Studying the stability of a quantum chaotic system at finite temperature via coupling to a 2-level probe

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We start by considering the kicked harmonic oscillator (KHO) as a closed quantum chaotic system with unitary dynamics. In this case, the dynamics is given in terms of a Floquet operator. Then we calculate the fidelity amplitude as a function of time, where we perturb the system by small changes of the kick strength. Our results for this part show that we can go from the perturvative regime to the Fermi Golden Rule regime via changing the Lamb-Dicke parameter (effective Plank constant) and/or the perturbation strength [Fig 1]. In the second part of the work, we consider the KHO in thermal contact with a finite temperature heat bath and coupled to a two-level system. The latter is done in such a way (dephasing coupling) that the coherence in the two-level system becomes equal to the fidelity amplitude in the limit of the closed system (reducing the coupling to the heat bath to zero). For the simulations, we use the “chord function”, the double Fourier transform of the Wigner function as introduced in Prado et al PRA(2017). There we find an interesting crystalline structure, despite the system is chaotic in the sense of quantum chaos [Fig 2]. In the presence of the heat bath, the decay of the coherence in the 2-level system has no longer an immediate interpretation as a fidelity for the non-unitary dynamics with and without perturbation. Never the less, the quantity can give relevant information about the properties of the KHO at finite temperature [López et al J.Phys.A(2020)]. In particular we verify the RMT prediction [Moreno et al PRA(2015)] that an increasing the coupling to the heat bath, slows down the decay of the coherence in the 2-level system.

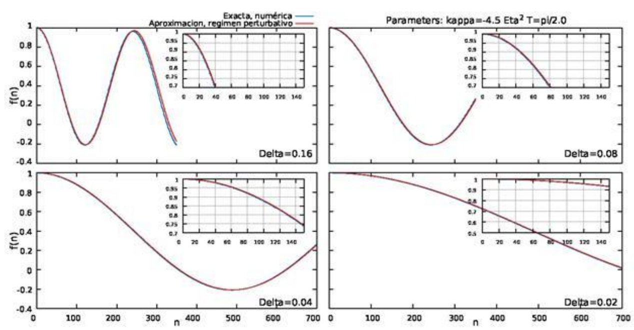

Figure 1

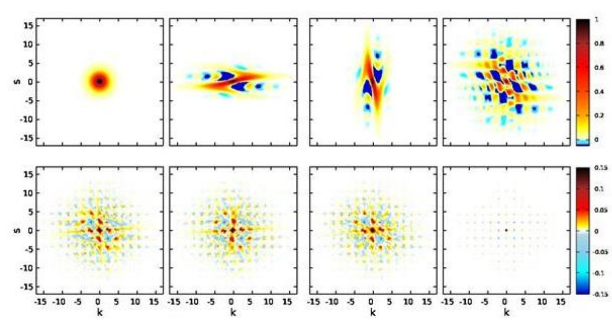

Figure 2