "Generating functions in physics", W. A. Schwalm and M. K. Schwalm, *Am. J. Phys.* **51**, 230-235 (1983).
13. "Experimental exploration of the scaling theory in 2D", H. H. Soonpaa and W. A. Schwalm, *Phys. Lett.* **100A**, 156-157 (1984).
14. "Lure of mathematical science", W. A. Schwalm, *North Dakota Quarterly*, **54**, 212-230 (1986).
15. "Extension theory for lattice Green functions", W. A. Schwalm and M. K. Schwalm, *Phys. Rev. B* **37**, 9524-9542 (1988).
16. "Electronic properties of fractal glass models", W. A. Schwalm and M. K. Schwalm, *Phys. Rev. B* **39**, 12872-12882 (1989).
17. "Length scaling of corner-to-corner propagation on fractal lattices," W. A. Schwalm M. K. Schwalm and K. Rada, *Phys. Rev. B* **44**, 382-385 (1991).
18. "Closed formulae for Green functions on fractal lattices," W. A. Schwalm and M. K. Schwalm, *Physica A* **185**, 195-201 (1992).
19. "Effects of surface roughness on transport in quasi-one-dimensional and -two-dimensional ballistic channels", M. K. Schwalm and W. A. Schwalm, *Phys. Rev. B* **45**, 6868-6876 (1992).
20. "Damping effects on the Kubo-Greenwood conductance of lattice models in one, two and three dimensions", W. A. Schwalm and M. K. Schwalm, *Phys. Rev. B* **45**, 1770-1775 (1992).
21. "Biased interacting self-avoiding walks on the four-simplex lattice", G. F. Tuthill and W. A. Schwalm, *Phys. Rev. B* **46**, 13722-13734 (1992).
22. "Explicit orbits for renormalization maps for Green functions on fractal lattices", W. A. Schwalm and M. K. Schwalm, *Phys. Rev. B* **47**, 7847-7858 (1993).
23. "Perfect conductance on fractal lattices", W. A. Schwalm and M. K. Schwalm in *Fractals in the Natural and Applied Sciences*, M. M. Novak, editor (Elsevier, Amsterdam, 1994).
24. "Conic pencils and renormalization dynamics", W. A. Schwalm, C. C. Reese, M. K. Schwalm and C. J. Wagner, *Phys. Lett. A* **193** 238-244 (1994).
25. "Explicit Green functions for hierarchical lattices", W. A. Schwalm, C. C. Reese, M. K. Schwalm and C. J. Wagner, *Phys. Rev. B* **49**, 15650-15663 (1994).
26. "Exact solution of linear transport equations in fractal media I. Renormalization analysis and general theory", M. Giona, W. A. Schwalm, M. K. Schwalm and A. Adrover, *Chem. Engr. Sci.* **51**, 4717, (1996).

27. "Exact solution of linear transport equations in fractal media II. Diffusion and Convection" M. Giona, W. A. Schwalm, M. K. Schwalm and A. Adrover, Chem. Engr. Sci. **51**, 4731, (1996).
28. "Exact solution of linear transport equations in fractal media III. Adsorption and Chemical Reaction", M. Giona, A. Adrover, W. A. Schwalm and M. K. Schwalm, Chem. Engr. Sci. **51**, 5065, (1996).
29. "Analysis of linear transport phenomena on fractals" M. Giona, W. A. Schwalm, A. Adrover and M. K. Schwalm, Chem. Engr. J. **64**, 45 (1996).
30. "First-order kinetics in fractal catalysts: renormalization analysis of the effectiveness factor", M. Giona, W. A. Schwalm, A. Adrover and M. K. Schwalm, Chem. Engr. Sci. **51**, 2273 (1996).
31. "Renormalization analysis of diffusion and adsorption on fractal and disordered lattices in the presence of energetic disorder", M. K. Schwalm, M. Giona, W. A. Schwalm, A. Adrover and M. Giustiniani, Langmuir **13**, 1128 (1997).
