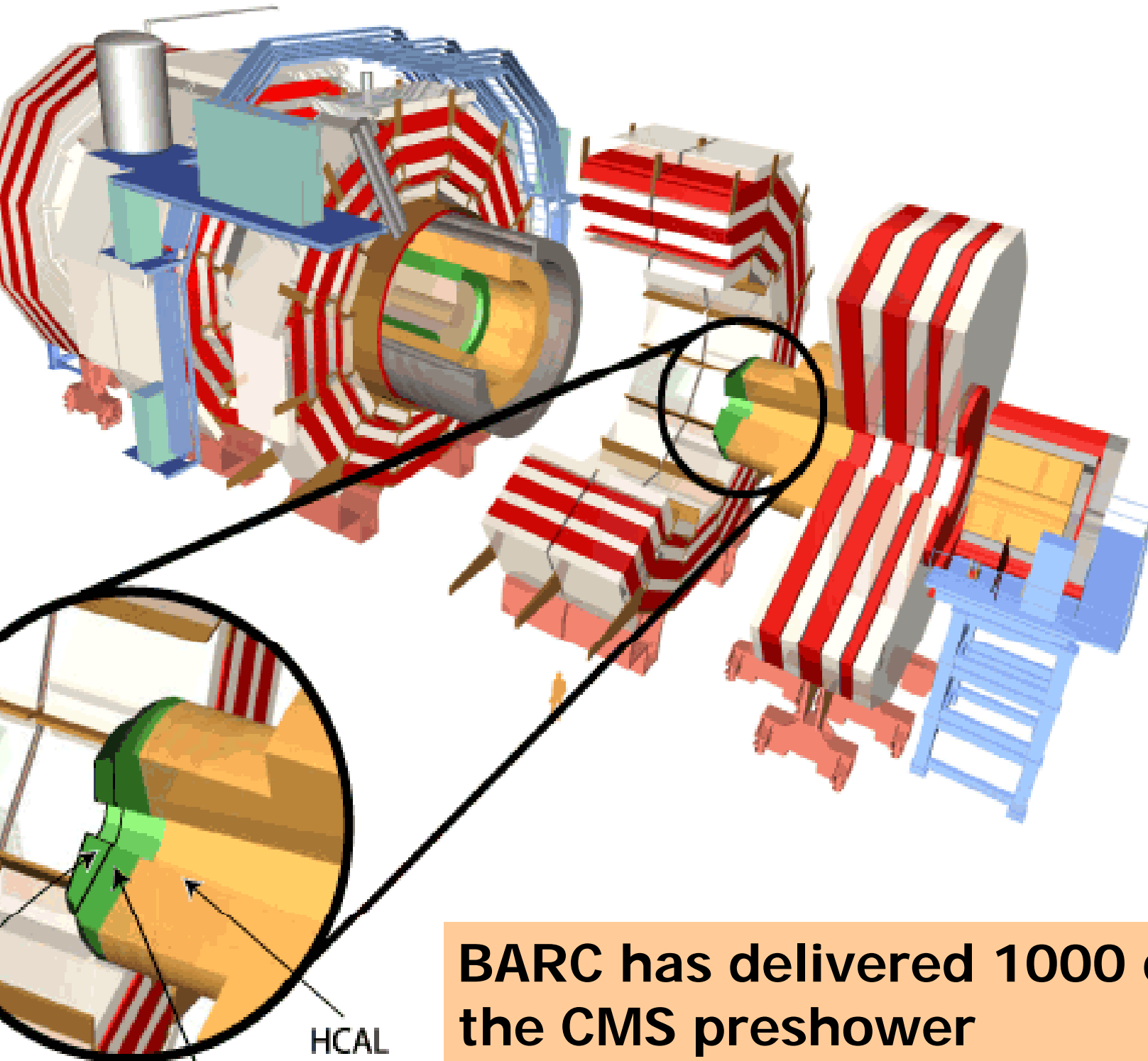


Wafers for CMS Preshower

Anita Topkar,
Bhabha Atomic Research Centre, Trombay
Mumbai, 400 080, India



End caps of detector will have 4300 silicon strip detectors covering area about 17 m²

BARC has delivered 1000 detector modules for the CMS preshower

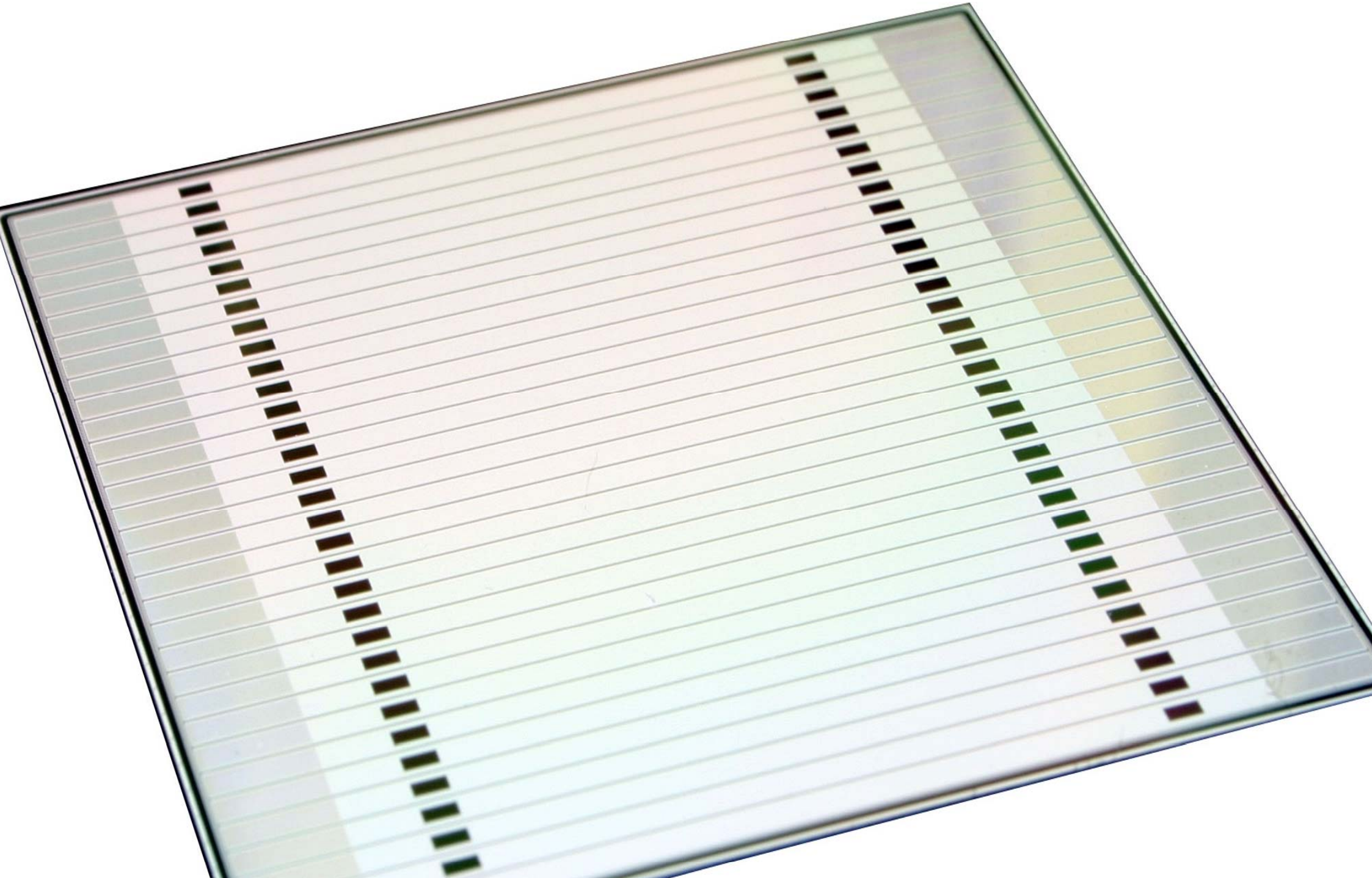
The Freshower Silicon Detector

Geometrical specifications

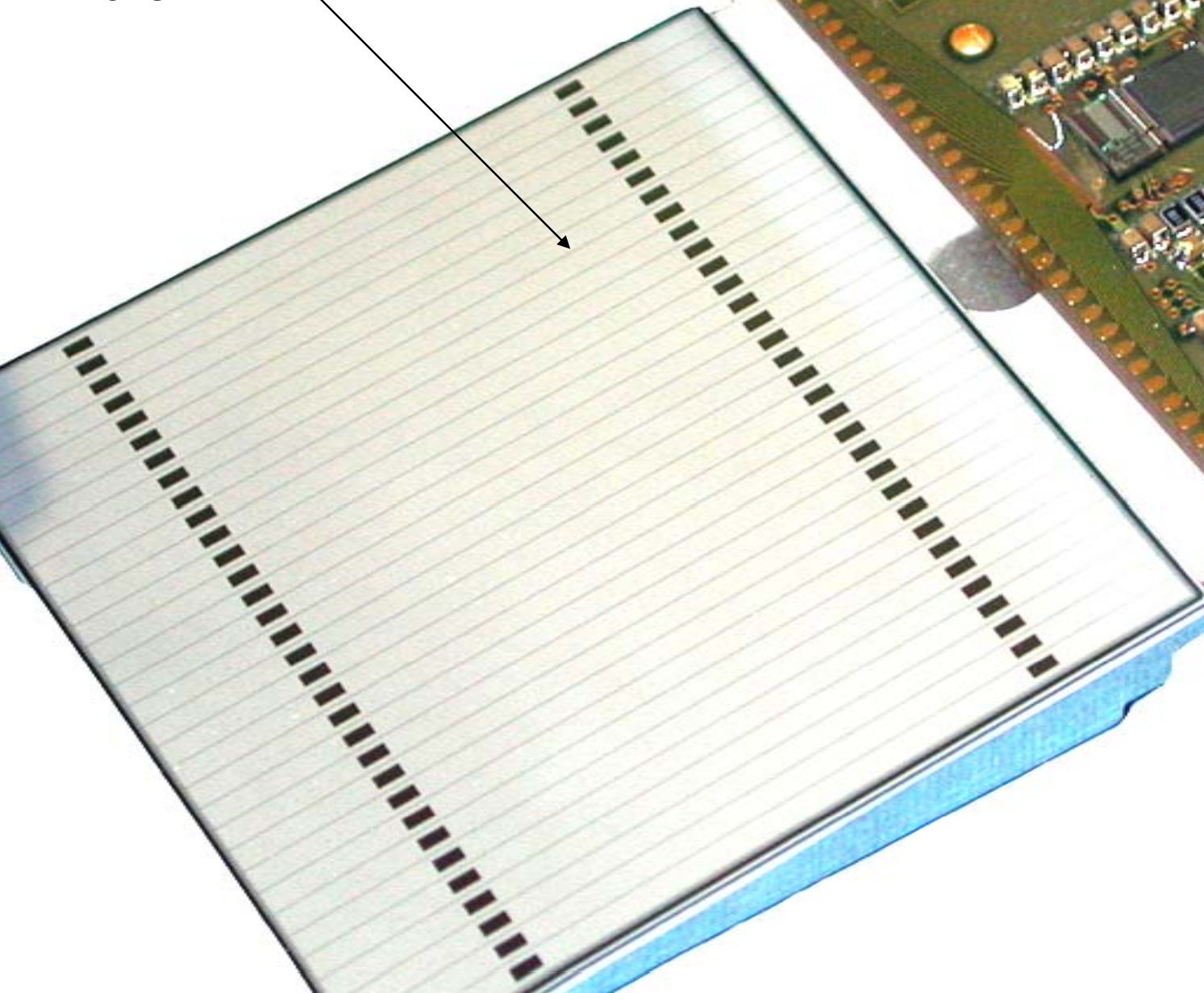
- **Strips of 1.78 mm width with a pitch of 1.9 mm**
- **Area - 63mm x 63mm**

