The Baym-Kadanoff equation within the GKBA: the only way to a realistic, ab-initio approach? Pros and Cons.

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Thanks to the implementation of the Baym-Kadanoff equations with the GKBA in the yambo code we have been able to calculate and interpret a wealth of experimental results. Applications range from transient absorption, time-resolved photoemission and Kerr rotation, and more. More observables are currently under development.

I will first briefly discuss one of the most recent theoretical applications of the KBE connected to the evaluation of the time-resolved Raman scattering amplitude in a fully quantistic fashion on the Keldysh contour.

I will, however, devote most of the time to discuss some key unphysical effects we currently observe (of which we lack of a proper understanding): (i) the reduction of the phonon-assisted thermalization when both electron-phonon and electron-electron are introduced in the collision integral; (ii) the most appropriate definition of an instantaneous single-particle basis to be used in order to properly define the time-dependent observables; (iii) the subtle problem of the formation of coherent versus incoherent excitons during the primary excitation process induced by the pump.