"Reinforcement Learning to Autonomously Control Strongly Periodically-Driven Systems"

Marin Bukov
Department of Physics, University of California, Berkeley, USA

Periodically-driven (Floquet) systems have emerged as a reliable toolbox to engineer states of matter otherwise inaccessible in static condensed matter systems. Examples include artificial gauge fields, topological and dynamically stabilized matter, and synthetic dimensions, just to name a few. The applicability of Floquet engineering requires the stability of the periodically driven system to detrimental heating, and the ability to prepare the system in the corresponding Floquet state. Currently, the state of the art in controlling Floquet steady states is the slow variation of parameters, yet the adiabatic limit does not exist. In this talk, I show that Reinforcement Learning, one of the most promising fields of artificial intelligence, can be used to autonomously steer quantum systems into Floquet-engineered states in the presence of strong periodic drives, by only using the information available rom quantum measurements. I will introduce the ideas of Floquet engineering using the paradigmatic example of the Kapitza pendulum, and demonstrate that an RL agent can reach the Floquet eigenstate at the inverted position with pretty good fidelity even in the presence of noise or occasional "failure" of the control apparatus. Thus, ideas from RL can be used to control quantum engineered matter far away from equilibrium.