Status Forward Si-Tracker (FSD) and Beam Si-Tracker (SiBT)

N. Zamyatin on behalf of Forward Silicon Tracker team

11th Collaboration Meeting of the BM@N Experiment at the NICA Facility,
28-30 November 2023

Radiation bulk current of SiBT-DSSD (175 μ thickness) after Xe-run

Fluence can be estimated by the empirical formula:

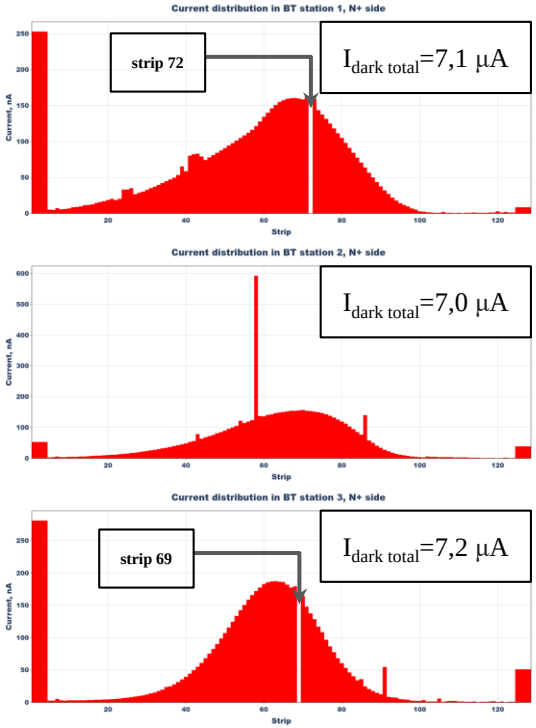
$$\Delta I = \alpha \cdot \Phi_n \cdot V_{det}$$

$$, \alpha = 3 \cdot 10^{-17}\ A \cdot cm^{-1}, V_{det} = 61 \cdot 61 \cdot 0.175\ mm^3$$

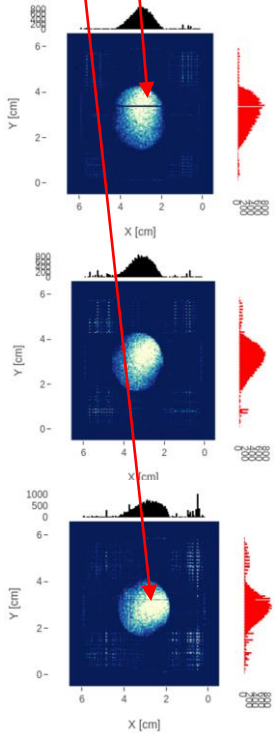
Total number of Xe-nuclei during run 2022-2023: **$4.44 \cdot 10^{10}$**

