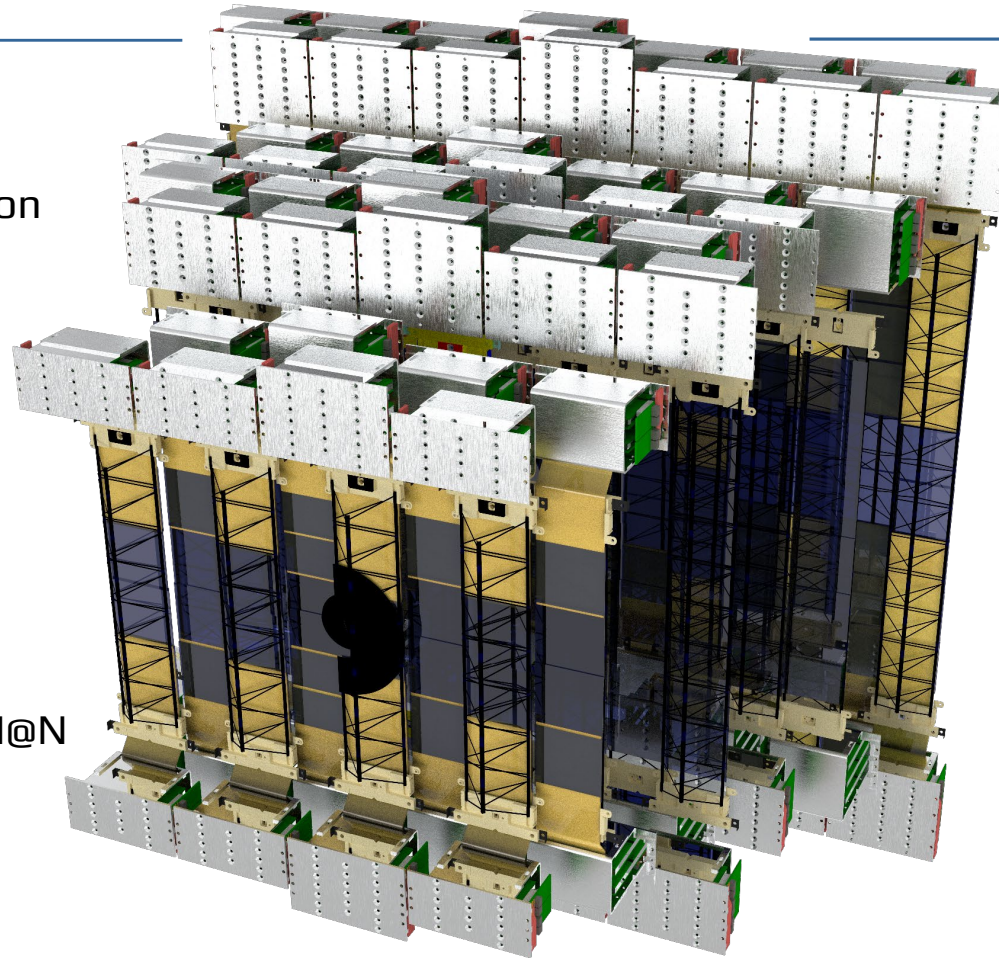




Progress in development of technology for series STS module assembly at JINR

Aleksei Sheremetev, JINR

for the CBM-BM@N STS Collaboration



6th Collaboration Meeting of the BM@N
Experiment at the NICA Facility
26.10.2020



Outline



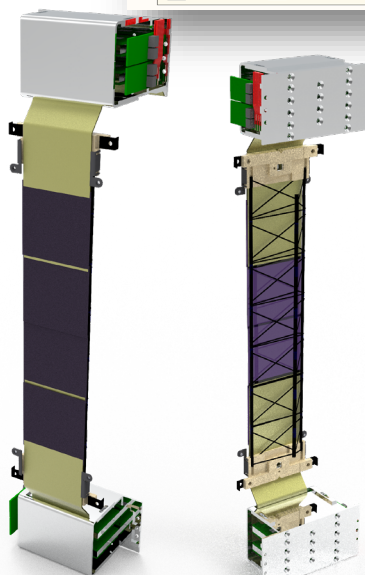
- Structure of BM@N STS Stations
- Module components for assembly
 - Silicon microstrip sensor
 - Flexible Capton-Aluminum cable
 - Front-end Board
 - Readout chip and LDO
- Cross section of module
- Technological processes of assembling modules for the BM@N STS
 - Assembly of the ASIC with flexible Al – microcables
 - Assembly of the Si- sensor with flexible Al – microcables
 - QA of assembly process
 - Wire bonding process ASIC and LDO to PCB
- Test of STS module
- Conclusions



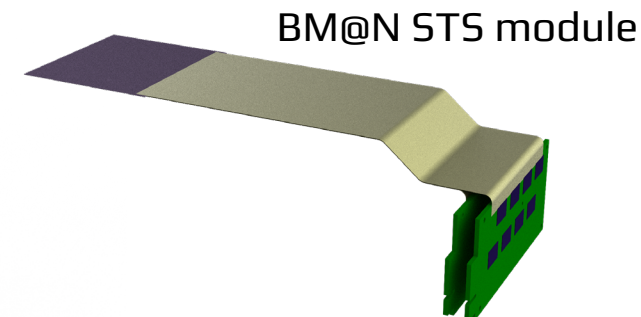
BM@N STS Stations

- 4x - Stations;
- 16x - CF-Frames
- 34x - Ladders;
- 292x - Silicon strip modules.

