TERAFLAG Workshop 2018

Christian Wenger

innovations
for high
performance
microelectronics

Leibniz
Association

September 06, 2018

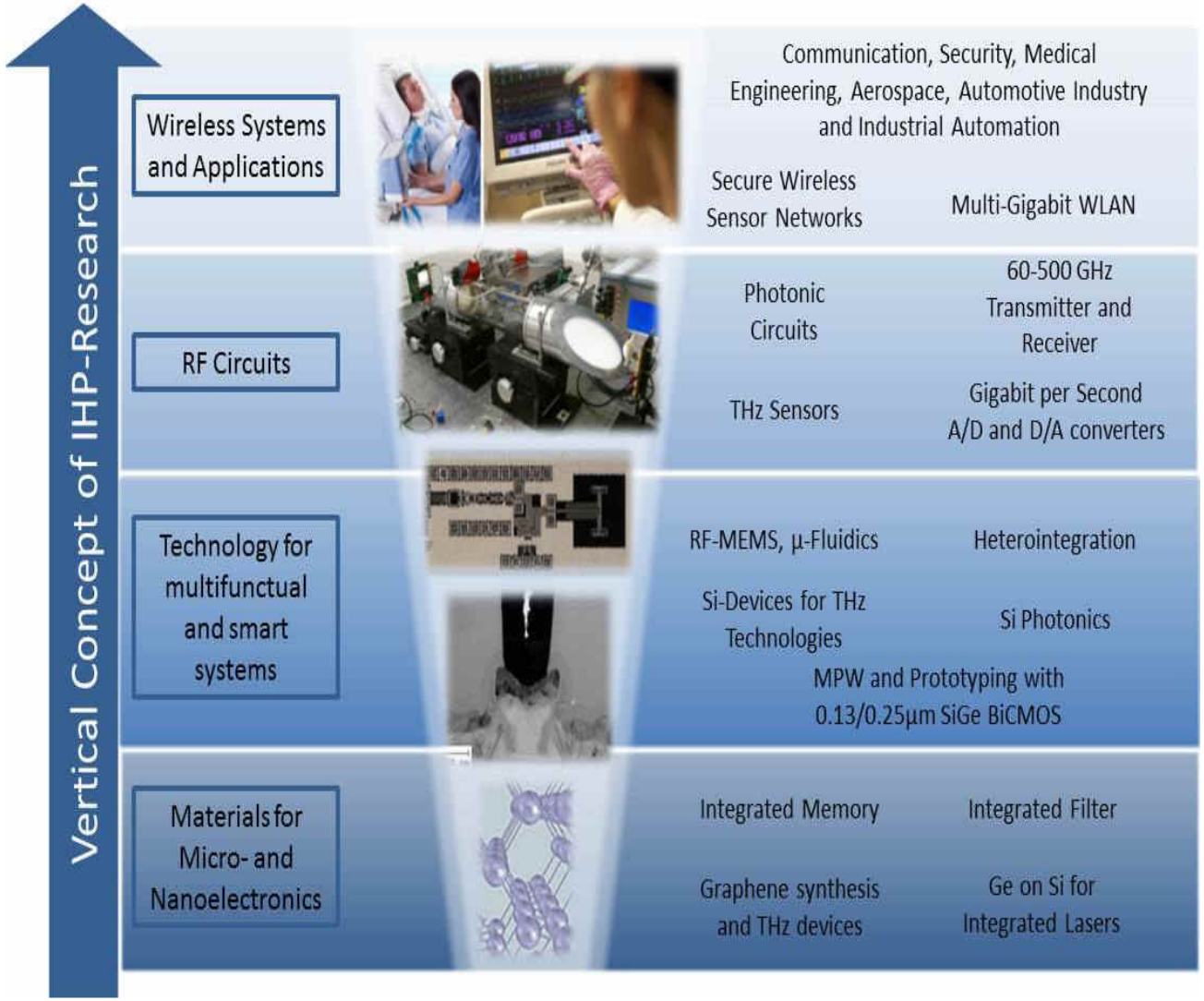
Cassis, France

IHP located in Berlin area

Main activities

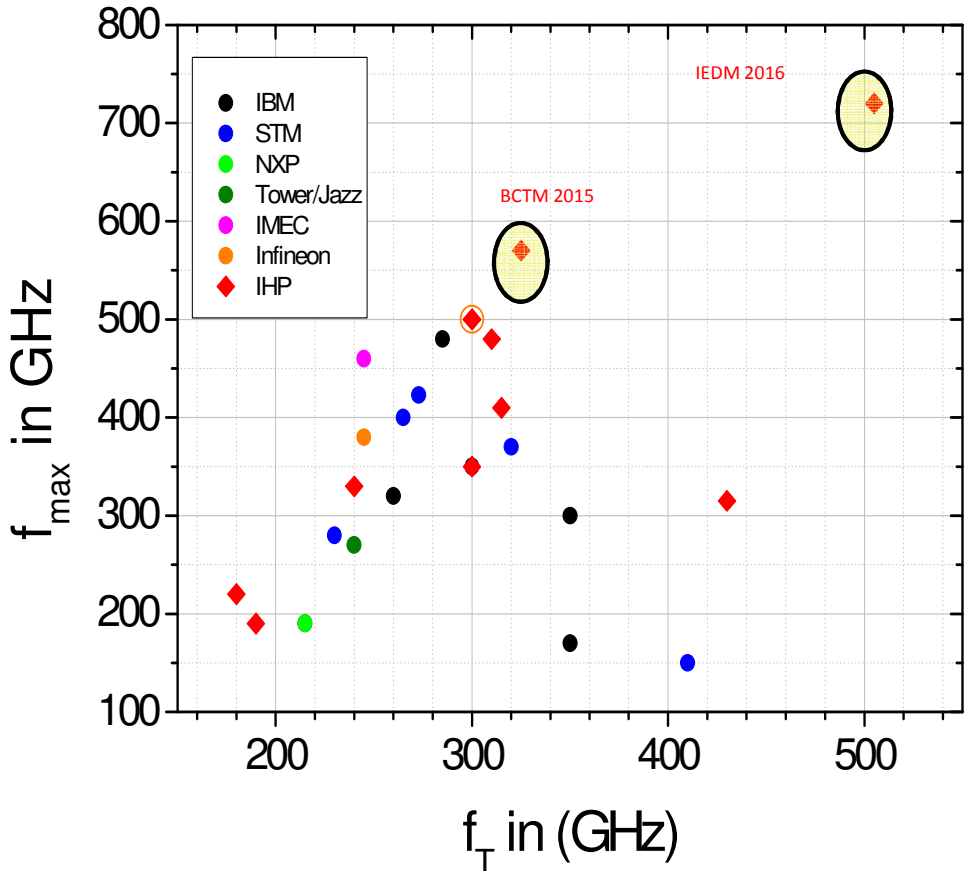
- **R & D for wireless and broadband communication, health, security, space and industrial automation based on RF circuit designs and RF technologies**

IHP‘s vertical concept



SiGe-HBT & BiCMOS Performance Benchmark

20 years of SiGe experience & expertise @ IHP



DOT5 → 500GHz f_{max}

- SG13G2 in production today

DOT7 → 700 GHz f_{max}

- Discrete HBT with f_T > 505 GHz and f_{max} ≈ 720 GHz (IEDM 2016)

TARANTO → 600 GHz f_{max} BiCMOS

- SG13Gx

