The Abdus Salam
International Centre
for Theoretical Physics
50th Anniversary 1964-2014

Workshop on Coherent Phenomena in Disordered Optical Systems
26 - 30 May 2014, Trieste, Italy

Chaos, Relaxation and Thermalization in Isolated Quantum Systems of Interacting Particles

F.M. IZRAILEV
Institute of Physics, BUAP, Puebla, Mexico,
and Michigan State University, USA

Abstract:

First, we shortly discuss old results concerning the onset of chaos and thermalization in isolated systems of interacting Fermi and Bose particles. We demonstrate that when stationary eigenstates of the Hamiltonian are fully chaotic inside the energy shell, the conventional Fermi-Dirac and Bose-Einstein distributions can emerge provided the inter-particle interaction is strong enough.

Next, we discuss recent results obtained for few dynamical systems of interacting 1/2-spins. Numerical data manifest the onset of chaos and statistical relaxation to a steady state distribution, occurring regardless of whether the system is integrable or not. We present the semi-analytical approach to identify the emergence of chaos, in correspondence with many-body delocalization restricted by the energy shell. The latter is determined by the strength function (SF) known as analogue of the LDOS in solid-state physics. We also show that the quench dynamics of deterministic systems can be described by analytical results obtained for two-body random matrix models.

1. V.V.Flambaum, F.M.Izrailev, "Statistical Theory of Finite Fermi-Systems Based on the Structure of Chaotic Eigenstates", Phys. Rev. E 56 (1997) 5144.

2. L.F.Santos, F.Borgonovi, F.M.Izrailev, Phys. Rev. Lett. 108 (2012) 094102; Phys. Rev. E. 85 (2012) 036209.