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Quantum thermalization and many-body Anderson localization

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A standard assumption in statistical mechanics is that the internal dynamics of a closed, interacting system of many degrees of freedom will bring the system to thermal equilibrium in the limit of long time. For many systems this is indeed true and that is the process of quantum thermalization, whereby the system is able to act as a "bath" for itself and thus under its own unitary quantum dynamics bring its subsystems to thermal equilibrium. But there are other systems that fail to be a bath for themselves due to being many-body Anderson localized. In such systems, there can be a novel dynamic quantum phase transition between the thermal phase that does thermalize and the many-body localized (MBL) phase that does not. This is a thermodynamic phase transition, but not in the usual sense of that phrase: in the thermal phase equilibrium thermodynamics does emerge at long time from the system's dynamics, while in the MBL phase equilibrium thermodynamics fails to emerge. I will review some recent developments in this fascinating topic.