

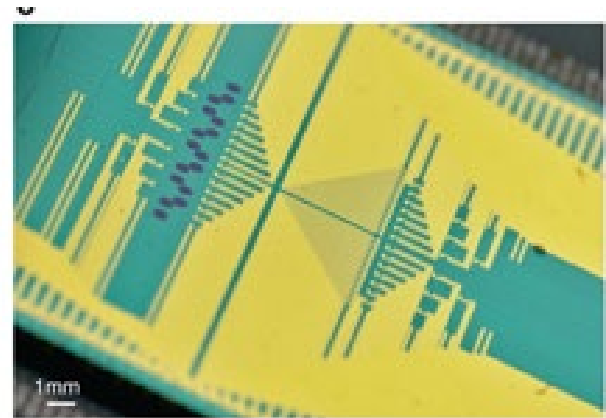
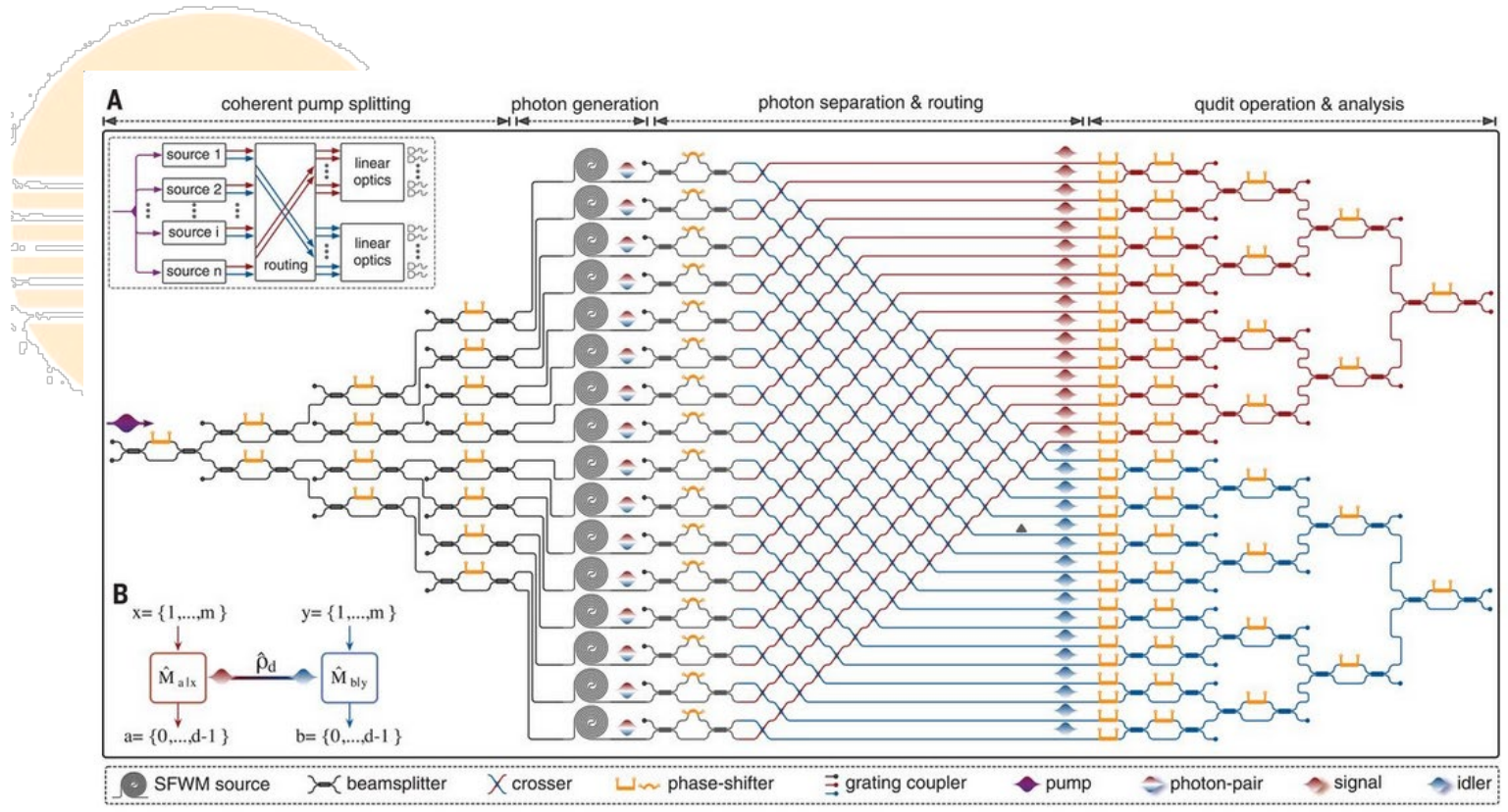


