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Quantum repeaters based on two-species trapped ion systems VLADIMIR MALINOVSKY, SRERAMAN MURALIDHARAN, SIDDHARTHA SANTRA, US Army Rsch Lab - Adelphi, LIANG JIANG, Applied Physics, Yale University, New Haven, CT 06511, CHRISTOPHER MONROE, Department of Physics, University of Maryland, College Park, MD 20742 — We consider the performance of quantum repeater architecture based on two-species co-trapped ion systems. One ion (Yb) provides a long-lived quantum memory while the other (Ba) serves as an optical communication qubit with high coupling efficiency. Our design includes quantum circuits that achieve intra-node Bell measurements between the ion-trap modules to perform entanglement-swapping locally within the nodes. Based on the fidelity of the required quantum operations and the currently available coupling efficiencies, we estimate the quantum key generation rates that can be achieved. We also analyze the dependence of the quantum key distribution rate on various experimental parameters, including coupling efficiency, gate infidelity, operation time and length of the elementary links.

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