

Curriculum Vitae: R. Torsten Clay

CONTACT INFORMATION	Department of Physics and Astronomy Mississippi State University Box 5167 Mississippi State, MS 39762-5167	<i>Voice:</i> (662) 325-0628 <i>Fax:</i> (662) 325-8898 <i>E-mail:</i> r.t.clay@msstate.edu
RESEARCH INTERESTS	strongly correlated electron materials, unconventional superconductors, quantum Monte Carlo and other many-body methods	
EDUCATION	University of Illinois, Urbana, IL, Ph.D., Physics, 1999. Yale University, New Haven, CT, B.S., Physics (cum laude), 1993.	
PROFESSIONAL EXPERIENCE	<i>Professor</i> , Dept. of Physics and Astronomy, Mississippi State University. 2014-present <i>Visiting Professor</i> , Institute for Solid State Physics, University of Tokyo, Kashiwa, Japan, Fall 2011. <i>Associate Professor</i> , Dept. of Physics and Astronomy, Mississippi State University. 2008-2014 <i>Assistant Professor</i> , Dept. of Physics and Astronomy, Mississippi State University. 2002-2008 <i>Postdoctoral Research Associate</i> , Dept. of Physics, University of Arizona, Tucson, AZ, 1999-2002.	
HONORS AND AWARDS	<ol style="list-style-type: none">1. Visiting Professor, Institute of Solid State Physics, University of Tokyo, 2011.2. Mississippi State University State Pride Award, 2011.3. Certificate of Appreciation, Increasing Minority Access to Graduate Education/National Society of Black Engineers (IMAGE/NBSE), from students in PH2223, Electricity & Magnetism, 2006.4. Ralph E. Powe junior faculty enhancement award, Oak Ridge Associated Universities, 2004.	
PUBLICATIONS	<ol style="list-style-type: none">1. RTC, N. Gomes, S. Mazumdar, "Theory of triangular lattice quasi-one-dimensional charge-transfer solids," <i>Phys. Rev B</i> 100, 115158 (2019) (8 pages).2. RTC, S. Mazumdar, "From charge- and spin-ordering to superconductivity in the organic charge-transfer solids," <i>Physics Reports</i> 788, 1 (2019) (89 pages).3. RTC, A. B. Ward, N. Gomes, and S. Mazumdar, "Bond patterns and charge-order amplitude in quarter-filled charge-transfer solids," <i>Phys. Rev B</i> 95, 125114 (2017) (7 pages).4. W. W. De Silva, N. Gomes, S. Mazumdar, RTC, "Coulomb enhancement of superconducting pair-pair correlations in a $\frac{3}{4}$-filled model for κ-(BEDT-TTF)₂X," <i>Phys. Rev B</i> 93, 205111 (2016) (8 pages).5. N. Gomes, W. W. De Silva, T. Dutta, RTC, S. Mazumdar, "Coulomb-enhanced superconducting pair correlations and paired-electron liquid in the frustrated quarter-filled band," <i>Phys. Rev B</i> 93, 165110 (2016) (7 pages).6. A.B. Ward, RTC, S. Mazumdar, "Comment on "Tuning the Magnetic Dimensionality by Charge Ordering in the Molecular TMTTF Salts" ", <i>Phys. Rev. Lett.</i> 113, 029701 (2014) (1 page).7. J.-P. Song, RTC, "Monte Carlo simulations of two-dimensional fermion systems with string-bond states," <i>Phys. Rev. B</i> 89, 075101 (2014) (7 pages).	