# Silicon Nitride Platform for Photonics Circuits Integration

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3. iTEAM Research Institute, Universitat Politècnica de València, Valencia (SPAIN)





Multidimensional quantum entanglement with silicon integrated optics: 550 quantum optical components and 16 photon sources

J. Wang et al., "Multidimensional quantum entanglement with large-scale integrated optics," Science, vol. 360, no. 6386, p. 285, 2018. DOI: 10.1126/science.aar7053

# Quantum Technologies Platform, QTEP



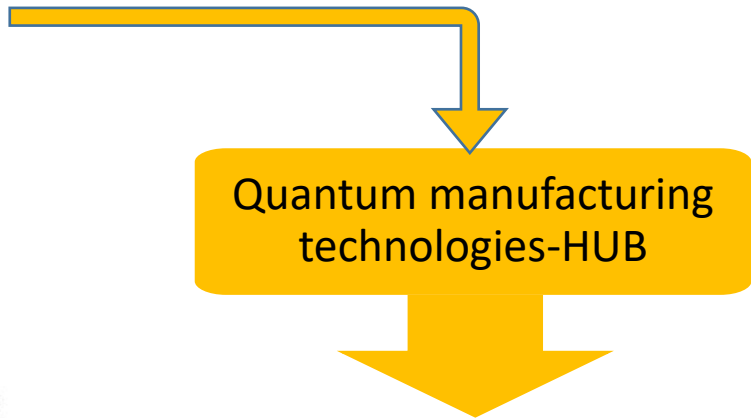
QTEP ABOUT ▾ RESEARCH ACTIVITIES TECHNOLOGY

Quantum  
Communication

Quantum  
Computing

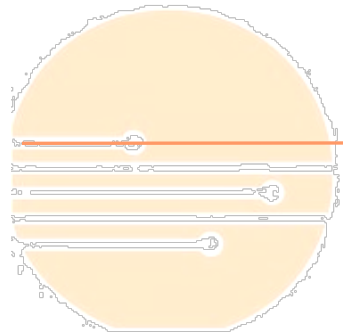
Quantum Theory

Quantum  
Fabrication

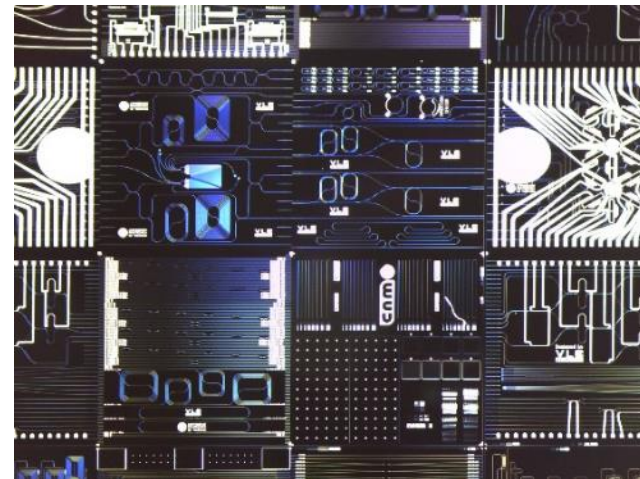
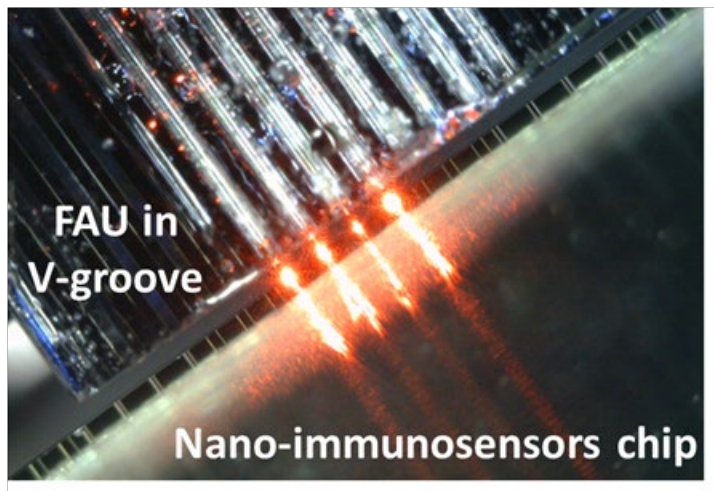


