A Bolometer Array for the SPectral Energy Distribution (SPEED) Camera

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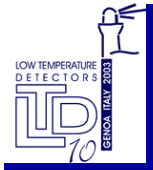
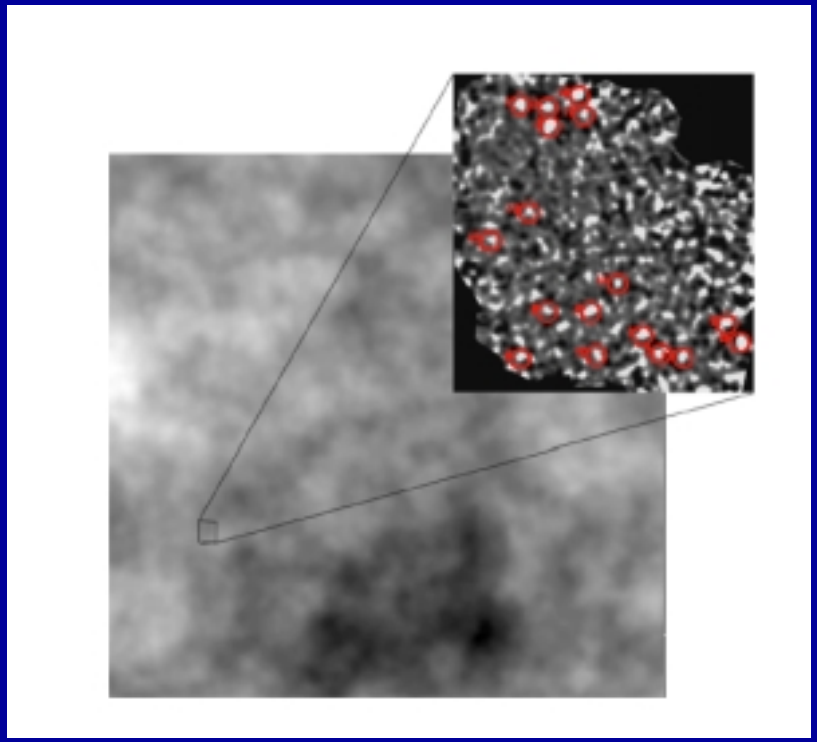


Overview of Talk

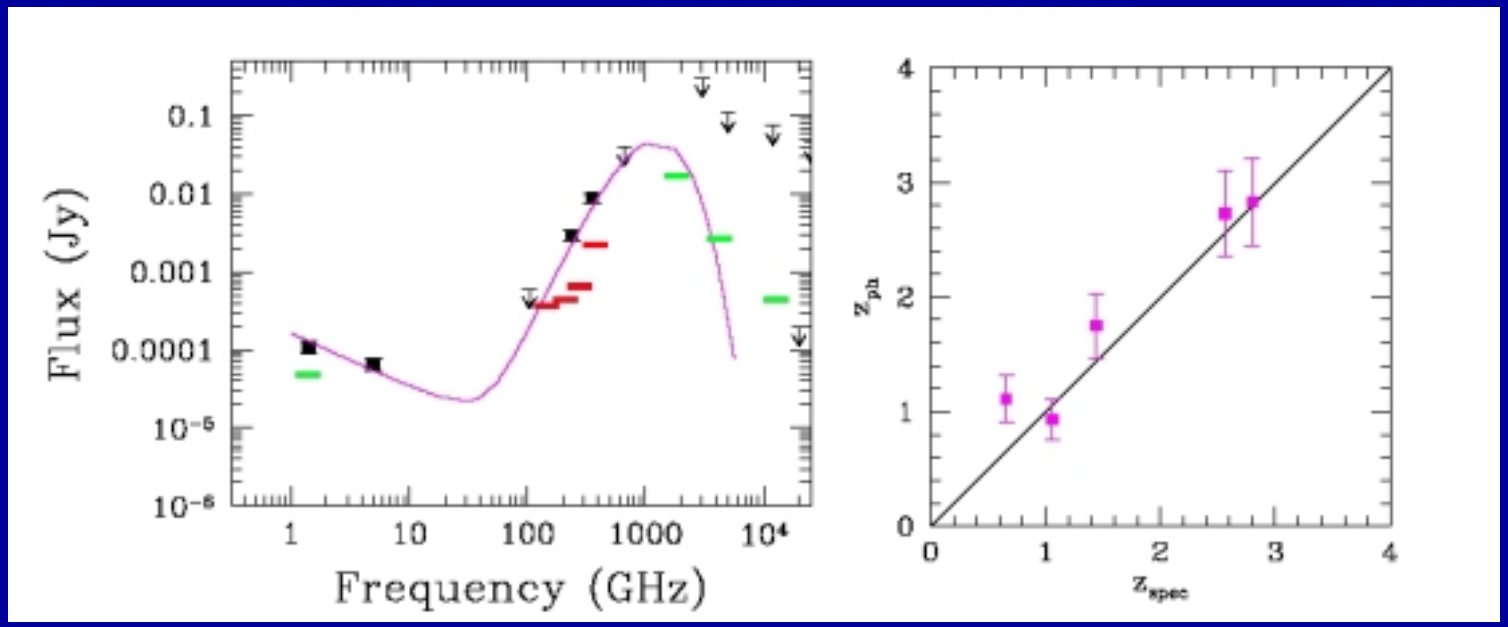
- SPEED Science Objectives
- Instrument Design
- Frequency Selective Bolometer (FSB)
- Detector Array Considerations
- Expected Performance
- Current Status

