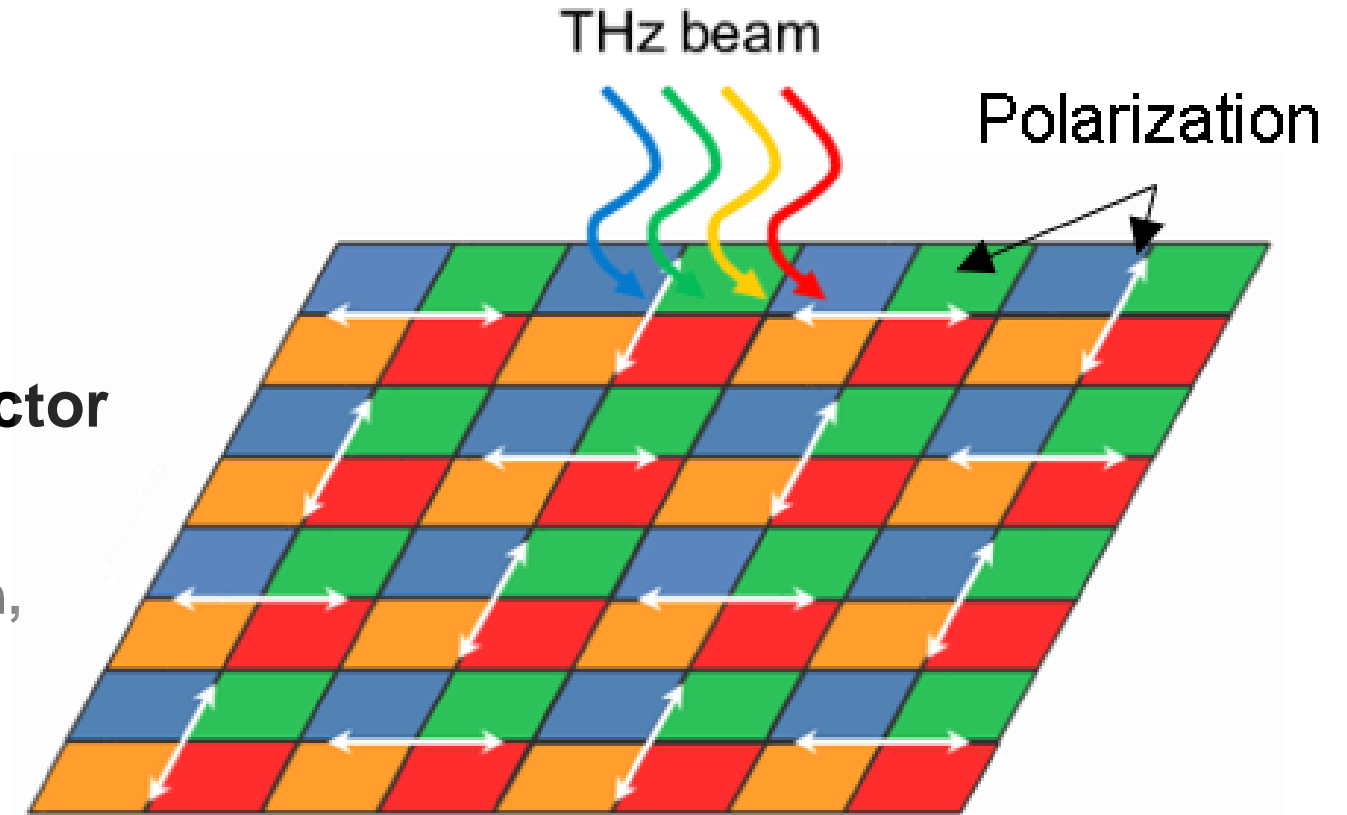


THESTRAL

A High Granularity THz Pixel Detector

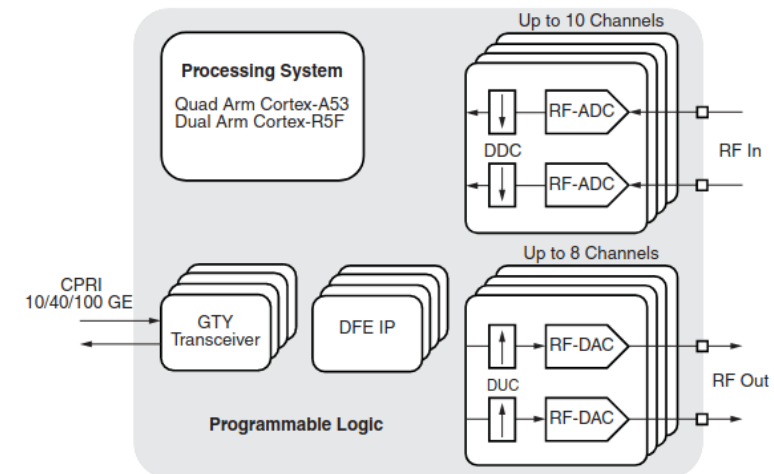
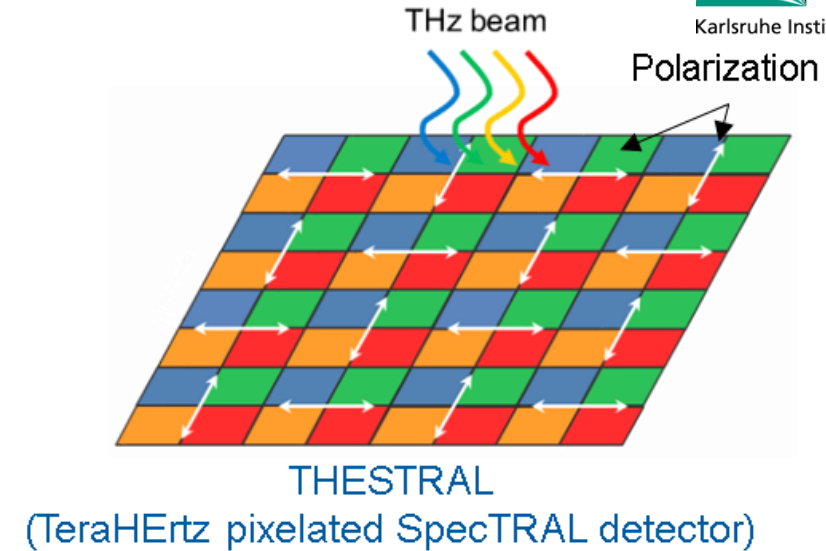
Alexander Elsenhans, Michele Caselle,
Ekaterina Kunakovskaya, Christian Bohn,
Ahmet Cagri Ulusoy



THESTRAL
(TeraHertz pixelated SpecTRAL detector)

