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Characterization of Sub-THz and THz Transistors

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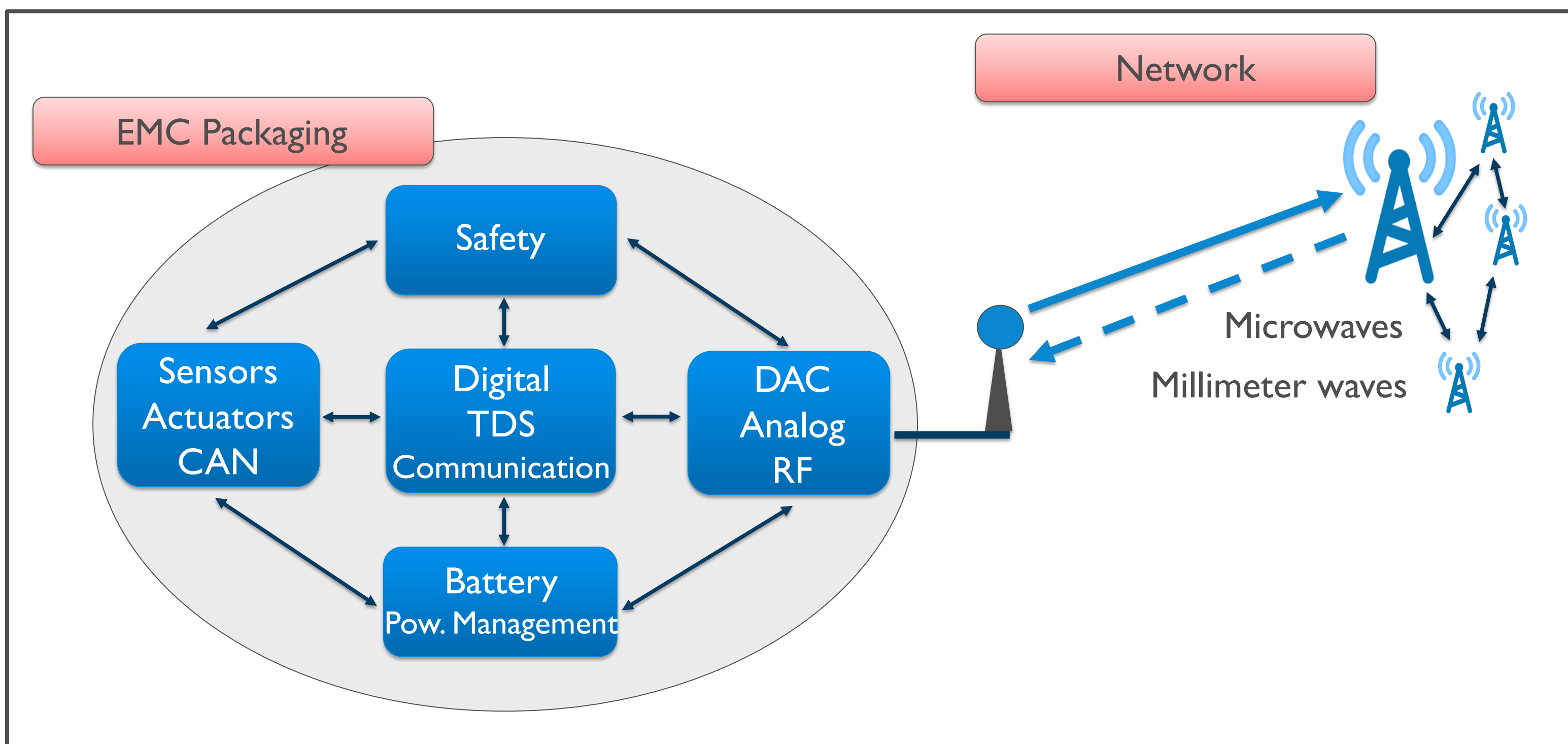
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Characterization of Sub-THz & THz Transistors

Abhishek K. Upadhyay, Marco Cabbia, Sébastien Frégonèse, Marina Deng, Magali De Matos, Thomas Zimmer

