DEPARTMENT OF PHYSICS
COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 03/01/2023

PROJECT TITLE: Neutrino Oscillation Research

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Project Description

The NOvA and DUNE experiments are both designed to study how neutrinos oscillate - that is, how they change type as they travel. This process has the potential to shed light on physical processes that are not currently understood. In particular, Prof. Aurisano is involved in searches for new neutrino types (sterile neutrinos) and inconsistencies between the number of neutrinos originally produced and the number detected (non-unitarity).

As part of this research group, students will have an opportunity students would have the option of working on either the NOvA or DUNE experiments. NOvA is a currently running experiment using a neutrino beam produced at Fermilab, near Chicago, that is detected in Northern Minnesota. Potential NOvA topics involve studying potential improvements to the NOvA simulation software used to predict what will be observed in the detector or exploring options to use new types of machine learning algorithms for identifying and understanding neutrino interactions. DUNE is a next generation neutrino experiment that is currently under construction. A student working on DUNE would have the opportunity to help develop a machine learning algorithm for identifying tau neutrinos. Tau neutrinos are the least well studied particle in our current best model of particle physics, and DUNE will have the potential to dramatically improve our understanding.

Programming experience is helpful, but not necessary. Depending on the project, the student will be trained in C++ and the ROOT analysis framework or in the PyTorch machine learning framework. Students must be enthusiastic and willing to devote time to learning essential software tools, computational techniques, and background on the type of physics being studied. No specific physics course are required.