Detector specifications are very stringent as they are to be operated in a high radiation background of neutrons ($2 \times 10^{14} / \text{cm}^2$) & gamma (10Mrad) for a long period of ten years

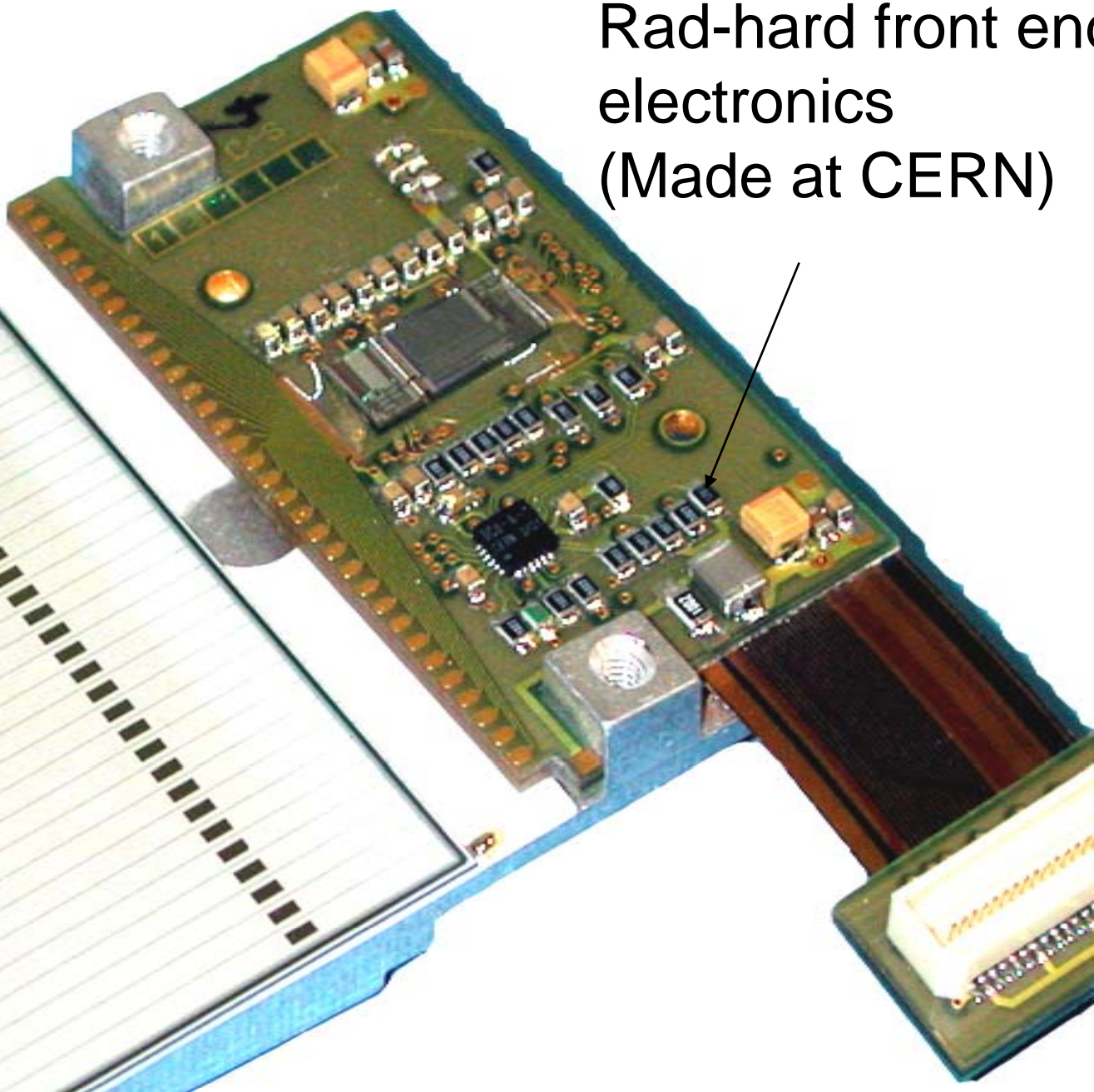
2-Dump Channel Setup



Strip Detector
in India



Rad-hard front end
electronics
(Made at CERN)



Detector Specifications

Electrical

High breakdown voltage

Breakdown voltage for all strips $\geq 300\text{V}/500\text{V}$

Low leakage: Total current of all strips $\leq 10 \mu\text{A}$ at 300V

Uniformity of all strips: Maximum 1 strip with leakage current $> 5 \mu\text{A}$ at 300V

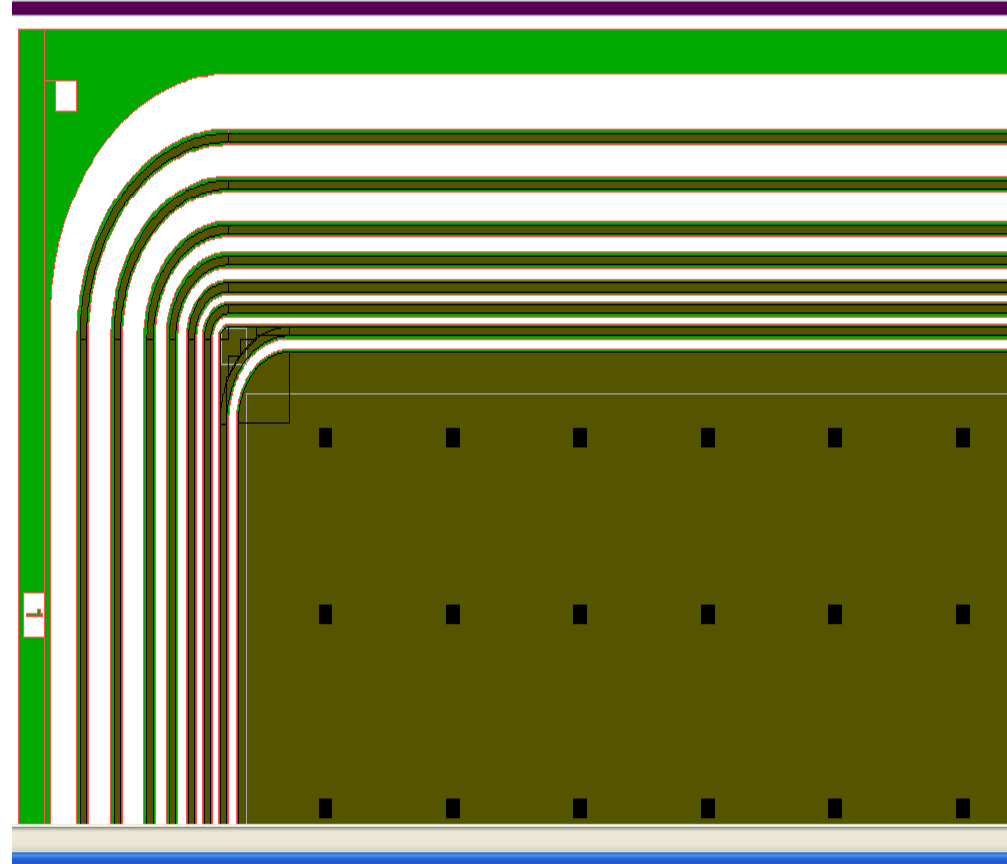
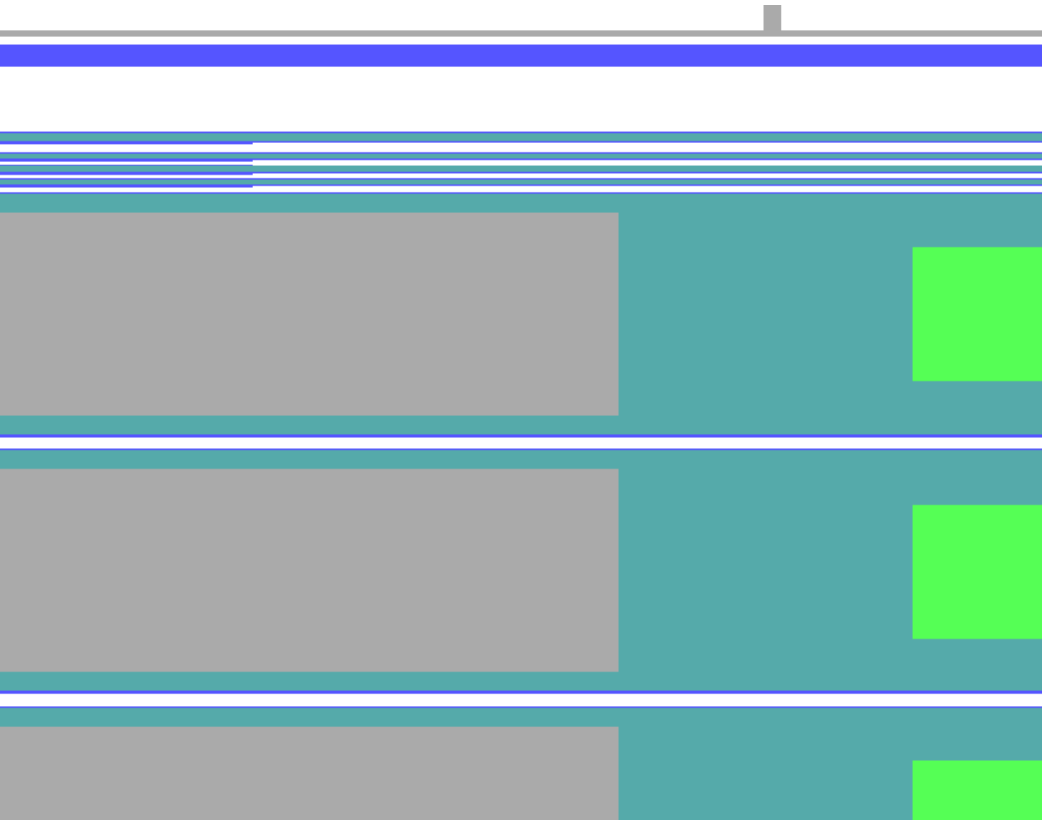
Geometrical

Tight control over dimensions

Length $63.0 \pm 0.1 \text{ mm}$

Detector Design

Design for improving breakdown voltage & reducing the leakage current



0 1 2 3 4 5 6 7 8 9

- **High resistivity <111>, FZ wafers**
- **Ion implanted junctions with oxide passivation**
- **P+ guard rings**
- **Gettering to reduce leakage currents**
- **Aluminum metallization**
- **PSG passivation on the top**

