

Silicon Photonics by Caliopa Belgium Research Center (BeRC)

Tom Janssens – Team Leader Silicon Processing



EPIC event on CMOS compatible integrated photonics-imec September 2022

Huawei: Leading Provider of ICT Infrastructure and Smart Devices



Vision & mission

Bring digital to every person, home and organization for a fully connected, intelligent world

195,000

employees

170+

countries and regions

No. 44

on Fortune Global 500

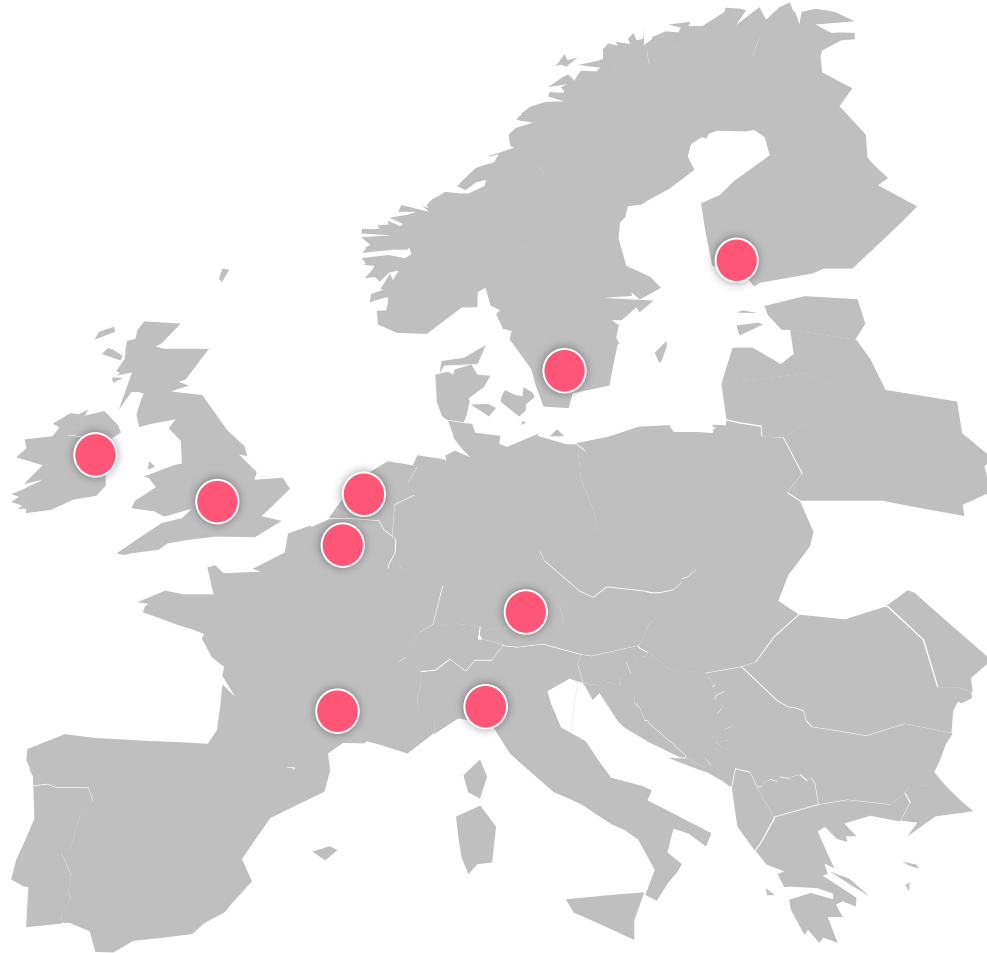
No. 2

in R&D investment

54.8%

of employees are in R&D

Huawei Research activities in Europe



- Philosophy: **Huawei opens research centers where the talent is based**
- Over **3500** R&D staff, **\$1bln** invested, presence in Europe since 1999
- **30** R&D organizations in **14** European countries (BE, NL, FI, FR, DE, IR, IT, SE, UK,..)
- Europe's largest patent applicant, over 100,000 patents owned worldwide
- Over **200** university partnerships, over **100** technology partnerships and more than **10** joint labs or innovation labs

