Anderson Localization and Many-Body Localization in Time Crystals

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Apart from Anderson localization in the configuration space and in the momentum space, yet another type is possible: Anderson localization in the time dimension due to the presence of disorder in time. In interacting many-body systems, the temporal disorder can result in many-body localization. These are examples of condensed matter phenomena which can be observed in time crystals. Experimentally localization in the time dimension can be realized in systems ranging from driven ultra-cold atoms to a Rydberg electron perturbed by fluctuating microwave field. Moreover, if the interaction strength between ultra-cold atoms is modulated in a disordered way in time, it is possible to create Anderson molecules: bound states of atoms that form not due to attractive interactions between atoms but due to destructive interference.