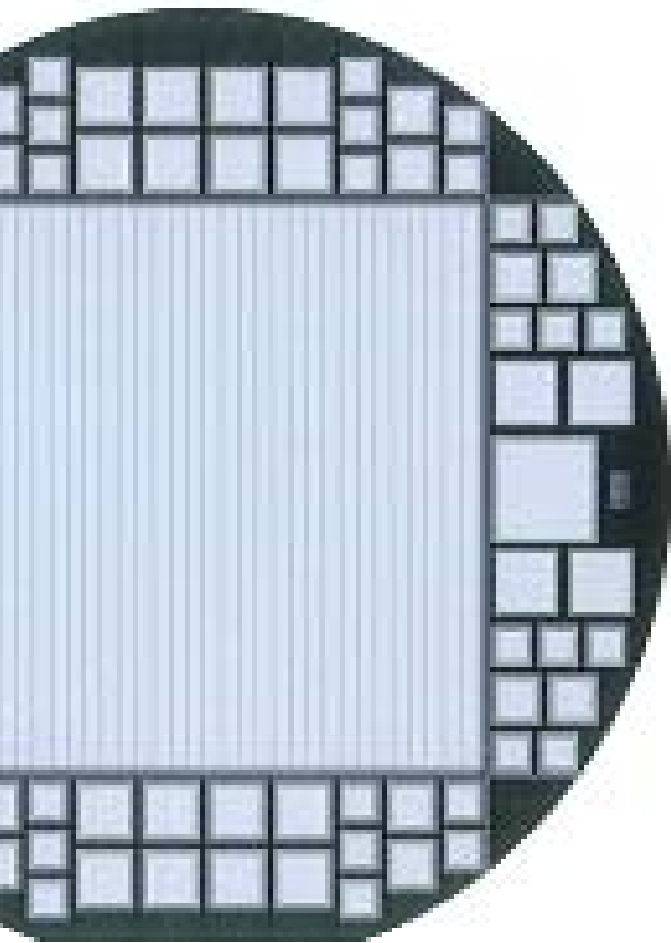
detectors has been developed in India at a bipolar foundry having class '100' clean room

Production of 1000 Nos of silicon detectors has been completed

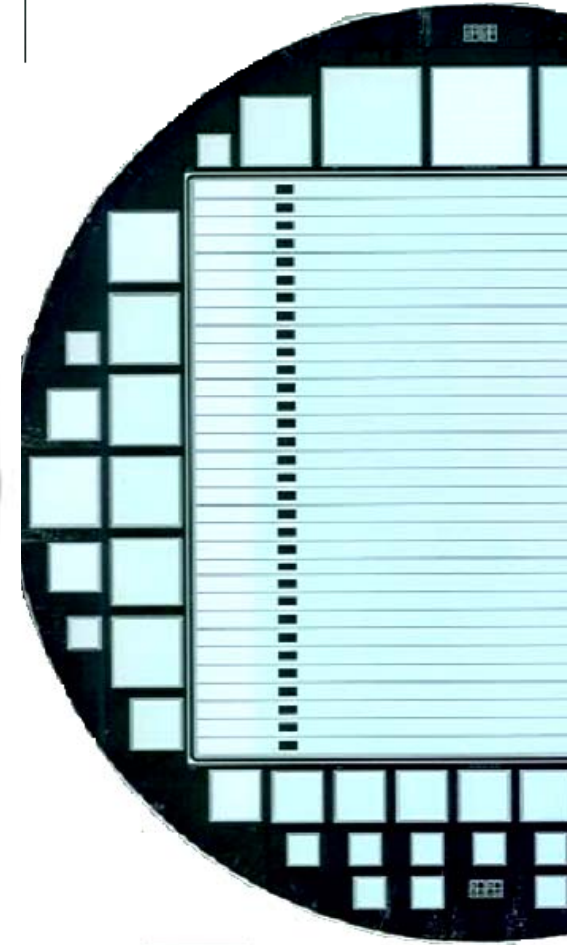
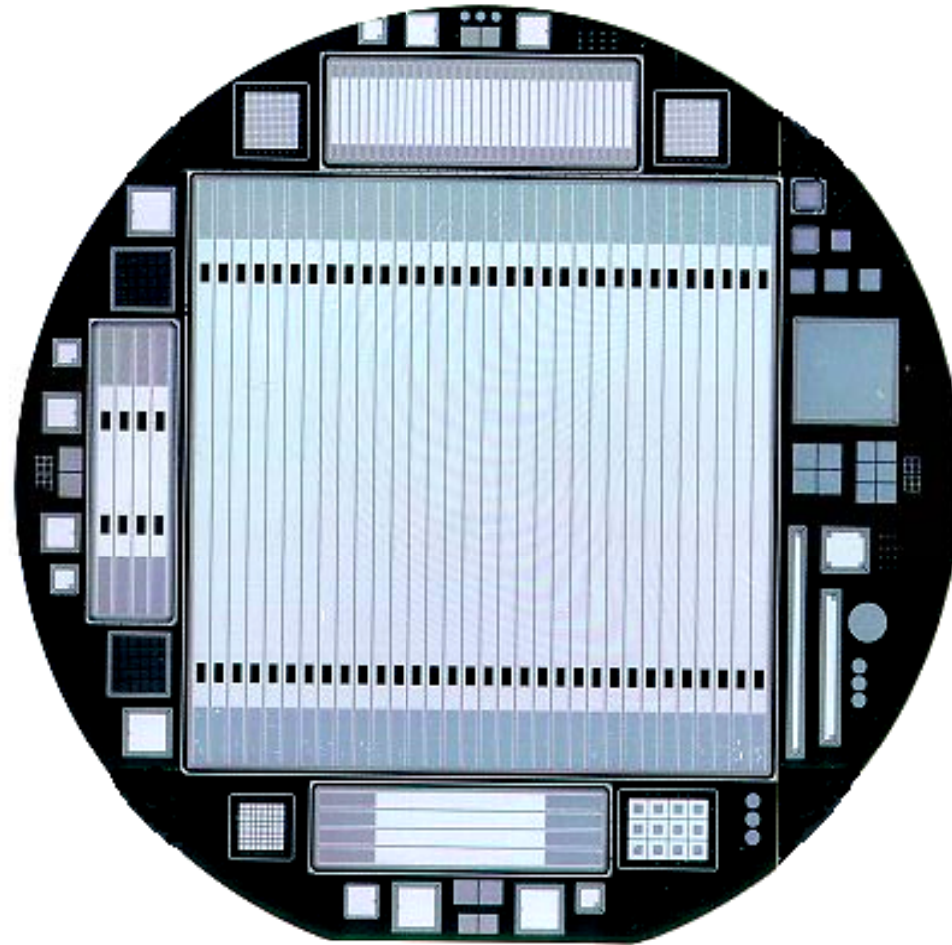
Testing facility was setup in a class '10,000' environment for qualification of detectors through a set of geometrical and electrical tests

Detectors are assembled on ceramic and AlN tiles

Prototype



Preproduction & Production



Characterization of the detector

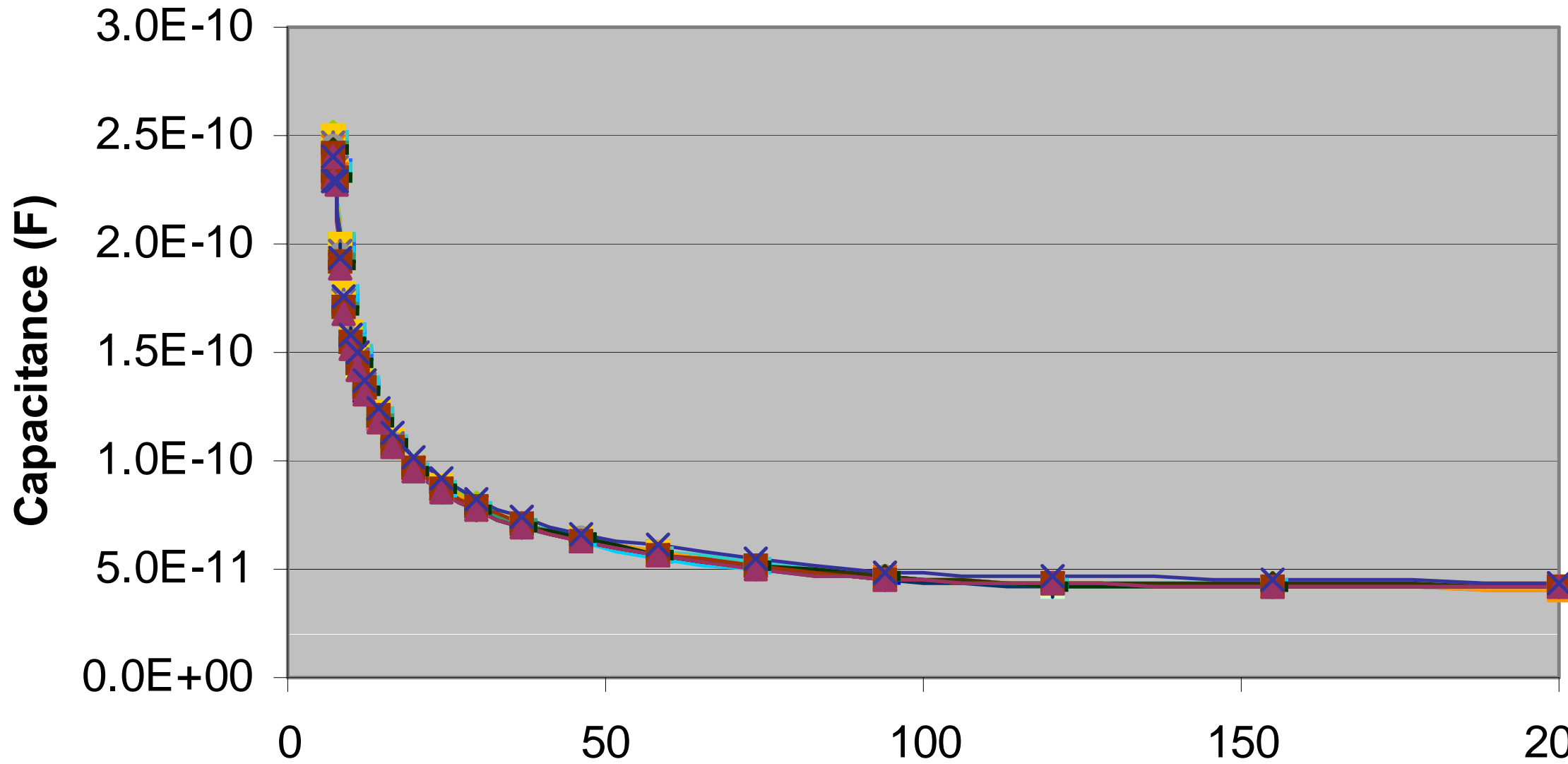
Probe-jigs to make simultaneous contact to the strips

Simultaneous measurement of strip current of 3 strips (IV)

