PROPOSITION DE STAGE

Titre: **Extreme Light Confinement in Plasmonic Devices**

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Résumé: It is fully admitted that the reduction of the size of a nano-object or a nano-material down to the nanoscale leads to a strong modification of their transport properties depending then on their size, shape, structure and obviously on their environment. Energy carrier confinement combined to interface effects gives rise to new transport properties. That is the case in absorption and emission of light where the new properties are given by electromagnetic near field coupling between the nano-objets included in the material.
Since few years, the challenge of controlling temperature and heat conduction at the nanoscale using metallic nano-structures has received a major interest. Under a femtosecond illumination close to its resonance, a plasmonic object exhibits a strong light absorption, turning it into an ultra-fast nano- source of heat and remotely controllable using light. Such a powerful and flexible photothermal scheme is the basis of *femtosecond-thermo-plasmonics.*
All the processes occurring at time scales from femtoseconds up to nanoseconds are routinely accessible with ultrafast pump-probe techniques. i.e heterodyne optical sampling[1,2] allows to access to the energy transfer[3] and understand the heat propagation into nano-objects themselves. **The comprehension of energy transport mechanisms at the nanoscale and in a sub-picosecond time range is the challenge of this work.**

Methology
First, we propose, to explore the physics of heat generation and propagation in metallic thermoplasmonic systems under a femtosecond pulse illumination. A second part of the work relies on the control of heat transport properties tuned by the size and shape of the nano-objects. We will develop experimental methods leading to a deeper understanding of transport at the nanoscale as well as nano-heating engineers by plasmons.

*1- **Anomalous light absorption around subwavelength apertures in metal films,** O. Lozan, M. Perrin, B. Ea-Kim, J. M. Rampnoux, S. Dilhaire, and P. Lalanne, Physical Review Letters 112 (19), 193903 (2014).*
*2- **Increased rise time of electron temperature during adiabatic plasmon focusing**, O.Lozan, R. Sundararaman, B. Ea-Khim, J-M. Rampnoux, P. Narang, S. Dilhaire, P. Lalanne, Nature Communication, in press (2017)*
*3- **Precise control of thermal conductivity at the nanoscale through individual phonon-scattering barriers**, G. Pernot, M. Stoffel, I. Savic, F. Pezzoli, P. Chen, G. Savelli, A. Jacquot, J. Schumann, U. Denker, I. Monch, Ch. Deneke, O. G. Schmidt, J. M. Rampnoux, S. Wang, M. Plissonnier, A. Rastelli, S. Dilhaire, and N. Mingo, Nature Materials. 9(6), 491 (2010).*