

The **next** circuits for a better life

# KU Leuven ESAT-MICAS research group

## THz Activities

Prof. dr. ir. ing. Patrick Reynaert  
ir. David Maes

KU LEUVEN

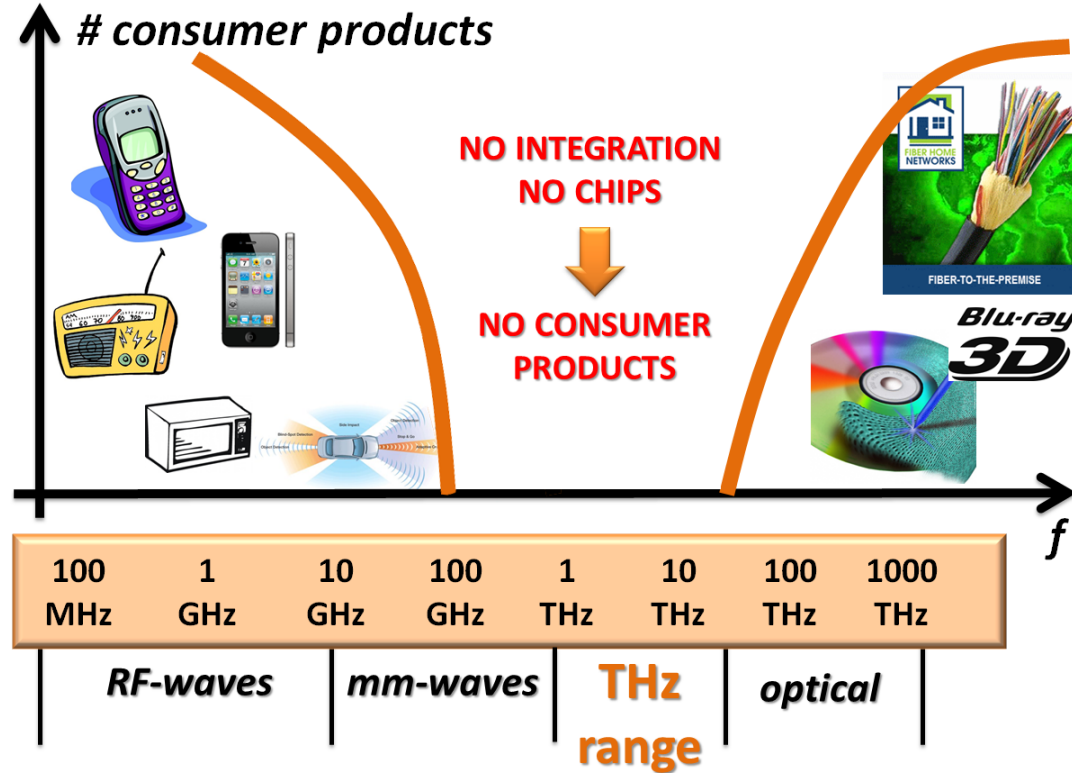


**Develop THz chips in CMOS**

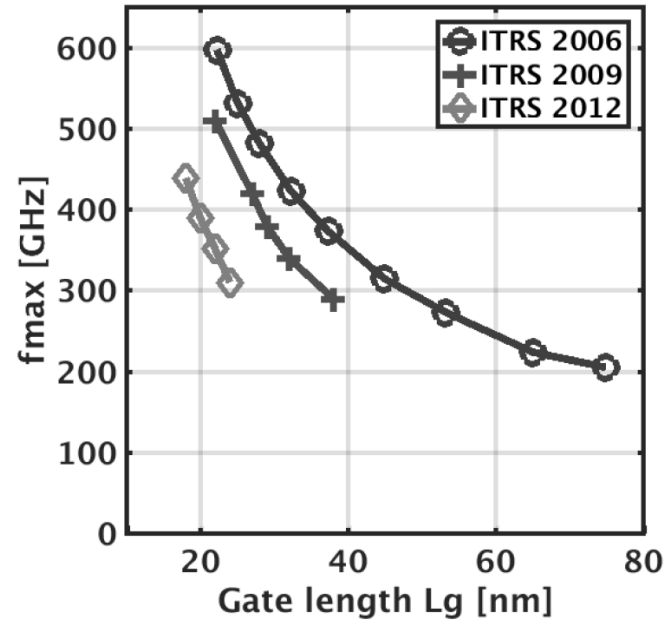
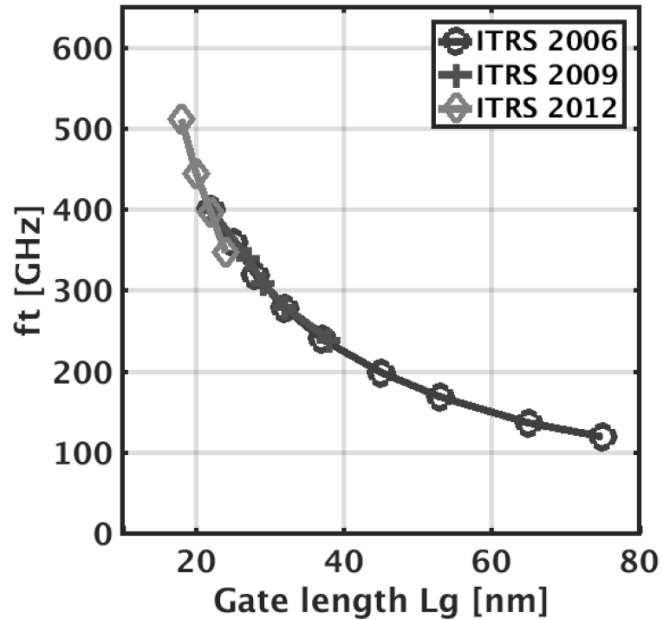
**Explore possible applications**

