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**A Unified View of Quantum and Classical Correlations with Applications**

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Abstract:

We ask if entanglement captures all there is to the "quantumness" of correlations?

We start by putting quantum entanglement and other measures of quantumness, such as quantum discord and classical correlations, on an equal footing. This allows us to carry out cross comparative studies for several applications where correlations play a crucial role.

We then analyse two tasks: deterministic quantum computation with one qubit and quantum metrology with mixed states. In the former, we will show that within specific limits quantum correlations (including discord and entanglement) vanish, yet a classically hard task is carried out with an exponential speed up. Yet, for the latter task, if the mixedness of the probe is fixed, we find that square of  $N$  advantage is retained independently of entanglement, but with quantum discord present. Finally we question how entanglement and quantum discord are related and attempt to shed light on a seemingly contradictory situation.