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Universal slow growth of entanglement in interacting strongly disordered systems MAKSYM SERBYN, Massachusetts Institute of Technology, ZLATKO PAPIC, DMITRY ABANIN, Perimeter Institute for Theoretical Physics — Localized phase of interacting particles has recently been shown to have a slow, logarithmic in time, growth of the entanglement entropy for initial product states. This property has been conjectured to distinguish the many-body localized phase from the ordinary Anderson insulator. In the present work we put this assumption on solid ground by uncovering the underlying mechanism of the entanglement generation. We show that the entanglement arises from dephasing due to exponentially small interaction-induced corrections to the eigenenergies of different states. For weak interactions, we find that the entanglement entropy grows as $\xi \ln(Vt/\hbar)$ with time t, where V is the interaction strength and ξ is the single-particle localization length. The saturated value of the entanglement entropy at long times is determined by the participation ratios of the initial state over the eigenstates of the subsystem. Our work shows that the logarithmic entanglement growth is a universal phenomenon characteristic of the many-body localized phase in any number of spatial dimensions, and reveals a broad hierarchy of dephasing time scales present in such a phase.

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