Aalto University
School of Electrical
Engineering

Recent Activities on RF Microelectronics at Aalto University

Department of Electronics and Nanoengineering

Kari Stadius

RF Research at Aalto
Department of Electronics and Nanoengineering

- Wireless systems
- Propagation
- RF engineering
- Antennas

- RF Microelectronics
  1) RF CMOS & GaN
  2) Antenna-IC co-design
  3) Superconductive IC
  4) RF ADCs
  5) Design Automation

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Plethora of IC Technologies

HV CMOS

RF GaN

HV GaN

Bulk CMOS

PIC

GaAs

SiC

FD-SOI CMOS

SiGe

FinFET

GAA

Characteristics of IC technologies have diverged (specialized)

→ NO CLEAR WINNER, **NO GOLDEN SOLUTION**

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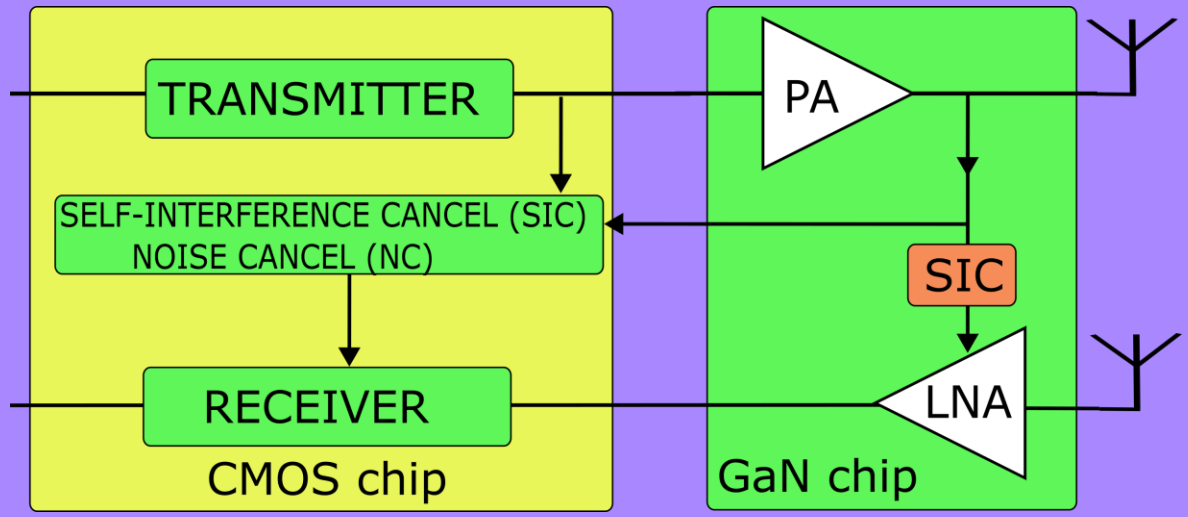
IC Design for 6G Communication and Sensing

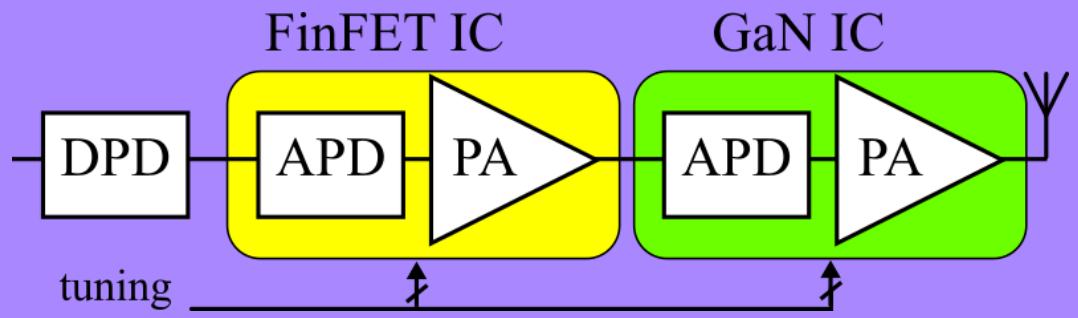
Technologies :

