



February 5, 2020

# Leti Photonics Workshop

W-Hotel, San Francisco

**SPIE.** PHOTONICS  
WEST

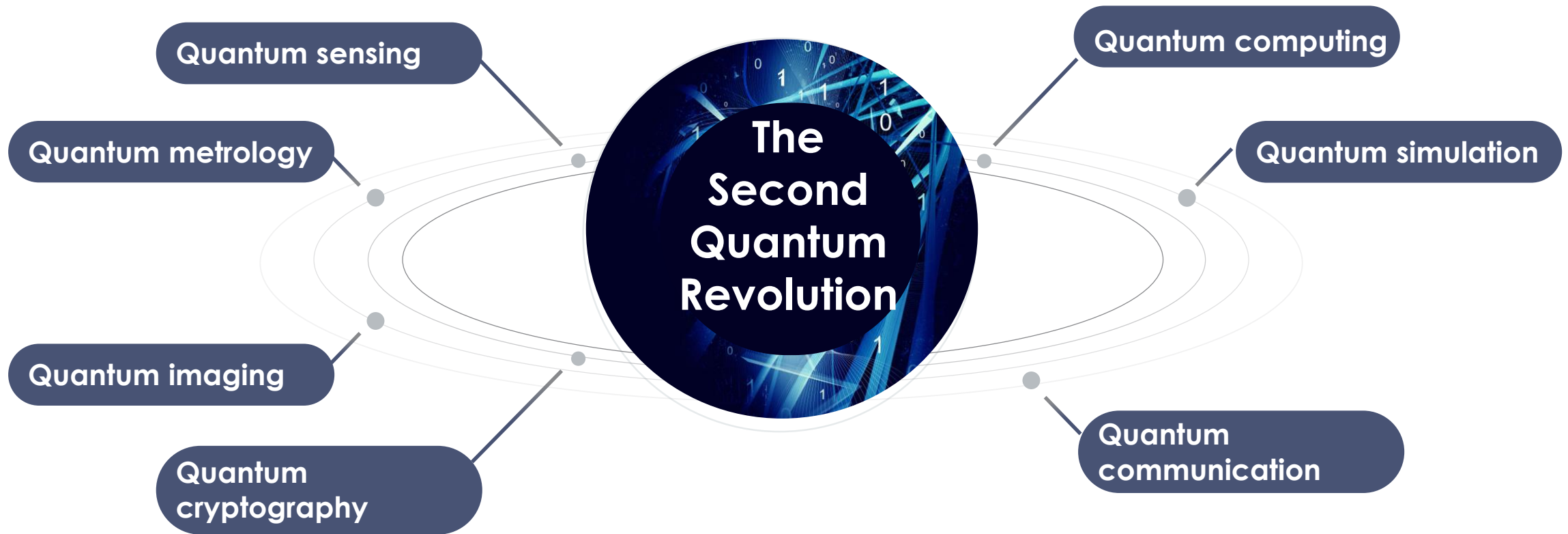
*Disruptive photonic concepts for new applications & markets*