SiGe-BiCMOS ➔ Benefits & Application

Benefits of SiGe BiCMOS

- Robust margin of f_t / f_{max} over design frequency
- Lower noise, higher gain and current drive
- Gain at lower current bias -> less power dissipation
- Breakdown Bvcer > 3V -> better amplifier linearity
- +MEMS, Photonics, TSV, high-speed PNP

Application space nowadays…

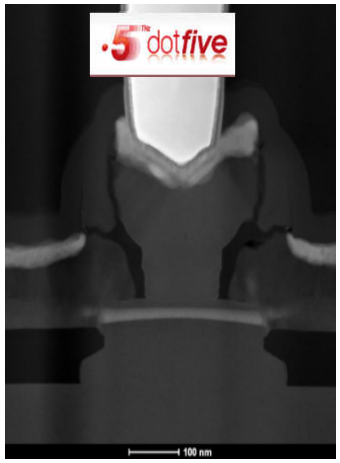
- Radar systems @ 24 GHz, 77 GHz, 120 GHz
- High data rate optical and wireless links …

…and for future

- High-speed communication (400G Data, Broad-band ADCs, 5G, Backhaul)
- Industrial & automotive radar
- mm- wave, THz imaging and sensing

SG13G2

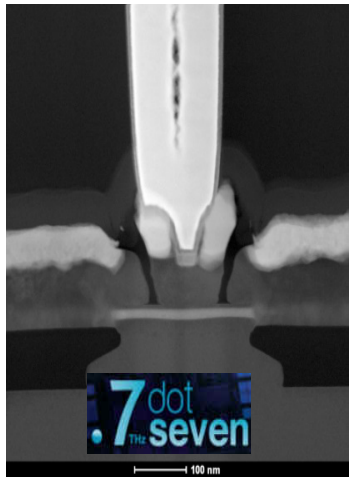
➔ f_T /f_{max} = 300/500 GHz



Next generations towards THz operation..

