

## Curriculum Vitae

Sanjoy K. Sarker

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Academic Specialization: Theoretical Condensed Matter Physics

### EDUCATION:

Cornell University	Ph.D. 1980	Theoretical Condensed Matter Physics
Dhaka University	M.Sc. 1974	Physics
	B.Sc. 1973	Physics (Honors)

### EMPLOYMENT

University of Alabama	Professor	1995- 2017 (emeritus)
	Associate Professor	1990 - 94
	Assistant Professor	1984-90
Cornell University	Post-doctoral Associate	1982-83
	Research Assistant	1976-80,
	Teaching Assistant	1974-76
Rutgers University	Postdoctoral Associate	1980-82

### VISITING POSITIONS:

#### Sabbaticals

Princeton University:	1992-93
Ohio State University	1998-99
Ohio State University	2005-06
Indian Institute of Science	2013

#### Summer Positions

Cornell University	Summer 1984, 1985, 1986.
Ohio State University	Summer 1988, 1989, 1990
Princeton University	Summer 1995, 1997
ICTP (Italy)	Summer 1984, 1991

## CURRENT RESEARCH:

Broad interest in theoretical Physics with focus on the fundamental issues in Condensed Matter Theory, including the breakdown of Fermi liquid theory, and Quantum phase transitions. Subjects of current interests are.

- Strongly- correlated systems
- High-temperature superconductivity
- Metal-insulator and magnetic transitions in Oxides.

Although a theorist by training, I enjoy working with experimentalists. For example, I have recently coauthored a paper with Prof. Leclair of UA on metal-insulator transition, and another on Graphene with Prof. A. Ghose of Indian Institute of Science.

In addition I have recently collaborated (and coauthored papers) with scientists working in other disciplines, such as:

- Dark Matter (astrophysics)
- Supersymmetry (particle physics)
- Biology

Science Education: I have deep interest in Public Policy and Science Education in emerging societies, particularly in South Asia, and have published OP-ED articles on this subject in Bangladeshi newspapers.

I would like to work on this area more, and help develop methodology to spread and modernize science education in South Asia.

## EARLIER WORK:

- Solitons, Anderson localization, Renormalization group
- Theory of transport in high electric fields
- Superconductivity in Bucky Balls, Double exchange in Manganites

## PUBLICATIONS: **Sanjoy K. Sarker**

Amogh Kinikar, T. Phanindra Sai, A. Agarwal, T. Biswas, **Sanjoy K. Sarker**, H. R. Krishnamurthy, Manish Jain, V. B. Shenoy and Arindam Ghosh, "Quantized edge modes n atomic scale point contacts in graphene". Nature Nanotechnology, accepted Jan 6, published online April3, 2017, nnnano 24.

T. Lovorn and **Sanjoy K. Sarker**, "Complex quasi-two-dimensional crystalline order embedded in VO<sub>2</sub> and other crystals". Phys. Rev. Lett. 119, 045501 (2017)

S. Keshavarz, J. Jones, A. Amiri, A. Singh, A. Gupta, S. Sarker, P. LeClair  
"Low-frequency Noise Spectroscopy of Vanadium Dioxide throughout the Metal-Insulator Transition" To be submitted PRB

A. Amiri, J. Orr, P. Leclair, A. Gupta and **S. K. Sarker**, "Strain effect on the resistance changes in vanadium dioxide (VO<sub>2</sub>) thin films". Submitted to APL.4.10.16

T. Lovorn and **S. K. Sarker**, "Effective Model for the Ionic Degrees of Freedom in VO<sub>2</sub>", (Abstract in, Bulletin APS, March 2016).

