SuperCam: a 64 pixel heterodyne imaging spectrometer

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And many collaborators from many institutions…

Supercam Team

University of Arizona

- Chris Walker (PI)
- Craig Kulesa (DPI, science team lead)
- Chris Groppi (Co-I, Instrument Scientist)
- Christian Drouet d'Aubigny
- Robert Stickney
- Dathon Golish
- Brian Love
- Jenna Kloosterman
- Tiara Cottam
- Yael Greenblatt

University of Cologne

- Patrick Puetz

Harvard Smithsonian Center for Astrophysics

- Abby Hedden

Jet Propulsion Lab

- Tom Kuiper

California Institute of Technology

- Sander Weinreb (Co-I, IF system)
- Jacob Kooi
- Hamdi Mani
- Glenn Jones
- Joe Bardin

University of Massachusetts

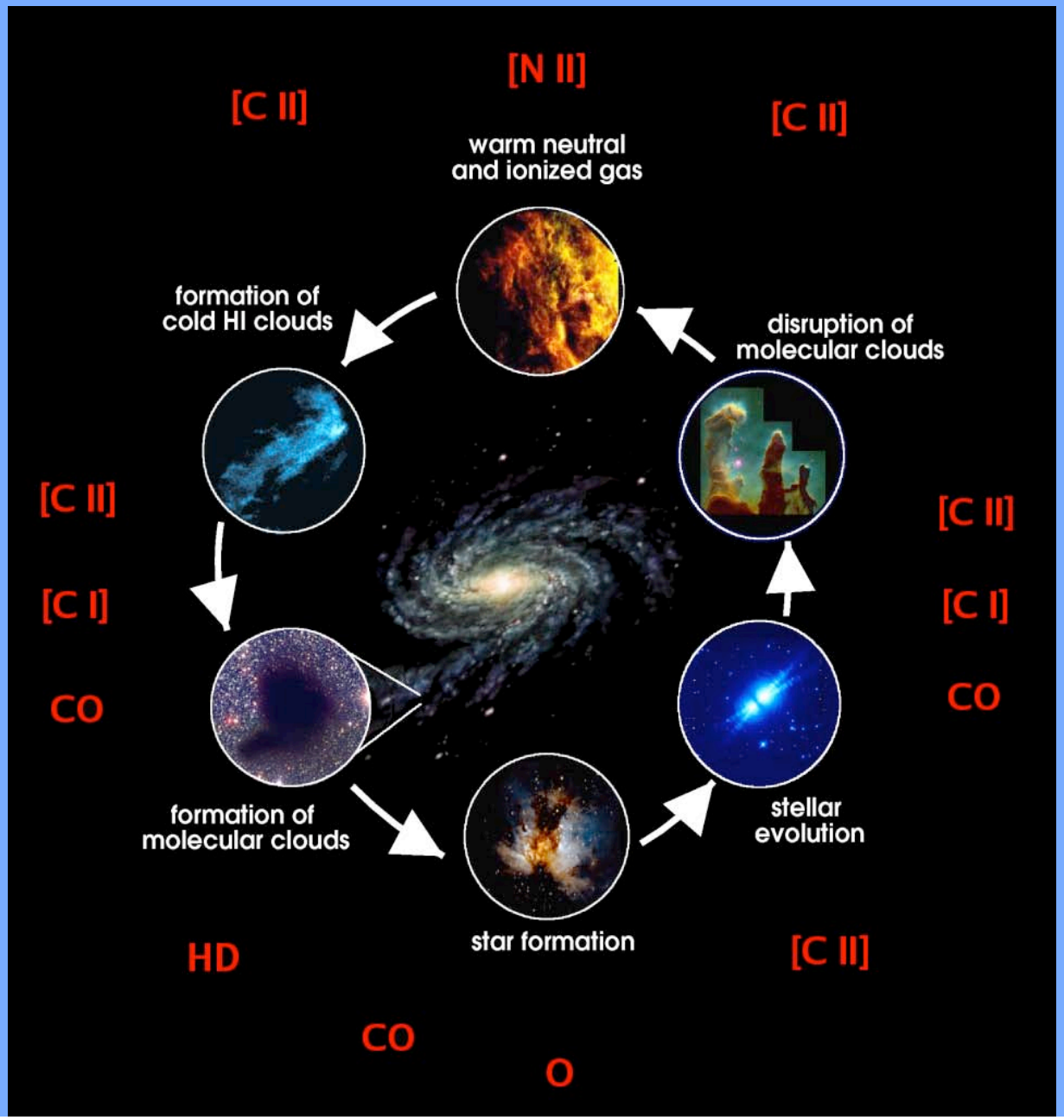
- Gopal Narayanan
- Ron Grosslein

University of Virginia

- Art Lichtenberger (Co-I SIS devices)
- Thomas Cecil

Industry Partners

- Omnisys AB (spectrometer)
- Virginia Diodes (Local Oscillator)
- Universal Cryogenics (Cryostat)
- NGST (LNA MMIC Fab)



Spectral diagnostics of the interstellar life cycle define a new, pressing need for large scale, high resolution spectroscopic surveys!

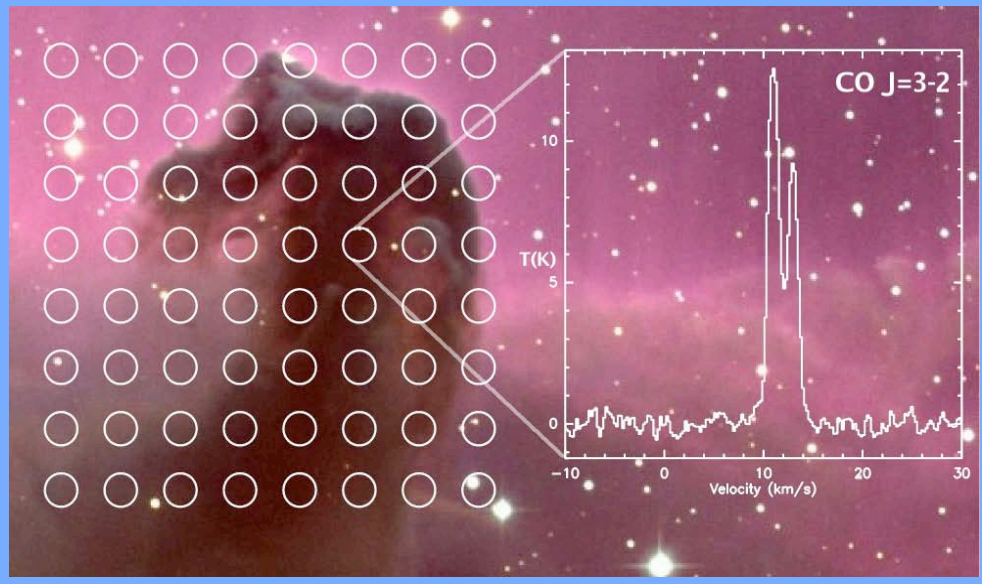
Continuum observations (dust emission) only tells pa of the story.

We want to know about the gas too!

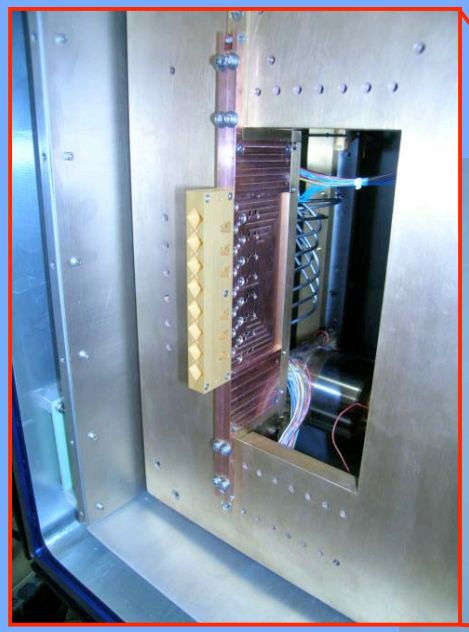
We need wide field mapping (many square degrees), ~km/s spectral resolution ar sub-arcminute spatial resolution.

