Assumptions and Realities in Non-Equilibrium Many-Body Physics

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In this talk, I will present an overview of some of our recent results in the area of non-equilibrium many-body theory. Experimental developments are enabling the study of electrons and atoms in the time domain with ever increasing resolution. The theoretical development has been somewhat lacking, and remains mostly rooted in extensions of equilibrium models. I will discuss a series of assumptions that underlie common modes of thinking about non-equilibrium many-body physics such as N-temperature models, separation of time scales based on energy scales, and Mathiessen's rule which says that interaction channels add linearly. Based on our numerical solution of the equations of motion in the time domain, I will demonstrate by contradiction that these assumptions and models are not generally valid, but have limited ranges of applicability, and I will present realities of non-equilibrium many-body theory that should be taken into account when considering time domain physics.