General Outline

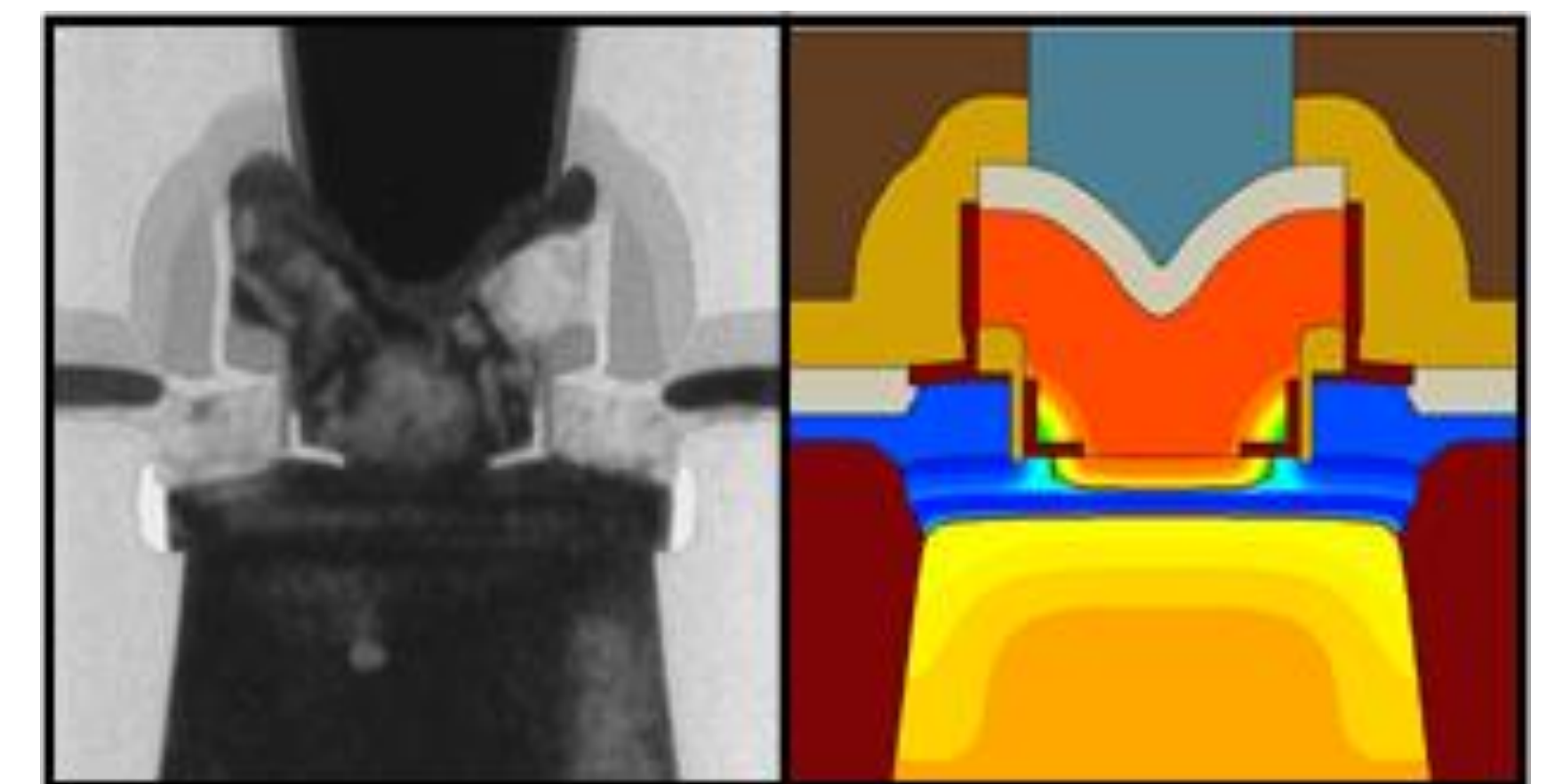
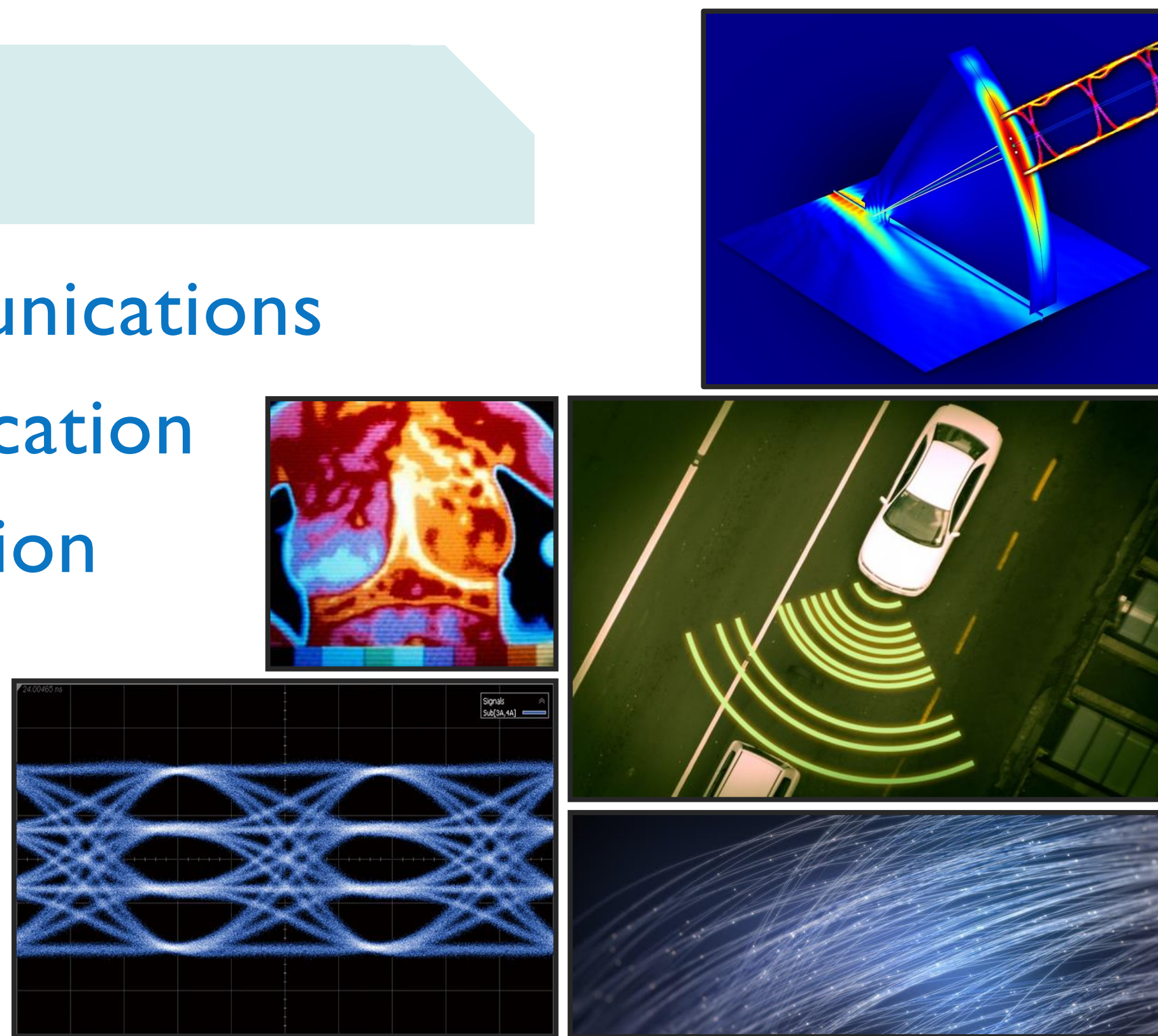


