PHYSICS
ART AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE WOMEN

FOR APPLICATION YEAR: 2021

PROJECT TITLE: <u>Electronic spectrum of channel Skyrmions in a Kondo insulator</u>

Yashar Komijani
College of Arts and Sciences
Department of Physics
425 Geophysics Department
komijani@uc.edu

Project Description

This project is in the area of theoretical condensed matter physics.

The goal of the project is to study the interior of topological defects in the channel orientation of a channel magnet. Channel-magnets appear as the low-energy phases of certain solid-state systems, called two-channel Kondo lattices. The defects in these channel magnets might have applications in realizing topologically protected qubits for quantum computation. Due to coupling to conduction electrons, these defects can act as trapping potentials that are able to confine electrons. In this project we want to compute the electronic spectrum of a ``skyrmion'' defect using a combination of numerical and analytical approaches. The problem can be reduced to some versions of a particle-in-a-box solution of the Schrodinger equation.

The WISE students are expected to be familiar with quantum mechanics and solutions of the Schrodinger equation. They should have interest and aptitude for computer programming and simulations.

Within this project the students will be exposed to key concepts like Kondo effect, Kondo lattices and topological defects. They will be trained to setup a numerical description of the Schrodinger equation in MATLAB and solve for the solution. The training will be done partially over zoom and partially in person, Covid-permitting. At the end of this project the students will acquire a grasp of the key concepts and get experienced in using Mathematical software to solve physics problems and can potentially contribute to a cutting edge research at the border of condensed matter physics and quantum computation. For more information on the physics, please see https://arxiv.org/abs/1911.13129.