Abstract

One of the key manifestations of quantum mechanics is the phenomenon of quantum entanglement. While the entanglement of bipartite systems is already well understood, our knowledge of entanglement in multipartite systems is still limited. This dissertation covers various aspects of the quantification of entanglement in multipartite states and the role of symmetry in such systems. Firstly, we establish a connection between the classification of multipartite entanglement and knot theory and investigate the family of states that are resistant to particle loss. Furthermore, we construct several examples of such states using the Majorana representation as well as some combinatorial methods. Secondly, we introduce classes of highly-symmetric but not fully-symmetric states and investigate their entanglement properties. Thirdly, we study the well-established class of Absolutely Maximally Entangled (AME) quantum states. On one hand, we provide construction of new states belonging to this family, for instance an AME state of 4 subsystems with six levels each, on the other, we tackle the problem of equivalence of such states. Finally, we present a novel approach for the general problem of verification of the equivalence between any pair of arbitrary quantum states based on a single polynomial entanglement measure.