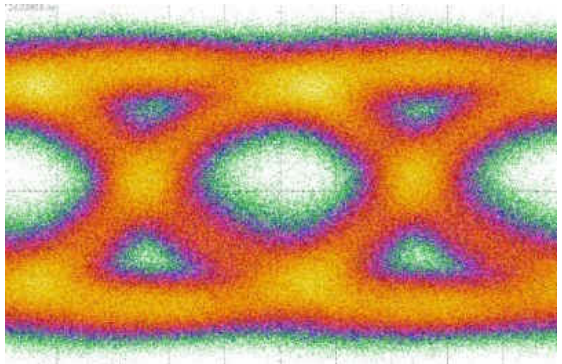
SiGe HBT

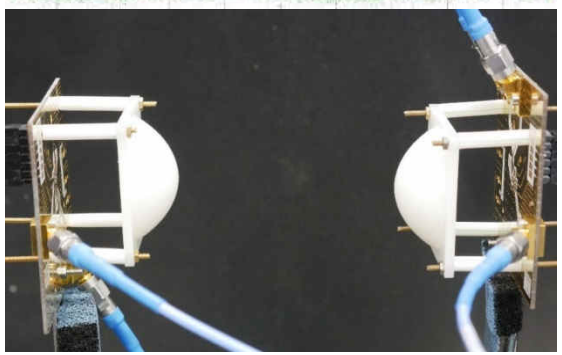
➔ f_T /f_{max} = 505/720 GHz

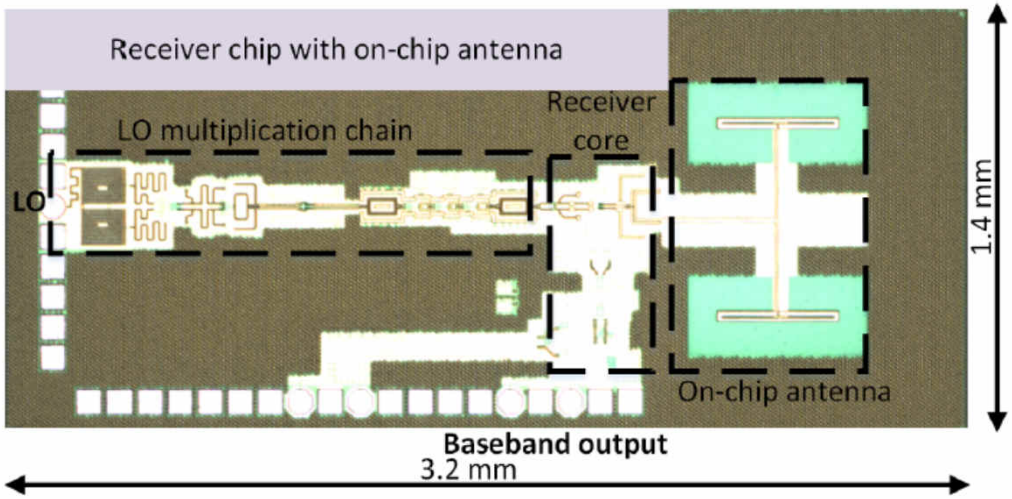


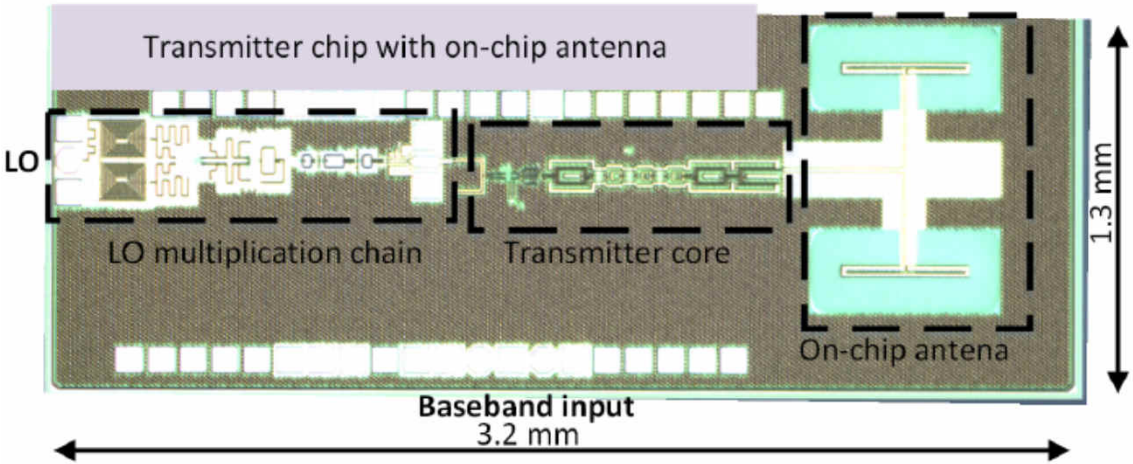
240-GHz Chipset for THz Wireless Communication

