CURRICULUM VITAE

Stephan Haas

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Date of Birth

- January 10, 1968, Berlin, Germany.

Education

- Ph.D. Physics, National High Magnetic Field Laboratory, Florida State University, Tallahassee (1995).
  Thesis title: *Dynamic Properties of Strongly Correlated Fermionic Systems.*
  Thesis advisor: Elbio Dagotto.
- Vordiplom Physics, Technische Universität Berlin, Germany (1989).

Employment

- Professor, Department of Physics and Astronomy, University of Southern California (2006 - present). Director of Graduate Studies since 2003.
- Associate Professor, Department of Physics and Astronomy, University of Southern California (2002 - 2006).
- Assistant Professor, Department of Physics and Astronomy, University of Southern California (1998 - 2002).

- Postdoctoral Research Associate, Theoretische Physik, ETH Zürich (1995-1998).
- Research Assistant, National High Magnetic Field Laboratory and Supercomputer Computations Research Institute, Florida State University (1991-1995).
- Teaching Assistant, Department of Physics, Florida State University (1990-1991).

Current Research Interests

- Adaptive Quantum Design: design of nanoscale devices by numerical optimization of atomic and molecular configurations that enable desired target response functions.
- Strongly Correlated Electrons: microscopic models and phenomenology of anisotropic superconductors and unconventional density waves.
- Quantum Magnetism: quantum phase transitions, thermodynamics, and excitation spectra of low-dimensional antiferromagnets.
- Impurities: disorder effects in superconductors and quantum magnets, impurity induced ordering, spin and charge textures.

Teaching Experience

- "Conceptual Physics", undergraduate lecture (USC).
- "Physics for the Life Sciences", undergraduate lecture (USC).
- "Fundamentals of Physics: Mechanics and Thermodynamics", undergraduate lecture (USC).
- "Fundamentals of Physics: Electricity and Magnetism", undergraduate lecture (USC).
- "Solid State Physics", graduate lecture (USC).
- "Methods of Computational Physics", graduate lecture (USC).
- "Advanced Solid State Physics","Statistical Mechanics", "Special Topics in Magnetism", recitation sections (ETH).
- "Quantum Mechanics" and "Superconductivity", seminar courses (ETH).
- "Introductory Astrophysics", laboratory sections (FSU).

Grants and Awards

- National Science Foundation: Career Award
- Department of Energy
- Defence Advanced Research Projects Agency
- University of Southern California: Raubenheimer Award
- University of Southern California: General Education Award
- Office of Naval Research
- Petroleum Research Fund
- Zumberge Foundation
- Fellow of the Supercomputer Computations Research Institute
- Fulbright Scholar

Advisement and Outreach Activities

- Principal Investigator of the USC Computational Condensed Matter Research Group.
- Director of Graduate Studies, Department of Physics and Astronomy, USC.
- Organizer of USC Condensed Matter Physics Seminar.
- Organizer of "Physics Instant Update - a Workshop for High School Teachers".
- Coorganizer of CALTECH-USC-UCLA Joint Condensed Matter Seminar and Mini-Workshop on Applications of Numerical Techniques to Condensed Matter Physics.
- Judge at California State Science Fair, Lecturer at USC Orientation Faculty Showcase and Summer Bridge Program for Underrepresented Freshmen, USC Contact to Los Angeles Physics Teachers Association, and Member of USC Thornton School of Music Early Music Ensemble.

Publications

1. *Topological order in paired states of fermions in two dimensions with breaking of parity and time-reversal symmetries*
   N. Bray-Ali, L. Ding and S. Haas, to be published in Phys. Rev. B (2009).

2. *Fidelity and superconductivity in two-dimensional t-J models*
   M. Rigol, B. S. Shastry and S. Haas, Phys. Rev. B **80**, 094529 (2009).

3. *Revealing Novel Quantum Phases in Quantum Antiferromagnets on Random Lattices*
   R. Yu, T. Roscilde, and S. Haas, to be published in Condensed Matter Physics (2009).

4. *Adaptation and Performance of the Cartesian Coordinates Fast Multipole Method for Nanomagnetic Simulations*
   W. Zhang and S. Haas, Journal of Magnetism and Magnetic Materials **321**, 3687 (2009).

5. *Plasmonic excitations in tight-binding nanostructures*
   R. Muniz, S. Haas, A.F.J. Levi, and I. Grigorenko, Phys. Rev. B **80**, 045413 (2009).

6. *Scaling of the fidelity susceptibility in a disordered quantum spin chain*
   N. T. Jacobson, S. Garnerone, S. Haas, and P. Zanardi, Phys. Rev. B **79**, 184427 (2009).

7. *Electron-phonon bound states and impurity band formation in quantum wells*
   B.P.W. de Oliveira and S. Haas, Phys. Rev. B **79**, 155102 (2009).