Belgium Research Center (BeRC)



Belgium Research Center R&D

- **R&D Center in Gent**
 - focusing on photonics and MEMS devices
- **R&D Center in Leuven** with different groups working on
 - RFIC design (M4S)
 - Applied network technology lab (3NLab)

BeRC Gent: Caliopa

History

- Incorporated in 2010 as a Spin-off from UGent and imec
- Bringing to market 15 years of research in the field of Silicon Photonics
- Acquired by Huawei Technologies in August 2013
- Now part of Huawei Belgium Research Center
- Located at Flanders' ICT cluster at "Technologiepark Zwijnaarde"
 - Proximity to UGent Photonics Department
 - City of Gent friendly environment for international talent

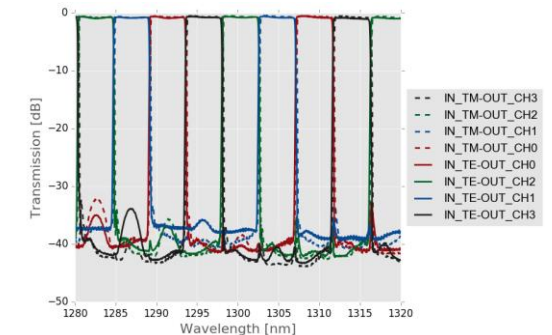
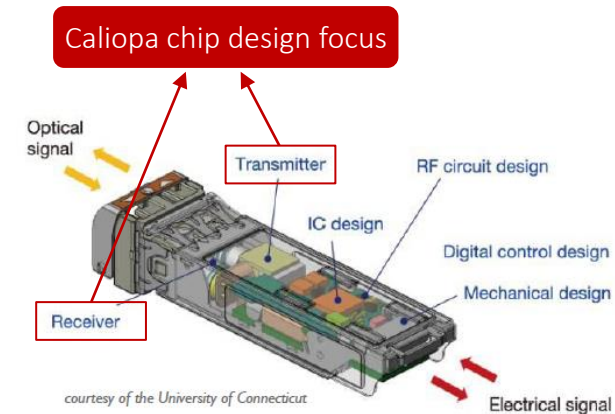


View from Caliopa office

BeRC Gent: Caliopa

Our team today

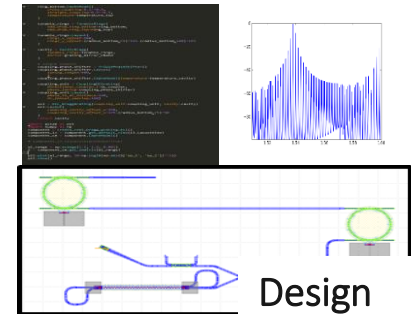
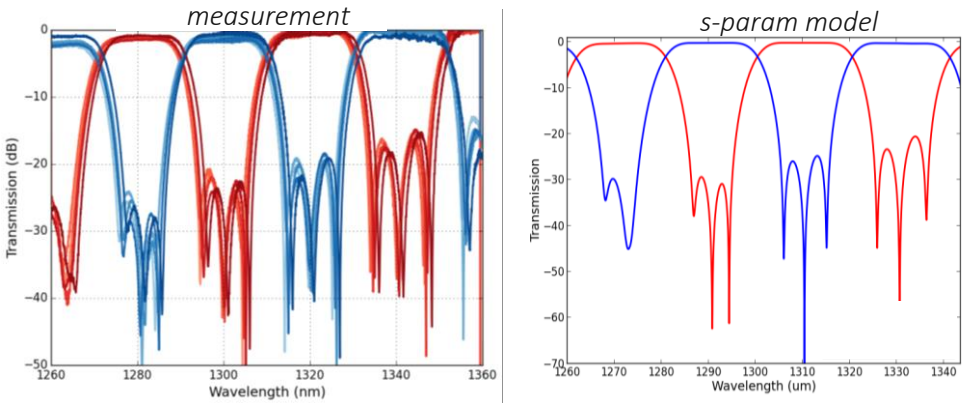
- Team of world leading photonics researchers and engineers
 - International talent from Belgium, Canada, China, Croatia, France, Israel, Italy, Portugal, Spain, Russia and UK
 - Photonics Design, MEMS design, Processing and Testing
- Developing photonics on SiN and Si platforms as well as MEMS for a wide range of telecom applications. Since the acquisition, 9 products have been successfully brought to market in volume
- Investing in technology, amongst others, in cooperation programs with Gent University & imec
- State-of-the-art optical & electronics testing lab for automated waferscale and high bandwidth testing
- In-house computing cluster for design simulations



