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Scaling Theory of Entanglement at the Many-Body Localization Transition PHILIPP T. DUMITRESCU, University of Texas at Austin, ROMAIN VASSEUR, University of California, Berkeley and Lawrence Berkeley National Laboratory, ANDREW C. POTTER, University of Texas at Austin — We study the universal properties of eigenstate entanglement entropy across the transition between many-body localized and thermal phases. Using a real space renormalization group approach, we can numerically simulate large system sizes and systematically extrapolate to the infinite system size limit. Unlike conventional critical points, the short interval entanglement depends non-locally on system size. In the infinite size limit, the entanglement only shows scaling on the localized side of the transition and jumps to its fully thermal value immediately upon entering the thermal phase. On the many-body localized side, the entanglement shows universal scaling intermediate between area and volume law behavior and consistent with a logarithmic dependence on interval size. The full distributions of scaling quantities show bimodal structure and infinite randomness behavior.

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