J. Davidson, **S. K. Sarker** and A. Stern, "Possible Evidence of Thermodynamic Activity in Dark Matter Haloes", arXiv:1207.2383 [astro-ph:GA], AstroPhys J., 788:37, 1, 2014

Holinsworth, B.S.; Mazumdar, D.; Sims, H.; Sun, Q.-C.; Yurtisigi, M.K.; **Sarker, S.K.**; Gupta, A.; Butler, W.H.; Musfeldt, J.L., "Chemical tuning of the optical band gap in spinel ferrites: CoFe<sub>2</sub>O<sub>4</sub> vs NiFe<sub>2</sub>O<sub>4</sub>," *Applied Physics Letters*, vol.103, no.8, pp.082406,082406-4, Aug 2013

**S. K. Sarker** and A. Stern, "An effective thermodynamic description of dark matter haloes"; submitted to Classical and Quantum Gravity.

X. Zhong, P. R. LeClair, **S. K. Sarker**, and A. Gupta, "Impedance spectroscopy of the metal-insulator transition in epitaxial VO<sub>2</sub> thin films on TiO<sub>2</sub>." Phys. Rev. B 86, 094114 (2012).

Q. Haider and **S. K. Sarker**, "Scientific research in Bangladesh: New opportunities", Op-Ed article in the Daily Star, Bangladesh, May 21, 2012.

Q. Haider and **S. K. Sarker**, "Science cannot coexist with backwardness", Op-Ed article in the Daily Star, Bangladesh, Aug 7, 2012.

**S. K. Sarker**, "Only solution is a knowledge-based economy" Op-Ed article in Bengali in Samakal, May 21, 2012

**S. K. Sarker** and T. Lovorn, "Charge pair hopping and Bose-Einstein condensation in underdoped Mott insulators", ArXiv:0158312, Phys.Rev. B85, 144502 (2012)

**S. K. Sarker** and T. Lovorn, "A consistent theory of underdoped cuprates: Evolution of the RVB state from half filling", Phys. Rev. B82, 014504 (2010); arXiv:0910.2204v2 [cond-mat.str-el], 18 Oct 2009

L. C. Clavelli and **S. K. Sarker**, "Covalent Molecular Binding in a Susy Background", ArXiv:0811.1022, November 2008; Int. J. Mod. Phys. A, 24, 4245 (2009).

- M. E. Williams, W. H. Butler, C. K. Mewes, H. Sims, M. Chshiev, and **S. K. Sarker**, "Calculated electronic and magnetic structure of rutile phase  $V_{1-x}Cr_xO_2$ ", J. Appl. Phys. 105 07E510 (2009)
- S. K. Sarker**, "Metallic conduction and superconductivity in the pseudogap phase", cond-mat/LANL/ 0701288 (2007); Phys. Rev. B77, 052505 (2008).
- J. Belev, A. Bandyopadhyay, W. H. Butler and **S. K. Sarker**, "Electronic and magnetic structure of transition-metal-doped alpha-hematite", Phys. Rev. B71, 205208 (2005).
- S. K. Sarker** and S. Lair, "Negative-U Hubbard model with long-range Coulomb interaction: Metal-insulator transition far from half filling", J. Phys. Condens. Matt. 17,3885 (2005).
- A. Bandyopadhyay, **S. K. Sarker**, J. Belev, W. H. Butler and O. Bengone, "Effect of electron-correlation on the electronic and magnetic properties of Ti-doped alpha hematite", Phys. Rev. B69, 174429 (2004).
- S. K. Sarker**, "Spin-Charge Separation and Kinetic Energy in the t-J Model", Phys. Rev. B68, 085105 (2003).
- S. K. Sarker** "On Possible Coexistence of Superconductivity and Charge Density Wave in Hole Doped  $C60$ ", Cond-Mat/LANL/0111500,(2001).
- S. K. Sarker** "Spin-charge Recombination and Superconductivity in the t-J Model", Phys. Rev. B61, 8663 (2000)
- S. K. Sarker**, "Metal Insulator Transition in Disordered and Interacting Systems", (preprint) (1998).
- S. K. Sarker** and P. W. Anderson, "Spin-Gap and Superconductivity in the Interlayer Pair Tunneling Model.", Cond-Mat/LANL/9704123 (1997).
- S. K. Sarker**, "Phase Transition in the Double-Exchange Model: A Schwinger Boson Approach", J. Phys. Cond. Matt. 8, L515 (1996).
- S. K. Sarker**, "Confinement in the Three-dimensional Anisotropic t-J Model: A Mean-Field Study", J. Phys. Chem. Solids 56, 1753 (1995).
- S. K. Sarker**, "Metal Semimetal Transitions in Extended Hubbard Model on the FCC Lattice: Implications for Superconducting Fullerenes", Phys. Rev. B51, 3031 (1995).
- Fengming Hu, **S. K. Sarker** and C. Jayaprakash, "Domain Walls, Spiral States and Phase Separation in the Extended Hubbard Model: A Hartree-Fock Analysis", Phys. Rev. B50, 17901 (1994).
- S. K. Sarker**, C. Jayaprakash and H. R. Krishnamurthy, "Non-Fermi Liquid Behavior in the t-J Model: Role of Quantum Fluctuations", Physica C228, 309 (1994).
- S. K. Sarker**, "Charge-Density-Wave Semimetallic and Superconducting States for  $A_3C_{60}$ ", Phys. Rev. B 49, 12047 (1994).
- S. K. Sarker**, "Coulomb Interactions and the Stability of Spiral States in the t-J Model", Phys. Rev. B47(Rapid Communications), 2940 (1993).