8. S. Mazumdar, RTC, “The Chemical Physics of Unconventional Superconductivity”, *Int. J. Quantum Chem.* **114**, 1053–1059 (2014) (7 pages).
9. N. Gomes, RTC, S. Mazumdar, “Absence of superconductivity and valence bond order in the Hubbard-Heisenberg model for organic charge-transfer solids,” *J. Phys.: Condens. Matter* **25**, 385603 (2013) (5 pages).
10. S. Dayal, RTC, S. Mazumdar, “Absence of long-range superconducting correlations in the frustrated half-filled-band Hubbard model,” *Phys. Rev. B* **85**, 165141 (2012) (8 pages).
11. RTC, S. Dayal, H. Li, S. Mazumdar, “Beyond the quantum spin liquid concept in frustrated two dimensional organic superconductors,” *Phys. Status Solidi B* **249**, 991–994 (2012).
12. RTC, J.-P. Song, S. Dayal, S. Mazumdar, “Ground State and Finite Temperature Behavior of 1/4-Filled Band Zigzag Ladders”, *J. Phys. Soc. Jpn.* **81**, 074707 (2012) (11 pages).
13. S. Mazumdar, RTC, “Is there a common theme behind the correlated-electron superconductivity in organic charge-transfer solids, cobaltates, spinels, and fullerenes?”, *Phys. Status Solidi B* **249**, 995–998 (2012).
14. S. Mazumdar, RTC, H. Li, “Similarities in electronic properties of organic charge-transfer solids and layered cobaltates,” *Physica B* **407**, 1722–1724 (2012).
15. S. Dayal, RTC, H. Li, S. Mazumdar, “Paired Electron Crystal: Order from Frustration in the Quarter-Filled Band,” *Phys. Rev. B* **83**, 245106 (2011) (12 pages). **Editors’ Suggestion.**
16. H. Li, RTC, S. Mazumdar, “Theory of Carrier Concentration-Dependent Electronic Behavior in Layered Cobaltates,” *Phys. Rev. Lett.* **106**, 216401 (2011) (4 pages).
17. RTC, H. Li, S. Sarkar, S. Mazumdar, T. Saha-Dasgupta, “Cooperative orbital ordering and Peierls instability in the checkerboard lattice with doubly degenerate orbitals,” *Phys. Rev. B* **82**, 035108 (2010) (7 pages).
18. H. Li, RTC, S. Mazumdar, “The Paired-Electron Crystal in the Two-Dimensional Frustrated Quarter-Filled Band,” *J. Phys.: Condens. Matter* **22**, 272201 (2010) (7 pages). **Featured as “IOP Select” article.**
19. RTC, H. Li, S. Mazumdar, “Bipolaron density-wave driven by antiferromagnetic correlations and frustration in organic superconductors,” *Physica B* **405**, S253–S255 (2010).
20. RTC, S. Mazumdar, H. Li, “Local singlets, frustration, and unconventional superconductivity in the organic charge-transfer solids,” *Physica B* **404**, 487–489 (2009).
21. S. Mazumdar, RTC, H. Li, “From valence bond solid to unconventional superconductivity in the organic charge-transfer solids,” *Synth. Metals* **159**, 2419–2421 (2009).
22. RTC, H. Li, S. Mazumdar, “Absence of superconductivity in the half-filled band Hubbard model on the anisotropic triangular lattice,” *Phys. Rev. Lett.* **101**, 166403 (2008) (4 pages).
23. S. Mazumdar, RTC, “Quantum critical transition from charge-ordered to superconducting state in the negative- U extended Hubbard model on a triangular lattice,” *Phys. Rev. B* **77**, 180515(R) (2008) (4 pages).
24. J. L. Musfeldt, S. Brown, S. Mazumdar, RTC, M. Mas-Torrent, C. Rovira, J. C. Dias, R. T. Henriques, and M. Almeida, “Infrared investigation of the charge ordering pattern in the organic spin ladder candidate $(\text{DTTTF})_2\text{Cu}(\text{mnt})_2$,” *Solid State Sciences* **10**, 1740–1744 (2008).
25. RTC, R. P. Hardikar, S. Mazumdar, “Temperature-driven transition from the Wigner crystal to the bond-charge-density wave in the quasi-one-dimensional quarter-filled band,” *Phys. Rev. B* **76**, 205118 (2007) (12 pages).
26. R. P. Hardikar, RTC, “Phase diagram of the one-dimensional Hubbard-Holstein model at half and quarter filling,” *Phys. Rev. B* **75**, 245103 (2007) (10 pages).
27. RTC, S. Mazumdar, “Charge ordering and spin gap transitions in quarter-filled ladders,” *J. Low Temp. Phys.* **142**, 365–370 (2006).

