

State-Independent Proofs of Bell's Theorem Without Inequalities and Bell Inequality for Four-Qubit System

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Abstract: A state-dependent proof of Bell's theorem without inequalities using the product state of any two maximally entangled states (Bell states) of two qubits for two observers in an ideal condition, each of which possesses two qubits, is proposed. It is different from the other proofs in which there exists a fundamental requirement that certain specific suitable Bell states have been chosen. Moreover, in any non-ideal situation, a common Bell inequality independent of the choices of the 16-product states is derived, which is used to test the contradiction between quantum mechanics and local reality theory in the reach of current experimental technology.

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Key words: Bell's theorem without inequalities, maximally entangled state, EPR pair

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