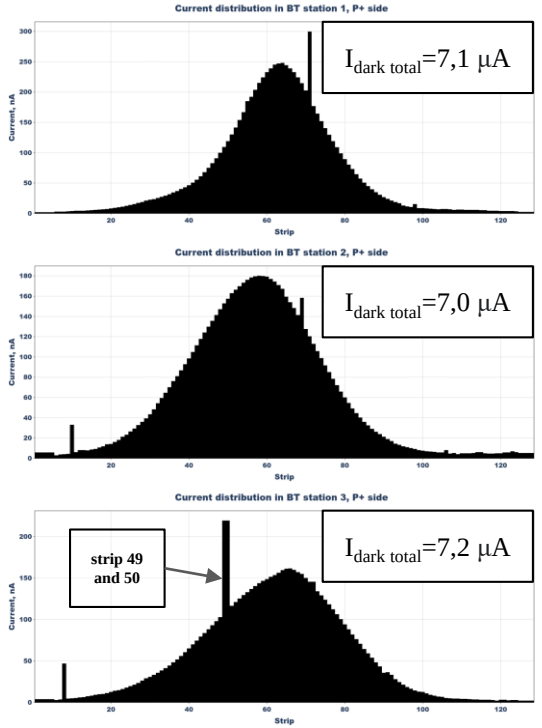
$$\Phi_n = k \cdot \Phi_{Xe}$$

k - hardness factor of 4 A*GeV Xe, k =276



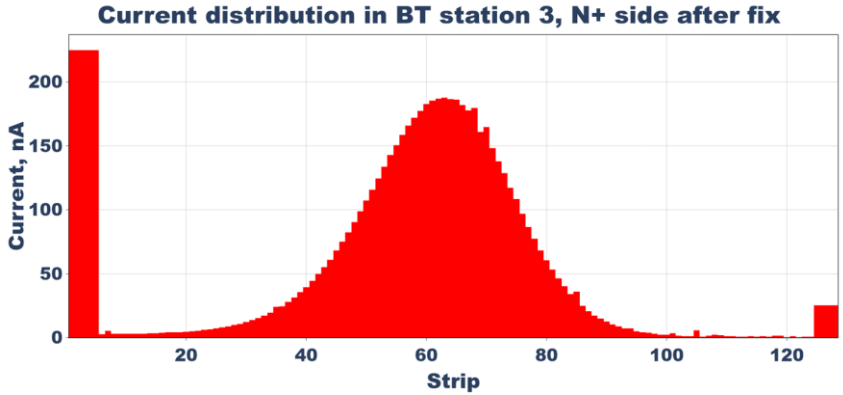
defects have been found

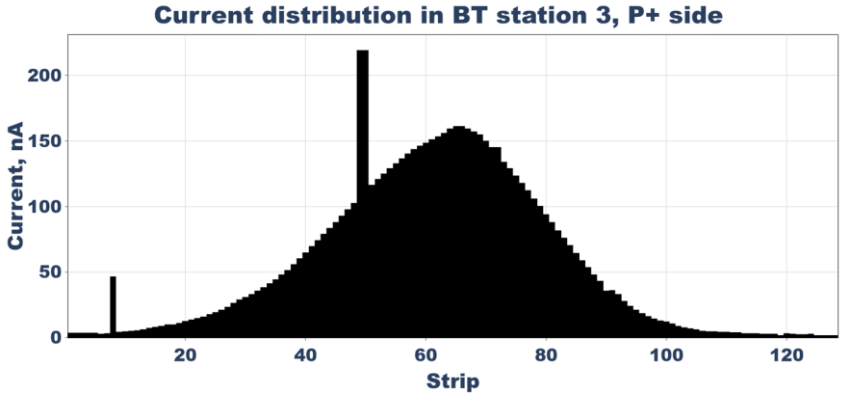




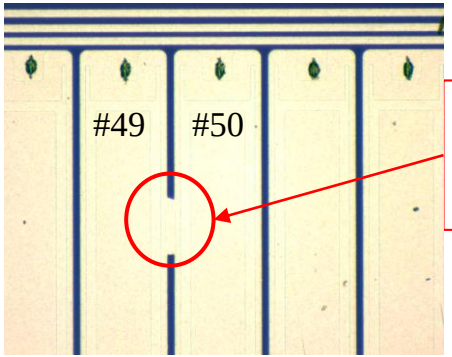
run 6705, 13.12.2022

SiBT station #3 status





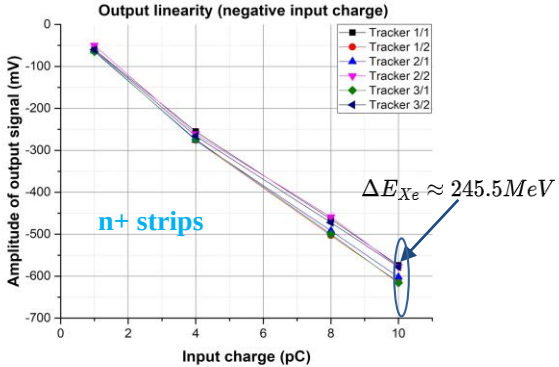
There was no pin connect #69 on the connector

