Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Short-time dynamics of correlated quantum Coulomb systems

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Strong correlations in dense Coulomb systems are attracting increasing interest in many fields ranging from dense astro-
physical plasmas, dusty plasmas and semiconductors to metal clusters and ultracold trapped ions [1]. Examples are bound
states in dense plasmas (atoms, molecules, clusters) and semiconductors (excitons, trions, biexcitons) and many-particle
correlations such as Coulomb and Yukawa liquids and crystals. Of particular current interest is the response of these systems
to short excitations generated e.g. by femtosecond laser pulses and giving rise to ultrafast relaxation processes and build
up of binary correlations. The proper theoretical tool are non-Markovian quantum kinetic equations [1,2] which can be
derived from Nonequilibrium Green’s Functions (NEGF) and are now successfully solved numerically for dense plasmas and
semiconductors [3], correlated electrons [4] and other many-body systems with moderate correlations [5]. This method is
well suited to compute the nonlinear response to strong fields selfconsistently including many-body effects [6]. Finally, we
discuss recent extensions of the NEGF-computations to the dynamics of strongly correlated Coulomb systems, such as single
atoms and molecules [7] and electron and exciton Wigner crystals in quantum dots [8,9].

Quantum Kinetic Theory, Teubner, Stuttgart/Leipzig 1998;
Rev. B 55, 5110 (1997);
(2006);

1Supported by the Deutsche Forschungsgemeinschaft via SFB-TR 24