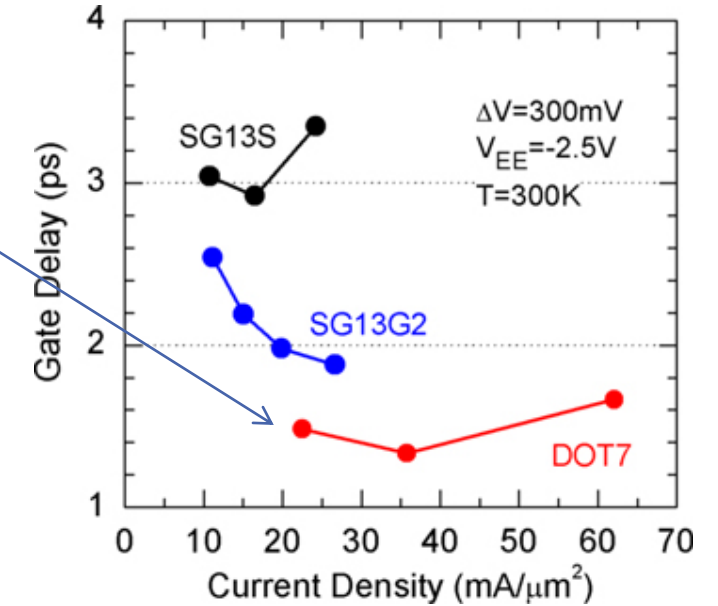
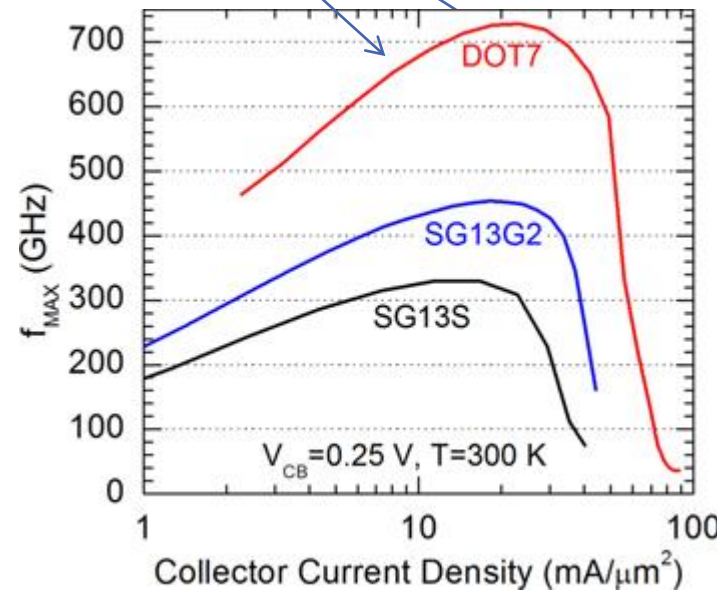
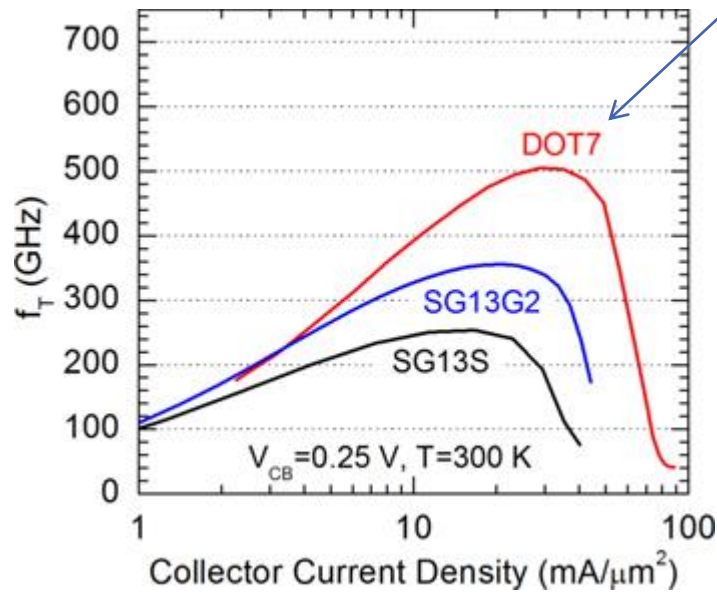
THESTRAL

- THz-Camera that combines spatial, spectral, timing and position measurement
- 16 Pixels and 500 Mfps
- Each Pixel can host several antennas tuned to different frequencies and polarizations
- Readout by RFSoc



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

IHP SG13G3 130 nm BiCMOS



H. Rucker 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.

■ Design of circuits at very high frequencies possible

Questions

- Minimum Responsitivity and NEP required?
- Spectrum or Polarization Information more important?
- Applications in Bunch Diagnostics?

