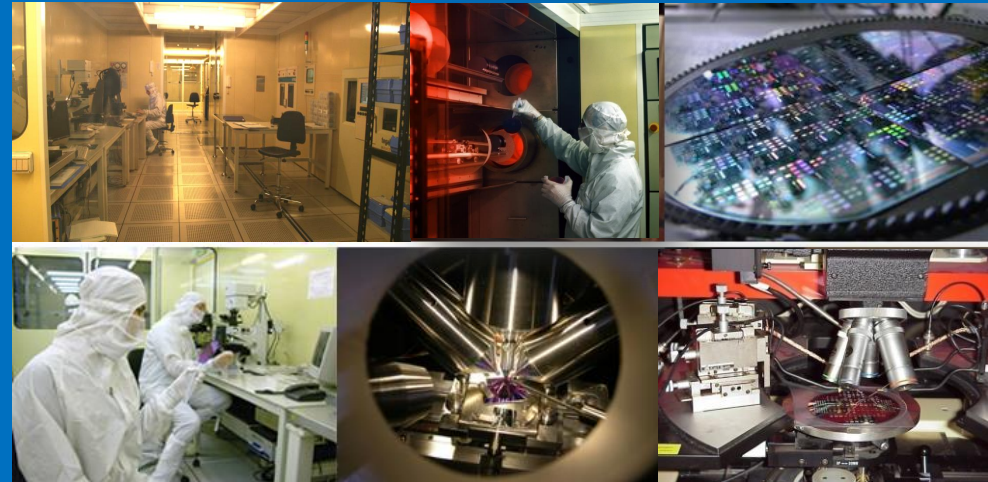


Microtechnologies for Space Applications at MTLab Facility of FBK-CMM

P. Bellutti – MicroTechnologies Lab

<http://mtlab.fbk.eu/en/home>

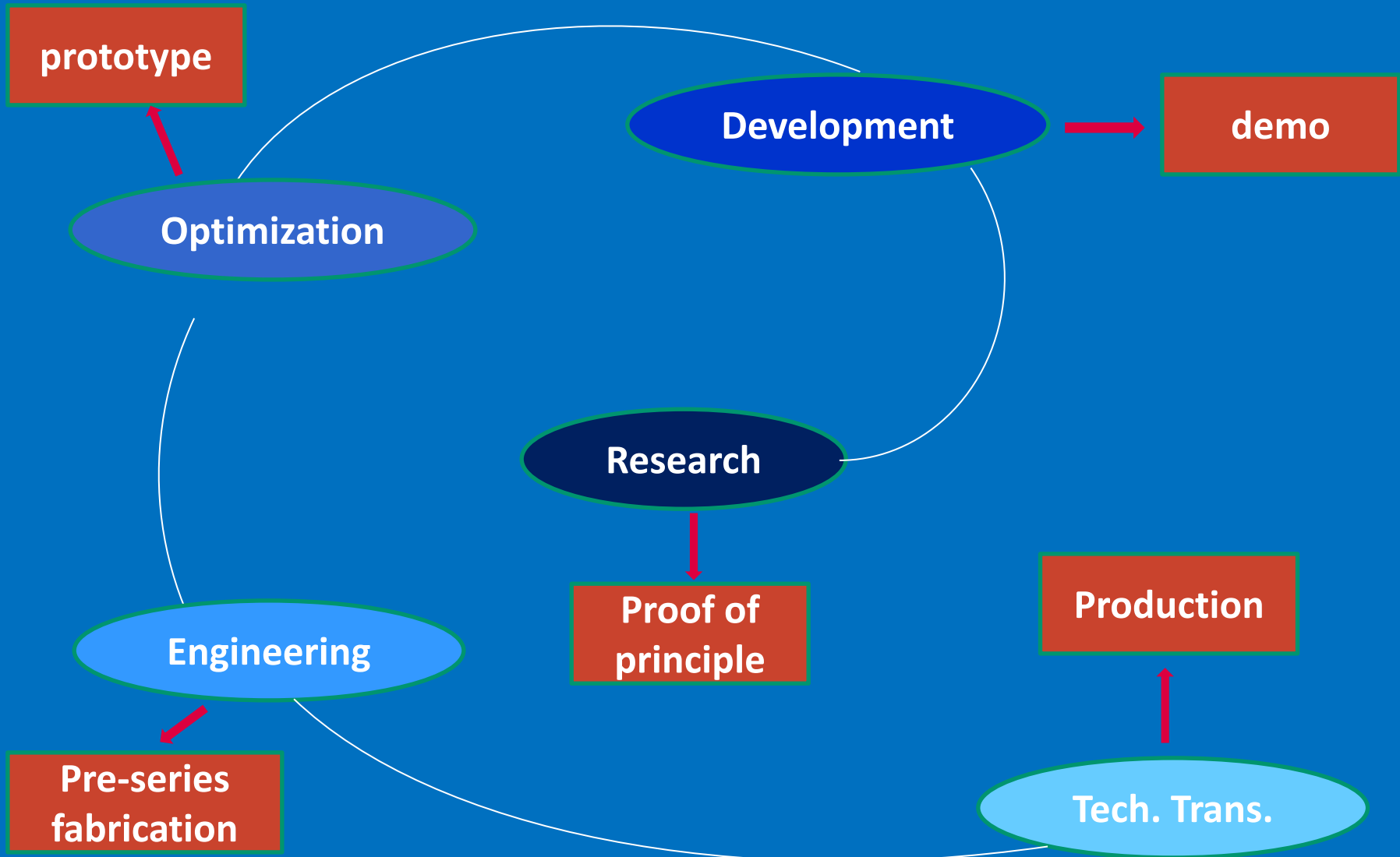
INFN-Space/3
Frascati 19/09/2013



Microtechnologies Lab Facility

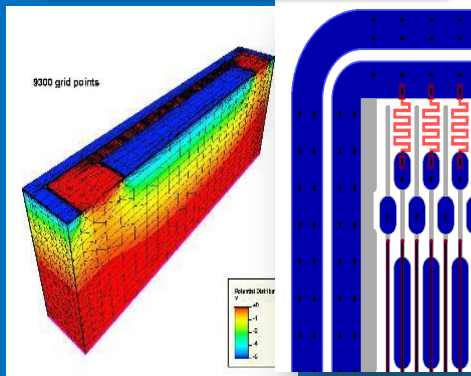
Nationwide, the **MTLab Facility** is the only Public Research site currently providing at the same Location such extensive MOS, MEMS and advanced Radiation Detection R&D and Manufacturing Capabilities, **open to both Industrial and Institutional Partners.**