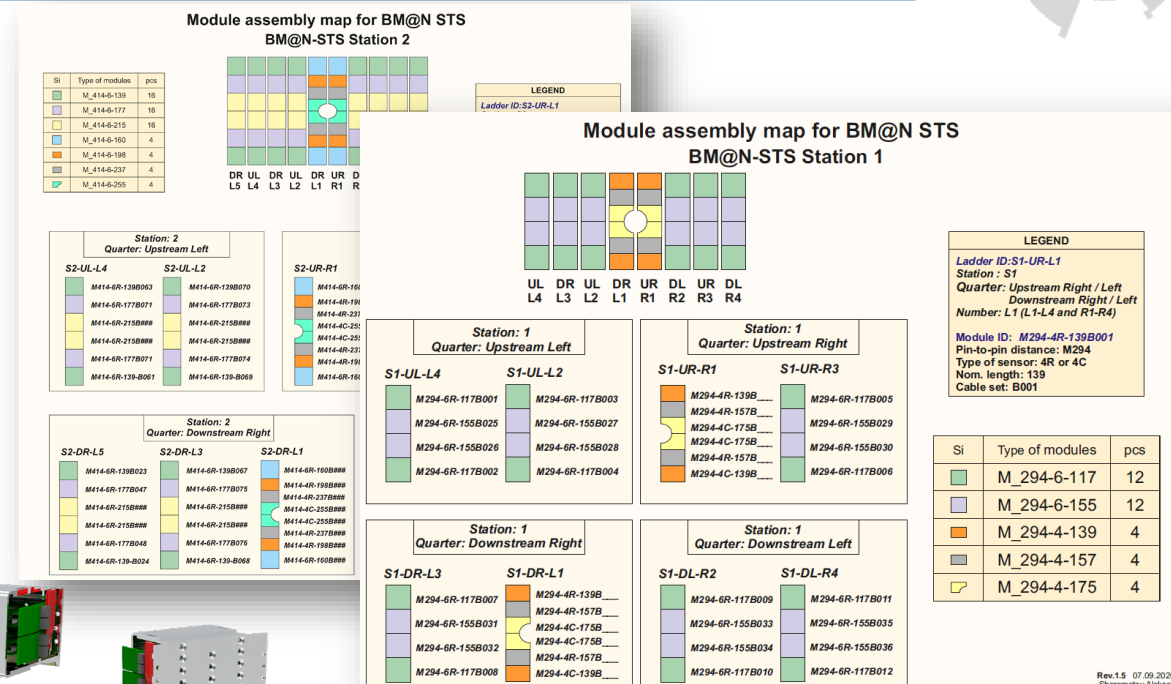
BM@N STS Station



BM@N STS Ladder

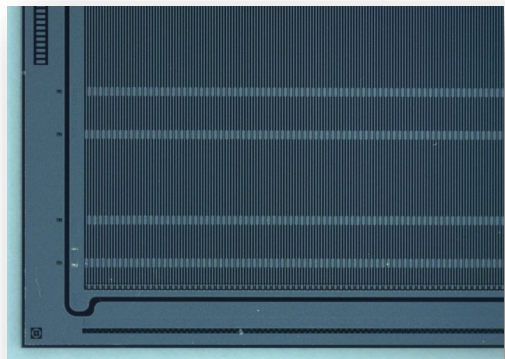


BM@N STS module

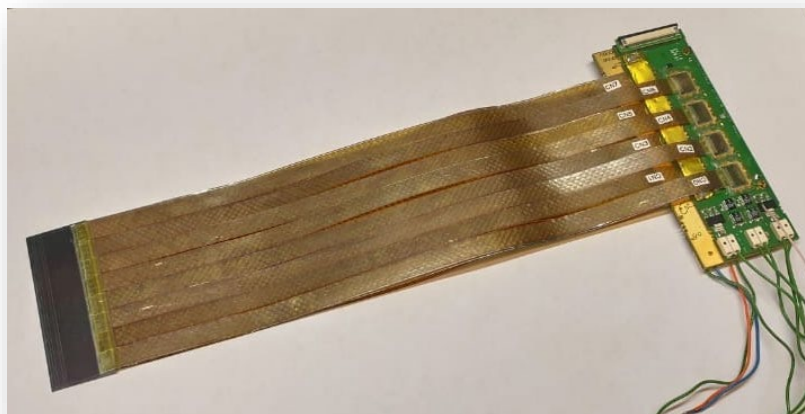




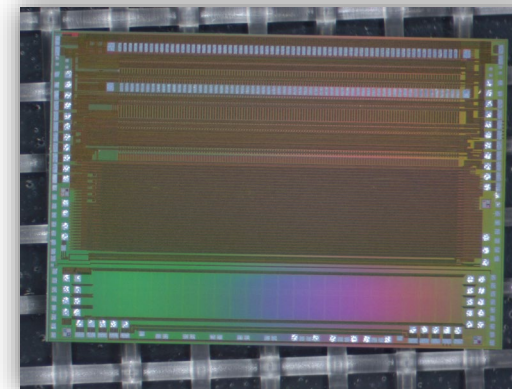
Module components for assembly



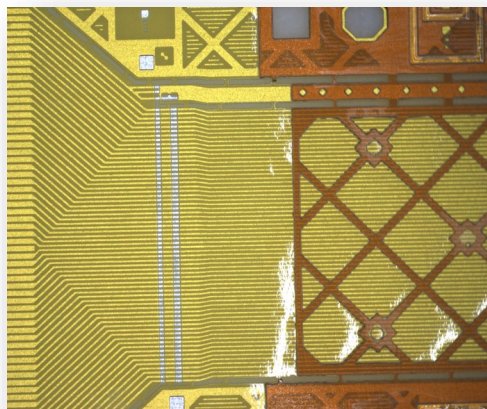
Silicon Strip Sensor



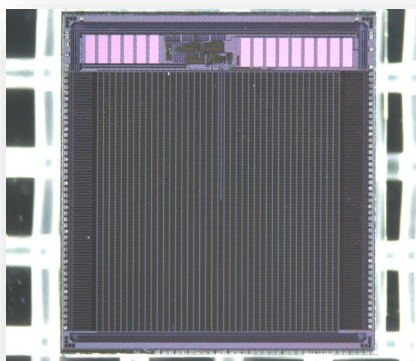
BM@N STS module



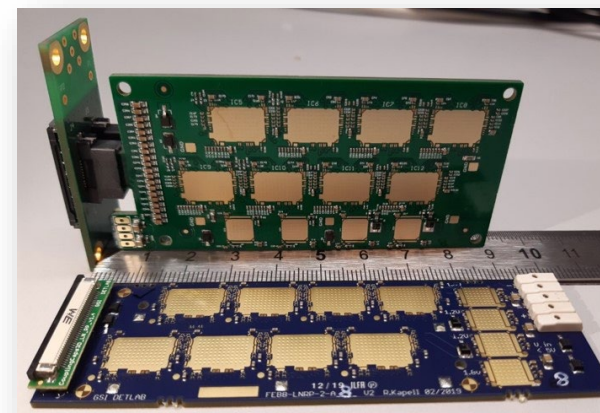
Readout electronics
(ASIC)



Capton flexible cable



Low-dropout regulator (LDO)



Front Electronic Board
(FEB)



Silicon microstrip sensor

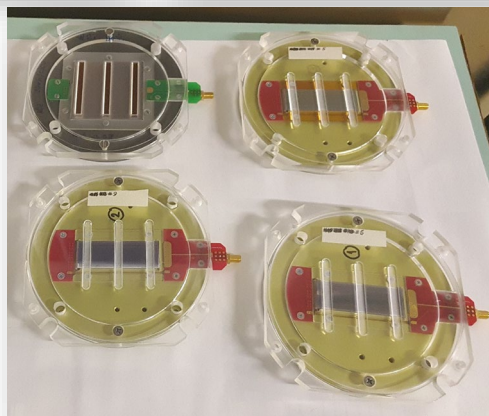
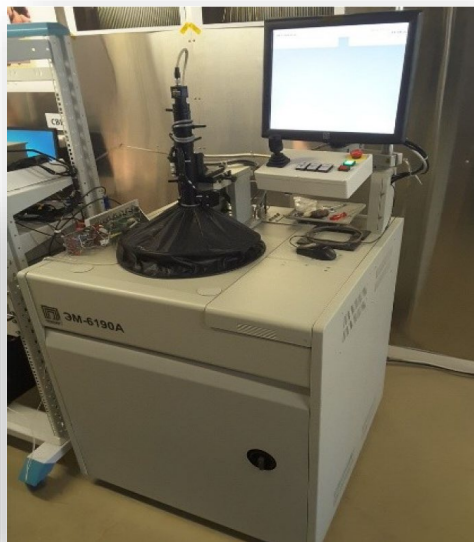
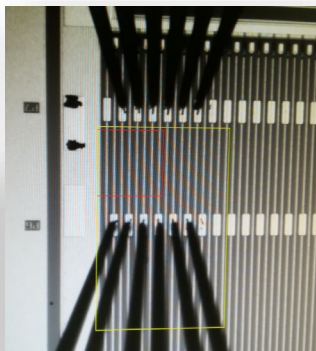
Manufacture: CiS (Germany) and Hamamatsu (Japan)

Type of sensor: 42× 62 mm, 62× 62 mm;

Thickness of sensor: 320 μm ± 15 μm ;

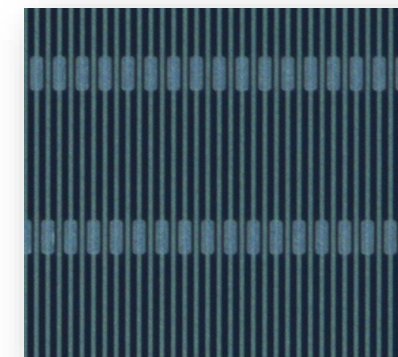
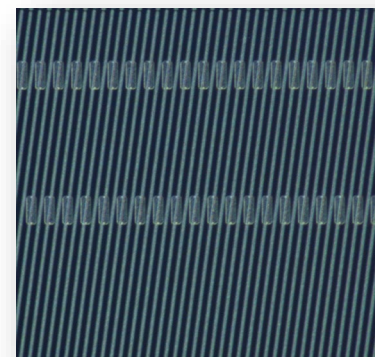
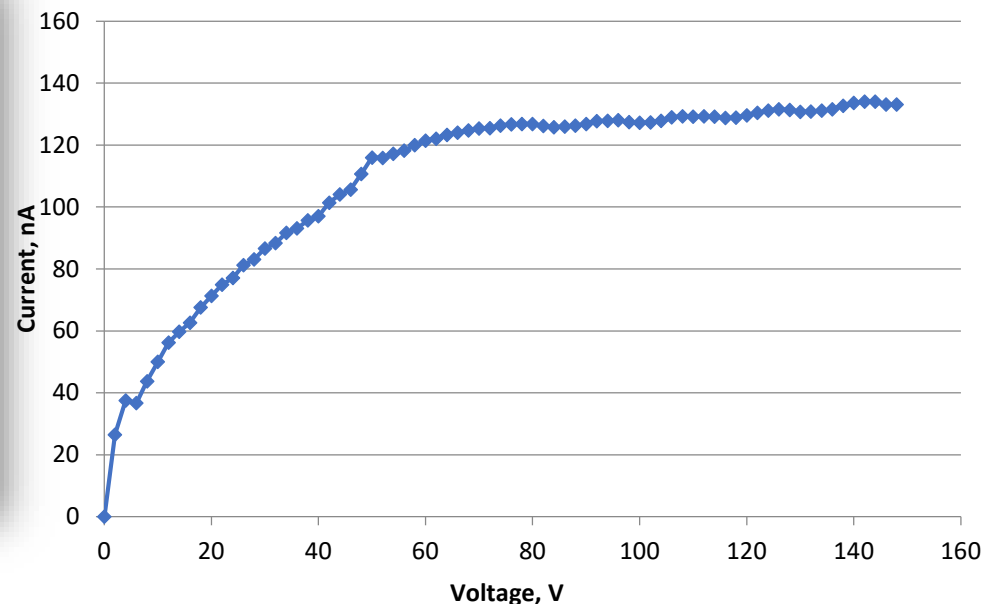
Number of strips: 1024

Pitch of stripes: 58 μm



Testing by:
Sheremeteva A, Streletskaia E

Current-Voltage characteristic 62 x 62 mm at 25 °C



Stereo angle of p - side 7.5 deg Front n - side 0 deg



Flexible Capton-Aluminum cable

Number of signal traces - 64;

Width of trace in long work area - 30 μm ;

Pitch of trace of long work area - 112 μm ;

Width of trace in bond area - 45 μm ;

