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An Operator Algebra Approach to Entropy Spread and Quantum Chaos

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In an interacting quantum system far from equilibrium, initially local information spreads into and melds with its environment. This has many manifestations, from entanglement spread in quantum quenches to environmental coupling induced by quantum channels. The rate of entropy spread is often difficult to calculate outside of free, perturbative or holographic regimes. We propose an operator algebra approach to the problem. The close connection between Rényi entropies and non-commutative measures has yielded strong results in the channel setting. We apply similar ideas to the setting of many-body quantum quenches, including in the SYK model. We discuss connections to chaos and rates of scrambling. For practical applications, we consider how our methods apply to decoherence in quantum computation and memory.

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