**S. K. Sarker**, "Theory of Spin-Charge Separation and Recombination in the t-J Model", Phys. Rev. B46, 8617 (1992).

W. K. Lim, **S. K. Sarker** and J. K. Hardman, "Enzymatic Properties of Mutant *xi it coli* Tryptophane Synthase alpha-Subunits", J. Biol. Chem, 266, 20205 (1991).

**S. K. Sarker**, C. Jayaprakash, H. R. Krishnamurthy and W. Wenzel, "Spiral States in the Square-Lattice Hubbard Model", Phys. Rev. B43 (Rapid Communications) 8775 (1991).

C. Jayaprakash, H. R. Krishnamurthy, **S. K. Sarker**, and W. Wenzel, "Metal-Insulator Transition in the Hubbard Model on a Triangular Lattice", Europhys. Lett. **{\bf {15}}**, 625 (1991).

H. R. Krishnamurthy, C. Jayaprakash, W. Wenzel and **S. K. Sarker**, "The Mott-Hubbard Metal-Insulator Transition in Non-Bipartite Lattices", Phys. Rev. Lett. 64, 950 (1990).

**S. K. Sarker**, H. R. Krishnamurthy, C. Jayaprakash and W. Wenzel, "Mean-Field Theories of Hubbard and t-J Model", Physica C163, 541 (1990).

H. R. Krishnamurthy, C. Jayaprakash, W. Wenzel and **S. K. Sarker**, "New Mean-Field Theories of the Hubbard Model", Physica C162-164, 1447 (1989).

C. Jayaprakash, H. R. Krishnamurthy and **S. K. Sarker**, "Mean-Field Theory for the t-J Model", Phys. Rev B40 (Rapid Communications), 2610 (1989).

Y. -K. Hu, J. W. Wilkins and **S. K. Sarker**, "Quantum Transport Equation Approach to Nonequilibrium Screening", in it Nanostructure Physics and Fabrication, p 273 (1989), Eds. M. A. Reed and W. P. Kirk, Academic Press.

**S. K. Sarker**, C. Jayaprakash, H. R. Krishnamurthy and M. Ma, "A Bosonic Mean-Field Theory of Quantum Heisenberg Spin Systems-- Bose Condensation and Magnetic Order", Phys. Rev. B40, 5028 (1989).

