



Analysis of beam intensity data for determination of absorbed dose to solid materials for high-energy ion beams

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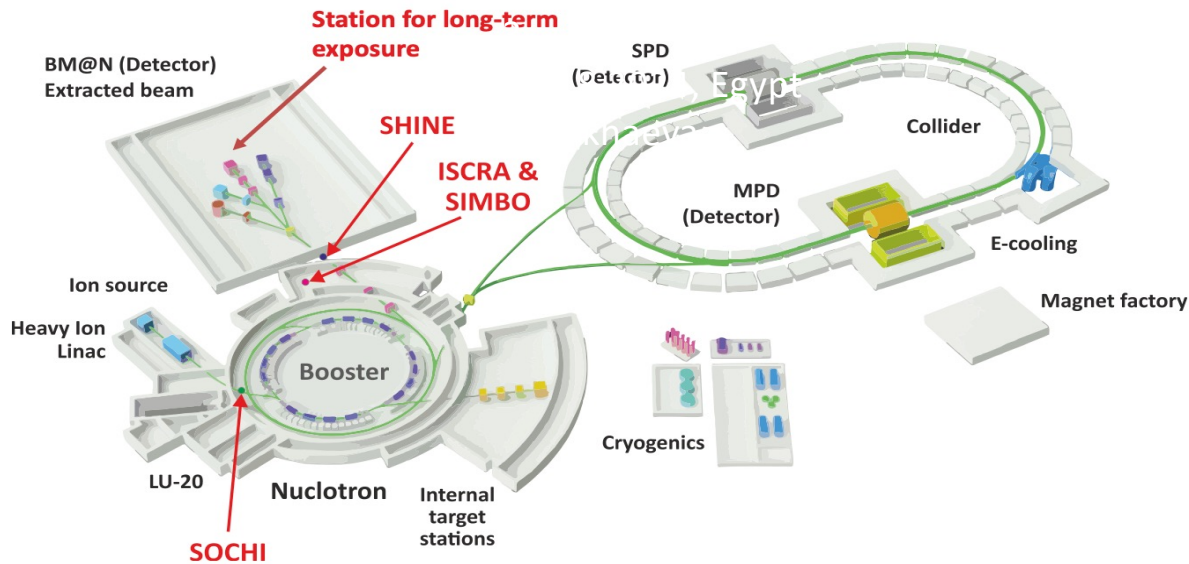
Nuclotron-based Ion Collider fAciity



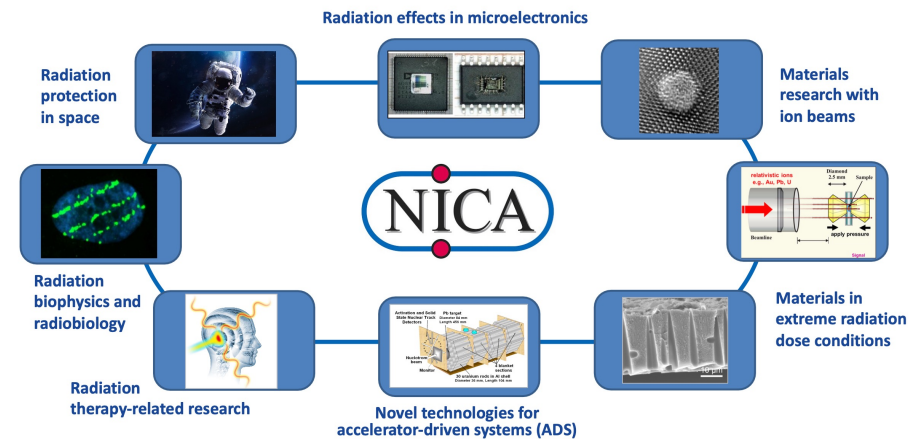
- Beams: from p , d^1 to Au
- Luminosity: $10^{27}(Au)$, $10^{32}(p)$
- Collision energy 4 – 12.6 GeV
- 2 interaction points: **MPD**(2025), **SPD**(2028)
- Fixed target experiment **BM@N**
- applied research: **ARIADNA** experiments