- Superconducting circuits and qubits
- Nanopatterning of novel materials
- $\text{Si}_3\text{N}_4$  technology for quantum photonics

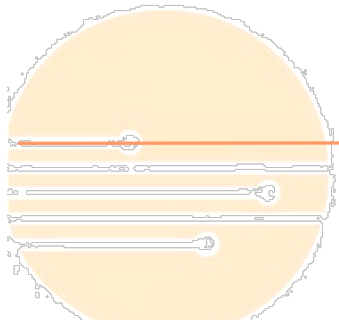
# IMB-VLC Technological Platform



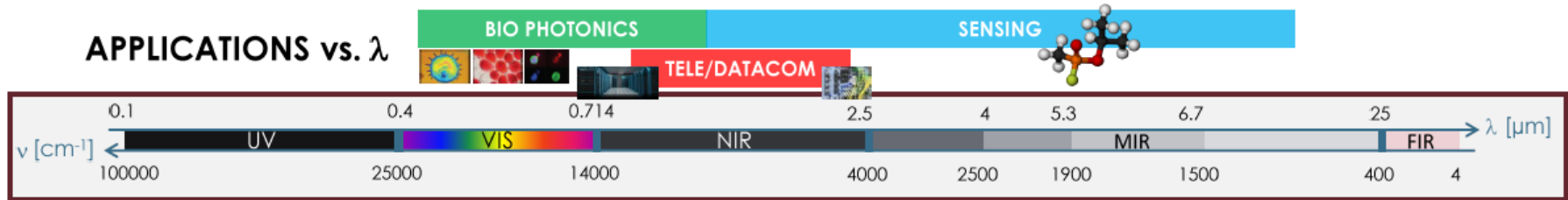
IMB-CNM has developed a fabrication process on **Silicon Nitride technology** in collaboration with UPV and VLC Photonics.



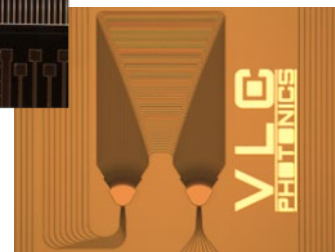
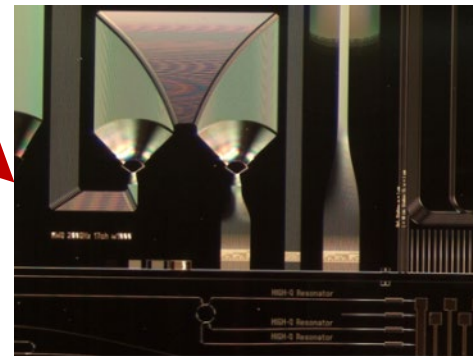
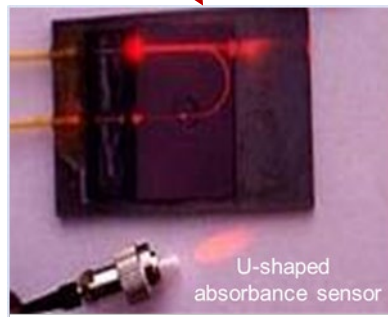
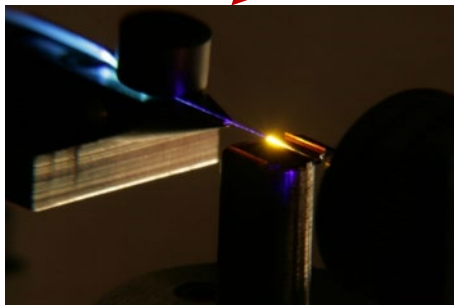
# Photonics Technology: Silicon Nitride