32. "Length scaling of conductance distribution for random fractal lattices", M. K. Schwalm and W. A. Schwalm, Phys. Rev. B **54**, 15086 (1996).
33. "Scaling and cross-over for transport on anisotropic structures", A. Adrover, W. A. Schwalm, M. Giona and D. Bachand, Phys. Rev. E **55**, 7304 (1997).
34. "Lie groups and solution of dynamical problems on fractal lattices", W. A. Schwalm, M. K. Schwalm and M. Giona, in *Fractal Frontiers* M.M. Novak T. G. Dewy (World Scientific, Singapore, 1997)
35. "Group theoretic reduction of linear transport on regular fractal structures", W. A. Schwalm, M. K. Schwalm and M. Giona, Phys. Rev. E **55**, 6741 (1997).
36. "Group theoretic reduction of linear transport models on regular fractal structures", W. A. Schwalm, M. K. Schwalm and M. Giona, Fractals and Chaos in Chemical Engineering, ed. M. Giona and G. Biardi (World Scientific, Singapore, 1997) p. 199.
37. "Perspectives and application of Green function renormalization to transport phenomena", M. Giona, W. A. Schwalm, M. K. Schwalm and A. Adrover *ibid.* p. 68.
38. "Solution of transport schemes on fractal lattices by means of Green function renormalization - Application to integral quantities", M. Giona, W. A. Schwalm, A. Adrover and M. K. Schwalm, Fractals, **5**, 473 (1997).
39. "Finding Lie groups that reduce the order of discrete dynamical systems," B. Moritz, W. Schwalm, and D. Uherka J. Physics A: Math. Gen. (London) **31**, 7379 (1998).
40. "Vector difference calculus for physical lattice models," W. Schwalm, B. Moritz, M. Giona, Phys. Rev. E **59**, 1217-1233 (1999).
41. "Triangle lattice Green functions for Vector fields," B. Moritz, W. Schwalm, J. Phys. A: Math. Gen. (London) **34** 589-602 (2001).
42. "Topological lattice model of an electron coupled to a classical polarization field," W. Schwalm, S. Crockett and B. Moritz, International J. Mod. Phys. B, **24 & 25** 3339 (2001).
43. "Dynamics of Cremona maps from physical models," W. Schwalm, B. Moritz and M. Schwalm, *ibid.* 2379.
44. "Gauge simplification of Hamiltonians with off-diagonal  $\pm 1$  disorder," M. Schwalm and W. Schwalm, *ibid.* 3287.

#### Conference presentations:

1. "Combined XPS and ISS characterization of Bi-Te-S compounds", Paul A. Linfors, Tom Rush and William A. Schwalm, 4-th International Symposium on Applied Surface Analysis, Dayton, OH, July, (1982).
2. "Detailed electrostatics of the NaCl point lattice by Half-Line decomposition", Am. Phys. Soc. March meeting, Baltimore, MD; Bul. Am. Soc. **30** 319 (1985).
3. "High field conductance in 2D", Bul. Am. Soc. March meeting, Baltimore, MD;

- Bul. Am. Soc. **30** 550 (1985).
4. "Rings and aromaticity in self-similar graphitic lattices", 33rd Midwest Solid State Conference, Kansas City, MO, Nov. 8-9, 1985.
  5. "Solvable model interface between ordered and chaotic, graphite-related planar lattices", Am. Phys. Soc. March meeting, Las Vegas, NV; Bul. Am. Phys. Soc. **31** 382 (1986).
  6. "Algebraic extension theory for lattice Green functions", W. A. Schwalm and M. K. Schwalm, Am. Phys. Soc. March meeting, New Orleans, LA; Bul. **33**, 487 (1988).
