Summer 2024 – Undergraduate Research Placement in Plasma Physics

Imperial College London

AMPLIFI Prosperity Partnership

New Diagnostics for Magnetized Laser Plasma Experiments

Project type: **Experimental (analysis)**	Open to: **Undergraduates (years 2 & 3 preferred*)**
Location: **Blackett Laboratory, Imperial College London, SW7 2BW**	
Duration: **8-10 weeks** **(June-Sept period, dates flexible)**	Bursary: **approx. £400/week (TBC)** funded by EPSRC AMPLIFI Prosperity Partnership with First Light Fusion
Application deadline: **Weds 21st Feb 2024, 5 pm**	Contact: **Dr Ellie Tubman(e.r.tubman@ic.ac.uk)**

*Students must be enrolled in a degree program at the time of the placement (i.e. graduating 2025 or later). 4th year students accepted for 5-year degree programs.

Project description

Fusion is an ongoing effort worldwide to produce a 'clean' energy resource. There are several approaches to achieving net energy gain that are being utilised. Inertial confinement fusion (ICF) is a method of achieving fusion energy, typically using lasers to implode and heat the fuel. In the past couple of years exciting advances have been made in this field with the world first achievement of producing more energy out than put into the target at the National Ignition Facility (NIF), California USA. However, there are, and will be, further physics challenges that are ill-diagnosed and not yet understood. The need for understanding these questions as well as fundamental plasma physics has led to a wide breadth of experiments being performed on laser facilities across the world. One suggestion is that magnetic fields produced in laser-target interactions lead to diverting energy away from heating the fuel, but little has been done to address this question. This project offered at Imperial College London, working with Dr. Ellie Tubman, is investigating magnetic fields created under hohlraum-like conditions. Applications are welcomed from undergraduate students for the summer 2024.

We have conducted exciting, new experiments to give us insight into the dynamics of laser-plasma interactions and fields generated. Work undertaken in this project will be helping to analyse data and develop new diagnostics. Proton radiography is a technique used to measure the conditions, whereby protons are deflected when they pass through electromagnetic fields (from the Lorentz force). We can image the protons onto different mediums, such as imaging plates or film, and use various analysis techniques to extract the fields from the proton fluence. The analysis of experimental data will give us magnitudes and shapes of the fields created. The fields then can be modelled using simulations to match the experimental signatures. Alongside data analysis we are also evolving the setup of the proton diagnostics. We will be trialling new methods to improve the detection of protons onto imaging plates and writing analysis codes to quantify measurements. Prior experience in plasma physics is not necessary, but applicants should demonstrate experimental and technical experience and proficient in undergraduate level laboratory and data analysis techniques. To apply please send your CV and an accompanying cover letter

Further reading

http://www.imperial.ac.uk/urop
https://lasers.llnl.gov/about/how-nif-works

[1] Tubman et al., NIM 1060, March 2024 https://doi.org/10.1016/j.nima.2023.169027
[2] Tubman et al., Nat. Comms. 12, Jan 2021 https://doi.org/10.1038/s41467-020-20387-7
[3] Gatu Johnson et al., RSI 94 Feb 2023 https://doi.org/10.1063/5.0127438
[4] Campbell et al., PRL 125 Sep 2020 https://doi.org/10.1103/PhysRevLett.125.145001