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Coherent Backscattering and Many-Body Spin Echo in Fock Space: Genuine Many-Body Interference vs. Equilibration

Abstract: Universal interference effects like coherent backscattering, which manifests itself as an enhancement of the return probability over its classical value in disordered media, play an important role in many different quantum systems. Those effects are accurately described by semiclassical methods in the spirit of Gutzwiller, where quantum coherent effects are characterized by interference between classical paths. In mesoscopic systems semiclassics has proofed to be a very powerful tool to explain and predict such universal interference effects. We have transferred these methods into the realm of interacting many-body systems enabling us to predict genuine many-body interference effects that lie beyond mean field theories. One is the analog of coherent backscattering in Fock space which is a coherent enhancement of the return probability for many-body states. It implies that quantum interference gives rise to a systematic deviation from full thermalization that is generally assumed to take in for mesoscopic interacting many-body systems. Another example will is many-body spin echo characterized by an increase of the return probability echoing an intermediate sudden spin-flip. It is independent of the interaction strength within a large regime of parameters showing that the well known Hahn (spin) echo cannot be fully destroyed by interactions.