Technology

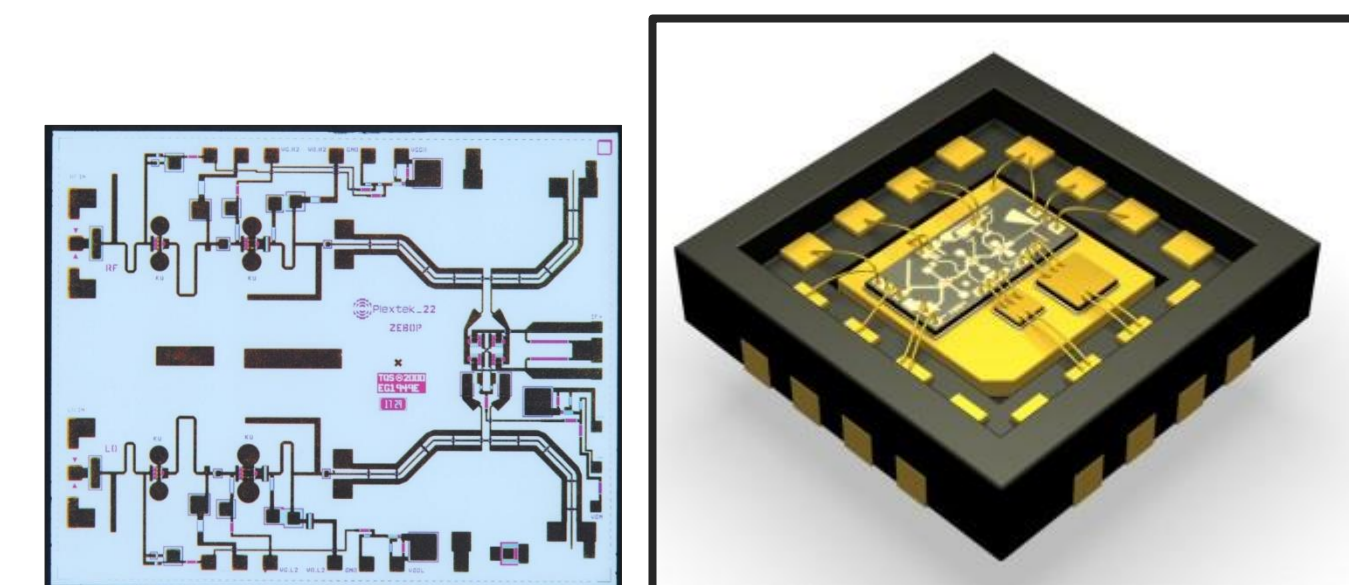
- SiGe HBT with very high f_{max} : 600 GHz
- Integrated with very high density CMOS processes:
 - 130/90 nm for Infineon
 - 55/28 nm for STMicroelectronics
 - Advanced studies at IHP on SiGe HBT with 700 GHz f_{max}

