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Dissipative production of a maximally entangled steady state YI-HENG LIN, JOHN GAEBLER, NIST, FLORENTIN REITER, QUANTOP, The Niels Bohr Institute, University of Copenhagen, TING REI TAN, RYAN BOWLER, NIST, ANDERS SØRENSEN, QUANTOP, The Niels Bohr Institute, University of Copenhagen, DIETRICH LEIBFRIED, DAVE WINELAND, NIST, NIST COLLABORATION, QUANTOP, THE NIELS BOHR INSTITUTE, UNIVERSITY OF COPENHAGEN COLLABORATION — We combine unitary processes with engineered dissipation into a zero-temperature bath to deterministically produce and stabilize an approximate Bell state of two trapped-ion qubits independent of their initial state [arXiv:1307.4443]. We implement the process on a $^{9}Be^{+}$-$^{24}Mg^{+}$-$^{24}Mg^{+}$-$^{9}Be^{+}$ four-ion chain in a linear radio-frequency Paul trap. The two $^{9}Be^{+}$% ions serve as qubit ions while the two $^{24}Mg^{+}$ ions are used for sympathetic cooling as the zero-temperature bath. We simultaneously apply a combination of a unitary process consists of microwave and laser fields on $^{9}Be^{+}$ ions, and dissipative processes of optical pumping on $^{9}Be^{+}$% ions and sympathetic cooling on $^{24}Mg^{+}$ ions. We realize maximally entangled steady states with a fidelity of F = 0.75(3). We also demonstrate that a sequential stepwise application of unitary and dissipative process can speed up the dynamics of the scheme and achieve a fidelity of F = 0.89(2) after approximately 30 repetitions. In both cases, the errors can be attributed to known experimental imperfections.

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