  7. "Field dependent conduction in thin crystals", H. H. Soonpaa and W. A. Schwalm, Am. Phys. Soc. March meeting, New Orleans, LA; Am. Bul. Am. Phys. Soc. **33**, 495 (1988).
  8. "Landauer conductance for narrow 2D channels", M. K. Schwalm and W. A. Schwalm, Am. Phys. Soc. March meeting, St. Louis, MO; Bul. Am. Phys. Soc. **34**, 590 (1989).
  9. "Schrödinger Eigenstates of infinitely ramified Fractal glass models with fractal dimension  $d_f = 3$  and spectral dimension  $d_s > 2.5$ ", with K. Rada, Am. Phys. Soc. March meeting, St. Louis, MO; Bul. Am. Phys. Soc. **34**, 629 (1989).
  10. "Scattering from ordered fractals", W. A. Schwalm and L. Reed, Am. Phys. Soc. March meeting, St. Louis MO, Bul. Am. Phys. Soc. **34**, 1016 (1989).
  11. "Biased self-avoiding walks on hierarchical lattices", W. Schwalm and B. Sampson, Am. Phys. Soc. March meeting, Anaheim, CA; Bul. Am. Phys. Soc. **35**, 390 (1990).
  12. "Effects of rough edges on electron transport", M. Schwalm and W. Schwalm, Am. Phys. Soc. March meeting, Anaheim, CA; Bul. Am. Phys. Soc. **35**, 492 (1990).
  13. "Statistical mechanics of biased self-avoiding walks on fractal lattices", W. Schwalm, Gordon Research Conference: Fractals, Plymouth, NH (July 1990).
  14. "Closed formulas for Green functions on fractal lattices", W. Schwalm and M. Schwalm, International Conference on Complex Systems: Fractals, Spin-Glasses and Neural Networks, International Center for Theoretical Physics, Trieste, Italy (July 1991).
  15. "Constructing exact orbits for chaotic dynamics of certain planar mappings", W. Schwalm and M. Schwalm, Math Assn. of Am., Summer Seminar on Non-Linear Dynamics and Chaos, Duluth, MN (August, 1991).
  16. "Constructing exact orbits for the dynamics of the renormalization recursion for Green functions on the  $(k+1)$ -simplex", W. Schwalm and M. Schwalm, Am. Phys. Soc. March meeting, Indianapolis, IN; Bul. Am. Phys. Soc. **37**, 70(1992).
  17. "Interacting biased SAW's on the 4-simplex lattice", G. F. Tuthill and W. A. Schwalm, Am. Phys. Soc. March meeting, Indianapolis, IN; Bul. Am. Phys. Soc. **37**, 421 (1992).
  18. "Perfect conductance on fractal lattices", W. A. Schwalm and M. K. Schwalm, Fractal 93: International working conference on fractals in the natural and applied sciences, London, UK (September, 1993).
  19. "Scaling of conductance distribution function for a structure ensemble of fractal lattices with random disorder", M. Schwalm, W. Schwalm and C. J. Wagner, Midwest Solid State Theory Symposium, Detroit, MI, (October, 1993).
  20. "Conductance scaling on fractals: Scaling of conductance distribution for structure ensembles", M. Schwalm and W. Schwalm, Am. Phys. Soc. March meeting, Pittsburgh, PA ;Bul. Am. Phys. Soc. **39**, 264 (1994).
  21. "Anderson transition in infinitely ramified regular fractals", W. Schwalm and M. Schwalm, Am. Phys. Soc. March meeting, Pittsburgh, PA; Bul. Am. Phys. Soc. **39**, 264 (1994).
  22. "Conductance, diffusion/adsorption on regular fractals including infinitely ramified structures", W. Schwalm, M. Schwalm, M. Giona and A. Adrover, Am. Phys. Soc. March meeting, San Jose; Bul. Am. Phys. Soc. **40**, 172 (1995).

