LSU College of Science
Department of Physics & Astronomy

WEEKLY CALENDAR

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202 NICHOLSON HALL
Louisiana State University
Baton Rouge, Louisiana 70803-4001

WEEKLY CALENDAR

October 20 - 24, 2014

DEPARTMENTAL COLLOQUIUM

"The Impact of Binary Stars on Our Understanding of Supernova Progenitors"

3:30 PM October 23, 2014
109 Nicholson Hall

Ori Fox
University of Berkeley

Host: Jeffrey Clayton

• Refreshments served at 3:10 PM in 232 (Library) Nicholson Hall •

Despite the robust empirical supernova (SN) classification scheme in place, the underlying progenitor systems remain ambiguous for many subclasses. The most straightforward constraint relies on a detection of the progenitor star in high-resolution pre-explosion images. Such a direct identification is typically not feasible, however, even with modern telescopes such as Hubble. Instead, astronomers are forced to rely on supernova "forensics." I will begin the talk with a review of the limited number of direct progenitor detections already made, followed by a discussion of the indirect methods for constraining supernova progenitors that have never been seen. Although progenitor discussions have historically considered mostly single star systems, I will focus a significant portion of the discussion on the impact binary stars may have on our understanding of these results.

LA-SiGMA
Louisiana Alliance for Simulation-Guided Materials Applications

Fall Seminar

"Exact Results on Itinerant Ferromagnetism in Multi-orbital Systems on Square and Cubic Lattices"

Congjun Wi
University of California, San Diego

3:00pm - 4:00pm, Wednesday, October 22, 2014
600 Lindy Boggs Building, Tulane University

LA-SiGMA

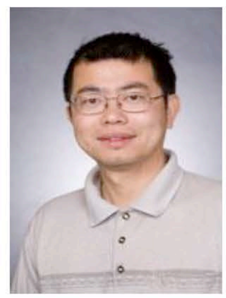
Louisiana Alliance for Simulation-Guided Materials Applications

Fall Seminar
3:00pm - 4:00pm, Wednesday, October 22, 2014
600 Lindy Boggs Building, Tulane University

Exact Results on Itinerant Ferromagnetism in Multi-orbital Systems on Square and Cubic Lattices

By

Congjun Wu
University of California, San Diego



Itinerant ferromagnetism (FM) is one of the major challenges of condensed matter physics. FM is not only a strong-correlation phenomenon but also a highly non-perturbative problem. Even at U=\infinity, FM is not guaranteed. For example, the Lieb-Mattis theorem proved that itinerant electrons with the nearest neighboring hopping in 1D can never be FM no matter how strong interaction is. Exact theorems are, therefore, indispensable for understanding the mechanism of FM. Previously known examples of FM in 2D and 3D usually fall into one of the two categories: the 'Nagaoka FM' as a result of coherent hopping of a single hole in lattices under U=\infinity, or, the 'flat-band FM' on line graphs, like the Kagome lattice, where zero penalty from kinetic energy greatly assists the development of FM.

In this talk, we present our study on itinerant FM in multiorbital Hubbard models in certain two-dimensional square and three-dimensional cubic lattices. In the strong coupling limit where doubly occupied orbitals are prohibited, we prove that the fully spin-polarized states are the unique ground states, apart from the trivial spin degeneracies. Compared to the Nagaoka FM, our theorems apply to a large region of filling factors, and thus establish a stable thermodynamic phase of itinerant FM. Possible applications to p-orbital bands with ultracold fermions in optical lattices, and electronic 3d-orbital bands in transition-metal oxides such as the $SrTiO_3/LaAlO_3$ interfaces, are discussed. The ferromagnetic phases established by this theorem is free of the quantum Monte-Carlo sign problem, and thus a lot of open problems of thermodynamic properties of itinerant ferromagnetism can be addressed at a high numerical accuracy.

References:

1. *Yi Li, E. H. Lieb, Congjun Wu, "Exact Results on Itinerant Ferromagnetism in Multi-orbital Systems on Square and Cubic Lattices", Phys. Rev. Lett. 112, 217201 (2014).*

2. *Shenglong Xu, Yi Li, Congjun Wu, "Sign problem free QMC simulation on thermodynamic properties of itinerant ferromagnetism," in preparation.*

Biography:

Congjun Wu received his Ph.D. in physics from Stanford University in 2005, and did his postdoctoral research at the Kavli Institute for Theoretical Physics, University of California, Santa Barbara, from 2005 to 2007. He became an assistant professor in the Department of Physics at the University of California, San Diego (UCSD) in 2007, and an associate professor at UCSD in 2011. His research interests include quantum magnetism, superconductivity, orbital physics, and topological states in condensed-matter and cold-atom systems.

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