# Probing Many-Body Localization with synthetic ultracold matter: Interplay between ergodicity and localization

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A generic alternative to thermalization in isolated quantum systems is provided by the phenomenon of Many-Body Localization (MBL). In such a phase, global transport is absent and the system can remember local information even at very long times.

However, such a phase is exactly defined only in an absolutely isolated system. Therefore, it becomes extremely important to understand the interplay of MBL systems with bath like structures. In particular, we study a minimal system where we look at the effect of coupling identically disordered MBL systems with each other and ask - "Can these localized systems collectively serve as a bath for one-another and delocalize the entire system?" We find that MBL is indeed *unstable* to such a coupling and generically delocalizes. Further, we find that the behavior is strikingly different from Anderson Localization, which remains *stable* to such a coupling. In such a system, the geometry of the system protects the delocalized modes and on coupling them with localized modes, they delocalize the entire system. I will briefly comment on interplay of a large Markovian bath and an MBL system[3].

If time permits, I would also show a glimpse of our recent works on driven MBL systems and the studies of critically slow relaxation around the MBL critical point.

References:

1. Observation of many-body localization of interacting fermions in a quasirandom optical lattice: Schreiber et.al. Science 349, 842845 (2015)

2. Coupling Identical one-dimensional Many-Body Localized Systems: Bordia et.al. Phys. Rev. Lett. 116, 140401 (2016)

3. Lüschen et.al. (in preparation)