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- Integrated Receiver Technology
  SRON, IREE

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ESA contract 11653/95/NL/PB

# SUBMILLIMETRE INTEGRATED RECEIVER SIS IMAGING RECEIVER TECHNOLOGIES (SISIRT)

FINAL PRESENTATION

## Contributors:

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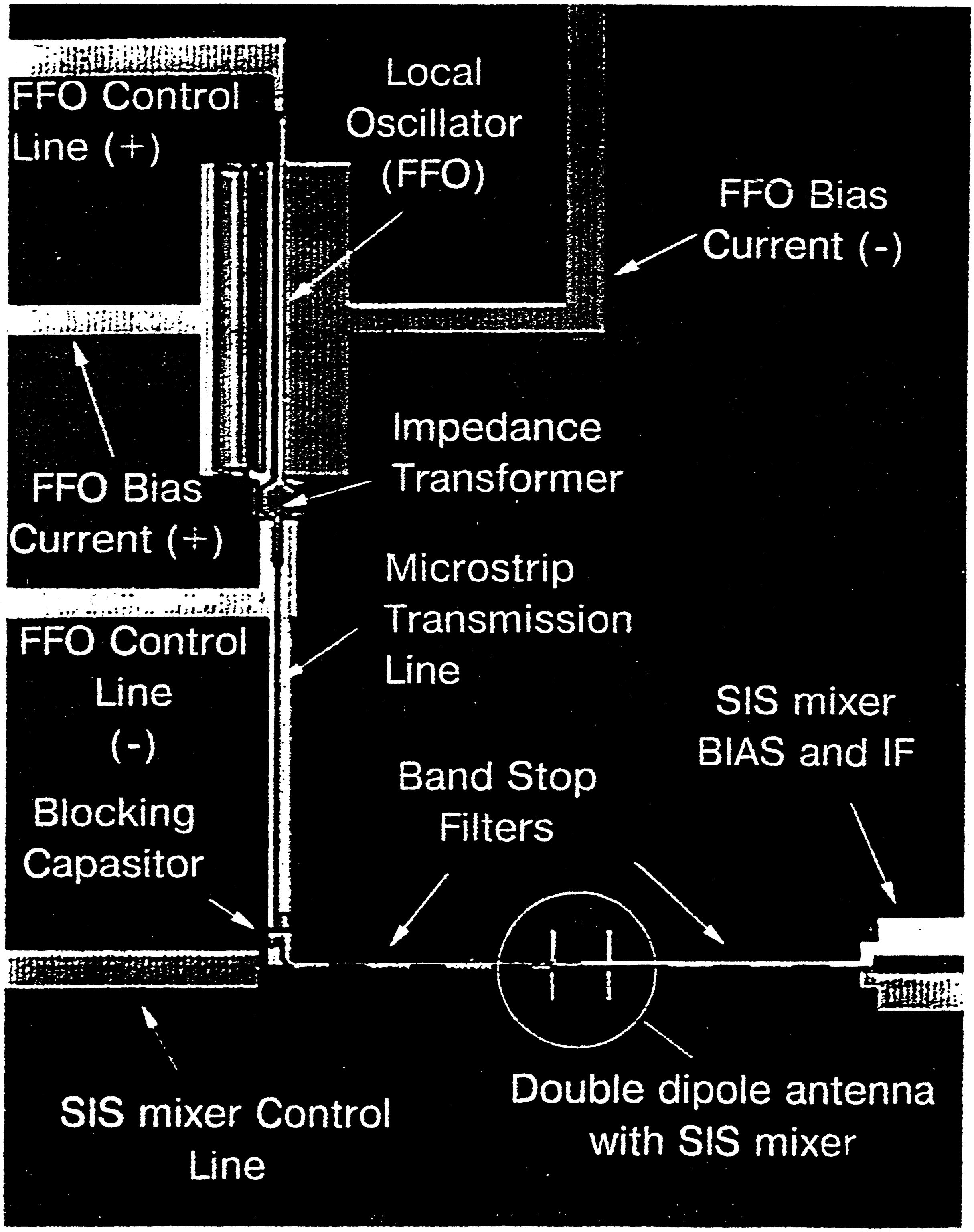
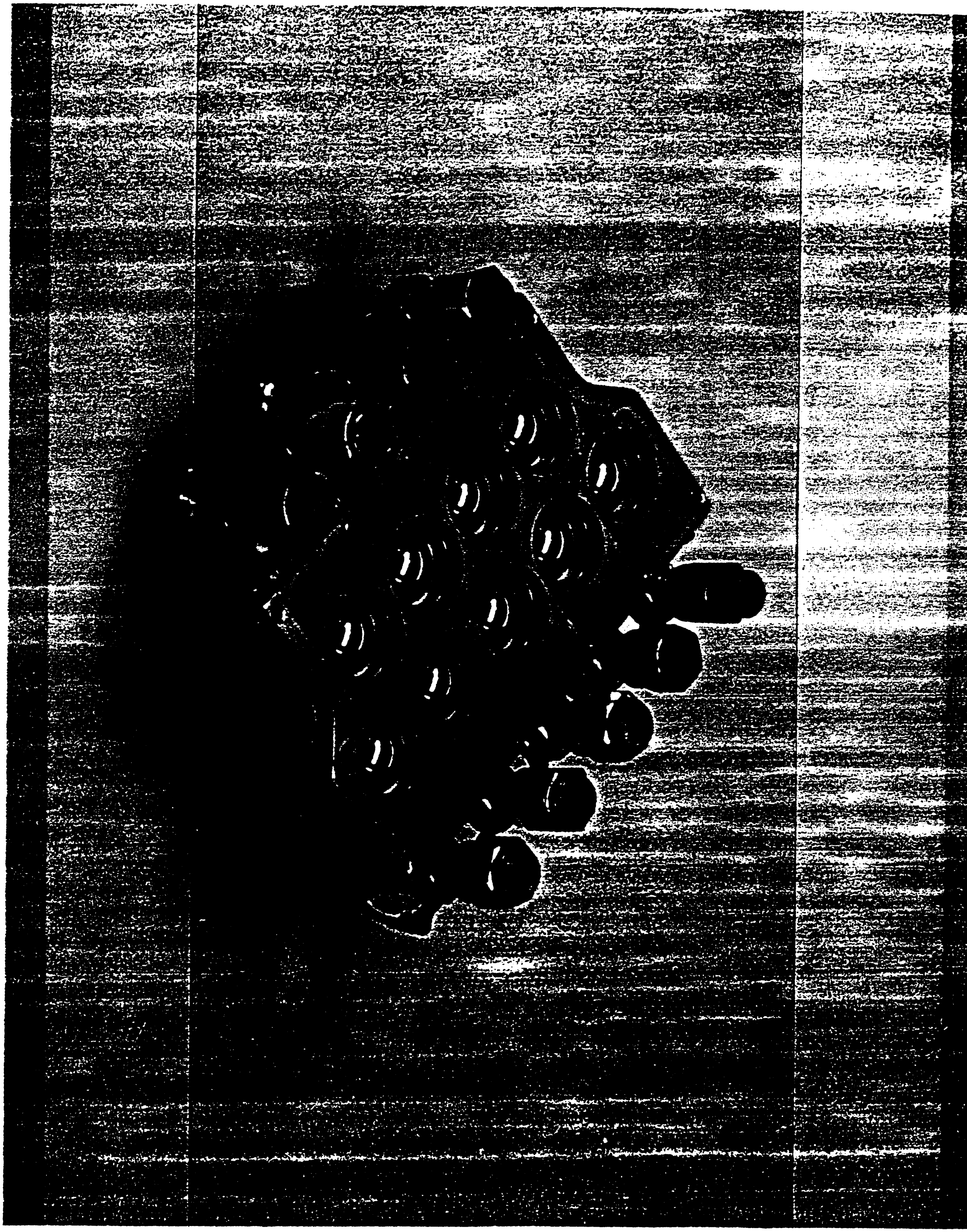
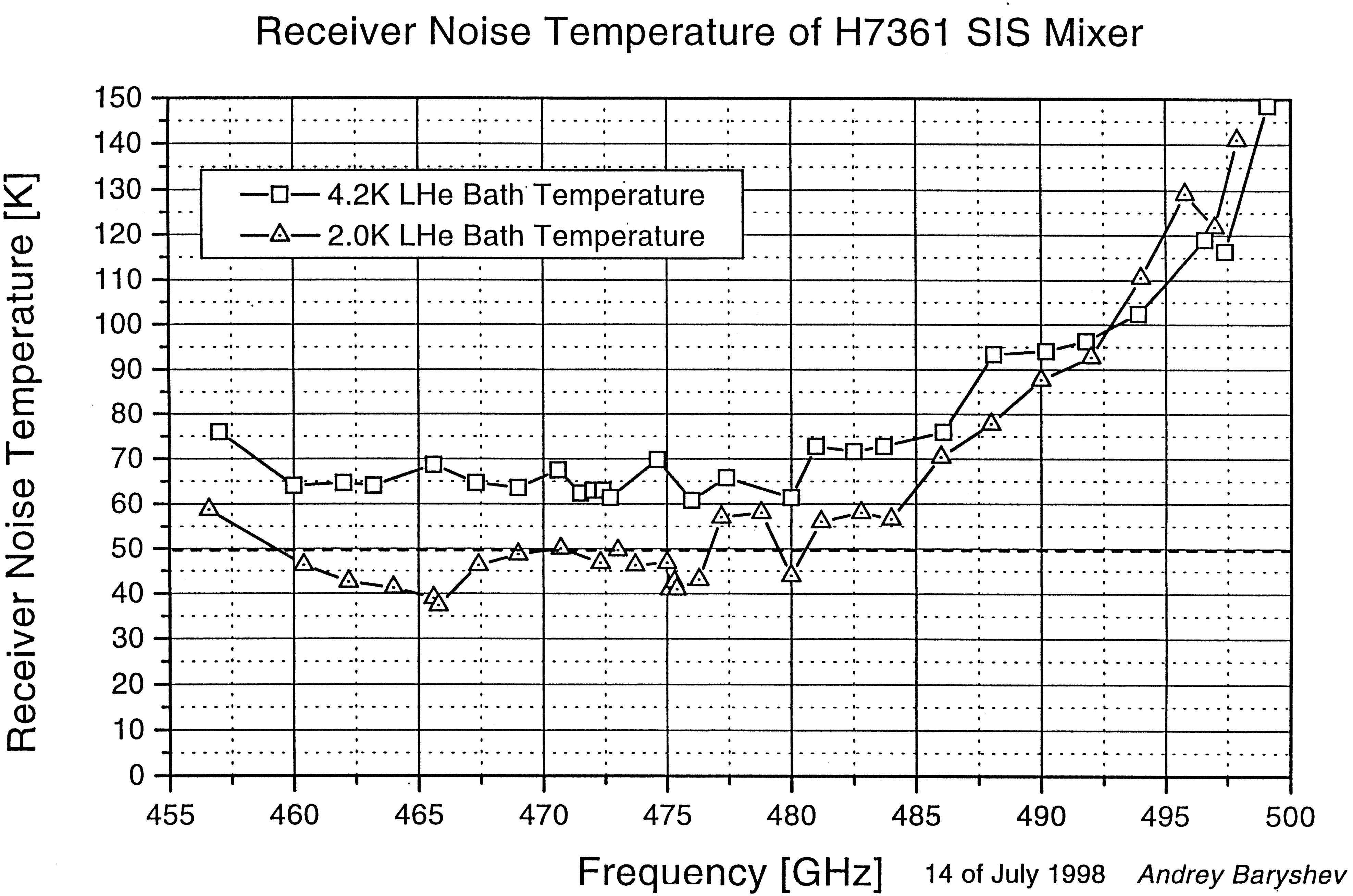
# Layout of Integrated Receiver

