

An efficient test for product states

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We give a test that can distinguish efficiently between product states of n quantum systems and states which are far from product. If applied to a state ψ whose maximum overlap with a product state is $1-\epsilon$, the test passes with probability $1-\Theta(\epsilon)$, regardless of n or the local dimensions of the individual systems. The test uses two copies of ψ . We prove correctness of this test as a special case of a more general result regarding stability of maximum output purity of the depolarising channel.

One application of the test is to Quantum Merlin-Arthur games, where we show that a witness from two unentangled provers can simulate a witness from arbitrarily many unentangled provers up to a constant loss of soundness. Our test can also be used to construct an efficient test for determining whether a unitary operator is a tensor product.

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