28. S. Mazumdar, RTC, "Charge ordering and local-singlet formation in quarter-filled band charge-transfer solids and oxides of early transition metals," *Journal de Physique IV* **131**, 63 (2005).
29. RTC, R. P. Hardikar, "Intermediate phase of the one dimensional half-filled Hubbard-Holstein model," *Phys. Rev. Lett.* **95**, 096401 (2005) (4 pages).
30. RTC, S. Mazumdar, "Co-operative density wave and giant spin gap in the quarter-filled zigzag electron ladder," *Phys. Rev. Lett.* **94**, 207206 (2005) (4 pages).
31. RTC, S. Mazumdar, "Magnetism in BEDT-TTF materials," *Synth. Metals* **153**, 445–448 (2004).
32. RTC, S. Mazumdar, D. K. Campbell, "The pattern of charge ordering in quasi-one-dimensional organic charge transfer solids," *Phys. Rev. B* **67**, 115121 (2003) (9 pages).
33. S. Mazumdar, RTC, D. K. Campbell, "The ubiquitous 1100 charge ordering in organic charge-transfer solids," *Synth. Metals* **137**, 1317–1319 (2003).
34. RTC, D. K. Campbell, S. Mazumdar, "Charge order in quasi-one-dimensional organic charge-transfer solids," *Synth. Metals* **135–136**, 681–682 (2003).
35. RTC and S. Mazumdar, Comment on "Origin of Giant Optical Nonlinearity in Charge-Transfer–Mott Insulators: A New Paradigm for Nonlinear Optics," *Phys. Rev. Lett.*, **89**, 039701 (2002).
36. M. Ashida, Y. Taguchi, RTC, S. Mazumdar, Yu P. Svirko, M. Kuwata-Gonokami, "Dimensionality dependence of optical nonlinearity and relaxation dynamics in cuprates," *Eur. Phys. Lett.* **58**, 455–461 (2002).
37. RTC, S. Mazumdar, D.K. Campbell, "Charge ordering in θ -(BEDT-TTF)₂X materials," *J. Phys. Soc. Japan* **71**, 1816–1819 (2002).
38. RTC, S. Mazumdar, D. K. Campbell, "Re-integerization of fractional charges in the correlated quarter-filled band," *Phys. Rev. Lett.* **86**, 4084–4087 (2001).
39. S. Mazumdar, RTC, D. K. Campbell, "The nature of the insulating state in organic superconductors," *Synth. Metals* **120**, 679–682 (2001).
40. H. Q. Lin, D. K. Campbell, RTC, "Broken Symmetries in the One-Dimensional Extended Hubbard model," *Chinese J. Phys.* **38**, 1–23 (2000).
41. S. Mazumdar, RTC, D. K. Campbell, "Bond-order and charge-density waves in the isotropic interacting two-dimensional quarter-filled band and the insulating state proximate to organic superconductivity," *Phys. Rev. B* **62**, 13400–13425 (2000).
42. S. Mazumdar, D. K. Campbell, RTC, S. Ramasesha, Comment on "Wigner Crystal type of charge ordering in an organic conductor with a quarter-filled band: (DI-DCNQI)₂ Ag," *Phys. Rev. Lett.* **82**, 2411 (1999).
43. S. Mazumdar, S. Ramasesha, RTC, D. K. Campbell, "Theory of Coexisting Charge and Spin-Density Waves in (TMTTF)₂Br, (TMTSF)₂PF₆, and α -(BEDT-TTF)₂MHg(SCN)₄," *Phys. Rev. Lett.* **82**, 1522–1525 (1999).
44. S. Mazumdar, S. Ramasesha, RTC, D. K. Campbell, "Theory of Coexisting Charge and Spin-Density Waves in Organic Conductors," *Synth. Metals* **103**, 1843–1844 (1999).
45. RTC, A. W. Sandvik, D. K. Campbell, "Absence of Superconductivity in the 1D extended Hubbard Model with repulsive interactions," *Synth. Metals* **103**, 2060–2061 (1999).
46. RTC, A. W. Sandvik, D. K. Campbell, "Possible Exotic Phases in the One-Dimensional Extended Hubbard Model," *Phys. Rev. B* **59**, 4665–4679 (1999).

