Nonclassical correlation and information causality

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I. ABSTRACT

We consider classical and nonclassical correlations in a given quantum state. It has been a natural goal to quantify the degree of correlation in any given state, and also to quantify to what extent the correlations are of a quantum or of a classical nature. We consider the classical correlations that two observers can extract by measurements on a bipartite quantum state, and we discuss how they are related to the quantum mutual information of the state. We show how complementarity gives rise to a gap between the quantum and the classical correlations, and we relate our quantitative finding to the so-called classical correlation locked in a quantum state. We derive upper bounds for the sum of classical correlation obtained by measurements in different mutually unbiased bases and we show that the complementarity gap is also present in the deterministic quantum computation with one quantum bit. Causality is a word that describes the relationship between a cause event and an effect event, it is a fundamental concept in all natural science. I shall also discuss information causality, and present quantitative conditions that any quantum information procedure satisfies.