**Enable widespread use**

# Why CMOS? Integration Leads To Market Breakthrough!

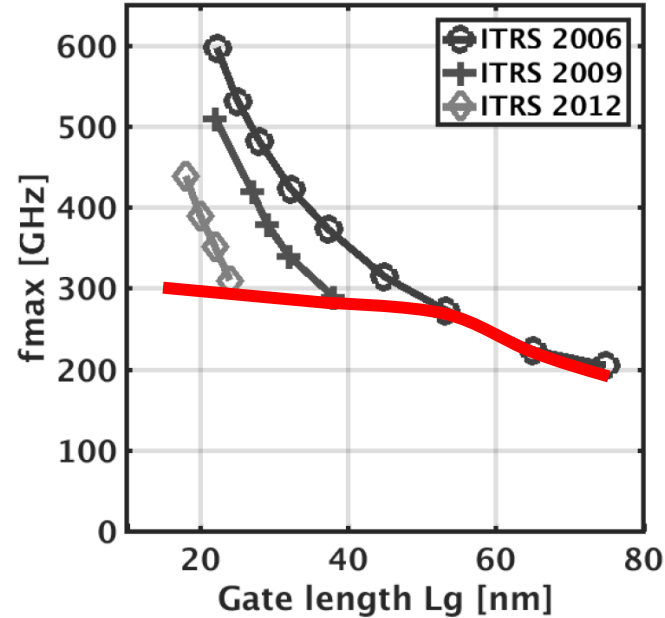
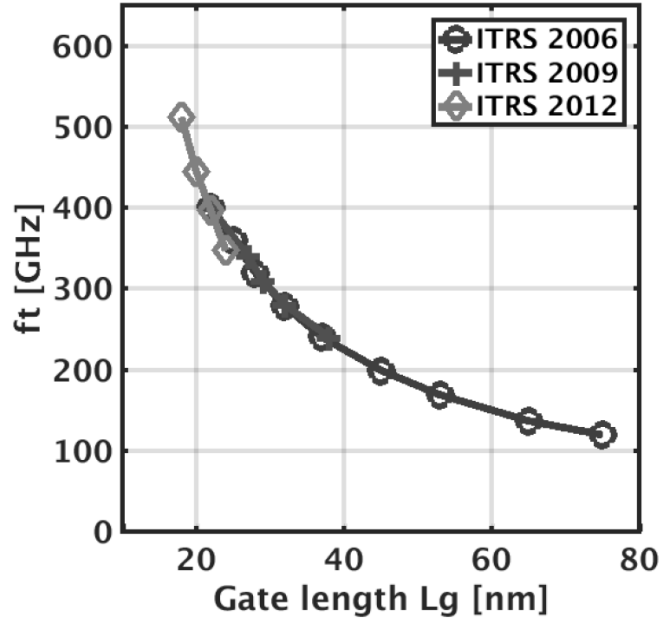