MT Facility – Innovation model @ CMM



Silicon Facility Expertise @CMM

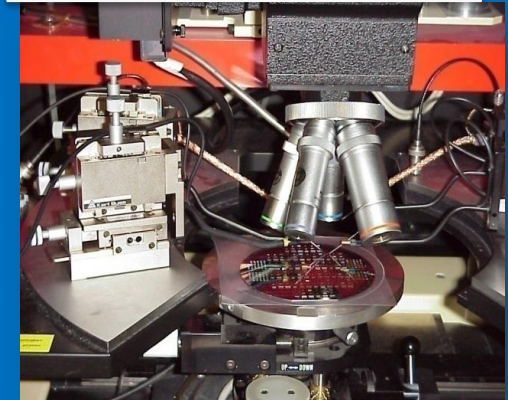
TCAD simulation
CAD design



Fabrication



Device testing

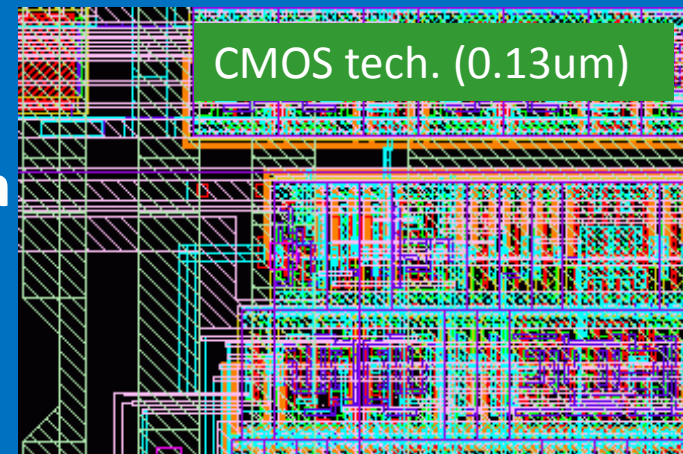


Material Characterisation:

- XPS
- SIMS
- ToF-SIMS
- TXRF
- AFM
- SEM

Custom CMOS design

Development of ROIC by exploiting state of the art CMOS tech (external services)



MT Facility: MicroFabrication Area

Two separate clean rooms

- 500m² of «derectors» clean room (class 10-100)
- 150m² of clean area (class 100-1000) equipped for MEMS technology

6 inch wafers (Si, Quartz, Glass)



Employees

7 Researchers

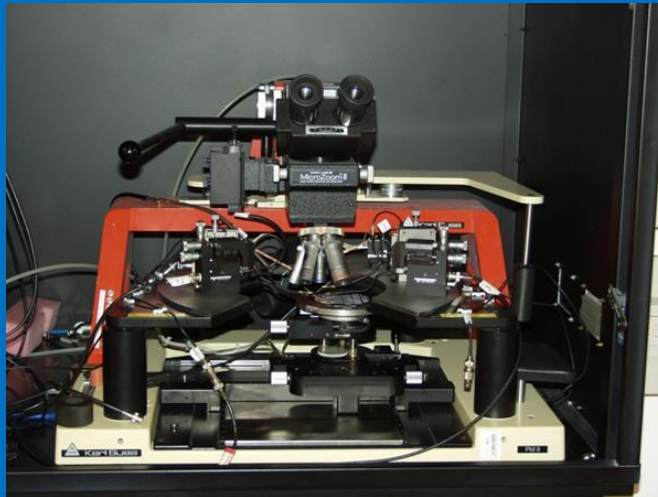
9 Technicians

Planar processing capacity : 4000 moves/week (on one shift)

MT Facility: Testing Area

Four labs

- 20m² for manual parametric testing (2 probers)
- 15m² for solar cells qualification
- 60 m² for automatic parametric/functional testing (4 probers)
- 20 m² optical testing



Employees

2 Researchers

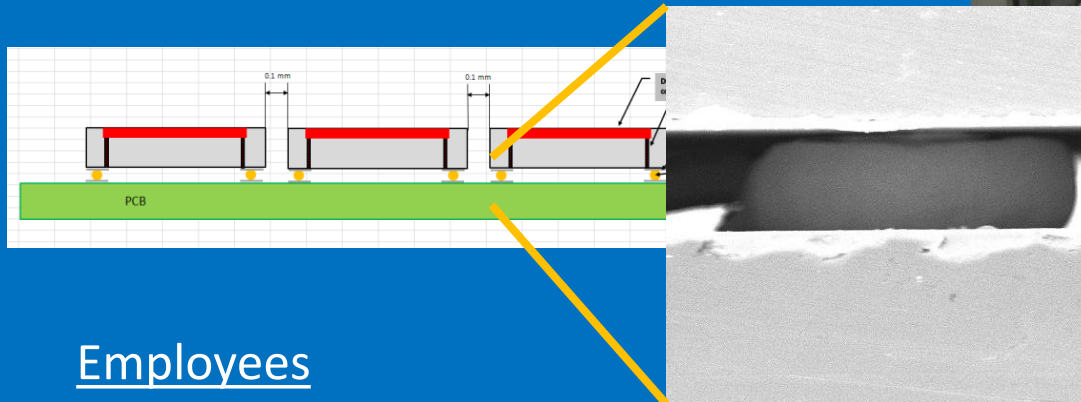
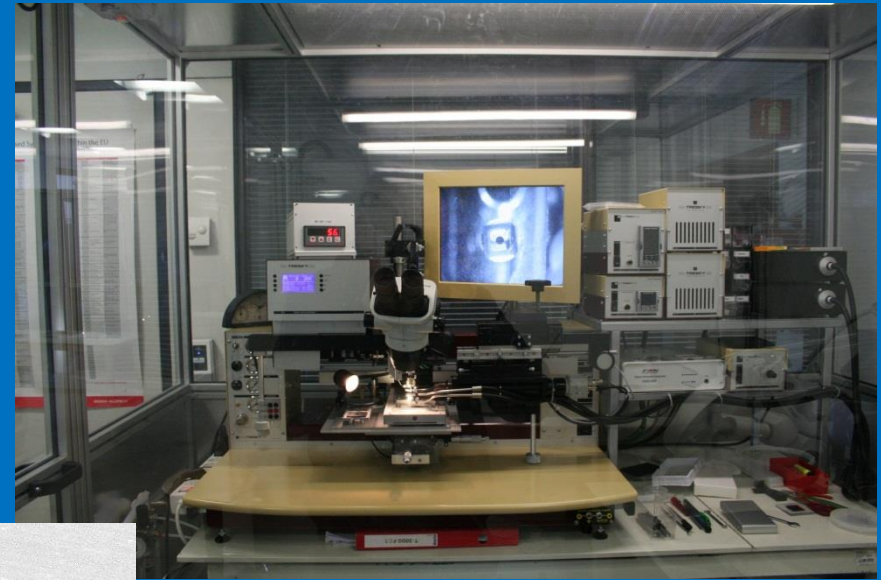
3 Technicians