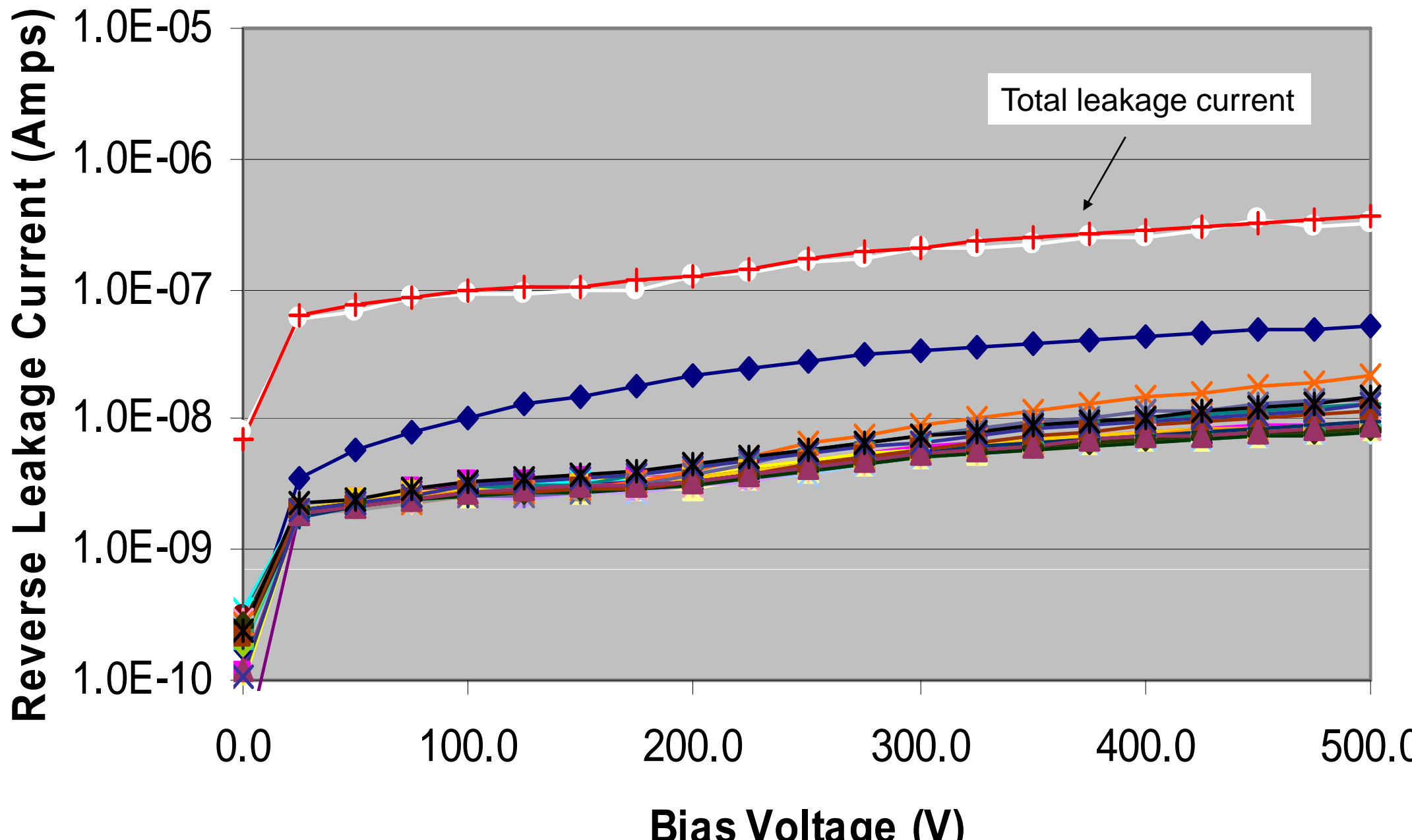
Simultaneous measurement of strip capacitance 32 strips (CV)

Noise measurements

Full depletion capacitance – 45pf/cm²



Average leakage current of the strip is about 10-20nA/cm² at 500V



& at 300V/500V

Static Characteristic for
33304010000027

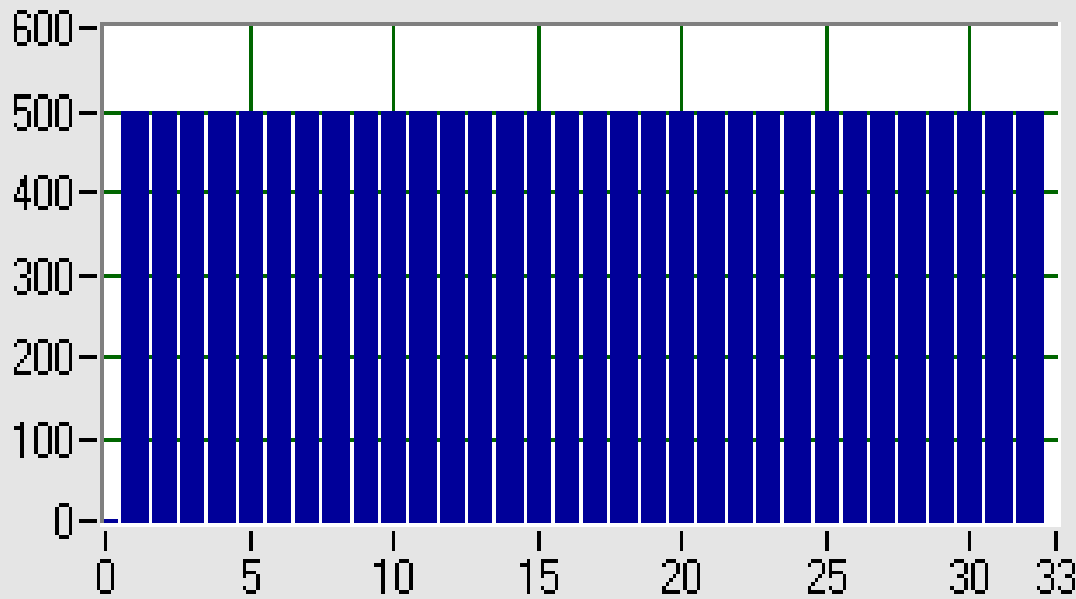
Barcode

33304010000027

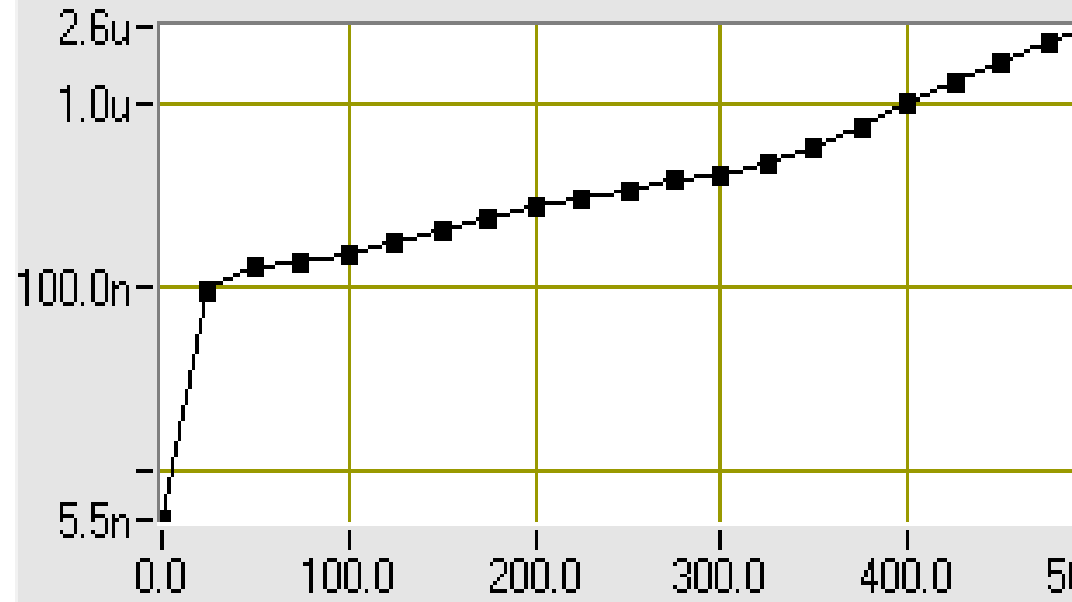
Remark:

Break Down Voltage [V]

Vbd= 500.0

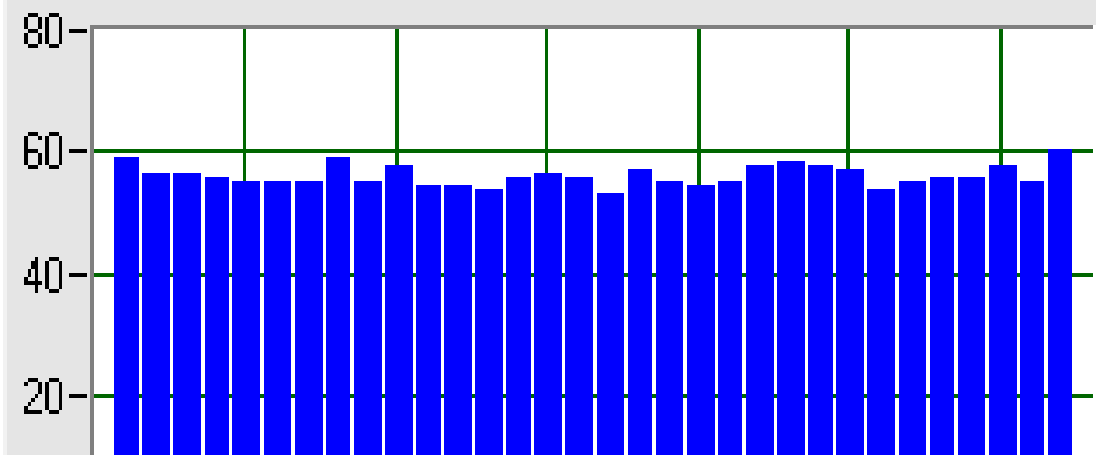


Total Current



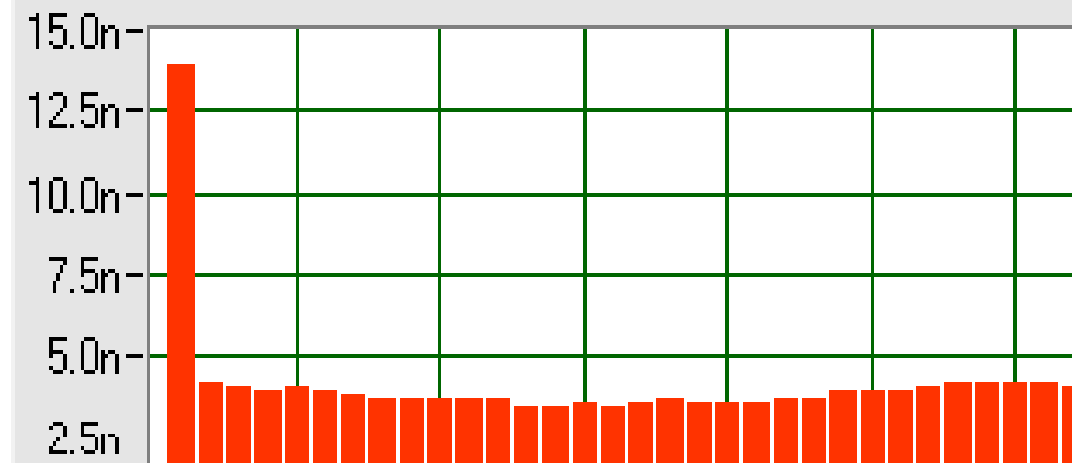
Full Depletion Voltage [V]