# ITRS roadmap: delayed for $f_{\max}$ !



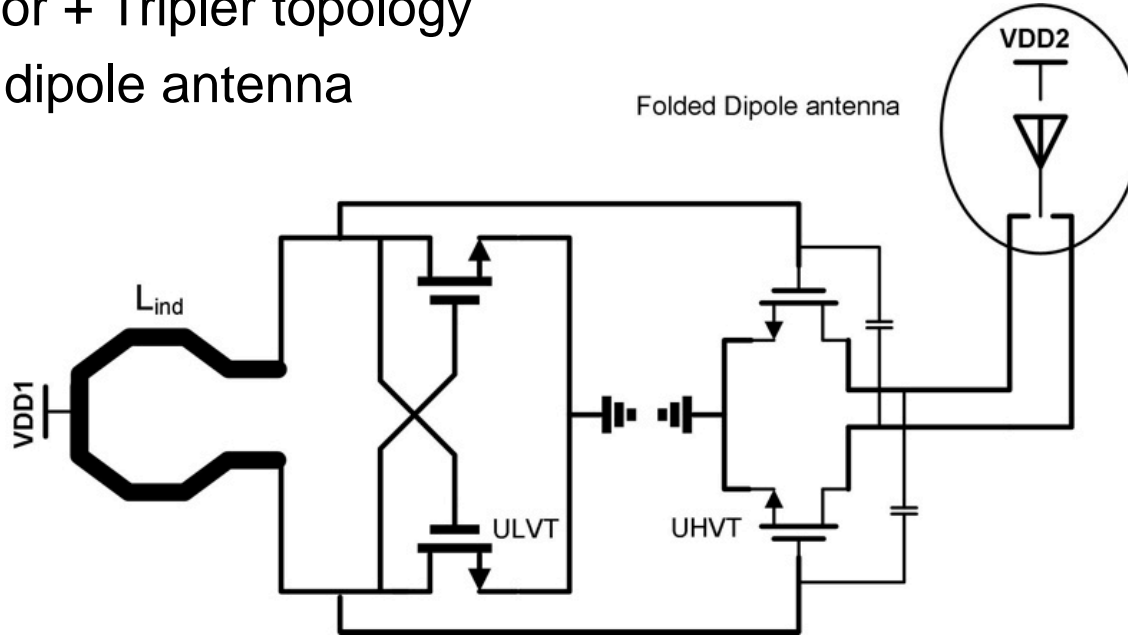


# ITRS roadmap: delayed for $f_{\max}$ !



# Our Baseline Approach: Concept

- **Non-linearities** go beyond  $f_{\text{MAX}}$
- Oscillator + Tripler topology
- Folded dipole antenna

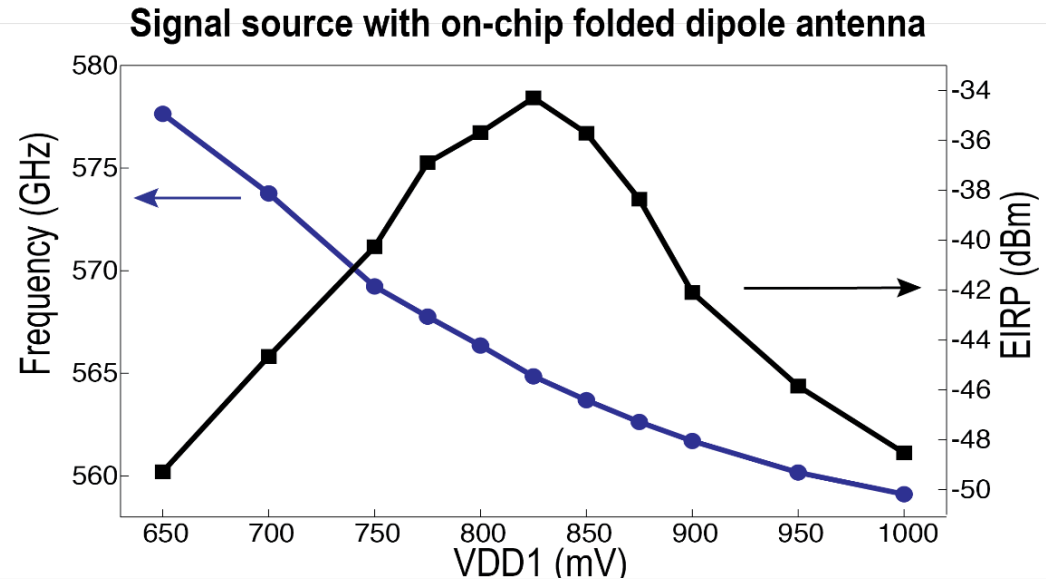
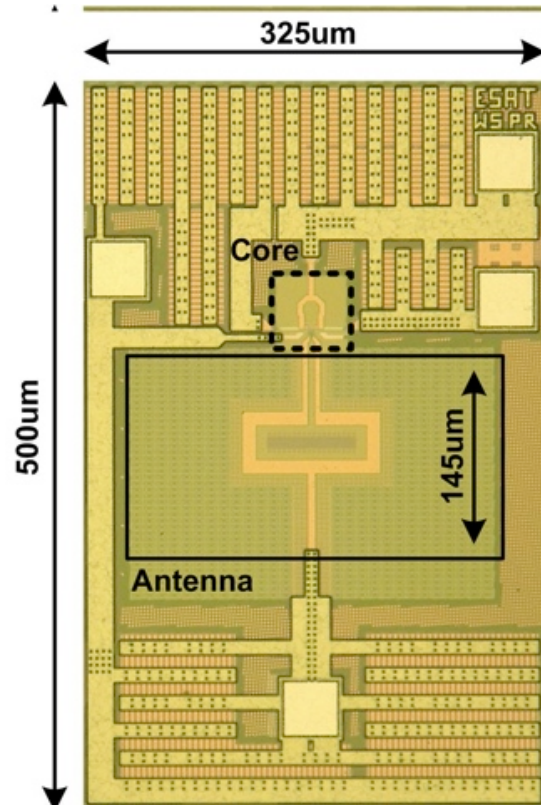