8. *Magnetic and metallic state at intermediate Hubbard U coupling in multiorbital models for undoped iron pnictides*
   R. Yu, K.T. Trinh, A. Moreo, M. Daghofer, J. A. Riera, S. Haas, and E. Dagotto, Phys. Rev. B **79**, 104510 (2009).

9. *Fidelity in topological quantum phases of matter*
   S. Garnerone, D. Abasto, S. Haas, and P. Zanardi, Phys. Rev. A **79**, 032302 (2009).

10. *Effects of Strong Correlations and Disorder in d-Wave Superconductors*
    M. Rigol, B.S. Shastry, and S. Haas, Phys. Rev. B **79**, 052502 (2009).

11. *Quantum fluctuations in small lasers*
    K. Roy-Choudhury, S. Haas, and A.F.J. Levi, Phys. Rev. Lett. **102**, 053902 (2009).

12. *Fidelity Approach to the Disordered Quantum XY Model*
S. Garnerone, N.T. Jacobson, S. Haas, and P. Zanardi, Phys. Rev. Lett. **102**, 057205 (2009).

13. *Formation of collective excitations in quasi-one-dimensional metallic nanostructures: size and density dependence*
A. Cassidy, I. Grigorenko, and S. Haas, Phys. Rev. B **77**, 245404 (2008).

14. *Subarea law of entanglement in nodal fermionic systems*
L. Ding, N. Bray-Ali, R. Yu, and S. Haas, Phys. Rev. Lett. **100**, 215701 (2008).

15. *Entanglement, fidelity, and topological entropy in a quantum phase transition to topological order*
A. Hamma, W. Zhang, S. Haas, and D. A. Lidar, Phys. Rev. B **77**, 155111 (2008).

16. *Scaling Analysis and Application: Phase Diagram of Magnetic Nanorings and Elliptical Particles*
W. Zhang, R. Singh, N. Bray-Ali, and S. Haas, Phys. Rev. B **77**, 144428 (2008).

17. *Entanglement entropy in the two-dimensional random transverse field Ising model*
R. Yu, H. Saleur, and S. Haas, Phys. Rev. B **77**, 140402 (2008).

18. *Optimal control of electromagnetic field using metallic nanoclusters*
I. Grigorenko, S. Haas, A.V. Balatsky, and A.F.J. Levi, New J. Phys. **10**, 043017 (2008).

19. *Field induced disordered-local-moment phase in site-diluted spin-gap antiferromagnets*
R. Yu, T. Roscilde, and S. Haas, New J. Phys. **10**, 013034 (2008).

20. *Generalized cuprate gap symmetry and higher d-wave harmonics: Effects of correlation length, doping, temperature, and impurity scattering*
D. Parker, S. Haas, and A.V. Balatsky, Phys. Rev. B **76**, 104503 (2007).

21. *Quantum glass phases in the disordered Bose-Hubbard model*
P. Sengupta and S. Haas, Phys. Rev. Lett. **99**, 050403 (2007).

22. *Mott glass in site-diluted S=1 antiferromagnets with single-ion anisotropy*
T. Roscilde and S. Haas, Phys. Rev. Lett. **99**, 047205 (2007).

23. *Disorder-enhanced phase coherence in trapped bosons on optical lattices*
P. Sengupta, A. Raghavan, and S. Haas, New J. Phys. **9**, 103 (2007).

24. T_1^{-1} *peak near* T_c *in unconventional Bardeen-Cooper-Schrieffer superconductors*
D. Parker and S. Haas, Phys. Rev. B **75**, 052501 (2007).

25. *Electromagnetic response of broken-symmetry nano-scale clusters*
I. Grigorenko, S. Haas, and A.F.J. Levi, Phys. Rev. Lett. **97**, 036806 (2006).

26. *Scaling Behavior of Entanglement in Two- and Three-Dimensional Free Fermions*
W. Li, L. Ding, R. Yu, T. Roscilde, and S. Haas, Phys. Rev. B **74**, 073103 (2006).

27. *Quantum disorder and Griffiths singularities in bond-diluted two-dimensional Heisenberg antiferromagnets*
R. Yu, T. Roscilde, and S. Haas, Phys. Rev. B **73**, 064406 (2006).

28. *Synthesis of Electron Transmission in Nanoscale Semiconductor Devices*
P. Schmidt, S. Haas, and A.F.J. Levi, Appl. Phys. Lett. **88**, 013502 (2006).

29. *Bose-Glass Phases in Disordered Quantum Magnets*
O. Nohadani, S. Wessel, and S. Haas, Phys. Rev. Lett. **95**, 227201 (2005).

30. *Quantum localization in bilayer Heisenberg antiferromagnets with site dilution*
T. Roscilde and S. Haas, Phys. Rev. Lett. **95**, 207206 (2005).

