# Aristotle University of Thessaloniki
# (6G-IA full member)

ARISTOTLE
UNIVERSITY
OF THESSALONIKI

**Agapi Mesodiakaki, PhD**

***Senior Researcher, Aristotle University of Thessaloniki***

***Center for Interdisciplinary Research and Innovation***

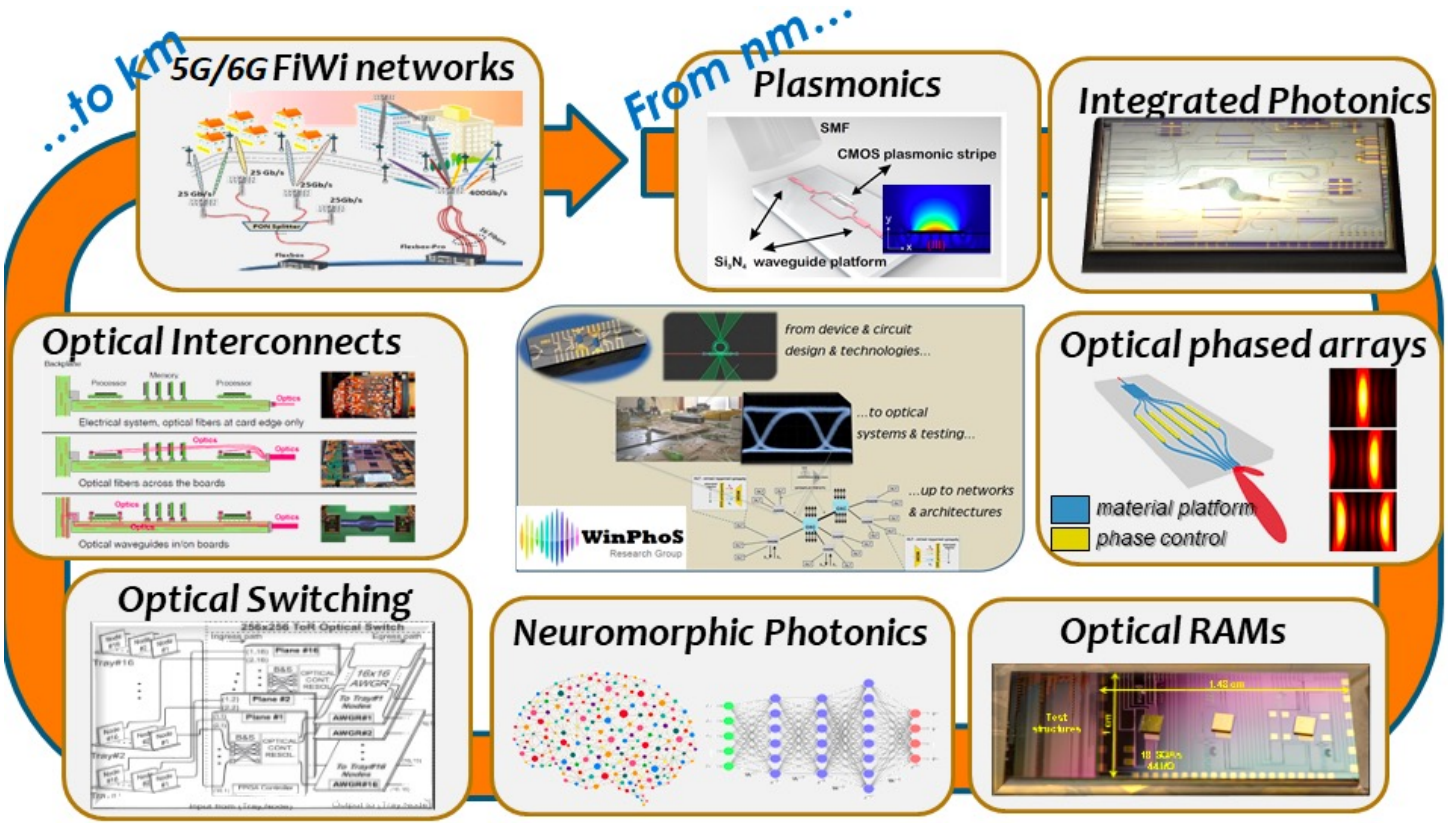
# Aristotle University of Thessaloniki (AUTH)

