

# HF Electronics and Photonics

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- Passive components, antennas
- Power amplifiers (III-V, III-N)
- III-V and III-N MMICs
- HF (Microwave, mm-wave) Characterization and Modeling
- Reliability
- CMOS and SiGe HF electronics







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IU.NET know how – HF Electronics

CMOS and SiGe HF electronics

























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**GRADE:** Graphene-based devices and **Circuits for RF Applications (FP7)** 





















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Sapienza

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INIMO





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### Hot topics in HF – Microwaves – Millimeter waves

- Space applications → mainly III-V, now III-N → main players ESA and ASI, an inter-university department exists in Italy (MECSA)
- 5G → interesting scenario, several frequency bands involved, many H2020 projects
- IOT
- ...others...













# 5G and microwaves & mm-waves

#### ery high data rates, very low latency, Itra-high reliability, energy efficiency and xtreme device densities.

ey technology components include xtension to higher frequency bands, access/ ackhaul integration, device-to-device ommunication, flexible duplex, flexible pectrum usage, multi-antenna transmission, ltra-lean design, and user/control eparation.

o support increased traffic capacity and to nable the transmission bandwidths needed o support very high data rates, 5G will xtend the range of frequencies used for nobile communication. This includes new pectrum below 6 GHz, as well as spectrum n higher frequency bands up to 100 GHz.



## From Ericsson white paper April 2016, "5G radio access – capabilities and technologies"





# H2020 calls of interest on 5G

- ICT-23-2018: 5G End to End Facility
- ICT-25-2019: Advanced 5G validation trials across multiple vertical industries
- ICT-26-2019-2020: <u>5G Long Term Evolution</u> (Strand 3: Radio network enabling technologies)
- ICT-44-2018: EU-US Collaboration for advanced wireless platforms (possibly)























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- Detector design

- Modulator design
- Reliability
- LASER modeling
- GaN LED modeling and design
- Image sensors

















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#### ilicon Photonics rationale: copper $\rightarrow$ optical (INTEL)



Decreasing Distances  $\rightarrow$ 





#### Monolithic? icon Photonics ECL Modulator M Filter Next Integration: silicon sion (INTEL) devices into hybrid modules Passive Integrated in Silicon Allanment Photodetectors DEMUX Taper Receiver t: Prove Silicon good Photodetector Chip optical material \*Many at 40Gb/s lacciv Atign Driver Level of integration Chip Determined by Modulation t Source Guide Light Application/cost MUX Lasers Revenue des des loss Low Cost Assembly Intelligence Time

# H2020 Photonics calls

- ICT-03-2018-2019: Photonics Manufacturing Pilot Lines for Photonic Components and Devices (Indium Phosphide - 2018 call; Silicon Photonics 2018 call; Next generation free-form optics - 2019 call; Advanced optical medical device technologies for medical diagnostics - 2019 call)
- ICT-04-2018: Photonics based manufacturing, access to photonics, datacom photonics and connected lighting
- ICT-05-2019: Application driven Photonics components
- Total budget H2020-ICT-2018-2019 ~1200 MEuro
- DT-ICT-03-2020: Photonics Innovation Hubs





# Image Sensors



AIM INFRAROT-MOD GmbH

• Design of multi-wavelength FIR MERCATEL focal plane arrays (PoliTO)







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# Image Sensors



• CMOS image sensors & THz detection (Roma La Sapienza)



Bright spots in CMOS Image Sensors are correlated to the metal contaminant Z, not to the energy. Tungsten leads to a large number of hot spots also ato low concentration.

From F.Russo et al., Hot pixels in CMOS image sensors due to metal contamination



# The MONET proposal 😣

Research & Innovation H2020-ICT-2016-2017, title: *Monolithic III-V on CMOS integratio* platform for emerging ToF (Time of Flight) applications, ~4 Meuro UE requested contribution, IU.NET 334 KEuro

Fraunhofer, PMD Tech., IBM Research, Infineon, IU.NET (Udine, Polito), Un. Thessalonil SCIPROM







# Thanks!



