FACOLTÀ DI SCIENZE MATEMATICHE, FISICHE E NATURALI
DIPARTIMENTO DI MATEMATICA E FISICA "NICCOLÒ TARTAGLIA"
INTERNATIONAL DOCTORAL PROGRAM IN SCIENCE

Ultrafast opto-thermo-mechanics in metal nanoparticles

Prof. Natalia Del Fatti

FemtoNanoOptics group, Institut Lumière Matière (iLM), Université de Lyon, CNRS

Abstract

Controlling and modeling the mechanical and thermal response of nano-scale systems raise fundamental questions, which are also of central interest for many technological issues. In this size range, breaking of translational invariance leads to appearance of discrete vibrational acoustic modes of a nano-object. Investigation of their frequencies over sizes ranging from few thousand of atoms to few atoms raises the question of the limit of their description in terms of continuum elastic theory. It also yields new ways for characterizing nano-materials. Understanding of their mechanical damping is even more challenging, as this is largely dominated by energy transfer from the nano-objects to their environment for deposited or embedded ones. This mechanism, also ruling thermal energy transfer, is thus highly sensitive to the nano-object – environment interface and the nature of the mode.

In this context, femtosecond nonlinear optical techniques are key tools to analyze the acoustic and thermal responses of metal nanoparticles. These measurements are based on driving out-of-equilibrium the electron distribution of a metal nanoparticle by a pump-pulse, the induced transient change of its extinction cross-section being subsequently monitored by a time-delayed probe-pulse. In this talk, after introducing the main concepts for description of the acoustics and thermics of nano-objects, we will present experimental results obtained with time-resolved pump-probe spectroscopy and their application to the investigation of the ultrafast acoustic and thermal relaxation, on both ensembles of metal nanoparticles and at single nano-object level.

PhD Minicourse

Mercoledì 12 giugno 2019
Sala Riunioni, ore 11.00
Via dei Musei 41 - Brescia

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