Vfd= 55.7



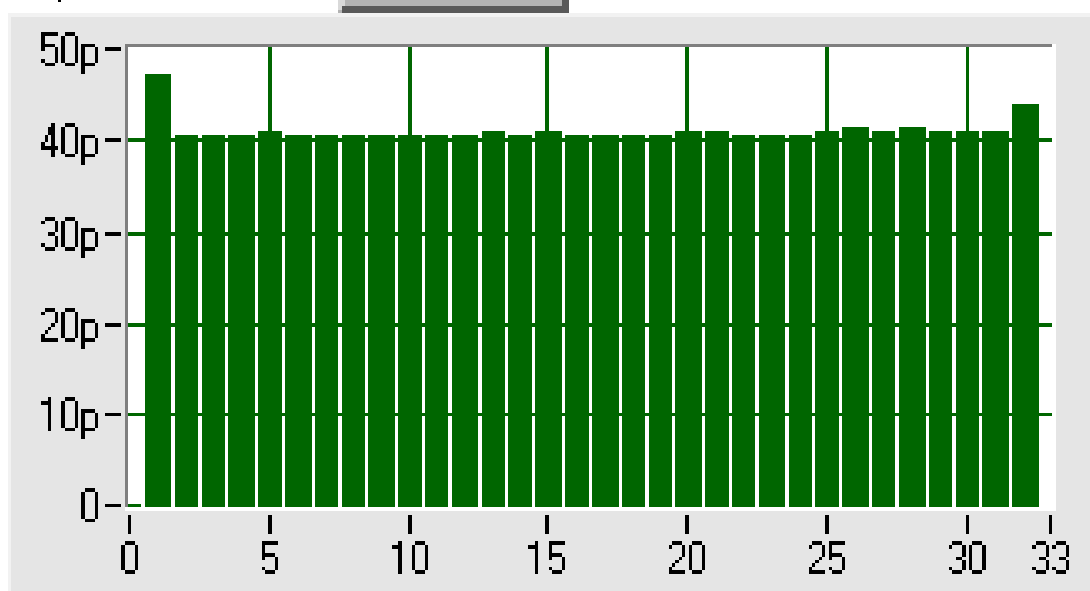
Current at Vfd

I_{tot} [μA] at V_{fd} = 0.132



Capacitance at

Plateau



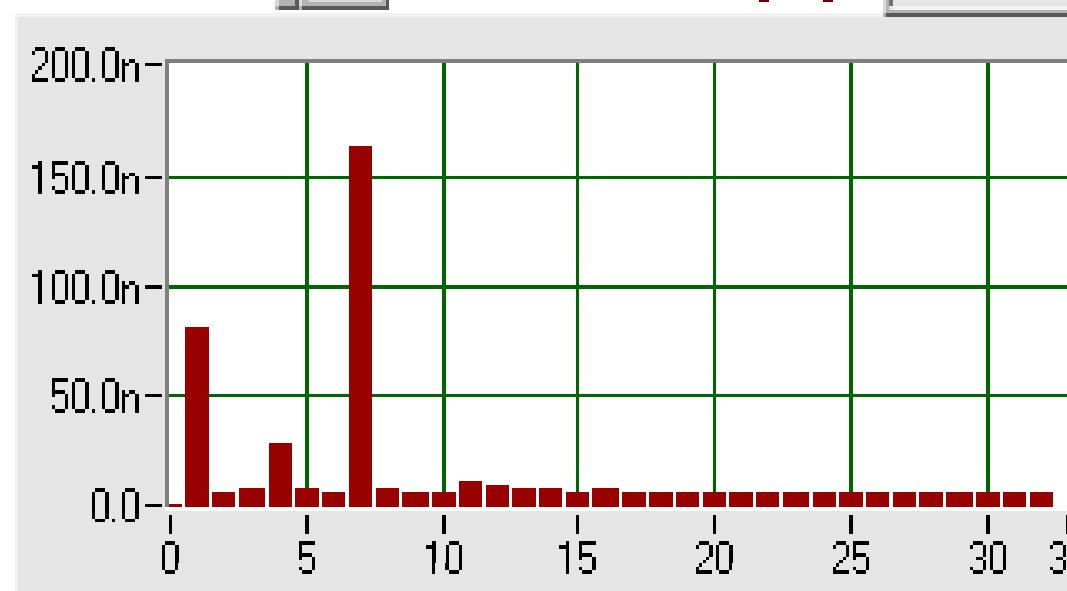
Current at V=

300

(-1:Vfd+150)

Itot [uA] =

0.431



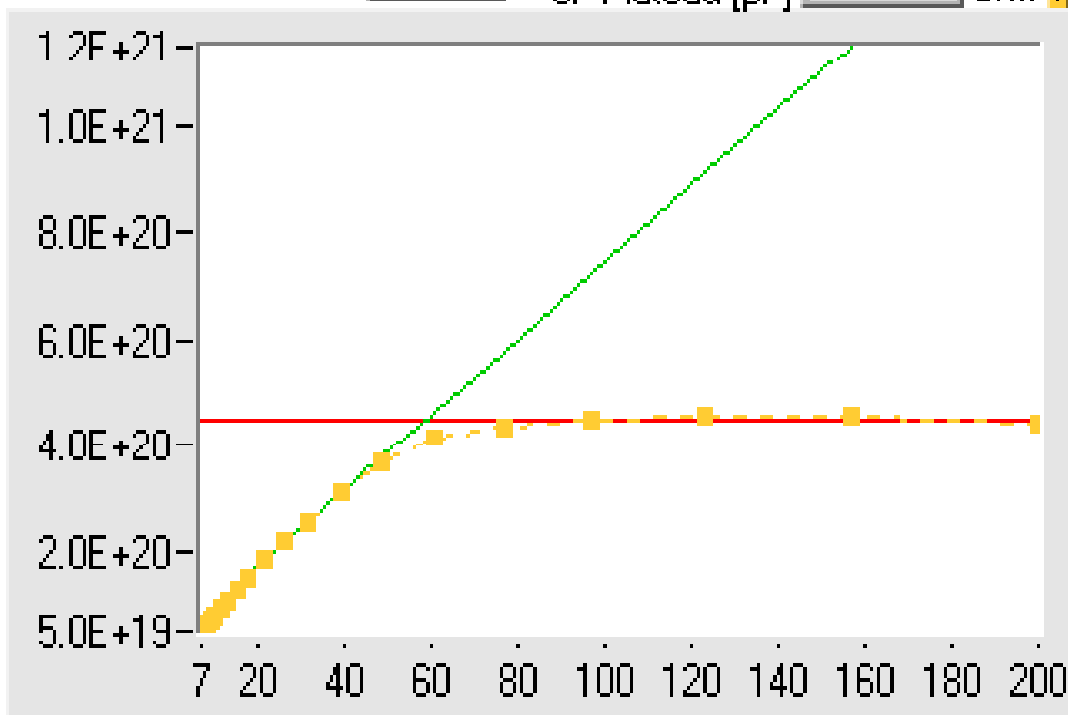
1/C^2 and fit

Vfd 59.0

Capacitance of Plateau [pF]

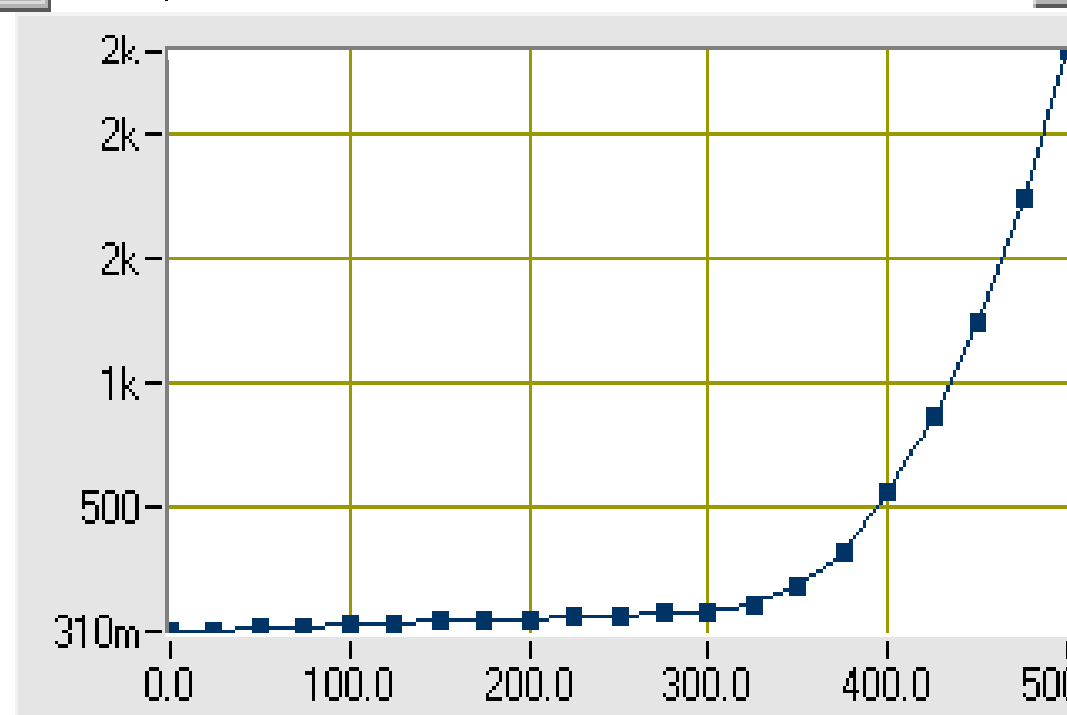
47.1

Ch# 1



Stripl Current

Inf. Loop



start path

F:\BELDATA\BATCH B\BATCH B1\CV33304010000027.dat

Path

F:\BELDATA\BATCH B\BATCH B1\CV33304010000027.dat

Produced in India

yield of about 50%

average strip leakage current of

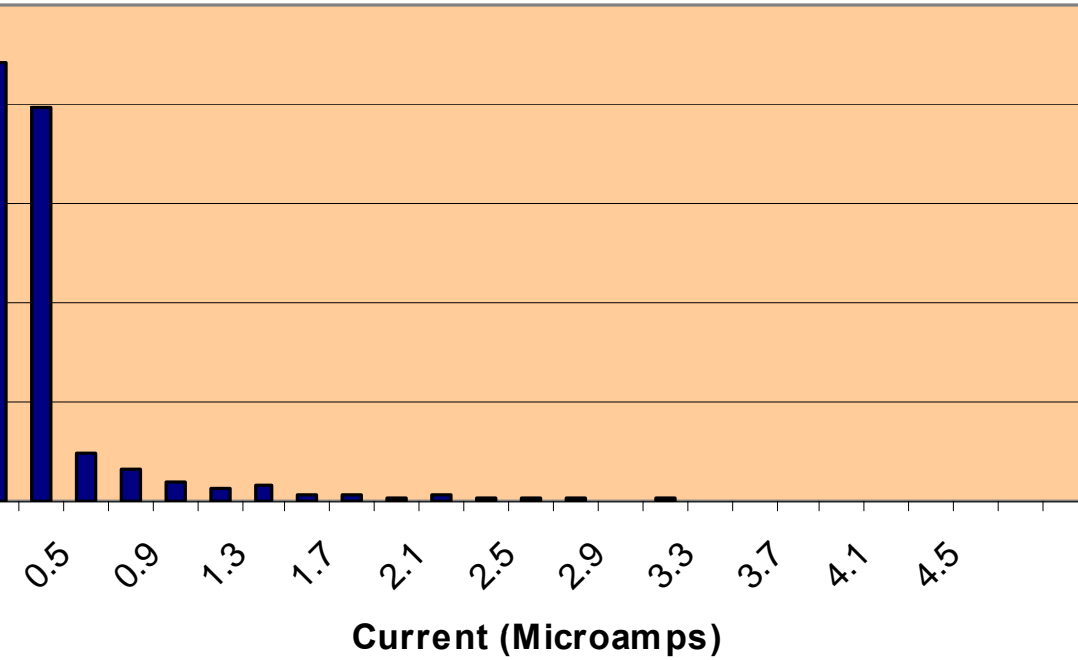
$\sim 20\text{nA/cm}^2$

total leakage per detector of about 200nA
 100V

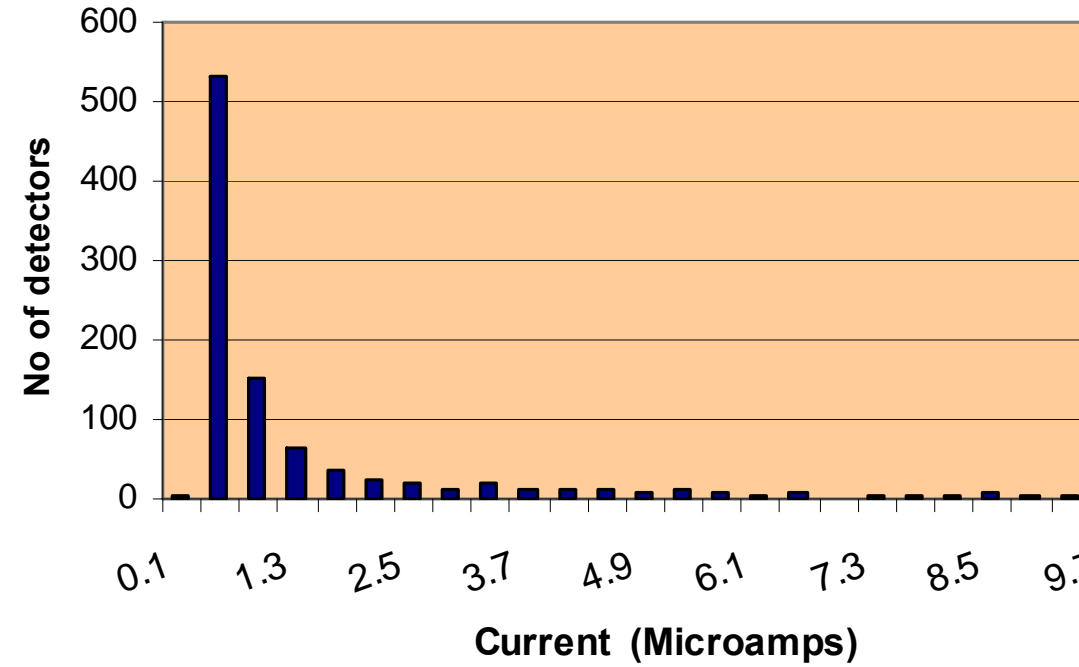
breakdown voltage of strips $> 500\text{V}$

