



Regional Introduction to Plasma Processes



Project Title: Fast imaging of plasma instabilities and structures

Project Reference Code: Thakur-Auburn 2

Name of Project Leader: Saikat Chakraborty Thakur

Host Facility: Auburn University

Internship Location: Leach Science Center, Suite 2158

Host Facility Location: 380 Duncan Drive, Physics Department, Auburn University, Auburn, AL 36849

Project Description:

In this project we shall use a fast camera (up to 100,000 frames per second) to observe and investigate different kinds of plasma structures that form in various plasma devices at the Magnetized Plasma Research Laboratory (MPRL) situated in the Department of Physics at Auburn University (AU). In the Magnetized Dusty Plasma EXperiment (MDPX), we find structure formation at high enough magnetic fields. At low magnetic fields, the plasma seems uniform, but as we increase the magnetic field, the plasma starts to become nonuniform in space, which can be seen on the fast camera. The plasma structures go through several phases such as turbulence (looks similar to oil spills on water), quasi stable azimuthal modes (looks like petals of a flower), unstable spatiotemporally changing structures (structures moving in space and changing in time) etc. There are certain windows in rf power, neutral pressure, and magnetic fields where we find these very interesting and rich plasma phenomena. Fast imaging will be the tool to use to investigate and understand such novel phenomena. Structure formation is an important subject in several aspects of Nature such as star and planet formation, formation and motion of cyclones and tornadoes, sand dunes in deserts etc. Imaging techniques learnt in the project will be applicable to many other fields of research. We can also use the same fast camera to study plasma turbulence and plasma rotation in the 2 m long Auburn Linear EXperiment on Instability Studies (ALEXIS) device. No prior experience in plasma physics or fast imaging is necessary. We will learn all the necessary details during the project.

Disciplines: Physics, Mathematics, Engineering

Importance:

Structure formation is an important subject in several aspects of Nature such as star and planet formation, formation and motion of cyclones and tornadoes, sand dunes in deserts etc. When they are too fast to see with our own eyes, we need a faster framing camera (similar to trying to see the fluttering wings of a hummingbird or imaging a balloon bursting in real time). Fast imaging will be the tool to use to investigate and understand such novel phenomena. Imaging techniques learnt in the project will be applicable to many other fields of research, such as astrophysics, meteorology, satellite imaging analysis etc.

Requirements:

- **Preferred Major**
 - Physics, Mathematics, Engineering
- **Class work**
 - N/A



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- **Programming knowledge**
 - N/A
- **Software knowledge**
 - N/A
- **Other**
 - N/A

Biography:

Dr. Thakur grew up in the neighborhood of an industrial town in India, being the first one in a large extended family to pursue higher studies in any STEM field. He moved to one of the bigger cities, Kolkata, to finish his high school and bachelor's in physics. After finishing his master's in physics in India, he moved to the USA. He completed his PhD in experimental plasma physics from West Virginia University in 2010. He then joined the University of California at San Diego as a postdoctoral scholar and continued there as a research scientist. He joined Auburn University as a faculty in 2020, during the middle of the pandemic. As a research scientist, he has mentored more than 30 undergraduate students and 30 high school students in various research projects and most of them are pursuing a higher degree in a STEM field of their choice.

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

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Internship Coordinator/ HR manager: Saikat Chakraborty Thakur (szc0199@auburn.edu) and Mary Prater (mlp0077@auburn.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.