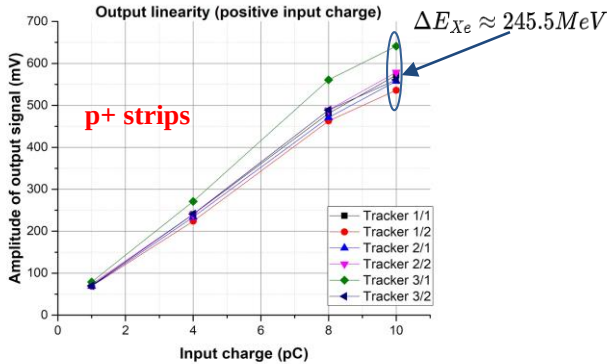


49 and 50th strips are shorted out on the detector. Irreparable defect

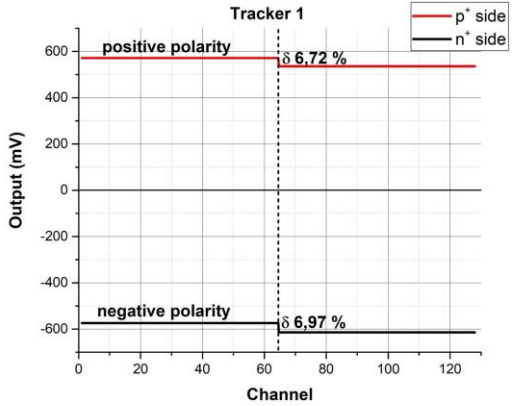
SiBT FEE status

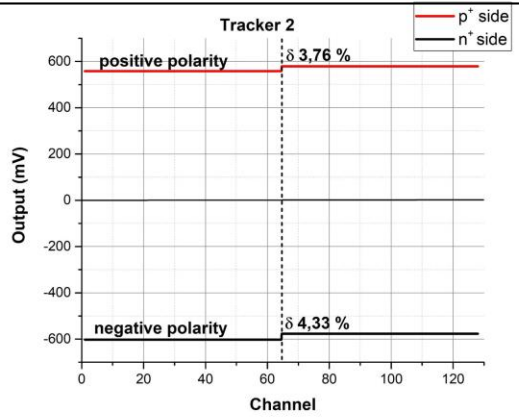
Linearity of ASICs after PCB tuning (t_s=240 nS)