- **12-nm CMOS FinFET**
- **0.15μm GaN on SiC HEMT**

Full-duplex transceiver with self-interference and noise cancelling



RF ECO3: Highly linear transmitter for FR3



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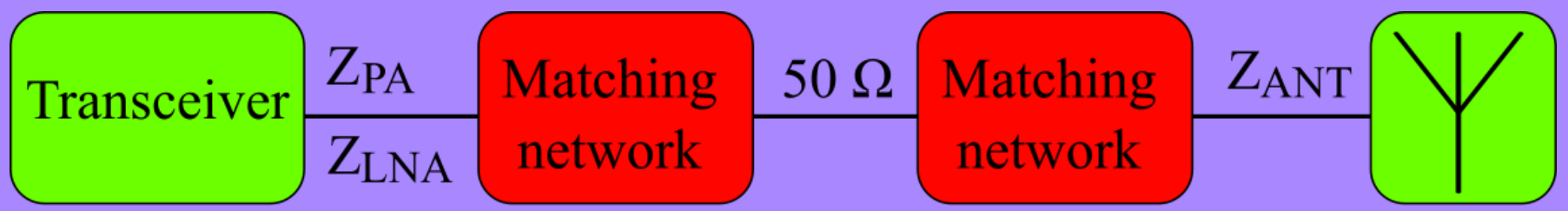
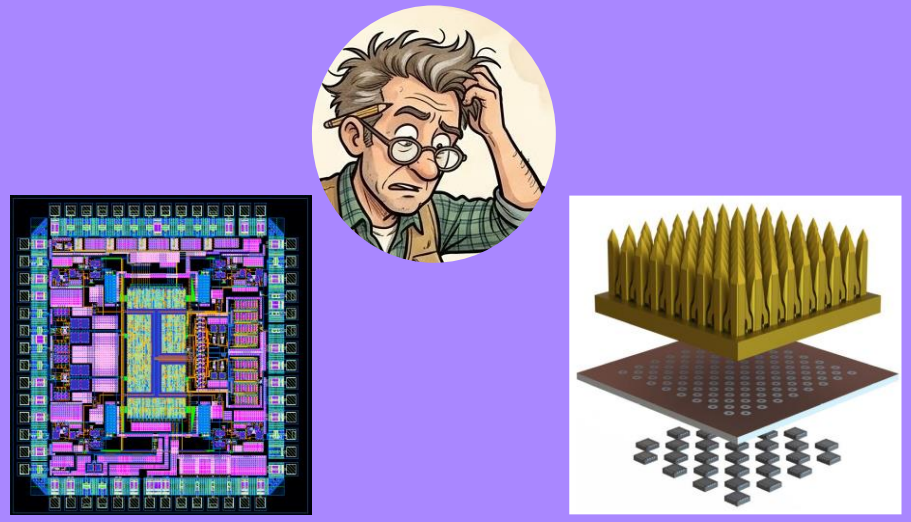