31. *Synthesis for semiconductor device design*
J. Thalken, S. Haas, and A.F.J. Levi, J. Appl. Phys. **98**, 044508 (2005).

32. *Quantum Phase Transitions in Coupled Dimer Compounds*
O. Nohadani, S. Wessel, and S. Haas, Phys. Rev. B **72**, 024440 (2005).

33. *Quantum percolation in two-dimensional antiferromagnets*
R. Yu, T. Roscilde, and S. Haas, Phys. Rev. Lett. **94**, 197204 (2005).

34. *Entanglement and factorized ground states in two-dimensional quantum antiferromagnets*
T. Roscilde, P. Verrucchi, A. Fubini, S. Haas, and V. Tognetti, Phys. Rev. Lett. **94**, 147208 (2005).

35. *Triplet superconductivity in the skutterudite* $PrOs_4Sb_{12}$
K. Maki, S. Haas, D. Parker, H. Won, K. Izawa, and Y. Matsuda, Eur. Phys. Lett. **68**, 720 (2004).

36. *Studying quantum spin systems through entanglement estimators*
T. Roscilde, P. Verrucchi, A. Fubini, S. Haas, and V. Tognetti, Phys. Rev. Lett. **93**, 167203 (2004).

37. *Adaptive Design of Excitonic Absorption in Broken-Symmetry Quantum Wells*
J. Thalken, W. Li, S. Haas, and A.F.J. Levi, Appl. Phys. Lett. **85**, 121 (2004).

38. *Anisotropy-Induced Ordering in the Quantum J_1-J_2 Antiferromagnet*
T. Roscilde, A. Feiguin, A. L. Chernyshev, S. Liu, and S. Haas, Phys. Rev. Lett. **93**, 017203 (2004).

39. *Universal scaling at field-induced magnetic phase transitions*
O. Nohadani, S. Wessel, B. Normand, and S. Haas, Phys. Rev. B **69**, 220402 (2004).

40. *Adaptive Quantum Design of Atomic Clusters*
Jason Thalken, Yu Chen, A.F.J. Levi, and S. Haas, Phys. Rev. B **69**, 195410 (2004).

41. *Upper Critical Field and Fulde-Ferrell-Larkin-Ovchinnikov State in $CeCoIn_5$*
H. Won, K. Maki, S. Haas, N. Oelscher, F. Weickert, and P. Gegenwart, Phys. Rev. B **69**, 180504 (2004).

42. *Aperiodic Nano-Photonic Design*
Ioan L. Gheorma, Stephan Haas, and A.F.J. Levi, J. Appl. Phys. **95**, 1420 (2004).

43. *Quasiparticle spectrum of the hybrid s+g-wave superconductors YNi_2B_2C and $LuNi_2B_2C$*
K. Maki, H. Won, and S. Haas, Phys. Rev. B **69**, 012502 (2004).

44. *Reply to Comment on "Theory of c-axis Josephson tunneling in $\mathrm{d}_{x^2-y^2}$-wave superconductors"*
K. Maki and S. Haas, Phys. Rev. B **68**, 226502 (2003).

45. *Adaptive Design of Nano-Scale Dielectric Structures for Photonics*
Y. Chen, R. Yu, W. Li, O. Nohadani, S. Haas, and A.F.J. Levi, J. Appl. Phys. **94**, 6065 (2003).

46. *Quantum Antiferromagnetism in Quasicrystals*
S. Wessel, A. Jagannathan, and S. Haas, Phys. Rev. Lett. **90**, 177205 (2003).

47. *Theory of c-axis Josephson tunneling in $\mathrm{d}_{x^2-y^2}$-wave superconductors*
K. Maki and S. Haas, Phys. Rev. B **67**, 020510(R)(2003).

48. *Redistribution of Spectral Weight in Spin-1/2-Doped Haldane Chains*
S. Wessel and S. Haas, Phys. Rev. B **65**, 132402 (2002).

49. *Anisotropic s-wave superconductivity in MgB_2*
S. Haas and K. Maki, Phys. Rev. B **65**, 020502(R) (2002).

50. *Field-Induced Magnetic Order in Quantum Spin Liquids*
S. Wessel, M. Olshanii, and S. Haas, Phys. Rev. Lett. **87**, 206407 (2001).

51. *Phase Diagram and Thermodynamic Properties of the Square Lattice of Antiferromagnetic Spin-1/2 Triangles in* $La_4Cu_3MoO_{12}$
S. Wessel and S. Haas, Phys. Rev. B **63**, 140403 (2001).

52. *Order by Disorder from Non-Magnetic Impurities in a Two-Dimensional Quantum Spin Liquid*
S. Wessel, B. Normand, M. Sigrist, and S. Haas, Phys. Rev. Lett. **86**, 1086 (2001).