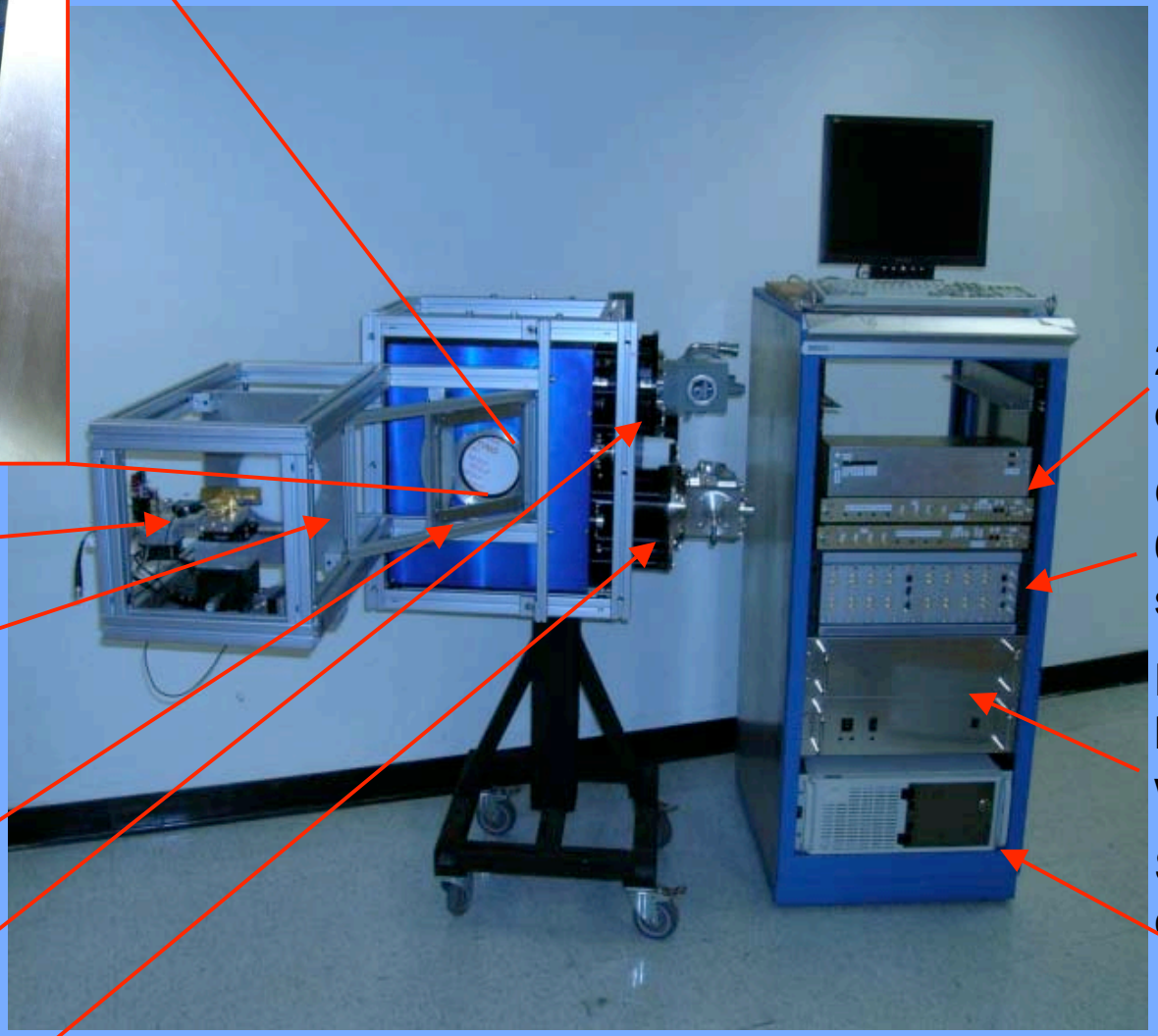
Supercam 64 beam heterodyne array

- Supercam is a 8x8 pixel heterodyne array receiver (imaging spectrometer), designed to operate in the 870 μm atmospheric window at the 10m Heinrich Hertz Telescope.
- Supercam will be two orders of magnitude faster than current generation single pixel receivers.
- Funded by NSF MRI in 2004
- Key project: fully sampled ^{12}CO(3-2) and ^{13}CO(3-2) survey of over 500 square degrees of the Galactic plane.



