Separable states with unique decomposition

Seung-Hyeok Kye

Seoul National University
kye@snu.ac.kr

18 Workshop, Będlewo 2018

Abstract

Entanglement is considered as one of the key resources in the current quantum information theory. Recall that a multi-partite state is said to be separable if it is a convex combination of pure product states. A non-separable state is called entangled. It is an important research topic to distinguish entanglement from separability, which is known to be NP-hard in general. We note that the boundary between separability and entanglement consists of faces of the convex set $\mathbb{S}$ of all separable states. In this context, it is important to understand the facial structures of the convex set $\mathbb{S}$.

In this talk, we look for faces of $\mathbb{S}$ which are affinely isomorphic to a simplex, which is called a simplicial face. This is equivalent to search for separable states with unique decomposition into the sum of pure product states. It is known that if a separable state has sufficiently small rank then it has a unique decomposition. We exhibit in this talk examples of separable states with unique decomposition whose ranks are full. More precisely, we construct one parameter families of faces isomorphic to the 9-dimensional simplex Δ_9 with ten extreme points, in the three qubit system. These also provide examples of three qubit separable states whose lengths are strictly bigger than the whole dimension.