Fundamental  
oscillator: **190GHz**

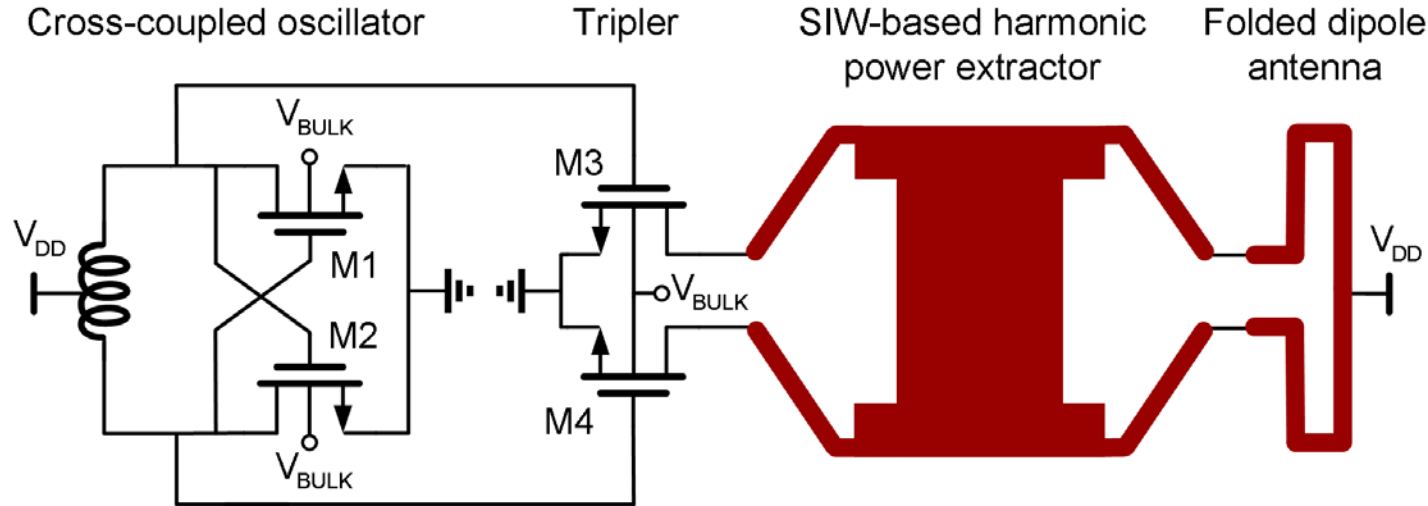
Tripler:  
**570GHz**



# Our Baseline Approach: Realization & Validation



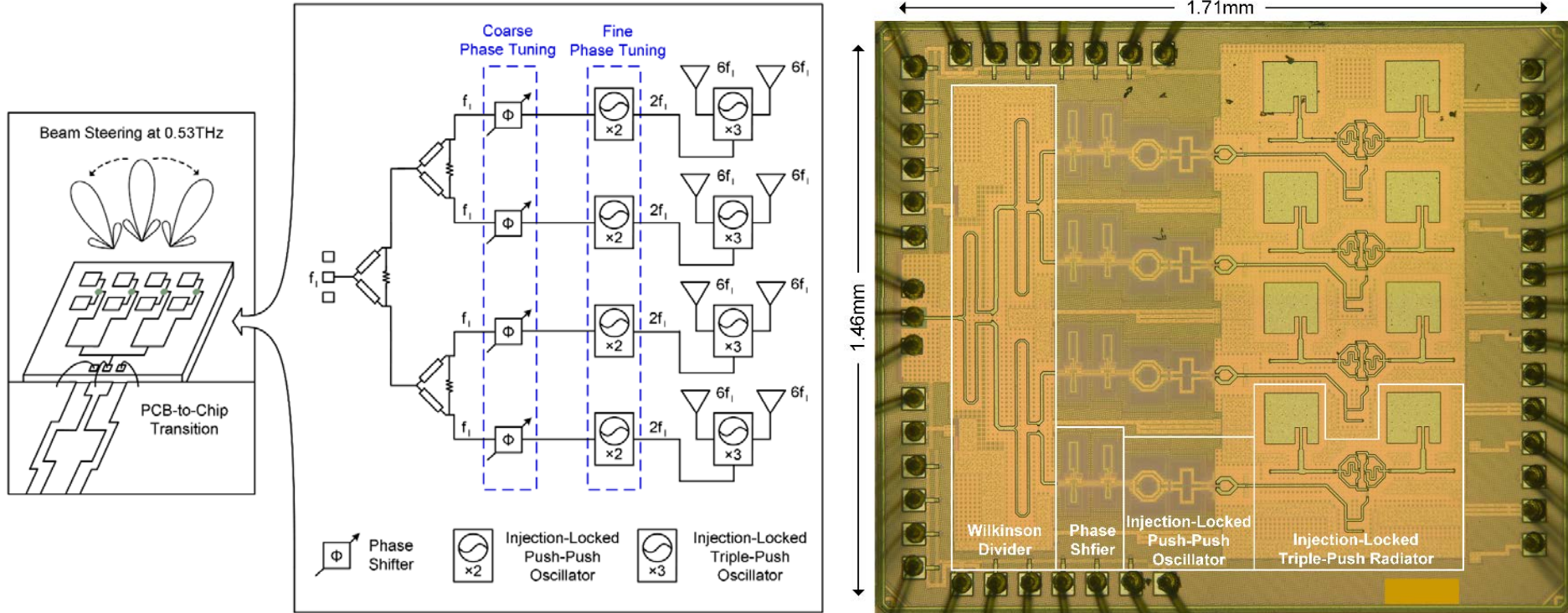
