**Department of Mechanical, Aerospace and Civil Engineering**

# Physics-Informed Data-Driven Modelling of Boiling Crises during Buoyancy Affected Flow in Pressurised Water Reactors

Applications are invited for a research studentship in the field of Computational Fluid Dynamics (CFD) simulation, leading to the award of a PhD degree. In this project you will apply high-fidelity two-phase Computational Fluid Dynamics (CFD) to simulate boiling phenomena in scenarios relevant to the design and operation of water-cooled nuclear reactors for propulsion and electricity generation applications. The post is supported by full bursary and tuition fees at the UKRI research student rate: https://www.ukri.org/what-we-offer/developing-people-and-skills/find-studentships-and-doctoral-training/get-a-studentship-to-fund-your-doctorate/

Once a water-cooled, Pressurised Water Reactor (PWR) is critical, it can be operated at an arbitrary high power and our ability to extract the desired amount of power from the reactor is limited by how efficiently, and safely, we can remove heat from the reactor core. PWRs are cooled by water in conditions close to, and, at some sections of the core, beyond the boiling point of water. The main requirement of such reactor designs is to avoid the breakdown in heat transfer performance, termed a "boiling crisis", that can occur when a solid surface becomes blanketed with vapour due to the onset of inordinate vapour generation events - or "Departure from Nucleate Boiling" (DNB) phenomena - typically triggered by merging or other interactions between bubbles generated at a solid surface during boiling.

In this project you will develop and demonstrate a framework to predict DNB at component level in industrially relevant scenarios. You will further develop a class of CFD methods that enable us to model the unsteady behaviour of the vapour-liquid interface via resolving it with small computational cells. You will apply such Interface Capturing CFD methods to model from first principles the interactions of a small population of bubbles at a solid surface. You will then use the methods of modern data science to derive closure models for three-dimensional component-scale “Eulerian-Eulerian” (EE) CFD modelling with the data arising from small-scale, physically-based Interface Capturing simulations. You will demonstrate the novel modelling framework on vertical flow boiling conditions with significant buoyancy effects to determine the limits of safe boiling heat transfer, and the likely parameters causing the onset of DNB phenomena.

You will be an enthusiastic and self-motivated person who meets the academic requirements for enrolment for the PhD degree at the University of Manchester. The successful candidate holds a MSc or equivalent degree in engineering, physics, applied mathematics or computer science.

For further details of the post contact giovanni.giustini@manchester.ac.uk. Interested applicants should send an up-to-date curriculum vitae to Dr Giovanni Giustini. For information on how to apply, go to: https://www.nuclear-energy-cdt.manchester.ac.uk/research/