53. *Dynamical Properties of Spin-Orbital Chains in a Magnetic Field*
W. Yu and S. Haas, Phys. Rev. B **63**, 24423 (2001).

54. *Impurity Bound States and Symmetry of the Superconducting Order Parameter in* Sr_2RuO_4
K. Maki and S. Haas, Phys. Rev. B **62**, R11969 (2000).

55. *Quasi-Particle Bound States around Impurities in* $d_{x^2-y^2}$*-wave Superconductors*
S. Haas and K. Maki, Phys. Rev. Lett. **85**, 2172 (2000).

56. *Paramagnetic Reentrance Effect in NS Proximity Cylinders*
K. Maki and S. Haas, Phys. Lett. A **272**, 271 (2000).

57. *Magnetic Field Induced Ordering in Quasi-One-Dimensional Quantum Magnets*
S. Wessel and S. Haas, Eur. Phys. J. B **16**, 393 (2000).

58. *Excitation Spectra of Structurally Dimerized and Spin-Peierls Chains in a Magnetic Field*
W. Yu and S. Haas, Phys. Rev. B **62**, 344 (2000).

59. *Three-Dimensional Ordering in Weakly Coupled Antiferromagnetic Ladders and Chains*
S. Wessel and S. Haas, Phys. Rev. B **62**, 316 (2000).

60. *Excitation Spectra and Thermodynamical Response of Segmented Heisenberg Spin Chains*
S. Wessel and S. Haas, Phys. Rev. B **61**, 15262 (2000).

61. *Generalization of the Luttinger Theorem for Fermionic Ladder Systems*
P. Gagliardini, S. Haas, and T. M. Rice, Phys. Rev. B **58**, 9603 (1998).

62. *Evolution of the Low-Energy Excitation Spectrum from the Pure Hubbard Ladder to the SO(5) Ladder: A Numerical Study*
D. Duffy, S. Haas, and E. Kim, Phys. Rev. B **58**, 5932 (1998).

63. *Spectral Analysis of Correlated One-Dimensional Systems with Impurities*
S. Haas, Phys. Rev. Lett. **80**, 4052 (1998).

64. *Lightly Doped t-J Three-Leg Ladders - an Analog for the Underdoped Cuprates*
T.M. Rice, S. Haas, M. Sigrist, and F.C. Zhang, Phys. Rev. B. **56**, 14655 (1997).

65. *Dynamical Properties of the Spin–Peierls Compound* α'*–*NaV_2O_5
D. Augier, D. Poilblanc, S. Haas, A. Delia and E. Dagotto, Phys. Rev. B **56**, R5732 (1997) (RC).

66. *Extended Gapless Regions in Disordered* $d_{x^2-y^2}$*-Wave Superconductors*
S. Haas, A. V. Balatsky, M. Sigrist, and T. M. Rice, Phys. Rev. B **56**, 5108 (1997).

67. *Hole Doping Evolution of the Quasiparticle Band in Models of Strongly Correlated Electrons for the High-*T_c *Cuprates*
D. Duffy, A. Nazarenko, S. Haas, A. Moreo, J. Riera, and E. Dagotto, Phys. Rev. B **56**, 5597 (1997).

68. *Spectral Functions of One-Dimensional Models of Correlated Electrons*
J. Favand, S. Haas, K. Penc, F. Mila, and E. Dagotto, Phys. Rev. B **55**, R4859 (1997) (RC).

69. *Low-Energy Properties of Antiferromagnetic Spin-1/2 Heisenberg Ladders with an Odd Number of Legs*
B. Frischmuth, S. Haas, G. Sierra, and T. M. Rice, Phys. Rev. B **55**, R3340 (1997) (RC).

70. *Spin and Charge Texture around Impurities in the* CuO_2 *Planes*
S. Haas, F.C. Zhang, F. Mila, and T. M. Rice, Phys. Rev. Lett. **77**, 3021 (1996).

71. *Photoemission Spectra in t-J Ladders with Two Legs*
S. Haas and E. Dagotto, Phys. Rev. B **54**, R3718 (1996) (RC).

72. *Predictions for Neutron Scattering and Photoemission Experiments on* $CuGeO_3$
S. Haas and E. Dagotto, Phys. Rev. B **52**, R14396 (1995) (RC).

73. *Magnetic Raman Scattering in Two-Dimensional Spin-1/2 Heisenberg Antiferromagnets: Spectral Shape Anomaly and Magnetostrictive Effects*
F.Nori, R. Merlin, S. Haas, A. W. Sandvik, and E. Dagotto, Phys. Rev. Lett. **75**, 553 (1995).

74. *Antiferromagnetically Induced Photoemission Band in the Cuprates*
S. Haas, A. Moreo, and E. Dagotto, Phys. Rev. Lett. **74**, 4281 (1995).

