Laboratoire Interdisciplinaire Carnot de Bourgogne

PhD position 2026–2029 :

Engineering Multi-Spin Systems for the Next Generation of Quantum Technologies

Scientific project

Color centers are a leading quantum platform for the development of next-generation quantum technologies : computing, sensing, long-distance entanglement distribution etc. This is due to their strong spin–optical properties and their ability to form multi-spin systems via coupling between electronic and nuclear spins. Scaling these systems for large-scale industrial applications remains a major challenge due to their fragility and sensitivity to environmental noise. Overcoming these limitations requires an exceptionally high level of quantum control, raising fundamental issues of controllability, robustness, and efficiency.

The DiTeQ team has a strong expertise in quantum optimal control, with the development of advanced theoretical and numerical tools such as shooting methods, GRAPE, and shortcuts to adiabaticity, etc. This expertise has recently been further strengthened toward quantum thermodynamics and the experimental implementation of control protocols.

The first goal of the PhD research project is to develop **theoretically and numerically new quantum optimal control techniques** to explore the physical limits in terms of sensitivity, speed and fidelity of quantum sensors and quantum computers based on multi-spin systems. Such results will allow us to investigate the optimal architecture of the next generation of quantum sensors and computers.

The second goal of the PhD research project is to develop a first-of-its-kind experimental setup in Burgundy (named QASSIS) dedicated to the **study of multipartite quantum systems, based on NV centers in diamond**. NV centers are well-known quantum systems, ideal for the study of new quantum protocols. The setup will consist of a room-temperature confocal microscope, equipped with newly acquired state-of-the-art hardware. The PhD student will thus be able to implement optimal control signals and directly test their theoretical models and findings on an experimental setup.

The PhD student will be part of multiple national and international interdisciplinary collaborations, with opportunities for research stays in partner laboratories. Furthermore, they will have the opportunities to participate in scientific diffusion activities as well as tutoring.

A **master internship** is available to the potential candidate.

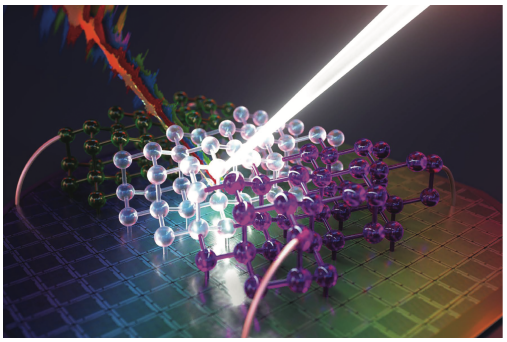

FIGURE 1 – Artistic representation of a color center, N. T. Son et al., *Appl. Phys. Lett* **116**, 190501 (2020)

Supervision

The candidate will be part of the DiTeQ team within ICQ department of the laboratoire interdisciplinaire Carnot de Bourgogne (ICB). They will be supervised by Pr. D. Sugny (PU) and Dr. C. Babin (MCF).

Candidate Profile

Applicants should hold a Master's degree (or equivalent) in Physics or Engineering. A background in quantum physics is mandatory. Interest in the development of experimental quantum system as well as in scientific programming (e.g. Python) is expected. Good English skills are required.

Application

Applicants should provide a motivation letter, a CV (including a complete list of exams and corresponding grades), their Master's thesis, and the names and email addresses of at least two referees. All documents should be sent as a single PDF file by email to Pr. D. Sugny (dominique.sugny@ube.fr) and Dr. C. Babin (charles.babin@ube.fr).

References

[1] Q. Ansel et al., *J. Phys. B : At. Mol. Opt. Phys.* **57**, 133001 (2024)

[2] D. Tinoco et al., hal-05404999 (2025)

[3] N. Ombredane et al., arXiv :2512.17836 (2025)

[4] C. Koch et al., *EPJ Quantum Technology* **9**, 19 (2022)

[5] M. Doherty et al., *Physics Reports* **528**,1-45 (2013)