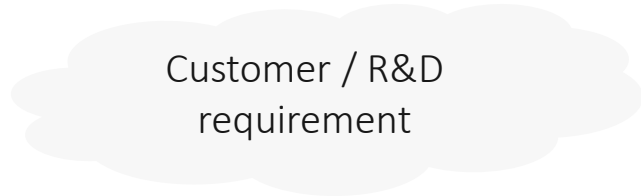
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Our team today

- We take our designs through the full cycle
 - From concept to test
 - Feeding test result back into our models (next design iteration)
 - Very well developed models on our standard platform now allow for “first time right design”

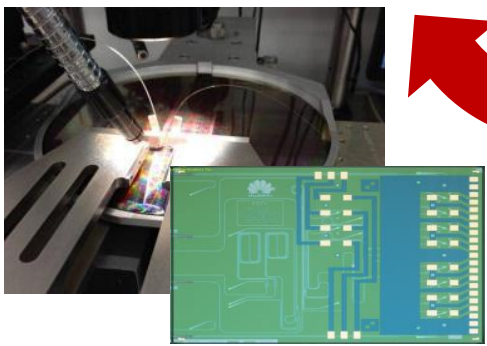


- Design**
- Concept
 - Simulation
 - Layout
 - Result analysis



- Test**
- Testing
 - Setup building
 - Automation

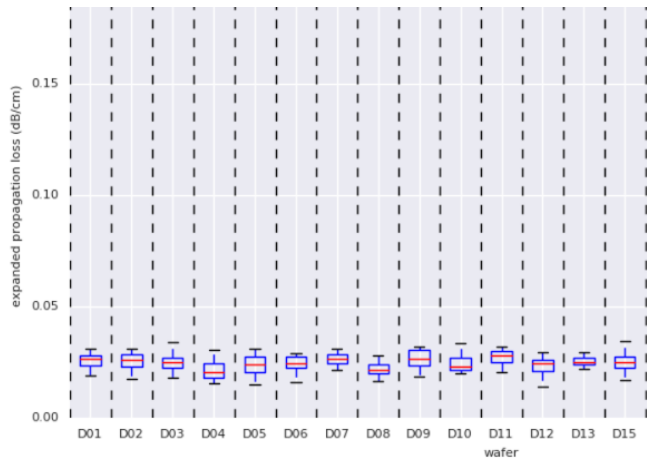
- Process**
- Process integration
FEOL/BEOL fab
 - In-house R&D