- Greece's largest University, founded in 1925
- Main campus located in the center of Thessaloniki (second largest city in Greece)
- 11 Faculties
  - ***Physical Sciences***, ***Engineering***, Law, Economics and Political Sciences, Agriculture Forestry and Natural Environment, Health Sciences, Education, Theology, Philosophy, Physical Education and Sport Sciences, Fine Arts
- 40 Schools
- > 85,000 students (~77,000 undergraduate, ~6500 postgraduate, ~3900 PhD students)
- > 1600 faculty members

# Aristotle University of Thessaloniki (AUTH)

- Numerous off-campus facilities (partial list):
  - University Farm
  - Teloglion Foundation of Art
  - Mount Olympus Meteorological Station
  - Center for Interdisciplinary Research and Innovation (CIRI, ΚΕΔΕΚ)
    - 22 research groups in diverse inter-disciplinary domains
    - Our group: ***Wireless and Photonics Systems and Networks (WinPhoS)***
      - Collaboration between departments of Physics, Informatics and Electrical & Computer Engineering
      - 5 faculty members, 11 senior researchers, >15 PhD/MSc students
      - > 22 FP7 and H2020 projects (>5 as coordinator)

# Summary of WinPhoS main research interests

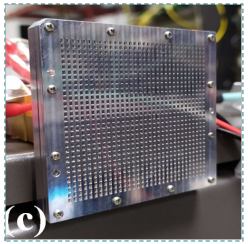


# WinPhoS expertise (details)

- **Optical communications (switching, interconnects, PICs)**
  - Optical computing (optical RAM, optical cache) & neuromorphic processing
  - Silicon integrated photonics and plasmonics
  - Laboratory evaluation of prototypes
- **Optical/wireless systems, Radio-over-Fiber, converged Fiber/Wireless architectures**
  - System/component modelling and network simulations in 3D networks
  - FiWi MAC layer protocols and performance analysis
- **Beyond 5G, 6G heterogeneous 3D network architectures and protocols**
  - Multi-RAT (mmWave/THz) X-hauling architectures in integrated TN-NTNs
  - E2E joint resource allocation optimization models and algorithm development
  - Design of field trials and testbed evaluation
- Matching SNS-2024-STREAM-B:
  - 01-01: System Architecture
  - 01-02: Wireless Communication Technologies and Signal Processing
  - 01-03: Communication Infrastructure Technologies and Devices

# WinPhoS hardware infrastructure

Massive MIMO antenna @ 60 GHz



D-band antenna @ 160 GHz

## Signal Generation

6-bit DAC @ 35GHz & 100Gsa/s

FPGA Board with 900Gb/s optical tranceivers

$LiNBO_3$ Mod @ 40GHz

RF Amplifier @ 65GHz

RF Signal Gen. up to 40GHz

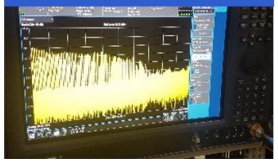
RF MUX up to 64Gb/s

**Soon**

- RF signal generation capabilities of **120Gsa/s!**
- InP modulators up to **56Gbaud/s!**

## Signal Reception & Analysis

Signal analyzer up to 50GHz



BERT up to 64Gb/s

35GHz IR Photoreceiver

RTO @ 63GHz & 160Gsa/s

- InP Photoreceiver up to **70GHz**
- Balanced PD up to **43GHz**!
- BERT up to **64Gb/s**

## Other capabilities

### Photonic Network Analyzer

### Optical amplification

EDFA and PDFA optical amplifiers are available

### Wire Bonder

# Wireless Communications& Information Group (WCIP)

## Team

- Leader, George K. Karagiannidis
- 9 PhD students+1 Visitor PhD Student, 3 Postdocs
- One of the most cited research group in Telecom and Signal processing

ARISTOTLE UNIVERSITY OF THESSALONIKI
WCIP
Wireless Communications & Information Processing Group

## Prof. Karagiannidis

- IEEE Fellow, 2015-2023 Clarivate Analytics Web-of-Science Highly Cited Researcher
- Humboldt Research Award (2022)
- 2021 IEEE Communications Society Radio Communications (RCC) Committee Technical Recognition Award, for Outstanding Contributions to Wireless Systems
- 2018 Signal Processing and Communications Electronics (SPCE) Technical Recognition Award of IEEE Communications Society for Outstanding Technical Contributions
- > 600 publications in journals and conferences, 8 filed patents (2 in EPO)