Applications

- 400 Gbit/s optical data communications
- 4G photonic mobile communication
- Two-way satellite communication
- 60 GHz wireless networking
- 77/120 GHz automotive radars
- mmW imaging and sensing
- Fast measurement equipment

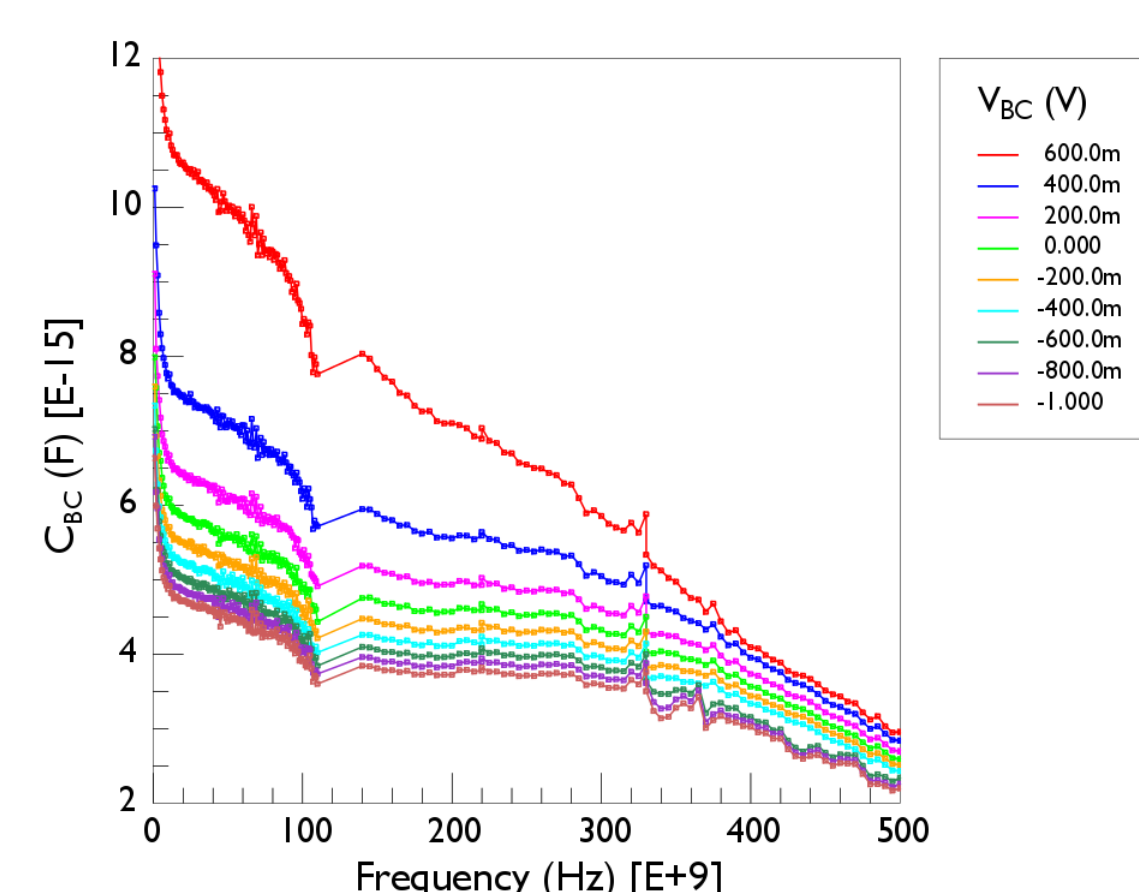


SiGe HBT Emitter-Base Architecture.
TEM picture (left), implementation in TCAD (right).