75. *Quasiparticle Dispersion of the t-J and Hubbard Models*
A. Moreo, S. Haas, and E. Dagotto, Phys. Rev. B **51**, 12045 (1995) (RC).

76. *Photoemission Spectra of $Sr_2CuO_2Cl_2$: A Theoretical Analysis*
A. Nazarenko, K. J. E. Vos, S. Haas, E. Dagotto, and R. J. Gooding, Phys. Rev. B **51**, 8676 (1995) (RC).

77. *Doping Dependence of the Fermi Surface in the $t - J$ Model*
S. Haas, Phys. Rev. B **51**, 11748 (1995).

78. *Liaison between Superconductivity and Phase Separation*
S. Haas, E. Dagotto, A. Nazarenko, and J. Riera, Phys. Rev. B **51**, 5989 (1995).

79. *Random Exchange Disorder in the Spin-1/2 XXZ Chain*
S. Haas, J. Riera, and E. Dagotto, Phys. Rev. B **48**, 13174 (1993) (RC).

80. *Dynamical Properties of Antiferromagnetic Heisenberg Spin Chains*
S. Haas, J. Riera, and E. Dagotto, Phys. Rev. B **48**, 3281 (1993).

81. *Isolated Ferromagnetic Bonds in the Two-Dimensional Spin-1/2 Heisenberg Antiferromagnet*
S. Haas *et al.*, Phys. Rev. B **46**, 3135 (1992).

Conference Papers, Book Chapters, Lecture Notes

1. *Bottom-up approach to high-temperature superconductivity*
H. Won, S. Haas, and K. Maki, Phys. Stat. Sol. B **244**, 4371 (2007).

2. *Anatomy of Gossamer superconductivity*
S. Haas, K. Maki, T. Dahm, and P. Thalmeier, Curr. Appl. Phys. **7**, 64 (2007).

3. *Resonance impurity scattering in superconductivity in* $PrOs_4Sb_{12}$
D. Parker, S. Haas, and K. Maki, Phys. Stat. Sol. B **243**, 3999 (2006).

4. *BCS theory of unconventional superconductivity in $PrOs_4Sb_{12}$*
D. Parker, S. Haas, and K. Maki, Physica B **378-380**, 902 (2006).

5. *New world of Gossamer superconductivity*
K. Maki, S. Haas, D. Parker, B. Dora and A. Virosztek, Phys. Stat. Sol. (c) **3**, No. 9, 3156 (2006).

6. *Gossamer superconductivity, new paradigm?*
H. Won, S. Haas, K. Maki, D. Parker, B. Dora, and A. Virosztek, Phys. Stat. Sol. (b) **243**, 37 (2006).

7. *Bose-Einstein Condensation vs. Localization of Bosonic Quasiparticles in Disordered Weakly-Coupled Dimer Antiferromagnets*
T. Roscilde and S. Haas, J. Phys. B: At. Mol. Opt. Phys. **39**, S153 (2006).

8. *Quantum phase transition in spin systems studied through entanglement estimators*
A. Fubini, S. Haas, T. Roscilde, V. Tognetti, and P. Verucchi Open Systems & Information Dynamics 13, 445 (2006).

9. *Perspectives on Nodal Superconductors*
K. Maki, S. Haas, D. Parker, and H. Won, Chin. J. Phys. **43**, 1 (2005).

10. *High-T_c Cuprate Superconductivity in a Nutshell*
H. Won, S. Haas, D. Parker, and K. Maki, Phys. Stat. Sol. (b) **242**, 363 (2005).

11. *Upper Critical Field and Fulde-Ferrell-Larkin-Ovchinnikov State in $CeCoIn_5$*
H. Won, S. Haas, and K. Maki, J. of Magnetism and Magnetic Matter **272**, 191 (2004).

12. *Aspects of Nodal Superconductivity*
H. Won, D. Parker, S. Haas, and K. Maki, Current Appl. Phys. **4**, 523 (2004).

13. *Pressure- and field-induced magnetic quantum phase transition in $TlCuCl_3$*
B. Normand, M. Matsumoto, O. Nohadani, S. Wessel, T.M. Rice, and M. Sigrist, J. Phys.: Cond. Matt. **16**, S867 (2004).

14. *Impurity Bound States in the Pseudogap Phase of High-*$\mathrm{T_c}$ *Cuprates*
D. Parker, K. Maki, and S. Haas, Acta Phys. Pol. B **34**, 583 (2003).

15. *Effects of Andreev Scattering on the Tunneling Conductance in Superconducting MgB_2*
K. Maki, R. Gerami, and S. Haas, J. Phys. Chem. Solids **63**, 1501 (2002).