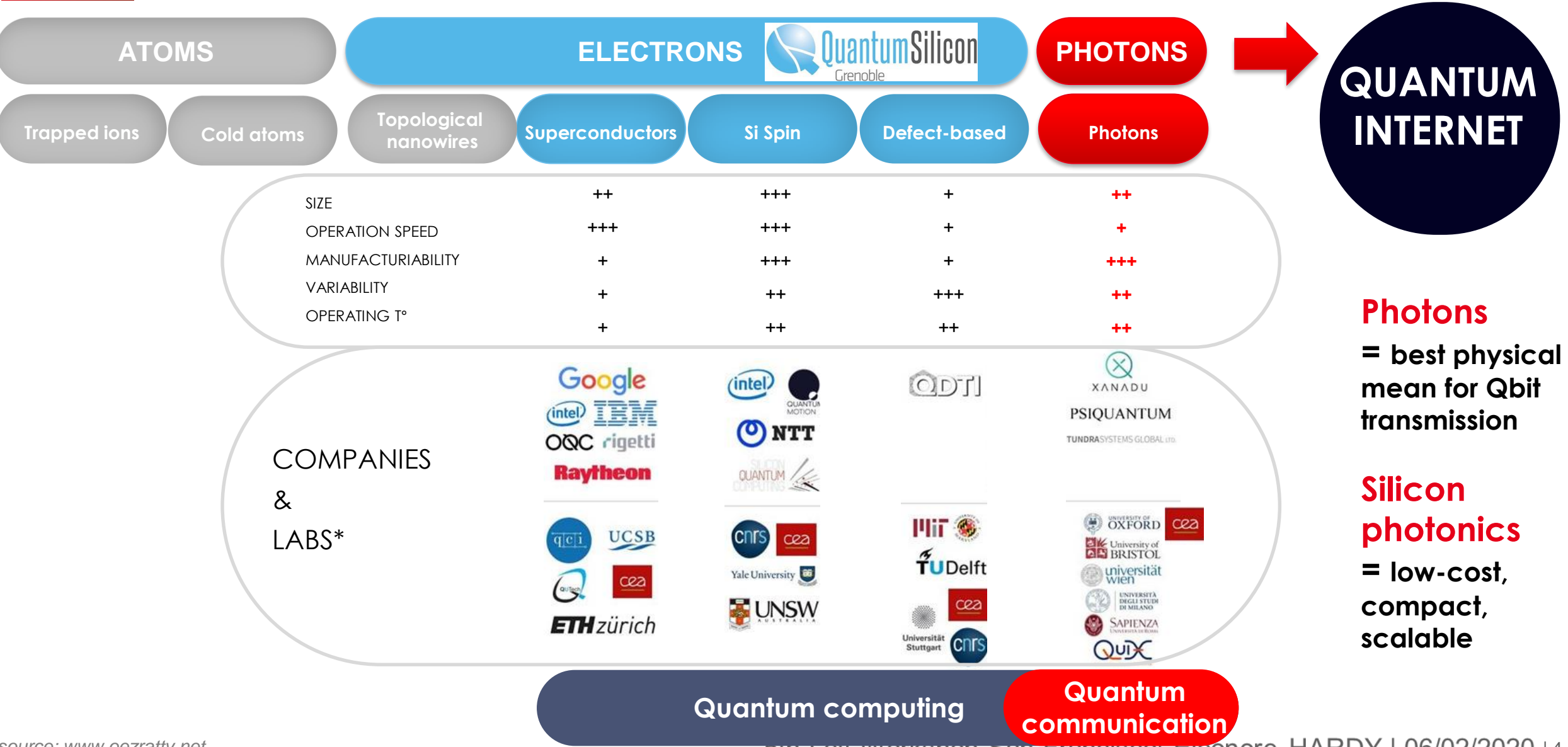
# LOW-LOSS SILICON PHOTONICS PLATFORM FOR QUANTUM TECHNOLOGIES

5th Leti Workshop San Francisco | Eleonore HARDY | 06/02/2020

