## Generation of Gaussian quantum discord of two coupled bosonic modes in a thermal environment

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We give a description of the Gaussian entropic discord for a system consisting of two interacting bosonic modes embedded in a thermal environment. The time evolution of the Gaussian discord is given in terms of the four symplectic invariants obtained from the covariance matrix of the considered Gaussian system [1], which evolves according to the Markovian master equation obtained in the framework of the theory of open quantum systems based on completely positive dynamical semigroups.

For initial uni-modal squeezed states, which are product states with zero discord, the generation of Gaussian discord takes place, for all non-zero values of the interaction strength between the coupled bosonic modes [2]. For example, in Fig.1 is represented the dependence of Gaussian quantum discord *D* on time *t* and squeezing parameter *r* for an initial uni-modal squeezed state for the temperature  $\operatorname{coth}(\omega/2kT) = 2$  and interaction parameter between modes q = 0.5.

After reaching some maximum value of the Gaussian discord in the case of initial uni-modal squeezed states, and also for initial squeezed thermal states with initial non-zero Gaussian discord, *D* non-monotonically decreases in time and tends asymptotically for large times to some definite non-zero value. This can be observed in Fig. 1 for an initial uni-modal squeezed state, and in Fig. 2, which shows the dependence of the quantum discord of an initial squeezed vacuum state on time *t* and squeezing parameter *r*, for a temperature  $\operatorname{coth}(\omega/2kT) = 2$  of the thermal bath.

The asymptotic discord does not depend on the parameters characterizing the initial state, but strongly depends on the values of the coefficients characterizing the thermal bath (temperature and dissipation constant). In addition, the direct interaction between the two modes determines the creation and preservation of quantum discord at asymptotically large times.



- [1] 1. G. Adesso and A. Datta, Phys. Rev. Lett. 105, 030501 (2010).
- [2] 2. T. Mihaescu and A. Isar, in preparation.



FIG. 1. Gaussian quantum discord *D* versus time *t* and squeezing parameter *r* for an initial uni-modal squeezed state, for temperature  $\operatorname{coth}(\omega/2kT) = 2$ , interaction parameter between modes q = 0.5, dissipation parameter  $\lambda = 1$  and  $\omega = 1$ .



FIG. 2. Gaussian quantum discord *D* versus time *t* and squeezing parameter *r* for an initial squeezed vacuum state, for temperature  $\operatorname{coth}(\omega/2kT) = 1.2$ , dissipation constant  $\lambda = 0.1$ , interaction parameter between modes q = 0.3 and  $\omega = 0.2$ .