PHYS 600 - Theory of Quantum Magnetism Spring, 2016

Meets: 1:00pm - 2:15pm, TTh, FON 412

Instructor: Prof. Qimiao Si (BRK 307,× 5204, qmsi@rice.edu)

TA: Chia-Chuan Liu

Grades: Homework problems 40%; class presentations 10%; term paper 50% (30% substance, 10% writing, 10% presentation).

Textbooks:

* *Classnotes*
* *Interacting Electrons and Quantum Magnetism*, by A. Auerbach (recommended)
* *Electron Correlation and Magnetism*, by Patrick Fazekas (recommended)
* *The Kondo Problem to Heavy Fermions*, by A. Hewson (recommended)
* The list of additional recommended books can be found in the next page.

General:

1) This course is primarily designed for graduate students. It is assumed that the students have taken either graduate level quantum mechanics, or many-body theory, or quantum field theory.
2) It will be a survey course. You will be asked to present some designated materials in class.

Disability based accommodations:

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities should also contact Disability Support Services in the Ley Student Center.

Course Outline: The following is a tentative list of topics we intend to cover. We will tailor the list as we go along.

1. Origin and types of magnetism
2. Ising model and mean field theory
3. Quantum Heisenberg models

3a. Ground states

3b. Spin waves

4. Quantum non-linear sigma models

5. Itinerant magnetism

6. Kondo effect and heavy fermions

7. Mott transition

8. Quantum spin liquids

Additional recommended books:

* *Solid State Physics*, by N. W. Ashcroft and N. D. Mermin (For Sec. 1.)

* *Field Theories of Condensed Matter Systems*, by E. Fradkin

* *Quantum Phase Transitions*, by S. Sachdev

* *Condensed Matter Field Theory*, by A. Altland and B. Simons

* *Quantum field theory of many-body systems*, by X-G Wen

* *Advanced Solid State Physics*, by P. Phillips

* *Quantum Many-Particle Systems*, by J. W. Negele & H. Orland (especially path integrals for many-body systems)

* *Scaling and Renormalization in Statistical Physics*, by J. Cardy (introductory book on phase transitions and RG)