The properties of molecules and solids derive from the quantum mechanics of the electrons and nuclei they are made of. As a full quantum many-body treatment is impractical, virtually all theories begin from the Born-Oppenheimer approximation, where the many-electron problem is solved under the assumption that the usually sluggish nuclei are fixed in space. Solving the many-electron problem again and again for different fixed nuclear positions maps out an electronic wave function \( \Phi_R \), a conditional probability amplitude, depending parametrically on the set of nuclear coordinates \( R \). To complete the approximation, one solves for the nuclear wave function \( \chi \), a marginal probability amplitude, and constructs the full wave function as the product \( \Phi_R \ast \chi \). A recent breakthrough known as the exact factorization method [1] showed that this type of factorization into conditional and marginal amplitudes can be made exact, establishing a fundamentally new way of tackling nonadiabatic (beyond Born-Oppenheimer) effects. In this talk, I will introduce the basics of the exact factorization method and survey a variety of developments carried out in my group over the past several years. The foundation of a nonadiabatic density functional theory [2], seamlessly encompassing quantum nuclei, gives us a computationally tractable approach for timely problems in condensed matter physics, materials science and chemistry. I will describe applications to Jahn-Teller-active defects in crystals [3] and the renormalization of electronic band structure due to electron-phonon interactions [4].