SEMINARIO

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Magnetoelectric excitations probed at extreme conditions: optical studies using SR

Marine VERSEILS

Beamline AILES, synchrotron SOLEIL, Paris-Saclay

Understanding the nature and furthermore controlling the mechanisms of coupling between lattice, magnetic and orbital orders in magnetoelectric materials remains a fundamental challenge to achieve in order to open the path toward technological applications. The dynamic of collective order of lattice, spin and orbital results in low-energy excitations as phonons, magnons and crystal fields, respectively and the coupling between theses orders can give rise to hybrid excitation as electromagnon. These excitations lie in the THz and FIR energy range and carry either an electric or a magnetic dipole that can be directly excited by the electromagnetic wave of light making infrared spectroscopy a technique of choice to investigate them. Moreover, hydrostatic pressure or sub-K measurements can be used as a tuning parameter in order to reveal strong and complex coupling mechanisms at play and improve the resulting properties suitable for applications. However, the low-energy range (close to diffraction limit), the small intensity of the excitations and the sample limited size (typically a few hundred microns for high-pressure measurements) make this kind of experiments very challenging. We will show that, at the AILES beamline of synchrotron SOLEIL, the combination of the high brilliance and stability of the synchrotron beam in the low energy range with a highly focusing optics, allows one to measure and follow, i)as a function of hydrostatic pressure, ii) down to 150 mK, phonons, magnons, crystal fields but also electromagnons in a wide frequency range down to the diffraction limit. These measurements reveal unique information about the dynamical coupling of orders in magnetoelectric materials. The cases of several oxides will be presented.