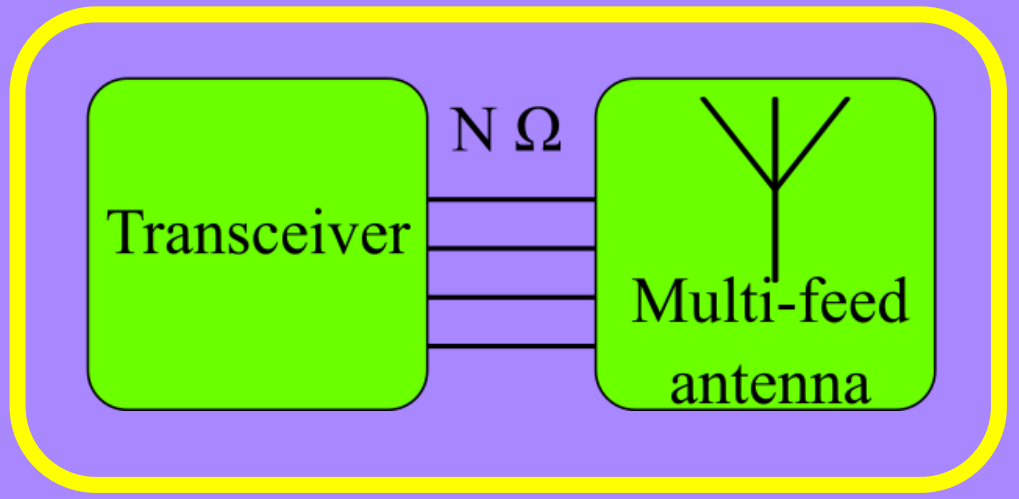
Antenna - IC Co-Design : Motivation







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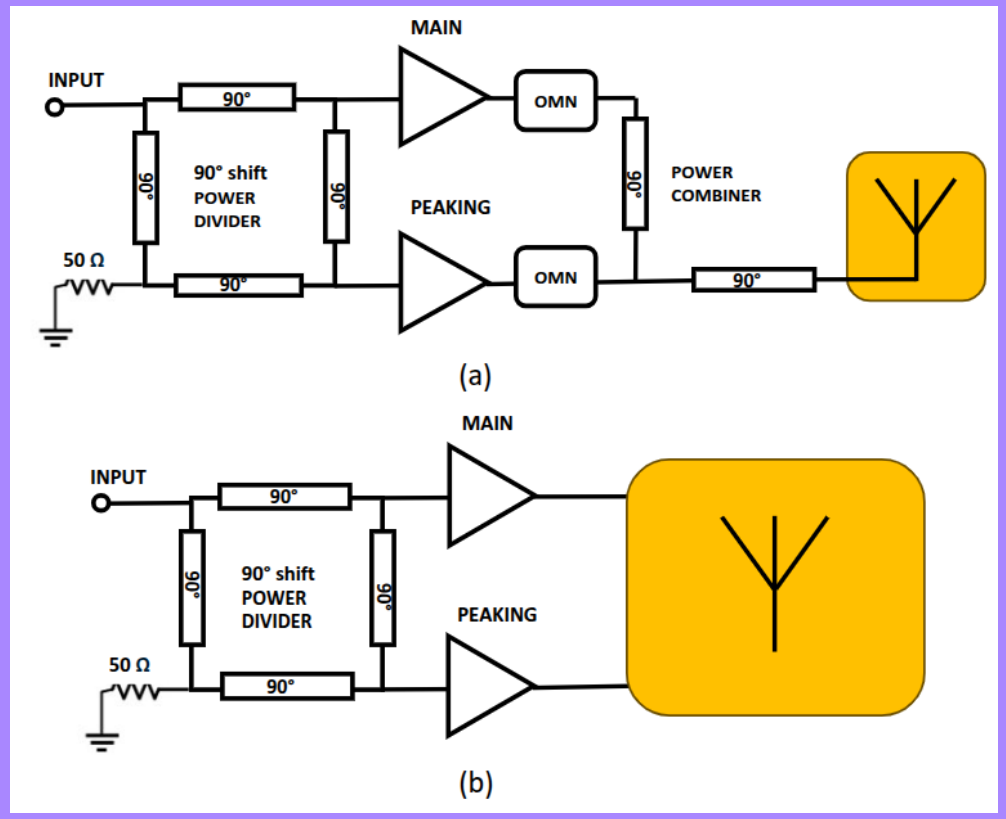
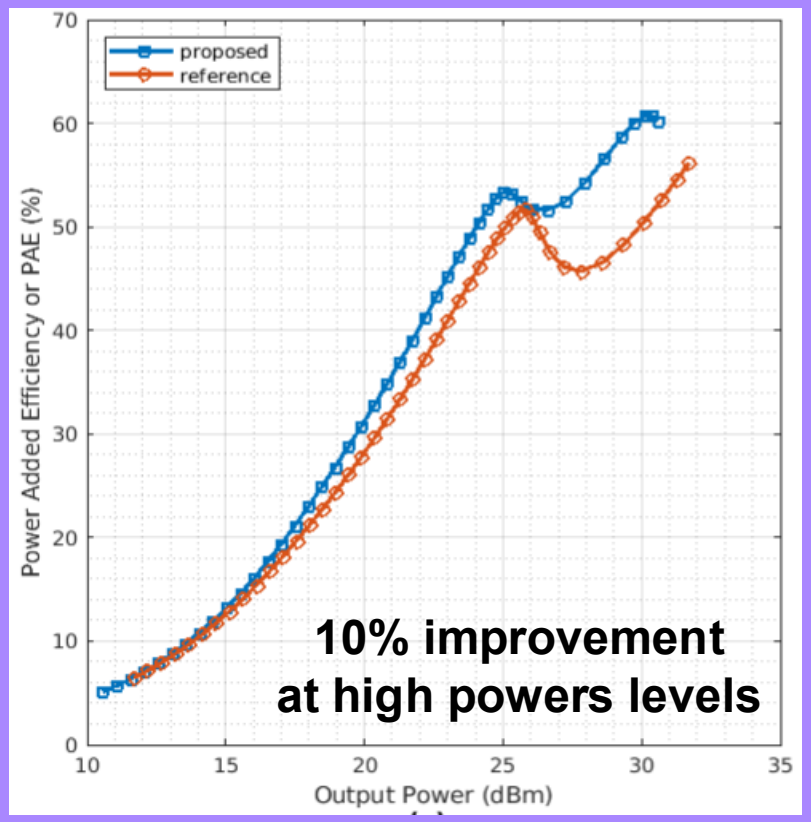
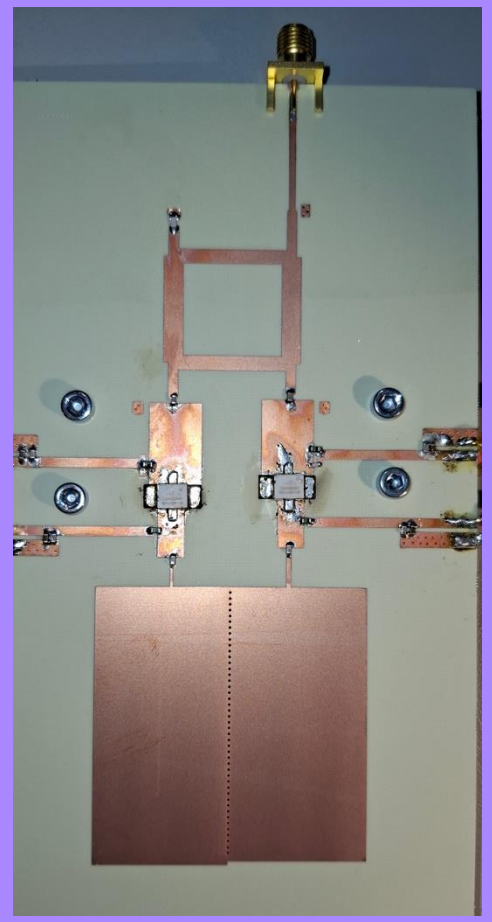
(1) Doherty Power Amplifier with On-Antenna Power Combining







