

Nuova Officina Assergi



a new reality for novel SiPM-based detector production

IFD 2022 : INFN Workshop on Future Detectors  
17-19 October 2022 Bari- Italy



Lucia Consiglio  
INFN LNGS

*Bari Lungomare Rotonda*

# New SiPM technology for light detection

## Why SiPMs?

- Higher Photon Detection Efficiency
- Higher fill factor
- Operated with low bias
- Lower cost

Tile: 24 SiPM array integrated with signal preamplifier  
Photo Detection Module (PDM)

Photo Detection Unit (PDU)

16 tiles -> 4 readout channels

94 900 SPADs

1cm<sup>2</sup>

5 x 5 cm<sup>2</sup>

20 x 20 cm<sup>2</sup>

SPAD: single photon avalanche diode 30 μm pitch

## Challenges

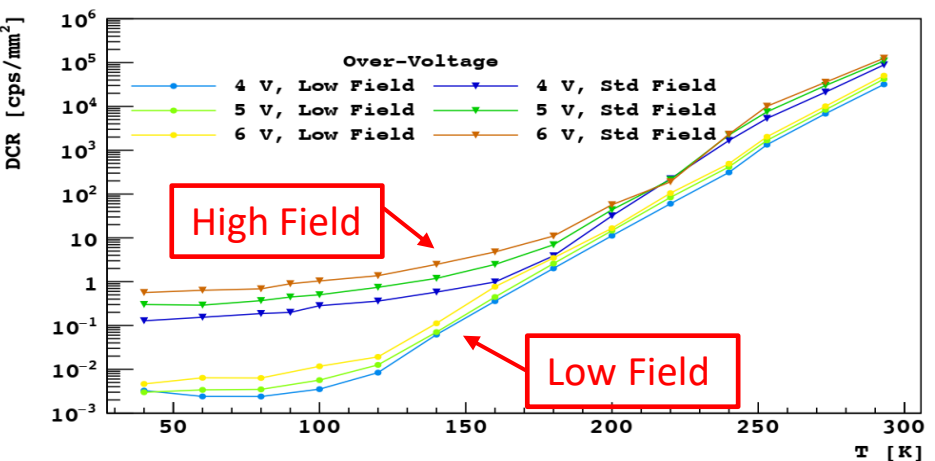
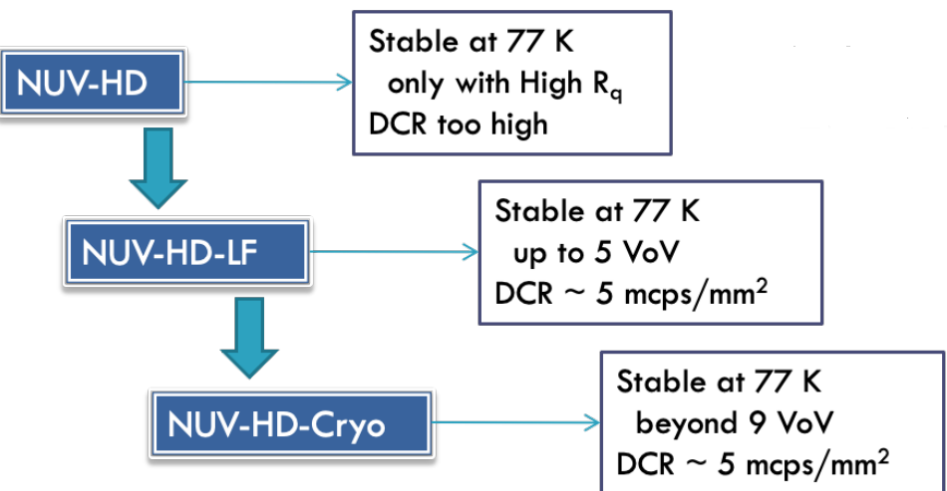
- Large area cryogenic SiPMs
- Low noise cryogenic electronics
- Technological transfer for photosensor massive production