- TX: 36 GHz RF BW, P1dB -3 dBm
- RX: 55 GHz RF BW, SSB NF 18 dB,
- 30 GHz local oscillator input
- Co-integration with antennas
- 25 Gbps data rate

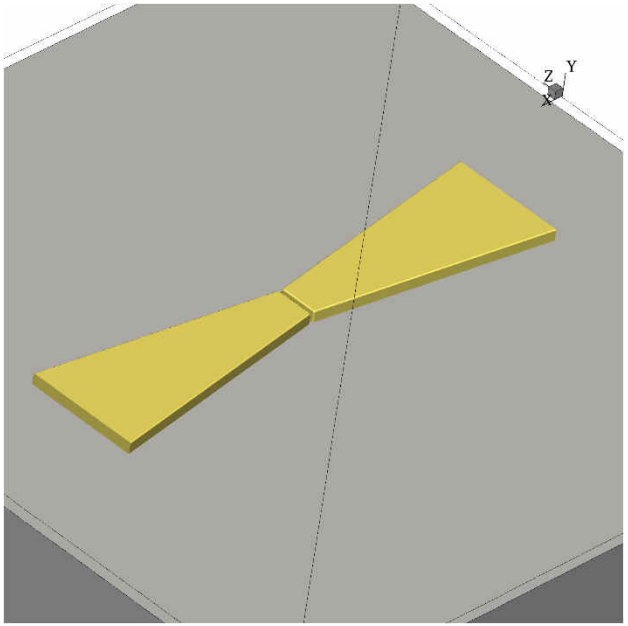




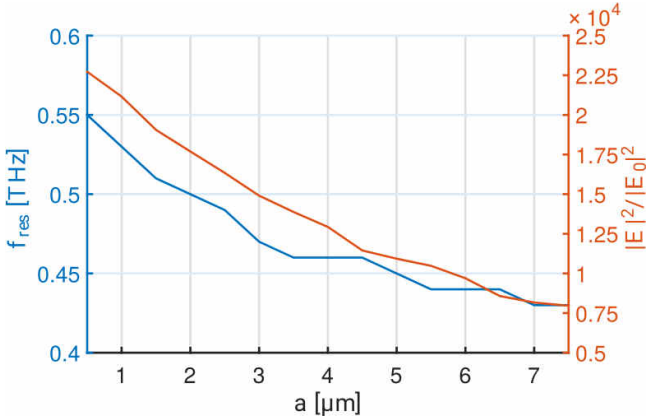




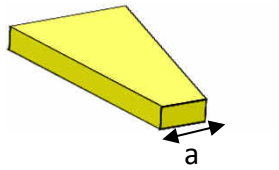
THz Plasmonics – Ge antennas on Silicon

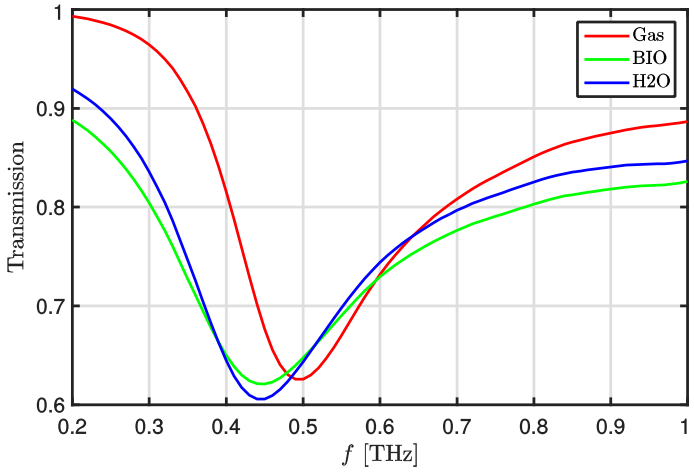


Ge antenna structure



Field enhancement





Sensitivity

Ge antennas on Si wafer: resonant frequency at 0.5 THz

Thank you for your attention!

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