**S. K. Sarker**, "Gutzwiller Approximation for the Emery Model", Phys. Rev. B39, 2155 (1989).

Y. -K. Hu, **S. K. Sarker** and J. W. Wilkins, "Quantum Kinetic Equation Approach to Semiconductor Hot-Carrier Screening", Phys. Rev. B39, 8468 (1989).

**S. K. Sarker**, "A New Mean-Field Approximation to the Two-Band Model for Copper-Oxide Superconductors", J. Phys. Cond. Matt. Lett. 1, 311 (1989).

**S. K. Sarker**, "A New Functional Integral Formalism for Strongly Correlated Fermi Systems", J. Phys. C. Lett 21, L667 (1988).

**S. K. Sarker**, "A Functional Intergral Method for the Strongly Correlated Hubbard Model", in First two years of high-temperature superconductivity. Ed. R. M. Metzger, Gordon and Breach Sci. Pub., p353 (1988).

**S. K. Sarker**, Y. -K. Hu, C. J. Stanton and J. W. Wilkins, "Exact Solution of a Transport Equation for Hot-Electron Effects in Semiconductors and Metals", Phys. Rev. **{\bf {B35}}**, 9229 (1987).

**S. K. Sarker**, J. H. Davies, F. S. Khan and J. W. Wilkins, "Quantum Corrections to Boltzmann Equation for High-Field Transport in Semiconductors", Phys. Rev. **B33**, 7263 (1986).

**S. K. Sarker**, "Quantum Transport Theory for High Electric Fields", Phys. Rev **B32**, 743 (1985).

**S. K. Sarker**, "Real Space Renormalization Group Method for the Ground State Properties of the Quantum Lattice Models", Phys. Rev. **30**, 2752 (1984).

**S. K. Sarker**, "On the Self-consistency of the One-Parameter Scaling theory of Localization", J. Phys. C Lett **16**, L991 (1983).

**S. K. Sarker**, "Inverse Localization Length in One Dimensional Anderson Model for Small Disorder", Phys. Rev. **B25** (Rapid Communications), 4304 (1982).

R. Cordery, J. Tobochnik and **S. K. Sarker**, "Physics of the Dynamic Critical Exponent in One Dimensaion", Phys. Rev. **B24**(RC), 5402 (1981).

J. Tobochnik, **S. K. Sarker** and R. Cordery, "Dynamic Monte Carlo Renormalization Group", Phys. Rev. Lett., **46**, 1417 (1981).

P. D. Beale, **S. K. Sarker** and J. A. Krumhansl, "Renormalization-Group Study of Cross-over in Structural Phase Transitions", Phys. Rev. **B24**, 266 (1981).

**S. K. Sarker** and E. Domany, "Scaling Theory of Anderson Localization: A Renormalization-Group Approach", Phys. Rev. **B23**, 6018 (1981).

**S. K. Sarker** and J. A. Krumhansl, "Effect of Solitons on the Thermodynamic Properties of a System with Long-range Interactions", Phys. Rev. **B23**, 2374 (1981).

**S. K. Sarker** and E. Domany, "A Scaling Theory of Anderson Localization", J. Phys. C Lett. **13**, L273 (1980).

E. Domany and **S. K. Sarker**, "Renormalization-Group Study of Anderson Localization", Phys. Rev. **B20**, 4726 (1979).

J. F. Currie, **S. K. Sarker**, A. R. Bishop, and S. E. Trullinger, "Statistical Mechanics of One-dimensional Complex Scalar Fields with Phase Anisotropy", Phys. Rev. **A20**, 2213 (1979).

**S. K. Sarker**, S. E. Trullinger, and A. R. Bishop, "Solitary-wave solution for a complex one-dimensional field", Phys. Lett. **59A**, 255 (1976).

INVITED TALKS AND SEMINARS:

Mississippi State Univ, Mar 4, 2014: Colloquium, 'High Tc Superconductivity'.

Institute of Math Science (IMSC), Chennai, Dec 11, 2013, 'High Tc Superconductivity'.