Pitch of trace in bond area - 116 μm ;

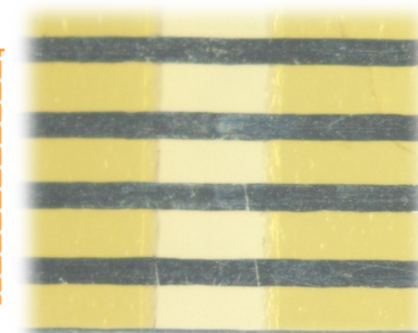
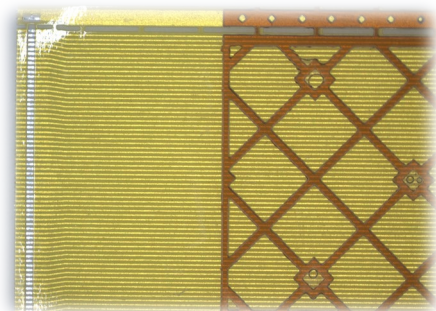
Width of windows of bond area - 165 μm

Trace capacitance - 0.45 pF/cm

Trace lengths 11 - 30 cm



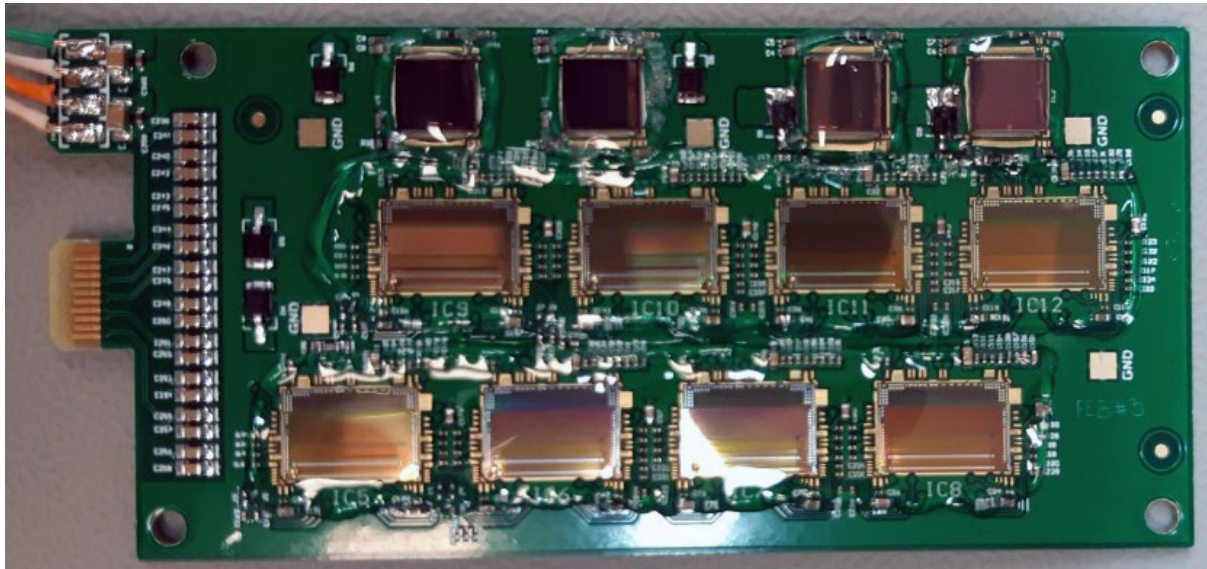
One set of components for assembly module



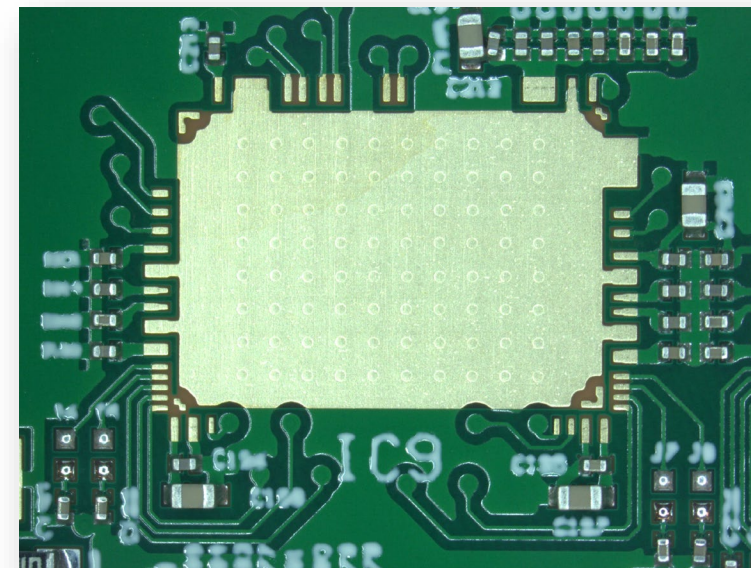


Front-end Board

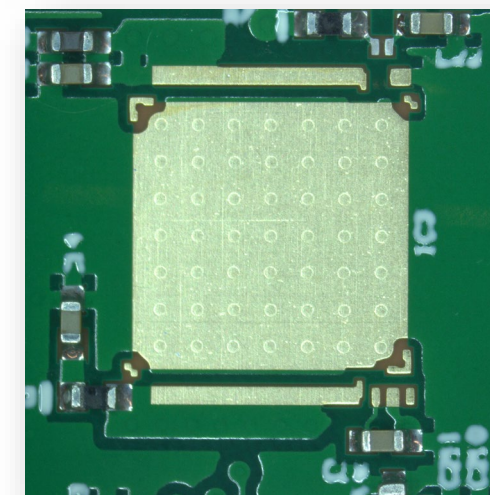
- Manufacture by Maraphon Ltd.
- Size of the PCB: 87×40 mm;
- Thickness with components: 3 mm;
- 1 Uplink 80 Mb/s per one ASIC
- 1x Downlink – 40 Mb/s
- 1x Clock - 40 MHz



BM@N STS FEB with 8 ASIC



Footprint of ASIC



Footprint of LDO



Readout chip ASIC v2.1 and LDO v.1

- Design by CBM collaboration
- 128 readout channels
- Flash ADC: 5 bit
- Data driven mode of operation
- Clock frequency 40 MHz
- Pitch of analog pads: 116 μm

Manufacture: Semiconductor Laboratory

V_{in} : 2.4 – 3.3 V

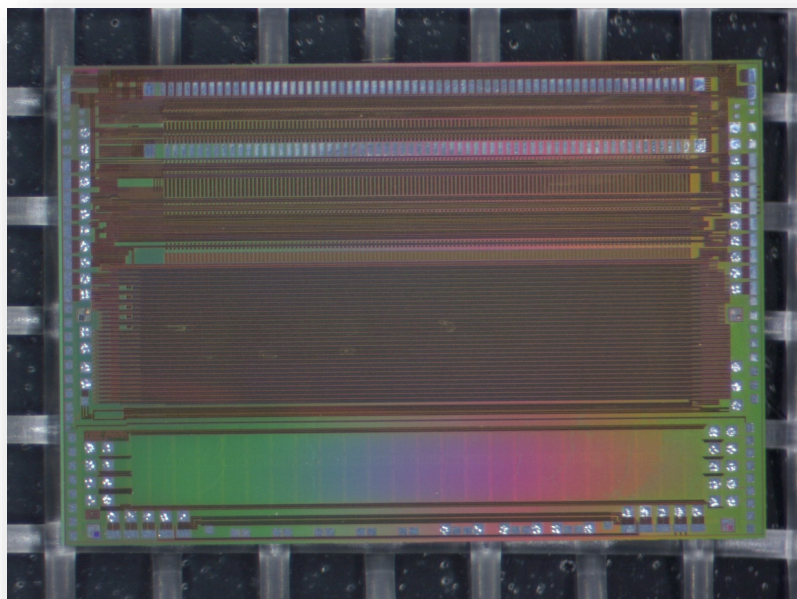
V_{out} : 1.8 V and 1.2 V

Size of chip: 5415 \times 5775 μm .

Thickness 600 μm .

Size of bond pads: 50 \times 50 μm

Pads: 45 input power pads;
44 output power pads;
5 control pads;
4 GND pads.



