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Title: Dynamics of complex systems through the prism of adiabatic transformations

Adiabatic transformations show up in many areas of physics from semiclassical Bohr-Sommerfeld quantization to such topics as quantum geometry and construction of effective low energy models. In this talk I will discuss the definition and some basic properties of the Adiabatic Gauge Potential (AGP)- the generator of such transformations both in quantum and classical Hamiltonian systems. In particular, I will highlight its connection to the low frequency noise. Then I will show how using the concept of the AGP allows one to systematically go beyond Born-Oppenheimer approximation naturally separating quantum and classical degrees of freedom. I will also discuss how one can use the notion of adiabatic complexity encoded in the quantum geometric tensor (norm of the AGP), to naturally define chaos, integrability and ergodicity both in quantum and classical systems. I will argue that integrable and ergodic/mixing regimes are generically separated by an intermediate KAM-like phase where the adiabatic complexity is maximal and which is characterized by very slow relaxation dynamics. In many-particle systems this phase is usually transient in the thermodynamic limit.