Control of vibrational coherence for enhanced bioimaging

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Maximizing coherence between vibrational states of a targeted molecule or a molecular group is at the heart of modern noninvasive bioimaging techniques. The implementation of ultrafast laser pulses having moderate intensities and shaped in terms of the field phase and amplitude has been initiated in the cutting edge research to induce selective excitations among many vibrational modes having close frequencies and enhance chemical sensitivity and resolution of imaging. In the framework of Maxwell-Schrödinger theory, we will discuss the background of the optical imaging that makes use of coherent Raman scattering. Novel quantum methods will be presented for optimizing the generation of the Raman fields based on the implementation of ultrafast chirped pulses for various scenarios in impulsive and non-impulsive regime of light-matter interaction.