

Faculty: Mark Hertzberg, Assistant Professor, Physics and Astronomy, Arts & Sciences

Project Locations: Tokyo, Japan (with the possibility of visiting other cities in Japan as needed)

Dates: June - end of July 2020

Project Title: Behavior of Axion Dark Matter

Project Details: The project will involve the investigation of a model of dark matter, which is known to dominate the mass of galaxies in the universe. In particular, the project will study the axion model, which leads to novel new predictions to compare to observations. Under some circumstances, axion dark matter can lead to coherent bursts of electromagnetic radiation at different places in the galaxy. The project will involve computing the rate of these bursts and to examine and constrain this phenomenon with existing galactic data. The international impact is very significant, as the nature and behavior of dark matter is a pressing problem at the core of fundamental physics and astronomy, and is a major research subject around the world. In particular, this is one of the primary interests at several institutions in Japan, including some of the faculty's colleagues, which is a country that would be ideal to host the student. Several pieces of progress have already been made on this subject. The faculty member has already written several papers laying the ground work for this project. Furthermore, the faculty member has already began collaboration with colleagues in Japan, and it would be the ideal place to continue this important work.

Tasks and Responsibilities of Research Assistant:

1. Learn background material on dark matter and axions
2. Become familiar with numerical code to solve the appropriate partial differential equations
3. Set up code that can solve for single axion clumps
4. Write a new numerical code that can evolve pairs of axion clumps and compute their rate of merging
5. Read the literature on including electromagnetic radiation into the process
6. Compute the rate of electromagnetic radiation emission
7. Determine the flux of radiation reaching the earth from merges in the galaxy
8. Summarize all results into a research paper, in collaboration with Japanese colleagues and faculty member

Qualifications:

1. Some background in computational work, or willingness to learn
2. Some background in calculus and differential equations is desirable, or willingness to learn
3. Interest in research, especially cosmology, astrophysics, particle physics

Housing in Japan:

The International House of Tokyo Tech provides accommodation to international researchers to promote international exchange in education and research. The International House is a non-smoking residence for researchers from abroad. The IH office staff, who speak Japanese and English, are able to help with information, procedures, and life at the IH. Similar accommodations will be arranged in other cities if needed.

