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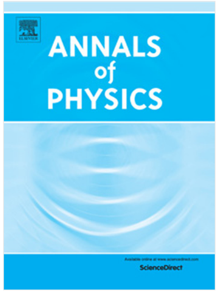

Contact manifolds and dissipation, classical and quantum

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Contact manifolds and dissipation, classical and quantum

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Abstract

Motivated by a geometric decomposition of the vector field associated with the Gorini–Kossakowski–Lindblad–Sudarshan (GKLS) equation for finite-level open quantum systems, we propose a generalization of the recently introduced contact Hamiltonian systems for the description of dissipative-like dynamical systems in the context of (non-necessarily exact) contact manifolds. In particular, we show how this class of dynamical systems naturally emerges in the context of Lagrangian Mechanics and in the case of nonlinear evolutions on the space of pure states of a finite-level quantum system.

Keywords: Contact manifolds, Dissipation, Nonlinear Schrödinger equation, Lagrangian and Hamiltonian Mechanics, General linear group, GKLS equation

1. Introduction

The advent of Quantum Technologies has boosted the interest in the foundational and phenomenological aspects of quantum mechanics. In particular, entanglement, one of the most important characteristic features of quantum mechanics, has stressed the role of environment in our description of physical systems. In general, the description of the dynamical evolution of a given system, when this system is correctly thought of as a subsystem of a larger one and the evolution is obtained as a suitable reduction of the evolution of the larger system, is in terms of density states or "density matrices" or "density operators" undergoing a transformation which is no more unitary, and we say the system is dissipative.

Dissipation is playing an increasing role in the description of dynamical systems. This is in part due to the interest in describing open quantum systems in relation with many physical applications like quantum computing, quantum information and quantum thermodynamics. While in classical physics the "coupling" with the environment may

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