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The Time-Dependent Born-Oppenheimer Approximation, Crossings, Avoided Crossings, and Some Non-Adiabatic Transitions

We review mathematical results concerning the time-dependent Born-Oppenheimer approximation. We then turn attention to some phenomena in molecular quantum mechanics that are not described by Born-Oppenheimer theory. These include fairly recent results concerning exponentially small non-adiabatic transitions and older results concerning level crossings and avoided crossings with small gaps.