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présentera un séminaire intitulé

“Acoustic Phonon Engineering in One-Dimensional Nanostructures”

Through the development of semiconductor nanostructures displaying controlled acoustic impedance modulations, a new area is growing in nanoscience: *nanophononics*. This area is devoted to the study of the vibrational and thermal properties at the nanometer scale, and the interaction of these engineered phonons with photons and electrons at high frequencies and reduced scales.

Following the concept of optical microcavity, acoustic nanocavities confine and amplify the acoustic field both spatially and in the spectral domain [1,2]. An acoustic cavity consists of two superlattices acting as distributed mirrors enclosing a spacer layer. I will describe the relevant parameters for the design and phonon engineering in these devices. Results of Raman scattering and coherent phonon generation will be presented, showing that monochromatic phonons are strongly confined in the center of a nanocavity.

Electronic Bloch oscillations, i.e., oscillations of an electron induced by a constant electric field in the presence of a periodic potential, are a beautiful and clear example of quantum effects in solids. Nanocavities provide localized acoustic states that resemble the confined electronic levels in atoms and quantum wells. Exploiting this parallel, structures displaying acoustic Bloch oscillations operative in the THz range (nm wavelength) can be designed using cavities as the basic building block [3,4]. Furthermore, a series of complex acoustic nanostructures with electronic equivalents can be conceived; these include phonon-molecules, acoustic minibands, and devices with generalized engineered phonon potentials [4]. In this talk I will introduce these devices and discuss alternative experimental strategies developed to study their properties in the spectral and time domains.

[1] Confinement of acoustical vibrations in a semiconductor planar phonon cavity, M. Trigo et al., Phys. Rev. Lett. **89**, 227402 (2002).

[2] Sub-THz phonon dynamics in acoustic nanocavities, A. Huynh et al., Phys. Rev. Lett. **97**, 115502 (2006)

[3] Phonon Bloch oscillations in acoustic-cavity structures, N. D. Lanzillotti-Kimura et al., Phys. Rev. B **71**(R), 041305 (2005)

[4] Phonon engineering with acoustic nanocavities, N. D. Lanzillotti-Kimura et al., Phys. Rev. B **75**, 024301 (2007)