Two papers to be presented at EuCAP 2026

20th European Conference on Antennas and Propagation

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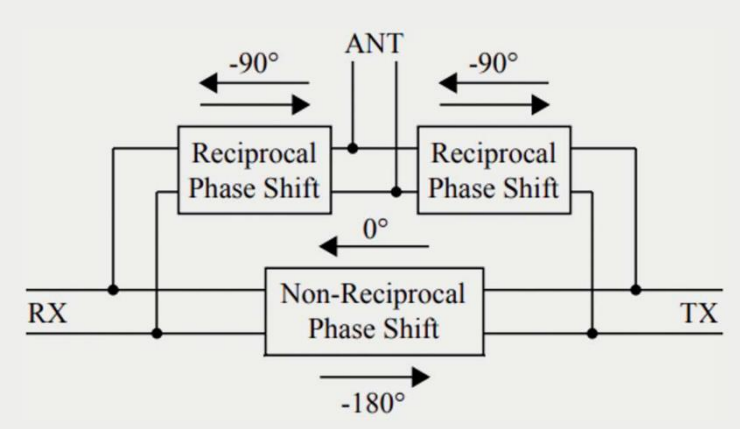
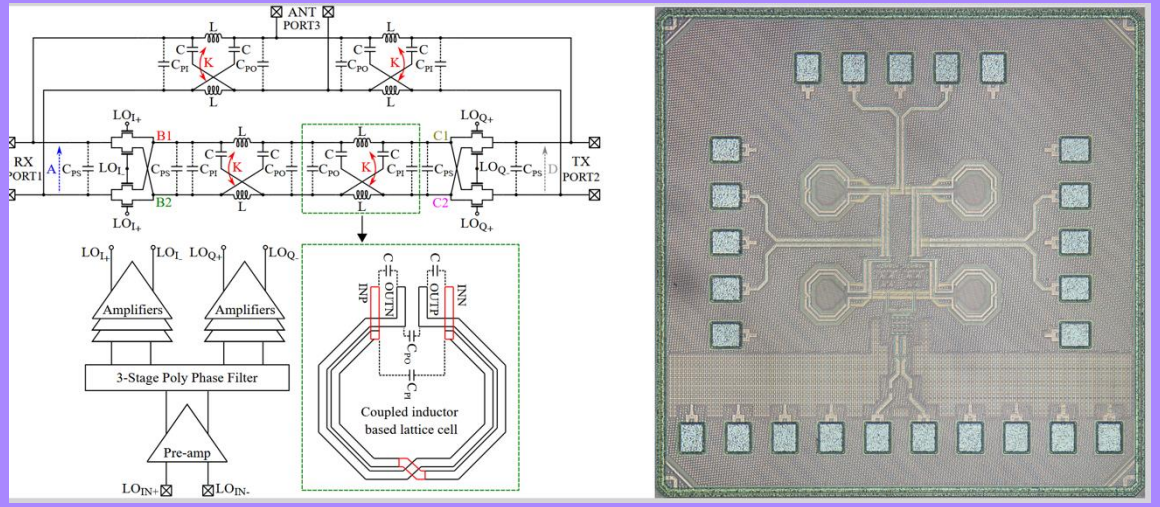
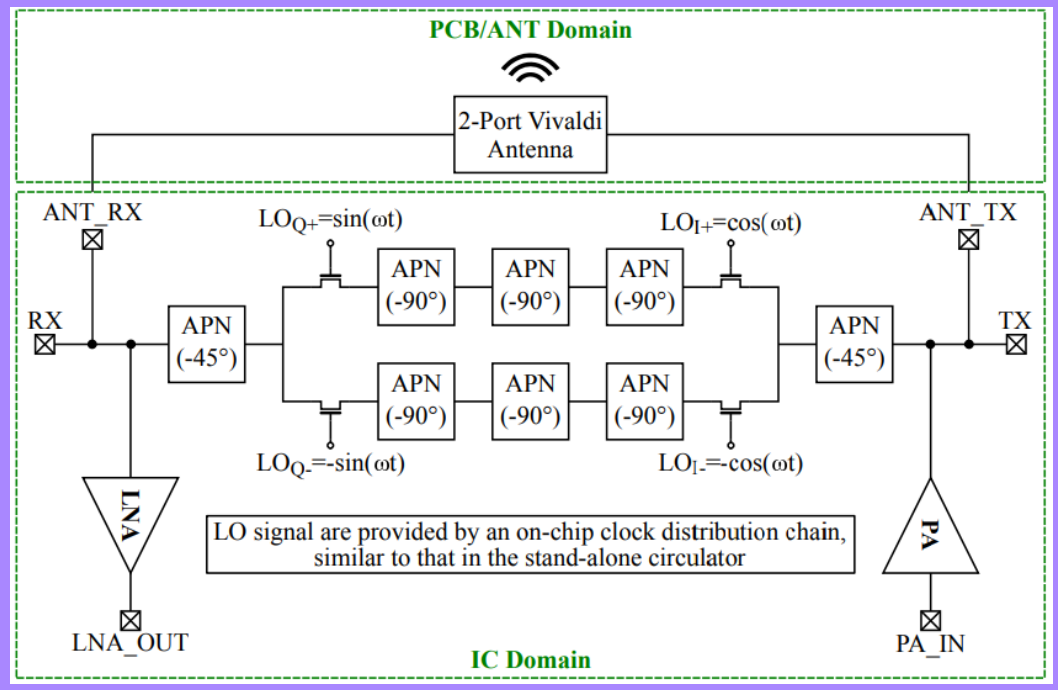
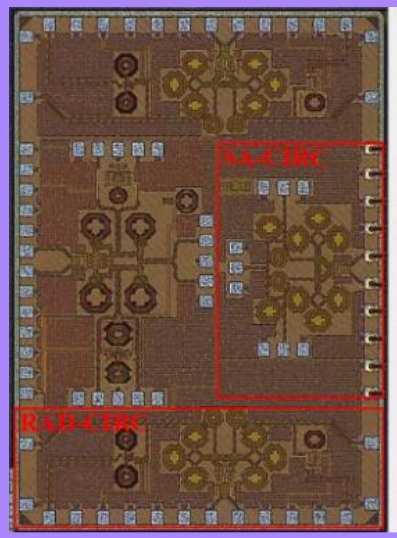
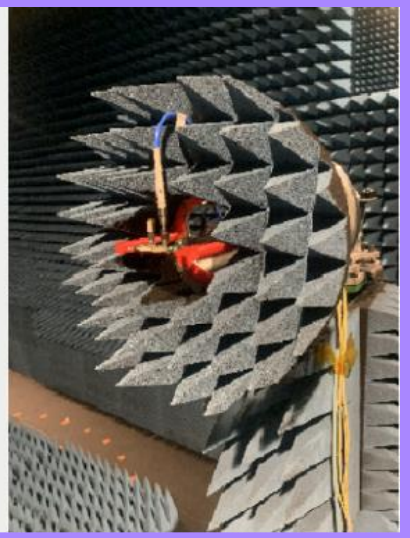
(2) Integrated Circulators and a Radiating Circulator



