SFB/TRR 21 - Seminar

31. Oktober 2014, Stuttgart

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Ultrafast electron dynamics beyond mean-field in a strongly-correlated ultracold Rydberg gas

We demonstrate a new strategy to realize a strongly-correlated Rydberg gas, in which we have circumvented the Rydberg blockade with a broadband picosecond (ps) laser pulse to increase the interaction by several orders of magnitude. The property of this strongly-correlated Rydberg gas has been investigated by time-domain Ramsey interferometry with attosecond precision. Our ps laser pulse allows for the real-time observation of coherent and ultrafast electron dynamics evolving more rapidly than expected for two-body correlations by several orders of magnitude. This observation is well reproduced by a theoretical model beyond mean-field approximation. Finally we have actively controlled such ultrafast many-body dynamics by tuning the principal quantum number and population of the Rydberg state and the atom density. Our new approach opens a new avenue to observe and manipulate the nonequilibrium dynamics of strongly interacting many-body systems on the ultrafast timescale.

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