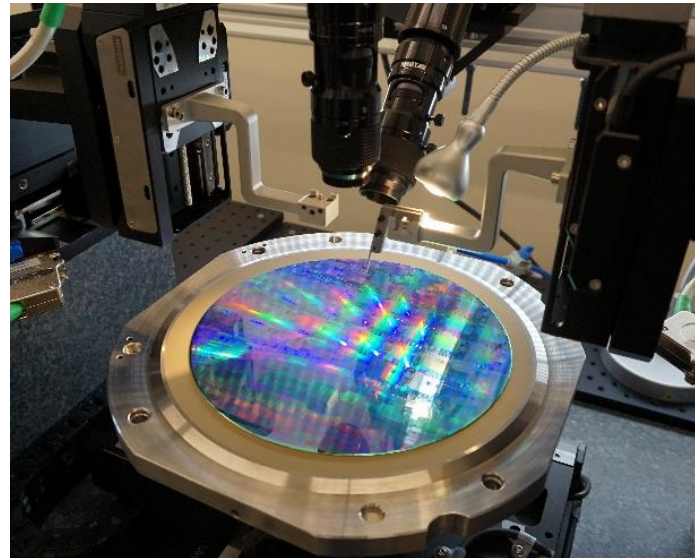
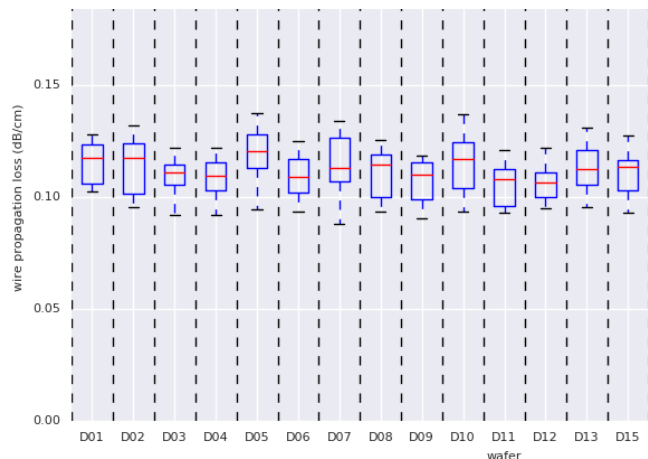
Photonic platform performance