ASIC



LDO



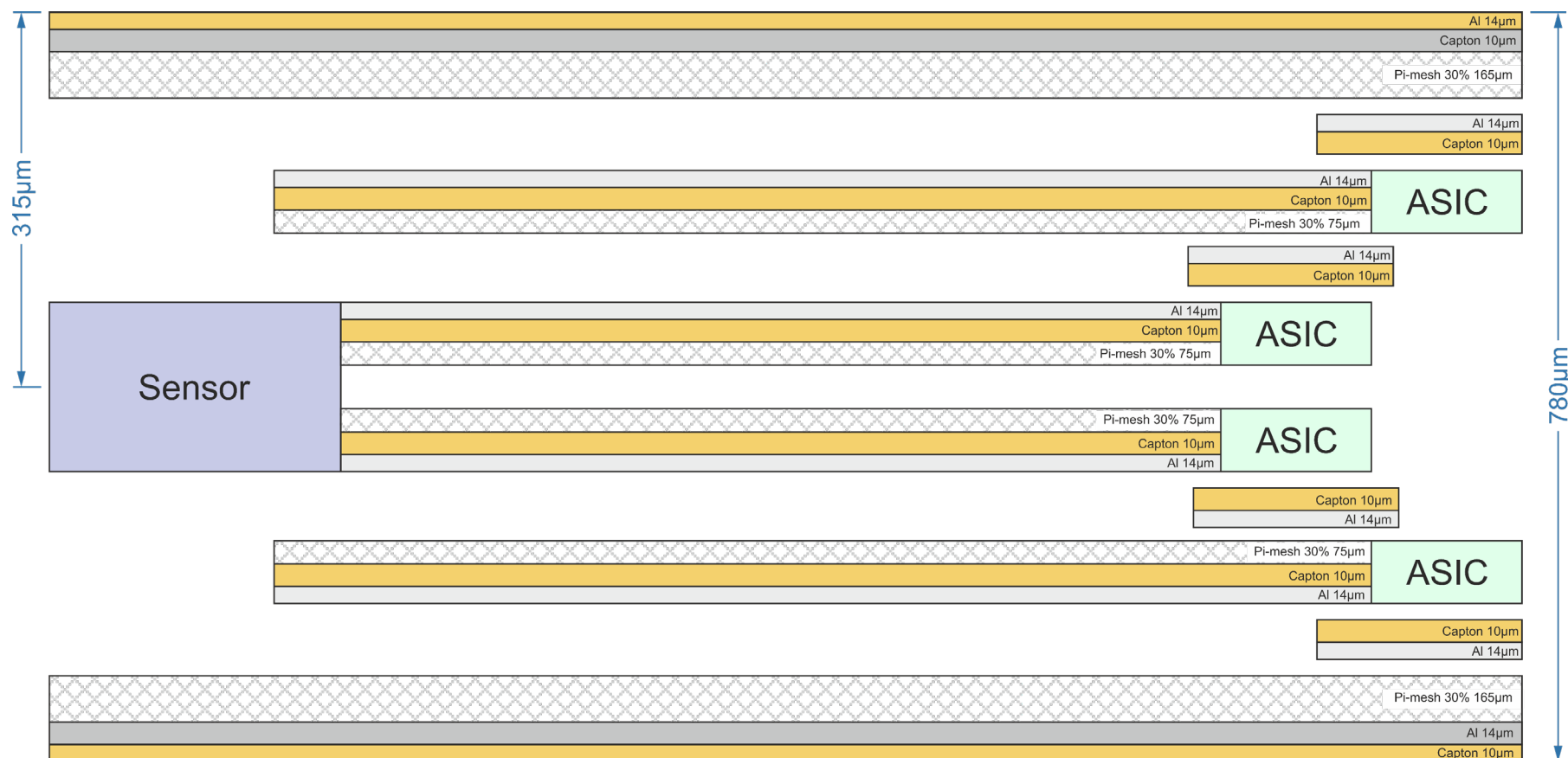
Cross section of module

Module material

Cable: TDA-24 (Aluminum 14 μm + Capton 10 μm)

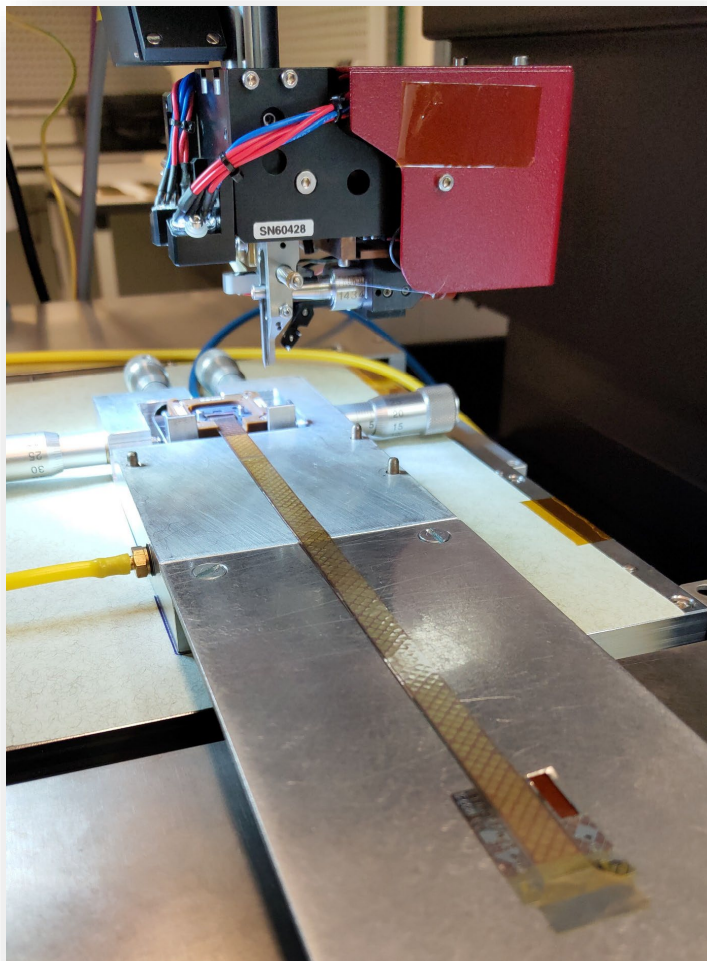
Pi-mesh of cable: Capton 75 μm

Pi-mesh of shielding: Foamtak II 165 μm

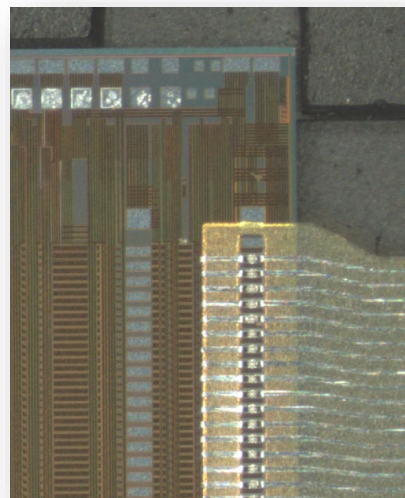




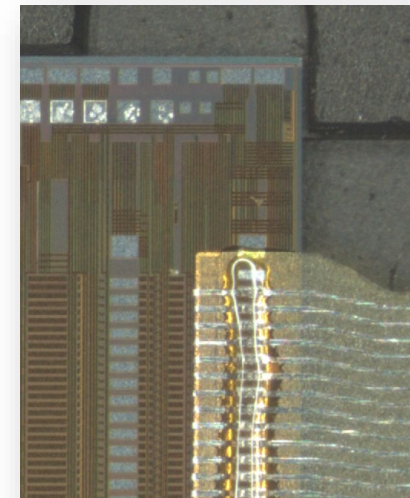
Assembly of the ASIC with flexible AI - microcables



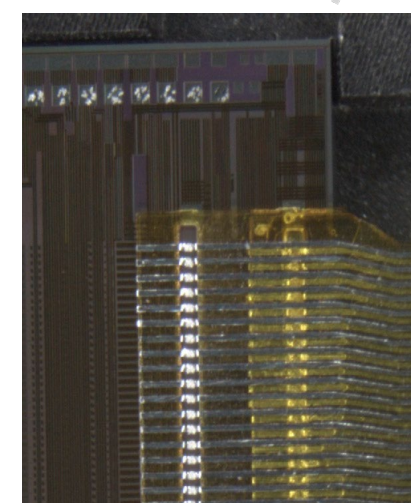
Ultrasonic assembly process
on TAB-bonding machine



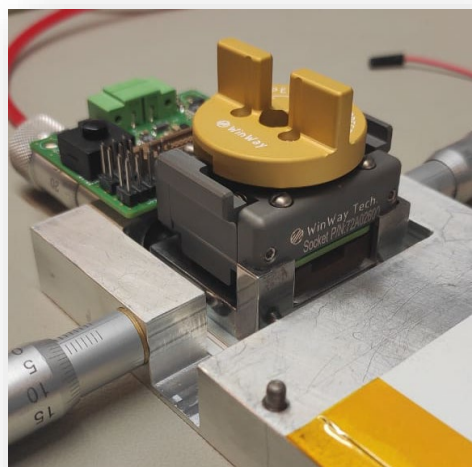
TAB - Bonding result
of 1-st row of contacts



