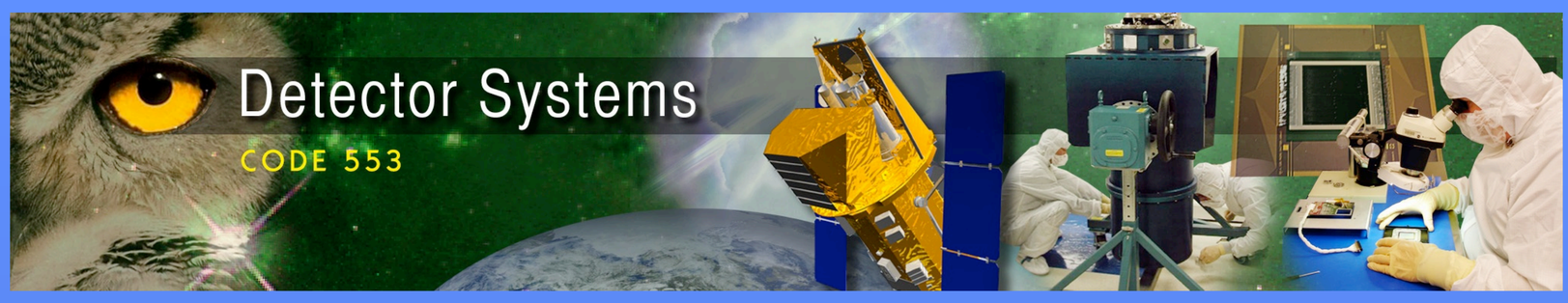

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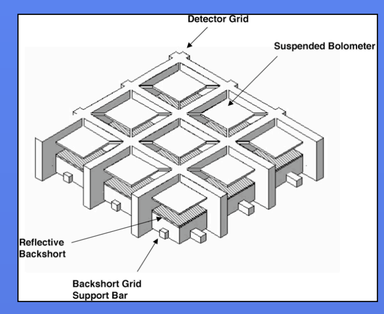
Large Format Bolometer Arrays for SOFIA Instruments

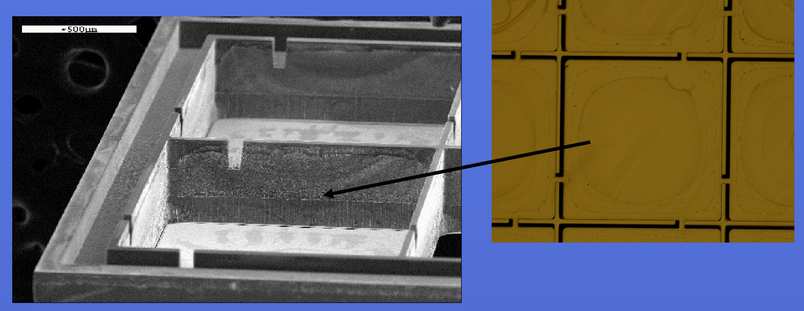
Overview: We are maturing a technology for 1,280 pixel, high-filling-factor bolometer arrays for operation at wavelengths of 30 μm to ~2 mm. The goal is to develop a large-format array architecture with background-limited sensitivity, suitable for a wide range of astronomical instruments. The array consists of three individual components merged into a single, compact unit: 1) a superconducting transition edge sensor bolometer array, operating in the 100-500 mK regime; 2) quarter-wavelength resonance backshorts for high efficiency optical coupling; and 3) a Superconducting Quantum Interference Device (SQUID) multiplexer readout. A small number of design parameters can be changed to tailor the array's sensitivity and wavelength range to suit a wide variety of SOFIA applications. The goal of this program is to develop a robust bolometer array to be directly mated to a large format SQUID readout, developed by NIST, Boulder.



The Backshort Under Grid (BUG) detector is designed as a square grid of bolometers having thin support legs for thermal isolation, and an array of backshorts nested in the cavities etched through the detector wafer.

