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Symmetry Resolved Entanglement in Quantum Systems and Gravity

Quantum entanglement is the key resource employed in modern quantum computation. Different entanglement measures such as the entanglement entropy and Renyi entropies also provide useful information about the entanglement structure of quantum field the- ories, in particular at critical points. I will discuss the symmetry resolved entanglement and Renyi entropies, a fine-grained version of the usual entanglement and Renyi entropies, both in the context of quantum field theory and AdS/CFT. In the presence of global con- served charges, they quantify the entanglement content of the reduced density matrix in a fixed charge sector. These entanglement measures can in particular be calculated in two- dimensional conformal field theories with U(1) Kac-Moody structure at level k, and are found to not depend on the value of the charge [1, 2]. This charge independence is called equipartition of entanglement, and implies that no charge sector is distinguished in terms of its entanglement content. Finally, I will discuss the symmetry resolved entanglement in the AdS3/CFT2 dual of the U(1) Kac-Moody CFT [1, 2]. Agreement with CFT results provides a further test of the AdS3/CFT2 correspondence. I finish with recent results [3] about the violation of the equipartition property in CFTs with W3 symmetry, and their AdS3/CFT2 dual in higher spin gravity.

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[2] K. Weisenberger, S. Zhao, C. Northe, and R. Meyer, Symmetry-resolved entanglement for excited states and two entangling intervals in ads3/cft2, Journal of High Energy Physics 2021 (2021), no. 12 1–31.
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