武汉物数所理论交叉学术交流系列报告

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

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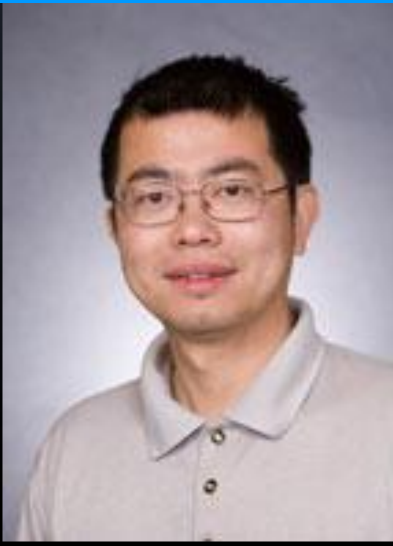
频标楼4楼报告厅

About the speaker:



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.

Abstract:

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 3*d*-orbital bands in transition-metal oxides, are discussed.

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