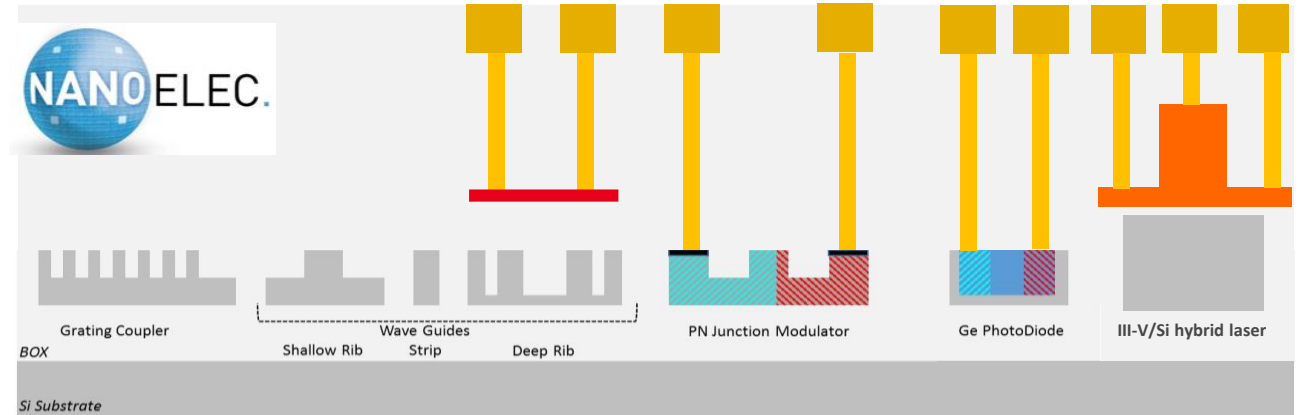




# QUBITS TECHNOLOGIES @ LETI

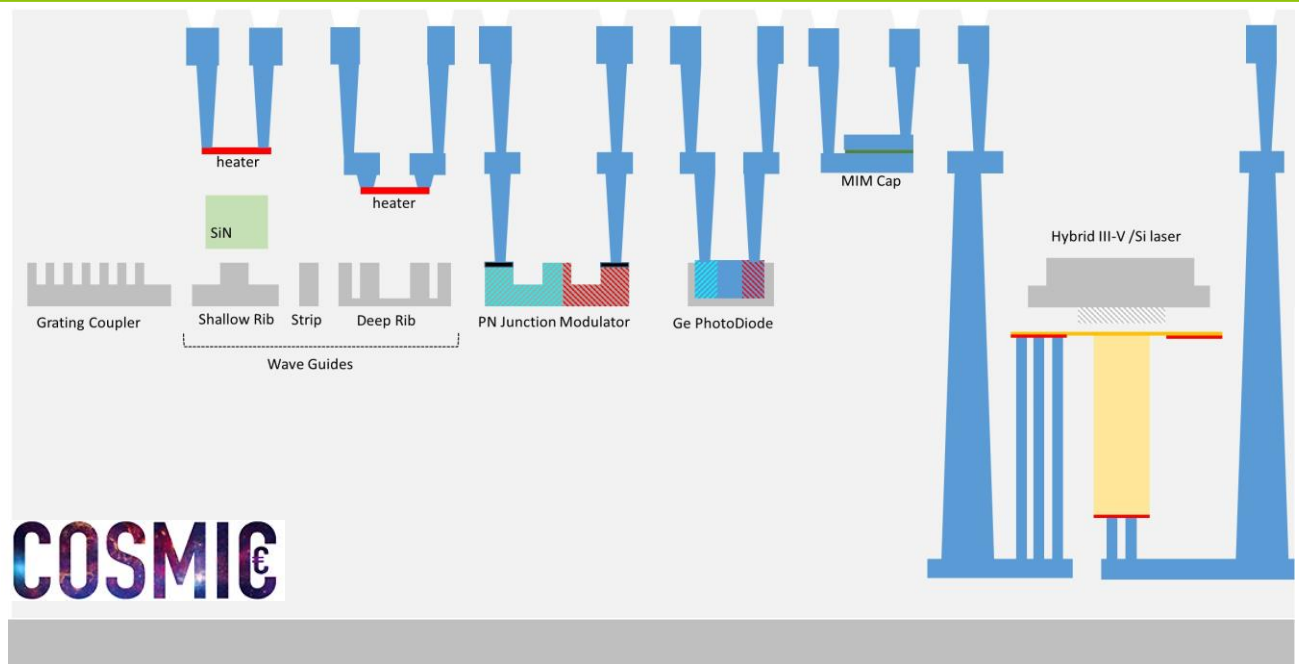


## • SILICON PLATFORM

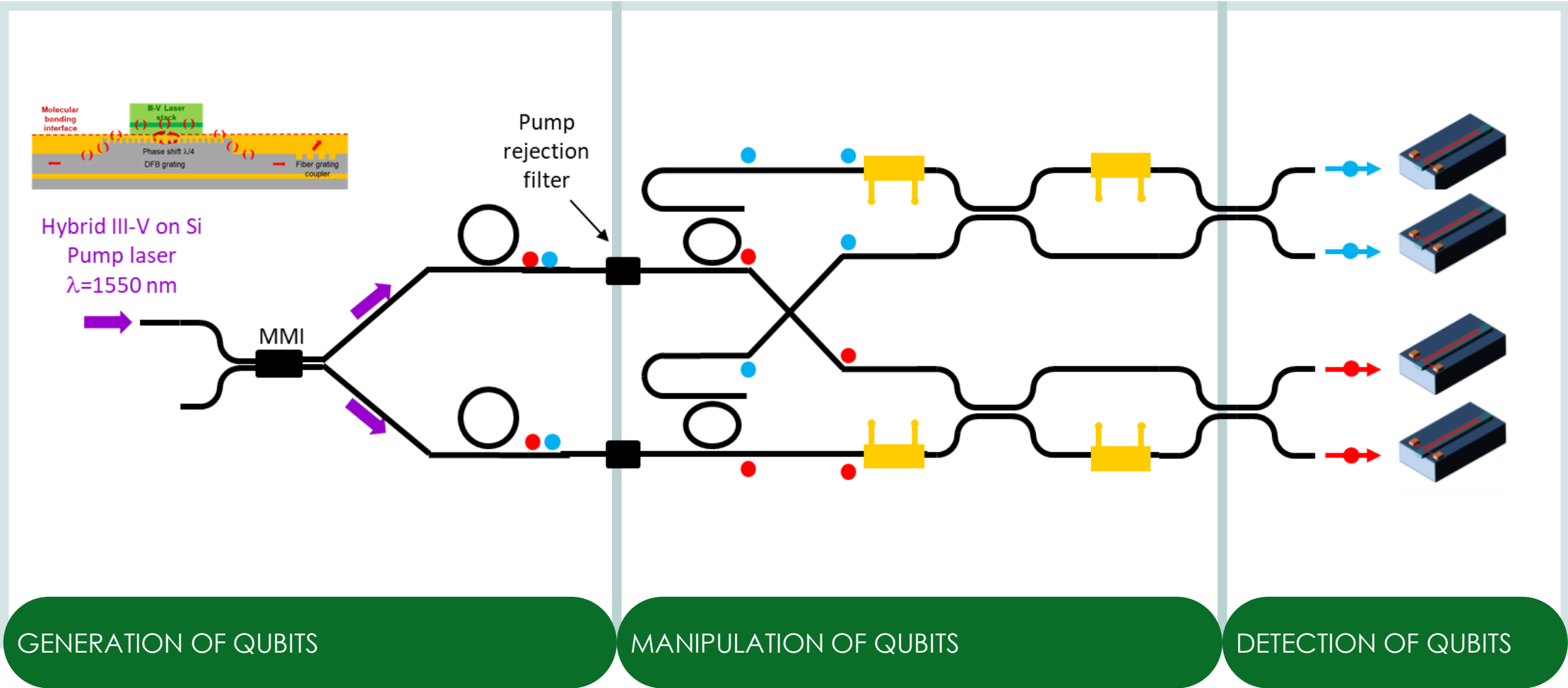


