Title: Investigation of the optical properties of $Si_{1-x}Ge_x$ nanowires for the optimization of photodetectors and solar cells

Duration: 2-6 months depending on the degree (M1-M2)

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Context: Semiconductor nanowires (NWs) are promising novel materials for the next-generation of nanoelectronics CMOS transistors, as well as for photovoltaic devices such as photodetectors and solar cells. It has been demonstrated recently[1] that, compared to a planar thin film, NWs have an excellent ability to guide, scatter or absorb light from the UV to the infrared spectral range.
In pure silicon NWs, the optical properties can be tuned by changing the nanowire diameter. In the case of silicon-germanium ($Si_{1-x}Ge_x$) NWs, we have shown that the chemical composition *x* provides another parameter to tailor the nanowire optical properties.[2]
Very recently, we used Si nanowires as antennas to enhance the photoluminescence of silicon nanocrystals located in their near field. Though the enhancement is not as high as those obtained using noble metal nanostructures, the results are promising and could provide an alternative to plasmonics.
The aim of the training is to investigate the optical properties of nanowires with graded composition along the NW axis, and to better understand the coupling between the nanowire and a luminescent system (Si nanocrystal, II-VI quantum dots, or molecule).

Required skills: Degree in physics (licence, bachelor, master) with knowledge in solid state physics, optics, electromagnetism, nanophysics. Interests in both experiments and numerical simulations.

Collaborations: LTM (Grenoble), LAAS-CNRS (Toulouse), University of Sfax (Tunisia).

[1]Linyou *Cao et al.*, Engineering light absorption in semiconductor nanowire devices, Nature Mat. **8**, 643, (2009). G. Brönstrup *et al*., Optical properties of individual silicon nanowires for photonic devices, ACS Nano **4**, 7113 (2010).
[2]H. Kallel *et al*., Tunable enhancement of light absorption and scattering in $Si_{1-x}Ge_x$ nanowires, Phys. Rev. B **86,** 085318 (2012).