**Nonadiabatic lattice dynamics in metals and magnets**

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In electronic structure theory, lattice vibrations are usually treated under the Born-Oppenheimer approximation, where electronic degrees of freedom are assumed to be fast compared to nuclear dynamics. However, going beyond this adiabatic approximation is necessary in many situations for an accurate description of phonons, and their effects on materials properties. I will discuss two such cases. The first case involves Born effective charges, which are crucial to understanding, e.g., ferroelectric polarization, phonon dispersions in ionic insulators, electron-phonon scattering, dielectric screening, electromechanical coupling, and optical spectra in the IR/THz regime. Via density-functional perturbation theory (DFPT) calculations, I will show that going beyond the adiabatic approximation extends the definition of Born effective charges from insulators to conducting systems and relates them to a seemingly unrelated fundamental property of metals: the Drude weight. The second case I will discuss is the coupling of magnetism and phonons in materials. Specifically, I will demonstrate a DFT-based methodology for including the velocity-dependence of interatomic forces, which explicitly accounts for time-reversal symmetry breaking in the nuclear equations of motion. I will show that in some magnetic materials, such as CrI3, the assumption of adiabatic separation between electron and nuclear dynamics breaks down completely due to the role of (slow) spin dynamics in the coupling between phonons and the magnetic order.