Encapsulation of 1-st
row of contacts

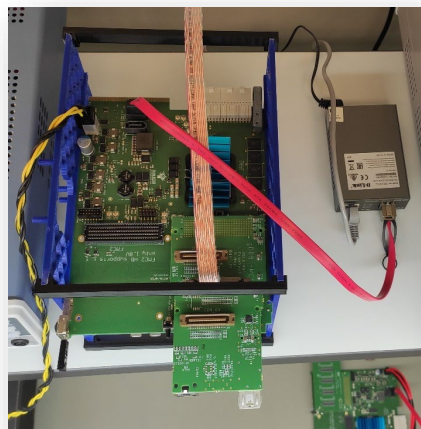


TAB - Bonding result
of 2nd row of contacts

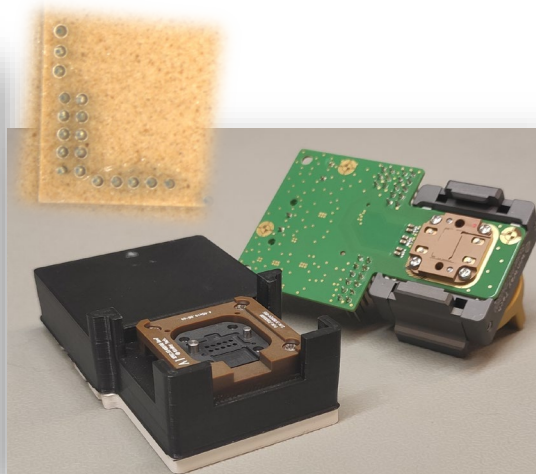




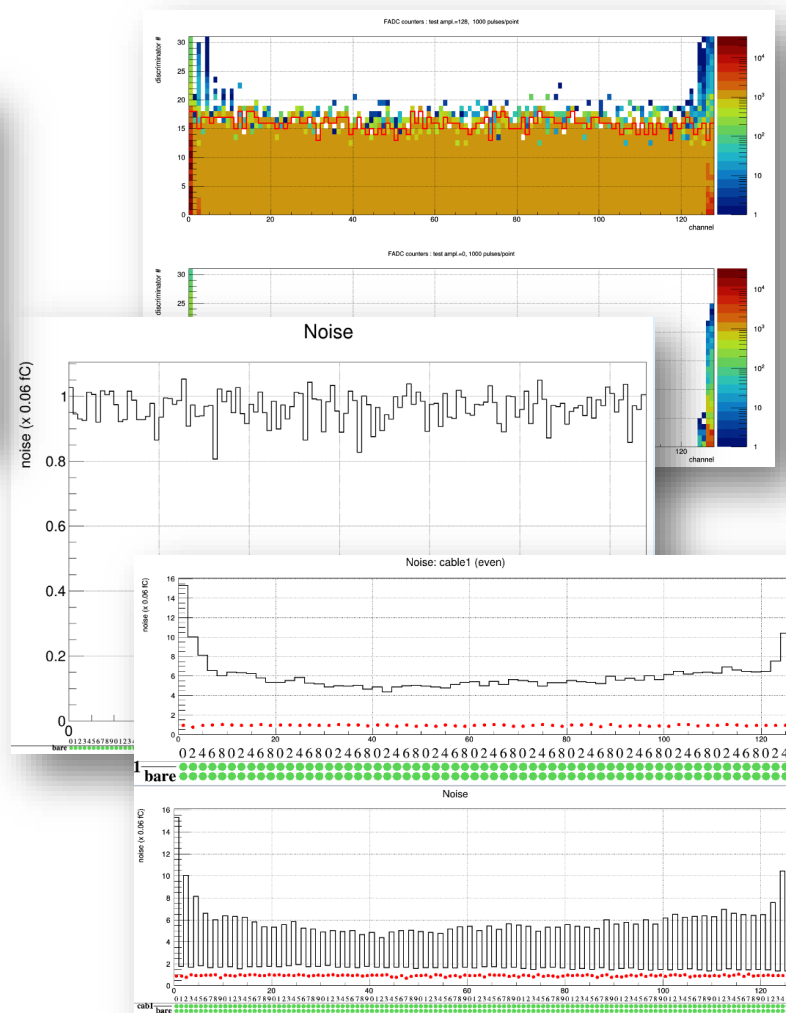
QA of assembly process



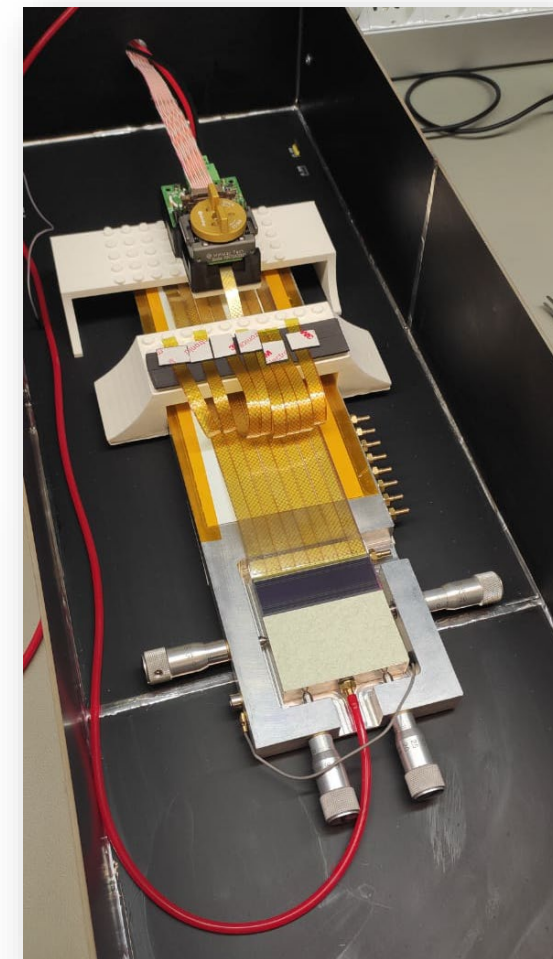
AFCK board v.1.1
and FMC board



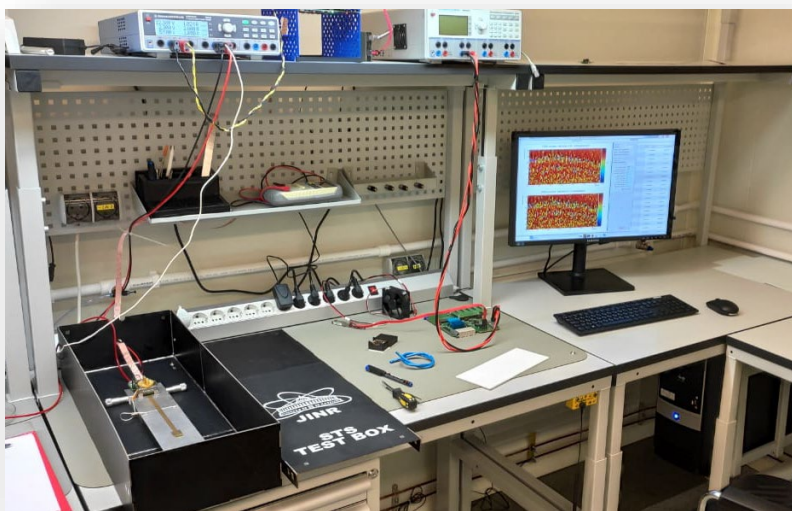
Winway socket
PogoPin device (GSI)

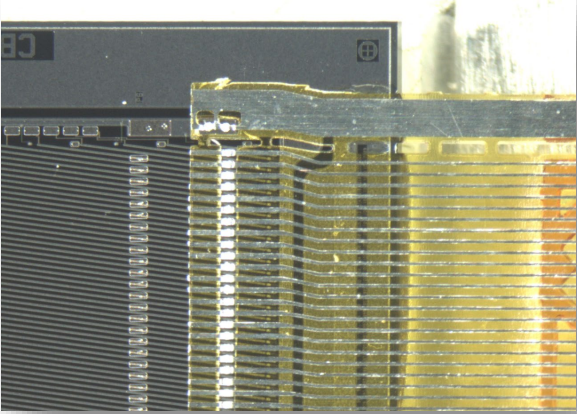


GUI of Test Program by
A. Kolozhvari (JINR)

