

The Seventh Conference on Information Theory and Complex Systems
TINKOS 2019

BOOK OF ABSTRACTS



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On the stability of the quantum Brownian rotator

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Summary

The standard quantum mechanical theory is insensitive to the number of particles. Therefore description of the quantum many-particle systems remains an open issue in the foundations of the theory. To this end, additional complications come from the fact that the realistic systems are with the definite geometrical size and shape as well as exposed to the environmental influence. For this reason, only the toy-models bearing high degree of spatial symmetry for both the system as well as for its environment are used.

The walk and progress in modern technology, such as nanotechnology, demands theoretical elaboration of the proper quantum models. In this regard, the large-molecule (the natural as well as artificial) rotators represent one of the basic 'setups' for the desired nano- and quantum-technological procedures [1, 2, 3]. The theoretical models are rather simplified, e.g. [4], and hardly of any use for certain realistic physical situations. Nevertheless, to this end, an elaborate approach and the basic results have recently been put forward [5, 6].

The propeller-shaped large-molecules rotators can be modeled by a single (rotational) degree of freedom as a rigid system that is open to the environmental influence and can be modelled by the so-called Caldeira-Leggett master equation [7]. The model argues for the linear dependence of both the moment of inertia and the damping

factor on the number N of blades of the propeller [5, 6]. A number of interesting theoretical predictions regarding stability of rotation are obtained exhibiting nontrivial (including nonlinear) dependence on the N .

Interestingly, in effect, some kind of *optimization*, which is characteristic for the macroscopic classical engineering, is needed for the proper control of the molecular rotators even for the one-dimensional model. The desired quantum optimal-control methods are in infancy yet.

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