INTERNSHIP PROPOSAL

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Internship location: Laboratoire Aimé cotton, bât 505, Rue du Belvédère, 91405 Orsay Cedex

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ERC

Universal deterministic single ion "implantor" setup with nanometric accuracy

Quantum circuits, made from specific doped materials, are foundational for quantum communication and computing. But, current ion implantation techniques face limitations due to non-deterministic ion sources and accuracy constraints.
We propose here to develop a high-precision, universal ion "implantor" setup for applications in semiconductors and quantum technology. For this we will take advantage of the correlation between each electron/ion pair, resulting from the ionization of an atomic beam, to actively control the ion passing trajectory based on the extra information given by the electron, as already developed on Cs atoms [Phys. Rev. Applied 11, 064049, 2019: https://doi.org/10.1103/PhysRevApplied.11.064049]. This development of a controlled source of ions at the sub-nanometric scale will open unique perspectives for implantation, etching, deposition and imaging experiments and will allow the development of a revolutionary analytical instrument in the semiconductors field.
For this we will adapt the cesium atomic beam system by using femtosecond pulsed multiphoton ionization to ionize atomic samples, creating a "cold" ion source for better accuracy. The use of other ions will allow us to realize precise ion trajectory control and deterministic single-ion creation. The internship will consist of testing the approach with Cs on the existing setup. The next steps, possibly in PhD, will consist of developing a deterministic Bi or N source, to integrate with a new FIB column to finally achieve nanometer scale implantation.

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: NO