TPC Optical Plane  
21 m<sup>2</sup>

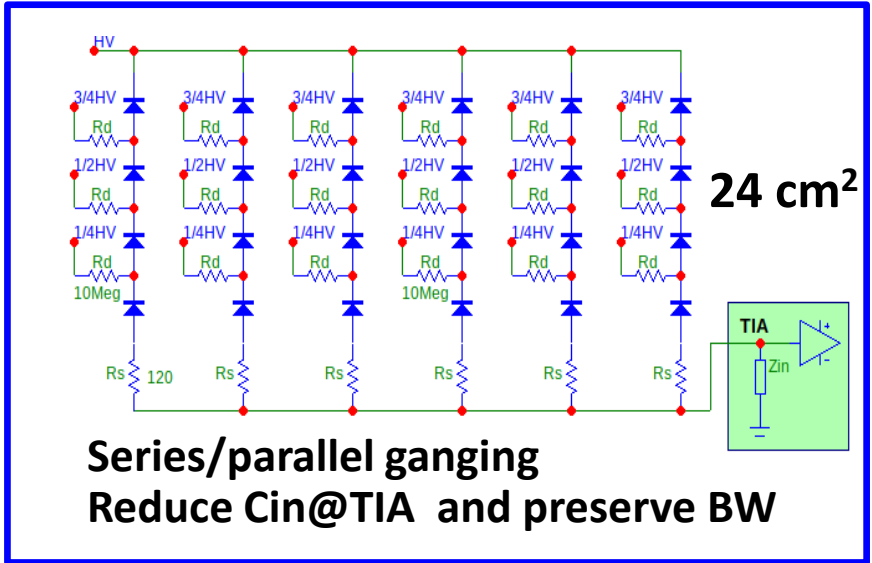
DarkSide-20k top and bottom planes equipped with 528 PDUs

# STEP 1 SiPM development

Custom cryogenic SiPMs developed in collaboration with Fondazione Bruno Kessler (FBK)

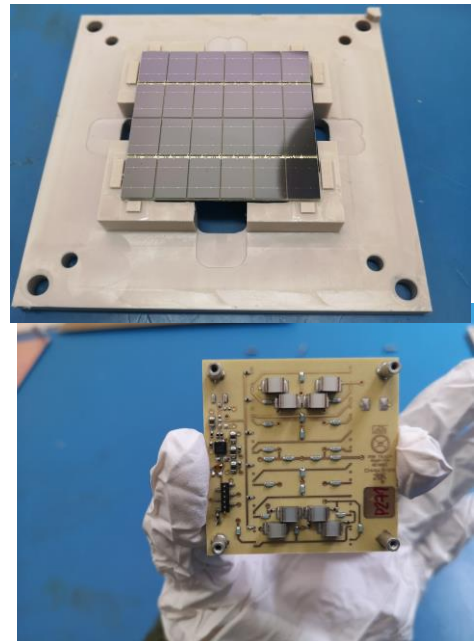


# STEP 2 Electronics design

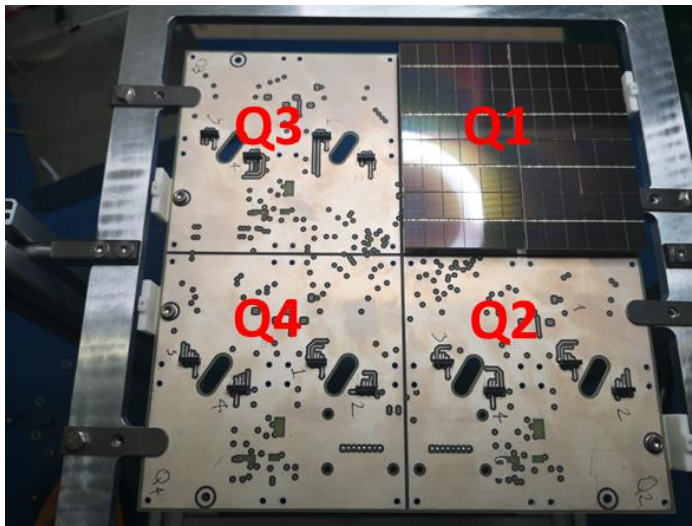


SiPM = current generator + huge output capacitance (~60pF/mm<sup>2</sup>)  
**Transimpedance amplifier (TIA)**  
**High Bandwidth and Low Noise**

