Von Neumann entropy and entropy production of a damped harmonic oscillator

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In this presentation we analyze the entropy and entropy production of a nonisolated quantum system described within the quantum Brownian motion framework. This is a very general and paradigmatic framework for describing nonisolated quantum systems and can be used in any kind of coupling regime. We start by considering the application of von Neumann entropy to an arbitrarily damped quantum system making use of its reduced density operator. We argue that this application is formally valid and develop a path-integral method to evaluate that quantity analytically. We apply this technique to a harmonic oscillator in contact with a heat bath and obtain an exact form for its entropy. Then we study the entropy production of this system and enlighten important characteristics of its thermodynamical behavior on the pure quantum realm and also address their transition to the classical limit.