positioning accuracy of about 20-30 microns
 3.00 mm

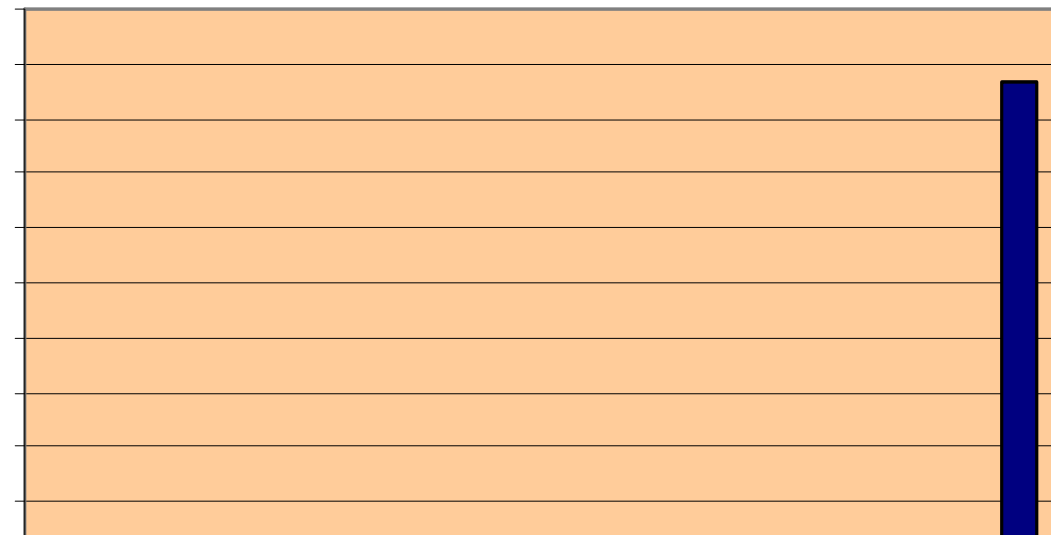
Voltage for 1000 Detectors



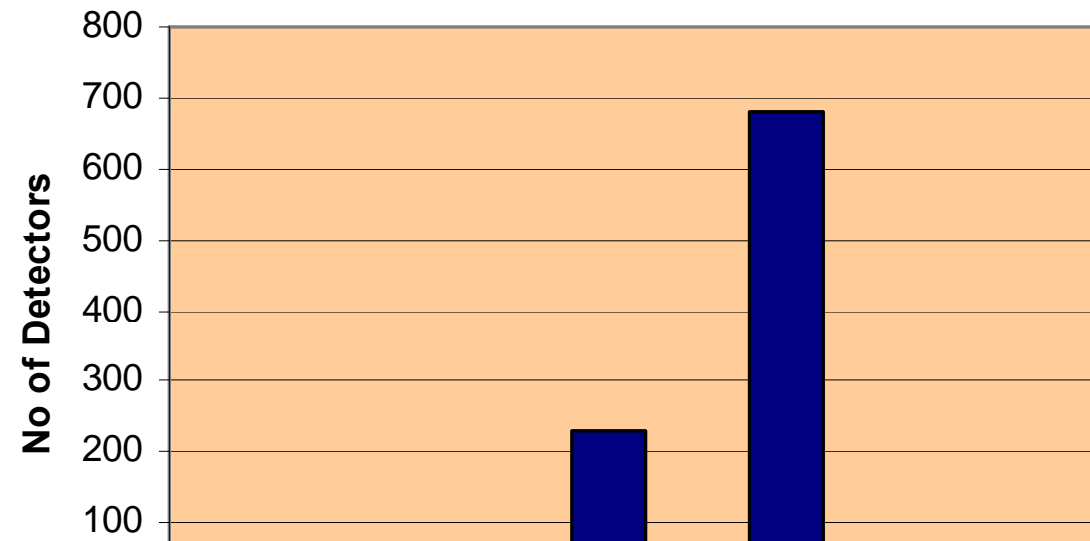
Detectors



Distribution of VBD for 1000 Detectors

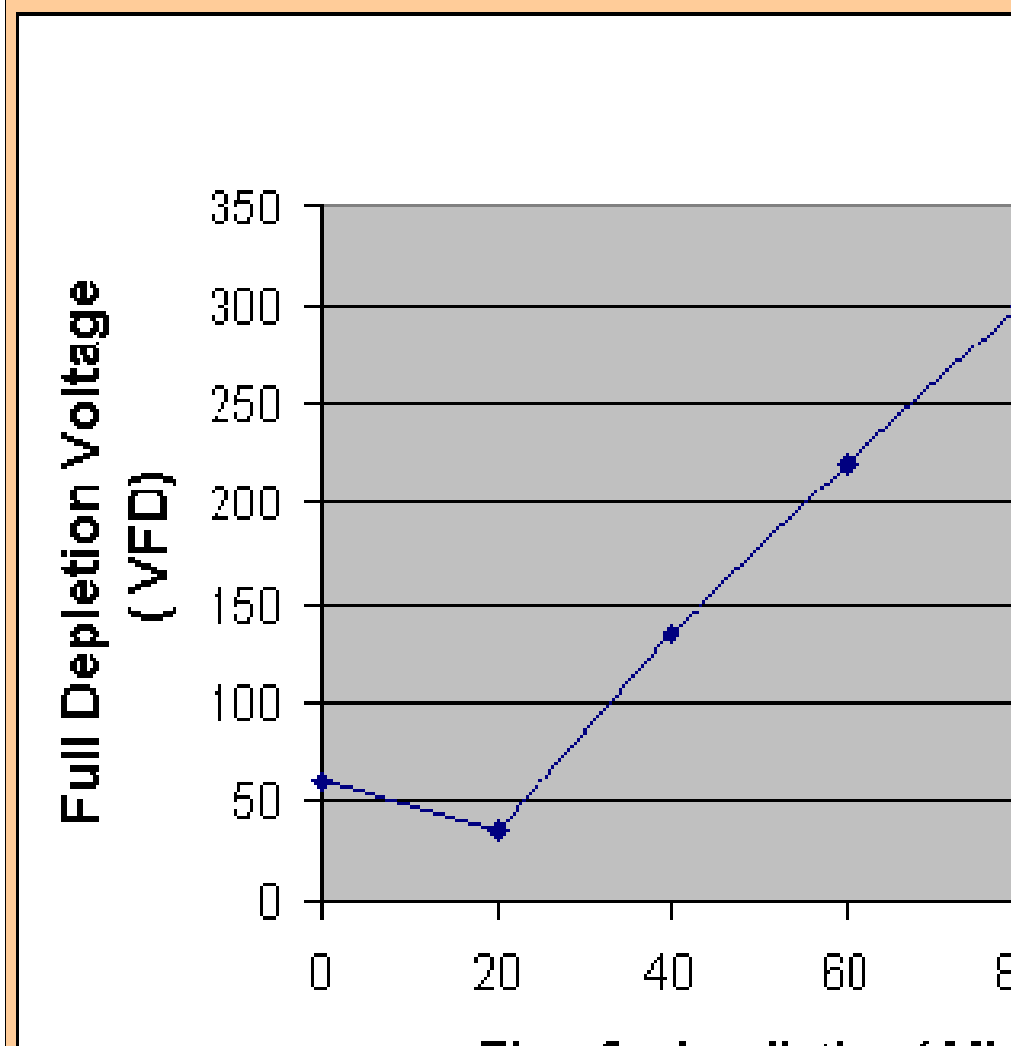
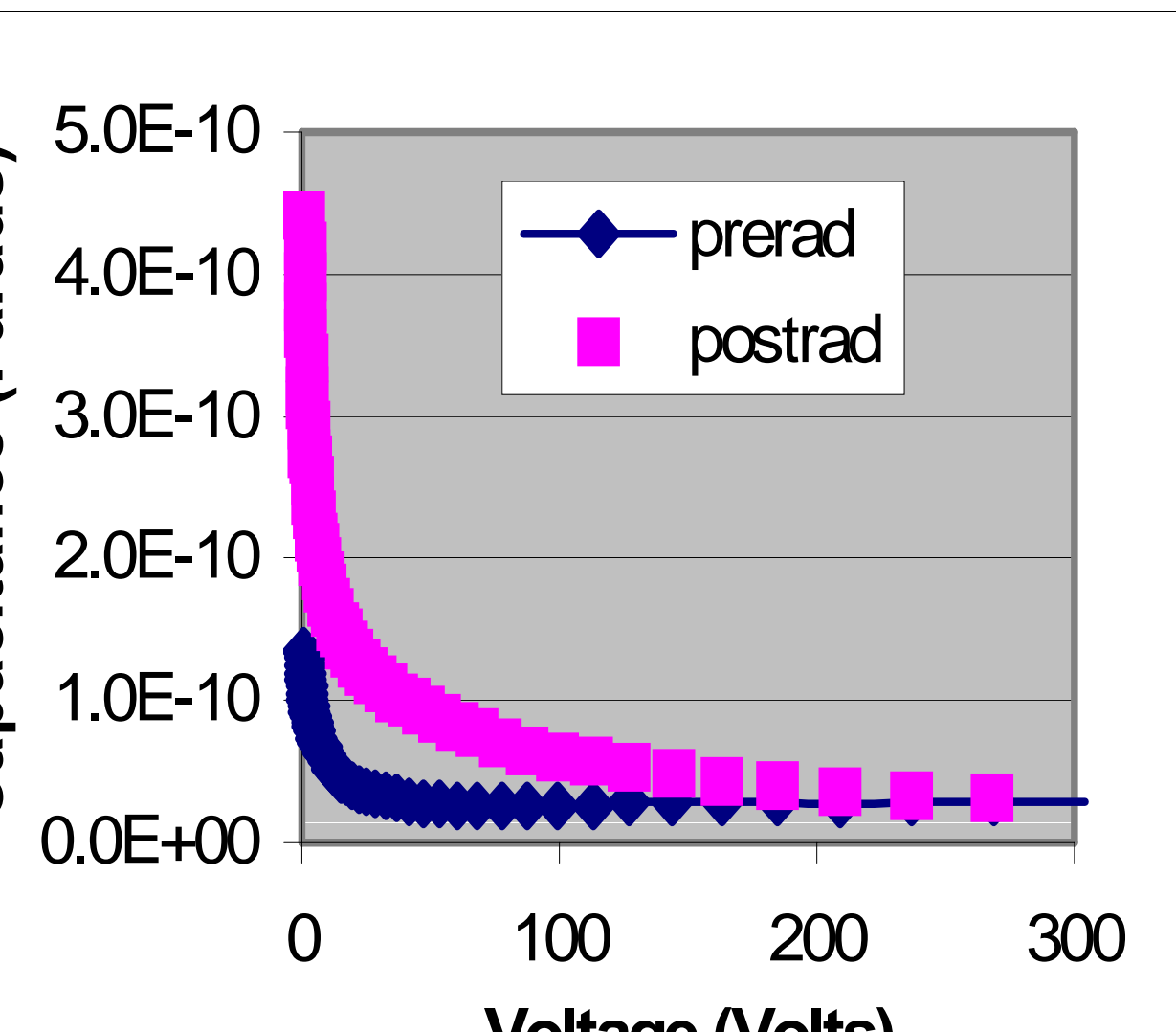