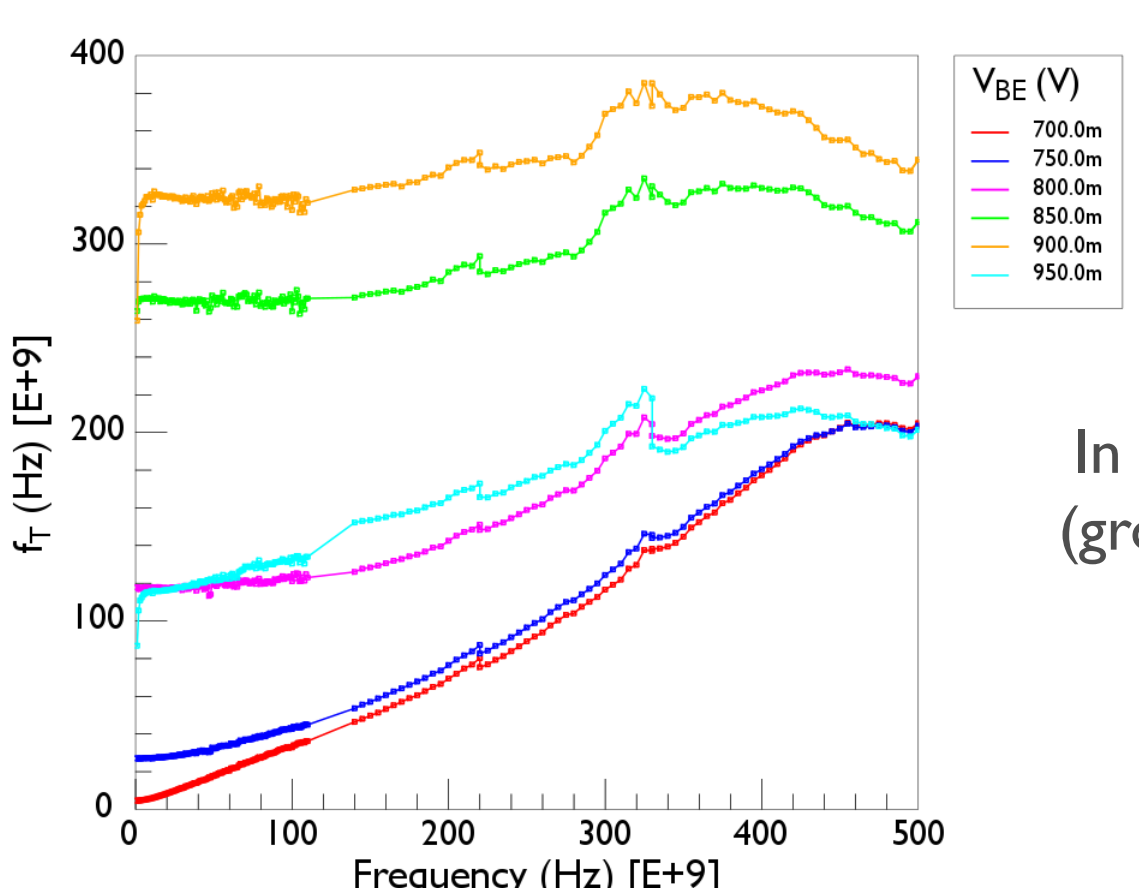


Monolithic Microwave Integrated Circuits (MMICs).
Top view (left), packaging (right).