Low loss SiN

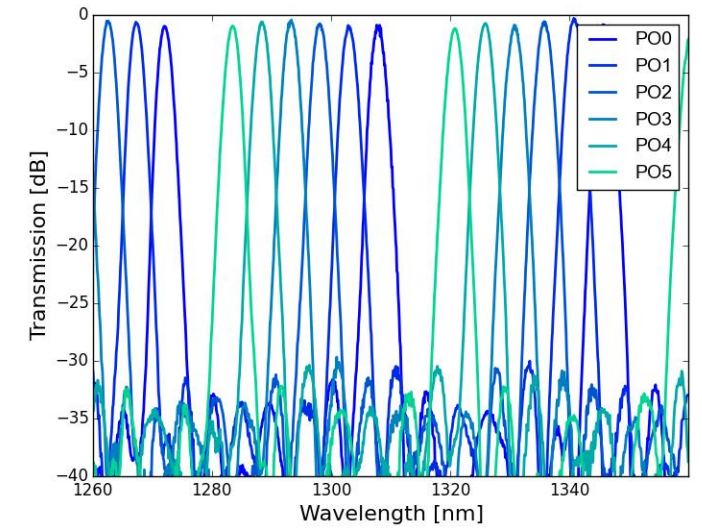
O-band
Expanded Waveguide <0.05dB/cm



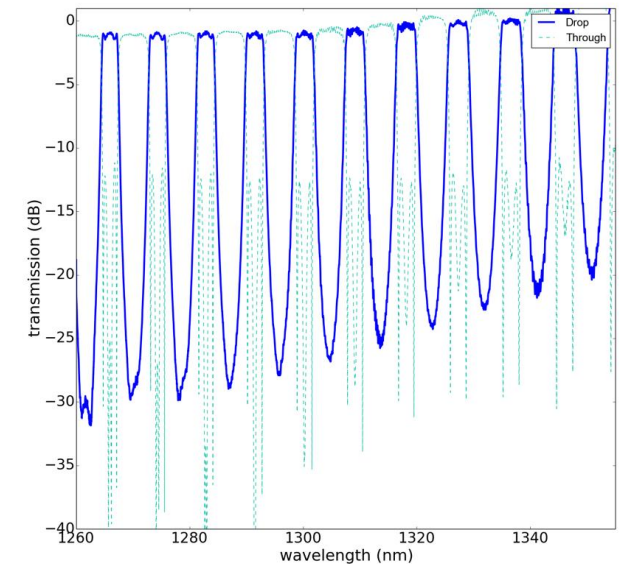
Wire Waveguide < 0.15dB/cm



Low X-talk AWG



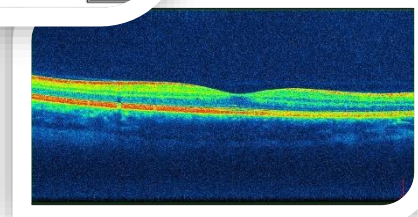
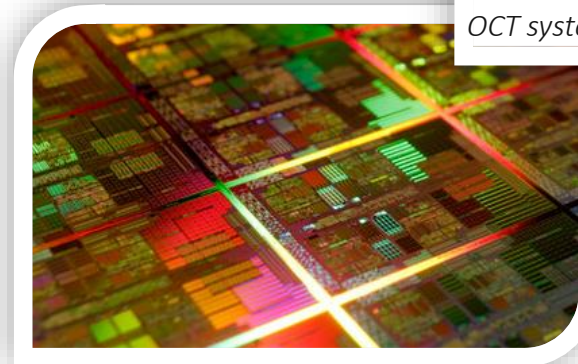
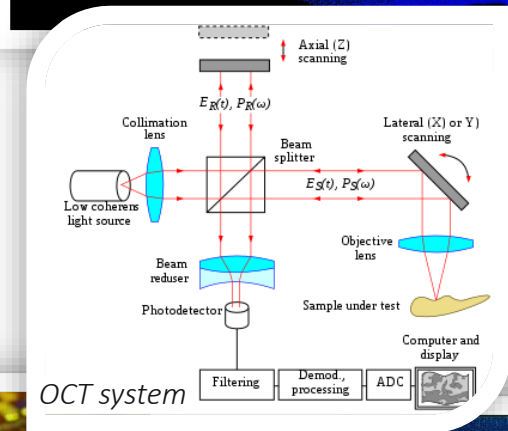
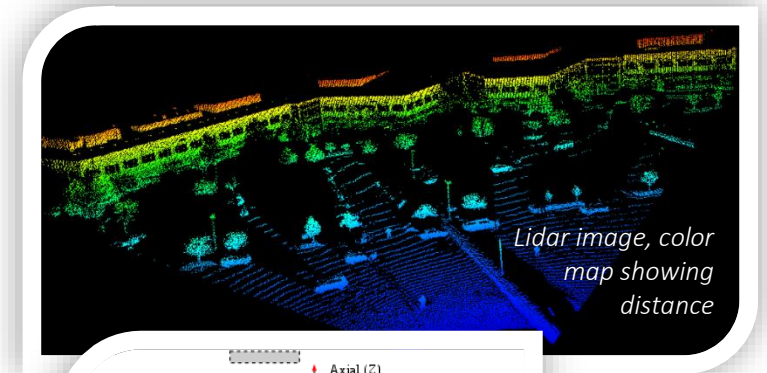
Normalized spectrum of 4 Coupled rings



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Future prospects

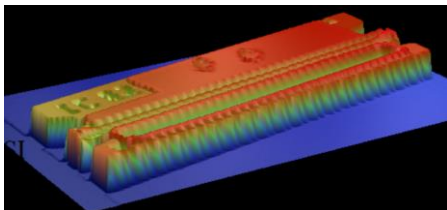
- Continuing to bring photonics transceivers and MEMS to production
- Explore different electronic photonic integration approaches
- Aspirations to leverage our expertise in new application areas
 - SiP based sensing: 3D sensing (Lidar), wearables, chip based gyroscope
 - Medical systems on chip, e.g. handheld OCT
 - RF photonics
 - Optical computing
 - ...



Open to collaboration & European projects

Example: *TOP-HIT Transfer-print Operations for Heterogeneous Integrations* (2015-2018)

