REBECCA FLINT

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Education

Ph.D., Physics — 2004 - present
Rutgers University, New Brunswick, NJ
Anticipated PhD date: July 2009

B. Sc. with Honors, Physics — 2000 - 2004
California Institute of Technology, Pasadena, CA

Research Experiences

Ph.D. research, Rutgers University — 2006 - present
Thesis supervisor: Piers Coleman
Development of symplectic-N technique and application to problems in frustrated magnetism and superconductivity
(see attached abstract)

Summer Undergraduate Research Fellowship(SURF), Caltech — Summer 2003
Supervisors: John Preskill and Sougato Bose
Quantum communication through spin chains of various geometries

Summer Undergraduate Research Fellowship(SURF), Caltech — Summer 2002
Supervisor: Chris Leger(JPL)
Application of genetic algorithms to rover navigation systems

Publications

1. Rebecca Flint, M. Dzero, and P. Coleman, *Heavy Electrons and the symplectic symmetry of spin*, Nature Physics **4**, 643 - 648 (2008).

2. Rebecca Flint and P. Coleman, *Symplectic N and time reversal in frustrated magnetism*, Phys. Rev. B **79**, 014424(2009).

3. R. Flint, H.-T. Yi, P. Chandra, S.-W. Cheong and V. Kiryukhin, *Magnetization and Spin State Crossover in Multiferroic* Ca_3CoMnO_3, arXiv:0909.4773(2009).

4. Rebecca Flint and P. Coleman, *A Hybrid Model of Superconductivity in* $CeMIn_5(M = Ir,Co,Rh)$, (in preparation) (2009).

Presentations

APS March Meeting Contributed Talk — March 2009

Interplay of Composite Pairs and Magnetism in Heavy Fermion Superconductors

APS March Meeting Contributed Talk — March 2008

Two Channel Kondo Effect and Superconductivity in Pu and Np Compounds

Poster presented at ICAM-I2CAM Cargese Summer Workshop — July 2009

Poster presented at Metro-Gotham Conference — April 2009

Poster presented at Boulder Summer School: Strongly Correlated Electrons — July 2008

Poster presented at Gordon Research Conference: Correlated Electron Systems — June 2008

Poster presented at ICAM-FAPERJ Brazil Spring School — March 2007

Activities

Metro-Gotham Condensed Matter Conference — April 2009

Member of student organizing commmittee, designed conference program.

Graduate Student Condensed Matter Journal Club: Organizer — 2006 - 2008

Organized weekly meetings where students presented papers or pedagogical talks.

Directed Reading Project: — Fall 2007

Supervised undergraduate's reading on path integrals in quantum field theory.

Directed Reading Project: — Spring 2006

Supervised undergraduate's reading on Landau-Ginzburg and superconductivity.

Recitation Instructor(Rutgers University): Physics for the Sciences — 2005-2006

Other Skills

Programming experience in Mathematica, Matlab, Python, and C++. Recently, I developed routines to solve mean field equations, involving numerical integration over the Brillouin zone and numerical root-finding in a multi-dimensional space, searching for both second and first order phase transitions, using Python's SciPy package.

Thesis Abstract: Symplectic-N in strongly correlated materials
Advisor: Piers Coleman

Strong correlations give rise to emergent phenomena from spin liquids to unconventional superconductors to quantum criticality, provide both exciting possibilities and unique challenges to theorists as they sit at the intersection of kinetic and potential energy scales, where traditional, perturbative many body techniques fail. One method that has had some success here is large N theory, which generalizes the number of components of the electron spin from 2 to N, providing an artificial perturbation expansion about a strongly correlated state which, if chosen properly, captures the essential physics. Large N has been heavily used in both the Kondo lattice and in frustrated magnetism, where $SU(2N)$ is the traditional generalization of the electron spin group, $SU(2)$. In chosing the large N group, we chose which symmetries to preserve and which to keep. With Piers Coleman and Maxim Dzero, we have shown that $SU(2N)$ inadvertently loses the time inversion and charge conjugation properties of $SU(2)$; while some generators invert under time reversal like spins, $\vec{S} \rightarrow -\vec{S}$, and remain neutral under charge conjugation, the others behave more like electric dipoles: neutral under time reversal and flipped by charge conjugation. To treat phenomena like frustrated magnetism and superconductivity, which relies on the formation of Cooper pairs, we must restrict ourselves to the subgroup of spin-like generators, $SP(2N)$, a large N limit we call symplectic-N. This limit differs from the $SP(2N)$ limit introduced by Sachdev and Read, which breaks the $SU(2N)$ symmetry of the Hamiltonian down to $SP(2N)$ in that the interaction Hamiltonian is constricted solely from symplectic spins. In this thesis, I have studied the symplectic-N limits of several models:

- The Heisenberg model, where the symplectic-N limit treats ferro- and antiferromagnetic correlations simultaneously, exacting an energy cost for frustrating antiferromagnetic bonds. As an example, we treated the two dimensional $J_1 - J_2$ model, where the symplectic-N phase diagram improves over previous large N treatments both at zero and finite temperatures(Flint and Coleman, PRB 2009).

- In the two channel Kondo lattice model, where the symplectic-N limit treats not only the Kondo hybridization in the strongest channel, but also the superconductivity that develops cooperatively between the channels as resonant Andreev scattering off the local moments. The superconducting gap inherits its symmetry from the crystal fields of the underlying Kondo channels, which when spin-orbit coupled as in heavy fermion superconductors like $PuCoGa_5$ or $NpPd_5Al_2$ leads to d- or g-wave gaps, depending on the crystal fields(Flint,Coleman and Dzero, Nat. Phys. 2008). In materials with nearby magnetism, like $CeCoIn_5$, the d-wave superconductivity cooperates with the magnetically mediated superconductivity to enhance the overall transition temperature(Flint and Coleman, in preparation).

- The symplectic-N Hubbard operators are the large N generalization of the $SU(2)$ slave bosons introduced by Wen and Lee to treat the $t-J$ model, and can be used to construct the symplectic Anderson or $t-J$ models, which we studied with an eye towards the cuprate high temperature superconductors(unpublished).