## • SILICON + SILICON NITRIDE PLATFORM

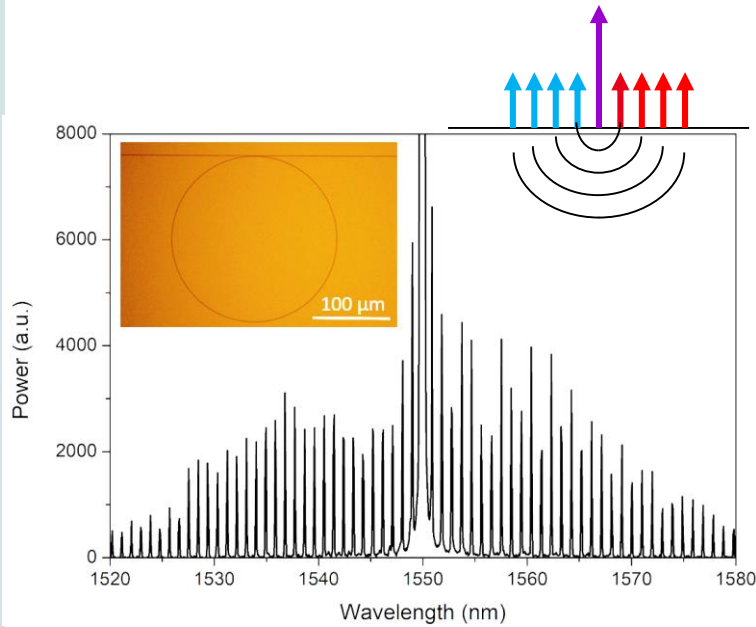
- O and C-band
- Variable thicknesses
- Possible III-V add-on
- Transfer in 300mm in progress with immersion lithography