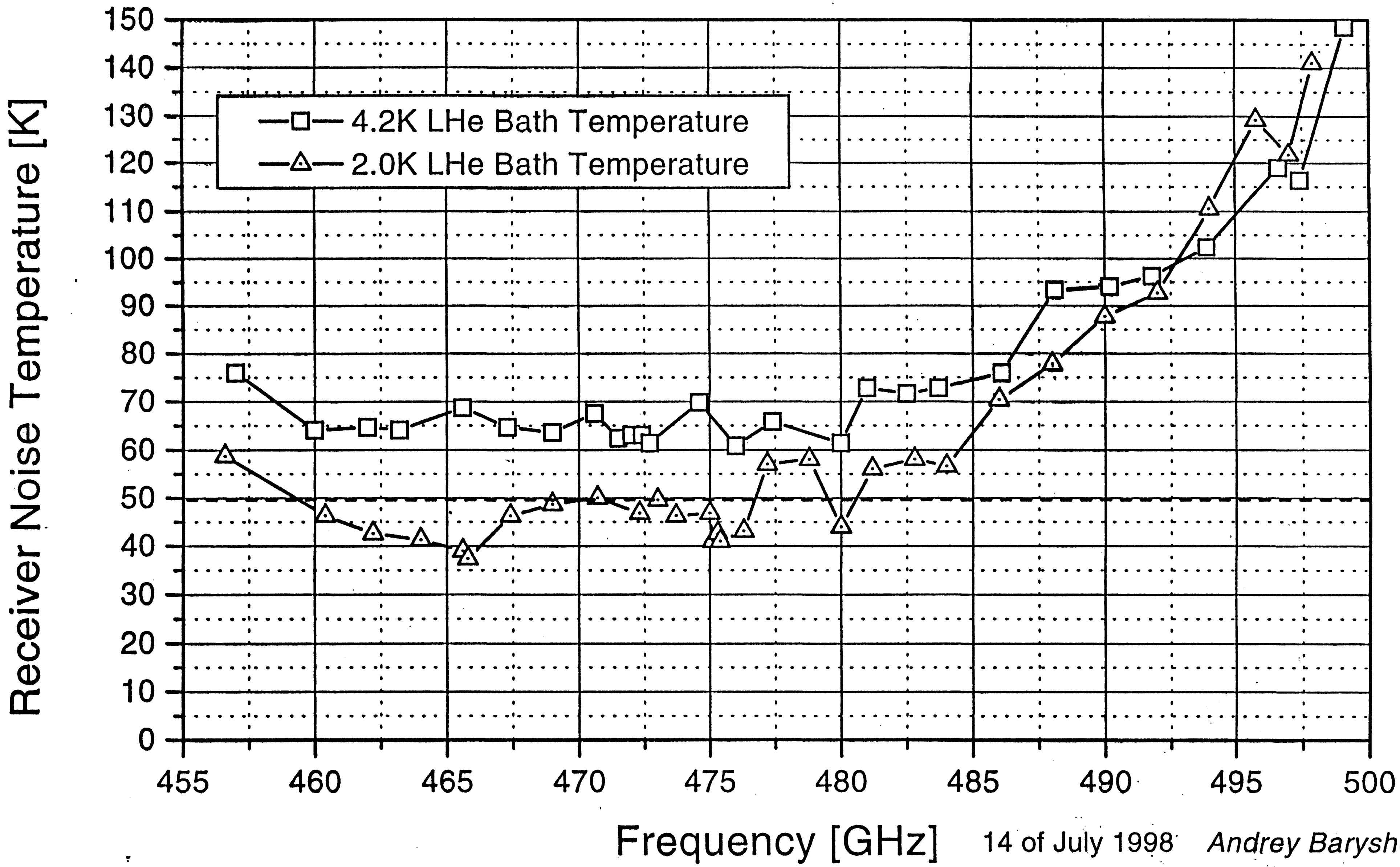







14 of July 1998 *Andrey Baryshev*

## Receiver Noise Temperature of H7361 SIS Mixer




14 of July 1998 *Andrey Baryshev*

# CONCLUSION

- **Quasioptical Superconducting Integrated Receiver designed for silicon Superior low-noise performance @ 470 - 530 GHz**

- **Imaging Array Receiver 9 pixels "Fly's Eye"**

- **The receiver DSB noise temperature @ 500 GHz:**
  $T_{RX}$ = 150 K for *array* configuration
  $T_{RX}$ = 85 K for *balanced SIS mixer*
  $T_{RX}$ = 40 K for *reference SIS mixer*

