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Mixing-Chamber Preamplifier for Spin Qubit Readout[1] MATTHEW CURRY, University of New Mexico, ANDREW MOUNCE, TROY ENGLAND, RONALD MANGINELL, JOEL WENDT, TAMMY PLUYM, STEPHEN CARR, MALCOLM CARROLL, Sandia National Laboratories — Spin qubit states are often read out with a nearby charge sensor. To improve signal-to-noise ratio (SNR) and bandwidth, we amplify a charge sensor with a low-current-bias, silicon-germanium heterojunction-bipolar-transistor (HBT) [Curry et al., APL 106, 203505 (2015)]. The HBT is located at the mixing chamber of a dilution refrigerator, which minimizes parasitic capacitance and amplifies signal before fridge noise is introduced. Using the HBT-charge-sensor circuit, we tune a few-electron quantum dot (QD) into resonance with a donor-like object and observe singlet-triplet (ST) behavior. ST separation in this MOS donor-implanted-QD molecular system is measured using magnetospectroscopy to be approximately 100 μeV. The low current bias of the HBT minimizes both heating of the charge-sensed QD as well as maintains an overall low power at the mixing chamber. HBT bias impact on QD electron temperature is examined and we find that the HBT preamplifier can operate at around 100 nW with a current gain of around 500 without influencing the electron temperature, which is around 150 mK. We will also examine single-shot readout of a charge state using the HBT preamplifier.

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