# VERSATILE SI QUANTUM PHOTONICS PLATFORM FOR Q-PICS

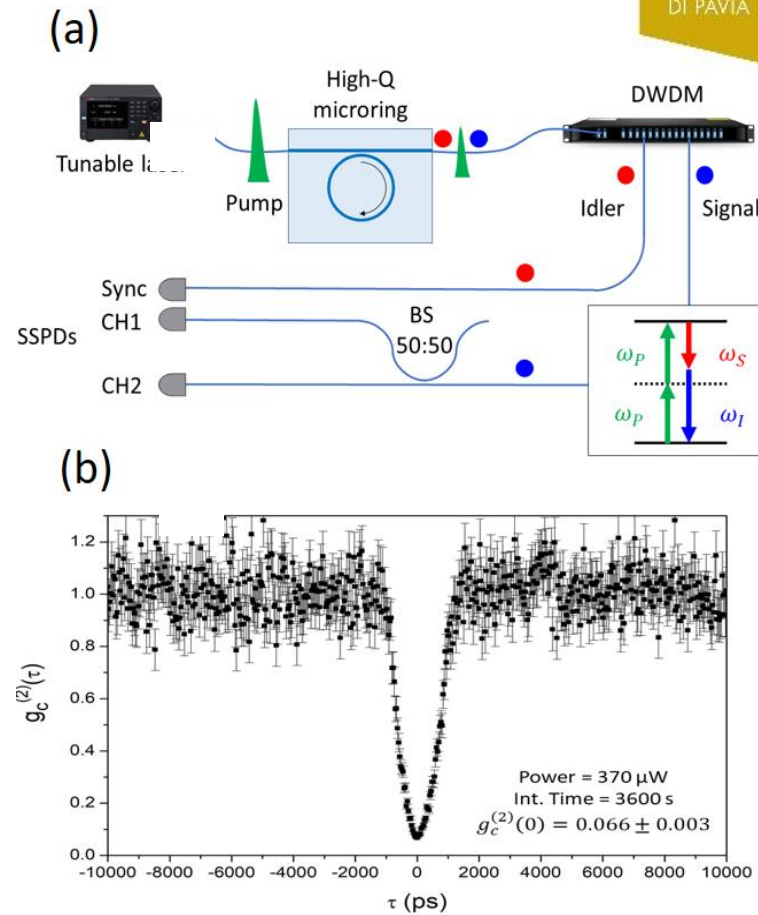


# 1. GENERATION OF QUBITS



*Silicon ring for  
Entangled photons on chip  
Made @ LETI*

## Entanglement demonstrated



## Towards

➤ Generation of qubits with dimensions over 2



➤ DFB laser

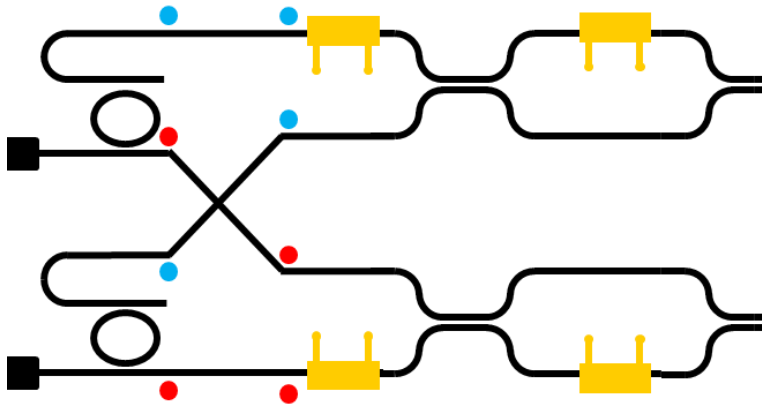


## And more integrated lasers!

➤ Pulsed laser

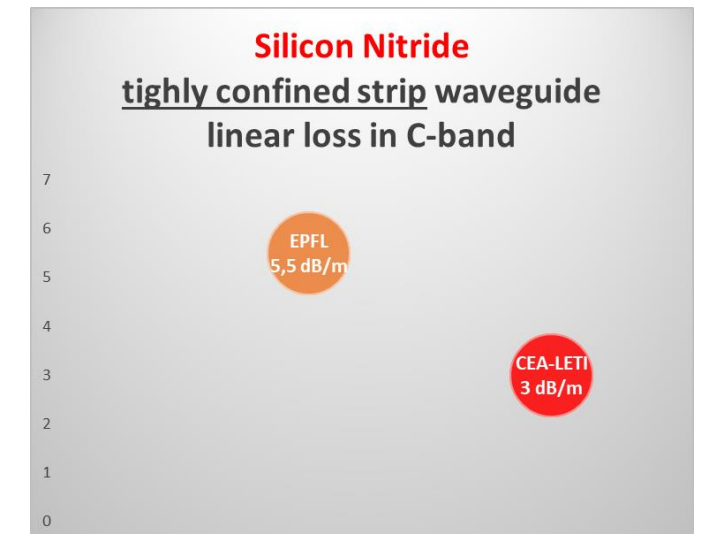
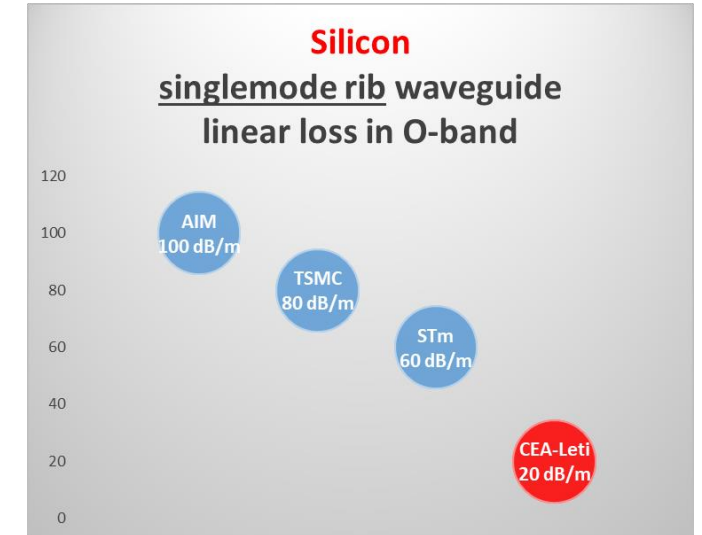
➤ Tunable laser

