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JOB OFFER – POST-DOCTORAL
QUANTUM COMPUTING for LATTICE BOLTZMANN METHOD

OFFER INFORMATION

Reference: ALGO-2024-CL-02 **Location:** 42 Avenue Gaspard Coriolis – 31057 Toulouse
Team: ALGO **Contact person**: LAMBERT Catherine

Period: 1 year - from: 01/10/2024
Salary: 40 K€/year (gross)
Level of education required: PhD

Key words: Quantum Computing, LBM, HPC

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HOSTING TEAM - ALGO

The ALGO team conducts fundamental research on numerical algorithms for high-performance simulations. This includes a wide range of topics in applied mathematics, such as scalable algorithms in numerical linear algebra, methods for solving partial differential equations, data assimilation, optimization, uncertainty quantification, and scientific machine learning. The team also does technology watching on new architectures and novel computing technologies for scientific computing.

CONTEXT

The Navier-Stokes (NVS) equations are used extensively in engineering, meteorology, oceanography, and many other fields to model fluid behavior. They can describe a wide range of phenomena from the airflow over an aircraft wing to ocean currents and weather patterns.

Quantum computers are emerging as an increasingly viable tool for algorithm speedup enabled by the principles of quantum mechanics, such as superposition and entanglement. In some cases, exponential speedups over classical computer architectures. Quantum algorithms for solving PDEs have also gained attention but their implementation require deep circuits and many quantum gates to achieve results comparable to what one can solve on even a modern laptop.

A promising direction include mesoscale methods, which operate between molecular and continuum scales. Lattice methods are a common example and are well suited for quantum computation because

they are intrinsically statistical, resolving only samples or probabilities of the fictitious particles they comprise. Moreover, they are based on simple mathematical calculations and are suitable for parallel computation because interactions between lattice nodes are linear, and non-linearity enters during a local collision step. The Lattice Boltzmann method (LBM) is a common approach that solves the Boltzmann transport equation.
This research proposal aims to develop and implement a Quantum Lattice Boltzmann Method (QLBM) for solving the Navier-Stokes equation, leveraging the computational power of quantum computing. By addressing the limitations of classical methods, this project aspires to make significant contributions to the simulation of complex fluid flows in various scientific and engineering domains.

MISSION

The primary objective of this postdoctoral research program is to develop and implement a Quantum Lattice Boltzmann Method (QLBM) for solving the Navier-Stokes equations, leveraging quantum computing's computational power. The project aims to address the limitations of classical methods in simulating complex fluid flows across various scientific and engineering domains.
Phase 1: Literature Review and Preliminary Studies
Phase 2: Development of Quantum Algorithms
Phase 3: Simulation and Validation

DESIRED PROFILE

- Ph.D. in Physics, Applied Mathematics, Computer Science, or a related field, defended less than 3 years ago
- Strong background in quantum computing and algorithms.
- Experience with numerical methods for fluid dynamics, particularly the lattice Boltzmann method.
- Proficiency in programming languages used in quantum computing (e.g., Qiskit, Cirq).
- Excellent problem-solving skills and ability to work independently.

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- Flexible working arrangements, with the possibility of working from home up to two days a week.
- A sustainable mobility package enabling employers to pay up to a maximum of 500 euros a year to cover the home-to-work travel costs of staff who cycle to work.

HOW TO APPLY ?

To apply, please send your CV and covering letter to nasri@cerfacs.fr , applications are open until 16/09/2024.

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