# Extract More Power: Special Filters



**Low-loss resonator, based on a Substrate Integrated Waveguide**

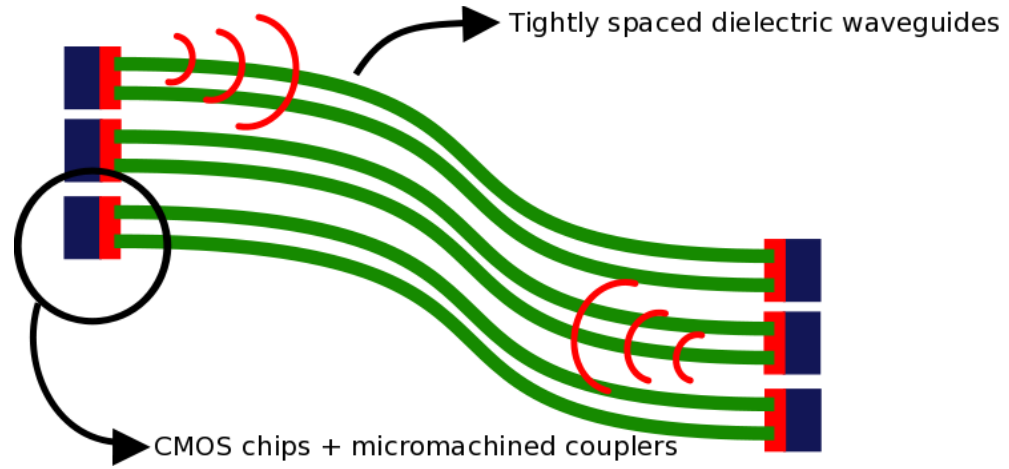
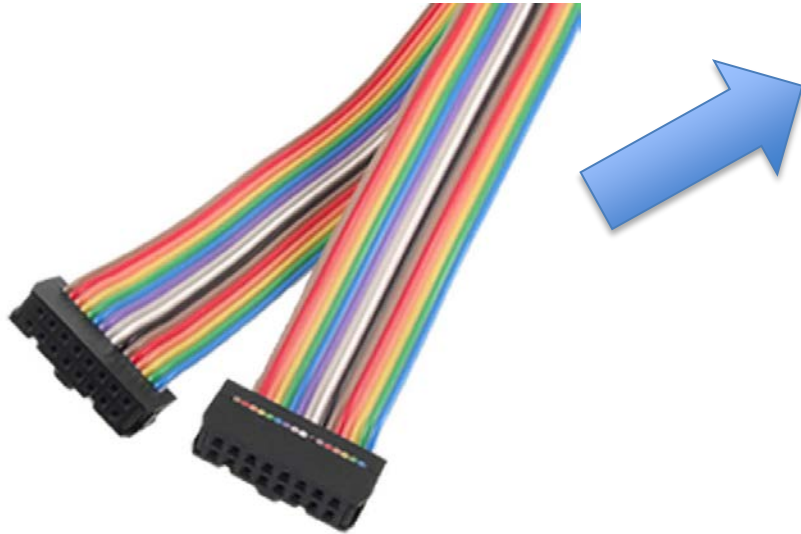


