

PhD in Computational Physics

Carleton University (Ottawa), Ecole Polytechnique de Montreal (Montreal), General Fusion (Vancouver)

Title: Hydrodynamics and MagnetoHydroDynamics simulations for Magnetized Target Fusion based nuclear reactor

Description & Objectives

It is largely recognized by the scientific and political community that controlled nuclear fusion is the best long-term means of meeting mankind's growing need for a clean, renewable and inexpensive energy source. The two main kinds of nuclear fusion devices are based on Magnetic Confinement Fusion (MCF), like the Tokamak design, and Inertial Confinement Fusion (ICF), like the NIF design using intense lasers. An improved understanding of plasma physics over the last 20 years and the huge technical difficulties in designing MCF and ICF reactors, has re-awoken the interest in several alternative reactor designs, in particular in those that capitalize on the increased stability of Field Reversed Configurations (FRC) with increased currents. In this vein, General Fusion, a company from Vancouver, has embarked since 2002 on a project of implementing a device based on Magnetic Target Fusion (MTF) first proposed in the 80s by researchers at the US Naval Weapons Research Lab. This approach is an intermediate approach between MCF (low plasma density, very strong magnetic fields, large confinement times) and ICF (high plasma density, very intense lasers, short confinement times).

The PhD student general overall objectives will be to numerically validate the chosen physical models of some essential physics within General Fusion's device thereby i) providing numerical proof-of-concept ii) reducing operating uncertainties and iii) optimizing reactor design. Specialized numerical codes, often classified, exist for the simulation of specific reactor designs (MCF or ICF) but not for MTF. The PhD student will then adapt existing High-Performance codes for Hydrodynamics, Plasma Physics (Magneto Hydrodynamics), namely Frontier [<http://frontier.ams.sunysb.edu/news/news.php>] and [<http://w3.pppl.gov/apdec-cemm/>], in order to address important questions about plasma instabilities during compression, Lawson's criterion, vortex collapses. Details on General Fusion's reactor can be found on [<http://www.generalfusion.com>].

Keywords: Hydrodynamics, Rayleigh-Taylor Instabilities, Plasma Physics, Magneto Hydrodynamics, Numerical Methods, High Performance Computing.

Requirements: A MSc in one of the following areas is required: Applied Mathematics, Physics, Mechanical or Electrical Engineering. Applicants should have a strong background in Scientific Computing ideally applied to Fluid Dynamics and/or Plasma Physics.

Supervision: This position will be funded by MITACS and General Fusion and will part of a MITACS Cluster project. It will be co-supervised by Marc Laforest (Ecole Polytechnique de Montreal), Emmanuel Lorin (Carleton University), and Frederic Sirois (Ecole Polytechnique de Montreal). The student could be registered at Carleton University or Ecole Polytechnique de Montreal and will have to apply for admission at one of these 2 institutions. Frequent visits in Vancouver are expected.

Starting date: January 2010

Salary: \$24,000 per year.

Applications: Interested applicants should submit a cover sheet, a resume with a publication list, a description of current research interests, and two letters of recommendation, by email to Marc Laforest, Emmanuel Lorin, and Frederic Sirois:

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