Testing capacity : 12000 hours/year

MT Facility: Microsystems Integration Area

40m² devoted to:

microassembly,
bonding,
micromilling/drilling
screen printing



Employees

1 Researcher

1 Technician



Devices for Space Applications

@ a glance

Production of Microstrip Detectors Technology

AMS experiment (@ISS)

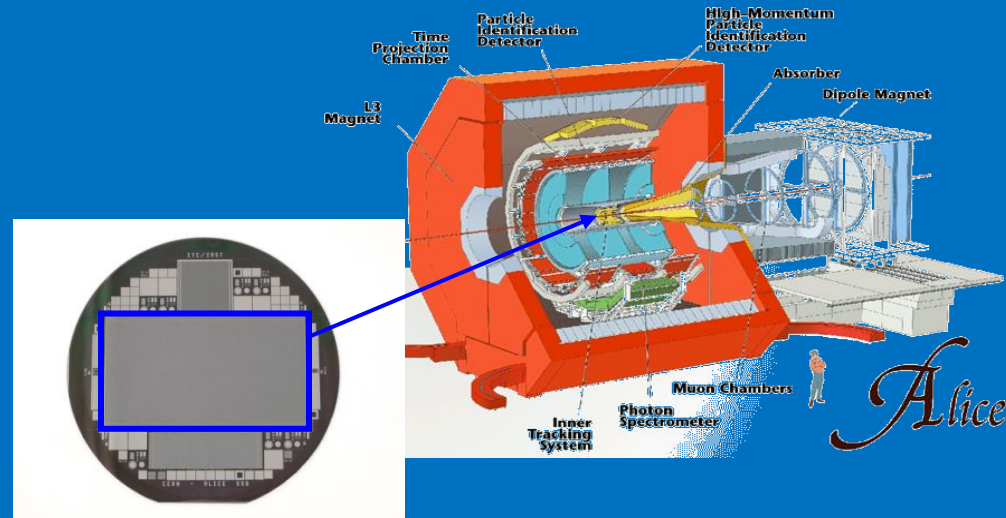


Detector characteristics:

- Area: $7.2 \times 4.2 \text{ cm}^2$
- **double-sided** with orthogonal strips

700 in spec detectors produced

ALICE experiment (@CERN)



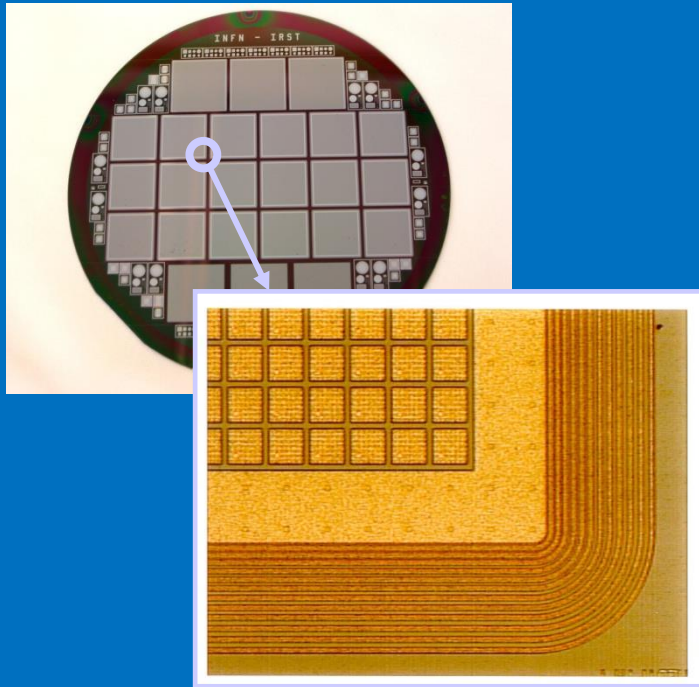
Detector characteristics:

- Area: $7.5 \times 4.2 \text{ cm}^2$
- **double-sided** with strips slightly tilted
- AC coupled

600 in spec detectors were fabricated
ALICE Industrial Awards in 2006

Pixel Detectors Technology

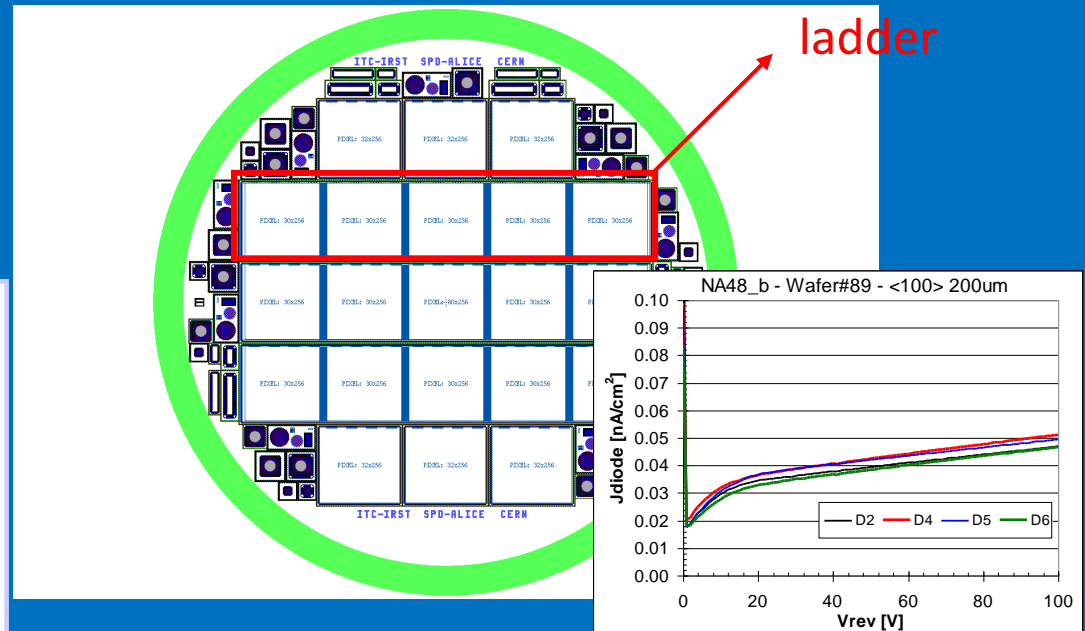
Medipix 1&2



- Medipix1: pixel size $170 \times 170 \mu\text{m}^2$
- Medipix2: pixel size $55 \times 55 \mu\text{m}^2$

