

Results from the Kilopixel Array Pathfinder Project (KAPPA): a 6mm × 6mm 650 GHz Heterodyne Mixer Pixel with Integrated SiGe LNA and Permanent Magnet

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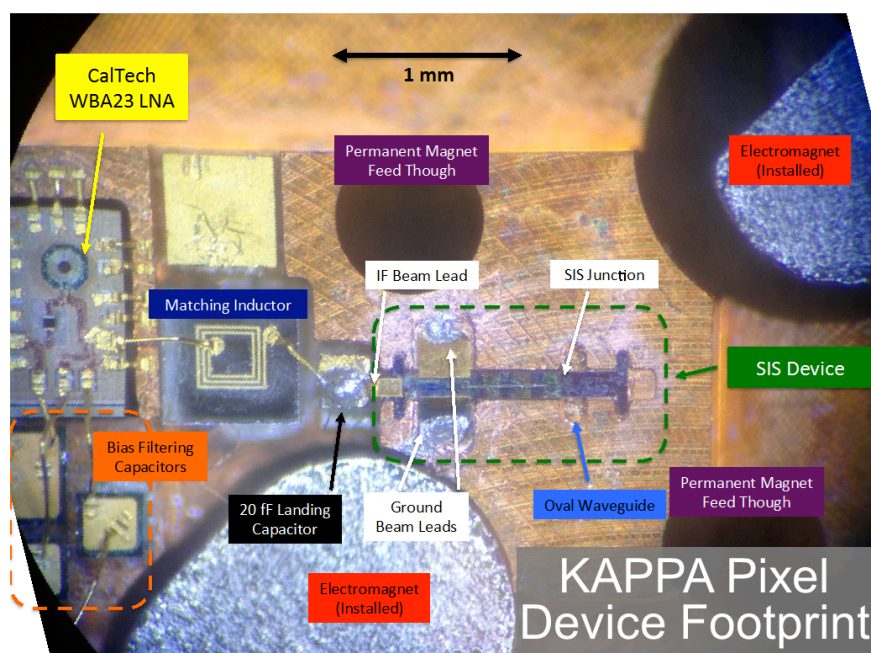
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Abstract—We present the results of the Kilopixel Array Pathfinder Project (KAPPA) instrument, a technology development project aimed at addressing several key technological issues confronting the expansion of heterodyne arrays to formats approaching ~1000 pixels. The KAPPA receiver was built to test an integrated 6mm × 6mm heterodyne pixel cell operating from 600-700 GHz. The pixel cell contains a single ended waveguide SIS mixer, IF matching network, low power dissipation SiGe LNA, IF output and permanent magnet all contained beneath the 6mm aperture of the waveguide feedhorn. This design allows the pixel cell to be tiled to arbitrary array size without mechanical interference from neighboring pixels. The KAPPA test receiver can house a tunable electromagnet, used to optimize the applied magnetic field and also a permanent magnet that applies a fixed field. Our permanent magnet design uses off-the-shelf neodymium permanent magnets and then reshapes the magnetic field using machined steel concentrators. These concentrators allow the use of an unmodified commercial permanent magnet in the back of the detector block while two small posts provide the required magnetic field across the SIS junction in the detector cavity. Performance of the test mixer meets the requirements for ALMA band 9 for most of the 600-720 GHz band, while retaining the simplicity and reliability needed for use in large format heterodyne array applications.



A micrograph of the assembled KAPPA pixel cell.