## 2. MANIPULATION OF QUBITS



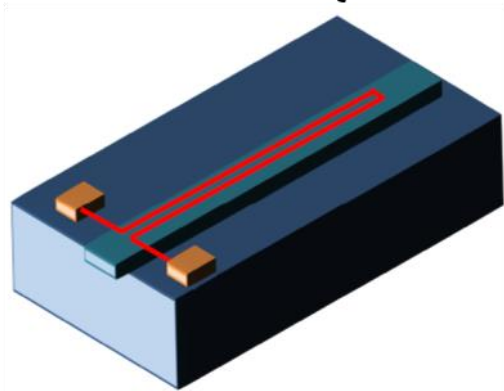
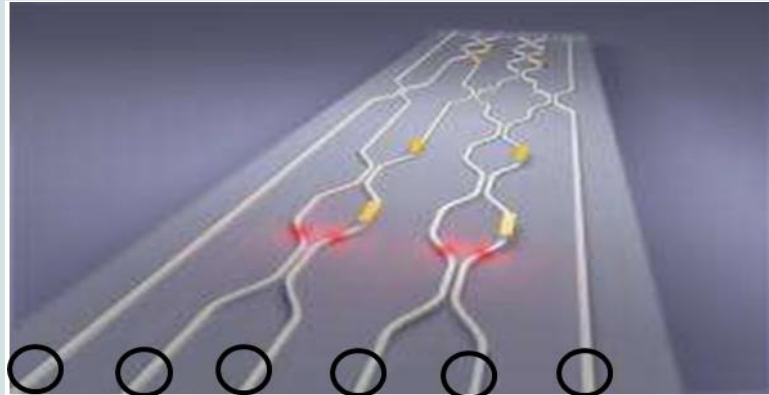
*Reconfigurable  
photonic circuit*

- **Components available**
  - ✓ MZI with heater  
or rapid phase shifters
  - ✓ Low Loss Silicon  
& Ultralow loss Silicon Nitride
- **Towards**
  - Demos on 300mm platform  
with immersion lithography
  - Integration of high rejection  
pump filter
  - New reconfigurable circuits  
customized for various crypto  
protocols