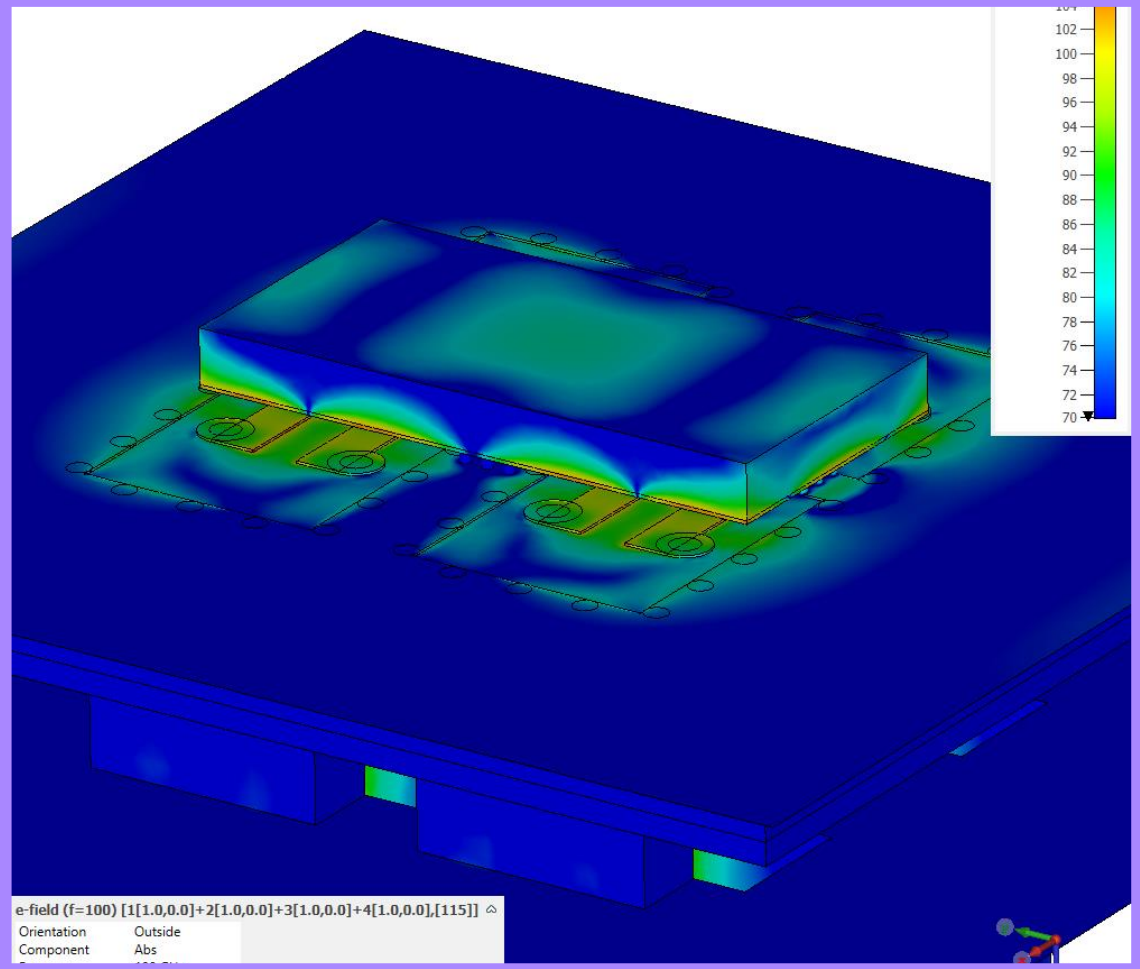


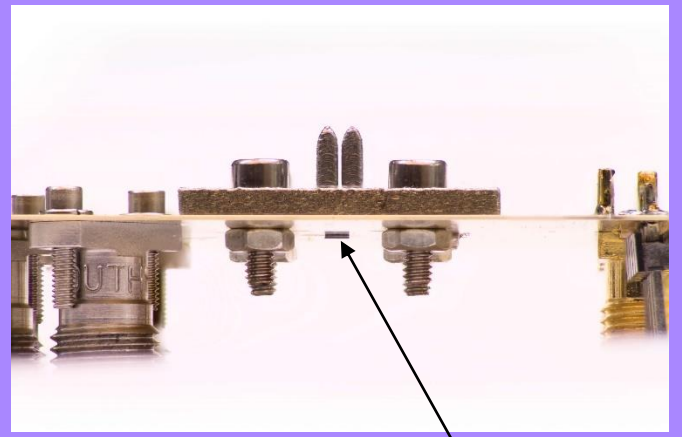


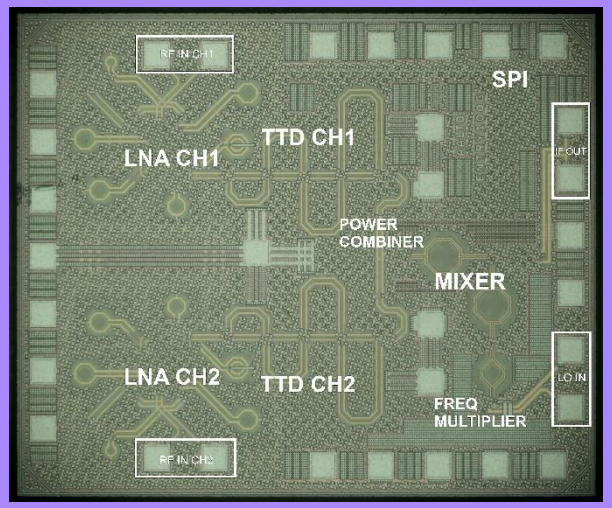




(3) Fully Differential CMOS Phased-Array Receiver Integrated with Metallic 3D-Printed Vivaldi Antennas for E-Band







