The Supercam IF Processor: Back-end Technology for Large-Format Focal Plane Arrays

Glenn Jones*, Joseph Bardin, and Sander Weinreb
California Institute of Technology, Pasadena, CA 91125

Supercam is a 64 pixel focal plane array of superheterodyne receivers designed to observe the 870 um atmospheric window. The SIS junctions and cryogenic IF amplifiers have been optimized for an IF output in the 4-6 GHz range. These 64 signals must be down converted to baseband for digitization by the spectrometers. Previous, smaller arrays have accomplished this using off the shelf coaxial components. For 64 pixel and larger arrays, this is no longer practical nor cost effective. Fortunately, discrete RFICs are commercially available at low cost which can perform the same function. We have designed a printed circuit board module that is capable of filtering, downconverting, and amplifying eight IF signals. Thus the overall system is made up of eight such modules. Each channel provides independent control of the gain and selection between two band pass filters. Focusing and calibration require rapid, accurate measurements of the total power from each channel. Each total power detector drives a voltage to frequency converter which clocks a counter on an FPGA to provide true integrated total power. RFI was found to be a problem in the baseband amplification circuitry, so each PCB is mounted in an RFI-tight enclosure. Digital control signals enter the enclosure through a fiber optic link. The baseband outputs drive commercially available FPGA based spectrometers.

With 1000 element focal plane arrays on the horizon, it will be necessary to scale the back end systems. The current architecture is well suited to mass production, but the cost is dominated by the band pass filters. For arrays as small as 1000 pixels, a custom ASIC solution begins to look attractive. An alternative technique suitable for the upcoming hot-electron bolometer mixers is direct digitization of a 1-3 GHz IF. This reduces the analog circuit cost and complexity enormously, by moving the processing to an FPGA, and should improve stability.