16. *A Model of Anisotropic s-Wave Superconductivity for MgB_2*
K. Maki and S. Haas, book chapter in "Superconducting Magnesium Diboride - Studies of High-Temperature Superconductors" edited by. A. Narlikar, Nova Publishers, Commack N.Y.. (2001).

17. *Properties of Anisotropic s-wave Superconductivity in MgB_2*
Y. Chen, S. Haas, and K. Maki, Current Appl. Phys. **1**, 333 (2001).

18. *Paramagnetic Response of NS Proximity Cylinders*
S. Haas and K. Maki, Physica C **341**, 2667 (2000).

19. *Magnetic Field Induced 1D to 3D Transition in Spin-1/2 Antiferromagnetic 2-Leg Ladders*
S. Haas and M. Sigrist, in "Physical Phenomena at High Magnetic Fields III", edited by J.R. Schrieffer, L. Gorkov, and Z. Fisk, p. 545, World Scientific, Singapore (1999).

20. *From the Hubbard to the SO(5) Ladder*
D. Duffy, S. Haas, and E. Kim, in "Physical Phenomena at High Magnetic Fields III", edited by J.R. Schrieffer, L. Gorkov, and Z. Fisk, p. 536, World Scientific, Singapore (1999).

21. *Phase Diagram of Three-Leg Ladders at Strong Coupling along the Rungs*
M.Y. Kagan, S. Haas, and T.M.Rice, Physica C **317-318**, 185 (1999).

22. *Real Space Pairing Theories of Superconducivity : Influence of Hole Doping*
E. Dagotto, D. Duffy, A. Nazarenko, S. Haas, A. Moreo, and J. Riera, Physica C **282-287**, 1729 (1997).

23. *Evolution of the Quasiparticle Band with Doping in Models of Strongly Correlated Electrons for the High-T_c Cuprates*
A. Moreo, D. Duffy, A. Nazarenko, S. Haas, J. Riera, and E. Dagotto, Physica C **282-287**, 1867 (1997).

24. *Localized States and Chiral Spin Texture around Impurities in* $La_2Cu_{1-x}Li_xO_4$
S. Haas, Z. Physik B **103**, 157 (1997).

25. *Photoemission Bands in Systems of Strongly Correlated Electrons*
S. Haas in *Strongly Correlated Magnetic and Superconducting Systems*, Lecture Notes in Physics Vol. 478, Springer (1997).

26. *Superconductivity in the Cuprates as a Consequence of Antiferromagnetism and a Large Hole Density of States*
A. Nazarenko, A. Moreo, S. Haas, and E. Dagotto, J. Supercond. **9**, No. 4, 379 (1996).

27. *Influence of Long-Range Interactions on Superconductivity and Phase Separation*
S. Haas, E. Dagotto, and A. Nazarenko, J. Supercond. **8**, No. 5, 657 (1995).

28. *Quasiparticle Dispersion of* $Sr_2CuO_2Cl_2$
A. Nazarenko, K.J.E. Vos, S. Haas, E. Dagotto, and R.J. Gooding, J. Supercond. **8**, No. 5, 671 (1995).

29. *Shadow Bands in Models of Correlated Electrons*
A. Moreo, S. Haas, and E. Dagotto, J. Supercond. **8**, No. 4, 475 (1995).

30. *A Simple Theory for the Cuprates: The Antiferromagnetic van Hove Scenario*
E. Dagotto, A. Nazarenko, A. Moreo, S. Haas, and M. Boninsegni, J. Supercond. **8**, No. 4, 483 (1995).

31. *Study of ARPES Data and d-Wave Superconductivity using Electronic Models in Two Dimensions*
A. Moreo, A. Nazarenko, S. Haas, A. Sandvik, and E. Dagotto, J. Phys. Chem. Solids **56**, No. 12, 1645 (1995).

32. *Raman Spectra of Two-Dimensional Spin-1/2 Heisenberg Antiferromagnets*
S. Haas, E. Dagotto, J. Riera, R. Merlin and F.Nori, J. Appl. Phys. **75**, 6340 (1994).

33. *Magnetic Properties of an Isolated Ferromagnetic Bond Embedded in Heisenberg Antiferromagnets*
S.T. Ting, S. Haas, and J.E. Crow, J. Appl. Phys. **75**, 6748 (1994).

34. *Magnetic Properties of an Isolated Missing Link in the Anisotropic Two-Dimensional Heisenberg Antiferromagnet*
S. Haas, J. Appl. Phys. **73**, 6642 (1993).

Invited Seminars

1. Georgetown University (October 2009), “Adaptive Design of Quantum Devices”.

2. University of California Irvine (April 2009), “Designer Nanoplasmonics - Dielectric Response of Nanoclusters”.

3. MOSIS Integrated Circuit Fabrication Service, Los Angeles (March 2009), “Designer Nanoplasmonics - Dielectric Response of Nanoclusters”.

