Sponsored PhD in Computational Modelling of Compressible Multi-material Flow with Application to Energy Generation

An opportunity exists to undertake a PhD with the Matar Fluids Group in the Department of Chemical Engineering at Imperial College London. The successful student will contribute to the modelling and simulation of multi-material and multiphase high-energy density flows, with application to novel, inertially-confined, nuclear fusion schemes at First Light Fusion (FLF) Ltd. Fusion can provide a clean baseload power supply, which is inherently safer and more secure than fission power. There is an increasingly urgent need for such new technologies to act on climate change.

FLF is a focused and agile corporation researching energy generation by inertial confinement fusion. The company was spun out from the University of Oxford in June 2011 and is based near Oxford. Inertial confinement fusion for energy generation is a well-established research field and is being pursued in many laboratories worldwide, perhaps most notably in the US at the National Ignition Facility. FLF is exploring several alternative research directions that harness the same fundamental physics, with the prime focus being power generation. FLF's work to-date has included theoretical analysis, detailed numerical simulation using in-house HPC facilities, and experimental validation. This has allowed description of the accessible parameter space and led to a clear vision of the pathway to fusion.

Hydrodynamic material interface-tracking represents a challenging problem in terms of both accuracy and computational model robustness. Understanding the dynamics and mixing of materials is critical to the successful design of an inertial confinement fusion target, where high-energy densities also bring additional complexities to the computational fluid models. In general, it is difficult to obtain a detailed understanding of fusion target performance from experimental methods alone. There is therefore a heavy reliance on computational tools for predicting, understanding and extrapolating the parameter design space.

It is expected that the successful student will develop the current fluid interface-tracking capabilities of the Matar Fluids Group to include fluid compressibility using the OpenFOAM CFD code. An emphasis on improving the existing state-of-the-art in hydrodynamic methods that conserve mass, energy, and momentum across the interface, as well as the treatment of diffusive processes is anticipated. Code validation and verification will potentially be performed against FLFs in-house numerical tools and experiments, as well as other sources.

The student will receive support from the Matar Fluids Group, and will have access to its high-performance computing facilities in addition to those provided by Imperial College London. In return for PhD sponsorship, the successful candidate would be required, in the first instance, to join FLF's numerical physics team on a part-time basis, then full-time after successful completion of their PhD studies.

The PhD scholarship is available from October 1st 2019 and is open to all UK applicants. The scholarship covers both the tuition fees and an annual bursary, and its standard period is 42 months. The successful applicant is expected to have obtained (or be heading for) a First Class Honours degree at Master's level (or equivalent) in chemical engineering, another branch of engineering, or related physical science. The post is based in the Department of Chemical Engineering at Imperial College London (South Kensington Campus).

Informal enquiries about the post and the application process can be made to Prof. Omar Matar (o.matar@imperial.ac.uk) by including a motivation letter and CV.