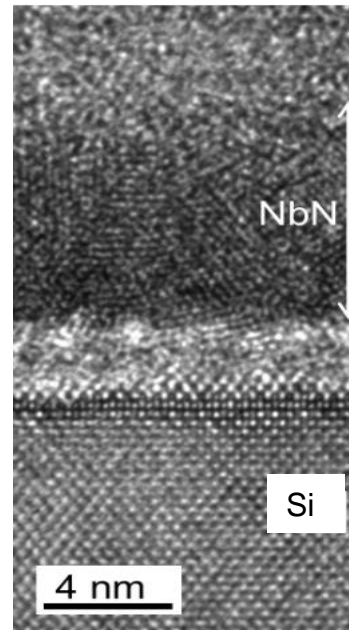
### 3. DETECTION OF QUBITS



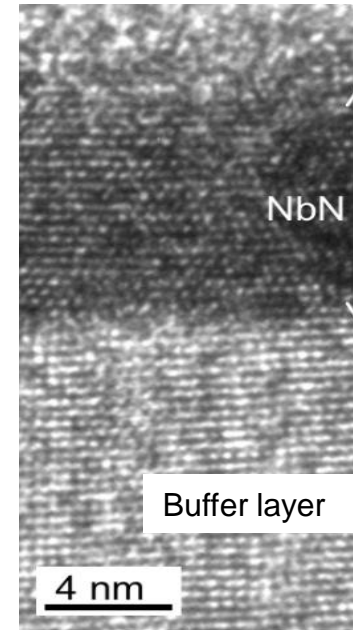
*Integration of SSPD  
in silicon photonic circuits*

- **NbN deposition available**

- ✓ NbN material deposited on 200 mm SOI wafers
- ✓ With optimized buffer layer



*Unoriented  
polycrystalline NbN*



*Textured  
polycrystalline NbN  
along z direction*

- **Towards**

- Validation of material performance for single photon detection in vertical detectors
- Technological process module compatible with the core silicon photonics platform
- Characterization of guided detectors at cryogenic temperature

***For high efficiency NbN SSPD***

## TAKE-AWAY

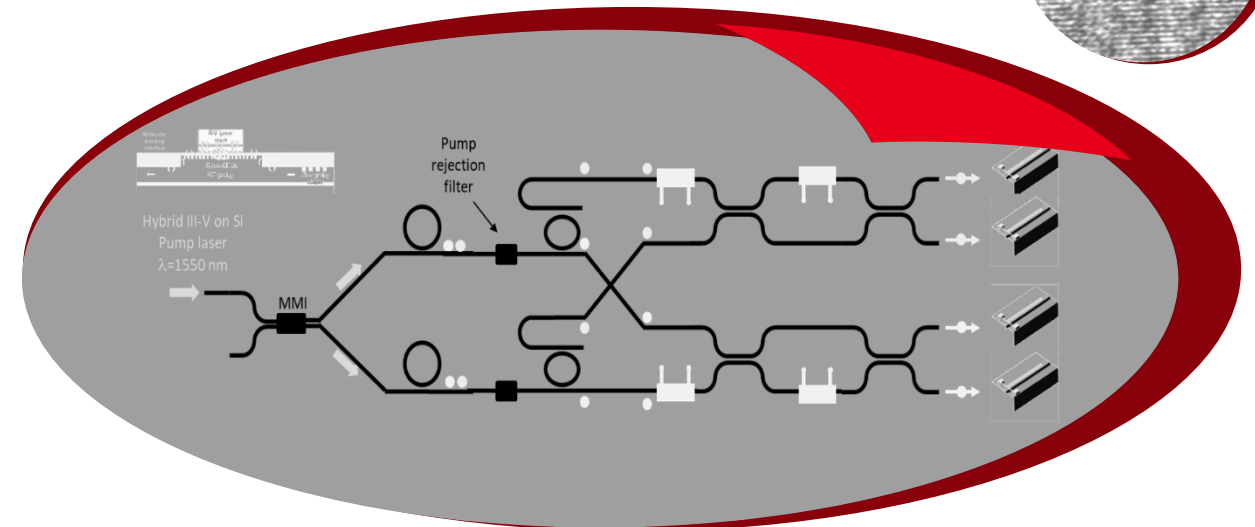
- **VERSATILE SILICON PHOTONICS PLATFORM for Q-PIC**

- ✓ Low Loss Si & Ultralow Loss SiN
- ✓ III-V laser add-on
- ✓ Flexibility to introduce new materials
- ✓ For all quantum applications

- **TOWARDS**

- Full library of components
- First quantum PIC for the implementation of QKD protocols

**ACCESS NOW  
TO OUR Q-PIC PLATFORM**



***Thank you  
for your  
attention***

***See Leti's demonstrators at booth 857A  
France Pavilion (South Hall)***

***And welcome in  
Grenoble in June >>***



Leti, technology research institute  
Commissariat à l'énergie atomique et aux énergies alternatives  
Minatec Campus | 17 rue des Martyrs | 38054 Grenoble Cedex | France  
[www.leti-cea.com](http://www.leti-cea.com)