Supercam System





LO System with 8 way power divider

LO Optics

LO Beamsplitter & dewar window

CTI 350 cooler

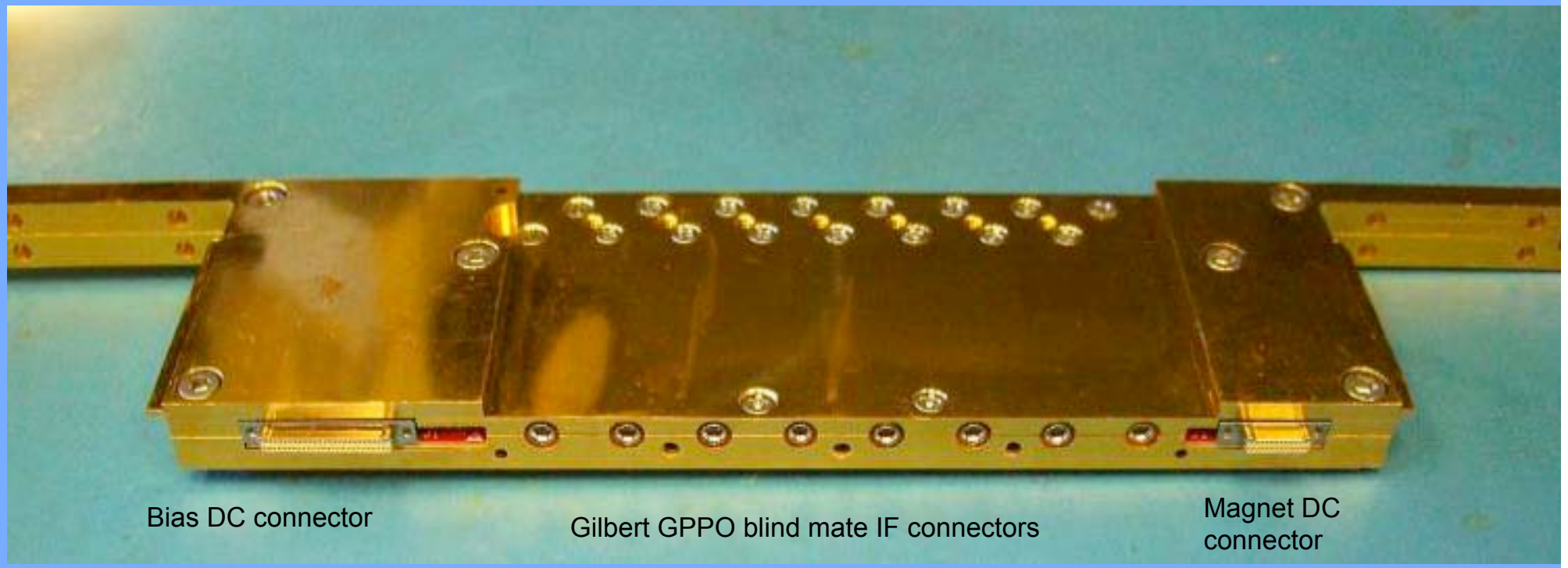
Sumitomo 4K cooler

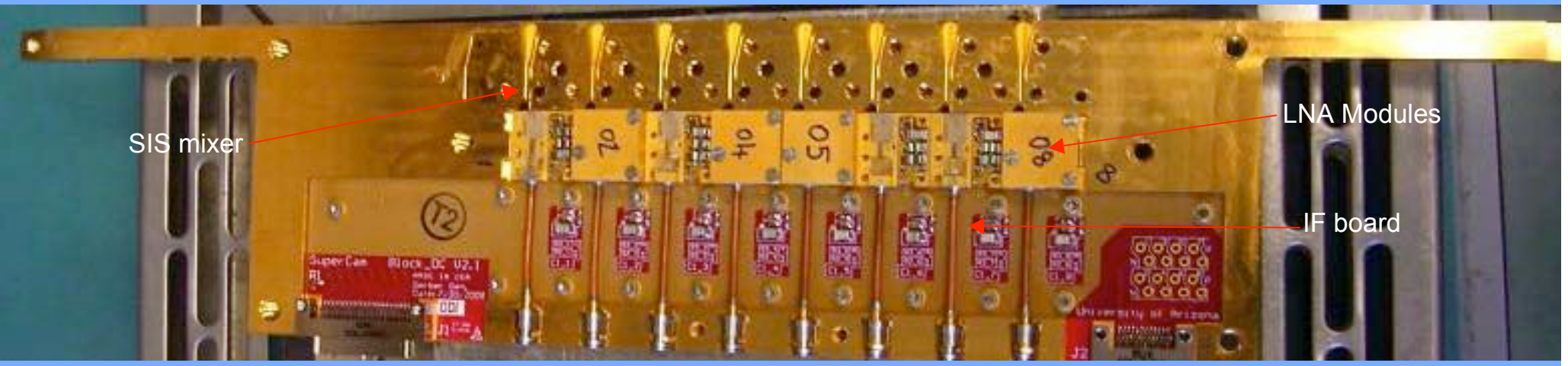
2 8 channel downconverter modul

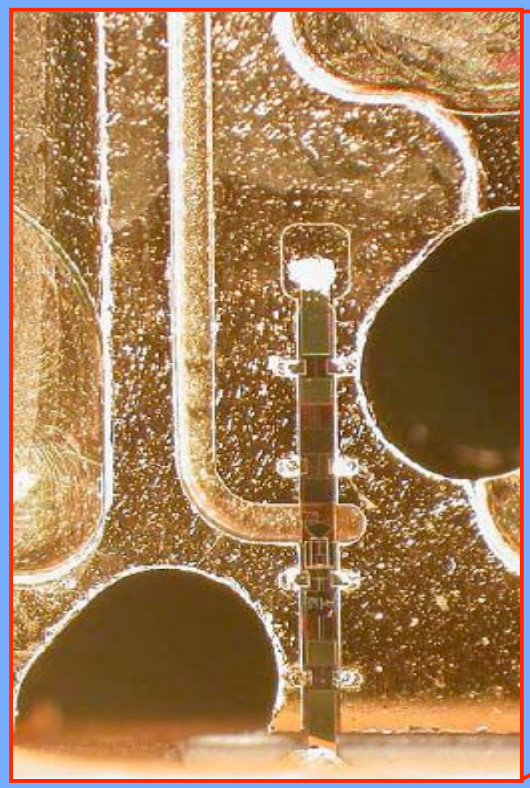
Omnisys Spectromete 64x250 MHz complete system

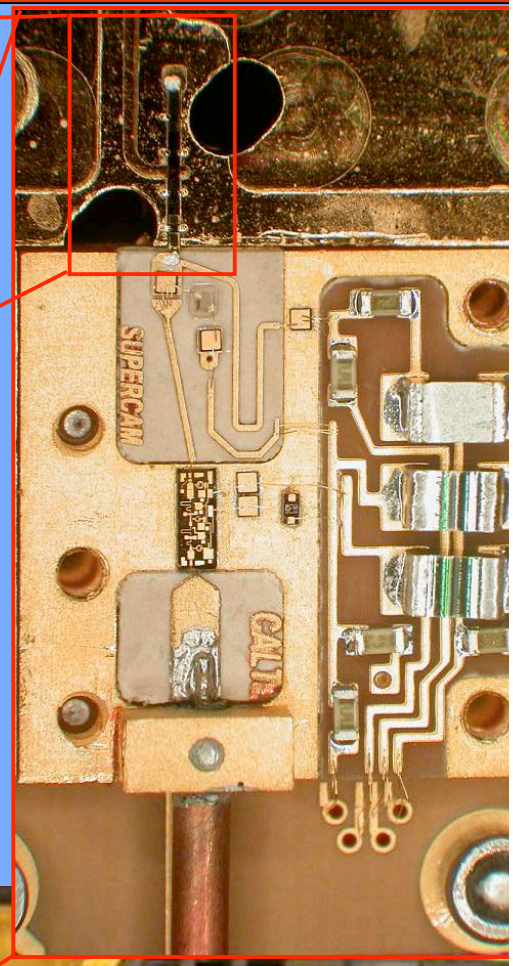
Prototype 8 channel bias system (1 6U car with power supplies)