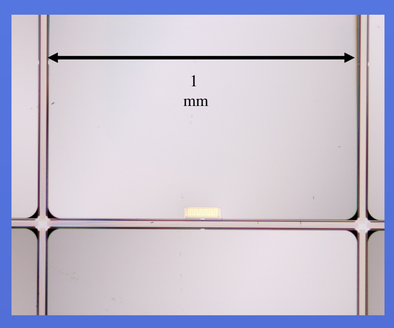
Detector Array Components

Deep RIE Grid with Interlocks for Backshort Array Insertion



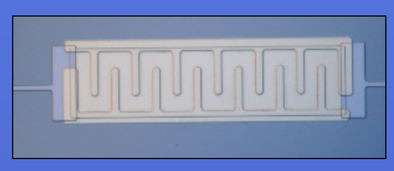
A backshort array is placed behind the detector, in the empty cavity left by deep reactive ion etching, during the processing step which frees the detector body from the thick, supporting silicon wafer. The interlocking features, designed into the back-side of the detector grid, allow nesting of the backshort array, without interference with the bottom of the grid, where electrical contact to the SQUID readout must be made.

1 mm Pixel on SOI Silicon



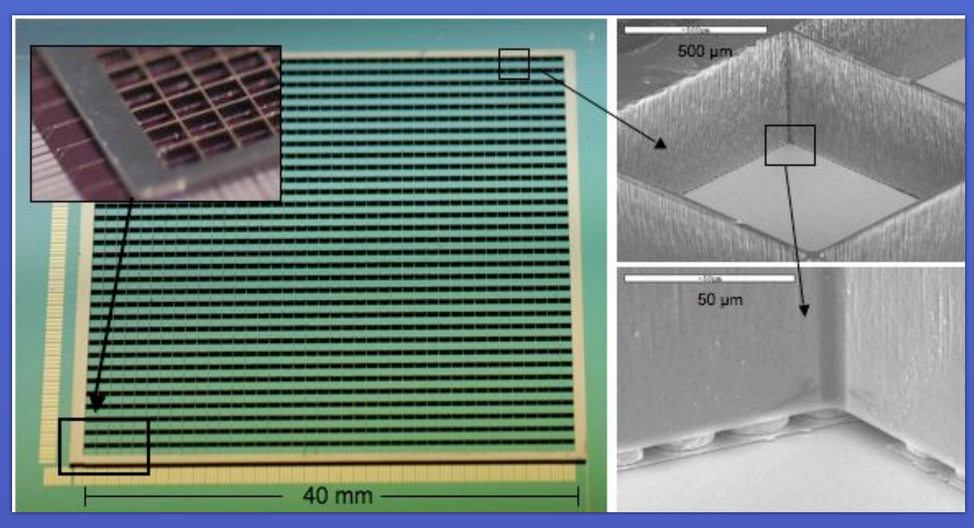
The detector consists of a thin (1μm) silicon body with an appropriate absorber material. The SEM image at right shows a portion of a single pixel. The dark line around the square pixel is the gap, isolating the detector from the silicon frame. The detector is suspended by long, 5μm wide support legs attached to the frame in corners.

Superconducting Transition Edge Sensor

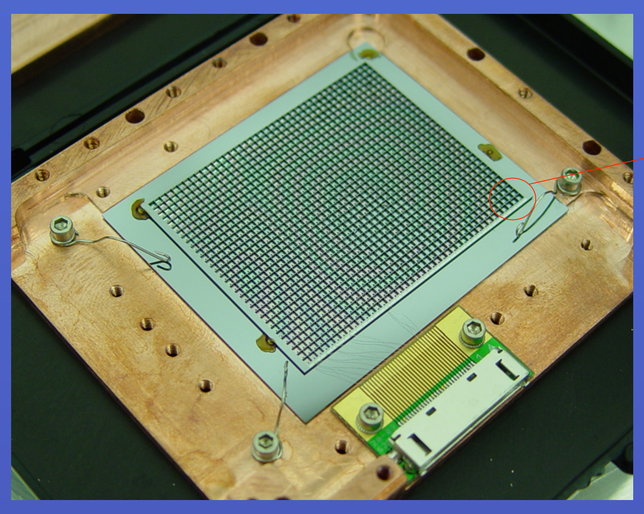


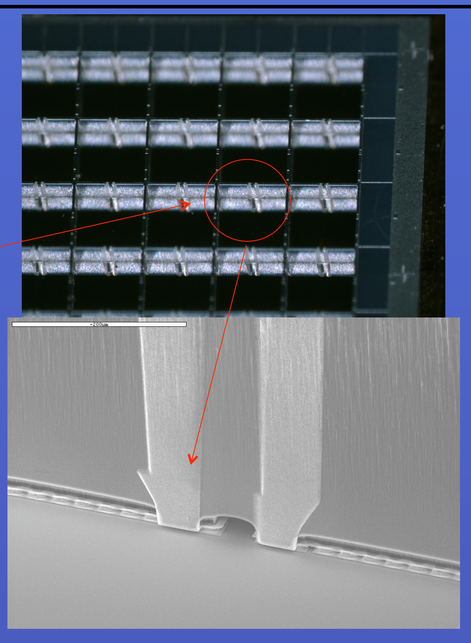
A key component of the detector is the superconducting transition edge sensor. In the image at right one can clearly see the zebra stripes, which are normal-metal bars found to inhibit excess 1/f noise in the superconducting transition.