GRANTS
(LAST 5 YEARS)

1. “Numerical investigation of low-dimensional strongly correlated materials,” allocation of supercomputer time at NSF XSEDE, award TG-DMR190068, 1,039,441 hours at the Pittsburgh Supercomputer Center (estimated value \$24,063), 10/01/2019–09/30/2020.
2. “Strongly correlated physics of quarter-filled materials,” startup allocation of supercomputer time at NSF XSEDE award, TG-DMR190052 (estimated value \$2,349), 06/03/2019–06/02/2020.
3. “Theory of unconventional superconductivity in the 1/4-filled band correlated-electron superconductors,” Department of Energy (DOE-BES) 09/01/15–08/31/17. \$150,000, RTC one of two PI’s.
4. “Theory of layered organic and inorganic materials with charge-spin frustration,” Department of Energy (DOE-BES) 09/01/12–08/31/15. \$450,000 (3 years), RTC one of two PI’s.
5. “Networked joint centre on Theoretical Studies of the correlated electronic structure of graphene”, Indo-US Science and Technology Forum, 07/2013-01/2016, \$62,300, for travel and collaboration between US and Indian researchers, RTC one of 4 PI’s.
6. “Simulation of layered materials with charge-spin frustration,” National Energy Research Scientific Computing Center (NERSC), 1,250,000 Cray XT4-equivalent hours of CPU time, 01/13/2015–01/11/2016.
7. “Simulation of layered materials with charge-spin frustration,” National Energy Research Scientific Computing Center (NERSC), 3,800,000 Cray XT4-equivalent hours of CPU time, 01/14/2014–01/12/2015.
8. “Simulation of layered materials with charge-spin frustration,” National Energy Research Scientific Computing Center (NERSC), 450,000 Cray XT4-equivalent hours of CPU time, 09/25/2012–01/13/2014.

Conference Presentations (last 2 years)

1. RTC, “Optimized multi-determinant trial wavefunctions for Constrained Path Monte Carlo,” 2019 APS March Meeting, March 5, Boston, MA.
2. RTC, “Correlated model calculations of β phase organic superconductors”, 2017 APS March Meeting, March 14, 2017, New Orleans, LA.

TEACHING
EXPERIENCE

Mississippi State University

Undergraduate/Service Level:

1. PH2213: Physics I, Mechanics
2. PH2223: Physics II, Electricity and Magnetism

Graduate/advanced Undergraduate Level:

1. PH4413/6413: Thermal Physics
2. PH4433/6433: Computational Physics. New class created by RTC.
3. PH4813/6813: Solid State Physics
4. PH8213: Graduate Mechanics
5. PH8743: Graduate Quantum Mechanics I
6. PH8753: Graduate Quantum Mechanics II

SERVICE ACTIVITIES (SELECTED) Referee: Physical Review Letters, Physical Review B, Physics Reports, European Physical Journal B, Journal of Physical Chemistry, Journal of Physics: Condensed Matter, NSF Division of Materials Research, Department of Energy, Cambridge University Press, Crystals, Louisiana Board of Regents.

Undergraduate coordinator and adviser, MSU Dept. of Physics & Astronomy. Aug 2010 – present. Principal adviser for approximately 40 undergraduate majors; chair undergraduate program committee.

Undergraduate coordinator and adviser, MSU College of Arts & Sciences BS in General Science degree. January 2012 – present.

Chair, Tenure and Promotion Committee, MSU Department of Physics & Astronomy, 2015-2017.

Member, MSU Honors Faculty.

Member, MSU Materials Working Group.

Member, MSU Center for Computational Sciences, MSU High Performance Computing Collaboratory (HPC²).

Book reviews:

1. “Review of ‘A First Course in Scientific Computing: Symbolic, Graphic, and Numeric Modeling’ ”, book review by R. T. Clay, *Am. J. Phys.* **74**, 653–655 (2006).
2. “A system Dynamics Approach to Teaching Computational Science—Introduction to Computational Science: Modeling and Simulation for the Sciences and Computational Recipes,” book review by R. T. Clay, *Computing in Science and Engineering* **10**, 85–86 (2008).

STUDENTS SUPERVISED

1. Dipayan Roy: MS Physics May 2019, current Ph.D. student
2. Dr. Wasanthi De Silva: MS Physics December 2015, Ph.D. December 2016; University of Sri Jayewardenepura, Sri Lanka.
3. A. Bryan Ward: MS Physics May 2015; U.S. Army Engineer Research and Development Center, Vicksburg, MS.
4. Dr. Saurabh Dayal: MS Physics 2008, Ph.D. August 2012; Intel Corp, Hillsboro, OR.
5. Dr. Jeong-Pil Song: Ph.D. December 2011; post-doc University of Arizona.
6. Dr. Rahul P. Hardikar: MS Physics 2005, Ph.D. December 2007; post-doc IISER Pune, India.