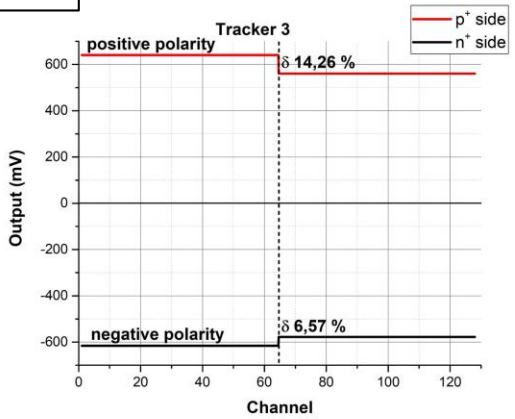




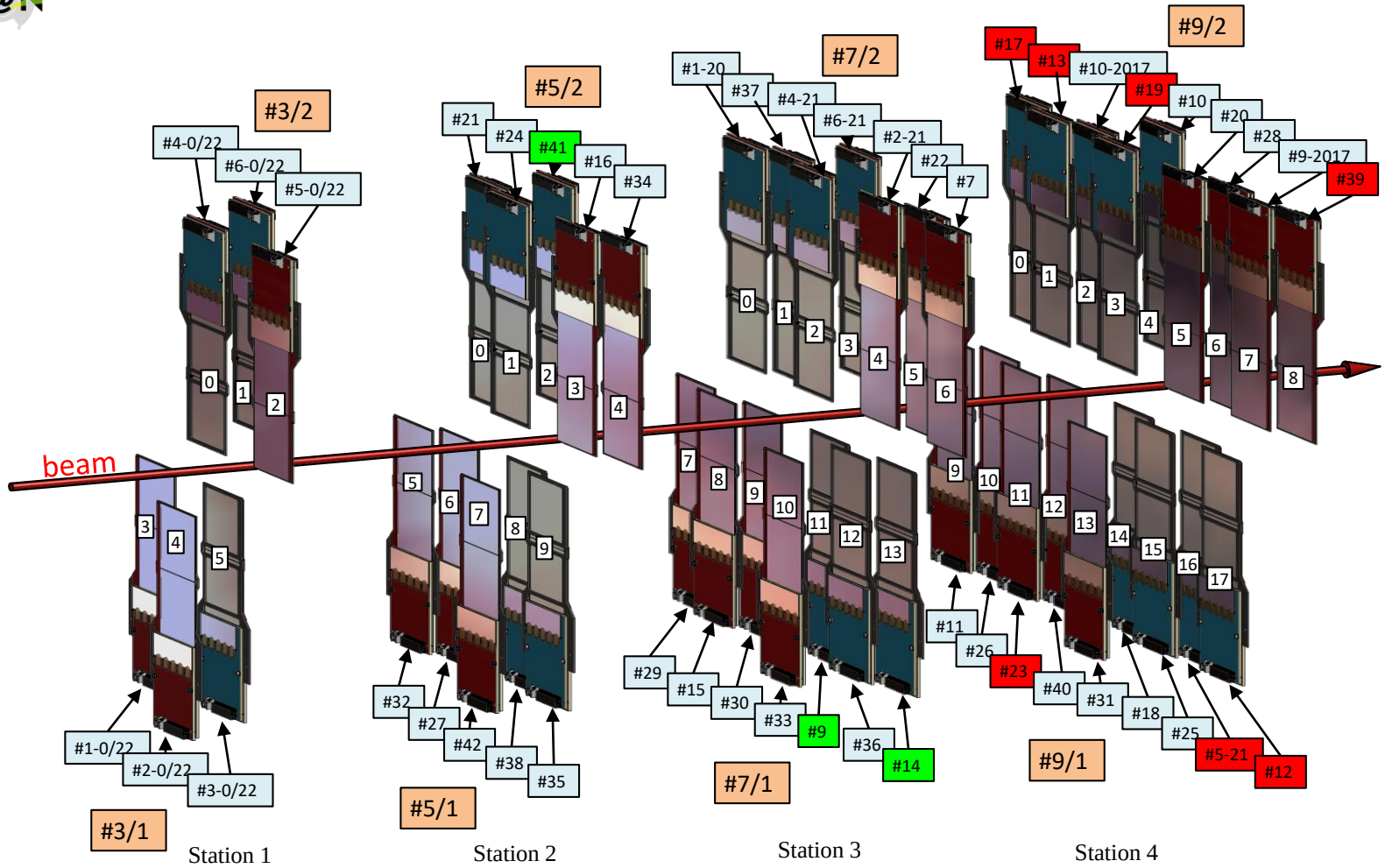
Uniformity of ASICs gain (input 10 pC, t_s=240 nS)





