Centre for Nanoscience and Nanotechnology
University Paris Sud and CNRS (France)

Horizon 2020
European Union funding
for Research & Innovation

FET-OPEN funded post-doctoral researcher position

"Optically pumped intersubband polariton lasers"

Applications are invited for a two-year post-doctoral position at University Paris Sud (France), in the *Quantum Cascade Lasers and Polaritonic Devices* group. The group is located at the Centre for Nanoscience and Nanotechnology, on the University premises.

Optoelectronic devices typically operate in the weak coupling regime between light and matter, for example in conventional lasers which rely on population inversion to achieve optical gain. Recently, however, there has been a surge of interest in quantum systems operating instead in the *strong coupling* regime, when the coupling strength of the light-matter interaction is so strong that new states – cavity polaritons – are created, partially light, and partially material excitation. In semiconductors, most of the attention has been so far devoted to exciton-polaritons [1]. Recently a new platform for strong coupling has been realized exploiting intersubband (ISB) transitions. The resulting excitations are called ISB polaritons [2], and they have two remarkable properties: (i) the bosonic character is maintained up to high carrier densities since they are not restricted by the Mott transition limit [3]; (ii) the Rabi splitting is dramatically reinforced [4]. While the scientific community has been already actively exploring the basic science of ISB polaritons, their potential for future and innovative optoelectronic devices is entirely untapped.

The post-doctoral research proposed will evolve in the context of the FET-OPEN project MIR-BOSE, whose goal is to demonstrate optoelectronic devices operating in the strong coupling regime between light and matter for the mid-IR and THz spectral ranges.

The specific objective of the proposed post-doctoral activity is to demonstrate polaritonic light-emitting devices with enhanced spontaneous emission in the mid-IR and - as a second step - ISB polariton lasers. The key enabling idea has been introduced in 1996 [5], and experimentally demonstrated for exciton-polaritons [1]. It can be shown that not only ISB polaritons are bosons [6], but also that an ISB polariton laser would have enhanced device performance in terms of operating temperature and power (see Ref. [3], from which the Figure is extracted).

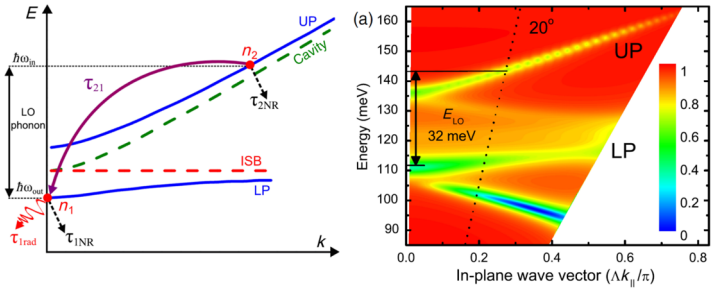

Figure: *Left: Typical dispersion diagram of intersubband polaritons in a metal-dielectric-metal cavity, with scattering channels. Right: Optimal ISB polariton-dispersion diagram for an optical pumping experiment* [3].

The successful applicant will be an energetic individual with strong academic record and experience in semiconductor physics, optical physics and optically pumped devices/systems. She/he will have completed a PhD program in Physics, Optics or Engineering. Numerical simulation capabilities, characterization tools and fabrication facilities are available at the host institution. The project will benefit from collaborations at the national and international level, being funded by a FET-OPEN program.

The position is available immediately. The starting gross salary is 50 k€/year.
Applications, including a cover letter and a CV, should be sent to Raffaele Colombelli (contact info below), preferably by e-mail.

[1] D. Bajoni, J. Phys. D. Appl. Phys. **45**, 313001 (2012).
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[4] Y. Todorov, a. M. Andrews, R. Colombelli, S. De Liberato, C. Ciuti, P. Klang, G. Strasser, and C. Sirtori, Phys. Rev. Lett. **105**, 196402 (2010).
[5] A. Imamoglu, R. Ram, S. Pau, and Y. Yamamoto, Phys. Rev. A **53**, 4250 (1996).
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