AN ALTERNATIVE REPRESENTATION FOR SYMMETRIC STATES OF QUBITS

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Introduction. With this work [1] we prove that the vast majority of symmetric states of qubits (quantum 2-dimensional systems) can be decomposed in a unique way into a superposition of spin 1/2 coherent states. This novel representation forms an alternative to the usual decomposition over Dicke states [2], or the geometric Majorana representation [3]. As an application, we employ the proposed decomposition for classifying the entanglement properties of symmetric states.

Methods. In order to prove the existence and uniqueness of the representation we employ methods from linear algebra and complex analysis. In addition, we attribute a geometric representation to our decomposition with the help of stereographic mapping of complex numbers on the Riemann sphere. Finally, concerning the application of the decomposition on entanglement classification, we employ group theoretical tools and previously obtained knowledge from the theory of quantum multipartite entanglement [4].

Results and discussion. The proposed representation is valid for the vast majority of symmetric states and we conjecture that its validity is strongly connected with the presence of genuine multipartite entanglement in the states. The representation can be considered as a multipartite generalization of the Schmidt decomposition which is known to be valid only in the bipartite case. It carries on the very useful features of the later while it bears a geometric interpretation just like Majorana representation for symmetric states.

Conclusions. Symmetric states span the same space as spin J systems, are of use in quantum optics and form a good test-ground for quantum theory. The proposed decomposition sheds new light on our understanding of these states, and provides a new mathematical tool for representing and eventually manipulating them.

References.

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