Scientific Objectives



- Protogalaxies
- Spectral Energy Distribution
- Dust
- Galaxy Formation Era
- Negative K correction

ProtoGalaxy Spectra

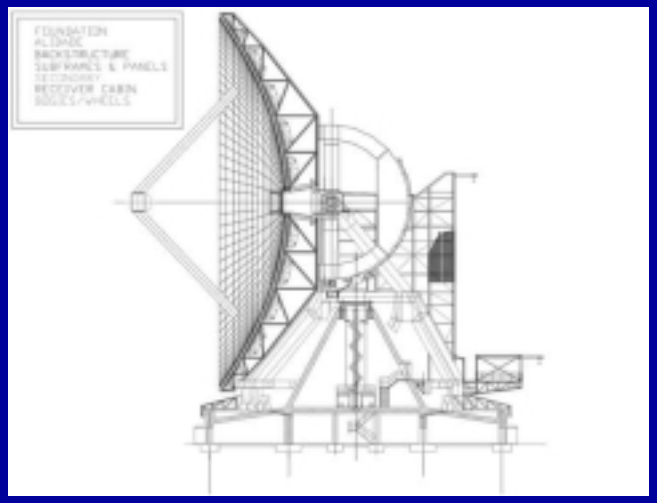


- Spectral Energy Distribution
- Photometric vs Spectroscopic Redshift

R. Silverberg, NASA/GSFC

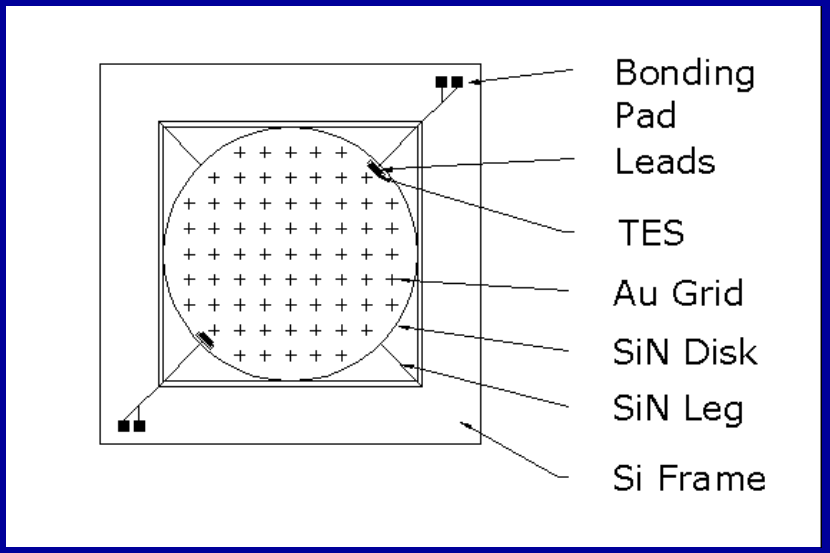
Instrument Design

- SPEED is designed for ground-based observing at millimeter telescopes
- HHT (10m) for initial run
- LMT (50m) later
- Simultaneous and coincident, spatial and spectral information