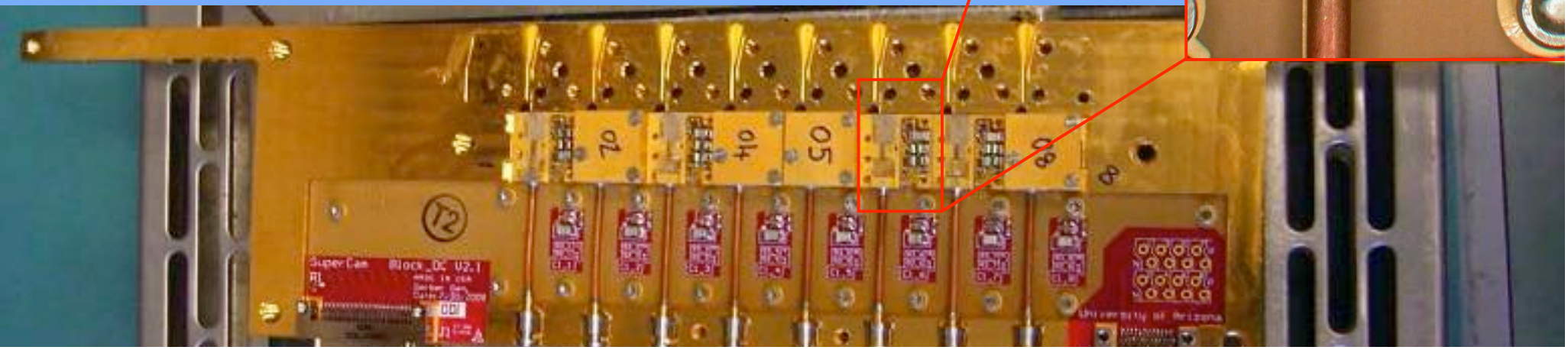
Spectrometer and bia control computer


Bias DC connector
Gilbert GPPO blind mate IF connectors
Magnet DC connector

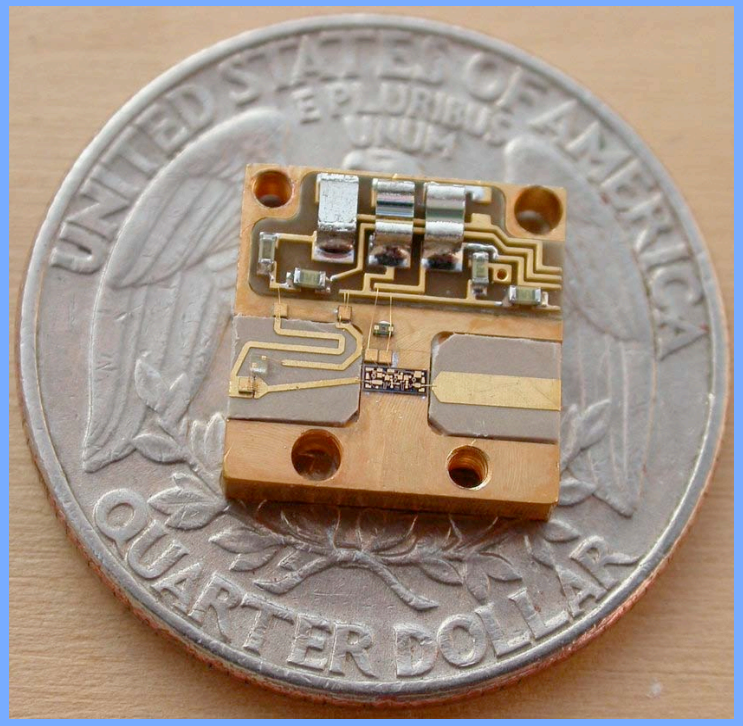

SIS mixer
LNA Modules
IF board

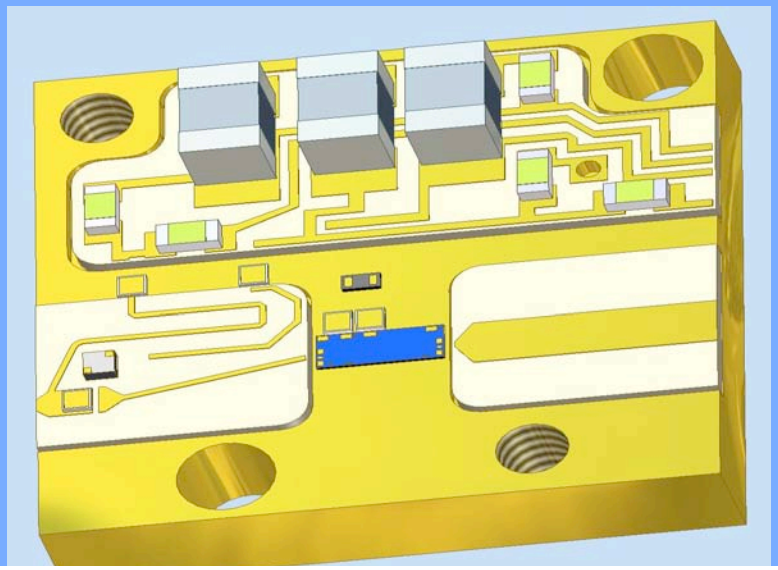


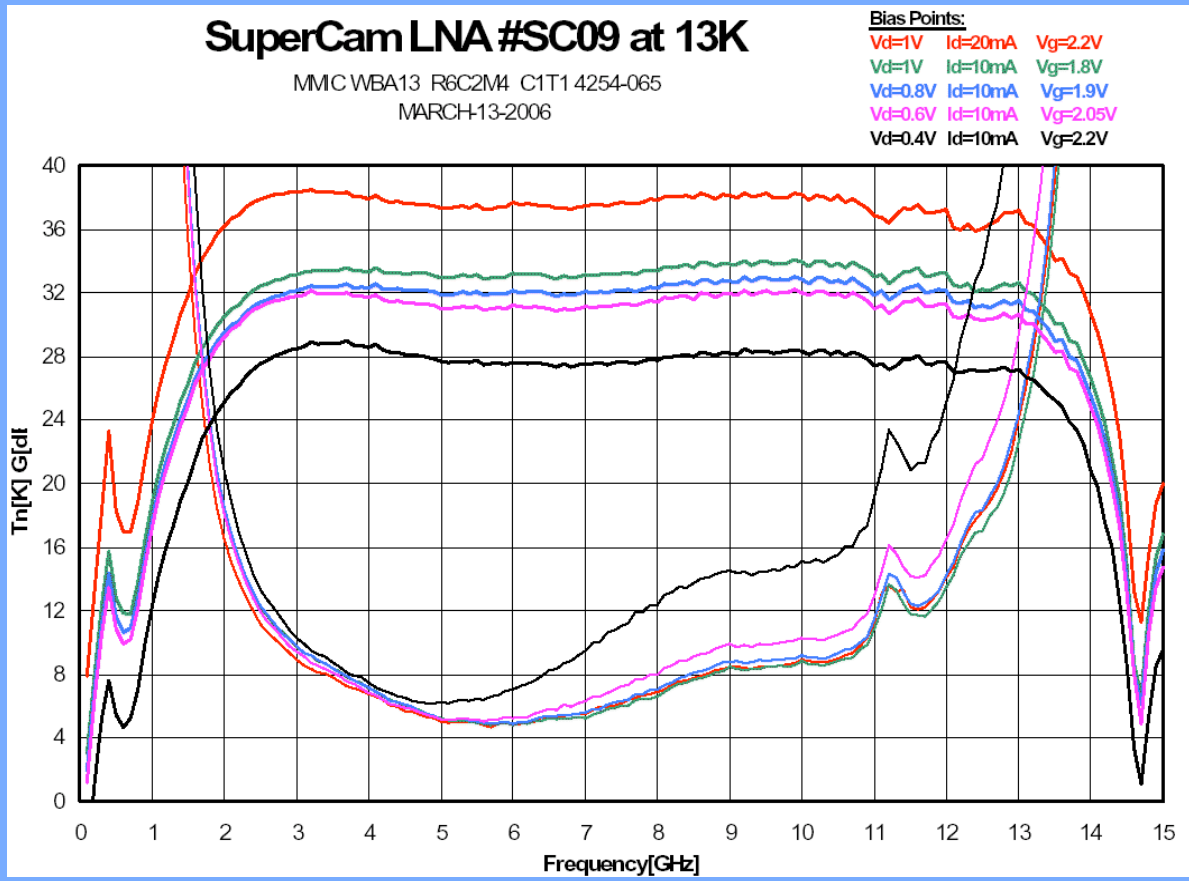

SUPERCAM



Low Noise Cryo Amplifiers (Caltech)



