Control of ultracold rubidium photoassociation with shaped femtosecond laser pulses

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We investigate the interaction of femtosecond laser pulses with an ensemble of ultracold rubidium atoms in a magneto optical trap. Particularly the process of photoassociation is time resolved studied in a pump probe scheme. Thereto, the pump pulse is shaped with a frequency filter to suppress trap loss due to resonant atomic excitation.
Via off resonant excitation by the strong field a pair of free atoms is transferred to a bound molecule. The transient of the molecular formation reveals an oscillatory behavior. We study the dependence of the molecular coherent transients on different pump pulse shapes. Moreover, the process is simulated by quantum dynamical calculations which show a good agreement with the experimental data. Together with further experiments the analysis provides a detailed picture of the underlying processes.

In a second experiment we applied a closed loop optimization on the multi-photon ionization of Rb_2 using a parametric evolutionary algorithm. The result is approved by a systematic investigation of the relevant frequency components and allows to assign the transitions to certain electronic states.

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