University of Crete
**Department of Physics**

# *Physics Colloquium*

Thursday, 9 November 2023 | 17:00 – 18:00, Seminar Room 3rd Floor

# The weak breakdown of ergodicity in interacting quantum systems


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## ABSTRACT


*Understanding the long-term dynamics of interacting quantum systems is a crucial question in quantum physics, with implications extending beyond theoretical exploration. Advances in the development of digital and analog synthetic quantum materials, the efficient utilization of quantum computation, and the effective engineering and manipulation of entangled quantum states, all require a deep comprehension of how quantum matter thermalizes.*

*In this talk, I will explain the fundamental concepts underpinning our current understanding of thermalization of interacting quantum matter, a phenomenon known as the Eigenstate Thermalization Hypothesis (ETH), wherein the system behaves as its own thermal reservoir. Subsequently, I will illustrate how recent experiments employing Rydberg Atom Arrays [1] have indicated the emergence of a new mechanism resulting in a weak violation of ETH [2]. This mechanism, termed quantum many-body scars (QMBS), suggests the intriguing coexistence of thermal and a limited number of non-thermal many-body eigenstates at the same energy density. I will describe the phenomenology that allows for the stability of QMBS. Specifically, I will present insights towards formulating a quantum analog of the Kolmogorov-Arnold-Moser theorem, by showing how a quantum system, can manifest both chaotic and regular behavior [3]. Finally, I will demonstrate how QMBS facilitates the effective manipulation of entangled quantum states [4] and propose areas for future research.*



*[1] Bernien et al Nature 551 (2017)*
*[2] Turner AM et al Nat Phys 14 (2018)*
*[3] AM et al PRX 10, 011055 (2020)*
*[4] Bulvstein AM et al Science 371 (2021)*