Indian Inst of Science, Bangalore, Aug 2013, 'High Tc Superconductivity'.

Raman research Institute, Bangalore, Nov 21, 2013, 'High Tc Superconductivity'.

Dept of Theory of Simulated Materials, Inst de Ciencia de Materials de Madrid  
May 13, 2013. 'High Tc Superconductivity'.

Dept de Fisika Teorica I, Univ Computense de Madrid, May 8, 2013 'High Tc  
Superconductivity'.

Conference on Status of Supersymmetry and Dark Matter. Oct 3-5,, 2013, Advanced center for  
QFT (IISC), Bangalore. (Invited): 'Possible Thermodynamic Activity in Dark matter Haloes'.

Barkatullah University, Bhopal, India, June 3, 2012, 'Advances in high Tc superconductivity'.

Bundelkhand University, Jhansi, India, June 4, 2012, 'Advances in high Tc superconductivity'.

Dhaka University, June 26, 2012 'High Tc superconductivity, Evolution from Mott Insulator'.

Intl Conf on Condensed Matter, ICTS, Dec 19, 2010. Bangalore, (Invited), 'A blind approach to  
high Tc superconductivity'.

S. N. Bose Institute, Calcutta, India, Dec 27, 2010, 'A blind man's approach to the problem of  
high-temperature superconductivity'.

Univ Alabama Huntsville, Nov 30, 2010. (Colloquium); 'A blind man's approach to the problem  
of high-temperature superconductivity.'

Princeton University, Aug 11, 2010. 'A blind man's approach to the problem of high-  
temperature superconductivity'.

Ohio State University, 2006, 'Theory of high Tc superconductivity'.

Ohio State University, Feb 4, 2004, 'Energetics of Spin-Charge Separation in the t-J Model',

Univ of Alabama at Birmingham, Nov 2004 (Colloquium), 'Physics of high T<sub>c</sub> Superconductors'.

Aspen Physics Center, July 2003, 'Energetics of Spin-Charge Separation in the t-J Model'.

Ohio State University, Nov 16, 2001, 'Fixed point structure of large-U Hubbard model'.

Max-Planck-Institute, Stuttgart, May 9, 2001, 'Spin-charge recombination in High-T<sub>c</sub> Superconductors'.

Univ of Karlsruhe, Germany, May 12, 2001, 'Spin-charge recombination in High-T<sub>c</sub> Superconductors'.

Nordita, Copenhagen, May 16, 2001. 'Spin-charge recombination in High-T<sub>c</sub> Superconductors'.

Bayreuth University, Germany, Dec 16, 1999, 'Spin-charge recombination in High-T<sub>c</sub> Superconductors'.

Saha Institute of Nuclear Physics, India, Dec 31, 1999, "Theory of high T<sub>c</sub> Superconductivity",

Aspen center for Physics, July 1999. 'Spin-charge binding and Superconductivity in the t-J model',

Ohio State University, May 1999, 'Spin-charge binding and Superconductivity in the t-J model',

University of Cincinnati, Nov, 1998, "Spin-charge Binding and Superconductivity".

Ohio State University, Oct, 1998, "Physics of fullerenes".

Ohio State Univ, Sep, 1998. "Basic issues of High-T<sub>c</sub> superconductivity".

Aspen Center for Physics, July, 1998. 'New results on the t-J model of high-T<sub>c</sub> superconductors'.

Aspen Physics Center, July 1996, 'Phase transition in the double-exchange model'.

National High Magnetic Field Laboratory, Florida State University, Feb 10, 1994. "CDW semimetal and Superconductivity in Fullerenes".

Bell Laboratories, Murray Hill, NJ, June 15, 1993, 'CDW semimetal and Superconductivity in Fullerenes'.

International Center for Theoretical Physics, Trieste, Italy, May 23, 1993. "CDW states in Fullerenes",



Max-Planck-Institute, Stuttgart, Germany May 20, 1993. “CDW states in Fullerenes”,

Princeton University, May 12, 1993, ‘Possible CDW state in Fullerenes’.

