Project Title:
Magnetic Reconnection and Plasma Acceleration

Project Reference Code:
UAH-Liang

Host Facility:
The University of Alabama in Huntsville

Host Facility Location:
301 Sparkman Dr.
Huntsville, AL 35899
https://www.uah.edu/

Project Description:
Magnetic reconnection is a fundamental plasma physical process. During magnetic reconnection, two flows of plasmas with anti-parallel magnetic fields are pushed together and form a thin current sheet. As plasma continue flowing towards the current sheet, magnetic field lines break and reconnect in a lower energy state and plasmas are accelerated and released as two symmetric outflow jets. Therefore, reconnection is a process where the magnetic field topology is dramatically re-arranged and the magnetic energy is violently released to high speed flows and thermal energy of plasma.

Magnetic reconnection is believed to be ubiquitous in the universe. It heats plasma at the solar surface in the form of solar flare and coronal mass ejections (CMEs). For magnetized planets like Earth, it occurs where the interplanetary magnetic field interacts with the magnetosphere, i.e., the magnetopause, and allows the solar wind plasma to break into the magnetosphere. It also occurs inside the long tail of the magnetosphere and triggers a series of disturbed geomagnetic activities such as strong geomagnetic storms and enlightened aurora. Recent studies further discovered that reconnection occurs within the solar wind and that it is one important mechanism that dissipates turbulent magnetic energy.

This project is designed to study magnetic reconnection and associated plasma acceleration by performing fully kinetic numerical simulations. The simulation will use a Particle-in-Cell (PIC) numerical code. The student will learn the elementary theories about magnetic reconnection and run an open-source PIC code on cluster computers. The student will analyze electromagnetic fields, the energy partitions, and particle acceleration mechanisms associated with reconnection, and will compare the simulation output with satellite observations. Through this project, the student will acquire skills on performing cluster computing, data analysis and visualization based on software such as Interactive Data Language (IDL), and usage of satellite data, e.g., Cluster or Magnetospheric Multiscale (MMS) mission.

Disciplines:
Physics, Math, Computer Science, Space Science

Is U.S. citizenship required to participate in this project?
No

Internship Location and COVID-19 related Backup Plan
The internship location is the University of Alabama in Huntsville. Due to the COVID-19 pandemic, we are preparing multiple options to ensure that the internship will take place. We are looking at least at an in-person, hybrid, and fully virtual option. For any in-person component we will ensure that there is adequate physical spacing between workspaces, following all university cleaning protocols.

Name(s) of Mentor(s) and contact information:
Haoming Liang (haoming.liang@mail.wvu.edu)
Gary Zank (gpz0001@uah.edu)

Internship Coordinator/ HR manager:
Dana Waller (dsw0012@uah.edu)

The name and contact information of personnel at the host facility is provided for further assistance with questions regarding the host facility or the project.

Interns will not enter into an employee/employer relationship with the host facility. No commitment with regard to later employment is implied or should be inferred.