- **Instantaneous bandwidth 15 – 20 % Fit application requirement**

- **Antenna beam**
  - Good symmetry f/10
  - Sidelobes < - 16 dB

- **No cross-talk found within Imaging Array Neither on *dc* nor on *rf* signal**

- **The computer system IRTECON:**
  - Qualification of chip receivers
  - Operating Superconducting Receiver

# PHASE LOCKED FLUX FLOW OSCILLATOR FOR SUB-MM WAVE INTEGRATED RECEIVER

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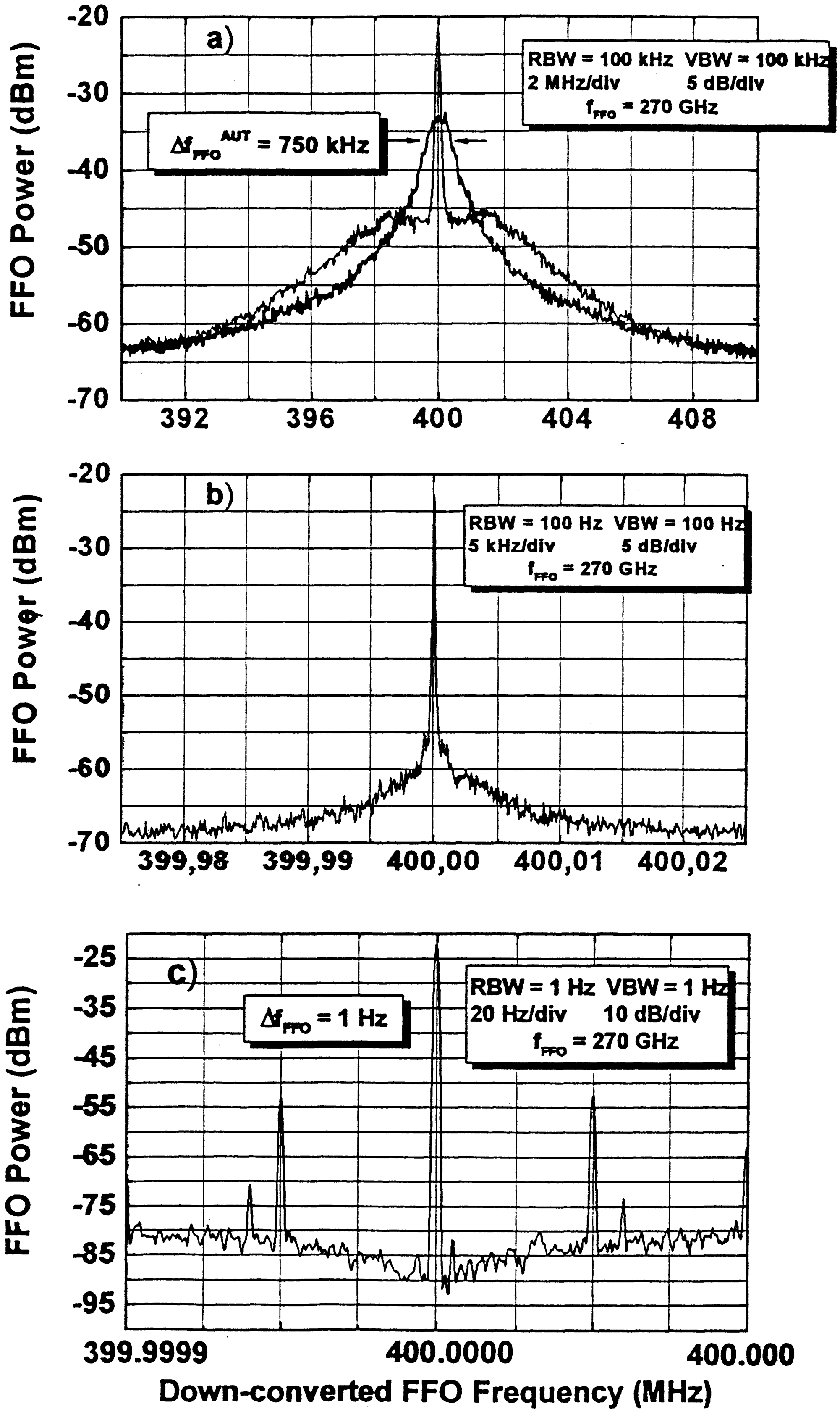
# Phase Locked Flux Flow Oscillator Spectra