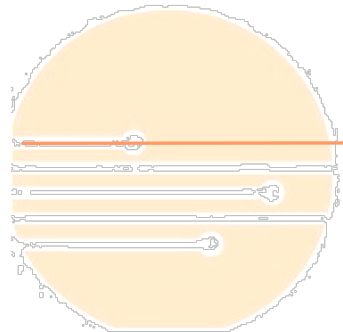
Pascual Muñoz, et al. *Sensors* 2017, Vol. 17, 2088; doi:10.3390/s17092088



UV: Ultra-Violet  
 VIS: Visible  
 NIR: Near Infrared  
 MIR/FIR: Mid/Far IR

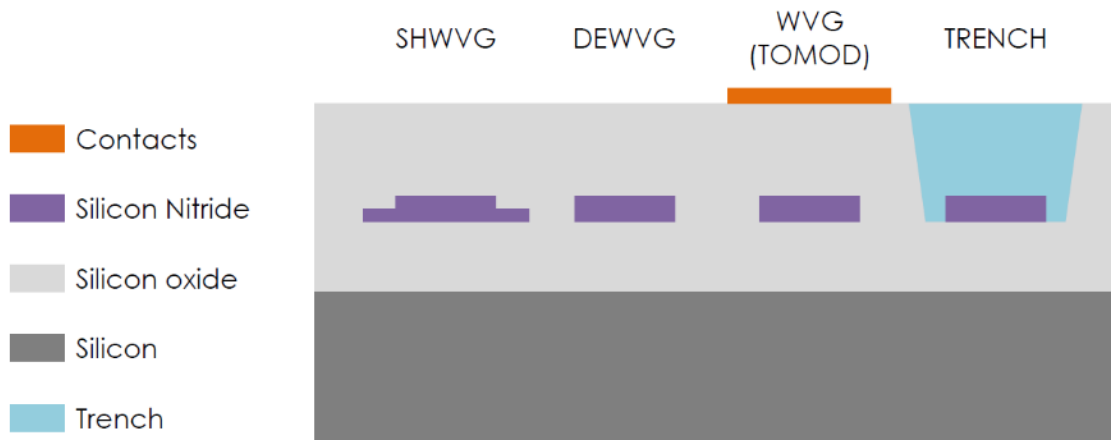
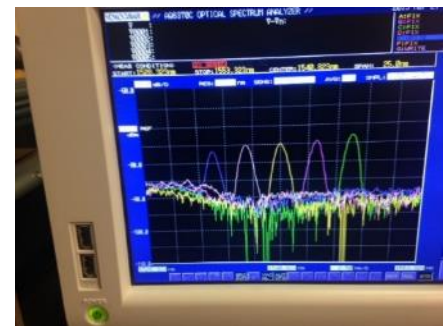
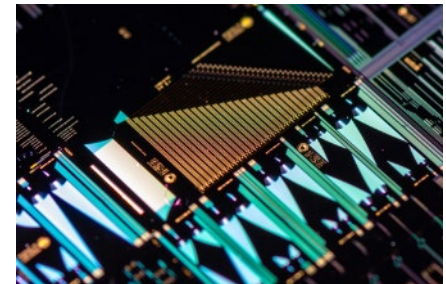


# IMB-VLC Technological roadmap



The **process technical** features are:

- Wavelength range from Visible to Mid infrared
- Three waveguide cross-sections (nitride film 300 nm height, shallow 150/300, deep 300 and mini-deep 150 nm)
- Thermo-optic tuners
- Selective area trenching
- Blocks developed: waveguides, MMI couplers, Mach-Zehnder Interferometers, Sagnac interferometers, Arrayed Waveguide Gratings, Echelles Gratings, ring resonators, ...