Frequency Selective Bolometer

- Absorbs radiation in a small band
- Passes radiation outside of the band
- Contains resonant absorber and temperature sensor and λ/4 resonant backshort
- Conductive(Au) crosses patterned on 0.5μm thick low-stress Si_xN_y free-standing suspended substrate
- Downside
  - Requires large focal ratio optics F/4 or larger
  - Large device (~1 cm x 1 cm)
- Fabrication-see poster by Chen et al. - Y14

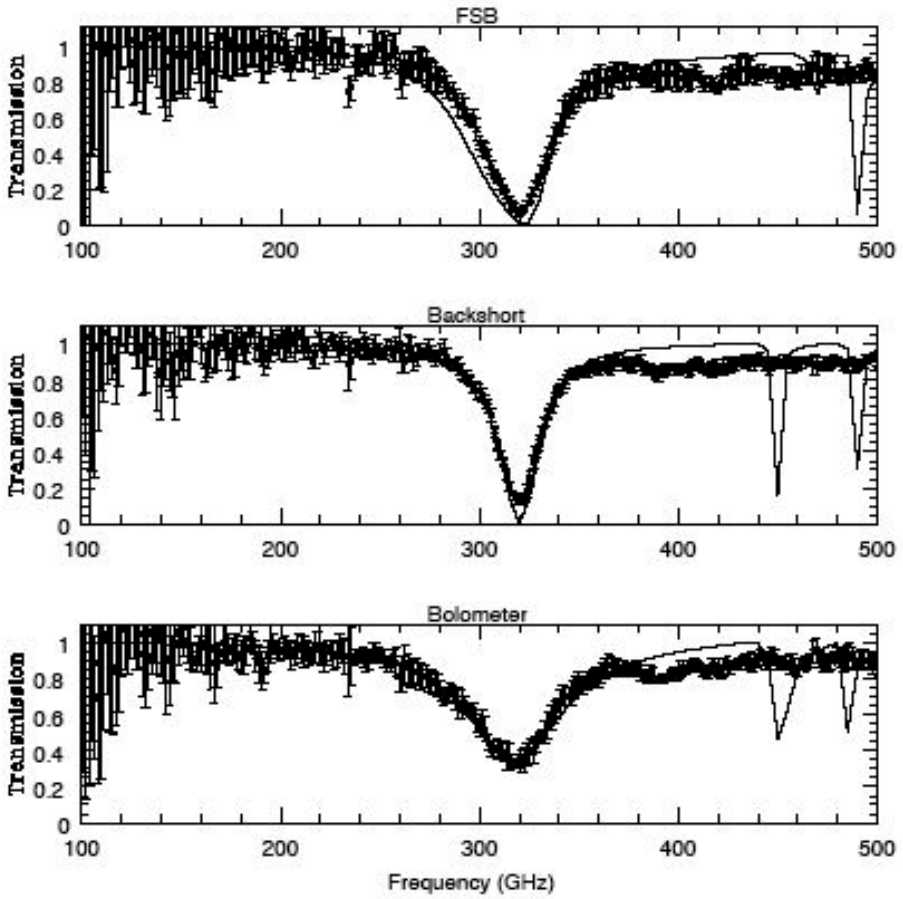


FSB Absorber Layer

Temperature Sensor/Electronics

