Russian scientists make teleportation a 'two-way road' using the same quantum resource

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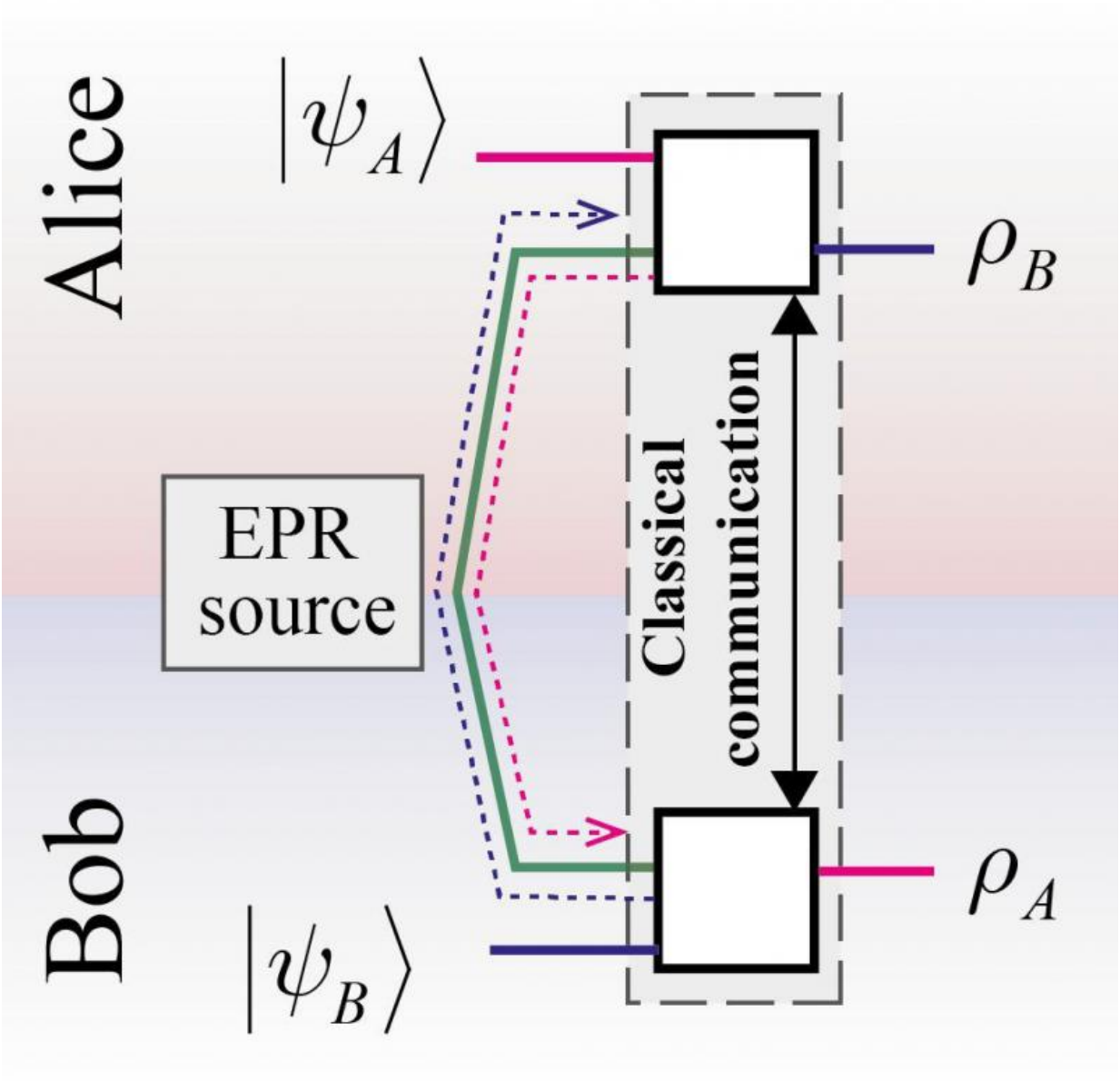

Credit: Russian Quantum Center

In quantum world teleportation is not a science fiction. But can teleportation be realized in both directions simultaneously? Scientists from Russian Quantum Center revealed that the answer is "yes". Moreover Alice and Bob can teleport quantum states of their bits (qubits) to each other using the same quantum resource as in the standard quantum teleportation protocol: preliminary shared pair of maximally entangled qubits (also known as Bell state), wrote Aleksey Fedorov and colleagues in a paper, recently published in *Physical Review A*.

In the original protocol Alice performs a joint measurement on a particle with the qubit state she wants transmit to Bob and a particle form the shared entangled pair. This measurement destroys the transmitted state on Alice's side together with initial entanglement of the pair. In the same time, Bob can reconstruct Alice's state on his particle from the pair using measurement outcome obtained from Alice via classical communication.

"In our approach, we propose slight modifications of the protocol: now Alice and Bob act in more symmetric and gentle way," said Fedorov.

Each of the parties performs soft measurements on their particles with states they want to transmit and particles from the entangled pair. This softness makes it possible to employ simultaneously the shared entanglement for bidirectional transmission and receiving of quantum information. Nevertheless, nothing comes free: the transmission of quantum states becomes imperfect and only noisy versions of input states could be obtained at the output.

"Using a duality between quantum states and channels (known as the

Choi-Jamiolkowski isomorphism) we show that such generalization of the seminal protocol demonstrates an interesting interplay between quantum entanglement and classical communication revealing a potential resource of entangled states for imperfect quantum state transmission", Fedorov noted.

More information: E. O. Kiktenko et al. Bidirectional imperfect quantum teleportation with a single Bell state, *Physical Review A* (2016). DOI: 10.1103/PhysRevA.93.062305

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