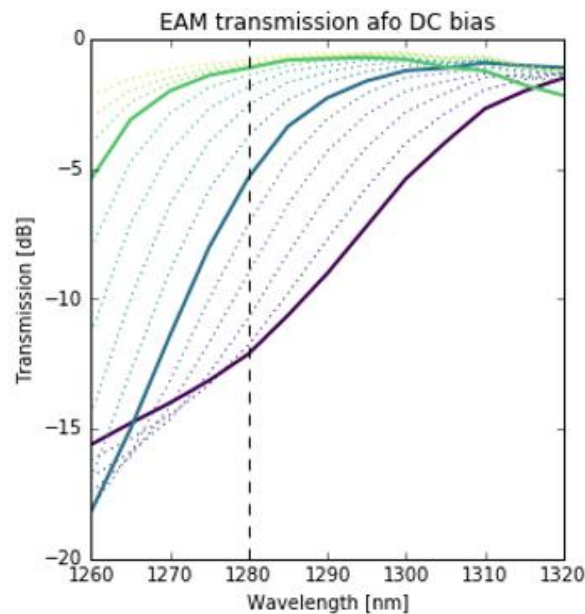
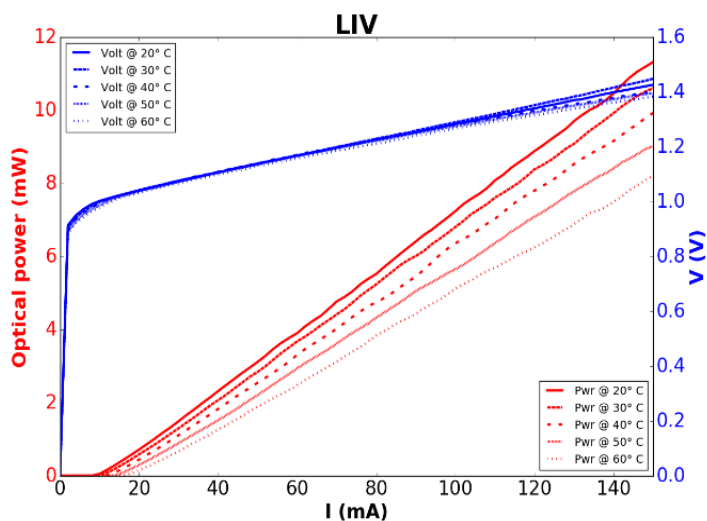
Lasers: printed on Si substrate



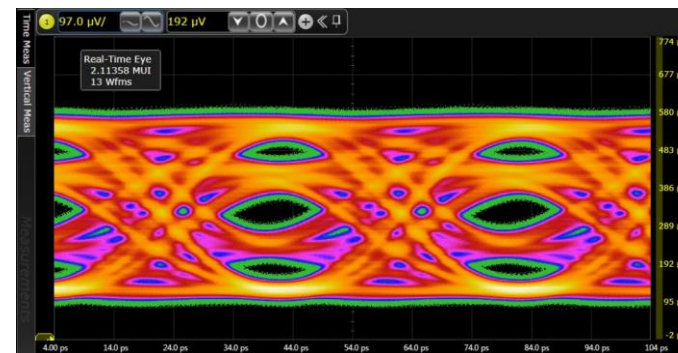
Electro-absorption modulators:
Integrated on Silicon Photonic Platform

Transmission at different biases

25GBaud pam-4 signal NRZ



Optical Eye diagram @ 1290nm



CMOS compatible Integrated Photonics and its competition

**System
with specifications**
Transceivers,
Lidar,
Sensors,...

Competition

- Existing solutions
 - free space optics, electronics based sensing
- III-V based solutions
 - Integrated photonic circuits in InP,...
- MEMS based solutions
 - Fast tunable sources, switching

Silicon Photonics

- Benefit of scale and cost if CMOS facility can be shared with photonics
- Different platforms exist: SiN, SOI
- Need for integration of non CMOS materials: light source, modulators, detectors

Choice depends on the business case (cost, market size) and technology maturity

Summary

Caliopa : looking for cooperation partners

BeRC Gent: Caliopa

- The Silicon Photonic experts, contributing from concept to test
- Resulting in products that go or are into mass production (telecom)
- Evaluating new opportunities: comparing Silicon Photonic approach to competitive alternative approaches
- Looking for European Experts to cooperate with

Looking for Cooperation

- New applications for existing photonic platforms: market expectation and system specifications by end users to be translated into chip specs (e.g FMCW Lidar, OCT, health sensing, ...)
- New integration methods (e.g. close integration of electronics & photonics)
- Open for direct collaboration but also EU projects

Bring digital to every person, home and organization
for a fully connected, intelligent world

Thank you for your attention!