# CONCLUSION

- A numerical model taking into account all known noise components of the FFO integrated in the real experimental circuit has been developed. This model was used for quantitative analysis of the FFO linewidth measurements in the frequency range 250 - 600 GHz.

- The presented results demonstrate our ability to decrease the intrinsic linewidth of a Josephson oscillator by an external electronic Phase Locked Loop (PLL) system, provided that the PLL bandwidth is larger than the initial oscillator linewidth.

- A FFO linewidth as low as 1 Hz (determined by resolution bandwidth of spectrum analyzer) has been measured in the frequency range 270 - 430 GHz; it is far below the fundamental level given by shot and thermal noise of the free-running tunnel junction.

- A concept of the Integrated Receiver with Phase Locked FFO is developed.

# Design and test of a 3x3 micromachined millimeter wave imaging array

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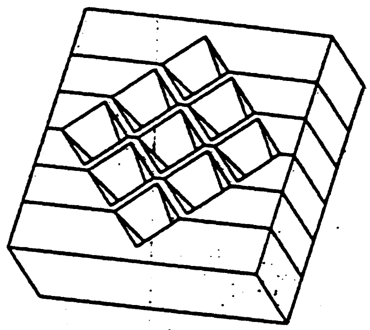
Erik Duerr, Qing Hu
*MIT*

David Osterman, Ray Robertazzi
*HYPRES*

## Introduction



## Receiver design

Mixerblock
Optics
Mask lay-out
Design of integrated receiver

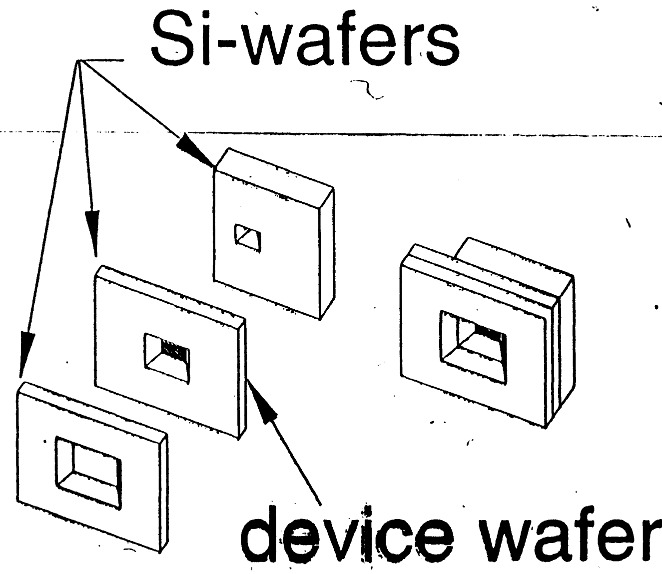
## Results

DC characteristics
Fourier Transform measurements
Antenna beam patterns
Receiver Noise
Bandwidth
Array uniformity

