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Announcement

Seminar on Deformation Quantization

8. 7. 2022 at 2pm CEST

Seminar in SE 31

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Quantum Theories and their Classical Limit: a C^*-Algebraic Approach

Quantization refers to the passage from a classical to a corresponding quantum theory. This notion goes back to the time that the correct formalism of quantum mechanics was beginning to be discovered. The converse problem, called the classical limit of quantum theories, is considered as a much more difficult issue and forms an important question for various areas of modern mathematical physics. As opposed to most traditional methods where one typically aims to obtain quantum mechanics from classical methods, this talk is based on quantization (more precisely, deformation quantization) as the study of the possible correspondence between a given classical theory, defined by a Poisson algebra or a Poisson manifold and possibly a (classical) Hamiltonian, and a given quantum theory, mathematically expressed as a certain algebra of observables or a pure state space. On the basis of this understanding quantization and the classical limit are two sides of the same coin.

In this talk I will present these ideas, first by introducing a natural framework based on the theory of C^*-algebraic deformation quantization. Subsequently, I will show how this relates to the classical limit of quantum theories. More precisely, the so-called quantization maps allow to take the limit for $\hbar \to 0$ of a suitable sequence of algebraic states induced by $\hbar$-dependent eigenvectors of several quantum models, in which the sequence typically converges to a probability measure on the pertinent phase space.

In addition, since this C^*-algebraic approach allows for both quantum and classical theories, it provides a convenient way to study the theoretical concept of spontaneous symmetry breaking (SSB) as an emergent phenomenon when passing from the quantum realm to the classical world by switching off a semi-classical parameter. This is illustrated with several physical models, e.g. Schrödinger operators and mean-field quantum spin systems.

Invited by Stefan Waldmann