Lieb-Robinson bounds with exponential-in-volume tails

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We present Lieb-Robinson bounds for nested commutators, using the equivalence class framework of arXiv:1905.03682. These nested Lieb-Robinson bounds capture the enhanced suppression of extended operators in higher dimensions. We present two applications of these Lieb-Robinson bounds: (1) tighter bounds on disorder parameters and ground state splitting in spontaneous symmetry breaking states and (2) tight bounds on classical resources for simulation of quantum dynamics up to time t with error ϵ in dimension d. This talk is based on arXiv.2502.02652.