

Rovibrational Wave Packet Manipulation using Shaped Mid-Infrared Femtosecond Pulses toward Quantum Computing

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It has been suggested that quantum gate operations with rovibrational states of molecules have several advantages over other methods, because of a long lifetime of vibrational excited states. One of the methods to realize quantum gate operations with rovibrational states of molecules is the manipulation of rovibrational wave packets with a shaped ultrafast pulses. Here we report a technique of complex shaping of mid-infrared femtosecond laser pulses towards accurate and precise control of rovibrational wave packets of molecules in the ground electronic state. The obtained frequency and time resolutions are sufficient enough for the realization of quantum gate operations with high fidelity [1]. As an example, shaped pulses that would realize the Hadamard and NOT quantum gates in a CO molecule will be demonstrated.

[1] M. Tsubouchi and T. Momose, *Opt. Comm.* **282**, 3757 (2009)