12.06.2018 / 10 Uhr c.t., Raum MG 272
Campus Duisburg

Dynamical Quantum Typicality: Concept and Applications

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The concept of typicality states that a single pure state can have the same properties as the full statistical ensemble. This concept is not restricted to specific states and applies to the overwhelming majority of all possible states, drawn at random from a high-dimensional Hilbert space. In the cleanest realization, even a single eigenstate of the Hamiltonian may feature the properties of the full equilibrium density matrix, assumed in the well-known eigenstate thermalization hypothesis. The notion of property is manifold in this context and also refers to the expectation values of observables. Remarkably, typicality is not only a static concept and includes the dynamics of expectation values. Recently, it has become clear that typicality even provides the basis for powerful numerical approaches to the dynamics and thermalization of many-body quantum systems at nonzero temperatures. These approaches are in the center of my talk.

I demonstrate that typicality allows for significant progress in the study of real-time relaxation. To this end, I review numerical work [1-3] on correlation functions of integrable systems. A comprehensive comparison with state-of-the-art methods verifies that typicality is satisfied in finite systems over a wide range of temperature. Moreover, without the restriction to small systems or short times, typicality sheds light on several long-standing questions. As important examples, I discuss the existence of current relaxation [1] and the emergence of diffusion [2,3] in isolated systems.

References

[1] R. Steinigeweg, J. Gemmer, and W. Brenig, PRL 112, 120601 (2014); PRB 91, 104404 (2015).
[2] R. Steinigeweg, F. Jin, D. Schmidtke, H. De Raedt, K. Michielsen, and J. Gemmer, PRB 95, 035155 (2017).
[3] R. Steinigeweg, F. Jin, H. De Raedt, K. Michielsen, and J. Gemmer, PRE(R) 96, 020105 (2017).

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

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