# WCIP expertise

- Wireless Networks (5G and Beyond, 6G)
- Convergence of Communications and Computing
- Optical Wireless Communications
- Wireless Power Transfer and Applications
- Reconfigurable Intelligent Surfaces
- Next Generation Internet of Things
- Communications and Signal Processing for Biomedical Engineering
- Stochastic Processes in Biology and Economics

# Thank you!

*Winphos website:*
*http://winphos.web.auth.gr/*

*WCIP website:*
*http://geokarag.webpages.auth.gr/*

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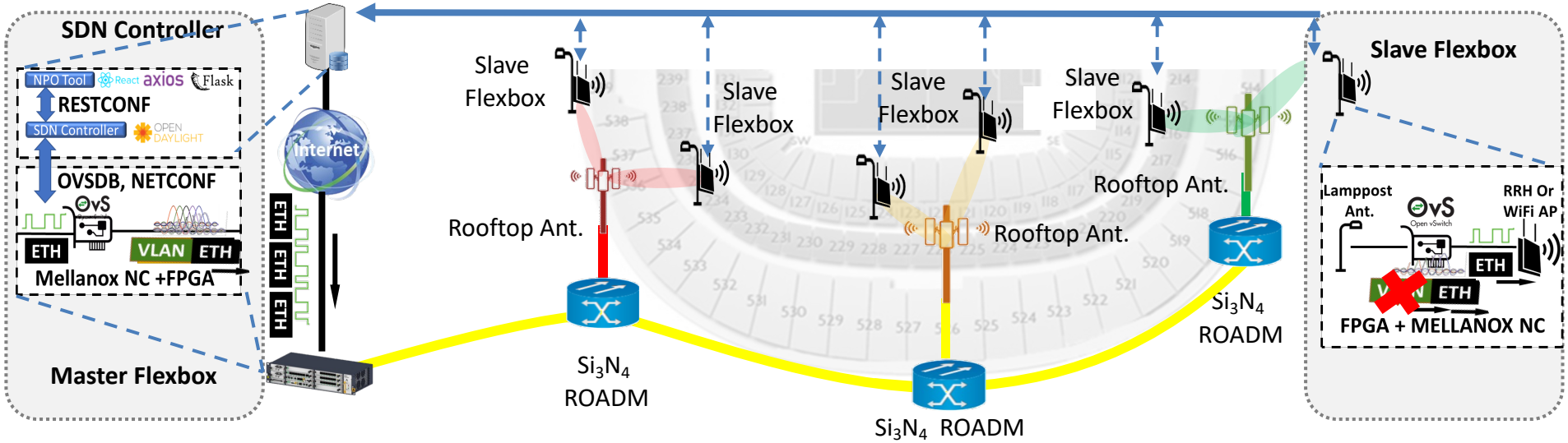
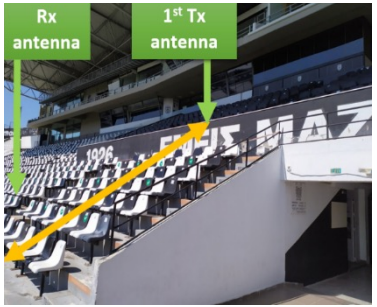
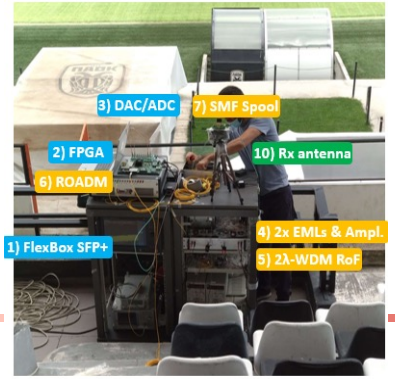
# Annex