VFD Distribution for 1000 Detectors

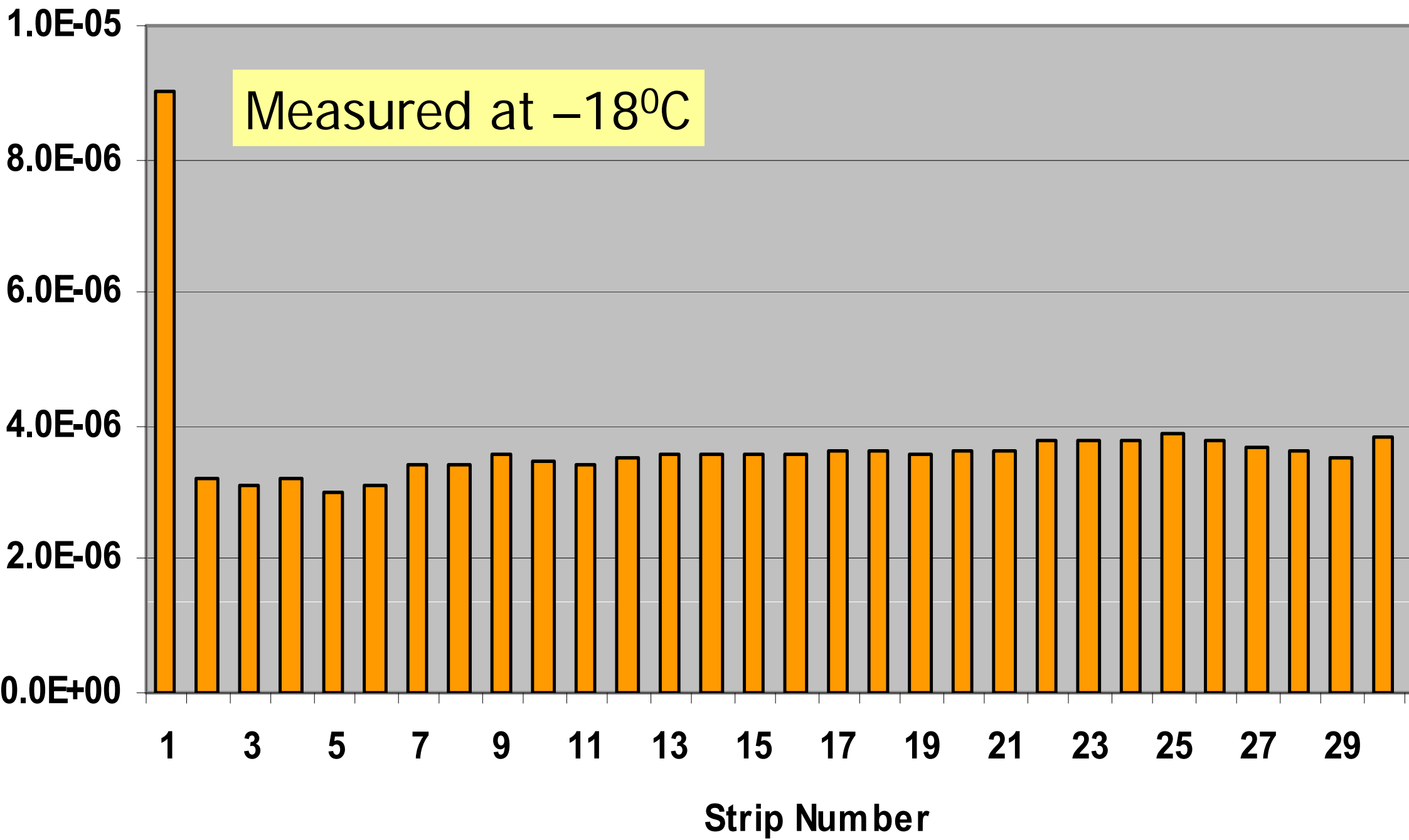


Radiation hardness of detectors

Change of full depletion voltage due to a neutron dose of 10^{14} n/cm² (Detectors irradiated in APSARA reactor at BARC)



Measurement of flux to film



uing of detector to ceramic tiles

uing of ceramic tiles to Al tiles

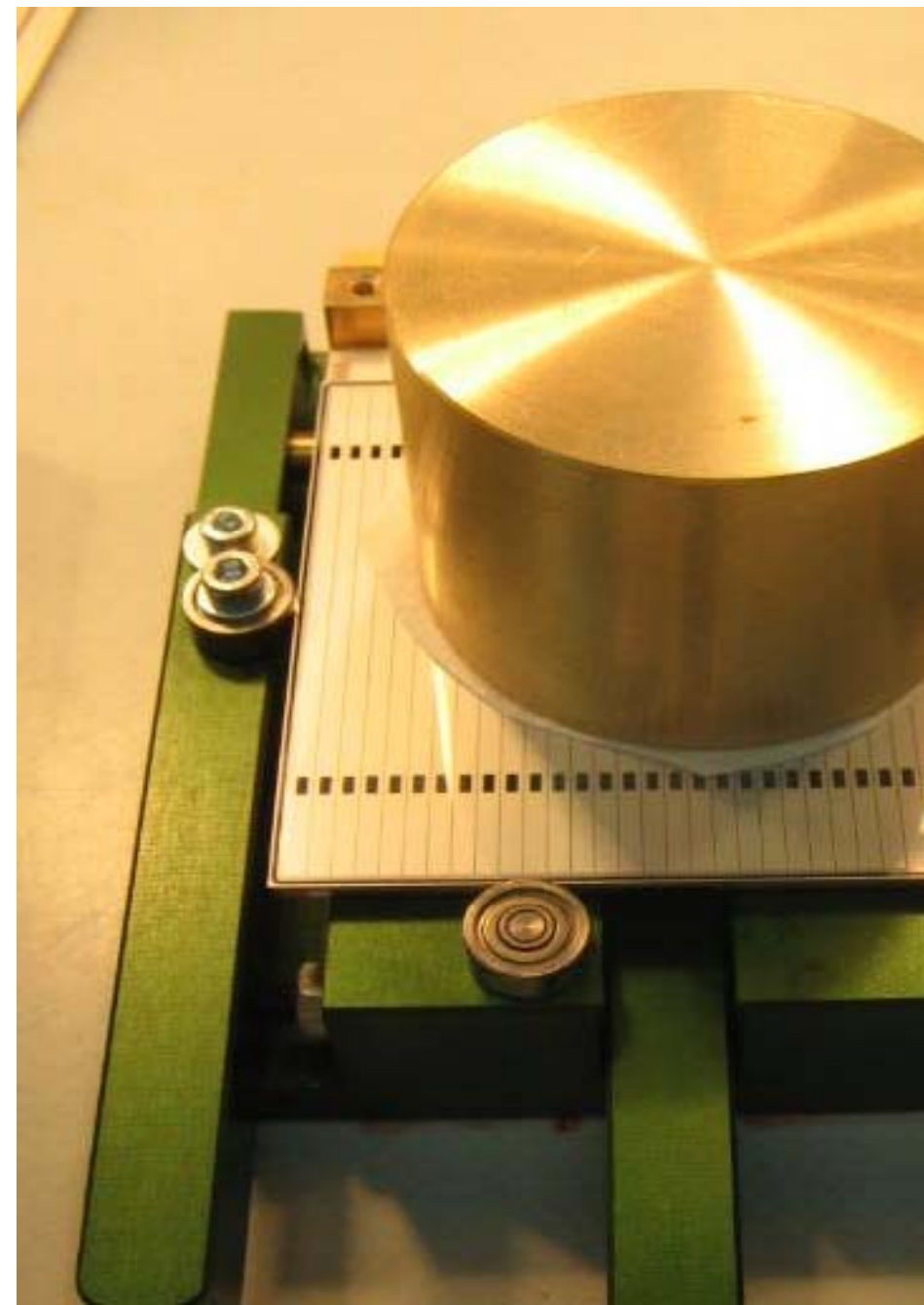
**everal quality control steps (electrical and vis
spection) to check damage/leakage current**

**crease/stability of detectors during assembly
d with time**

Gluing on the Ceramic



Gluing on the Al



(Ten Detectors guided at a time)