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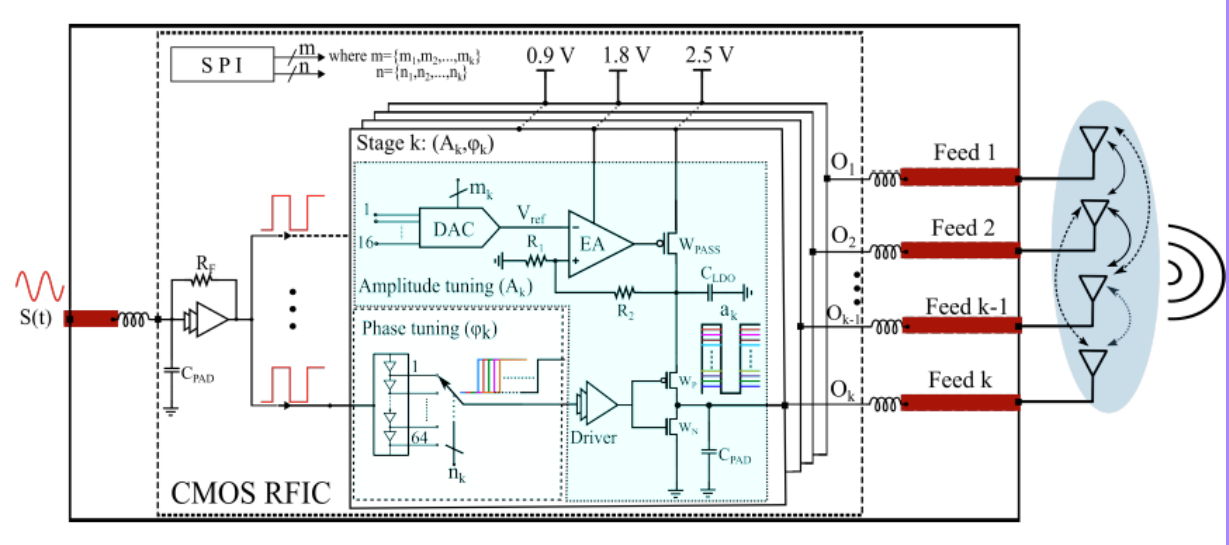
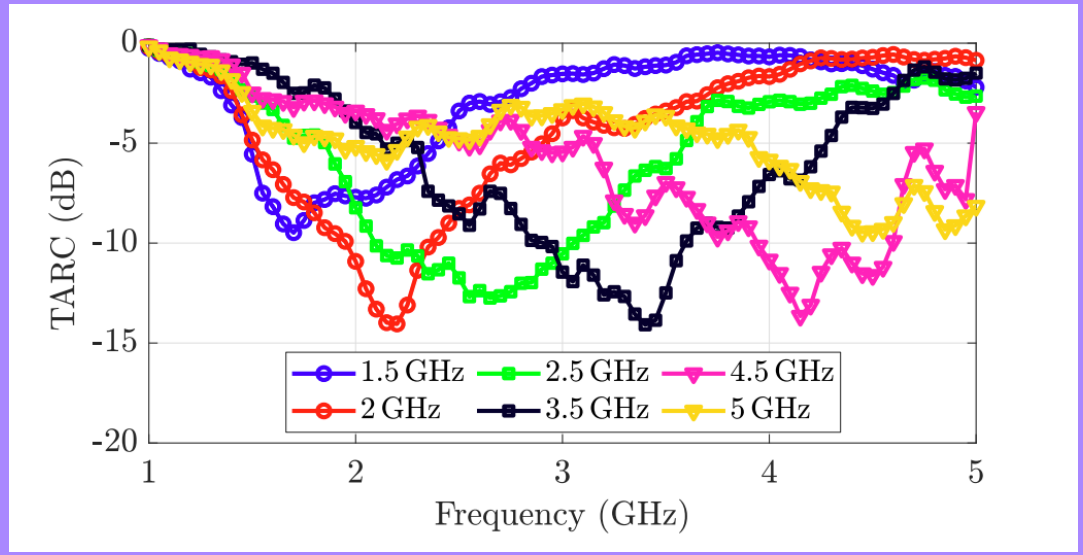
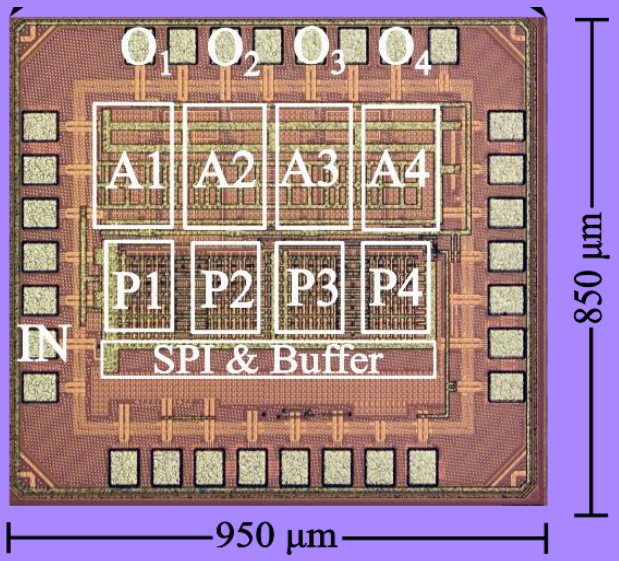
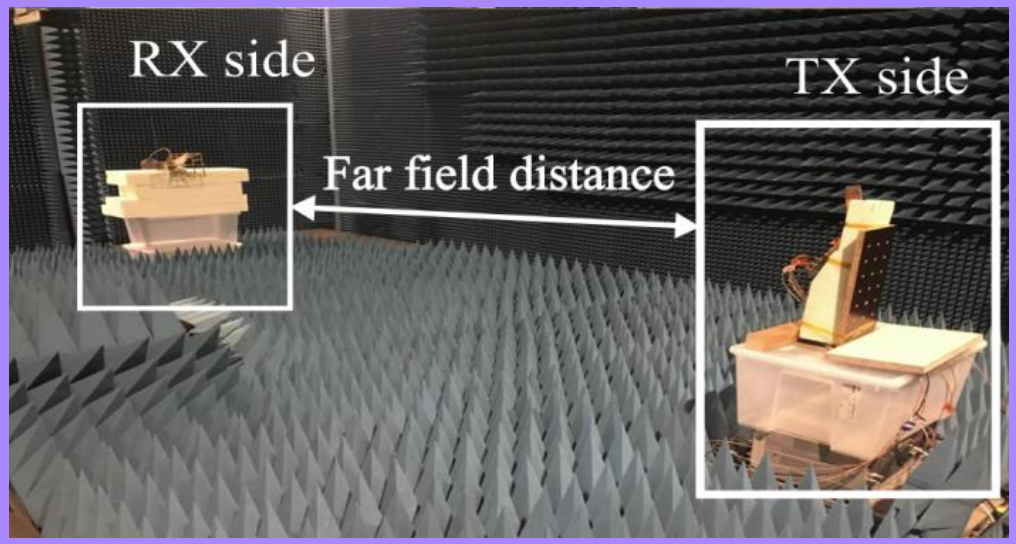
(4) Frequency-Tunable Transmitter with Active Matching









