

## PhD position in Physics

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### Investigation of thermal convection in a liquid metal battery

Liquid metal batteries are considered as one of the most promising solutions for large-scale energy storage. These batteries differ from classical ones by their liquid-state electrodes. They consist of three stratified liquid layers: a molten salt (the electrolyte) sandwiched between two liquid metals (the electrodes). They are operated at very high temperature to keep the electrodes in a liquid state and are subjected to current-induced internal heating and magnetic fields.

Liquid metal batteries have advantages in terms of kinetics, durability and adaptability due to their liquid-state electrodes. But as fluid systems they can be subject to hydrodynamic instabilities which may limit their performance and even cause its short-circuit by the rupture of the electrolyte.

This PhD proposal focuses on the thermal convection in a liquid metal battery, especially in the electrolyte and in the upper liquid electrode. Indeed an electric current through the electrolyte can induce internal heating which is accompanied by a vertical temperature variation. The later induces an unstable density stratification in the upper layer of the electrolyte which leads to an internal thermal convection. Moreover application of the magnetic field to a liquid metal with a temperature difference will modify the conditions of the appearance of the thermal convection. The objective of the PhD thesis is to carry out an exhaustive investigation of the conditions of the appearance of the natural convection in the electrolyte depending of the diffusive properties of the electrolyte and the effect of the magnetic field on the thermal convection in the upper electrode. Linear stability analysis will be used to determine the critical parameters and then direct numerical simulations will be implemented to compute the heat transfer as a function of the control parameters.

The applicant should have a Master degree in Physics or Mechanical Engineering with a solid basis of Fluid Mechanics and Electromagnetism. In particular, skills in Numerical Simulations are suitable. The selected candidate will be hired by the CNRS-Normandie

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Laboratory: LOMC, UMR 6294, CNRS-Université du Havre, France

Starting date and duration : 01/10/2021, 36 months

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