Saha Institute of Nuclear Physics, Calcutta, India, March 1993. ‘Superconductivity in Fullerides’.

Princeton University, September 1992, ‘Coulomb Interactions and Stability of the Spiral States in the t-J Model’.

Ohio State University, May 1992, ‘Spin-Charge Separation and Binding in the t-J Model’,

Saha Institute of Nuclear Physics, Calcutta, India, July 199, ‘Perspectives of High-T<sub>c</sub> Superconductivity”, Two lectures

International Conference on the Physics of Highly Correlated Systems, Santa Fe, September 1990, ‘Mean-field Theories of Hubbard and t-J Models’.,

University of Florida, March 1990, ‘Physics of t-J Model’.

University of Alabama, 1983, ‘Anderson Localization – Renormalization Group’.

University of Toronto, 1982,

Cornell University, 1981, ‘Anderson Localization – Renormalization Group’.

Los Alamos National Lab, 1980 ‘Anderson Localization – Renormalization Group’.

Rutgers University, 1980 ‘Anderson Localization – Renormalization Group’.

#### Other Talks

T. Lovorn (presenter) and S. K. Sarker, ‘Real-space holon pairing in underdoped cuprates’. Bull. Amer. Phys. Soc. Mar 2013.

A. Bandyopadhyay, W. H. Butler, J. Belev and S. K. Sarker, “Effect of electron-correlation on the electronic and magnetic properties of alpha hematite (Ti)”. Abstract: 9th Joint MMM/Intermag

S. K. Sarker, “Towards a Microscopic Theory of High-T<sub>c</sub> Superconductivity”, (Abs) Bull. Amer. Phys. Soc., 44, 1064 (1999).

S. K. Sarker, “Broken Symmetry and Semimetallic Phases for Superconducting Fullerides” Bull. Amer. Phys. Soc. 39, 404 (1994).

H. R. Krishnamurthy, C. Jayaprakash and S. K. Sarker, "A New Mean-Field Theory for the Hubbard Model", Bull. Amer. Phys. Soc. 34, 924 (1989).

Y. -K. Hu, J. W. Wilkins and S. K. Sarker, "Quantum Transport Equation Approach to Nonequilibrium Screening", Bull. Amer. Phys. Soc. 34, 1000 (1989).

N. E. Bonesteel (presenter), J. W. Wilkins and S. K. Sarker, "Modified One-Dimensional Emery Model with a single Hole", Bull. Amer. Phys. Soc. 34, 1034 (1989).

S. Sarker, H. R. Krishnamurthy and C. Jayaprakash, "Spectral Function and Superconductivity in the Heisenberg-Hubbard Model", Bull. Amer. Phys. Soc. 34, 1035 (1989).

Y. -K. Hu, C. J. Stanton, J. W. Wilkins and S. K. Sarker, "Exact Solution of a Boltzmann Equation for Hot Electrons", Bull. Amer. Phys. Soc. 32, 637 (1987).

S. K. Sarker, "Quantum Corrections to the High-Field Boltzmann Equation in a Semiconductor", Bull. Amer. Phys. Soc. 31, 693 (1986).

S. K. Sarker, "Quantum Transport Theory for High Electric Fields", Bull. Amer. Phys. Soc. 30, 261 (1985).

S. K. Sarker, C. Jayaprakash and H. R. Krishnamurthy, "Schwinger Bosons, Hole fermions and a New Mean-Field Theory for the Heisenberg-Hubbard Model", (poster) 16th Midwest Solid State Theory Symposium, Cincinnati, Ohio, Oct 14-15, 1988.

S. K. Sarker, "A functional integral method for the strongly Correlated Hubbard model", Intl. Conf. on the first two years of high- $T_c$  superconductivity. Tuscaloosa, Alabama 1988 (poster).