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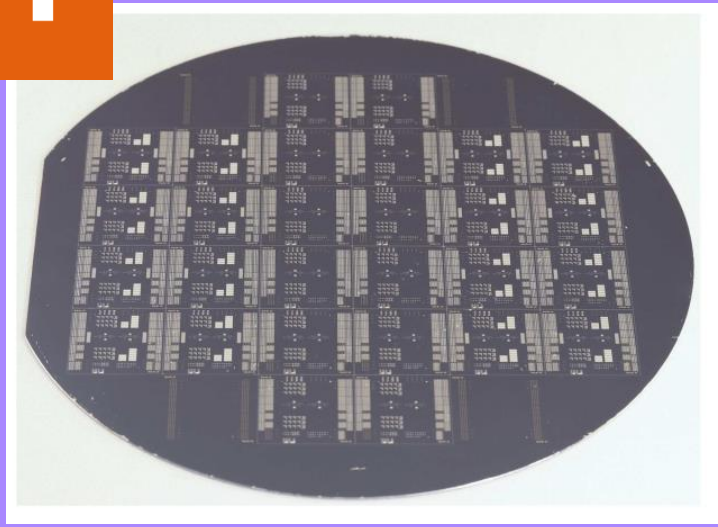
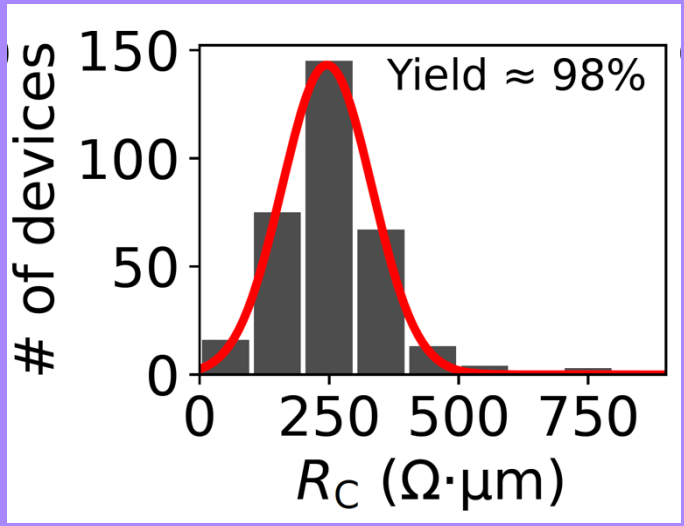
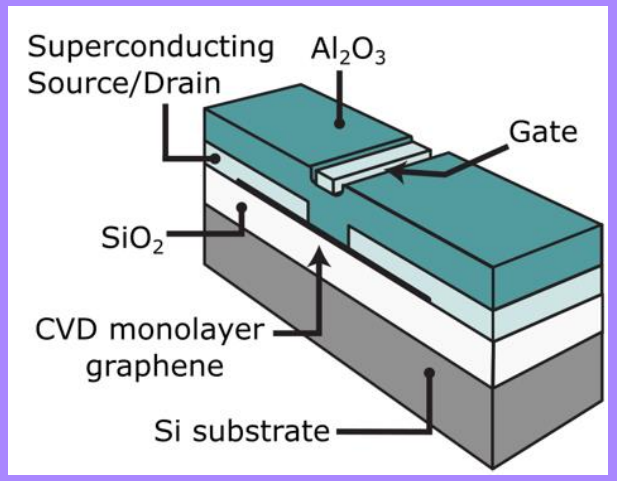
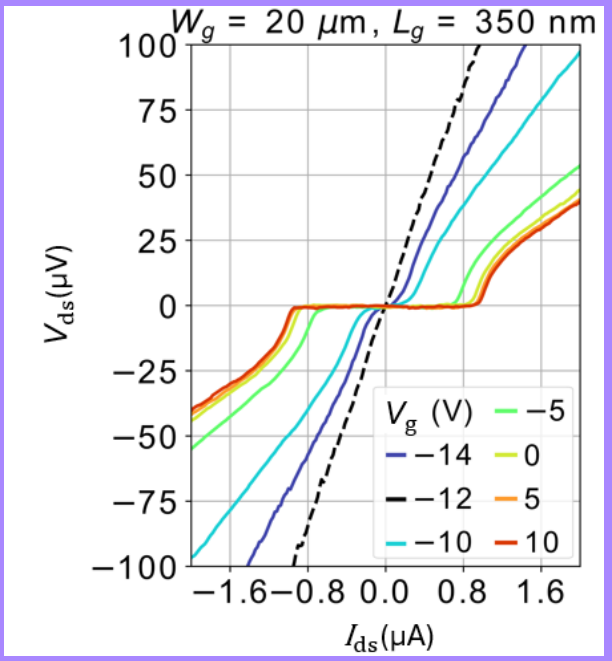
Cryogenic RF Electronics – Superconductive circuits

VTT









- Wafer-level integration with high yield
- Superconductive transistors up to 1 K
- Work in Progress
  - ➢ Technology development
  - ➢ Device modelling
  - ➢ Circuit design: MUX, parametric amps, filters, mixers

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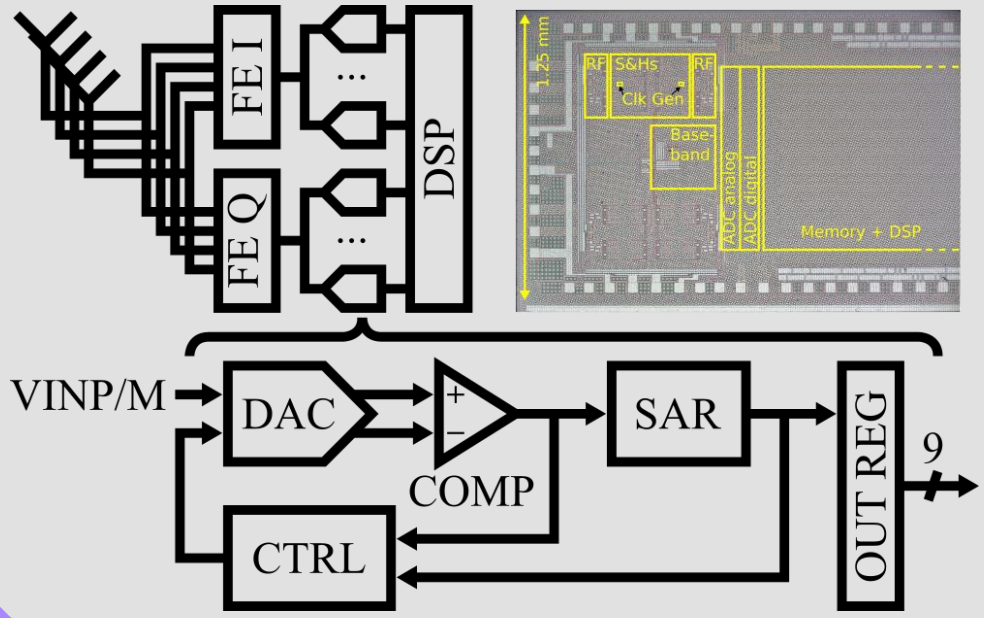
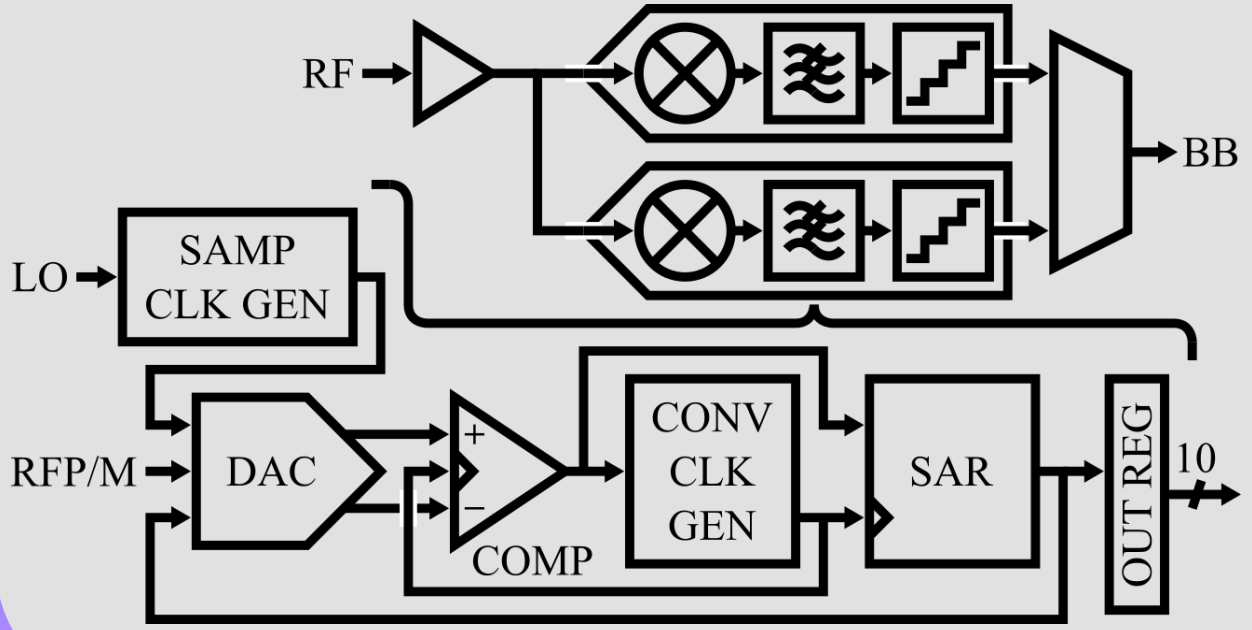
RF Analog-to-Digital Converters

