Quantum Many-body Physics
Fall 2023 PHYS 3707

Lecture: Tuesday/Thursday 3:00pm—4:15pm
Instructor: Roger Mong
Email: rmong@pitt.edu
Office Hours: Monday 1:00pm—2:00pm (Allen 214)
                 Friday 11am—11:30am (Allen 214)
                   & **by appointment**

References
   Assa Auerbach, "Interacting Electrons and Quantum Magnetism"
   Fetter and Walecka, "Quantum Theory of Many-Particle Systems"
   Piers Coleman, "Introduction to Many-Body Physics"
   Yoshio Kuramoto, " Quantum Many-Body Physics: A Perspective on Strong Correlations"

Course Description
This course will cover various topics in quantum many-body physics.
Topics include:
   Many-body Hilbert space, Second-quantization
   Ferromagnetism and Antiferromagnetism
   Spontaneous symmetry breaking, Goldstone bosons
   Various quantum models, for example: Hubbard model, XXZ/Heisenberg model, Ising model,
   Numerical techniques: Exact diagonalization, Matrix product states, and DMRG
   Mean field theory
   Superconductivity

Grading
   40%   Homework
   20%   Class participation
   40%   Class project + presentation

Homework Policy
Homework are due a week after being posted/handed out. Homework must be clearly written out and presented in an organized manner—no credit will be given out if the solutions are difficult to read! Students must contact instructor regarding **late homework** prior to the due date. Students may discuss homework problems with each other, but homework solutions must be written individually. If students do work together, they must **acknowledge** each other on their homework.

Late homework may be accepted for partial credit. Homework will not be accepted after the solutions have been posted.

Class Project
The project involving (1) choosing a research paper with a calculation component, (2) writing a pedagogical note on the foundations **of the calculations** (related to quantum many-body), and (3) giving a short presentation on motivation, results, and impact **of the research paper**.

Exams
There will no exams.