Substrate thick.: up to 1.5mm

NA48/ALICE experiment



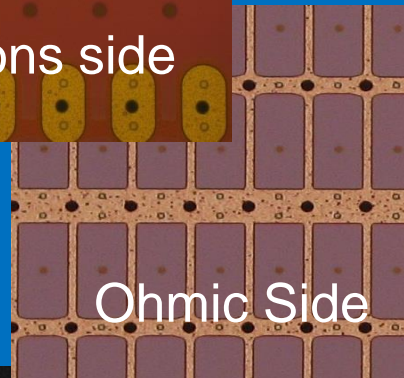
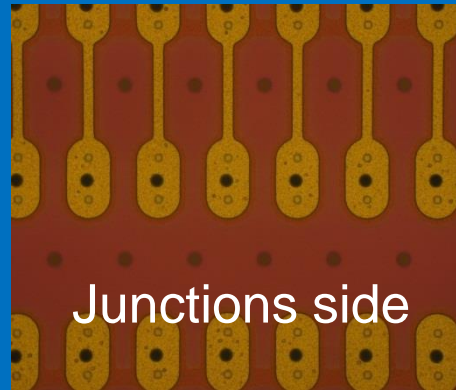
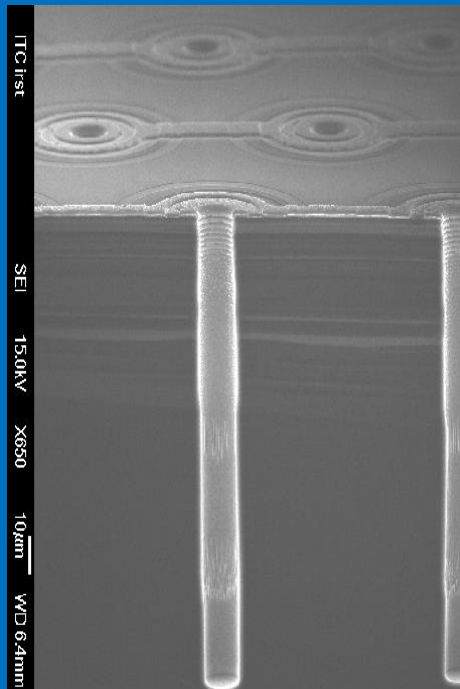
- ALICE SPD layout
- pixel size $50 \times 400 \mu\text{m}^2$

Substrate thickness: 200um

300 ladder produced
(2006-2007).

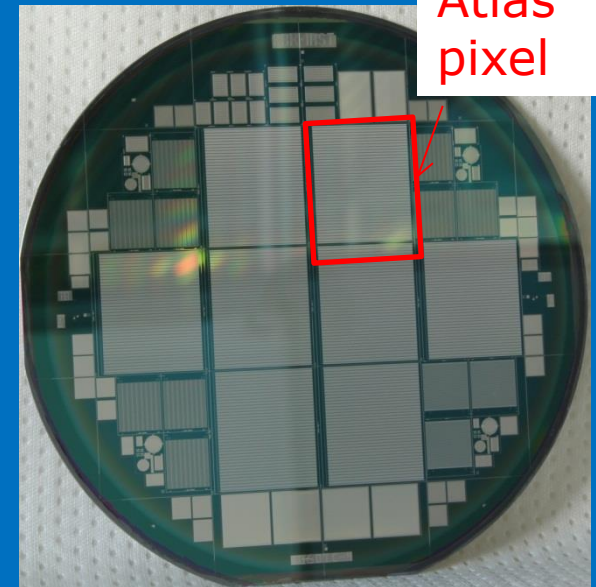
3D-Detectors Technology

- Ultra radiation-hard silicon particle detectors for future high-energy physics experiments
- Based on columnar electrodes (Pass through columns)



FBK has provided Si-3D pixel detectors for ATLAS IBL

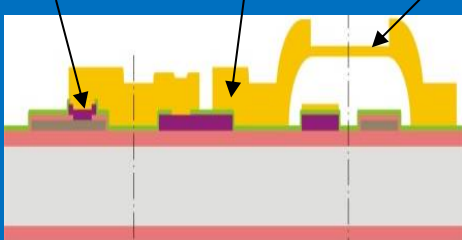
FE-I4
Atlas
pixel



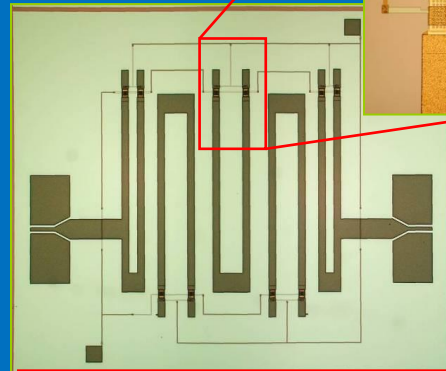
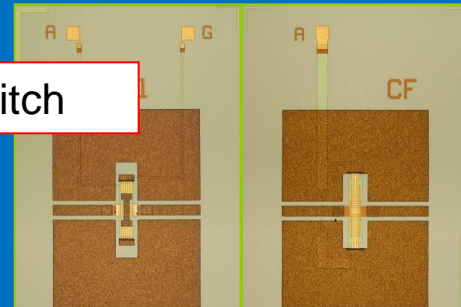
RF-MEMS Platform