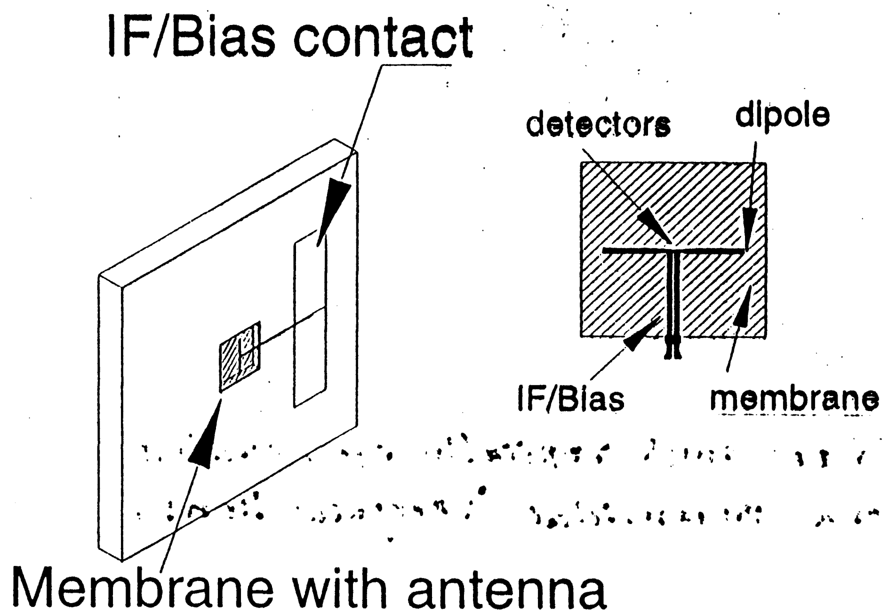
## Summary

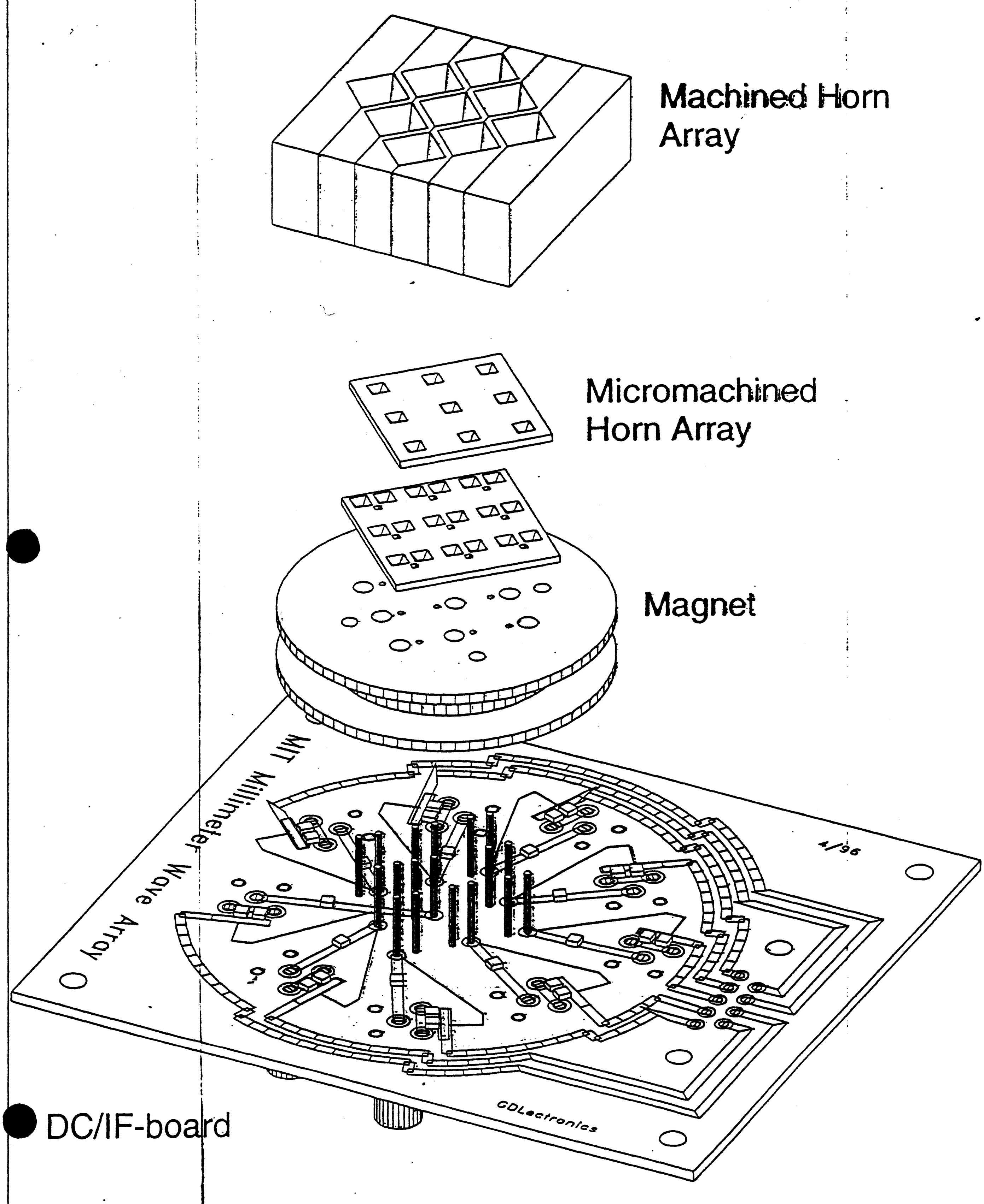
# Basic Principle

- **A stack of anisotropically etched Si (100) wafers forms a millimeter wave horn antenna with a flare angle of 70° (111-planes)**