Indium Bump Bonding to Wafer-Scale Grids



Wrap Around Via's





Existing Array Formats

8x8 Arrays of 1 millimeter pixels

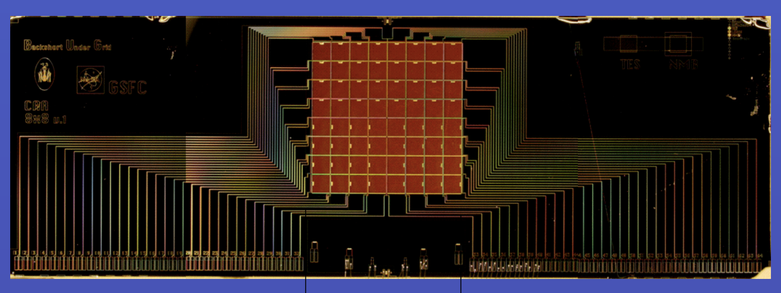
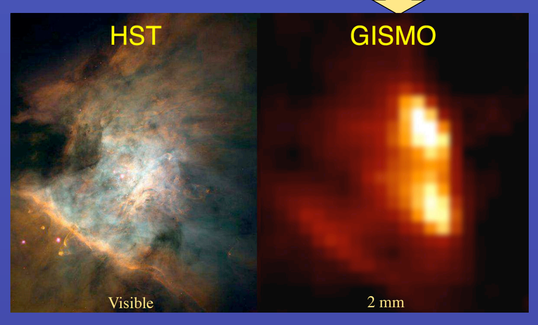
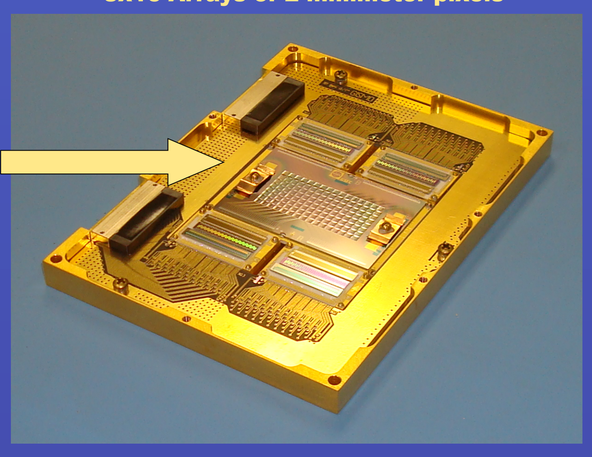


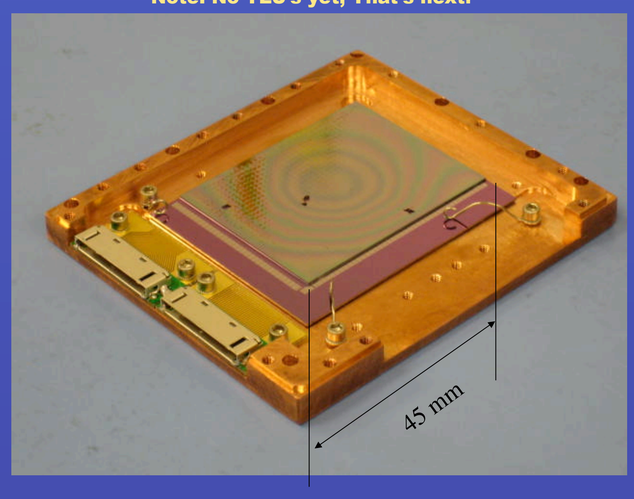
Image of Orion Nebula at 2 mm taken by the GISMO 8x16 array camera at the IRAM 30 meter telescope in November 2007. A Hubble image of the same sky field is shown for comparison.



GISMO Array
8x16 Arrays of 2 millimeter pixels



32x40 Arrays of 1 millimeter pixels
WAV Test Array with Membranes
Note: No TES's yet, That's next!



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