ESA / Alenia

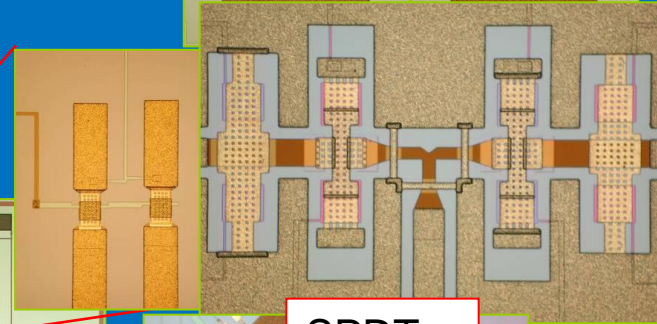
Resistor capacitor Bridge



Series Switch

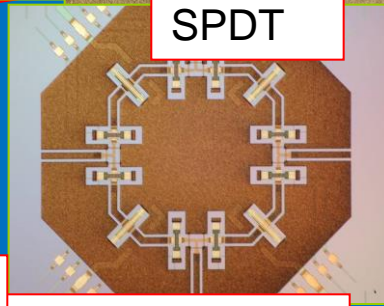


Reconfigurable
Hairpin Line Filter



SPDT

2 x 2 Matrix



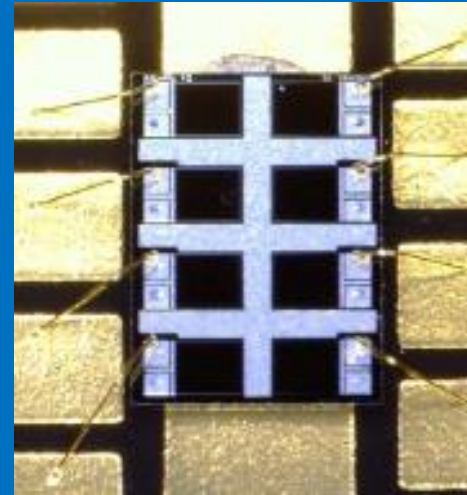
Phototransistors

In three different contracts

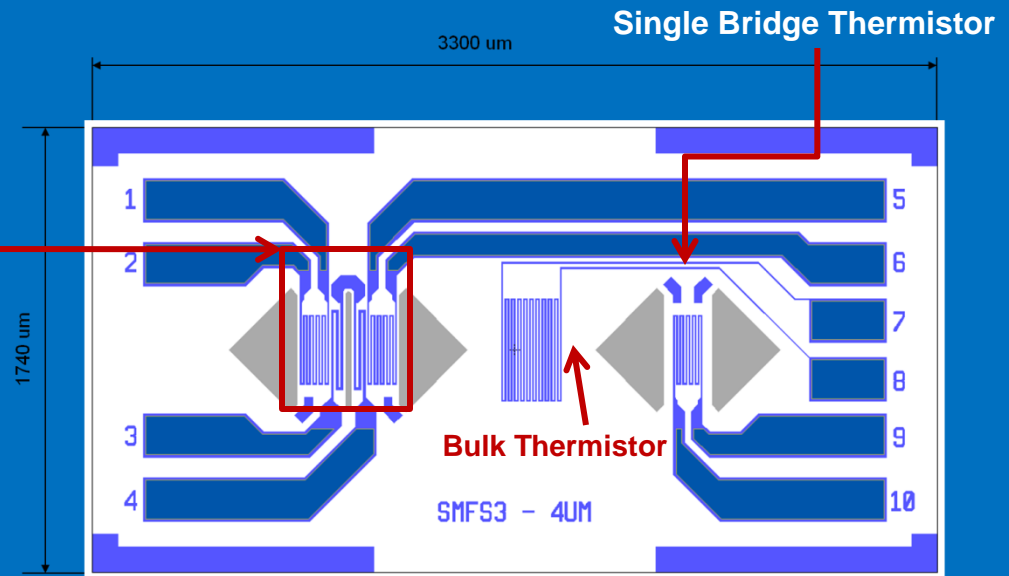
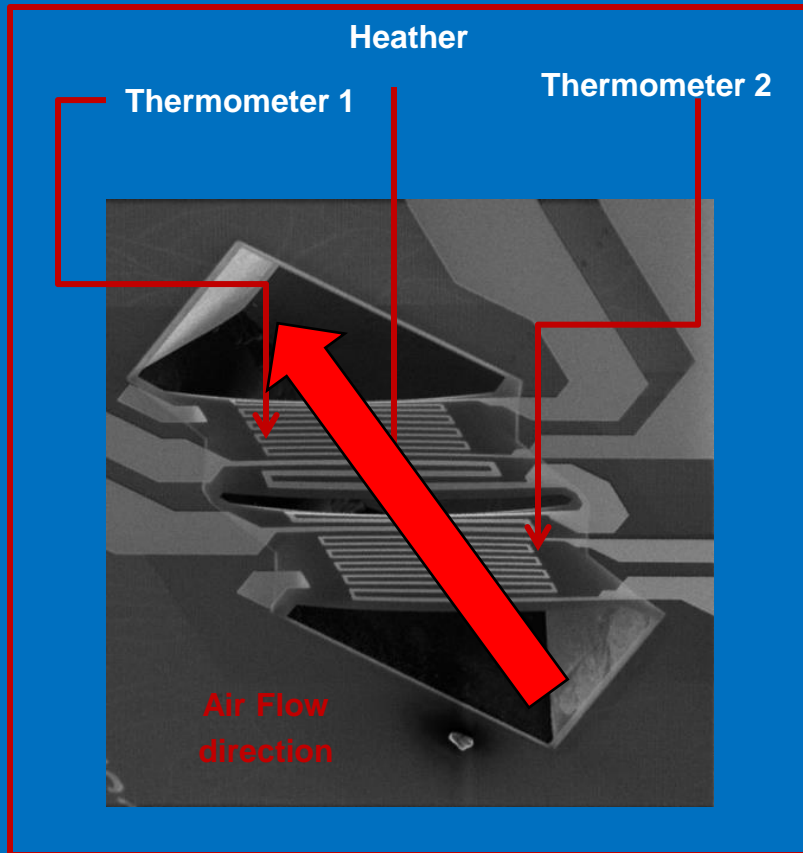
- CNES
- ESA (optocoupler)

