Project Title:
Investigation of Heating and Magnetic Reconnection in the Weakly Ionized Solar Chromosphere

Project Reference Code:
UAH-Yalim

Host Facility:
The University of Alabama in Huntsville

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

Project Description:
The physics of the solar chromosphere is complex from both theoretical and modeling perspectives. The plasma temperature from the photosphere to the corona increases from ~5,000 K to ~1 million K over a distance of only ~10,000 km from the chromosphere and the transition region. Certain regions of the solar atmosphere have sufficiently low temperature and ionization rates to be considered as weakly ionized. In particular, this is true for the lower chromosphere. As a result, the Cowling resistivity which takes into account the presence and effects of neutrals in the chromospheric plasma becomes orders of magnitude greater than the Coulomb resistivity. Ohm's law therefore includes anisotropic dissipation of currents. This could increase the heating of the chromospheric plasma significantly as well as enhance the magnetic reconnection rate that could result in eruptive flare formations in the chromosphere. The coronal mass ejections (CMEs) associated with these flares could eventually reach the Earth and interact with the Earth's magnetic field to cause space weather disturbances. These space weather disturbances can have significant effects on both ground-based and space-borne technological systems.

In this project, the student will investigate chromospheric heating and magnetic reconnection resulting in flare formation in the chromosphere. To do this, he/she will calculate the Cowling resistivity distribution in the chromosphere. To calculate the Cowling resistivity, it is necessary to know the external magnetic field strength and to estimate the neutral fraction as a function of the bulk plasma density and temperature. The student will be provided with the magnetic field topology calculated by using the non-force-free field extrapolation technique based on magnetogram data from NASA's Solar Dynamics Observatory (SDO) mission, and the stratified density and temperature profiles from both semi-empirical atmosphere models and solar observations. He/she will repeat this analysis for a number of different active regions, which are magnetically active regions on the photosphere (i.e. solar surface). The project will also involve post-processing of solution data corresponding to numerical simulations and their comparison with related solar observational data. The student will learn how to use IDL programming language, and Vapor and Tecplot which are data visualization software.

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:
Mehmet Yalim (msy0002@uah.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.