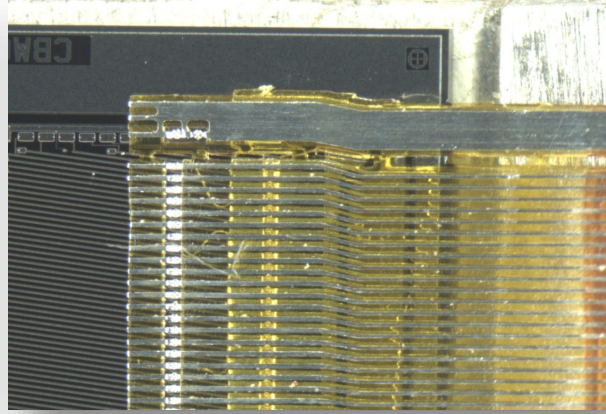


Bonding QA tests of 1st
row on sensor

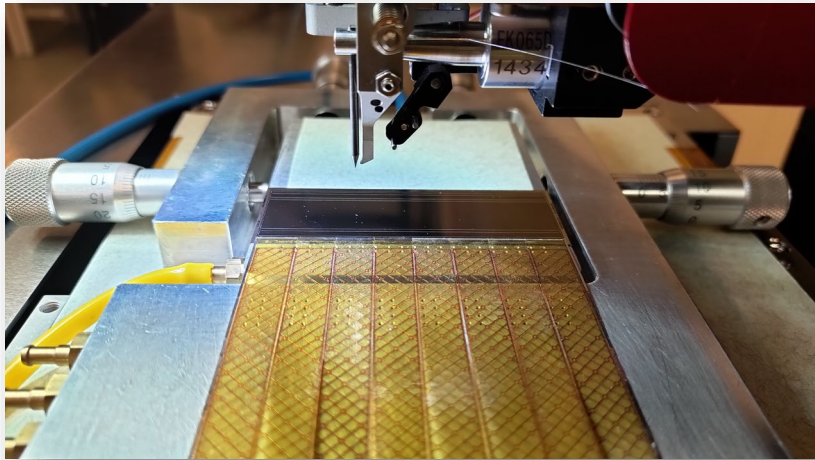




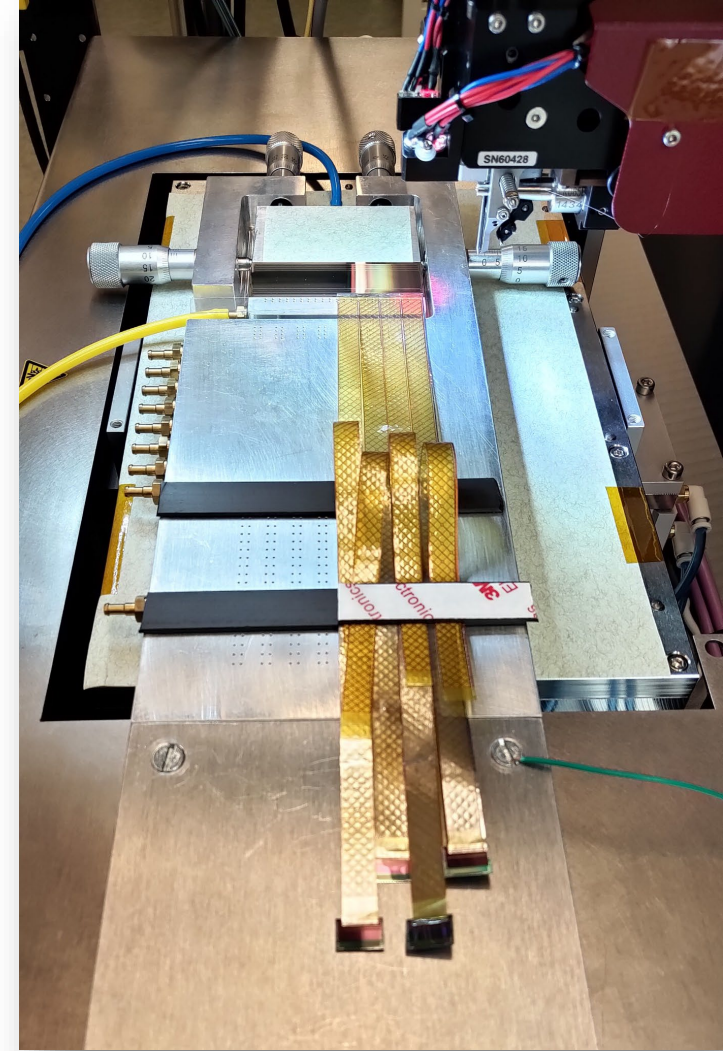
Bonding result of 1st row
of contacts on sensor



Bonding result of two rows
of contacts on sensor



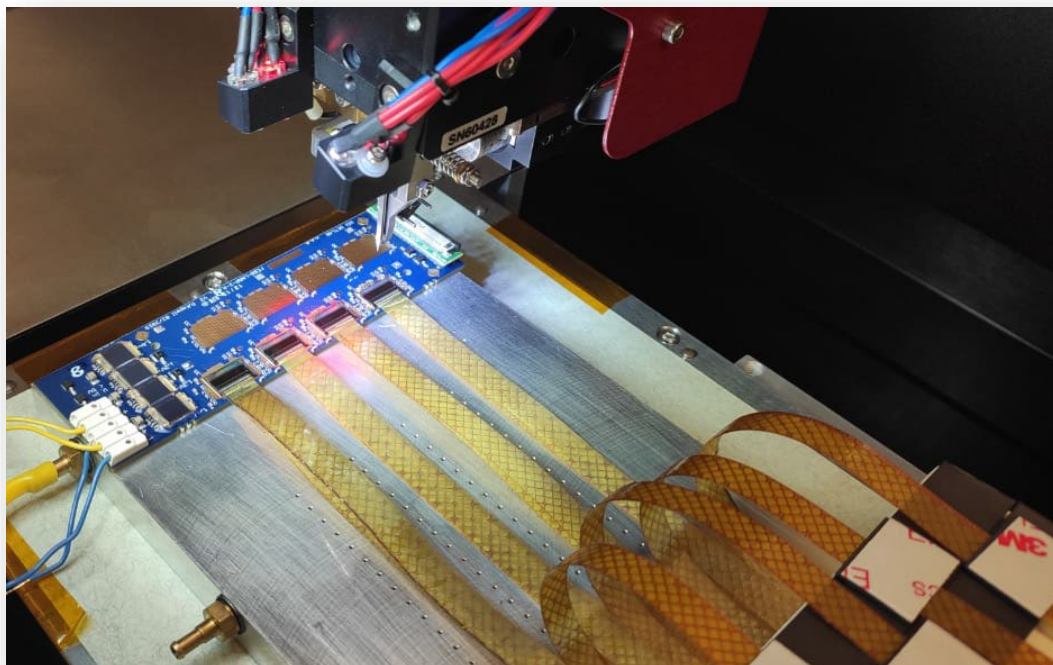
The result of bonding 1st row cables on Si -sensor



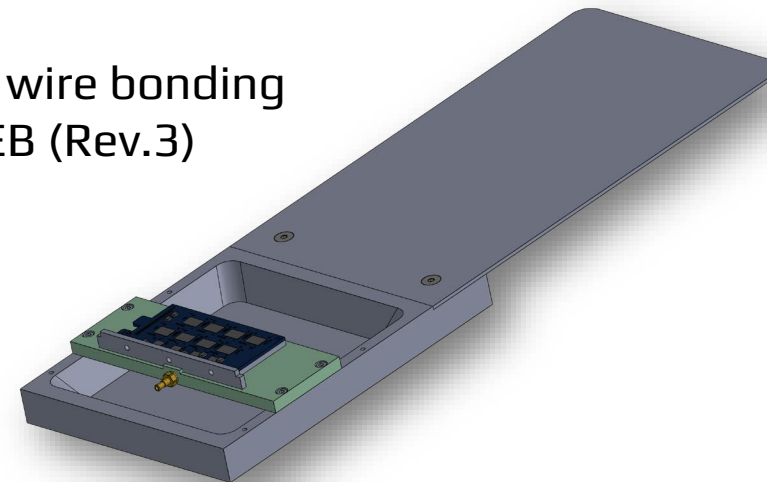
Jig of bonding 1st row cables on Si -sensor



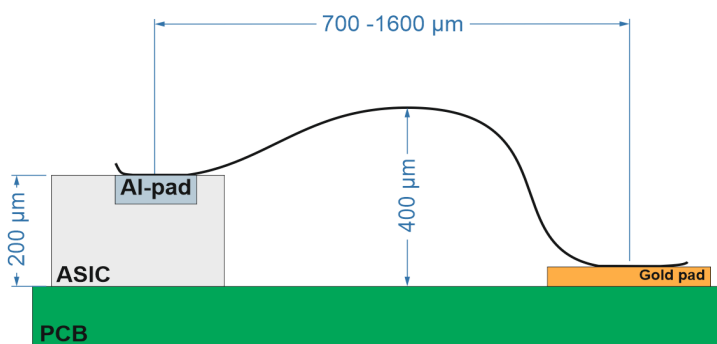
Wire bonding process ASIC and LDO to PCB



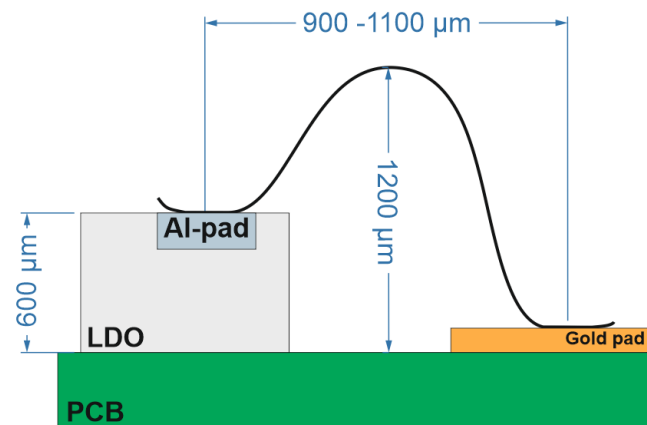
Jig for wire bonding
FEB (Rev.3)



