

**Special Seminar**  
**MPQ/LMU**

**Date:** Monday, February 3, 2014

**Time:** 10 a.m., s.t.

**Presentation:** Dr. Jean-Michel Ménard

**Title:** Ultrafast Mapping of Dynamical Polaritonic Systems and Charge Density Waves

**Location:** Chair Professor Theodor W. Hänsch  
LMU, Faculty of Physics  
Discussion Room H 311  
Schellingstr. 4/IIIrd floor  
D-80799 München/Munich

**Division of Laserspectroscopy, Director Professor Theodor W. Hänsch**

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**ABSTRACT**

Ultrabroadband electro-optic detection of light in the infrared spectral range provides unique access to low-energy dynamics. Fascinating physical phenomena in various materials can then be investigated with this optical technique also referred to as time-resolved THz spectroscopy.

In a first project, we trace the matter component of a cooling exciton-polariton gas, and observe, for the first time, the build up process leading to a Bose-Einstein condensate in solid state. Our measurements establish a fundamental difference between polariton and photon lasing and open novel possibilities for coherent control of a macroscopic quantum state.

Second, we map out a large photonic bandgap in a one-dimensional photonic crystal which is introduced by activating ultrastrong light-matter coupling on a sub-cycle scale. The results pave the way towards non-adiabatic quantum electrodynamics effects analogous to Hawking radiation of black holes. Finally, highly correlated materials exhibiting intriguing ordered states, such as superconductivity or a charge density wave, are investigated during the photo-induced melting and recovery processes of the microscopic ordering. We disentangle electronic and lattice parameters and trace the evolution of a new transient phase of matter which could be used to elucidate a broad class of phase transitions.