# Use Beamforming: Antenna Array On-Chip



# Communication: THz Ribbon Waveguides

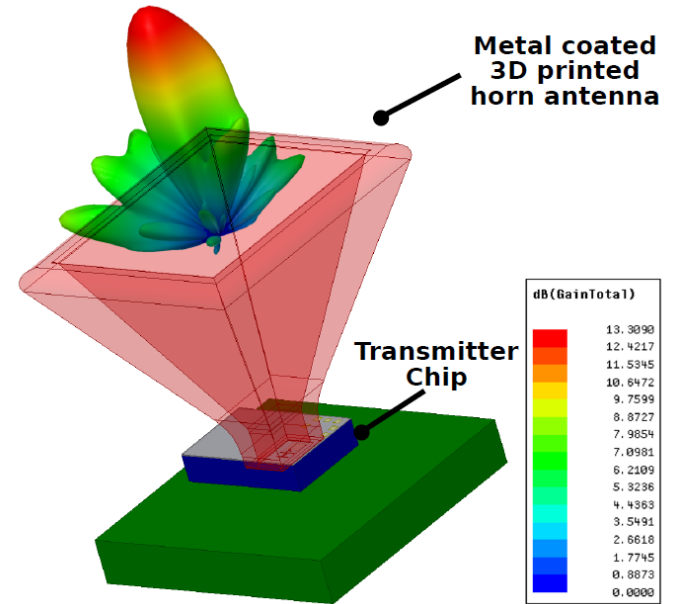
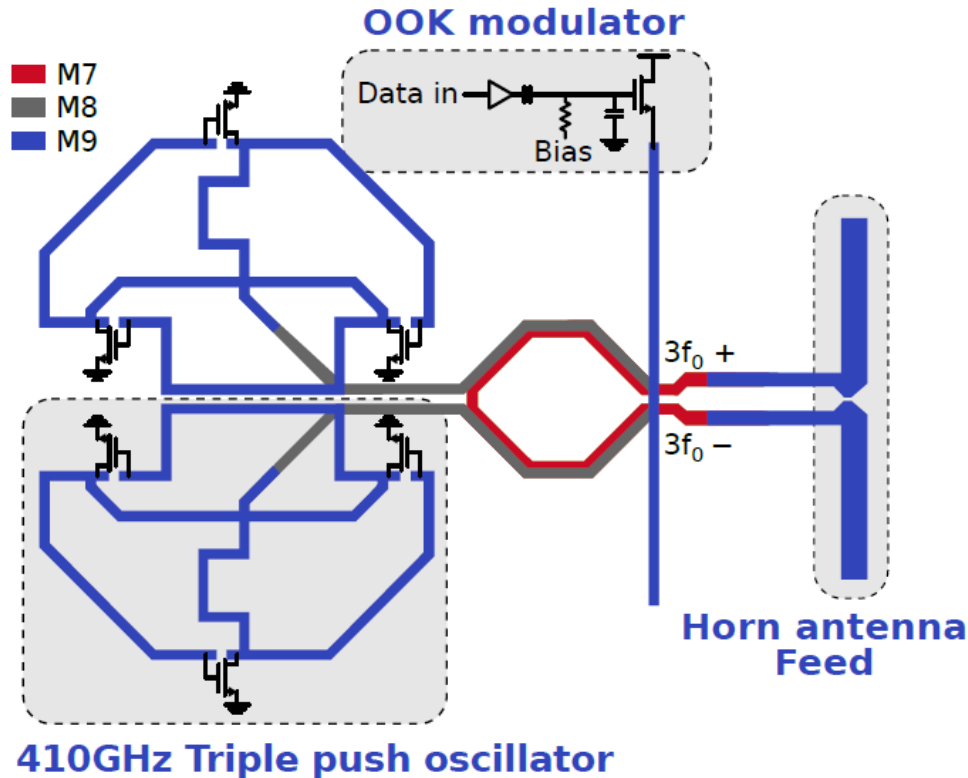
Short distance, high speed  
data link @ 400GHz