ESA Contract No.
4000102425/10/NL/NR

- ASI

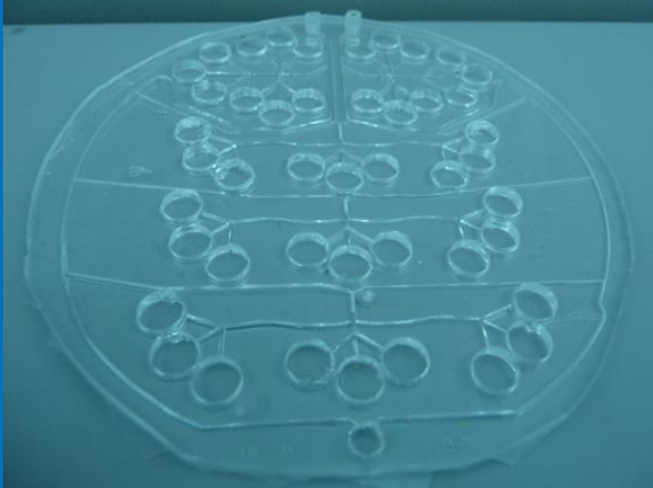


Mass Flow Sensors for Cold Gas Microthrusters

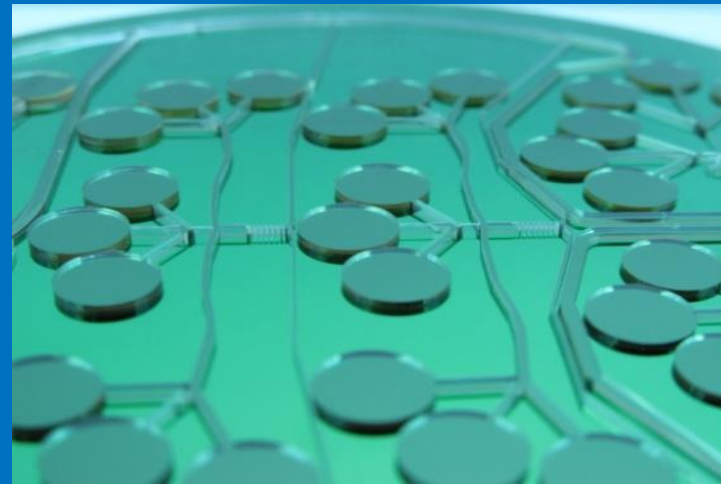


Thales Alenia Space
for GAIA/LISA Pathfinder

Miniaturised Multi-parameter Cell Analysis

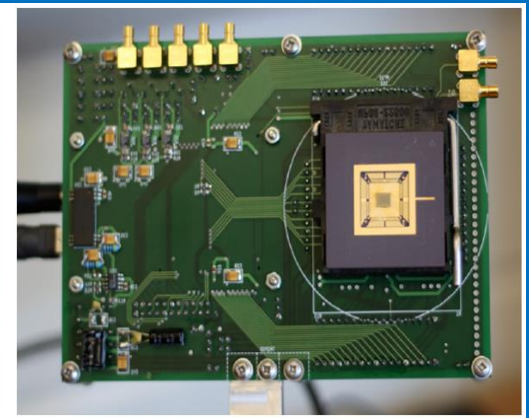
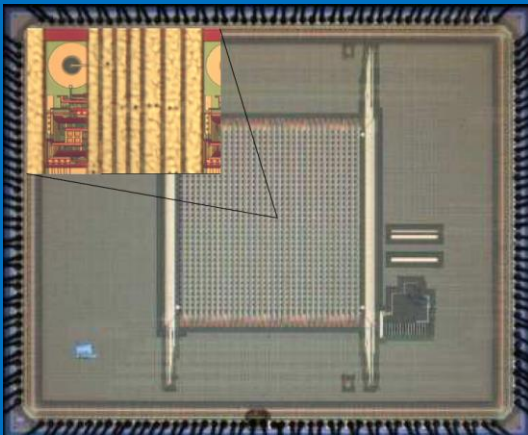


ASI Astralab

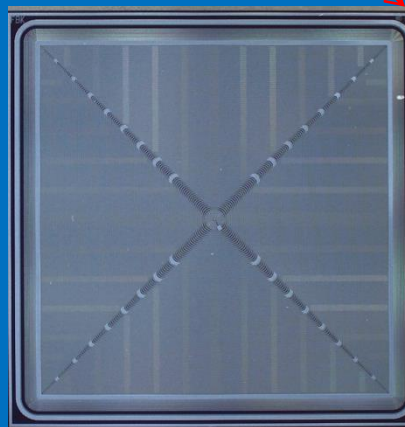
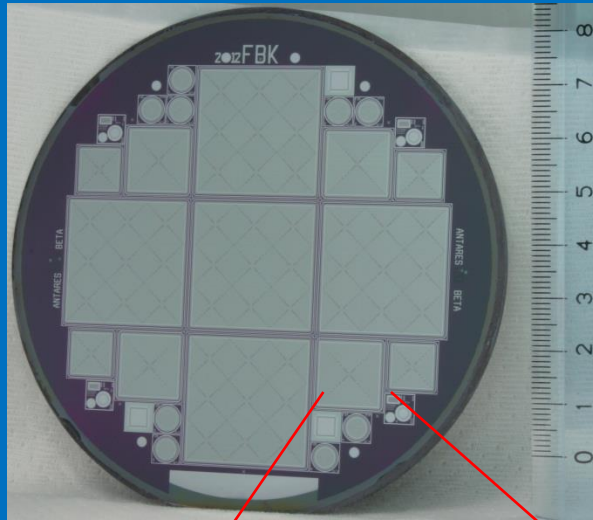


MILS ESA Project: CSEM, FBK, Astrium, LZH, EPFL

- FBK was technology provider of SPAD-based CMOS imager for LIDAR
- Different technologies have been assessed (CMOS PMD vs CMOS SPAD, micro mirrors)
- SPAD-based solution was demonstrated to be the best candidate for rendezvous and landing