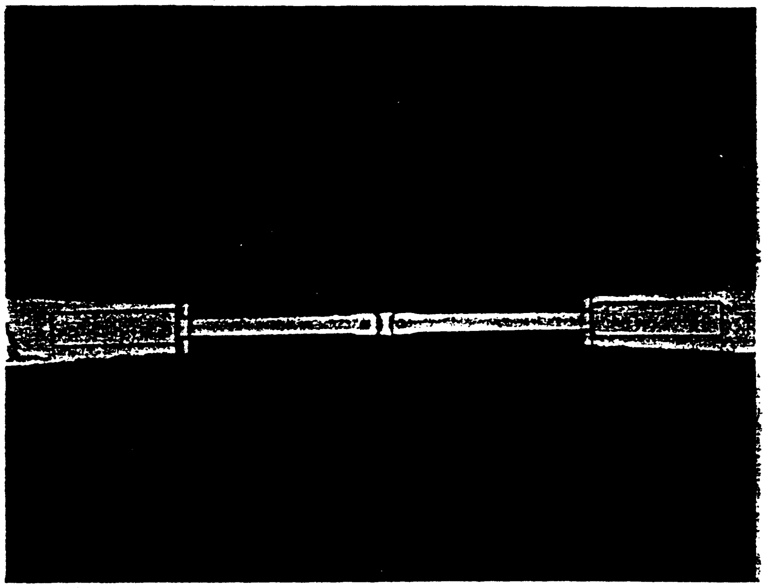



- **A 0.37 λ millimeter wave dipole antenna is fabricated on the thin $Si_3N_4$ membrane**

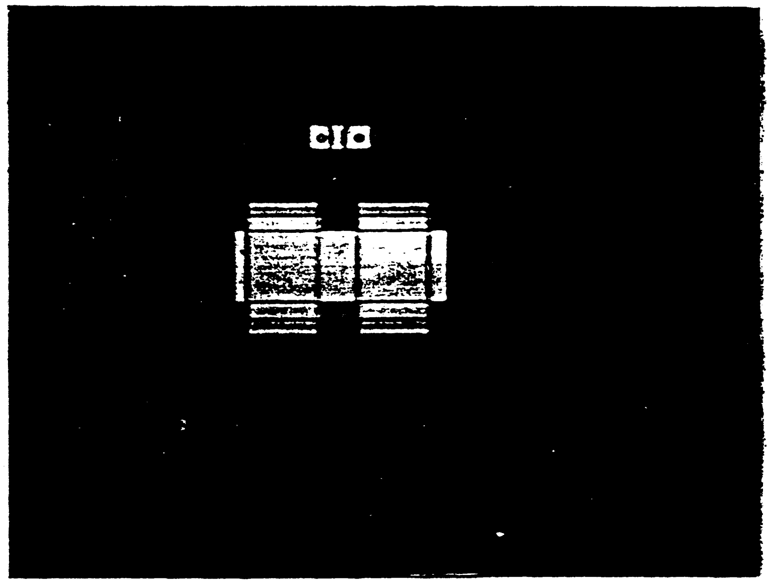



Machined Horn Array
Micromachined Horn Array
Magnet
MIT Millimeter Wave Array
4/96
GDLectronics
DC/IF-board