9-bit 2 GS/s 8xTI ADC



10-bit 400 MS/s 2xTI ADC



- Integrated downconversion from **6-12 GHz**
- Integrated 16-32 tap analog FIR filter depending on LO

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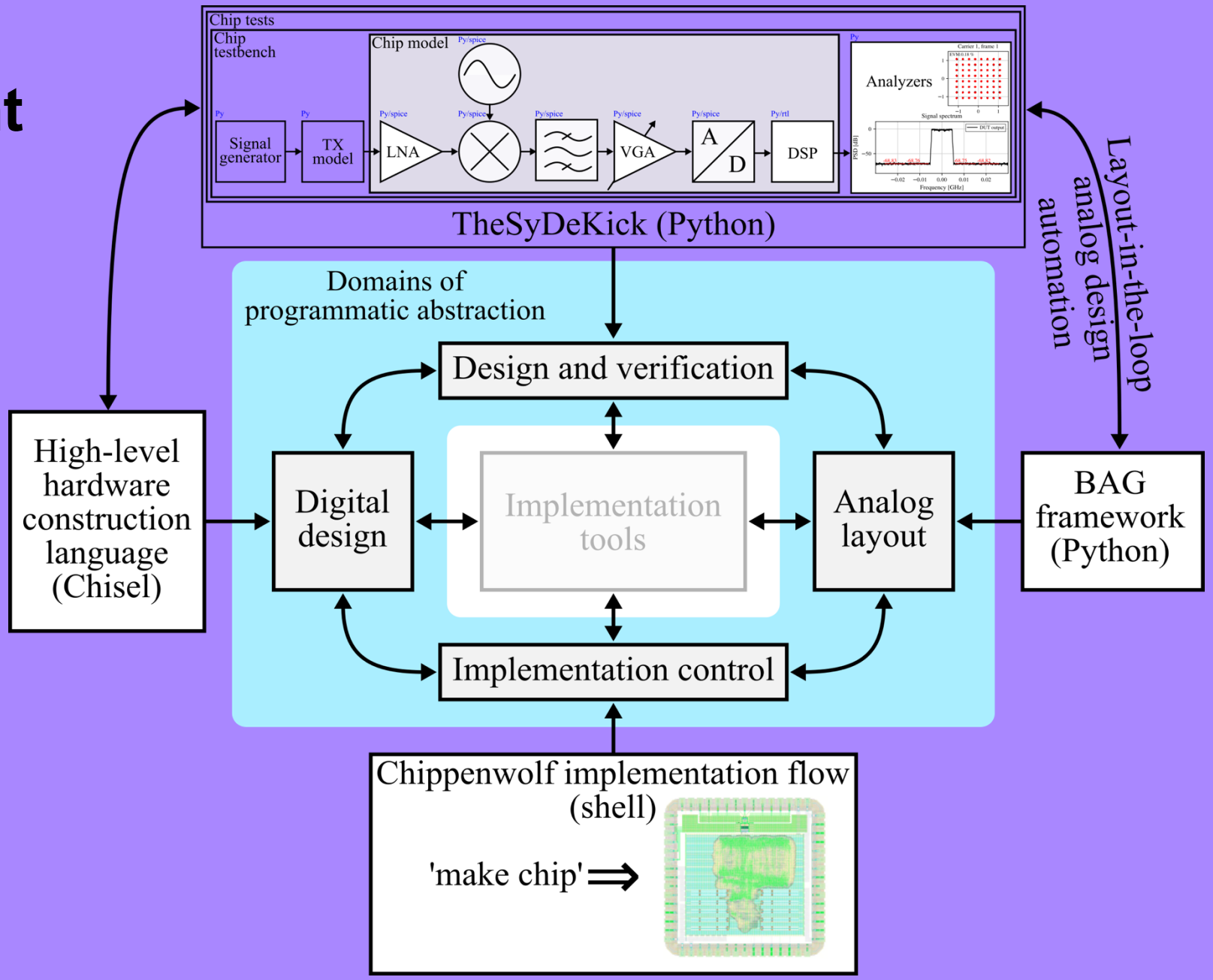
Fully programmatic IC design environment

- Open-source frameworks that interface with commercial IC design tools
- TheSyDeKick developed at Aalto
- BAG and Chisel from UC Berkeley



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RF Research at Aalto
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RF Microelectronics

- RF IC development with FinFET & GaN
- Antenna-IC co-design
- Cryogenic superconductive IC
- RF ADC
- Design Automation

A!