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Entangled state preparation enhanced by reinforcement learning
JUN-JIE CHEN[1], YOU LI[2], Tsinghua Univ — Fast and accurate generation of useful quantum states is fundamental to quantum information and quantum precision measurement physics. In actual applications, well-designed experimental protocols are called for. The recently developed learning frame of reinforcement learning (RL) can maximize a given reward by automatically exploring and exploiting without the necessity of any prior knowledge. This work reports our discovery of an efficient, effective, and high fidelity protocol with RL, that is capable of producing a target Twin-Fock state by driving external field from an initial polar state of a ferromagnetic spin-1 atomic Bose-Einstein condensate. For a small system of two atoms, we show that protocol from RL corresponds to the optimized one reaching the quantum speed limit. When illustrated in phase space, it clearly shows that the protocol from RL corresponds almost to a geodesic path connecting the initial and the target state. When applied to a many body system, we find that RL generally can offer a better solution than the old wisdoms such as adiabatic passage *etc.* can provide for. Furthermore, we find the RL protocol is robust to various types of noises in real experiments.

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