4. 2009 Workshop on Wave Function Engineering and Coherent Control in Nanostructured Materials, Los Alamos (February 2009), “Designer Nanoplasmonics - Dielectric Response of Nanoclusters”.

5. California State University Los Angeles (October 2008), “Quantum Phase Transitions, Disorder and Percolation”.

6. Workshop on Quantum Critical Phenomena Statics and Dynamics, Toronto (September 2008), “Information Theoretical Measures of Quantum Phase Transitions”.

7. University of Waterloo (May 2008), “Quantum Glass Phases in Diluted Antiferromagnets”.

8. Max Planck Institute for the Physics of Complex Systems, Dresden (June 2008), "Quantum Percolation".

9. Florida State University (February 2007), "Quantum Phase Transitions, Disorder and Percolation".

10. Florida State University (February 2007), "Adaptive Quantum Design for Nanotechnology".

11. University of Florida (February 2007), "Quantum Phase Transitions, Disorder and Percolation".

12. Los Alamos National Laboratory (January 2007), "Quantum Phase Transitions, Disorder and Percolation".

13. University of California Santa Cruz (January 2007), "Quantum Phase Transitions, Disorder and Percolation".

14. Institute for Theoretical Physics, Santa Barbara (October 2006), "Bose Glass in site-diluted quantum antiferromagnets".

15. National Chung Cheng University, Taiwan (June 2005), "Adaptive Quantum Design for Nanotechnology".

16. National Chiao Tung University, Taiwan (June 2005), "Adaptive Quantum Design for Nanotechnology".

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Current Research and Recent Results

I am interested in topics related to nanoscience, quantum magnetism, and unconventional superconductivity. My research group investigates microscopic models of interacting electronic systems, using numerical techniques to study their phase diagrams, thermodynamics, and excitation spectra. Recently, we have investigated field-induced phase transitions in quantum spin liquids, developed optimization algorithms to design nanoscale opto-electronic devices, and applied BCS theory to investigate the consequences of unconventional superconductivity in strongly correlated materials. Our work is connected to experiments in the fields of nano-photonics, quantum antiferromagnetism, and high-temperature superconductivity. Our numerical codes include the Stochastic Series Expansion Quantum Monte Carlo, which is based on a series expansion of the operator $\exp(-\beta \hat{H})$, the Dynamical Density Matrix Renormalization Group, which is a powerful technique to extract finite-frequency correlation functions of quasi-1D systems, and Genetic Optimization, which we have implemented on parallel computers to find broken-symmetry configurations that enable target response functions in nanoscale devices.

Quantum Percolation:

Percolation is known to occur in a variety of contexts, ranging from blood vessel formation to clusters of atoms deposited on substrate surfaces. A fundamental question which forms the basis of this project is whether the classical picture of permeating networks also applies to systems whose behavior is dominated by strong quantum fluctuations. In this respect, low-dimensional quantum magnets offer an ideal testing ground to investigate the interplay between quantum fluctuations and geometric randomness. Systematic experimental and numerical studies have begun only recently to probe the physics of these systems.

In this work we use the Stochastic Series Expansion Quantum Monte Carlo method to investigate quantum phase transitions in the spin-1/2 Heisenberg antiferromagnet on square lattices with inhomogeneous bond dilution. Recently, we demonstrated that quantum fluctuations can be continuously tuned by inhomogeneous bond dilution, eventually leading to the destruction of long-range magnetic order on the percolating cluster. Two multicritical points were identified at which the magnetic transition separates from the percolation transition, introducing a novel quantum phase transition. Beyond these multicritical points a new quantum-disordered phase appears, characterized by an infinite percolating cluster with short ranged antiferromagnetic order. In this phase, the low-temperature uniform susceptibility was found to diverge algebraically with non-universal exponents. This is a signature that the novel quantum-disordered phase is a quantum Griffiths phase, as it was also directly confirmed by the statistical distribution of local gaps. This study thus presented first evidence of a genuine quantum Griffiths phenomenon in a two-dimensional Heisenberg antiferromagnet.

Adaptive Quantum Design:

In the near future, it will be possible to control the precise spatial positions of atoms and molecules using the experimental techniques now being developed by nanoscience. To utilize these emerging capabilities we are creating new sets of theoretical tools to assist in the exploration of a potentially vast number of atom configurations and a corresponding enormous range of physical properties. In particular, we are developing adaptive quantum design algorithms to identify the best broken-symmetry spatial configurations of nanoscale building blocks such as atoms and molecules that enable desired target function responses. Recently, we have applied these techniques to tailor the quasiparticle density of states in atomic clusters, to achieve specific transmission profiles in dielectric structures for photonics, and to engineer many-body wave functions in quantum wells which can be used as excitonic modulators.