4 PDMs readout as a single analog channel

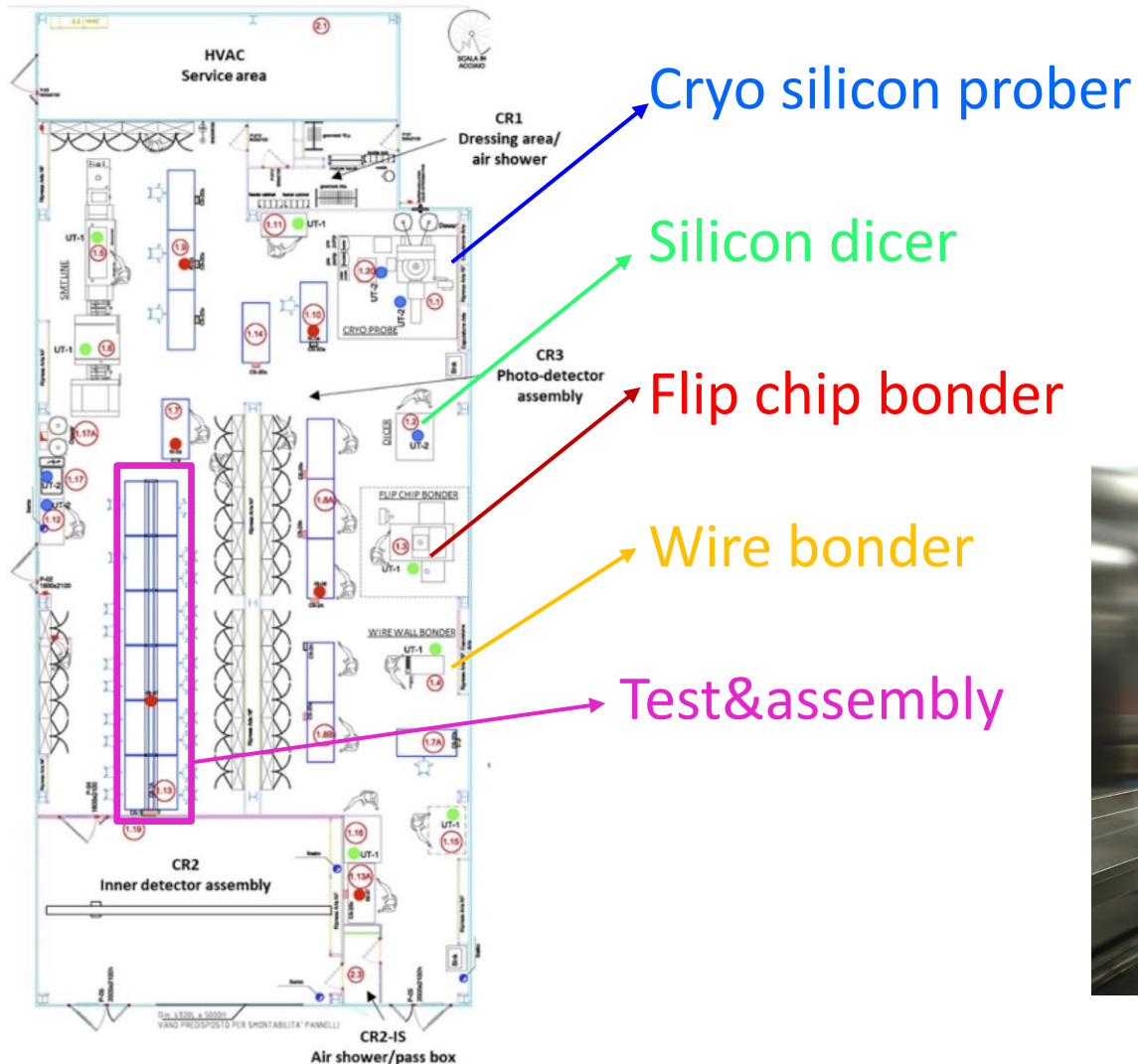


TILE + 1 TIA  
 ↓  
 Photo Detection Module (PDM)



# STEP 3 NOA clean room

420 m<sup>2</sup> clean area in LNGS (PON/RESTART Regione Abruzzo) for packaging, test and assembly of SiPM-based detectors



- Cryoprobe installed and wafer test started.

- Flip chip bonder final installation foreseen by November 2022



# Milestones & perspectives in NOA

- A unique infrastructure enhancing the high-tech capability INFN LNGS
- Support for integration of large arrays of radiopure SiPM-based photodetectors
- Start up operations in the beginning of 2023

## DarkSide-20k PDU assembly (2023-2025)

## Photo Detection Unit prototype

## What's Next?

- Production and test of photo-detectors for low background experiments.
- Start a network of collaborations to share laboratories and infrastructures

