

Propagation of correlations in quantum systems of many particles and kinetic equations

Thursday, 24 September 2026 10:30 (20 minutes)

The talk provides an overview of recent progress in the mathematical understanding of kinetic equations that govern quantum systems with many particles.

The talk will begin by discussing an approach to describing the evolution of correlations in systems of many quantum particles. This method is based on the von Neumann hierarchy of evolution equations for a sequence of correlation operators or cumulants of the density operators. It will be proved that the constructed dynamics of correlations underlie the description of the evolution of the state, both for finitely and infinitely many quantum particles, governed by the BBGKY hierarchy for reduced density operators or by the hierarchy of nonlinear evolution equations for reduced correlation operators.

Furthermore, this discussion will demonstrate that the concept of cumulants of the groups of operators for the von Neumann equations underlies nonperturbative solutions to hierarchies of fundamental equations that describe the evolution of observables and of the state of many quantum particles, as well as forming a foundation for the kinetic description of their collective behavior.

The talk will also introduce a new approach to the problem of a rigorous description of kinetic evolution using reduced observables. One of the advantages of the developed approach to deriving kinetic equations from the underlying dynamics of many particles is the ability to construct kinetic equations that incorporate initial correlations and to describe the processes of propagating these initial correlations under appropriate scaling approximations.

References

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