# Quantum speed and mode-entanglement in multipartite bosonic systems

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We revisit the problem of determining conditions under which a pure state, evolving under an arbitrary unitary transformation, reaches an orthogonal state in a finite amount of the transformation parameter. Simple geometric considerations disclose the existence of a fundamental limit for the minimal amount required, providing, in particular, an intuitive hint of the Mandelstam-Tamm and the Margolus-Levitin bounds. The geometric considerations leads us to focus on a particular, yet relevant, family of states that evolve towards orthogonality. Several dynamical features are discussed, which include the (relative) entropy production during transformation, and special attention is paid to multipartite systems of N bosons that are allowed to tunnel between two sites. The effects of the tunneling in the amount of transformation required for the system to attain an orthogonal state are revealed, and the relation between the latter, the tunneling intensity and the mode-entanglement is explored.

[1] Andrea Valdés-Hernández and Francisco J. Sevilla, J. Phys. A: Math. Theor. 54 (2021) 025301.