Project Title: Fast camera imaging techniques to study plasma instabilities and turbulence

Project Reference Code: Thakur-Auburn

Name of Project Leader: Saikat Chakraborty Thakur

Host Facility: Auburn University

Internship Location: Leach Science Center, Suite 2158

Host Facility Location: 380 Duncan Drive, Auburn, AL 36849

Project Description (roughly 300 words):
In this project we shall use multiple cameras (from 100 - 100,000 frames per second) to observe and investigate different kinds of plasma structures in the plasma devices at the Magnetized Plasma Research Laboratory (MPRL) at Auburn University (AU). In the Magnetized Dusty Plasma EXperiment (MDPX), at low magnetic fields the plasma seems uniform, but as we increase the magnetic field, the plasma starts to become nonuniform in space and time, 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, almost like radar images of clouds moving over a region) 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 used as a tool to investigate 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 another higher power RF plasma device called ALISSA, or in existing data from other experiments. 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 (understanding weather patterns), satellite imaging analysis, etc. The plasma physics and turbulence aspects behind the phenomena being studied can help the student pursue higher studies in any field of plasmas physics such as fusion, space physics, semiconductor manufacturing etc.

Requirements:

- Preferred Major
  - Physics, Mathematics, Engineering
- Class work
  - N/A
- Programming knowledge
  - N/A
- Software knowledge
  - N/A
- Other
  - N/A

Biography (roughly 100-150 words):
I 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. Later, I moved to our state capital city, Kolkata, to finish my high school and bachelor's in physics. After finishing my master's in physics in India, I moved to the USA for a PhD in experimental plasma physics from West Virginia University in 2010. Then I joined the University of California at San Diego as a postdoctoral scholar and continued there as a research scientist. I joined Auburn as a faculty in 2020, during the middle of the pandemic. So far, I have mentored more than 40 undergraduate students and 35 high school students in various research projects and most of them are pursuing a higher degree in a STEM field of their choice or are in the industry.

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

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