23. "Dynamical systems arising from renormalization of wave propagation on regular aperiodic lattices: Cases when recursion involve more than two variables", W. A. Schwalm and M. K. Schwalm, Am. Phys. Soc. March meeting, San Jose, CA; Bul. Am. Phys. Soc. **40**(1) 813 (1995).
24. "Scaling of conductance distribution functions for fractal structure ensembles", M. K. Schwalm and W. A. Schwalm, Am. Phys. Soc. March meeting, San Jose CA; Bul. Am. Phys. Soc. **40**(1) 357 (1995).
25. "Analysis of linear transport phenomena on fractals", M. Giona, M. K. Schwalm, W. A. Schwalm, The second Italian conference on Chemical and Process Engineering, Firenze, May 15-17, (1995).
26. "Renormalization analysis of diffusion and adsorption on fractal and disordered lattices in the presence of energetic disorder", W. A. Schwalm, M. Giona, M. K. Schwalm and A. Adrover, Second International Symposium on Effects of Surfaces Heterogeneity in Adsorption and Catalysis on Solids, Zakopane, Poland; Lavoca, Slovakia Sept. 4-10, 1995.
27. "Decoupling difference equations that appear in real space renormalization", W. A. Schwalm and M. K. Schwalm, Am. Phys. Soc. March meeting, St. Louis, MO; Bul. Am. Phys. Soc. **41**(1) 511 (1996).
28. "Quantum percolation on model percolation clusters", M. K. Schwalm and W. A. Schwalm, Am. Phys. Soc. March meeting, St. Louis, MO; Bul. Am. Phys. Soc. **41**(1) 547 (1996).
29. "Diffusion in anisotropic and heterogeneous fractal structures", A. Adrover, M. Giona, W. A. Schwalm, D. Bachand, Am. Phys. Soc. March meeting, St. Louis, MO, Bul. Am. Phys. Soc. **41**(1) 329 (1996).
30. "Decoupling difference equations that appear in real space renormalization", W. A. Schwalm and M. K. Schwalm, Am. Phys. Soc. March meeting, St. Louis, MO March 18-22, Bul. Am. Phys. Soc. **41**, 511 (1996).
31. "Group Theoretic Reduction of Linear Transport Models on Regular Fractal Structures", W. A. Schwalm, M. K. Schwalm and M. Giona, Conference on Chaos and Fractals in Chemical Engineering (CFIC96, Rome Sept. 2-6, 1996).
32. "Perspectives and application of Green function renormalization to transport phenomena", M. Giona, W. A. Schwalm, M. K. Schwalm and A. Adrover, Conference on Chaos and Fractals in Chemical Engineering (CFIC96, Rome Sept. 2-6, 1996).
33. "Lie groups and solution of problems on fractal lattices," *Fractal* 97 (Denver, March, 1997).
34. "Vector difference calculus," W. Schwalm, M. Schwalm and M. Giona, March Meeting of American Physical Society, Los Angeles CA, Bul. Am. Phys. Soc. **43**, 884 (1998).
35. "Lattice analog of differential forms," Centennial Meeting of American Physical Society, Atlanta GA, Bul. Am. Phys. Soc. **44**(1) 277 (1999).
36. "Analysis of full vector Maxwell equations in random structures using vector difference calculus," B. Moritz, W. Schwalm, S. Hewett, *ibid.* (2) 1565.
37. "A vector calculus for physical lattice models," M. Giona, W. Schwalm, B. Moritz and A. Adrover, *IcheaP-4*, 4<sup>th</sup> Italian Conference on Chemical and Process Engineering, Florence, Italy May 2-5 (1999), extended abstract.
38. "Discrete mathematics of fields and fluid flows," B. Moritz, W. Schwalm, 2<sup>nd</sup> *Biennial North and South Dakota EPSCoR Conference*, Sept. 10, (1999) prog. pg. 27.
39. "Algebraic topology and physics," W. Schwalm, M. Schwalm and B. Moritz, *ibid.*
40. "Cremona maps and discrete dynamics," W. Schwalm, North Central Section, Math. Assn. Am., St. Peter MN, April 2001.

