Entanglement asymmetry and quantum Mpemba effect in closed driven quantum systems

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We shall discuss the dynamics of entanglement asymmetry in periodically driven quantum systems using a periodically driven XY chain as a model for a driven integrable quantum system. We shall provide semi-analytic results for the behavior of the dynamics of the entanglement asymmetry, ΔS, as a function of the drive frequency and identify special drive frequencies at which the driven XY chain exhibits dynamic symmetry restoration and displays quantum Mpemba effect over a long timescale. We shall identify an emergent approximate symmetry in its Floquet Hamiltonian which plays a crucial role for realization of both these phenomena. We follow these results by numerical computation of ΔS for the non-integrable driven Rydberg atom chain and obtain similar emergent symmetry-induced symmetry restoration and quantum Mpemba effect in the prethermal regime. Finally, time permitting, we shall provide an exact analytic computation of the entanglement asymmetry for a periodically driven conformal field theory (CFT) on a strip. Such a driven CFT, depending on the drive amplitude and frequency, exhibits two distinct phases, heating and non-heating, that are separated by a critical line. Our results show that for m cycles of a periodic drive with time period T, $\Delta S \sim \ln mT$ [$\ln(\ln mT)$] in the heating phase [on the critical line] for a generic CFT; in contrast, in the non-heating phase, ΔS displays small amplitude oscillations around it's initial value as a function of mT. We provide a phase diagram for the behavior of ΔS for such driven CFTs as a function of the drive frequency and amplitude.