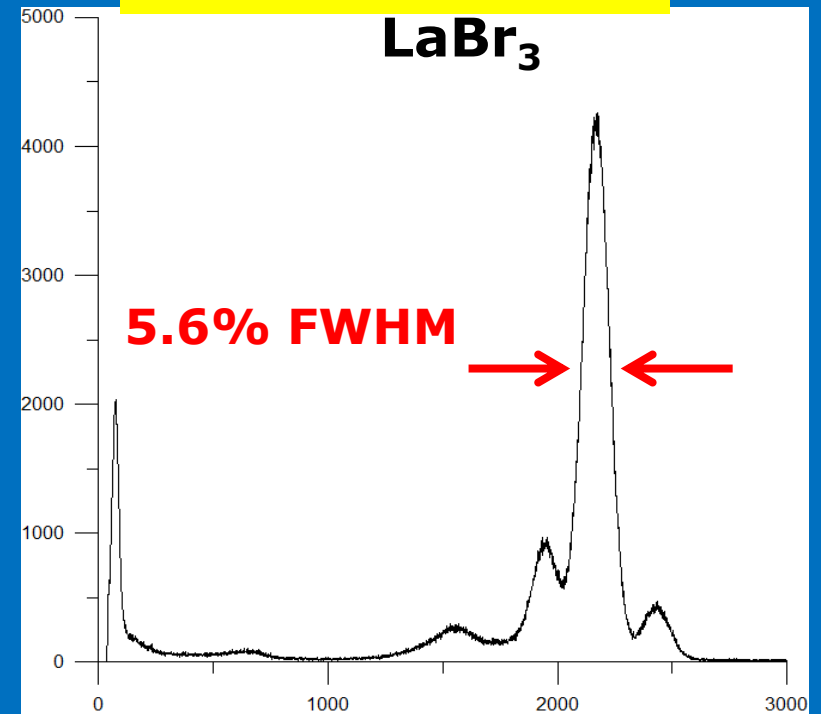


Silicon Drift Detectors



8x8 mm²

ESA Contract No.
4000102940/11/NL/NR



Gamma-ray spectrum of ⁵⁷Co

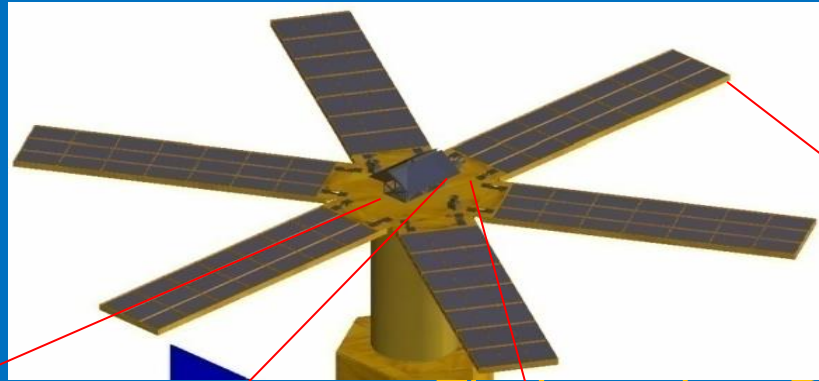
LOFT (Large Observatory For x-ray Timing)

Science: high energy astrophysics - state and nature of matter in ultradense (supra-nuclear) conditions (Equation of State of NS); behaviour of matter under strong gravitational field (General Relativity close to BH) and ultrastrong magnetic field; multi-purpose general observatory (high energy resolution combined with 10-m² effective collecting area).

Enabling Technology: large-area Silicon Drift Detectors (INFN-LHC-ALICE heritage, FBK SDD technology development since 2009, INFN-FBK Loft dedicated development since 2011) enable to deploy 18-m² of X-ray detectors in space

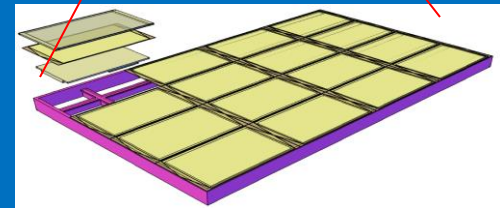
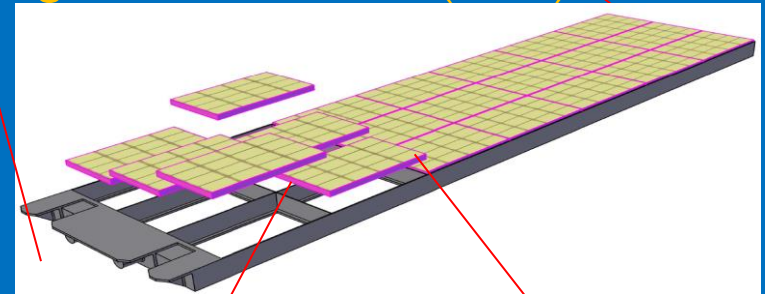
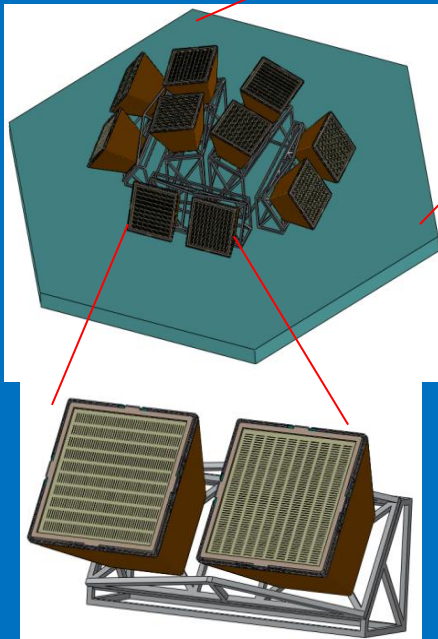
Scientific Consortium: Italy (PI), UK, France, Germany, Switzerland, Spain, Denmark, Finland, Poland, Czech Rep., USA, Japan, Brazil, India

In Italy: ASI, INAF, INFN, Universities; FBK to produce SDDs, TAS-I running for Prime contractor



The Wide Field Monitor (WFM)

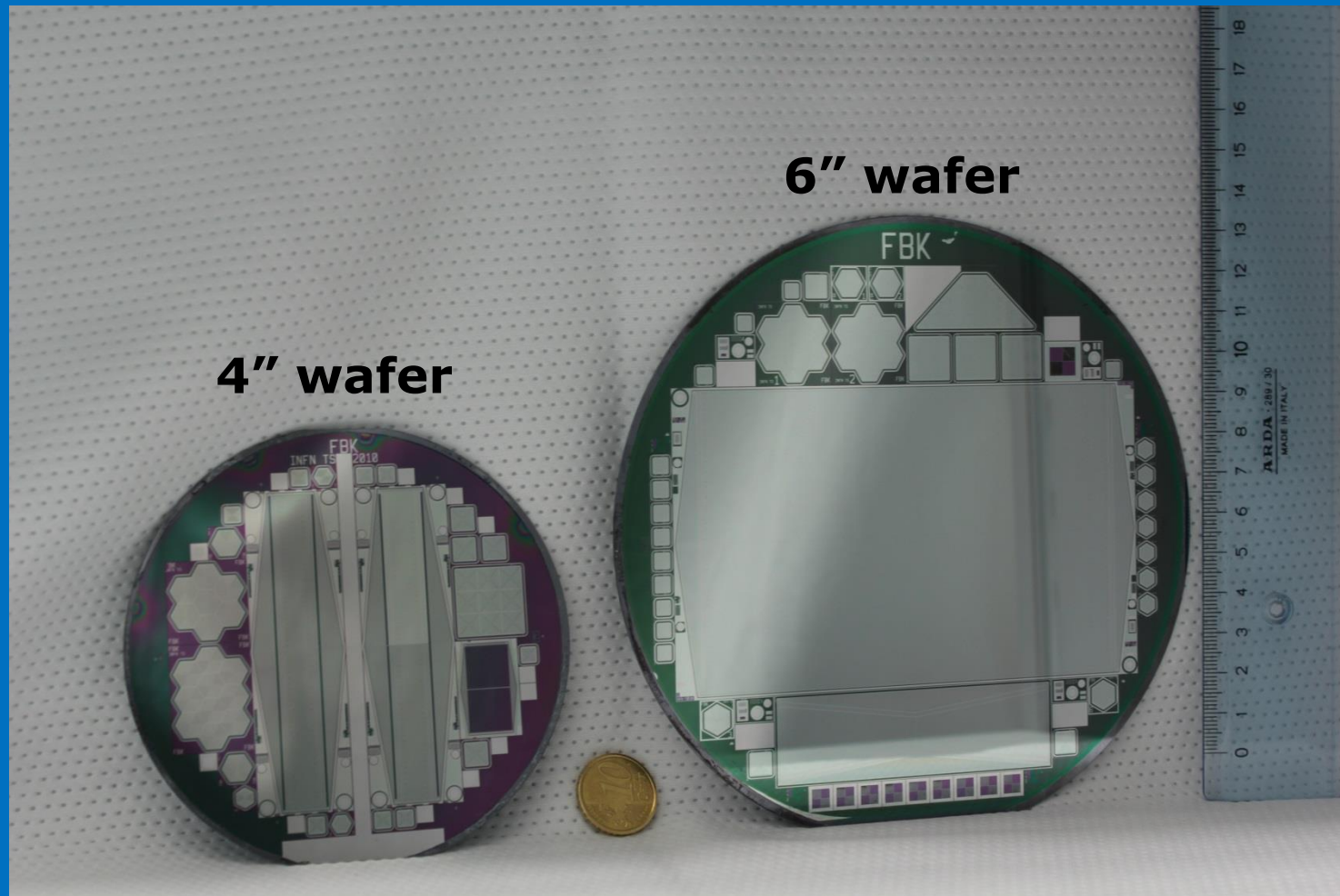
The Large Area Detector (LAD)



