

JOB OFFER – INTERNSHIP

Quantum Numerical Methods for Fluid Simulations

OFFER INFORMATION

Reference: ALGO-2026-JZ-01

Location: 42 Avenue Gaspard Coriolis – 31057 Toulouse

Team: ALGO

Supervisors: Julien Zylberman

Gratification: 800€ net per month - M2 level or last year at engineering school

Period: 4-6 months - from: 09/02/2026

Key words: Quantum computing, Quantum algorithms, Fluid dynamics, Numerical analysis

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HOSTING TEAM - ALGO

The Algo team conducts research in the fundamentals of high performance and quantum simulation. This includes a wide range of topics in applied mathematics, such as scalable algorithms in numerical linear algebra, iterative and direct algorithms for large linear systems, novel methods for solving partial differential equations, data assimilation, optimisation, uncertainty quantification and scientific machine learning.

CONTEXT

Classical simulations of physical phenomena encounter substantial limitations, particularly when applied to complex systems such as turbulent fluids, plasmas, or strongly correlated quantum materials. These simulations typically face prohibitive computational costs, limited scalability across multiple spatial and temporal scales, and inherent difficulties in accurately capturing non-linear or chaotic behaviors. Even with access to state-of-the-art high-performance computing (HPC) infrastructures, the faithful resolution of fine-scale dynamics or long-term evolutions remains particularly challenging.

Addressing these limitations requires the development of novel numerical approaches, which are of critical importance for both fundamental research and industrial applications. In this context, **quantum computing** emerges as a promising paradigm for the numerical study of complex dynamical systems and for the solution of the partial differential equations (PDEs) that govern them. Owing to the principles of **superposition** and **entanglement**, quantum computation offers fundamentally new strategies for numerical analysis, potentially enabling significant theoretical speedups for specific classes of problems.

MISSION

This internship is devoted to the **development of quantum numerical schemes for fluid simulations**. The proposed framework involves three main stages :

1. **Initialization**, consisting in encoding the initial conditions of the problem into a quantum state;
2. **Evolution**, which aims to reproduce the dynamical evolution prescribed by the governing PDE;
3. **Measurement**, through which observables of interest are extracted from the final quantum state encoding the solution.

The central difficulty resides in the **evolution stage**, which must capture the non-linear and dissipative nature of fluid dynamics, whereas quantum operations are inherently linear and unitary.

Depending on the candidate's background and interests, the internship may focus on one or several aspects of the project, ranging from the theoretical development of a specific method, to the design of quantum circuits for one of the computational stages, to the numerical analysis of the proposed approximations.

DESIRED PROFILE

- Candidates with knowledge or experience in quantum computing, quantum algorithms, numerical analysis, and/or fluid dynamics with a strong interest in research are particularly encouraged to apply.

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HOW TO APPLY?

To apply, please send your CV and covering letter to julien.zylberman@cerfacs.fr , applications are open until 31/12/2025.

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