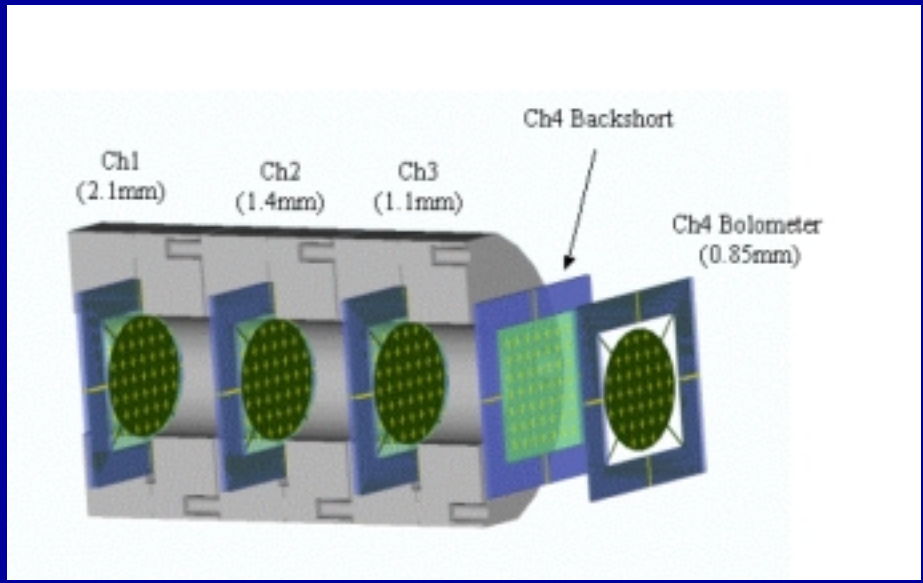
- TES temperature sensor
- Mo/Au proximity effect bilayer
- Operating voltage-biased
- Thermal Conductance-margin x4
- Ti/Al/Ti superconducting leads
- SQUID array/ time multiplexer (NIST)

FSB Performance

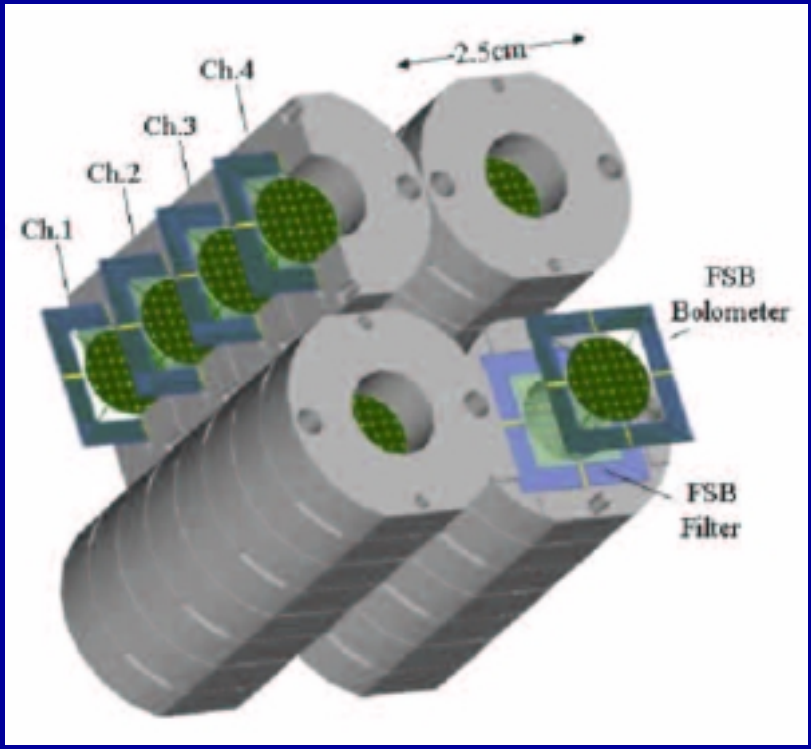


A SPEED Pixel

- Two Component FSB
- 4 FSB Stack
- Shortest wavelength first
- Terminate with absorber
- 150-375 GHz coverage
- Electrical connection through superconducting leads to SQUID readout
- Shunt Resistor
- Mount provides correct alignment/spacing



