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Quantumness and entanglement in quantum measurements

Given a multipartite system, we study the entanglement established between the system and a set of measurement apparatus used to perform local complete projective measurements. We prove that distillable entanglement is necessarily created by the measurement interaction unless the correlations between the subsystems to be measured are strictly classical. We thus quantify the amount of *quantumness of correlations* between the original subsystems by the minimum entanglement necessarily established in such an interaction. We prove that the quantumness so quantified is always greater than the entanglement between the original subsystems, independently of the measure of entanglement used. We apply our approach and results to the analysis of the spreading of (multipartite) entanglement and quantumness along a von Neumann chain.