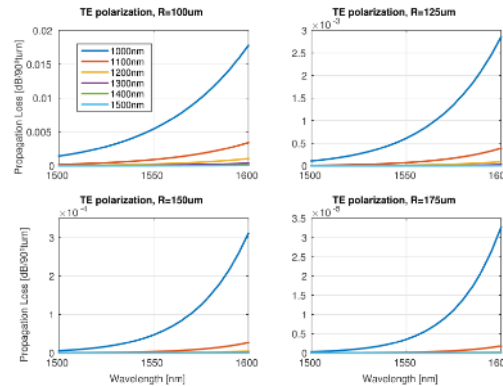
# Multi Project Wafer (MPW) approach

## Multi-Project Wafer: PDK



CNM-VLC Design Manual

Version v.1.0 Development Version  
May 1st, 2015  
CONFIDENTIAL

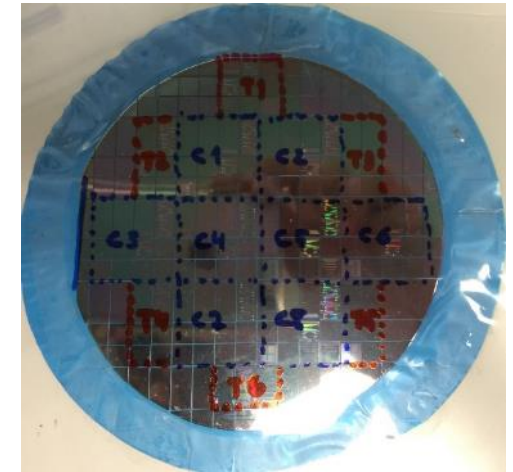
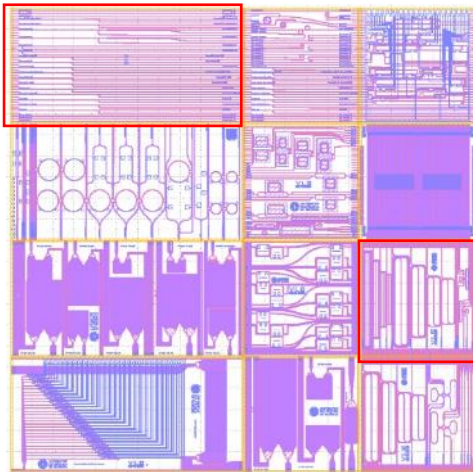


3.3.2 Deep to shallow waveguide transition	
Definition	1.0
Definition	A subguide transition element between the two cross-section available, from deep to shallow.
Parameters	None
Dimensions	None
Res. Size	X0 µm x Y0 µm
Input waveguide width	1.0 µm
Output waveguide width	1.50-0.0.0 µm
Parts	None
Optical Parts	in0, out0
Electrical Parts	None
Optical Properties	None
Insertion loss	< 0.1dB
Electrical Properties	None
None	None
Design Rules	None
Optical waveguide connections type	Variable
Modeling aspects	None
Phoenix Software	None
Lowest call ref	com-0259-0-10; 1 name

- ❑ A Process Design Kit (PDK) is available for the Phoenix Software platform.
- ❑ The PDK contains all the technology related information automatized for the design, simulation and layout of the user components.
- ❑ The PDK also contains the **standard building blocks offered to the MPW users**

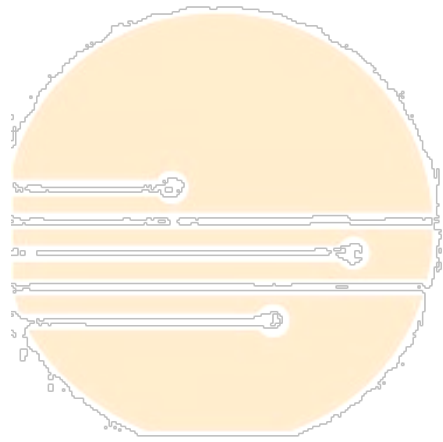
# Multi Project Wafer (MPW) approach

## Silicon Nitride Multi-Project Wafer runs



MWP#0, MPW#1, MPW#2 & MPW#3 finalized  
MPW#4 Course Jan. 2019, Mask deadline Jun. 2019  
Cells size L 5 x10 mm<sup>2</sup> & Cells size M 5x5 mm<sup>2</sup>