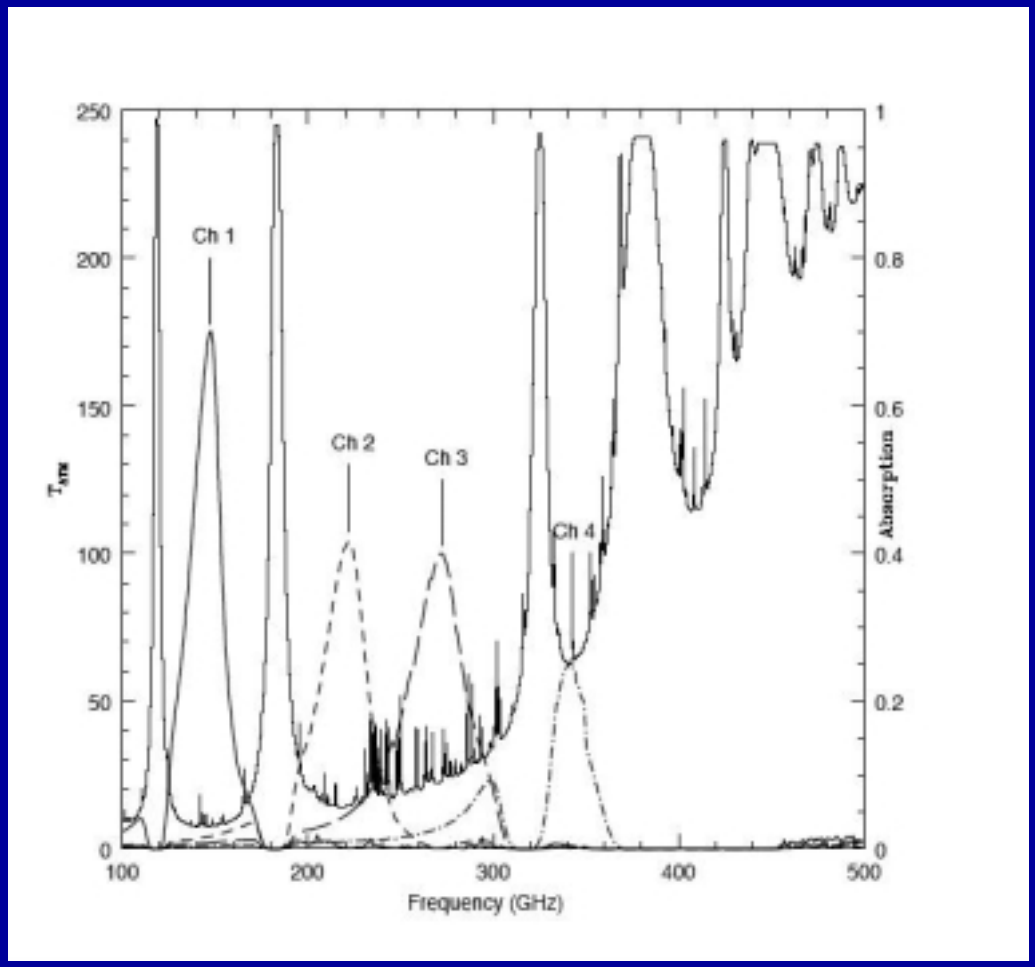
The SPEED Photometer



- Compact
- Simultaneous spatial and spectral information
- Efficient
- Horn-coupled
- Diffraction-limited at λ=2.1 mm

Photometer Bands

- Atmospheric filtering important
- Notch Filters Required



Expected Performance

Band	Center [GHz]	Loading [pW]	G [nW/K]	BLIP [aW/√Hz]	NEP [aW/√Hz] 1
	148	17	0.7	92	112
2	216	35	1.7	128	157
3	260	63	2.5	182	219
4	303	92	3.6	233	276

Notes: 1 aW=10^{-18} W

T_c~460mK

^{3}He bath @ ~270mK

Current Status

- Individual devices are being fabricated
- Cryostat to be delivered soon
- 'Dark' testing of samples underway