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Low noise, low jitter cryogenic amplifier for superconducting nanowire detectors.

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We present the development of a cryogenic Low-Noise Amplifier (LNA) for the readout of Superconducting Nanowire Single Photon Detectors (SNSPDs). The integrated circuit operates at 4 K and is based on fourth-generation heterojunction bipolar transistors from a state-of-the-art, commercially available SiGe BiCMOS platform, which allows large scale integration and economy of scale. Target specifications for the fully differential LNA include >20 dB gain, ~6 GHz BW, ~10 ps jitter, and <10 mW/channel. We discuss cryogenic modeling of the devices, design and test results of the prototypes (AC and DC coupled), the latest received in Feb 2021. The project is a collaboration between Fermilab, Georgia Tech, Caltech and JPL. The target application is low-noise, low-jitter single photon detection for high-speed quantum networks. The scalability of this technology, however, coupled with the availability of small feature size CMOS transistors on the same die, provides a path for the integration of a large number of low-noise, fast front end readout amplifiers, together with low-power digital backend logic for digital signal processing; thus enabling large, multi-Gbps SNSPD arrays for photon and particle detection, with direct application to QIST, HEP and NP programs.

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