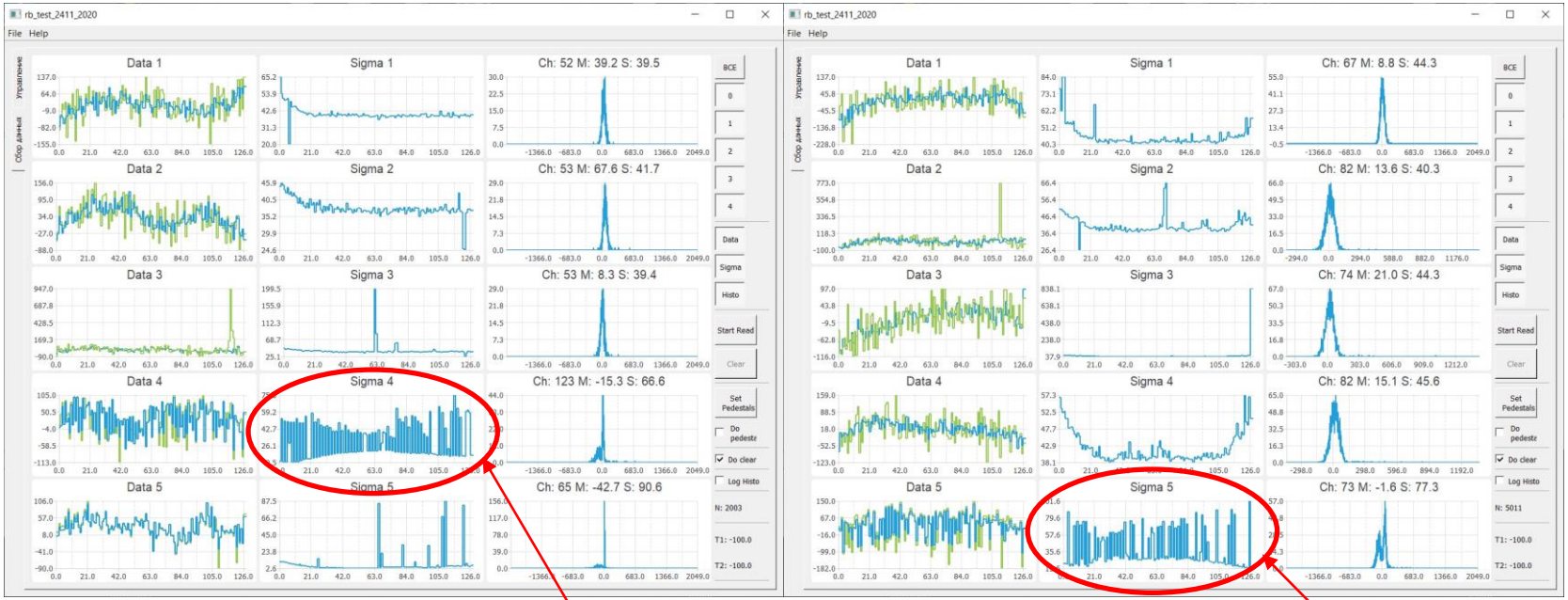


Location of FSD modules in session 2022-2023



Diagnostic of FSD defective modules

Pedestal run



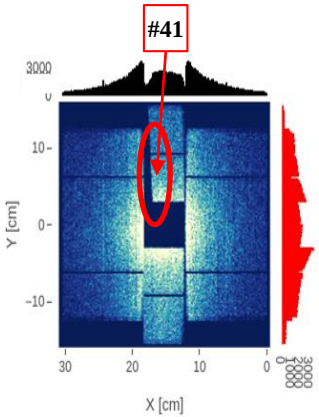
Module 14 (PCB_{p+} #23, defective chip #4)

Module 9 (PCB_{p+} #08, defective chip #5)

FSD planes before repair

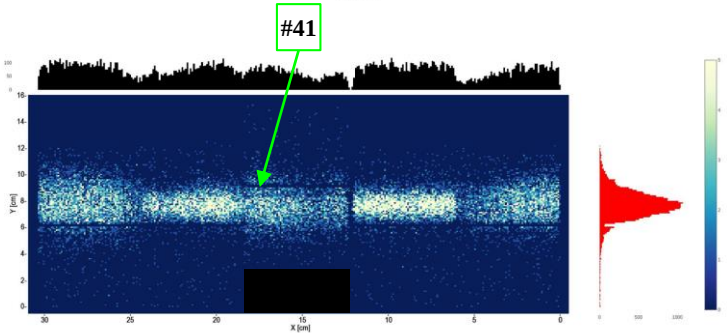
Session BM@N 2022 г. – 2023 г.
RUN 7529

Hits distribution at Station # 2 (10 modules, DSSD 63x63 mm^2 1 module = 2 DSSD)