Characterization & Modelling

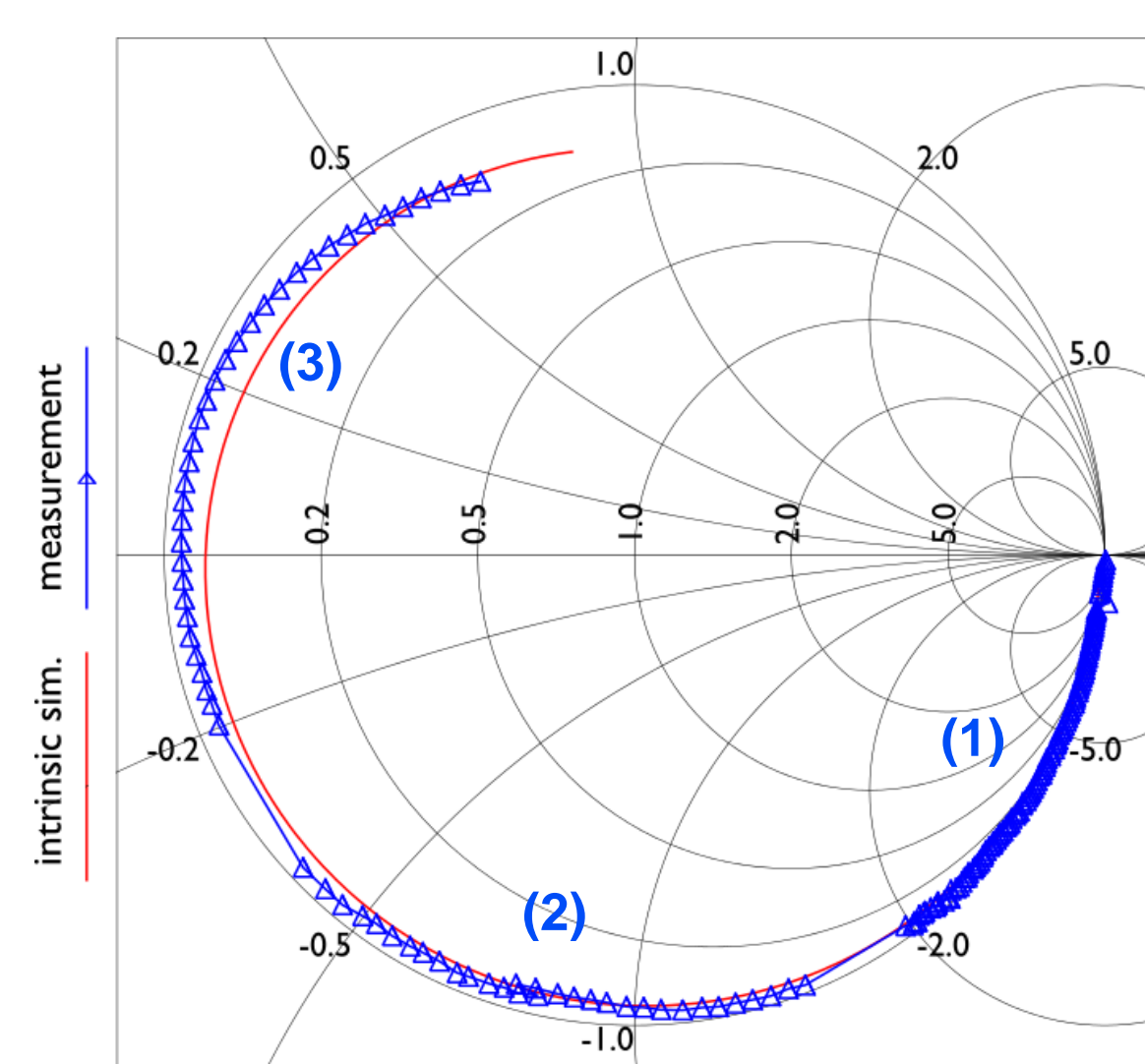


Collector-Base Capacitance.



Transit Frequency of the Reference HBT.

Model Validation



Smith Chart of the 500-GHz Meander Line.

In red, intrinsic HFSS simulation (1-500 GHz); in blue, measurement (group 1: 1-110 GHz, group 2: 140-290 GHz, group 3: 330-500 GHz).

