

Cryogenic Detector Technology for Space Science Application

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We review the current status of detector development at NASA's Goddard Space Flight Center and address future prospect for space science application. In particular, the IR detector capability and applicability to second generation SOFIA instrument will be discussed. We will examine areas such as 3-dimensional hybridization of large format bolometer arrays to readout multiplexers; advanced light coupling scheme for planar ortho-mode transducer circuitry; integration of high density readout wiring for low temperature detector arrays; and microwave multiplexers for large format superconducting detector arrays.

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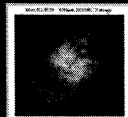
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Large Format Detector Arrays and Indium Hybridization to Readout Multiplexers

Semiconducting Bolometers for far-infrared imaging for the CSO/SHARC II and SOFIA/HAWC instruments



(384 Element Flight Array, 50 - 450 μm)



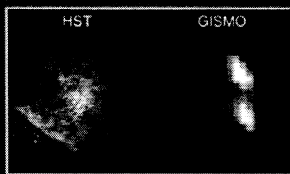
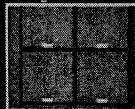
Star formation nearby shows multiple cores and outflows from young massive stars

Goddard/IRAM 2mm Camera "GISMO"

8x8 prototype array

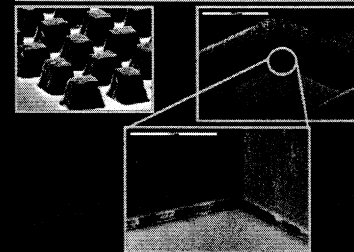
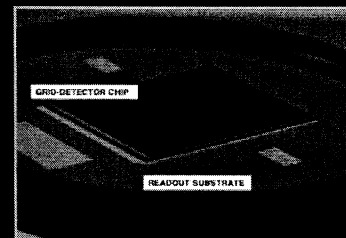


Enlargement of Pixels

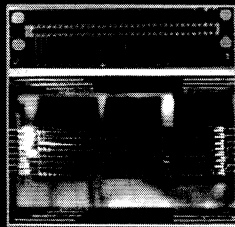


2mm wavelength, 8x16 array
Features 128 pixels = 2.2' x 4.4' FOV, with 17" resolution

Indium Bonded Mechanical Models

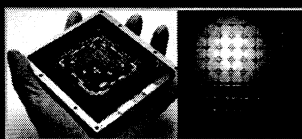


Transition Edge Sensor Detector Arrays for Atacama Cosmology Telescope



ACT camera will consist of 3 1024-element arrays from NASA/GSFC

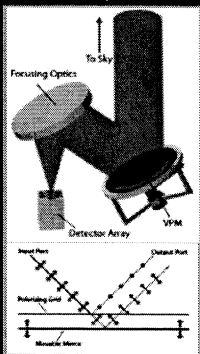
Green Bank Telescope 3mm camera



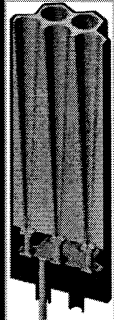
3.3mm wavelength, 8x8 array
Features 64 pixels = 32" x 32" FOV, with 8" resolution

CMB Polarization Detectors

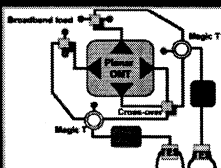
Polarization modulation prior to the main aperture



Light coupled from platelet feedhorn arrays to planar detector circuits

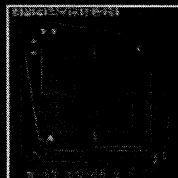


Superconducting Planar Microwave Circuits

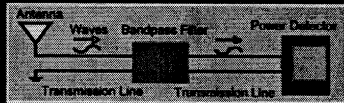


A planar "Magic-T" hybrid to introduce 180 degree phase shift and mix the signals from each of the polarizations.

Polarimeter chips in fabrication

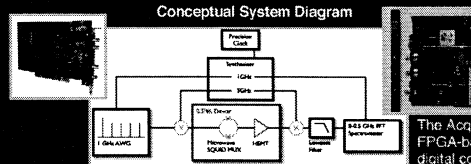


Antenna-coupled TES bolometers with microstrip filters



Microwave Multiplexers

Conceptual System Diagram



The Acqiris AC240, a FPGA-based analog to digital converter to de-multiplex signals.

A transition between the center pin of a coaxial connector and the coplanar wave guide transmission line on the silicon chip with the resonators.

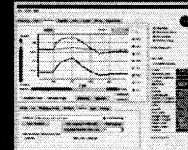


Microwave package for cryogenic tests of Nb/Si MKID resonator chips

Low noise 2-4 GHz cryogenic HEMT amplifier, and assembled microwave circuit with Nb MKIDs in dewar



Demonstrated multiplexed readout of time domain response of detectors to infrared LED illumination:



De-muxed time series of detector signals at each frequency are plotted versus time as LED is on and off.