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Quantifying Quantumness DANIEL BRAUN, University Toulouse and CNRS, OLIVIER GIRAUD, CNRS, PETER A. BRAUN, University Duisburg-Essen — We introduce and study a measure of "quantumness" of a quantum state based on its Hilbert-Schmidt distance from the set of classical states. "Classical states" were defined earlier as states for which a positive P-function exists, i.e. they are mixtures of coherent states [1]. We study invariance properties of the measure, upper bounds, and its relation to entanglement measures. We evaluate the quantumness of a number of physically interesting states and show that for any physical system in thermal equilibrium there is a finite critical temperature above which quantumness vanishes. We then use the measure for identifying the "most quantum" states. Such states are expected to be potentially most useful for quantum information theoretical applications. We find these states explicitly for low-dimensional spin-systems, and show that they possess beautiful, highly symmetric Majorana representations.

[1] Classicality of spin states, Olivier Giraud, Petr Braun, and Daniel Braun, Phys. Rev. A 78, 042112 (2008)

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