



Wednesday, May 11<sup>th</sup>, 2016 - 11:00 am  
CFEL Seminar room IV, 01.111, (Blgd. 99)

Michael Fechner

Materials Theory, ETH Zurich

## Parity odd magnetism and spin-phonon coupling in the pseudo-gap phase of cuprate superconductors

A characteristic of ferroic materials is the emergence of a temporally static finite expectation value of an order parameter. Here, we introduce a new mechanism [1] for ferroic order, in which a non-zero quasi-static magnetoelectric quadrupolar order appears, mediated by a strong coupling of spin and phonon fluctuations. We show that our proposed mechanism is consistent, to our knowledge, with many experimental observations for the onset of the pseudo-gap phase in cuprate superconductors and therefore propose the quasi-static magnetoelectric quadrupole as a possible pseudo-gap order parameter. By using first-principles calculations in combination with our recent developed formalism [2,3], to calculate multipole moments within a Berry phase approach, we calculate the magnitude of the effect for the prototypical cuprate superconductor,  $\text{HgBa}_2\text{CuO}_{4+\delta}$ . Using these results we finally show that our mechanism embraces several key findings of experimental reports and in addition also aspects of previous theoretical models.

[1] M. Fechner, M. J. A. Fierz, F. Thöle, U. Staub, and N. A. Spaldin, arXiv [cond-mat.supr-con](#), (2015).

[2] F. Thöle, M. Fechner, and N. A. Spaldin, arXiv [cond-mat.mtrl-sci](#), (2016).

[3] N. A. Spaldin, M. Fechner, E. Bousquet, A. Balatsky, and L. Nordström, Phys. Rev. B **88**, 094429 (2013).

