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Color Center in Silicon: From Ensembles to Single Qubit

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Abstract: Given its potential for integration and scalability, silicon is likely to be a key platform for large-scale quantum technologies. Individual electron-encoded artificial atoms, formed by either impurities or quantum dots, have emerged as a promising solution for silicon-based integrated quantum circuits. However, single qubits featuring an optical interface, which is needed for long-distance exchange of information, have never been studied for quantum technologies applications. During this seminar I will first introduce recent photoluminescence measurements from an ensemble of color centers in heavily carbon implanted commercial silicon. Especially I will address the recombination dynamics of a G-center in silicon involving a three-level system. In the second part I will report for the first time the isolation of single optically active point defects from low fluence carbon implanted silicon. These artificial atoms exhibit a bright, linearly polarized single-photon emission with a quantum efficiency of the order of unity. This single-photon emission occurs at telecom wavelengths suitable for long-distance propagation in optical fibers. Our results show that silicon can accommodate single isolated optical point defects like in wide-bandgap semiconductors, despite a small bandgap (1.1 eV) that is unfavorable for such observations.

Bio: Dr. Walid Redjem completed his master's degree in quantum devices at University of Paris Diderot in 2016, before joining University of Montpellier in France as a Ph.D. Student. There he worked mainly of color center in silicon for quantum technologies applications. And showed for the first time, the possibility of isolating single silicon color center. In 2020 he joined Boubacar Kante's group at UC Berkeley – EECS, as a post-doc where is developing new types of classical and quantum light sources based on topological photonics.