Driving technology:
FBK / INFN Trieste
Large-area
Silicon Drift Detectors

WFM FoV covers >50% of the LAD-accessible sky at any time, in the 2-50 keV energy range

- Fully modular/redundant by design (126 independent modules)
- fine detector segmentation (5×10^5 read-out channels, 0.3 cm^2 each)

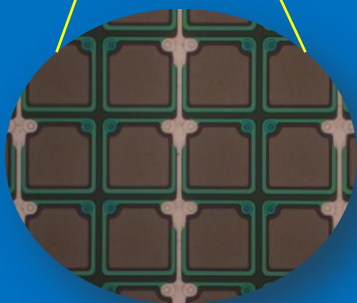
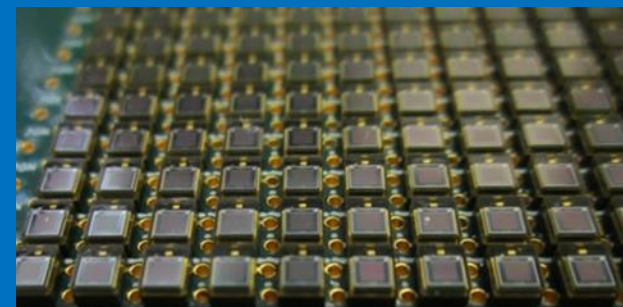
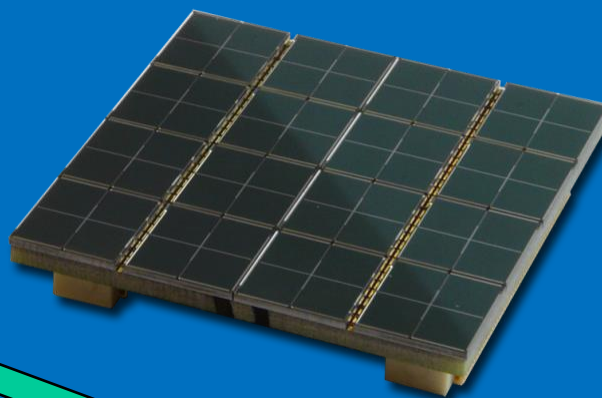
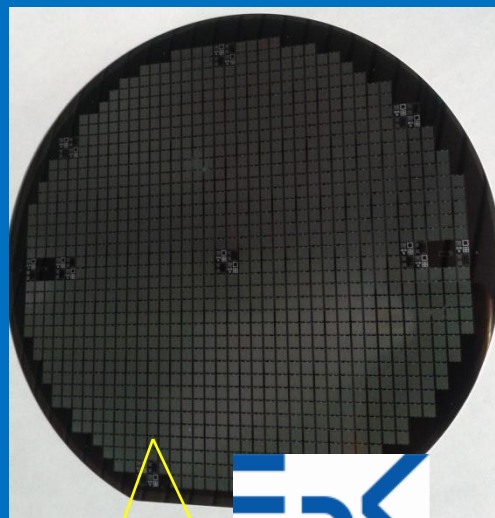


4" wafer

6" wafer

Silicon Photomultiplier Technology

For calorimetry

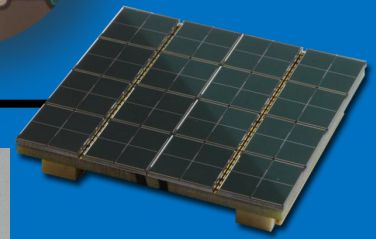
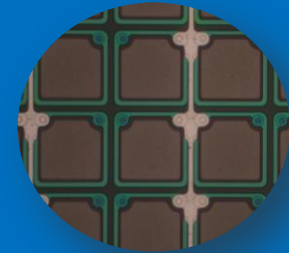


AdvanSiD
Advanced Silicon Detectors

SiPM Tech. Road Map

1st generation
2006 - 2010

Original technology



2nd generation
2010 - 2012

RGB-SiPM
(Red-Green-Blue SiPM)

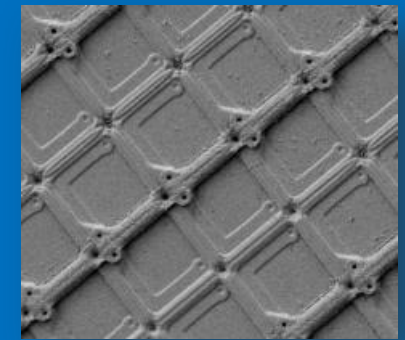
NUV-SiPM
(Near-UV SiPM)



3rd generation
2012 -

RGB-SiPM_HD
(Red-Green-Blue SiPM - high density)

NUV-SiPM_HD
(2014)





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IN THE FOLLOWING OPERATIONAL UNITS

MTLAB

VIA SEMMARIVE, 15 - 38122 POVO DI TRENTO (TN) ITALIA

IN COMPLIANCE WITH THE STANDARD

ISO 9001:2008

FOR THE FOLLOWING FIELD(S) OF ACTIVITY

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0A.24
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Emittente Corrente: 28/02/2013
Current Issue: 28/02/2013
Data scadenza: 28/11/2015
Expiry Date: 28/11/2015

Dr. Roberto Corvino
(Managing Director)

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