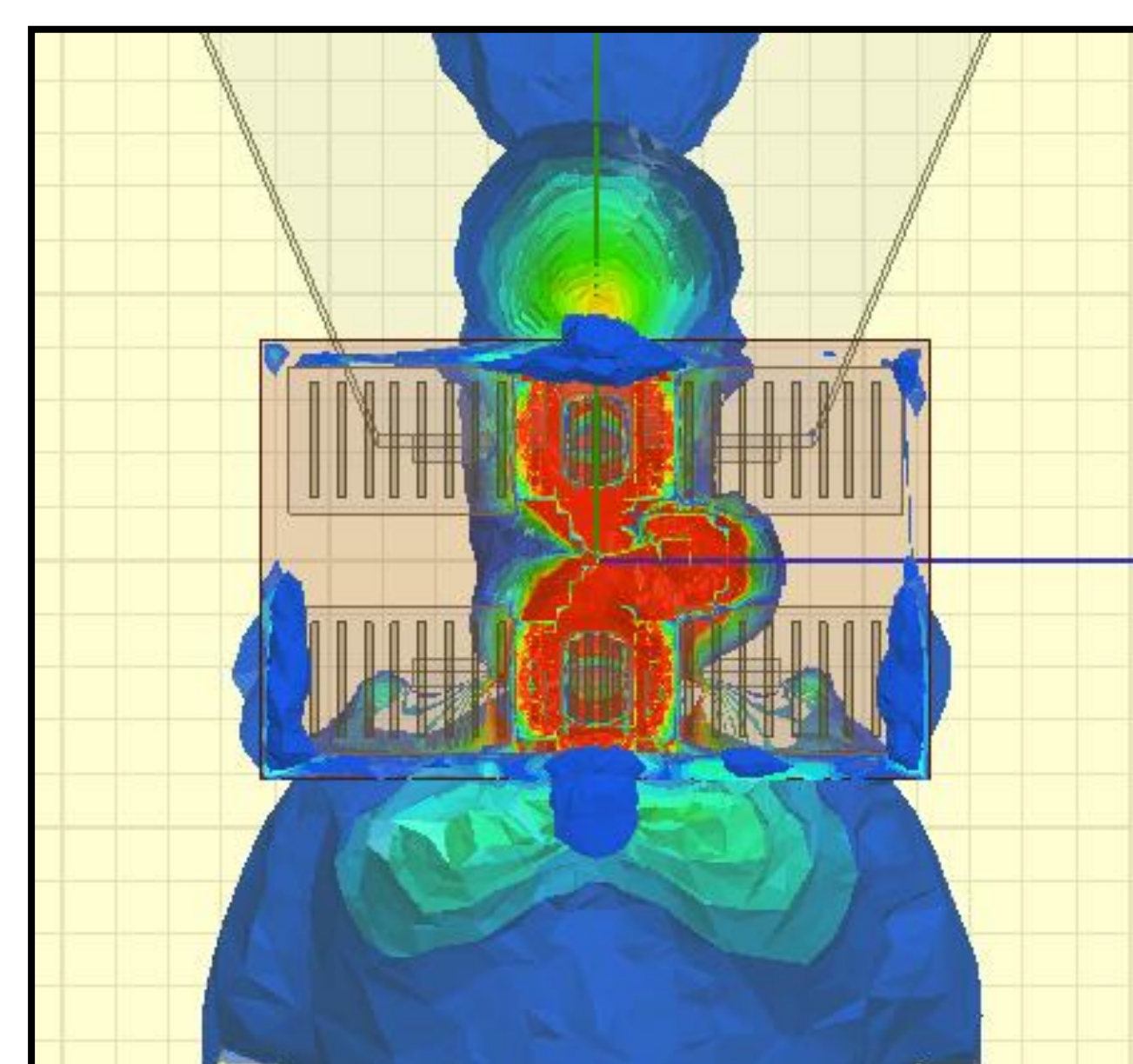
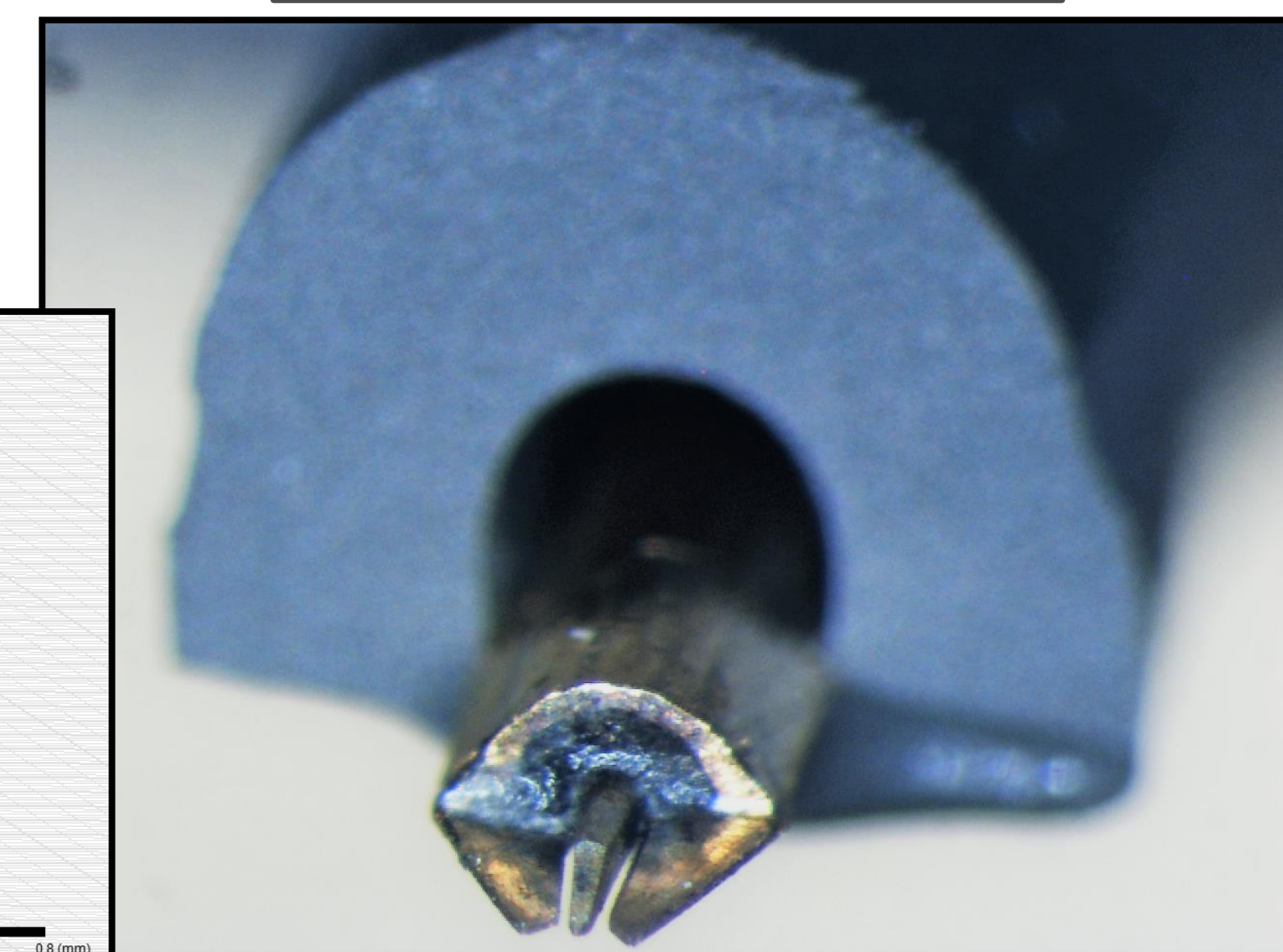
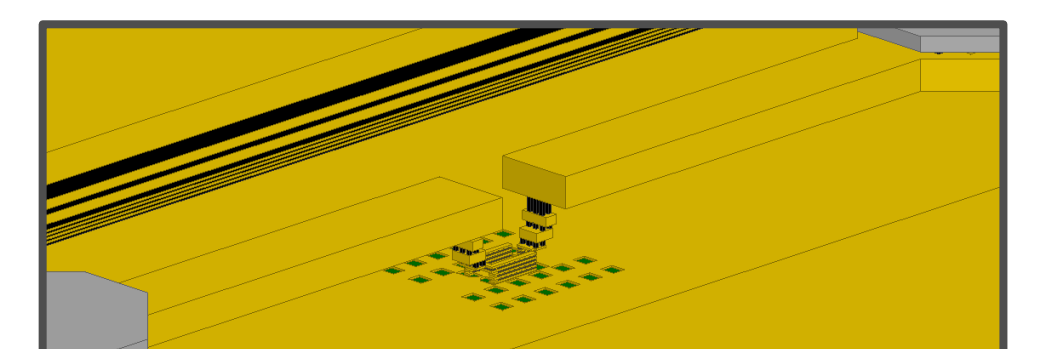
Measurements
up to 500 GHz