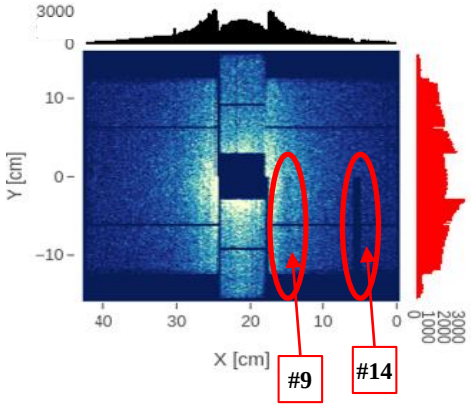


FSD planes after repair

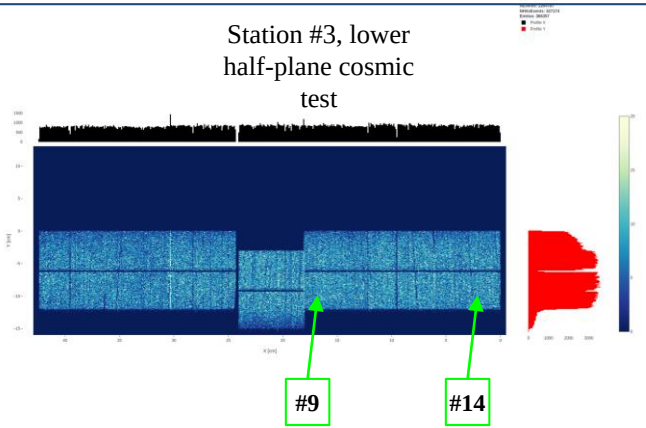
Station #2, upper half-plane with β-source



Hits distribution at Station # 3 (14 modules, DSSD 63x63 mm^2 1 module = 2 DSSD)



Station #3, lower half-plane cosmic test



Conclusions

SiBT:

- Study of long time stability of dark current DSSD SiBT-1 ÷ SiBT-3 at room temperature;
- Repair of dead channels at SiBT-1 (72 n+) and SiBT-3 (69 n+);
- Found technological defect at SiBT-3 (shorted 49 p+ and 50 p+), irreparable defect;

FSD:

- The IDs of modules with defects in the FSD planes #2, #3,# 4 are determined;
- Were assembled new FEE-PCBs: 5 PCB-640 n+ and 5 PCB-640 p+, should be assembled 8 new PCB-640 p+;
- For FSD plane #4 (18 modules) should be repaired 7 modules;
- FSD plane #2 (10 modules), FSD plane #3 (14 modules) are ready without dead chips;
- FSD planes (1 ÷ 4) should be ready for installation on BM@N experimental hall before 31 December.

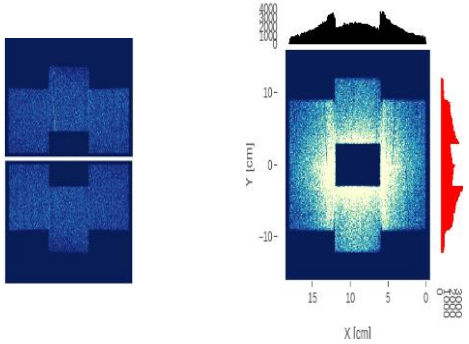
BACKUP

Analysis of the work of Si-planes FSD in Xe-run

defects before BM@N session defects after BM@N session

Cosmic tests

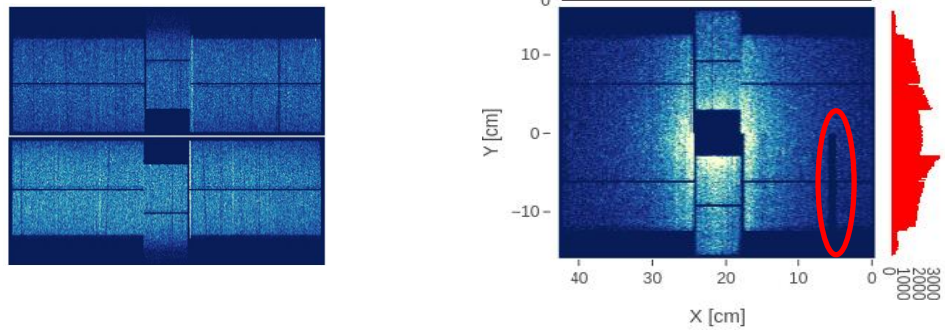
Session BM@N 2022 г. – 2023 г.
RUN 7529 (11.01.2023), t_c = 25,2°C
Target №2 CsI (2%)



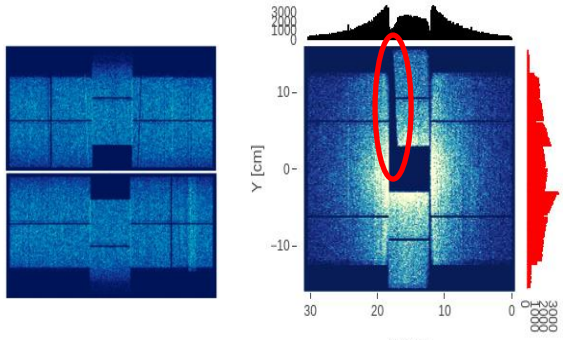
Hits distribution at Station # 0 (6 modules, DSSD 63x93 mm^2,
1 module = 1 DSSD) **$I_{start/stop}$ = 8,99 / 8,21 µA (06.12 / 01.02)**