Wire track on ASIC-PCB



Wire track on LDO-PCB

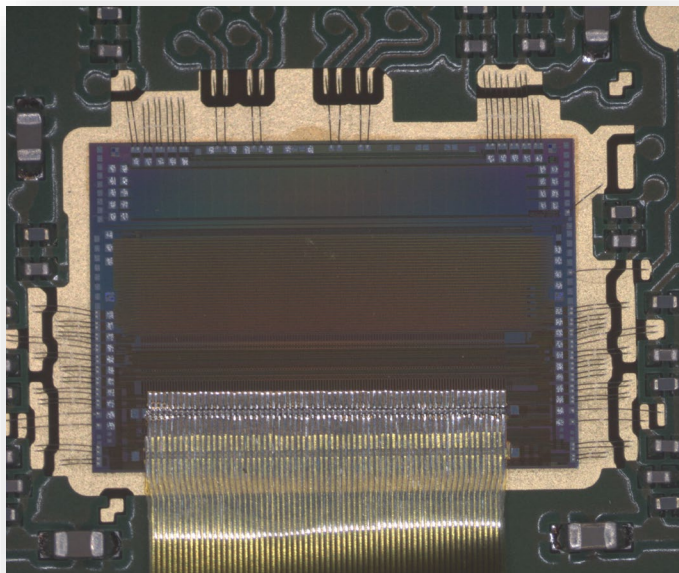


- Two types of wire bonding process;
- 25 μm Aluminum wire;
- Special ultrasonic needle with small pitch;

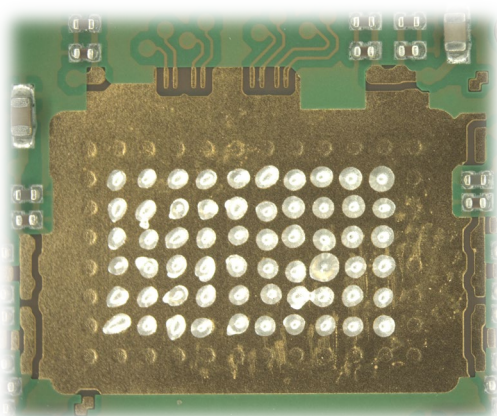


Wire bonding process ASIC and LDO to PCB

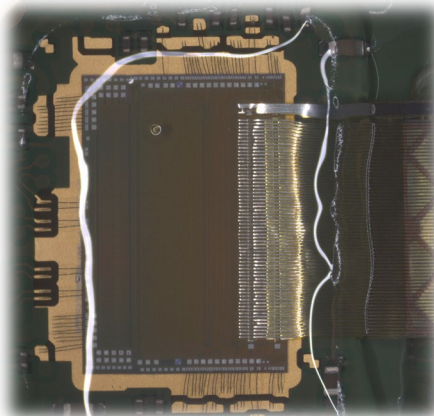
Wire bonding process of ASIC



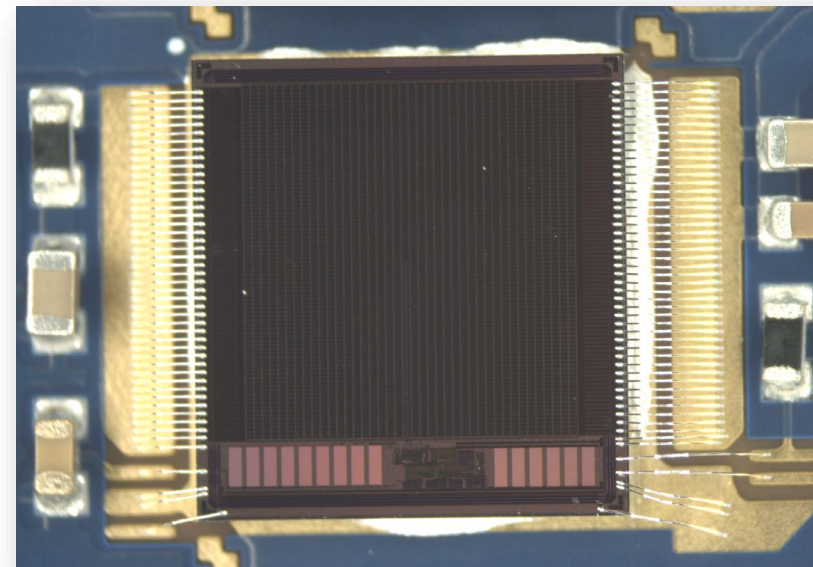
Thermal adhesives



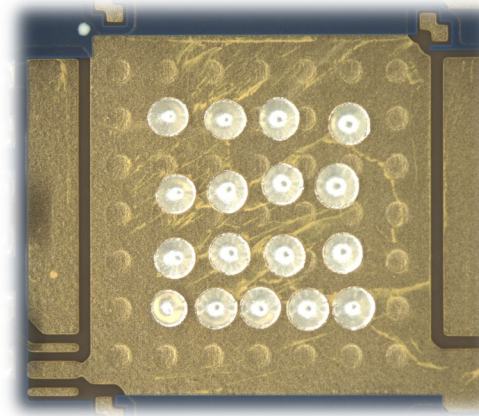
Encapsulate glue



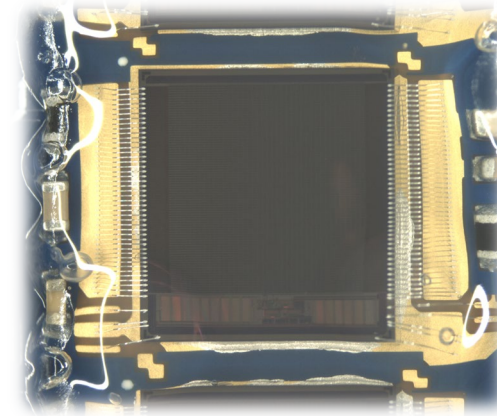
Wire bonding process of LDO



Thermal adhesives

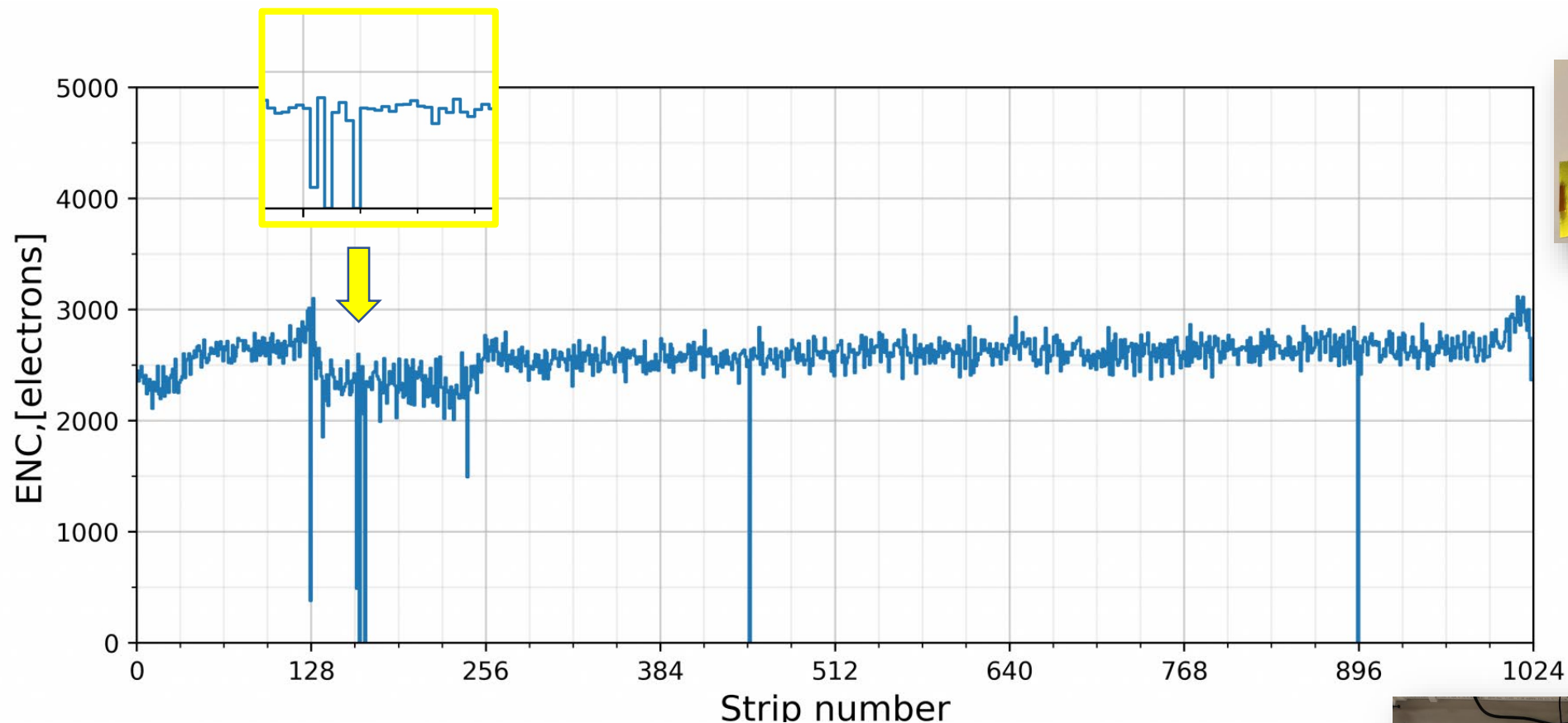


Encapsulate glue





Electrical test of half-module

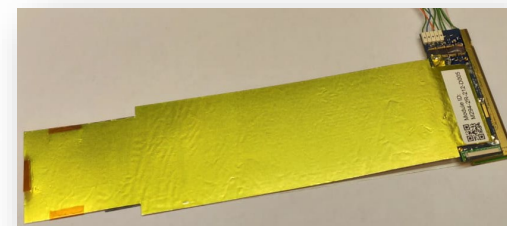


Dead channels= [164, 168, 450, 896]

