(Multipartite) entanglement theory in quantum information processing

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Quantum mechanics is mathematically and philosophically very different from classical mechanics. In the last decades it has been realized that if we develop enough experimental control, we can exploit this difference to build radically new technology. This has given rise to quantum information theory (gathering scientists from mathematics, physics and computer science) which offers revolutionary ways to transmit and process information such as quantum cryptography and quantum computation. A property of composite quantum states known as entanglement plays a fundamental role in these tasks and it is therefore regarded as a resource. This has led to the development of entanglement theory, which aims at characterizing entangled states, identifying which transformations among them are possible and quantifying how useful they can be. In this talk, in which I assume that the audience is not necessarily familiar with quantum theory, I will introduce the rules of the quantum game and the concept of entanglement. Then, I will review the basics of entanglement theory and explain a few important results for the bipartite case. At the end, I will present a few results of my own for the much more poorly understood case of multipartite systems. During the talk, I will try to put the emphasis on giving the audience a good idea of the mathematical tools and problems being dealt with in this context.