The induced order of quantum distinguishability and quantum speed limit

Francisco J Sevilla, Andrea Valdés-Hernández, and Alan Josep Barrios de la Cruz

Instituto de Física, Universidad Nacional Autónoma de México, Circuito de la Investigación Científica S/N, Coyoacán, Mexico

We present a comprehensive analysis of the set of energy probability distributions, $\{r_i\}$, that give rise to pure qutrits that evolve towards a distinguishable state at a finite time, when evolving under an arbitrary and time-independent Hamiltonian (it generalizes in this case the results presented in Ref. [1]). The orthogonality condition is exactly solved, revealing a non-trivial interrelation between τ and the energy spectrum, and allowing the classification of $\{r_i\}$ into families organized in a 2-simplex, δ^2, contained in the probability 2-simplex of R^3. Furthermore, the states determined by $\{r_i\}$ are likewise analyzed according to their quantum-speed limit. Namely, we construct a map that distinguishes those distributions $\{r_i\}$ in δ^2 correspondent to states whose orthogonality time is limited by the Mandelstam-Tamm bound, from those restricted by the Margolus-Levitin one. Our results offer a complete characterization of the physical quantities that become relevant both in the preparation and in the study of the dynamics of 3-level states evolving towards orthogonality.

[1] Andrea Valdés-Hernández and Francisco J. Sevilla, A new route toward orthogobality, Journal of Physics A: Mathematical and Theoretical 54 (2) (2021), 025301 (2021). arXiv:2009.03478 [quant-ph].

[2] Francisco J. Sevilla, Andrea Valdés-Hernández and Alan J. Barrios, The underlying order induced by orthogonality and the quantum speed limit, arXiv:2104.01802 [quant-ph].