# 5G pilot testbed at PAOK FC Stadium (H2020 5G-PHOS)

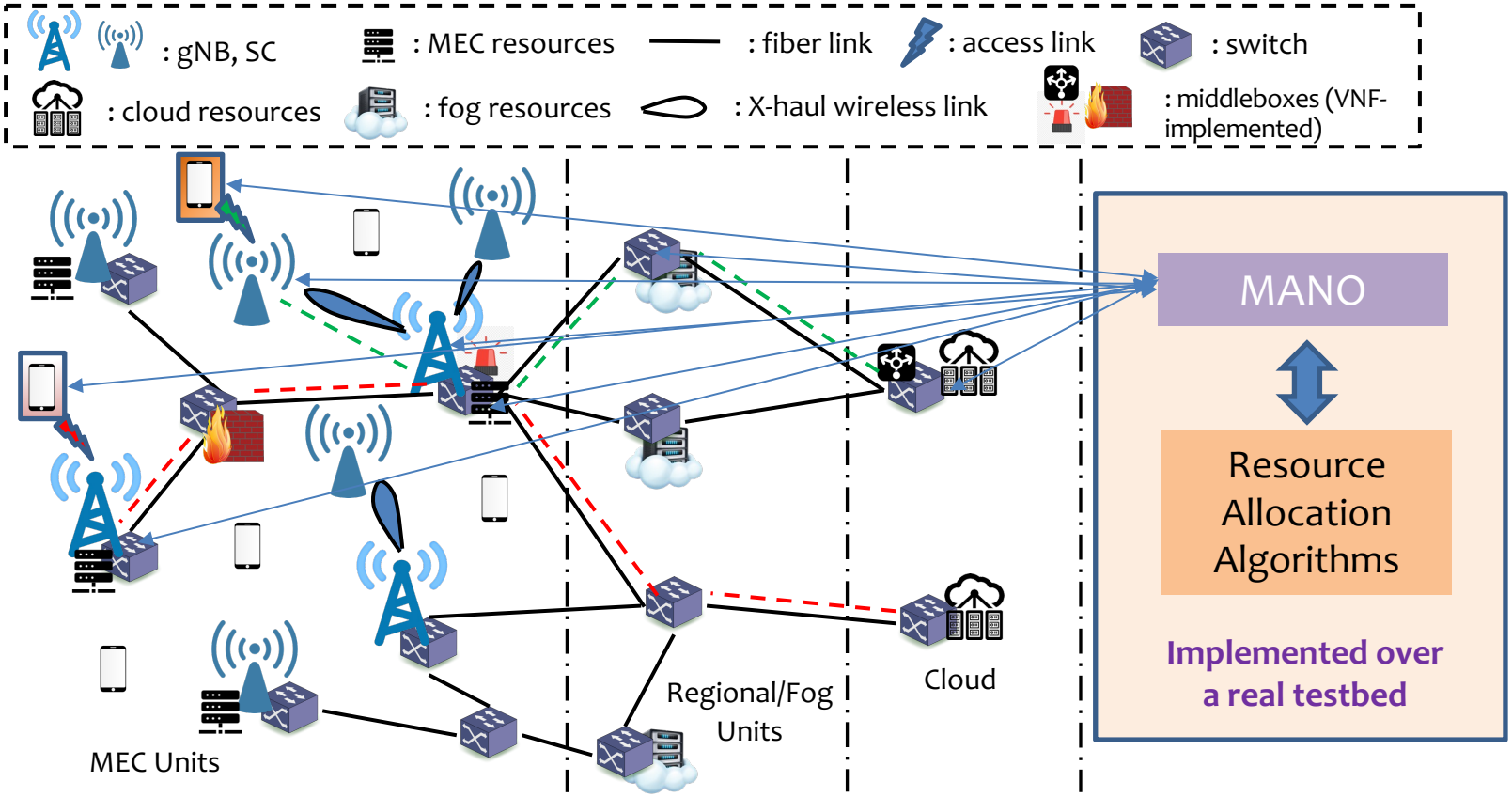


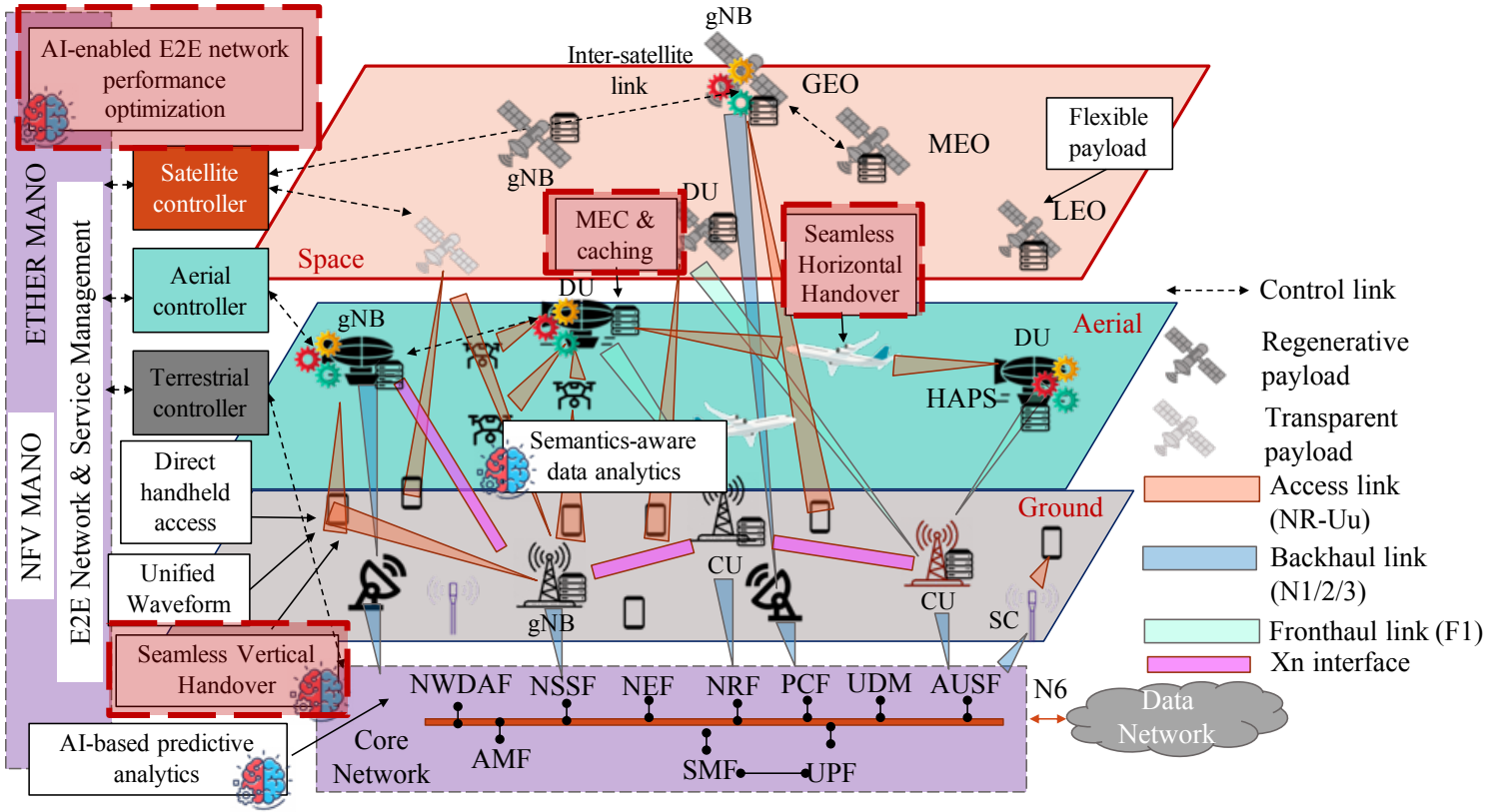



# 5G pilot testbed (indoor demonstrator) (H2020 5G-PHOS)

# Online E2E resource allocation in 6G Hetnets (5G-COMPLETE)

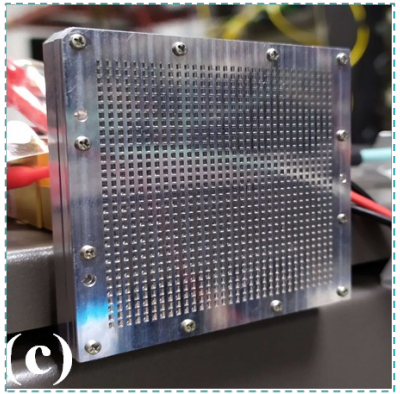


# E2E network optimization in 3D 6G networks (ETHER)

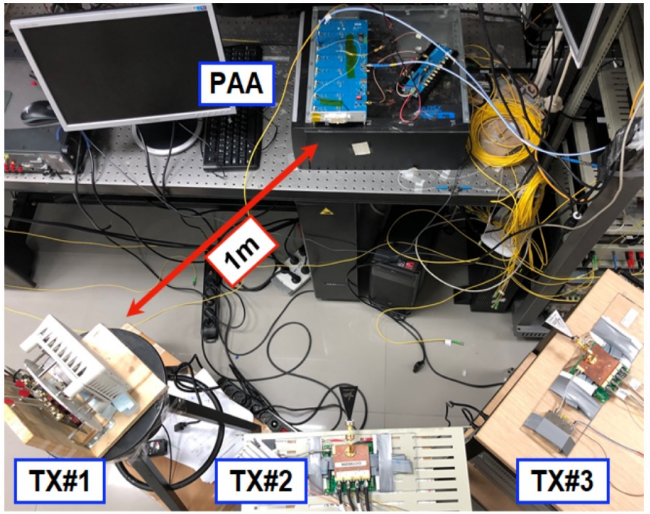


# Additional WinPhoS infrastructure (1/3)

Massive MIMO antenna @ 60 GHz

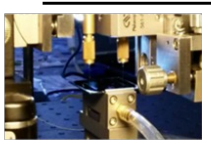


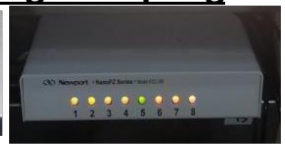