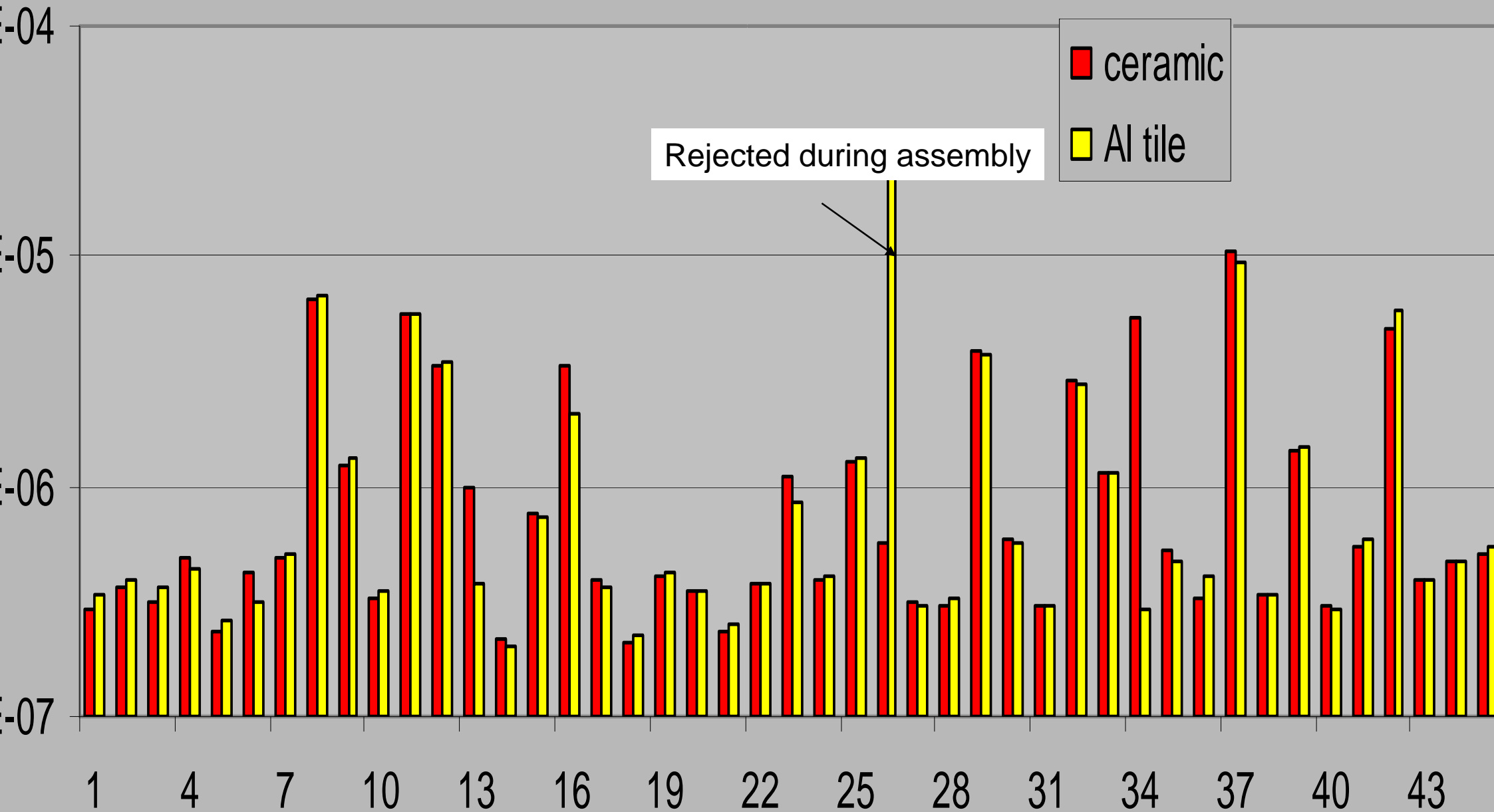
IONS MEASUREMENT

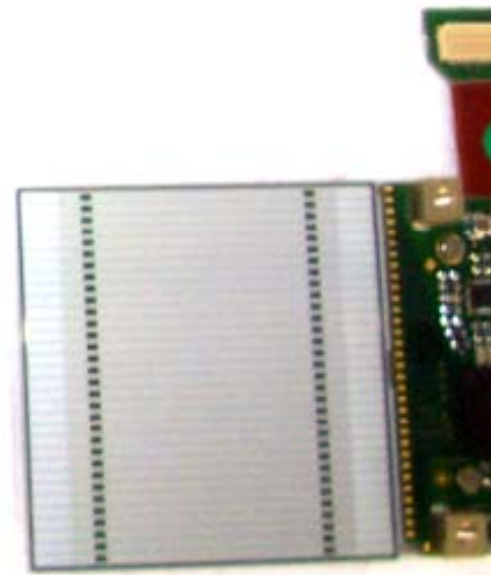
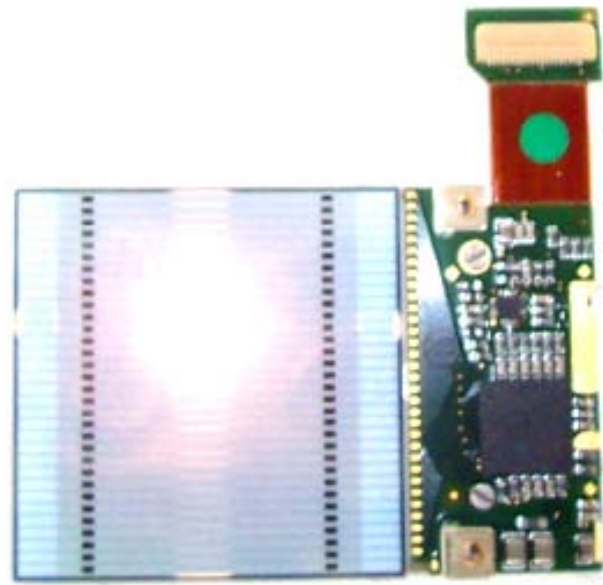
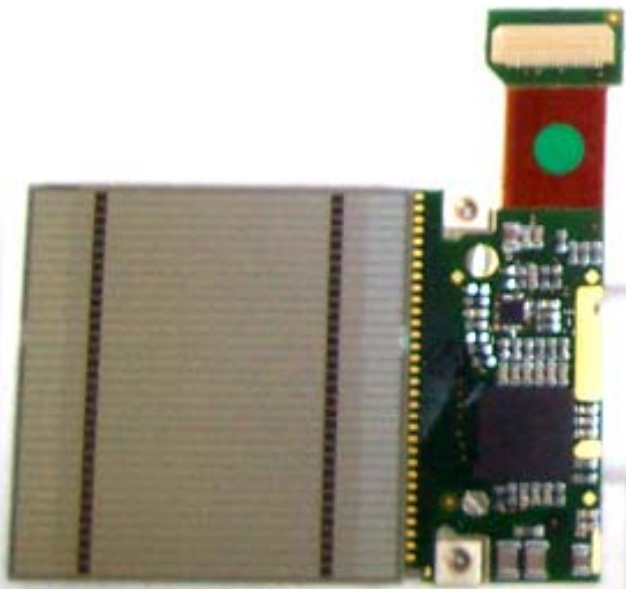
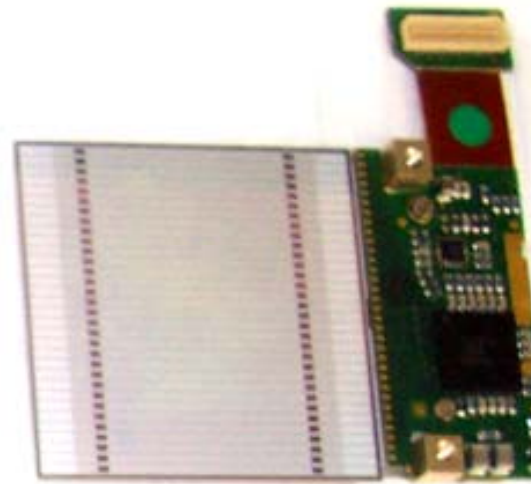
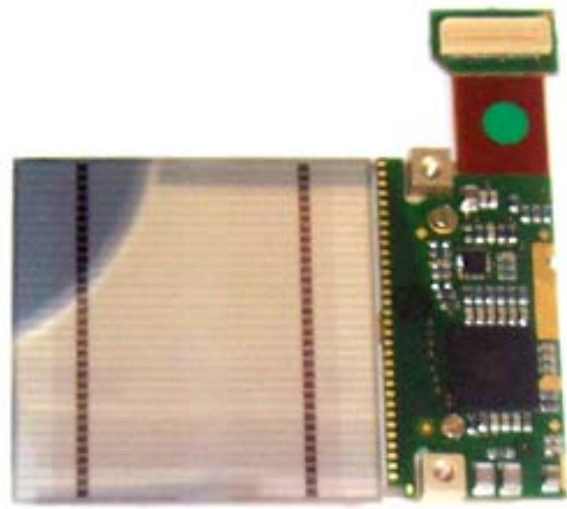
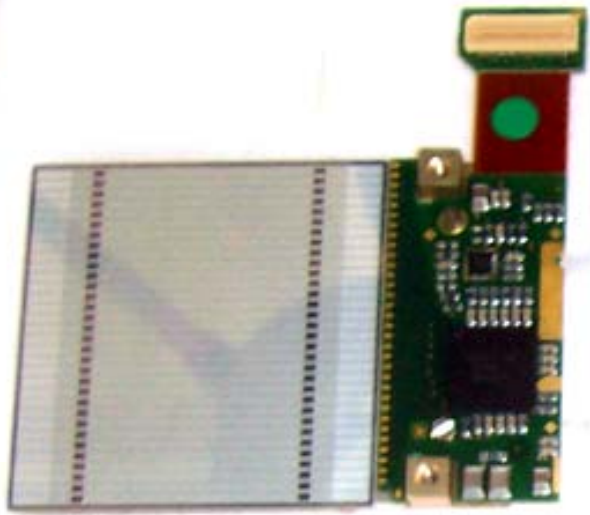
THICKNESS MEASUREMENT

VISUAL INSPECTION STATION

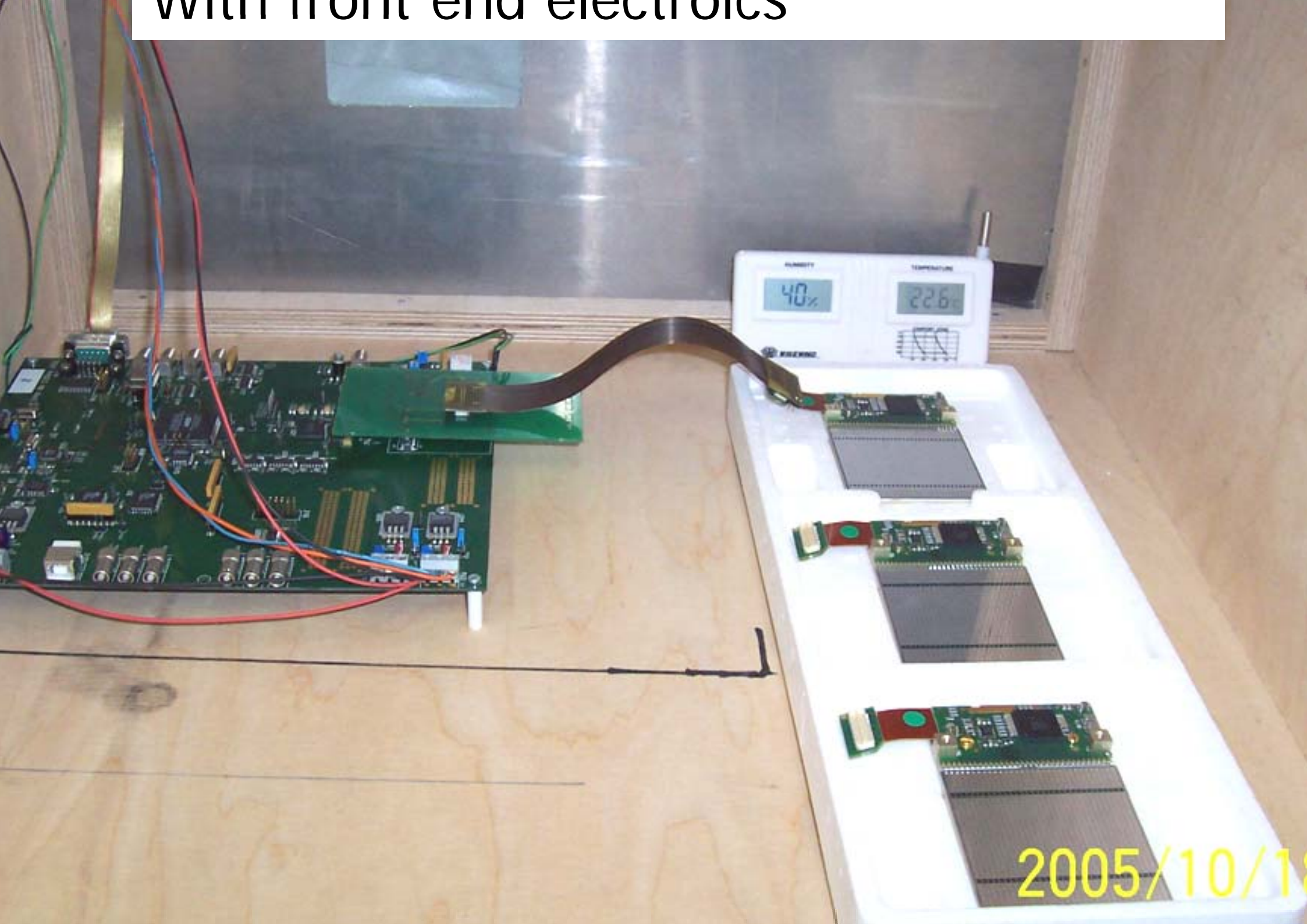


e detectors were fabricated in 2003)





with front end electronics



2005/10/18

Technology for large scale production of silicon detectors has been developed in InC. Experience and expertise in the areas of detector design, process & device simulation, process development & detector characterization is available

Technology could be adapted to produce detectors for calorimeter e.g. Si/W calorimeter

We also plan to initiate technology development for SiPM