



THE UNIVERSITY OF BRITISH COLUMBIA



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### **Funded PhD Position in modelling and simulation of cryogenic pool boiling**

Applications are requested for a **fully-funded** PhD position in computational fluid dynamics (CFD) applied to storage of cryogenic liquid fuels such as liquefied natural gas (LNG) and liquid hydrogen (LH<sub>2</sub>). To promote the use of liquid cryogenics as an alternative to conventional fuels in heavy trucking, shipping, and sustainable aviation, simulation tools for predicting cryogenic behavior in transport, storage, and spill are necessary. The current project is purposed with evaluating how pool boiling evolves throughout its nucleate, transition and film boiling regimes when spilled on various solid substrates. Cryogenic spills on such substrates lead to the dispersion of extremely cold, asphyxiating, and flammable fuel vapours. Establishing the boil-off rate and subsequently safety standards for transport vessels as well as liquefaction and storage facilities require the accurate simulation of pool boiling physics.

The successful applicant will participate in the development of an in-house lattice-Boltzmann (LB) solver, and its usage in computational studies of nucleation, phase change, and bubble morphology in pool boiling of liquid cryogenics. High-fidelity, mesoscale, direct-numerical simulations will be carried out on national high-performance computing resources to quantify the heat flux as a function of substrate thermo-physical properties and superheating, primarily in the nucleate-boiling regime, but subsequently in the transition and film-boiling regimes as well. The research objectives are

1. Formulate a nucleation and phase change model for cryogenic fluids; and
2. Develop and validate the in-house LB code for mesoscale modelling of cryogenic pool boiling; and
3. Conduct high-fidelity, massively-parallel simulations of various pool-boiling scenarios; and
4. Disseminate simulation results via academic journals, conferences and technology transfer activities with industrial partners.

The research will be supervised by Dr. [Joshua Brinkerhoff](#) at the [UBCO CFD Lab](#) in the [UBC Okanagan School of Engineering](#). The specific research activities will involve theoretical formulation of kinetic and thermodynamic models for cryogenic fluids, parallelization of the LB code with MPI and, if time permits acceleration on GPUs. The research will be a collaborative effort with a current PhD student who has worked on (1–3), and thus an eagerness to co-work is appreciated. Previous coursework or research experience with the LB method; thermodynamics; fluid dynamics—including complex, multiphase, phase-changing flows; C/C++ and parallel programming; and/or LB-simulations with proprietary or opensource code is preferred.

The position is open to students who have completed a Masters degree in mechanical, aerospace engineering, physics, applied mathematics, or a related discipline. Applicants with interests in the above are encouraged to apply.

This opportunity is available to Canadian citizens, permanent residents of Canada, and international applicants meeting the admission criteria for UBC Okanagan and the School of Engineering. It is expected that successful candidates will commence graduate studies from **May 1, 2023**, or as soon as possible thereafter.

Equity and diversity are essential to academic excellence. An open and diverse research team fosters the inclusion of voices that have been underrepresented or discouraged. Equity and diversity not only lead to a more fair and open society, but also improves the quality of the science and increases the opportunities to learn and grow from each other. Applications from members of groups that have been marginalized on any grounds enumerated under the B.C. Human Rights Code—including sex, sexual orientation, gender identity or expression, racialization, disability, political belief, religion, marital or family status, age, and/or Indigeneity—are especially encouraged to apply.

### **Application procedure**

Candidates are asked to submit:

- A cover letter describing their research interests, experience, and motivations for graduate study
- A detailed curriculum vitae highlighting their educational and professional achievements
- A list of three professional and/or academic references
- Unofficial transcripts from their Masters degree
- English test scores (if required). Applicants with degrees in a language other than English must have a minimum TOEFL score of 580 (PBT) or 92 (IBT) or IELTS minimum overall band of 6.5 (with nothing less than 6.0 per individual test)

Interested candidates should send the above documents and direct queries to Dr. Joshua Brinkerhoff ([joshua.brinkerhoff@ubc.ca](mailto:joshua.brinkerhoff@ubc.ca)). Additional information of Dr. Brinkerhoff's research is available from his research webpage: <https://cfdlab.ok.ubc.ca/>.

### **About UBCO CFD Lab**

The [UBCO CFD Lab](#) is a multidisciplinary team of research students, postdocs, and visiting collaborators engaging in CFD research in topics spanning wind energy, bioengineering, cryogenics, turbomachinery, and hydrogen systems—all with a focus on uncovering underlying physical mechanics via high-fidelity CFD simulations. The team has tremendous access to high-performance computing resources, giving team members unique opportunities to contribute to leading scientific challenges while conducting some of the largest-scale CFD simulations in Canada. The CFD Lab is characterized by team-work, collaboration, and exploration.

### **About UBC Okanagan**

UBC opened its Okanagan campus in 2005 as a bold new UBC presence in the interior of British Columbia, designed to deliver on the promise of a research-intensive institution purpose-built for the 21st century. UBC's Okanagan campus is home to over 10,000 undergraduate and graduate students, 630 faculty members and nine Faculties and Schools. With the campus rapidly emerging as a research powerhouse, UBC Okanagan students receive an outstanding education in a stimulating student-centric learning environment.

UBC's Okanagan campus is situated in Kelowna on the unceded lands of the Syilx (Okanagan) Peoples.