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Entropy of quantum states

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In a theory with superselections rules, a state can be represented by different density matrices. As a result, different von Neumann entropies can be associated with the same state. Motivated by a minimality property of the von Neumann entropy of a density matrix with respect to its possible decompositions into pure states, we give a purely algebraic definition of entropy for states of an algebra of observables, thus solving the above ambiguity. The entropy so defined satisfies all the desirable thermodynamic properties, and reduces to the von Neumann entropy in the quantum mechanical case. Moreover, it can be shown to be equal to the von Neumann entropy of the unique representative density matrix belonging to the operator algebra of a multiplicity-free Hilbert-space representation.

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