Cosmic tests

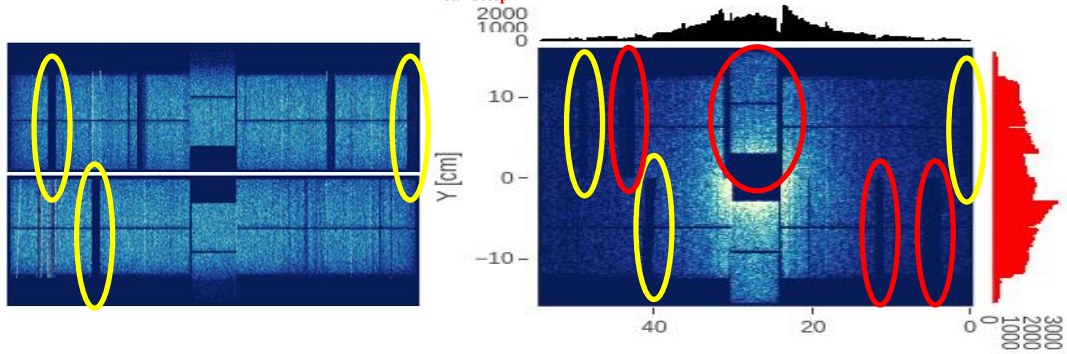
Session BM@N 2022 г. – 2023 г.
RUN 7529 (11.01.2023), t_c = 25,2°C
Target №2 CsI (2%)



Hits distribution at Station # 2 (14 modules, DSSD 63x63 mm^2
1 module = 2 DSSD) , **$I_{start/stop}$ = 27,6 / 28,5 µA (06.12 /01.02)**

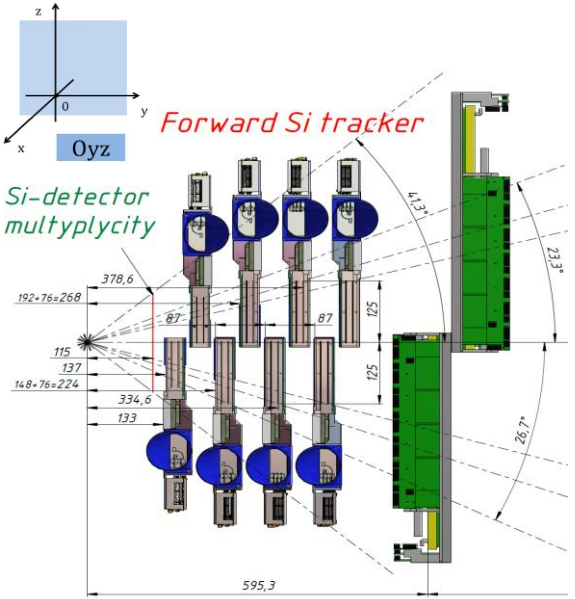


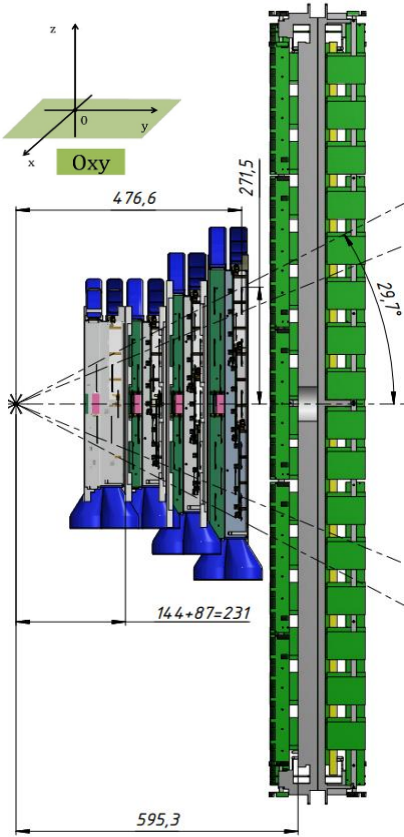
Hits distribution at Station # 1 (10 modules, DSSD 63x63 mm^2
1 module = 2 DSSD) **$I_{start/stop}$ = 40,7 / 48,33 µA (06.12 / 01.02)**