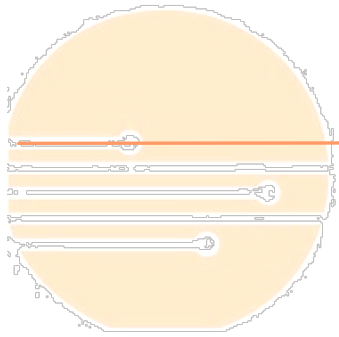


# Thank You for attending this presentation

<http://www.imb-cnm.csic.es/index.php/en/clean-room/silicon-nitride-technology>

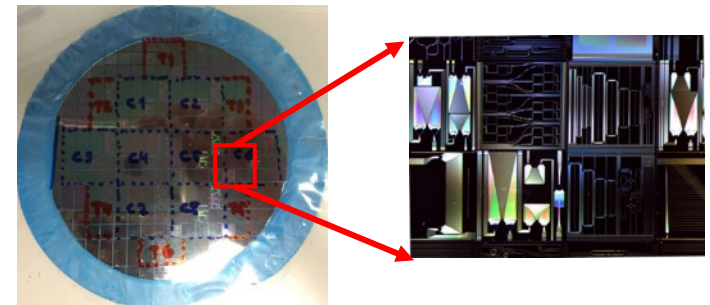
For more information:  
[Carlos.Dominguez@imb-cnm.csic.es](mailto:Carlos.Dominguez@imb-cnm.csic.es)

# Multi Project Wafer (MPW) approach



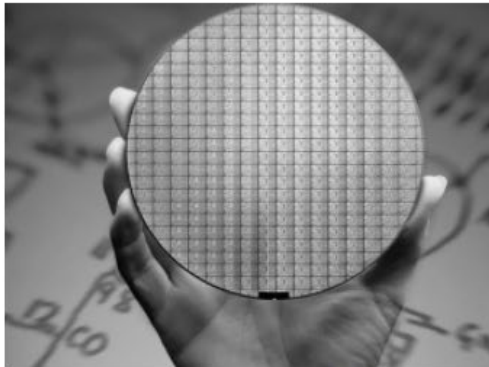
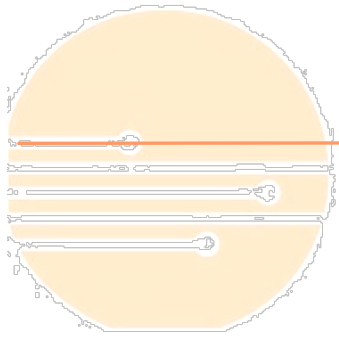
## Multi-Project Wafer

- **Developing dedicated processes for your PICS:**
  - Each wafer run can be 5 to 25k\$/wafer
  - Processes are often not well defined/characterized
  - Results in long cycles of trying, testing, & refining
  - Needs licenses for multiple design software packages
  - Requires integrated optics design experts
- **Using an open foundry with well defined processes:**
  - Eliminate need for own fab + reduces # design cycles
  - Participate in multi project wafers (MPW)
  - Significantly reduces the cost per cycle
- **Work with a design house for Multi-Project Wafers:**
  - With own library matching the MPW foundry
  - To reduce the # of design cycles
  - To avoid licensing costs



MPW COST FOR USER IS PER AREA / CELL  
INDEPENDENT OF ITS CONTENTS

# Multi Project Wafer (MPW) approach

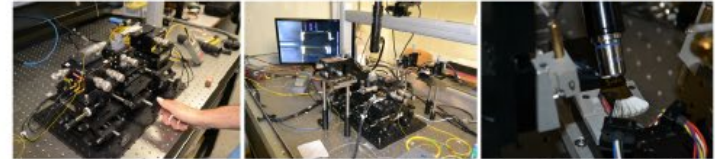


Process Design Kits & BBs

Clean room CMOS line



Clean room MEMS line



PIC characterization labs



Microscopy service

Combination of expertise and infrastructures available at VLC, CNM and UPV

# Multi Project Wafer (MPW) approach