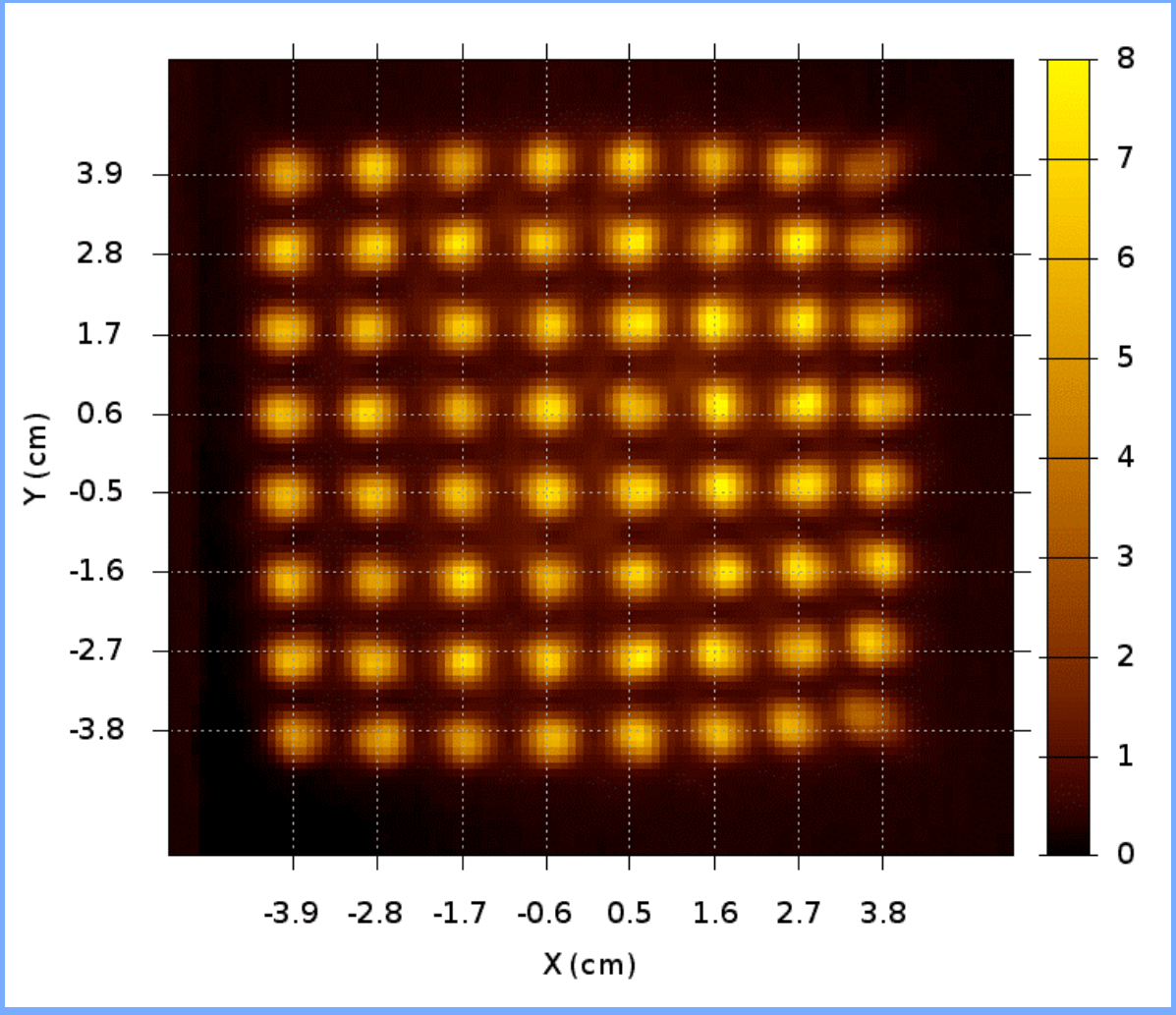


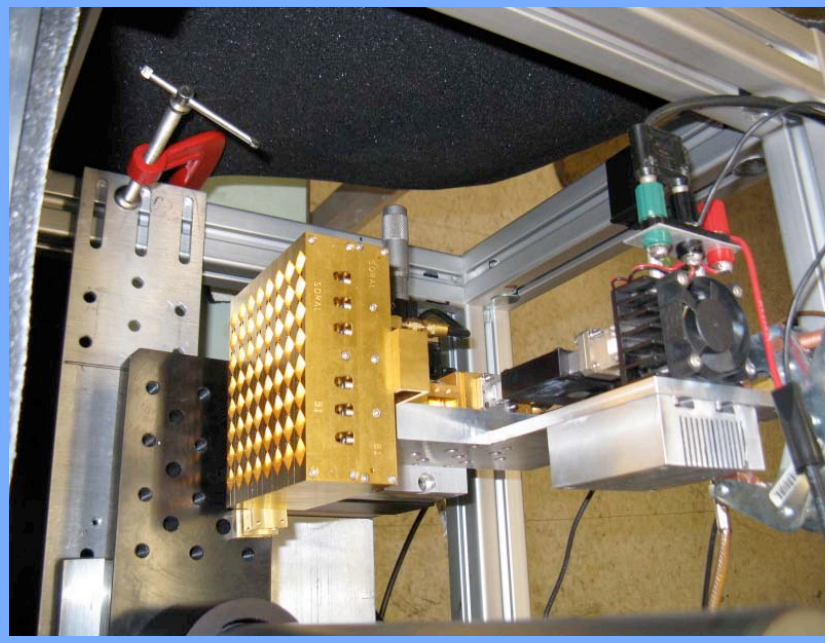


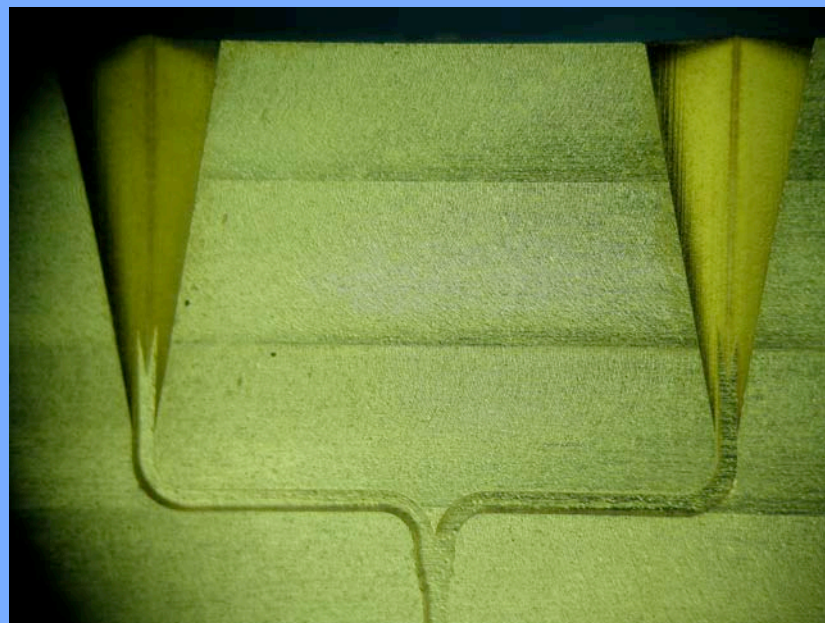
32 dB Gain, 5 K Noise at 8mW power dissipation

N. Wadefalk, I. Kooi, H. Mani & S. Weinreb, Caltech

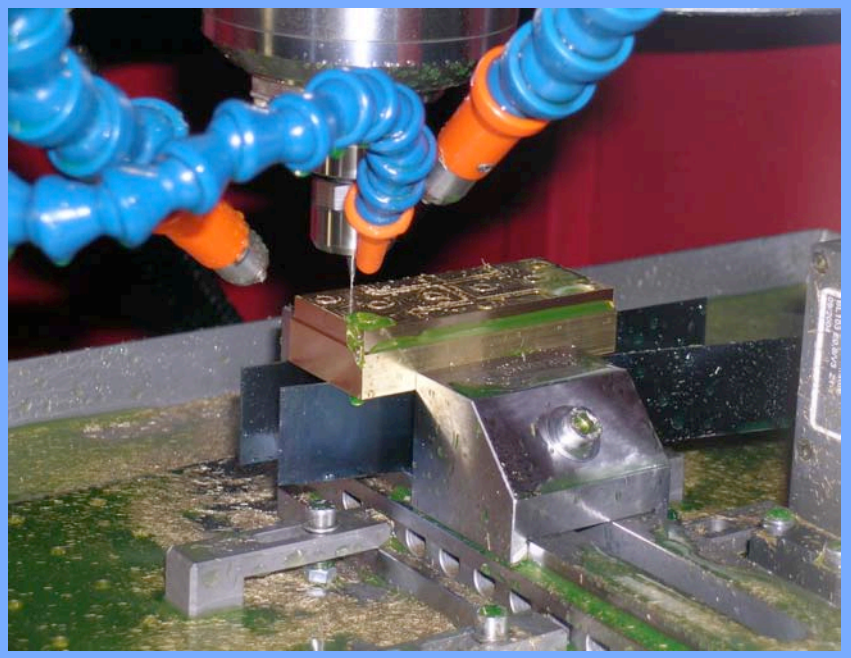
LO Multiplexing
64-way waveguide corporate divider