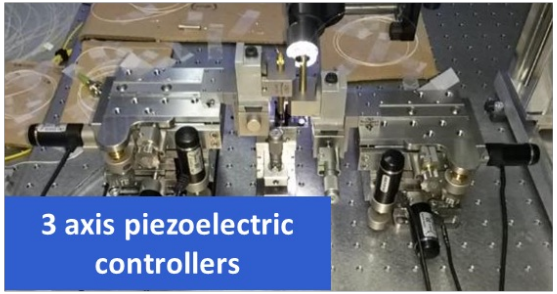

D-band antenna @ 160 GHz



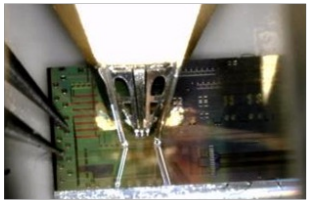
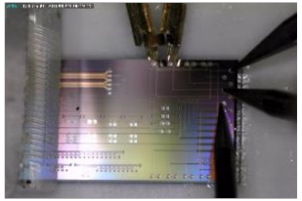
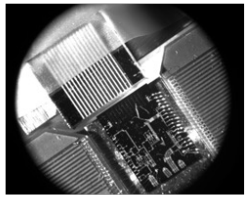
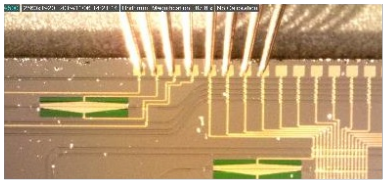
# Additional WinPhoS infrastructure (2/3)

## Vertical and Edge Coupling



3 axis piezoelectric controllers

Electrical RF probing characterization setup up to 50GHz
Upgrade to 67GHz and beyond - Soon!

## PICs characterization equipment

8-channel optical power meter

1260 – 1360 nm O band TLS

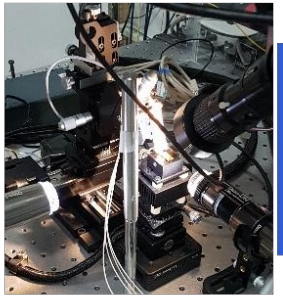
1500 – 1630 nm C band TLS

High Res. OSA

## IR Camera

InGaAs Sensor
640 x 512 pixels
(400 nm - 1700nm)

## Automation



Fully automate passive characterization measurements on a chip scale

# Additional WinPhoS infrastructure (3/3)

## Hardware

- **Mini HPC cluster** (8 workstations, 160 cores, 960 GB RAM)
- **NI-USRP** Software Defined Radios (wireless testing)

## Software

- **Lumerical** for EM simulations
- **VPIphotonics Design Suite** for system level setups
- **Synopsys** and **Nazca** for GDSII Design
- **Matlab** for wireless system modeling and optimization algorithms