A state $\rho$ of a quantum system composed of two subsystems $A$ and $B$ is called separable if it can be prepared by separately preparing the subsystems. A separable state can be expressed as $\rho = \sum_i p_i \rho_i^A \otimes \rho_i^B$, where $\sum_i p_i = 1$ and $\rho_i = |\psi_i\rangle \langle \psi_i|$. If such a convex linear combination does not exist, then the state is called entangled. This paper presents an explicit sufficient and necessary condition for separability of any quantum state represented by a rank-two density matrix on $\mathcal{H}_A \otimes \mathcal{H}_B$, where $\mathcal{H}_A$ and $\mathcal{H}_B$ are $M$-dimensional and $N$-dimensional complex Hilbert spaces, respectively.

Reviewed by Adán Cabello

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