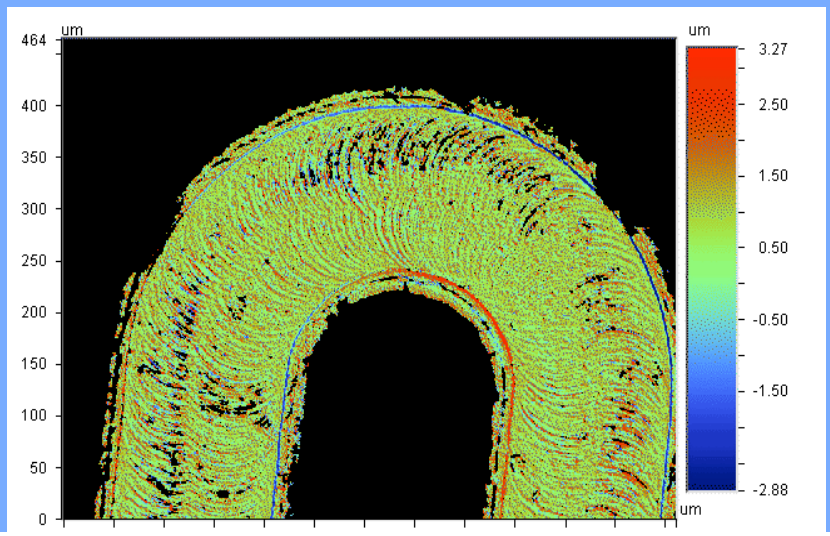


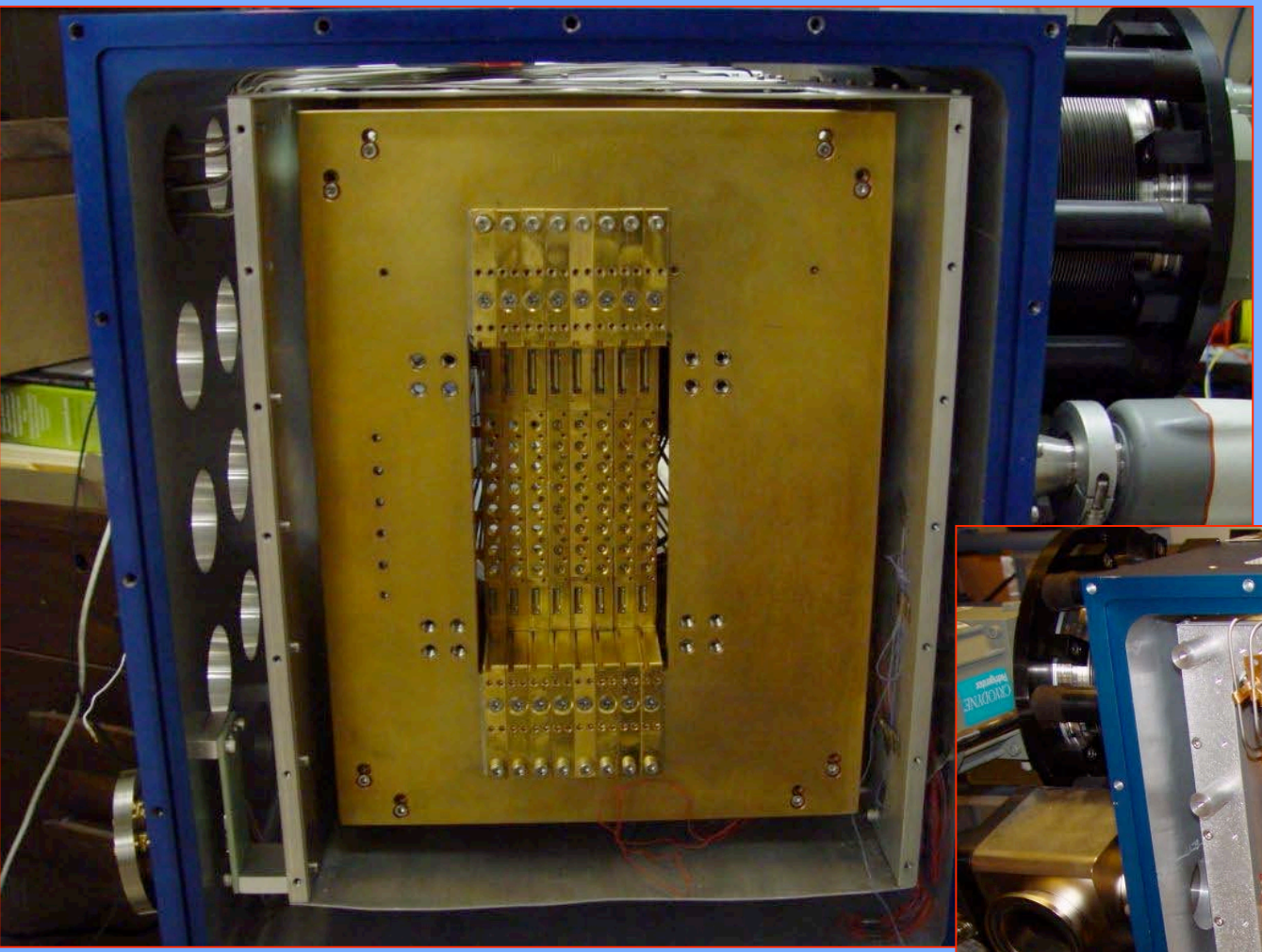


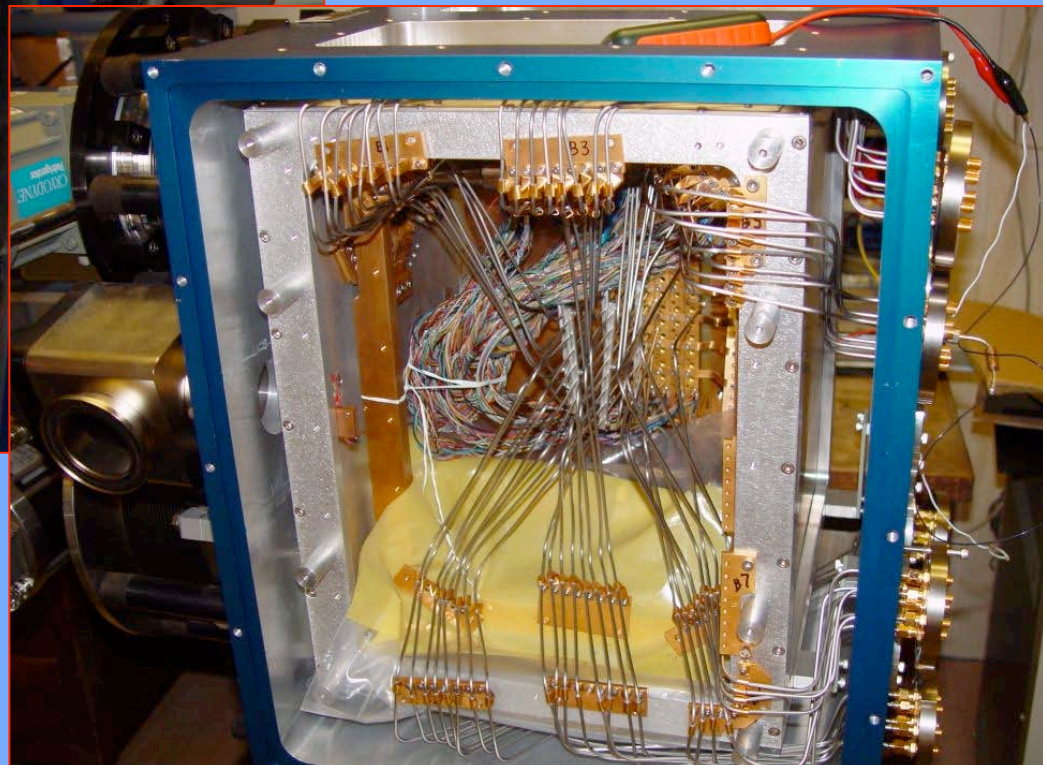


Micromachining

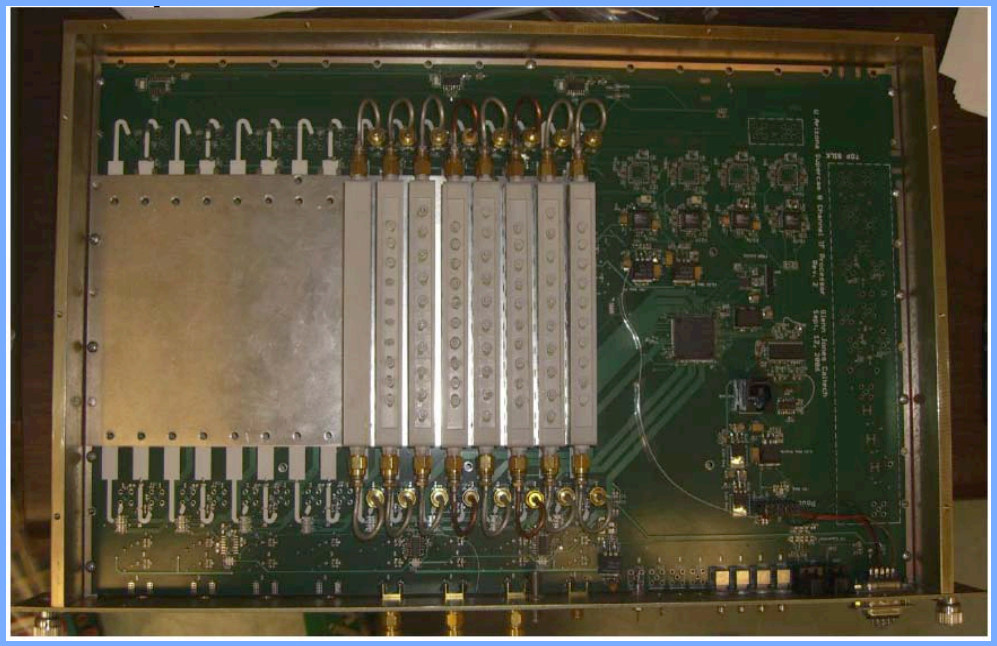






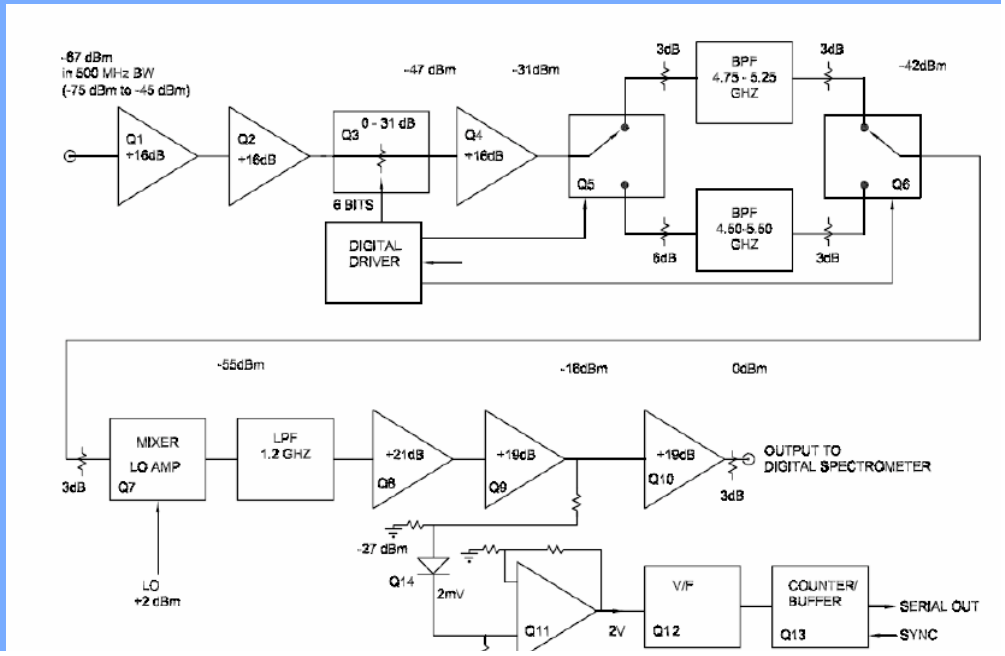


Supercam IF Processing (Caltech)



