

DEPARTMENT OF PHYSICS
ART AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 02/25/2022

PROJECT TITLE: Phase Diagram of Kondo Lattices

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Project Description

Condensed matter physics is the study of the interesting behavior that solid materials exhibit as a result of quantum dynamics of their electrons. The electrons in most ordinary materials can be treated as independent particles. As a result, each electron has its own Hilbert space. Systems in which the electrons strongly interact with each other, are known as strongly correlated electronic systems. These systems are notoriously difficult to understand, because as opposed to weakly interacting systems, the Hilbert space does not factor out into a product of smaller Hilbert spaces. While there are many experiments available on these materials, only an approximate theoretical understanding is currently available.

Certain class of quantum materials, known as heavy-fermions, belong to this family of strongly correlated electronic systems. They are theoretically modeled by the so-called Kondo Lattice model. The goal of the project is to study this problem in the large- N limit, where N is the size of $SU(2)$ spin. The undergraduate student will get trained on 2nd quantization, Green's functions, many-body physics and how to use an available program, known as heavy-fermion solver, in order to simulate Kondo lattices and obtain their phase diagram as a function of temperature and other tuning parameters.

This is a challenging project and requires a level of desire, determination and discipline. The student should be proactive in research and proficient in undergraduate quantum mechanics and mathematics.