V102a Demonstration of a Millimeter-wave Multibeam Receive Implemented with Superconducting MMICs

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Coherent focal plane array receivers are employed in radio astronomical observations for imaging celestial objects with high frequency resolution. At mm/sub-mm regime the complexity of coherent receiver frontends, which are conventionally constructed with metal waveguide circuits, imposes a limit on the number of pixels arrayed in the focal plane of a radio telescope and results in a narrow field of view. We have been developing an innovative approach to enable compact focal plane heterodyne detector arrays with SIS mixers for wide field-of-view astronomical observation at mm and sub-mm wavelengths.The new scheme is characterized by the adoption of silicon membrane-based waveguide probes, which allows superconducting monolithic microwave integrated circuits (MMICs) to couple signal and LO from CNC-machined waveguides through multiple paths. A 2 x 2 dual-polarization balanced SIS mixer array has been implemented with this scheme and assessed at 2 mm wavelengths. This compact array has demonstrated uniform LO distribution and low crosstalk between pixels. The RF performance of component pixels has been confirmed to be little affected by the high degree integration. The potential implementation of the HPI scheme at THz frequencies is also implied.