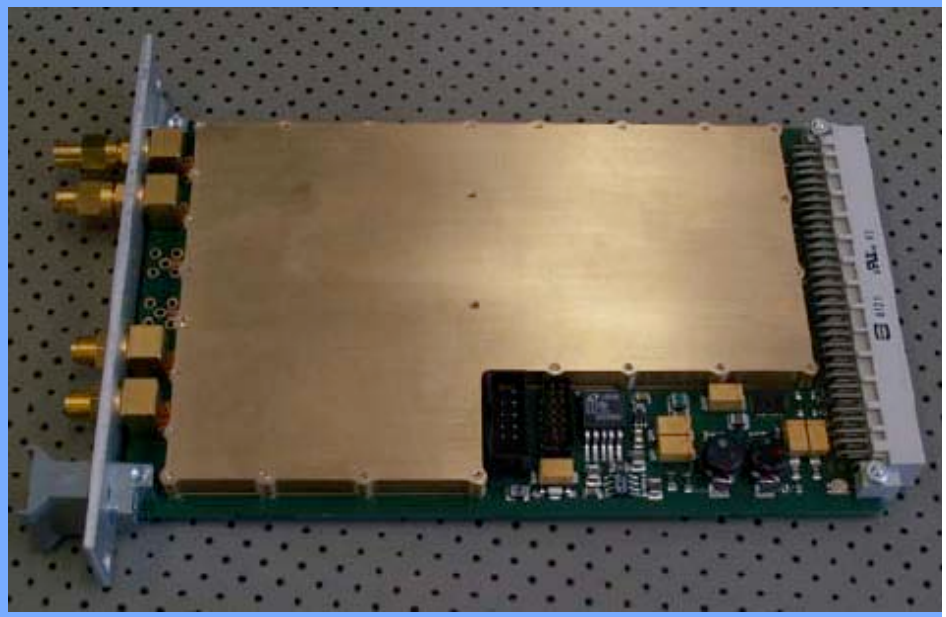
1x8 Downconverter module (Caltech: G. Jones and J. Bardin)

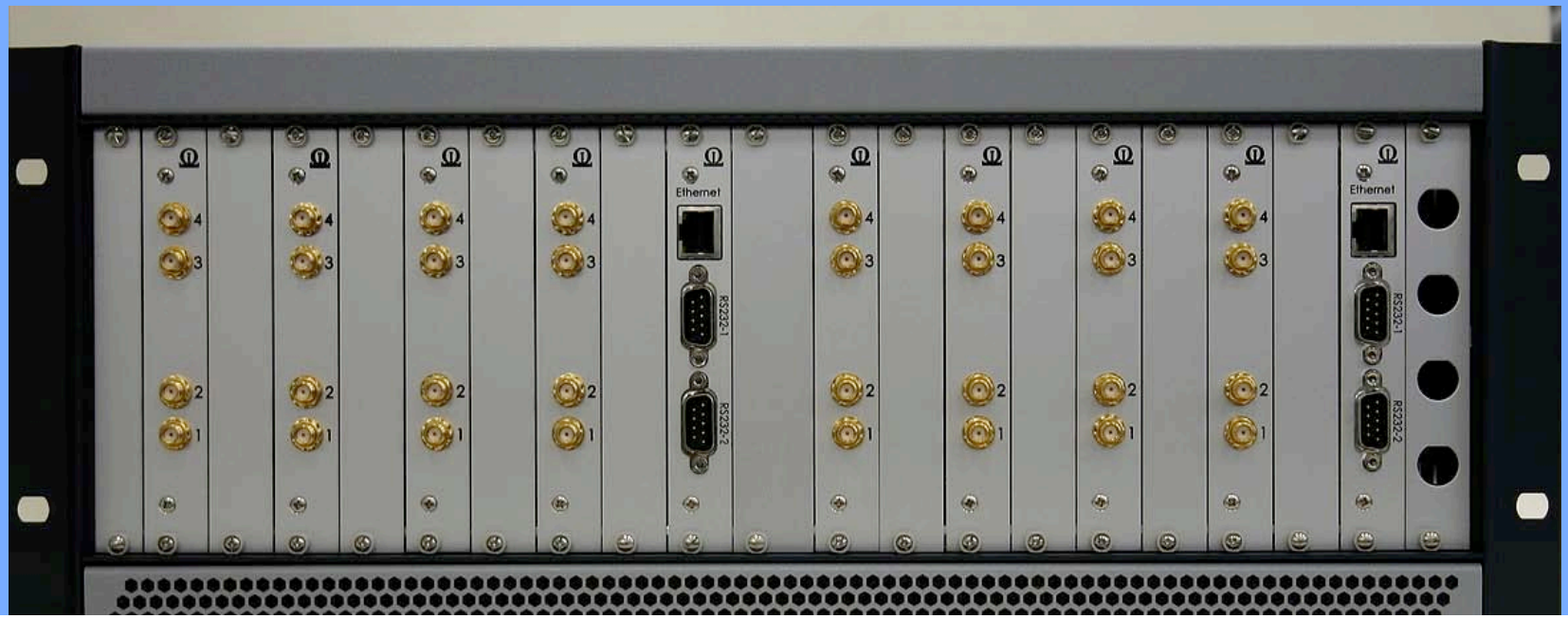
- Total power metering
- 250 MHz and 500 MHz bandwidth modes (1 GHz with filter change)
- Digital attenuators
- Low cost surface mount components



