INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Qobly, IPCMS, LOMA
CNRS identification code:
Internship director'surname: P. Roseiro, S. Yalouz, M. Saubanère
e-mail: matthieu.saubanere@cnrs.fr Phone number:
Web page:
Internship location: Grenoble (Qobly)

Thesis possibility after internship: YES
Funding: YES (CIFRE)

Quantum Algorithms for the Many-Body Problem on Silicon Spin Qubits

A 6-month Master 2 internship is available at the intersection of quantum computing and quantum chemistry. It is jointly supervised by Quobly (Grenoble), the CNRS LOMA laboratory (Bordeaux) and the IPCMS laboratory (Strasbourg). The internship is intended to lead to a CIFRE PhD with Quobly on the same topic.

Context: Simulating interacting electrons, the quantum many-body problem, is one of the most promising applications of quantum computers, with potential impact on materials science and quantum chemistry. Running such algorithms on real hardware raises specific challenges: noise, limited connectivity and native gate sets all depend on the qubit technology. Quobly develops quantum processors based on silicon spin qubits and has released SpinPulse, a library for transpilation and noise-accurate simulation of spin qubit quantum computers. [1]

Internship objectives: The goal is to implement a quantum algorithm for a small many-body problem and evaluate how it performs under realistic spin qubit noise. The internship will proceed in four steps:
1) Getting started: study the relevant literature on variational and subspace-based quantum algorithms, [2–4] and get familiar with SpinPulse and standard quantum computing tools.
2) Implementation: implement a quantum subspace (Krylov-type) method + QPE for small benchmark systems.
3) Noisy simulation and benchmarking: simulate their execution on silicon spin qubits with SpinPulse. Quantify the impact of noise on accuracy and resource cost, and compare the algorithms.
4) Reporting: write a report and present the results to the Quobly, LOMA and IPCMS teams.

Perspectives: The internship is designed as the first step of a CIFRE PhD with Quobly. The PhD would extend this work toward larger systems, advanced error mitigation strategies, resource optimization and, where possible, experimental validation on Quobly's quantum devices. Continuation into the PhD is subject to the evaluation of the internship and the CIFRE funding agreement.

Practical information : Location: Quobly, Grenoble, with regular interactions with the LOMA (Bordeaux) and IPCMS (Strasbourg) teams; Duration: 5-6 months; Start date: Q1 2027

References
[1] Vermersch, B. et al. The SpinPulse library for transpilation and noise-accurate simulation of spin qubit quantum computers. Preprint at https://doi.org/10.48550/arXiv.2601.10435 (2026).
[2] Akande, H. A., Perrin, A., Senjean, B. & Saubanere, M. Variational Quantum Subspace Construction via Symmetry-Preserving Cost Functions. Phys. Rev. A 112, 032623 (2025).
[3] Oumarou, O., Ollitrault, P. J., Polla, S. & Gogolin, C. Optimizing and Comparing Quantum Resources of Statistical Phase Estimation and Krylov Subspace Diagonalization. Preprint at https://doi.org/10.48550/arXiv.2603.15552 (2026).
[4] Rammal, H. et al. Orthogonal Quantum Krylov Diagonalisation. Preprint at https://doi.org/10.48550/arXiv.2607.09476 (2026).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	YES