## Challenges:

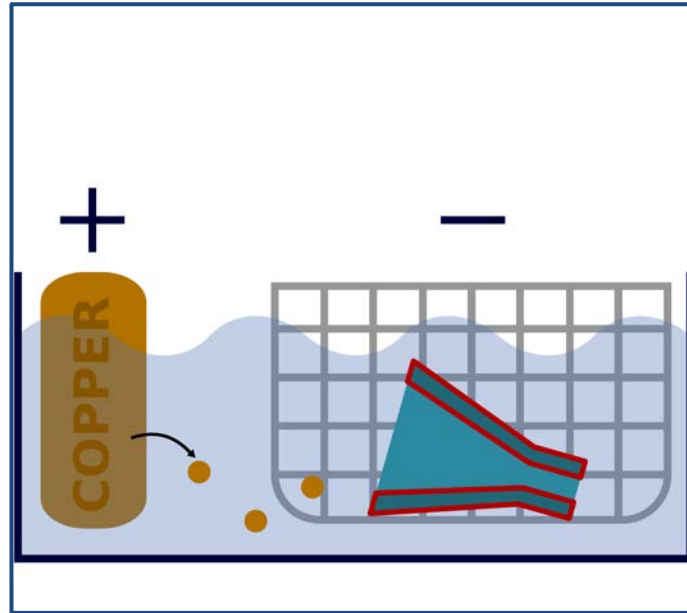
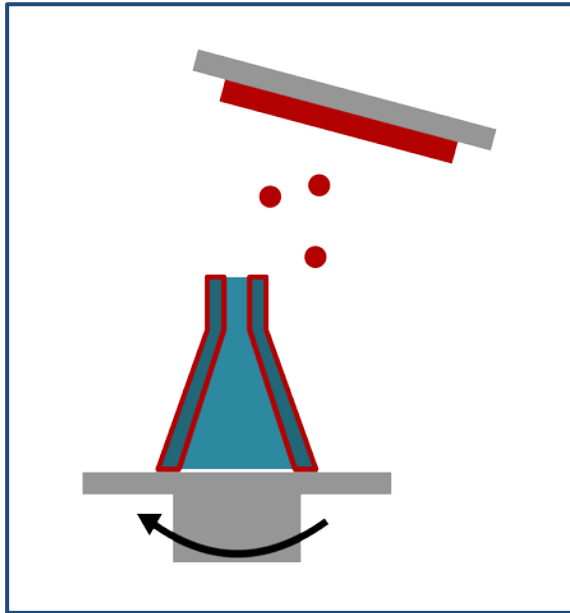
- Above  $f_{max}$  TX and RX
- Efficient coupling
- Design and fabrication of cable

