SuperCam: A 64 pixel superheterodyne camera

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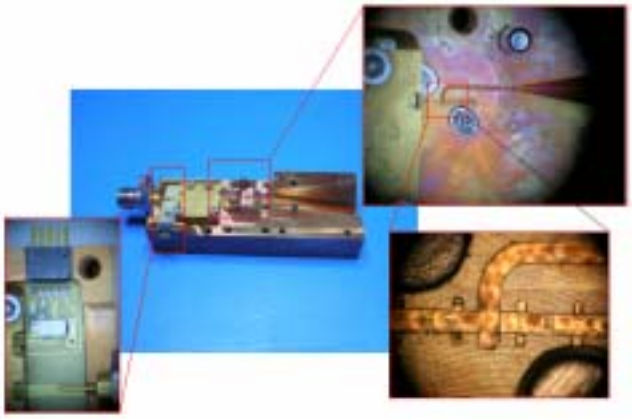
We report on the development of *SuperCam*, a 64 pixel, superheterodyne camera designed for operation in the astrophysically important 870 µm atmospheric window. *SuperCam* will be used to answer fundamental questions about the physics and chemistry of molecular clouds in the Galaxy and their direct relation to star and planet formation. The advent of such a system will provide an order of magnitude increase in mapping speed over what is now available and revolutionize how observational astronomy is performed in this important wavelength regime.

SuperCam is constructed by stacking eight, 1x8 rows of tunerless, SIS mixers. The SIS junctions use SOI (Silicon on Insulator) technology, with beamleads for device positioning and IF and ground electrical connections. The mixer modules are fabricated using a Kern MMP-2522 micromilling machine purchased specifically for this task. The IF output of each SIS device is directly connected to a low-noise, broadband MMIC amplifier module integrated into the mixer block. The instantaneous IF bandwidth of each pixel is 2 GHz, with a center frequency of 5 GHz. An IF processor constructed of eight 8-channel modules provides IF amplification, total power monitoring and baseband downconversion. A spectrum of the central 250 MHz or 500 MHz of each IF band is provided by an Omnisys real-time FFT spectrometer system, based on Xilinx Virtex 4 FPGAs. This spectrometer can operate in either 32 channel mode (500 MHz/channel) or 64 channel mode (250 MHz/channel). Local oscillator power is provided by a Virginia Diodes solid-state multiplier chain whose output is divided between the pixels with a matrix of waveguide power dividers. The mixer array is cooled to 4K by a closed-cycle cryostat with two cryocoolers. *SuperCam* will reside at the Cassegrain focus of the 10m Heinrich Hertz telescope (HHT) with a dedicated re-imaging optics system.

All subsystems of *SuperCam* have completed the development stage, and are now in fabrication or are already completed. We present results for the *SuperCam* LNA modules, integration of LNAs in a test mixer, IF processor performance, spectrometer performance, cryogenic system verification. Results from the fabrication, construction and testing of prototype SOI mixers, in both single pixel and 8 pixel versions will be shown, including end-to-end testing of the *SuperCam* system.



A prototype *SuperCam* single pixel mixer for SOI/Beamlead SIS junctions. This mixer is identical to a single channel in the *SuperCam* 1x8 mixer module.