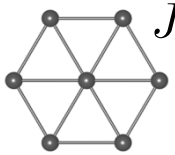
Mourigal Lab Research: Quantum Magnetism

Idea

magnetic material

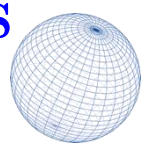
$\Leftrightarrow$ $\mathcal{H} = \sum_{(ij)} \hat{\mathbf{S}}_i J_{ij} \hat{\mathbf{S}}_j$ $\Leftrightarrow$

Heisenberg model



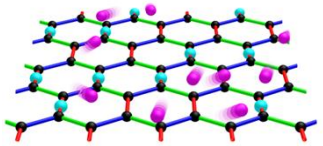
lattice-space

$\otimes$



spin-space

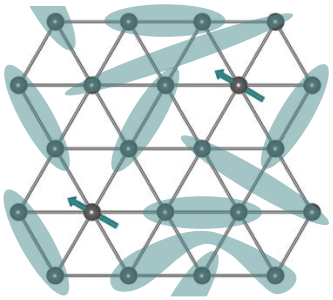
$\Leftrightarrow$



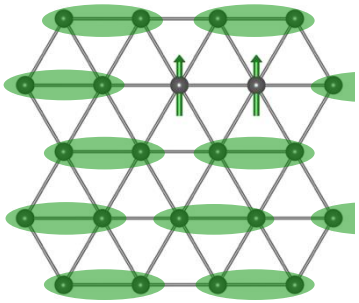
emergent quantum behavior

Challenge

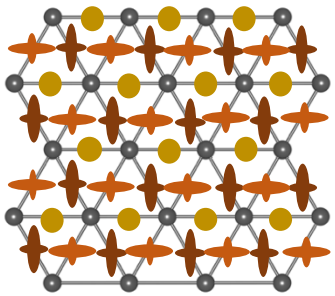
topological order — entanglement — local order — disorder



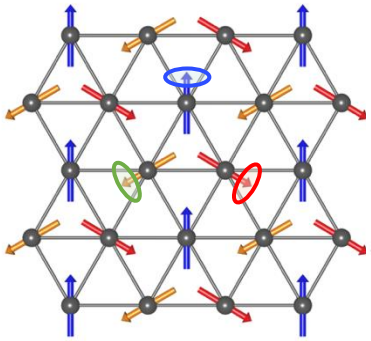
Quantum spin liquid



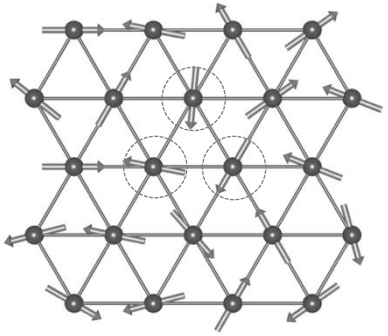
Quantum paramagnet



Quadrupolar order

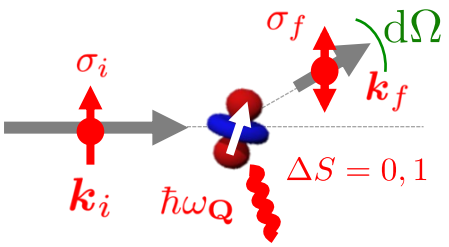


Dipolar order

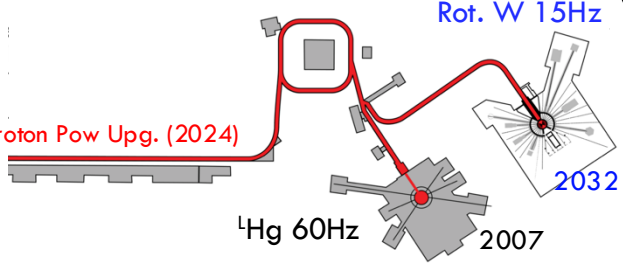


Paramagnet

Approach

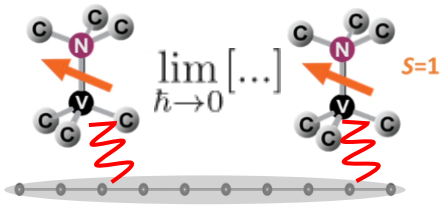


Inelastic neutron scattering



ORNL Spallation Neutron Source

Applications?



Transduction of quantum information

Doctoral Thesis

Course Information

- **Instructor:** Martin Mourigal (mourigal@gatech.edu)
- **Course Prefix and Number:** PHYS 9000 MM
- **Term:** Summer 2026

Course Description

This course provides academic credit for independent thesis research conducted under the supervision of a Georgia Tech faculty advisor. The course does not involve regular class meetings, assignments, or examinations. The scope and direction of research are determined by the student in consultation with the thesis advisor, consistent with the requirements of the degree program.

Course Learning Outcomes

By enrolling in this course, students will:

1. Engage in independent research under faculty supervision.
2. Gain experience in formulating research questions and applying methods appropriate to their discipline.
3. Communicate research activity through interactions with their thesis advisor and, as applicable, their Thesis Advisory Committee.

Required Course Materials

No textbooks or materials are required. Resources for research are determined in consultation with the thesis advisor.

Grading Policy

This course is graded on a **Satisfactory (S) / Unsatisfactory (U)** basis.

- A grade of **Satisfactory (S)** indicates that the student has made acceptable progress in their research toward degree completion, consistent with the number of thesis credit hours for which the student is enrolled for the semester.
- A grade of **Unsatisfactory (U)** indicates that the student did not meet the expectations for satisfactory performance during the term.

Attendance Policy

This course does not include scheduled class meetings. Students conduct independent research under the supervision of a thesis advisor. The frequency and format of student–advisor contact are determined by mutual agreement.

Academic and Research Honesty/Integrity Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the Student Code of Conduct and the Academic Honor Code, especially Appendix A: Graduate Addendum to the Academic Honor Code.

Students are expected to perform research in an ethical and responsible manner. All Doctoral and Master's Thesis students are required to take the Responsible Conduct of Research training, and it is expected that students abide by the principles taught in that training while performing research for this thesis course.

Allegations of scientific or scholarly misconduct are handled in accordance with the procedures outlined by the Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct.

Core IMPACTS

Not applicable.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Expectations of Advisors and Advisees

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Expectations of Advisors and Advisees articulates some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.