# Communication: CMOS Chips and 3D Structures

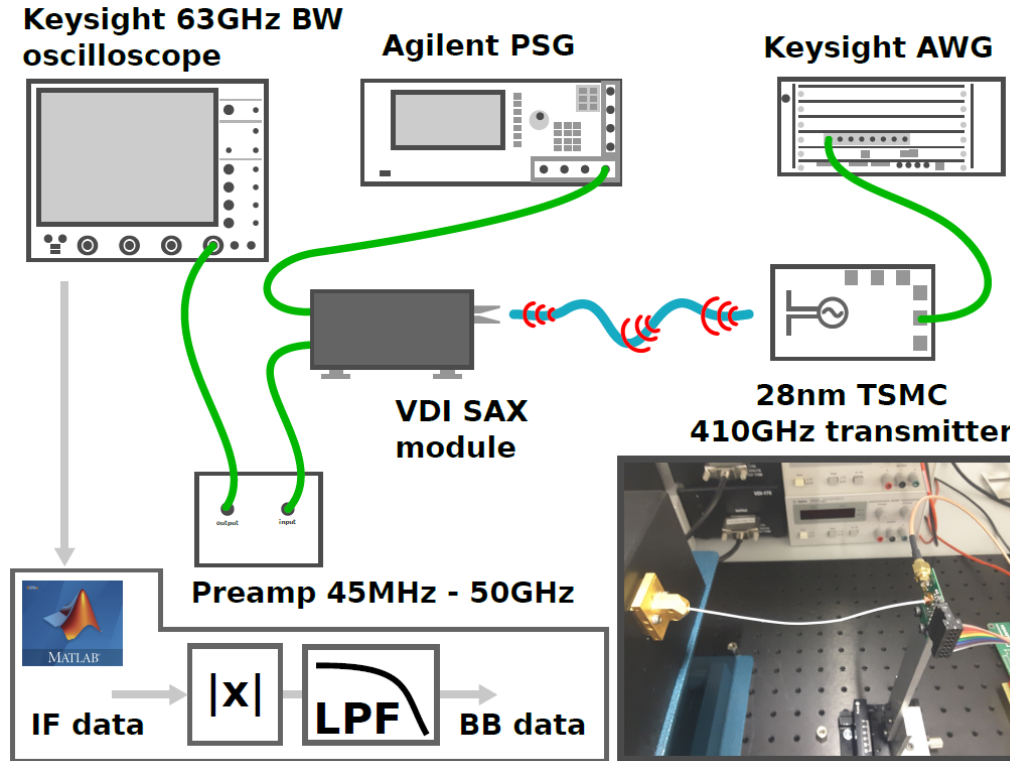


# We Fabricate Devices In Our Leuven Nanocenter

## Horn Antenna

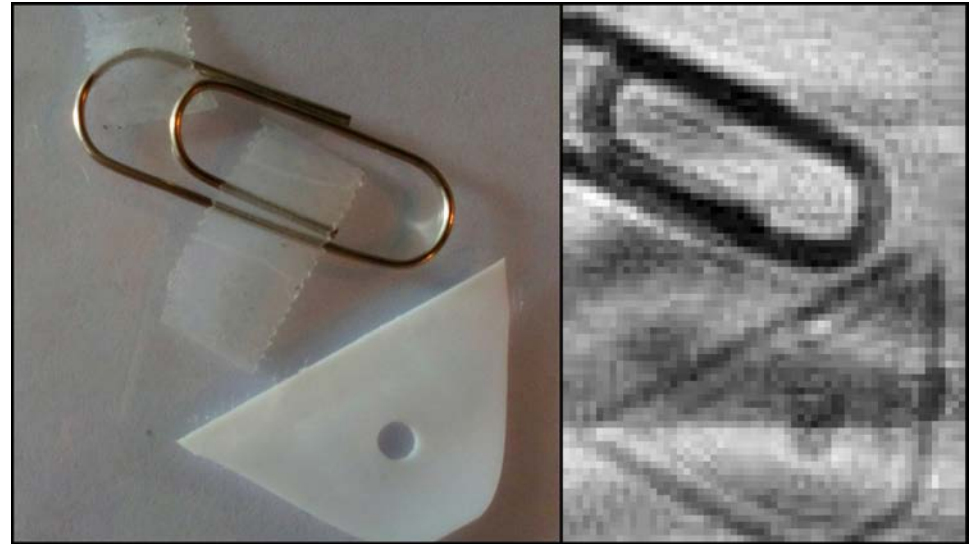
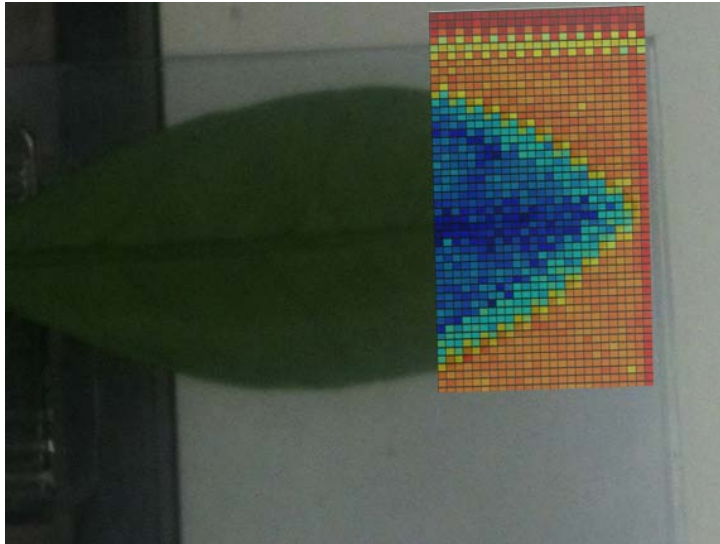


# We Do Modulated THz Measurements In Our IC-lab





# Imaging With Our THz Transmitters and Receivers





# KU Leuven ESAT-MICAS THz team



Prof. dr. ir. ing. Patrick Reynaert

*Wouter Steyaert – graduated 2017 – CEO of Tusk-IC*

**Kaizhe Guo** – THz beamforming



**Alexander Standaert** – THz polymer waveguides

**Dragan Simic** – THz receivers

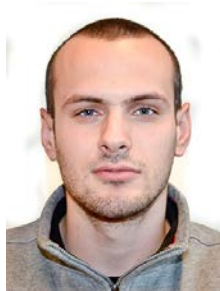
**Gabriel Guimaraes** - THz transmitters



**Kristof Dens** [8/2018 - THz plasmonics]

**Carl D'Heer** [10/2018 - THz communication]

**Ariane Devroede** [10/2018 - THz for sensing]





**Develop THz chips in CMOS**

**Explore possible applications**

**Enable widespread use**