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Large deviations of the periodic Toda chain

The highly complicated nature of far from equilibrium systems can lead to a complete breakdown of the physical intuition developed in equilibrium. A famous example of this is the Mpemba effect, which states that nonequilibrium states may relax faster when they are further from equilibrium or, put another way, hot water can freeze faster than warm water. Despite possessing a storied history, the precise criteria and mechanisms underpinning this phenomenon are still not known. I will present a quantum version of the Mpemba effect that takes place in closed many-body systems with a $U(1)$ conserved charge: in certain cases a more asymmetric initial configuration relaxes and restores the symmetry faster than a more symmetric one. I will outline the criteria for this to occur in arbitrary integrable quantum systems, relating it to the properties of the initial state.