SuperCam Spectrometer System

- Built by Omnisys AB
- Real-Time FFT system
- Virtex 4 SX55 FPGA
- 4x 500 MHz or 2x 1 GHz per board
- 1024 channels
- power consumption 25W per board
- Ethernet interface
- SuperCam spectrometer initially uses 8 identical boards for 64 x 250 MHz or 16 x 1 GHz operation





SORAL
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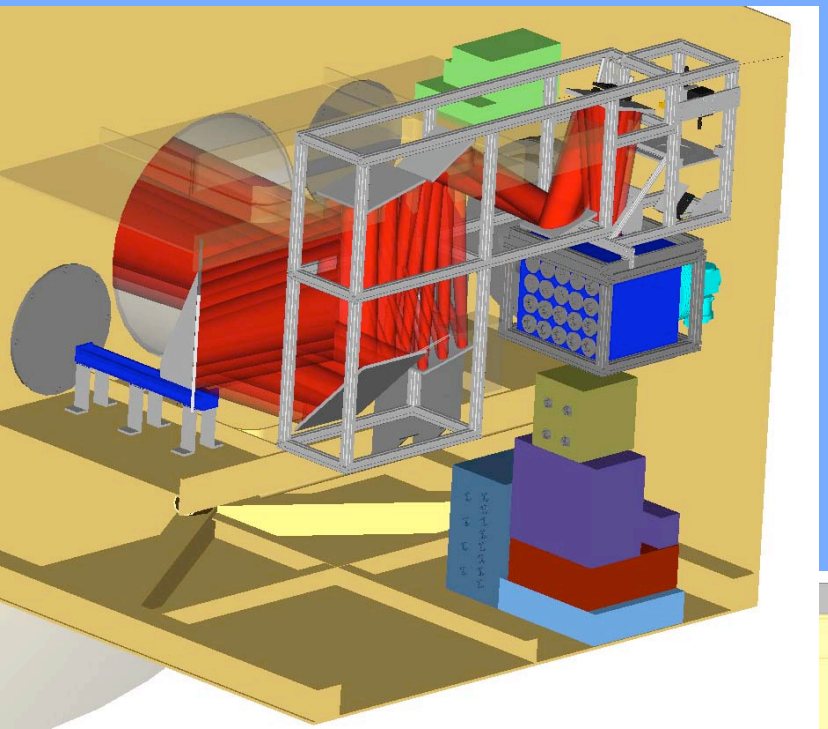
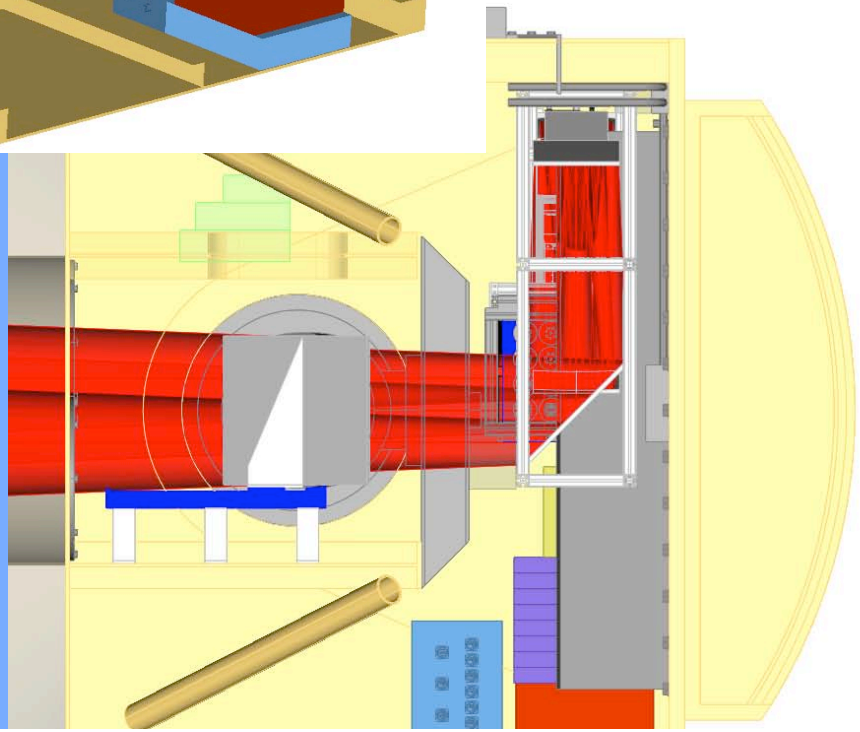
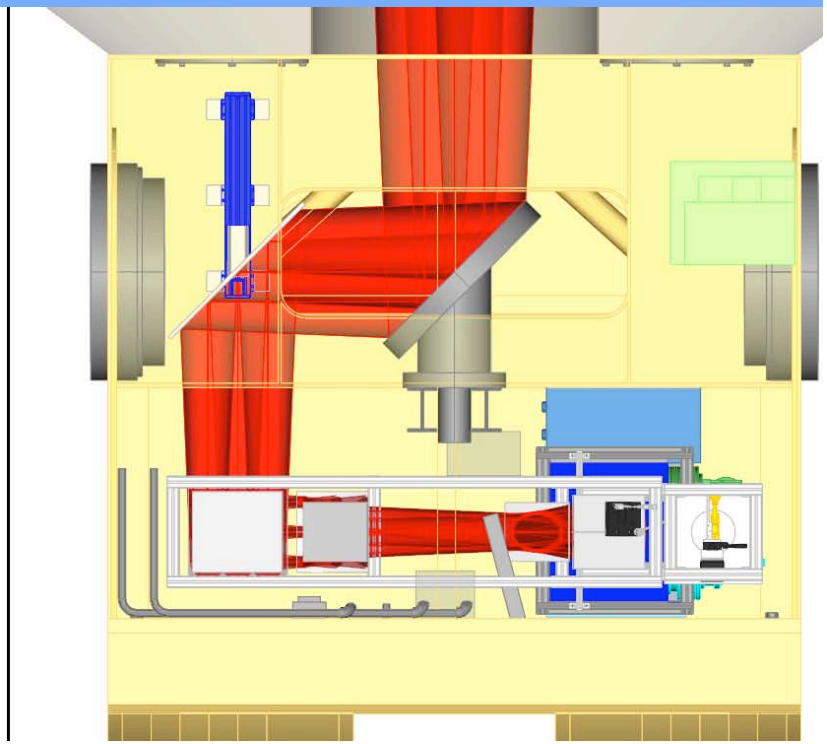
MMIC Array Receivers and Spectrographs Workshop 2
March 22-24, 2009







Conclusion

- The Supercam 64 beam array is nearing completion at the University of Arizona
- Supercam is built using 8 pixel integrated linear arrays of SIS mixers
- All components have been successfully prototyped
- LO system is complete
- All detector block machining will be completed this week.
- Detector assembly and testing will be completed in the next few months.