Creating Driven Imposters with Quantum Control

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The intrinsic properties of a material are those which uniquely identify it at equilibrium - one of the differences between gold and lead is the way in which they scatter light. What happens to these properties when the systems are driven from equilibrium however - is it possible to make one material mimic another?

Here we answer this question using a framework for controlling the observables of a general correlated electron system driven by an incident laser field. The approach provides a prescription for the driving required to generate an arbitrary predetermined evolution for the expectation value of a chosen observable, together with a constraint on the maximum size of this expectation.

To demonstrate this, we determine the laser fields required to exactly control the current in a Fermi-Hubbard system under a range of model parameters, fully controlling the nonlinear high-harmonic generation and optically observed electron dynamics in the system. This is achieved for both the uncorrelated metalliclike state and deep in the strongly correlated Mott insulating regime, flipping the optical responses of the two systems so as to mimic the other, creating "driven imposters" (see figure). We also present a general framework for the control of other dynamical variables, opening a new route for the design of driven materials with customized properties.

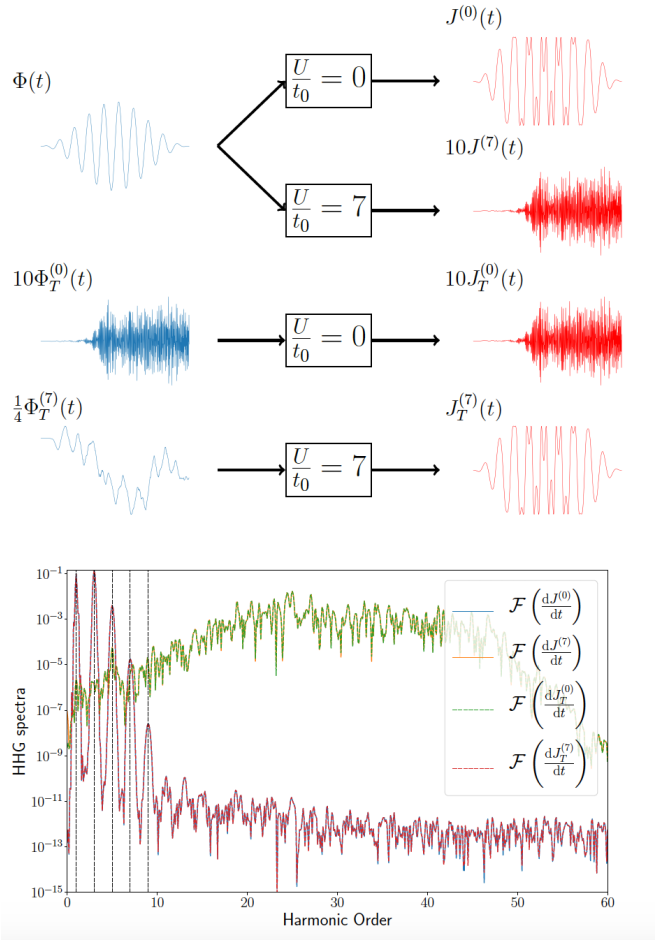

Figure 1: Using tracking, it is possible to make the high harmonic spectra of one system mimic the other. Here tracking has been implemented to swap the optical characteristics of two systems.

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