Design & EM Simulation

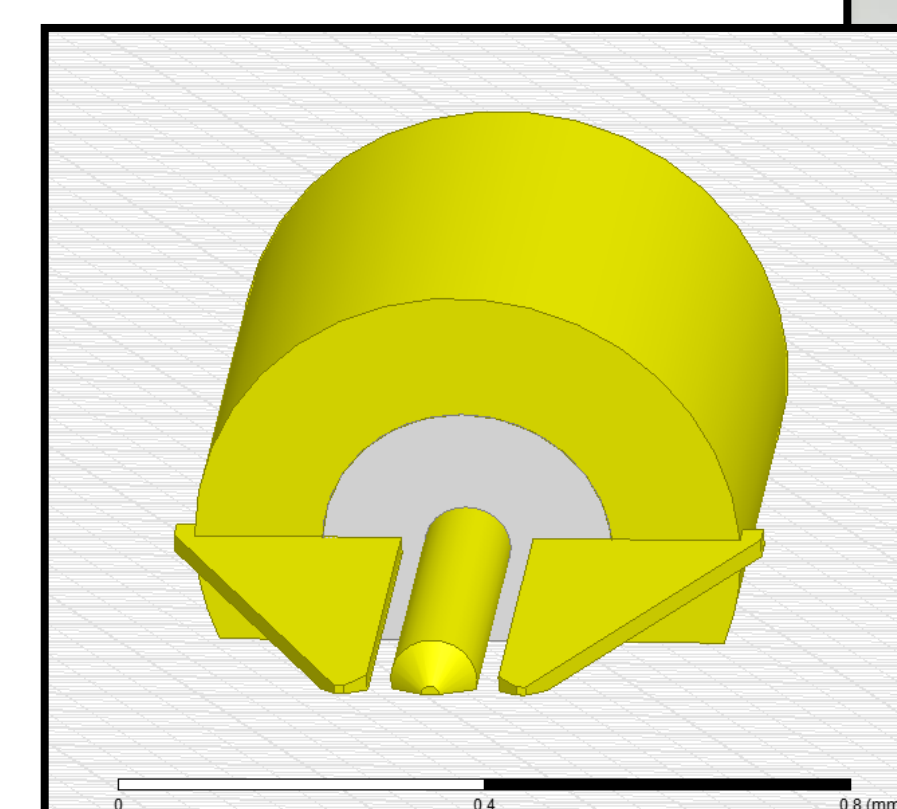
3D Visualisation of the Electric Field Contour

CAD Simulations.

Electric field propagation on a 500-GHz meander line structure with probes (left), metal-I short 3D representation (below).



Probe Design.
110-GHz Picoprobe probe with 100- μ m pitch. HFSS model (right, here on the side), TEM picture (far right).



Projects

National – Nano2017, Nano2022, Subtile (Région Aquitaine)

International – Taranto (Ecsel H2020)

