Multipartite Entanglement in Critical Systems

Dr. Gabriele De Chiara
Queens University Belfast

Nowadays it is well accepted that there exists a connection between the entanglement content of a many-body quantum state and its critical properties close to a quantum phase transition. In this contribution I will show that there is a more intimate relationship between the entanglement spectrum of the ground state of a one-dimensional spin chain and the order parameter characterizing its phase. Using the density matrix remormalization group, I will prove that the so called Schmidt gap, the difference of the two largest eigenvalues of the reduced density matrix of half the chain, scales with universal critical exponents [1].

Furthermore I will discuss a technique, based on witness operators, to detect genuine tripartite entanglement of a system composed of three qubits. As an application I consider three qubits embedded in a one dimensional XXZ spin chains and I will show the emergence of tripartite entanglement close to the model phase transition. Surprisingly, this multipartite entanglement survives beyond nearest neighbours [2].

References:
[1] G. De Chiara, L. Lepori, M. Lewenstein, A. Sanpera, Phys. Rev. Lett. 109, 237208 (2012)
[2] J. Stasinska, B. Rogers, G. De Chiara, M. Paternostro, and A. Sanpera, arxiv:1305.6225