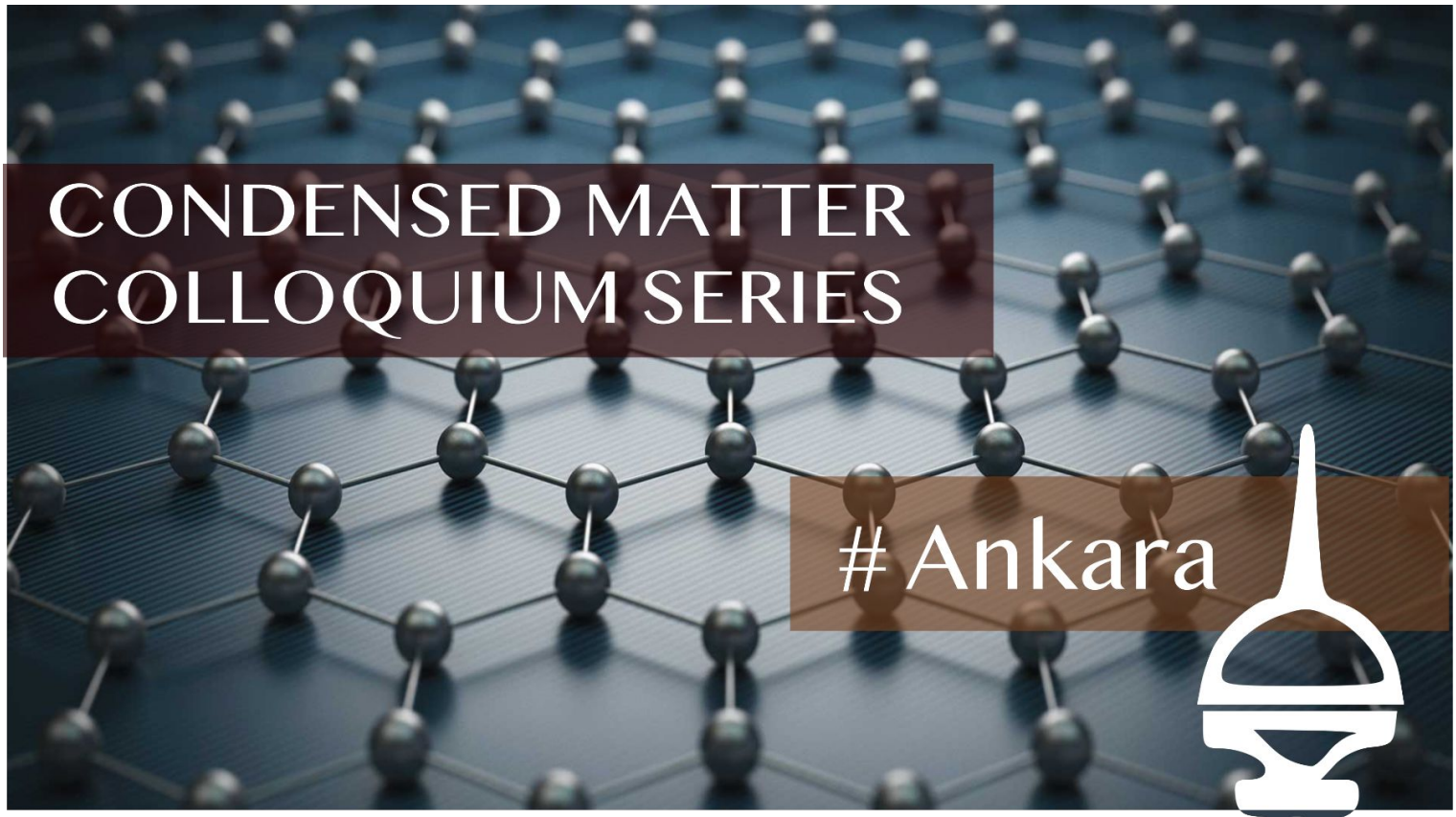

Ceren Dag

Harvard University

Breaking ergodicity: quantum scars, quantum many-body scars and regular eigenstates

Quantum many-body scars (QMBS) consist of a few low-entropy eigenstates in an otherwise chaotic many-body spectrum and can weakly break ergodicity resulting in robust oscillatory dynamics. The notion of QMBS follows the original single-particle scars introduced within the context of quantum billiards, where scarring manifests in the form of a quantum eigenstate concentrating around an underlying classical unstable periodic orbit (UPO). A direct connection between these notions remains an outstanding question. Here, I will first show that a spinor condensate, owing to its collective interactions, is amenable to the diagnostics of scars.

We characterize this system's rich dynamics, spectrum, and phase space, consisting of both regular and chaotic states. The former are low in entropy, violate the Eigenstate Thermalization Hypothesis (ETH), and can be traced back to integrable effective Hamiltonians, whereas most of the latter are scarred by the underlying classical UPOs, while satisfying ETH. I will exhibit the evidence on how the existing QMBS in the literature are akin to the regular states, rather than the quantum scars. Then I will move on to introduce a spatially many-body model with a mean-field limit by decreasing the range of the interactions. Remarkably, we find that UPOs affect the early-time many-body dynamics giving rise to a new type of QMBS. I will classify the QMBS in two main classes, discuss their distinct properties, and show how both QMBS states show up in our model in different parameter regimes. This talk aims (i) to clarify the connection of QMBS to quantum scars and regular eigenstates, and (ii) illustrate the fundamental principle of classical-quantum correspondence in a many-body system, and its current limitations.

April, 9
Tuesday

19:00, (Ankara Time)

Click here for zoom link
Meeting ID: 432 931 6595
Password: 326852

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