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Single and coupled dopants in silicon nanowire: A new tool box for quantum information

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Dopants are key ingredients in classical electronics as they can tune semiconductor properties, based on their concentration. Focus is now shifting from high dopant concentration to individual dopants. On the one hand because classical electronics, based on silicon technology, has reached size scale where the properties of devices are considerably changed by individual dopants. On the other hand because single dopants are a very promising building block for quantum information processing. So far experimentalists have electrically connected a single dopant and measured promising long spin coherence times in silicon. I will present the next step towards quantum information processing with dopants in silicon by demonstrating that we can couple two dopants and coherently manipulate a charge between them. The dopants are implanted in a silicon nanowire and individually addressed with electrical gates. We show that the two lowest energy states of the system, corresponding to an electron being located in one or the other dopant, are well separated from the other states in this nanostructure, allowing them to be used as a qubit. By applying microwave excitation we further show that we can coherently manipulate these two states, an experimental proof of concept that this system can be used as qubit. This work opens up the way for quantum computation with dopants.

Biography

Eva Dupont-Ferrier has completed her Ph.D. in University Joseph Fourier (Grenoble, France) and postdoctoral studies from Rutgers University on topologically protected qubit. She joined CEA, France, to lead research on single dopants in silicon for quantum information. She is now research associate at CNRS Grenoble where she develops novel architectures for quantum information such as NV centers in diamond and nano-optomechanical systems. In 2009 she received the 'young scientist' Block award.

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