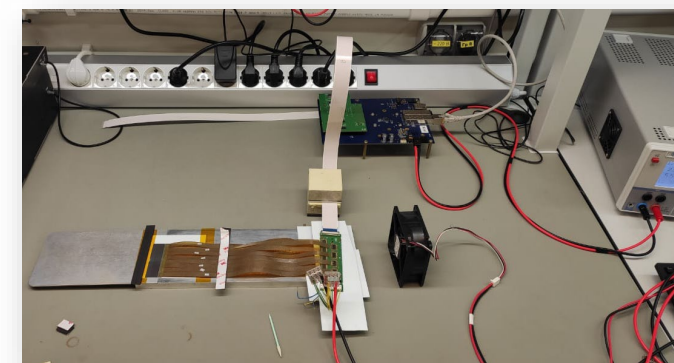
Not bonding channels = [128, 162, 235]

Not working channels on N-side of sensor: 7 Ch. [0.7%]

Test by: D. Dementev, M. Shitenkow,

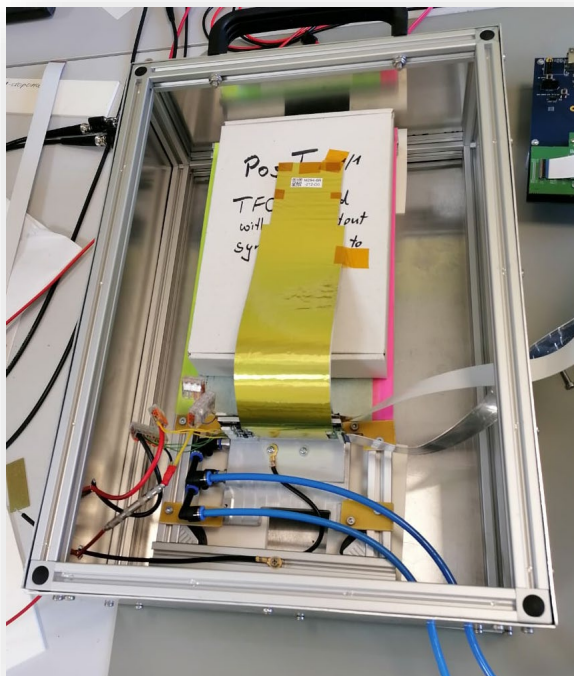


**Measurement without
HV and Test box**





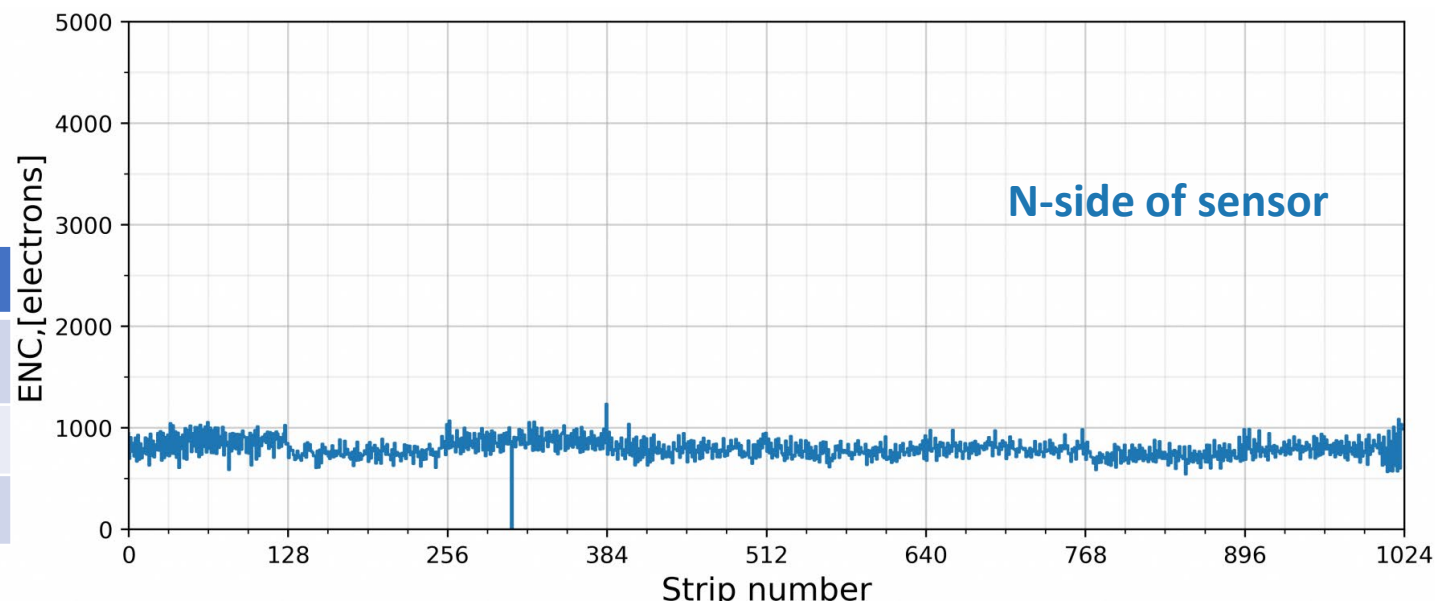
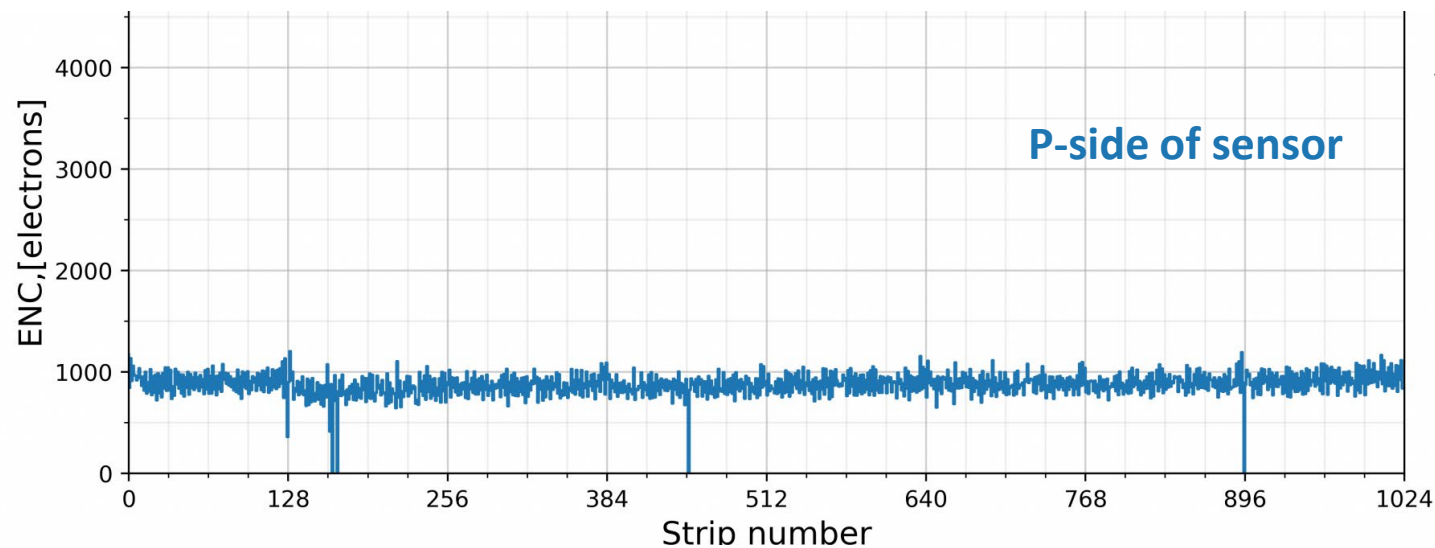
Test of STS module



Result of dead channels
at assembled modules

Module	N-side	P-side
M294-6R-212-D001	40 (4%)	23 (2,3%)
M294-2R-212-D003	5 (0.5%)	10 (1%)
M294-2R-212-D004	7 (0.7%)	11 (1.1%)

Test by: D. Dementev, M. Shitenkow.





Conclusions



- Assembly workflow has been developed and tested
- Workplaces and test benches for key technological operations has been prepared
- Set of bonding tools for assembly was designed and manufactured
- QA procedures for all components and steps of the assembly has been developed
- Technological documentation and Electronic logbook customize design has been development to store ELOG data during assembly modules
- Five modules have been assembled at JINR lab, still more components for assembly of 20 modules are required to estimate production yields for mass production

Thank you for attention!

