THESTRAL: A High Granularity Monolithic THz Pixel Detector

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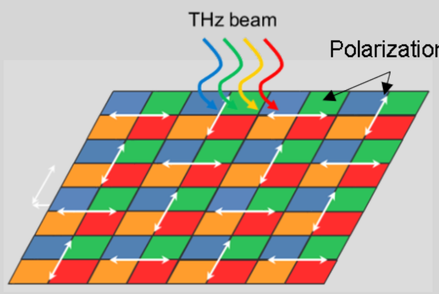
Goal

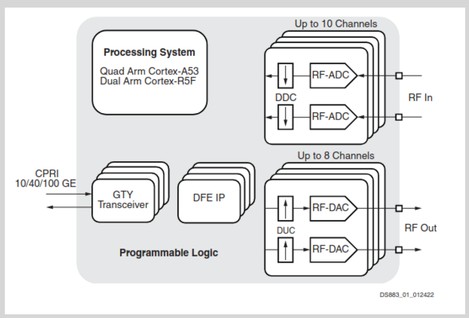


THESTRAL
(TeraHErtz pixelated SpecTRAL detector)

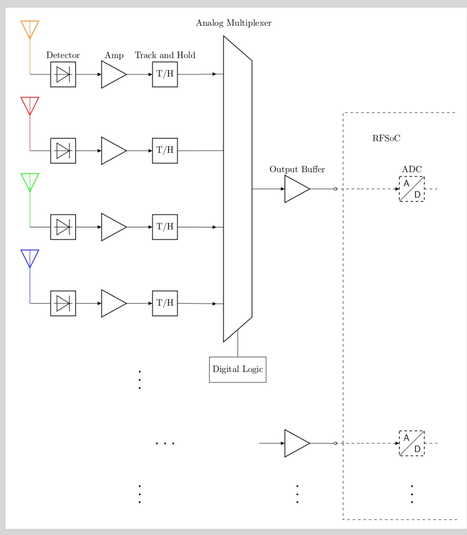
- Cutting-edge monolithic THz detector that combines: spatial, spectral, timing and polarization measurement

Principle

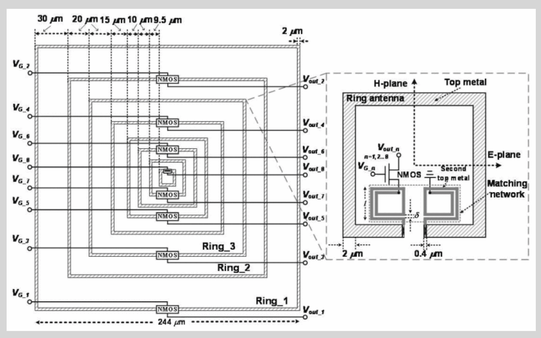
- 16 Pixel THz camera with 500 Mfps
- Each pixel contains several antennas tuned to different properties
- Readout with RFSoC from Xilinx [1]



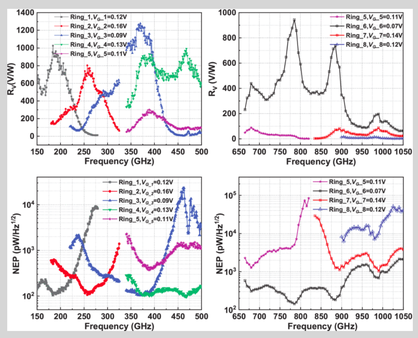
Chip Architecture



Antenna



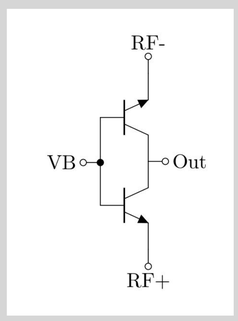
Array of ring antennas [2]



Measured Responsitivity and NEP [2]

- Possible design: arrays of ring antennas tuned to different frequencies
- Polarization measurement by antenna readout with 2 differential detectors [3]
- Principle already approved in 65 nm CMOS [2]

Detector

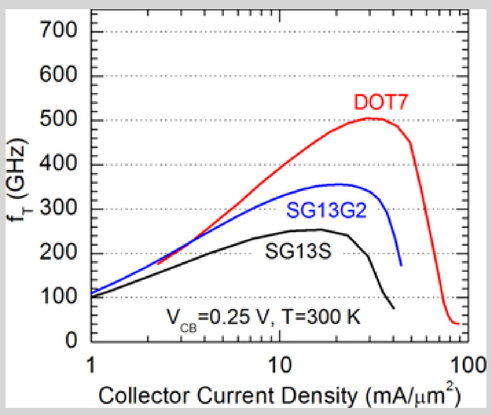


Differential Common Base detector [4]

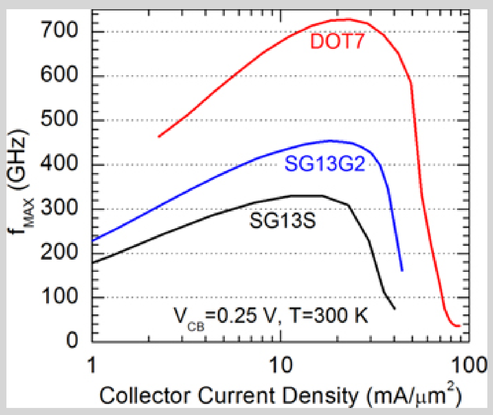
- Detector based on SG13G3 HBT with very high f_{max}
- Detection of signals > 1 THz feasible

IHP SG13G3

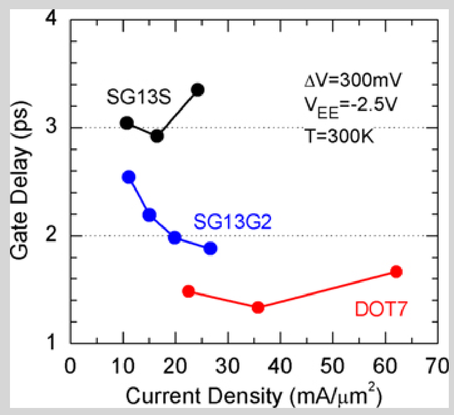
130 nm SiGe BiCMOS with extraordinary transistor performance developed in DOTSEVEN project [5]



Transit frequency f_T of HBTs (DOT7=SG13G3)



f_{max} of HBT (DOT7=SG13G3)



Gate Delay of HBT (DOT7=SG13G3)

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References

[1] Xilinx. “Zynq ultrascale+ rfsoc data sheet: Overview.” (2022), [Online]. Available: https://docs.xilinx.com/v/u/en-US/ds889-zynq-usp-rfsoc-overview.

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[3] Z. Li, B. Qi, X. Zhang, S. Zeinolabedinzadeh, L. Sang and J. D. Cressler, “A 0.32-thz sige imaging array with polarization diversity,” *IEEE Transactions on Terahertz Science and Technology*, vol. 8, no. 2, pp. 215–223, 2018. DOI: 10.1109/TTHZ.2017.2787958.

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[5] H. Rücker and B. Heinemann, “High-performance SiGe HBTs for next generation BiCMOS technology,” *Semiconductor Science and Technology*, vol. 33, no. 11, p. 114 003, Oct. 2018. DOI: 10.1088/1361-6641/aade64.