→ I am looking forward to a fruitful discussion at the poster session

Backup

Definitions

■ Responsivity

- Ratio of generated current/voltage and power arriving to the detector.
- If detector with voltage output:
 - $R = \frac{V_{out}}{P_{antenna}}$
- measured in V/W (volts per watt)

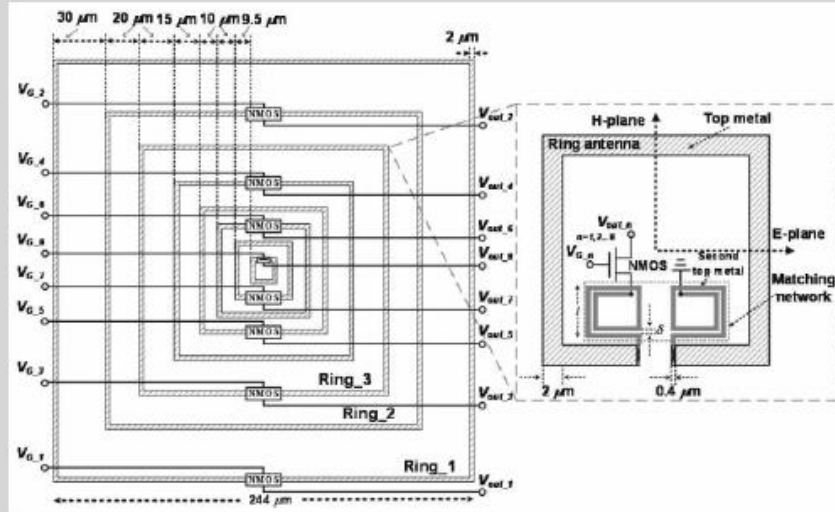
Alexander Cuadrado, José M. López-Alonso, Juan C. Martínez-Antón, Jose M. Ezquerro, Francisco J. González, Javier Alda, "Detectivity comparison of bolometric optical antennas," Proc. SPIE 9547, Plasmonics: Metallic Nanostructures and Their Optical Properties XIII, 954735 (28 August 2015); <https://doi.org/10.1117/12.2187926>

■ Noise Equivalent Power (NEP)

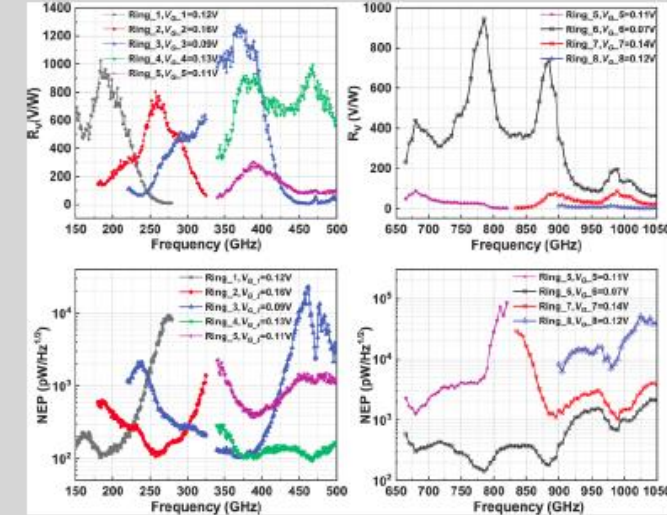
- “incident signal power required to obtain a signal equal to the noise in a one Hz bandwidth”

P. L. Richards, "Bolometers for infrared and millimeter waves", Journal of Applied Physics 76, 1-24 (1994) <https://doi.org/10.1063/1.357128>

Antenna



Array of ring antennas [2]



Measured Responsivity 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]

[2] Z.-y. Liu, F. Qi, Y.-l. Wang, P.-x. Liu and W.-f. Li, "A 150-to-1050 ghz terahertz detector in 65 nm cmos," in *2021 IEEE Asian Solid-State Circuits Conference (A-SSCC)*, 2021, pp. 1–3. DOI: [10.1109/A-SSCC53895.2021.9634828](https://doi.org/10.1109/A-SSCC53895.2021.9634828).

[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/THZ.2017.2787958](https://doi.org/10.1109/THZ.2017.2787958).