41. "Dynamics of Cremona maps from physical lattice models," B. Moritz, W. Schwalm, M. Schwalm, 48<sup>th</sup> Midwest Solid State Conference, Solid State Theory Symposium, Grand Forks, Oct. 2001.
42. "Gauge simplification of Hamiltonians with off-diagonal disorder," M. Schwalm and W. Schwalm *ibid.*
43. "Polaron in a simple, topological model of electron-phonon coupling," W. Schwalm, S. Crockett and B. Moritz, *ibid.*
44. "Dynamics of an electron confined to a random dendritic structure," W. Schwalm and M. Schwalm, March Meeting of American Physical Society, Seattle, *Bul. Am. Phys. Soc.* **46**, 189 (2001).
45. "Toulouse strings and off diagonal disorder in 2D, M. Schwalm and W. Schwalm, *ibid.* 190.
46. "Complete solution of dynamical system associated with the Ashkin-Teller model," B. Moritz and W. Schwalm, *ibid.* 195.
47. "Green functions for modified rectangle lattice of Dhar," C. Reese, W. Schwalm and B. Moritz, *ibid.* 457.
48. "Topological model of small polaron dynamics," W. Schwalm, S. Crockett and B. Moritz, *ibid.* 1056.
49. "Unsolvable differential equations," W. Schwalm, North Central Section, Math. Assn. Am., Grand Forks, October 2001.
50. "Continuous spectrum in hierarchical lattice," W. Schwalm, 49<sup>th</sup> Midwest Solid State Conference, Rapid City, October 2001.
51. "Topological model of coupled electromagnetic and elastic fields," W. Schwalm and M. Schwalm, March Meeting, American Physical Society, Indianapolis IN, March 18-22 : *Bul. Am. Phys. Soc.* Vol. 47, p.1188.
52. "Homology groups applied to fluid flow and wave interference," M. Schwalm and W. Schwalm, March Meeting, American Physical Society, Indianapolis IN, March 18-22 : *Bul. Am. Phys. Soc.* Vol. 47, p.860.
53. "Stand-alone laboratory modules for introductory physics, 125th National Meeting of the American Association of Physics Teachers, Boise ID, August 3-7, 2002.
54. "Cell-complex model of exterior calculus, W. Schwalm, Conference on Interactions between Representation theories, Knot Theory, Topology and Mathematical Physics, SUNY Potsdam NY, summer 2002, <http://www2.potsdam.edu/mahdavk/abst.html>
55. "Cell-complex model of vector calculus & physics in discrete space," W. Schwalm, Semi-plenary invited talk, Workshop on geometric integration theory, conference on Foundations of Computational Mathematics, Minneapolis (2002). <http://www.damtp.cam.ac.uk/user/na/FoCM/FoCM02>
56. "Elliptic functions as trigonometry," W. Schwalm, North Central Section, Math. Assn. Am., Moorhead MN, October 25-26, 2002.

### References:

1. Dr. Massimiliano Giona, Center for Disordered and Fractal Structure in Chemical Engineering, Univ. of Rome "La Sapienza," It, email: [max@giona2.ing.uniroma1.it](mailto:max@giona2.ing.uniroma1.it).
2. Professor John C. Hermanson, Montana State University, Bozeman, MT. 59717-0350, Tel.: (406) 994-6172, Fax: (406) 994-4452, email [uphjh@terra.oscs.montana.edu](mailto:uphjh@terra.oscs.montana.edu).
3. Professor Douglas K. Ludlow, Chair, Chemical Engineering, University of Missouri, Rolla, MO, Rm 143 Schrenk Hall, Rolla MO 65409-1230, Tel: (573) 341-4416, Fax (573) 341-4377, e-mail [dludlow@umr.edu](mailto:dludlow@umr.edu).