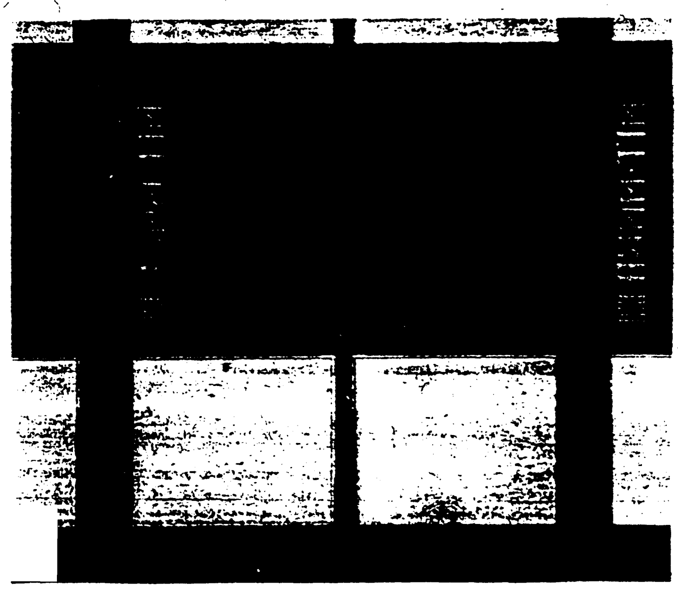
Two Section Stub



Coplanar Short

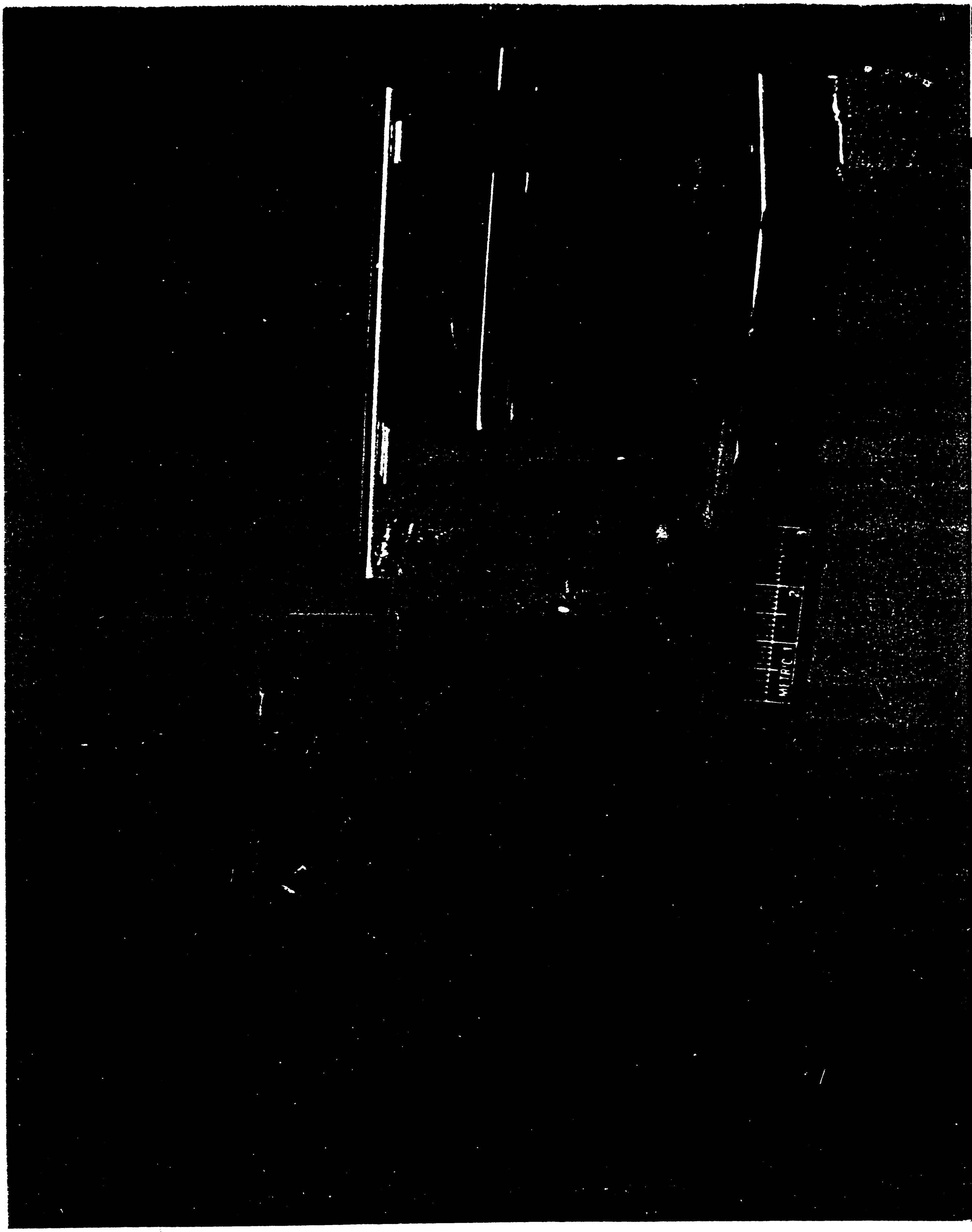


Array Element



# Advantages:

- Application in arrays
- possibility of integrating the detector with on-chip electronics (oscillators, in progress)
- low cost fabrication of (sub-) millimeter-wave structures, scalable into the THz frequency range
- The dipole antenna is nearly in free space, therefore no substrate losses.


METRIC

# Summary

*Described the design and fabrication of a 3x3 micromachined SIS imaging array, and the design of an integrated array receiver*

- *Lowest noise temperature measured 52 K @ 190 GHz for central element of array (waveguide 35-50 K)*
- *3-dB noise bandwidth 25-30 GHz*
- *Good quality Gaussian beam for central element, shoulder at -15 dB for off-axis element*
- *Array operation:*
  *9-element operating*
  *Tn 62-101 K DSB*
  *Variation most likely due to limited size of optics.*