Hits distribution at Station # 3 (18 modules DSSD 63x63 mm^2
1 module = 2 DSSD) **$I_{start/stop}$ = 6,9 / 7,38 µA (06.12 /01.02)**

FSD station #4

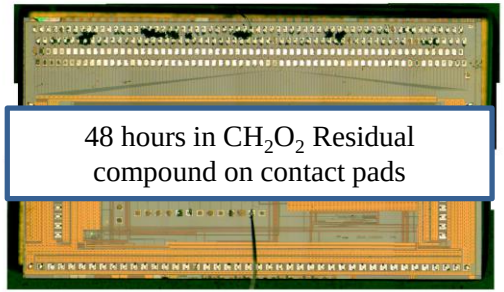




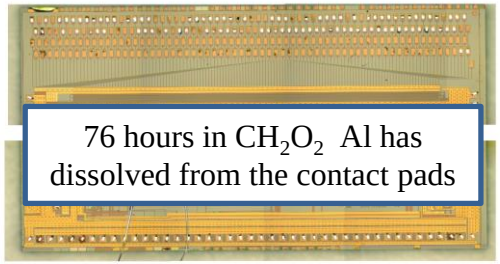
6 black PCBs and 1 red PCB are needed to eliminate all dead zones on station #4

Location of FSD planes in session 2023 (side OXY)

ASICs status



48 hours in CH_2O_2 Residual compound on contact pads



76 hours in CH_2O_2 Al has dissolved from the contact pads

Work was performed to de-encapsulate the black BE-08 compound from the electronics boards without damaging the ASICs and aluminum contact tracks in order to extract working ASICs

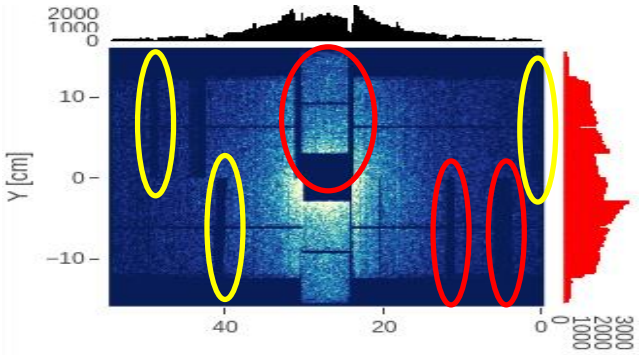
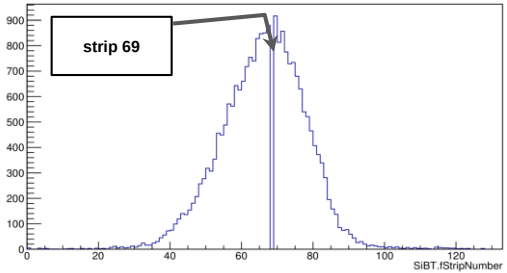
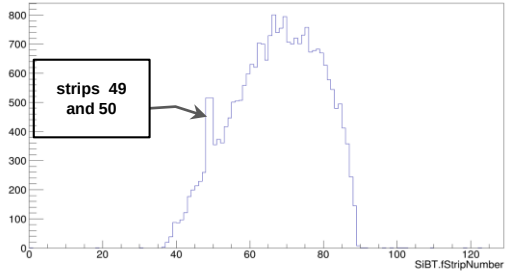
The following solvents were used:

- Dimethyl sulfoxide - C_2H_6SO
- Dimethylformamide - C_3H_7NO

The compound BE-08 degrades very slowly.

The following scheme was used:
Soaked for 48 hours in CH_2O_2 , removed the compound residue in a 1:1 solution of $C_2H_6SO + C_3H_7NO$.
To date, extracted 3 chips from 4 non-working boards.

FSD station #4



SiBT station #3