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Exponential Orthogonality Catastrophe in Single-Particle and Many-Body Localized Systems[1] DONG-LING DENG, J. H. PIXLEY, XIAOPENG LI, Dept. of Physics, University of Maryland — We investigate the statistical orthogonality catastrophe (StOC) in single-particle and many-body localized systems by studying the response of the many-body ground state to a local quench. Using scaling arguments and exact numerical calculations, we establish that the StOC gives rise to a wave function overlap between the pre- and post-quench ground states that has an *exponential* decay with the system size, in sharp contrast to the well-known power law Anderson orthogonality catastrophe in metallic systems. This exponential decay arises from a statistical charge transfer process where a particle can be effectively "transported" to an arbitrary lattice site. We show that in a many-body localized phase, this non-local transport and the associated exponential StOC phenomenon persist in the presence of interactions. We study the possible experimental consequences of the exponential StOC on the Loschmidt echo and spectral function, establishing that this phenomenon might be observable in cold atomic experiments through Ramsey interference and radio-frequency spectroscopy.

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