Properties of Unconventional Superconductors:

Many recently discovered strongly correlated systems, such as the high-T_c cuprates, the organic conductors, and the heavy fermion compounds, display signatures of unconventional ground states. These include nodal superconductivity, unconventional density wave order, and in some instances coexistence phases. We have developed a generalized BCS mean field theory to investigate these anisotropic states. Over the past years, I have collaborated with Manfred Sigrist and Kazumi Maki on several projects concerning the properties of unconventional superconductors. These works focus on ways to identify the superconducting order parameter of novel compounds, such as $CeCoIn_5$, MgB_2, and Sr_2RuO_4. Furthermore, we have extended the BCS formalism for anisotropic superconductors to the case of unconventional density wave states.

Magnetic Field Induced 3D Ordering in Antiferromagnets

We have studied magnetic field induced three-dimensional ordering transitions in weakly coupled low-dimensional quantum spin liquids, such as antiferromagnetic spin-1/2 Heisenberg dimers and ladders. Using stochastic series expansion quantum Monte Carlo simulations, we obtained their thermodynamic response functions down to ultra-low temperatures. Moreover, we extracted the critical scaling exponents which dictate the power-law dependence of the transition temperature on the applied magnetic field. These can be compared with recent experiments on candidate materials and with predictions for the Bose-Einstein condensation of magnons obtained in mean-field theory. We found that the critical exponents deviate from isotropic mean-field theory and also exhibit different scaling behavior at the lower and upper critical magnetic fields.

Teaching and Outreach Activities

Teaching, both on the graduate and the undergraduate level, is to me a most attractive aspect of being a faculty member at a major research university. A good balance between research and teaching is the basis of a rich and gratifying academic life.

At the present, I enjoy the opportunity to teach on both levels. On the undergraduate level, I have been teaching a conceptual physics course for majors in non-technical fields and a calculus based introductory mechanics and thermodynamics course for engineering and science majors. These classes have typical sizes of 150 - 200 students. My main objective is to keep the students involved. Therefore, demonstrations, such as the bed of nails and less dramatic ones, are extremely effective. Furthermore, components from Mazur's Peer Instruction, student led problem solving, physics "game shows", and physlet software resources are used in the lecture. This interactive learning environment is highly appreciated by the students who have in their evaluations rated the instructor 4.8 on a scale of 5. In 2001, I received the USC Raubenheimer award for the most outstanding junior faculty in research and teaching, and a general education teaching award by the College of Letters, Arts, and Sciences at USC.

For the graduate curriculum, I have developed and taught a new course on computational physics. The objective of this class is to furnish our physics graduate students with computational techniques needed for their research, such as programming, data analysis, and use of scientific software. Furthermore, it provides numerical skills which are useful in today's academic job market as well as in industry and the world of finance. This course has consistently had the highest ratings of all graduate classes which are offered in our department. Besides homework and a final project, the students are actively involved by giving presentations on special topics, such as Graphics and Animations or Programming with Numerical Recipes. I also invite colleagues from other related fields to give in-class presentations on topics such as brain imaging and financial forecasting. The course website is at http://physics.usc.edu/∼shaas/516/ .

With younger research collaborators, such as my postdoc, five graduate students, and two advanced undergraduate students, I have always found it beneficial to view them as equal colleagues. They enjoy research more, thus producing better results, when participating in setting the course of a project rather than merely executing detailed instructions. The students engaged in my field require a solid background in statistical mechanics and condensed matter physics, most of which is picked up while participating in the projects. Some of the less challenging numerical aspects of my work are within the grasp of advanced undergraduates and beginning graduates with good computational skills, and provide them with a broad background of methods for their future career.

Besides these activities, I have organized the departmental colloquium for 2 semesters, and the condensed matter seminar for the past 5 years. My aim is to ensure that the talks are kept on a level accessible to our graduate students. I am currently the director of graduate studies of our department. Here, my main focus is the aggressive recruitment of top students, and the reform of our present graduate curriculum in order to offer a wider spectrum of research oriented courses to our current students. In addition, I advice several undergraduate physics majors. I am giving lectures for the USC Orientation Faculty Showcase, at the Summer Bridge Program for Underrepresented Freshmen, and for the USC Science Day. Moreover, I am organizing an annual summer workshop for high school physics teachers in Los Angeles, and represent our department at the LAPTAG (Los Angeles Physics Teachers Alliance Group). This is a group of committed high school physics teachers who meet every other month to exchange ideas, plan common research projects for students, such as the Los Angeles Seismology Project. In this project, the propagation of shock waves, triggered by small controlled explosions, is measured at several points (high schools locations) within the greater Los Angeles area. We also regularly invite these teachers to USC to discuss and design new in-class demonstrations.