The Applied Research Infrastructure for Advanced Development at NICA Facility

- **ARIADNA-LS** – life science
- **ARIADNA-MSTE** – radiation materials science and radiation testing of electronics
- **ARIADNA-ADSR** – study of accelerator driven subcritical reactors



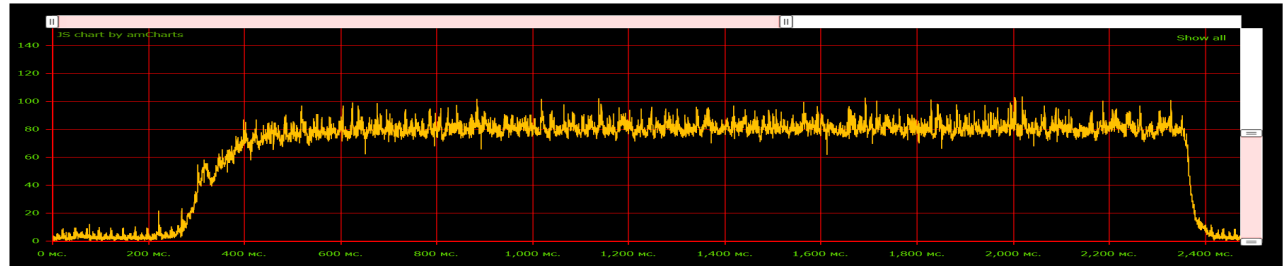
PILLARS OF APPLIED RESEARCH WITH NICA BEAMS



Analyzed data samples

The raw data were taken in the long-term exposure mode, which is the unique option currently available at the ARIADNA target station of the NICA facility

One Spill ->



- Calibration
- Sample I – seed
- Sample II – seed
- Sample III – seed
- Sample IV – seed
- Sample V – Sapphire +Films + Aluminum
- Sample VI – add composite ROC + VTSP(1)
- Sample VII – add composite MCS + VTSP(2)
- Sample VIII – Cobalt

- 2022-12-11 to 2022-12-15
- 2022-12-16 to 2022-12-20
- 2022-12-20 to 2022-12-21
- 2022-12-21 to 2022-12-22
- 2022-12-22 to 2022-12-23
- 2022-12-26 to 2023-01-20
- 2023-01-10 to 2023-01-16
- 2023-01-16 to 2023-01-20
- 2023-01-29 to 2023-01-30

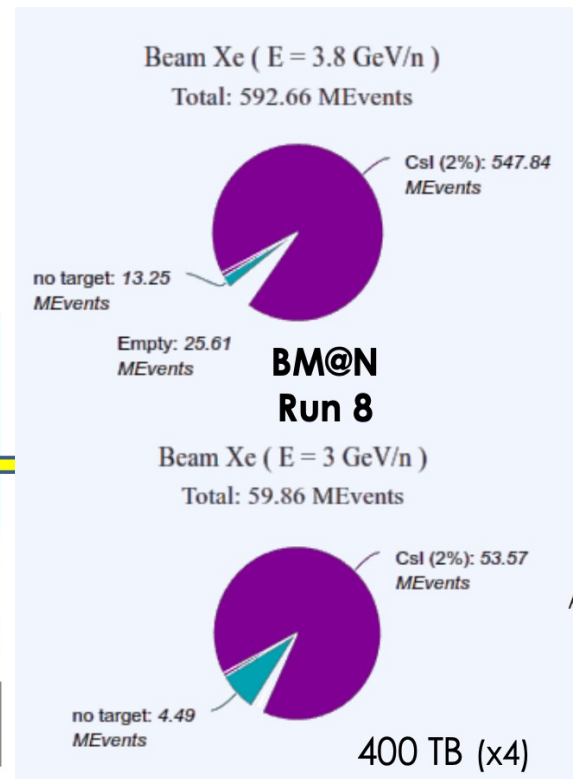
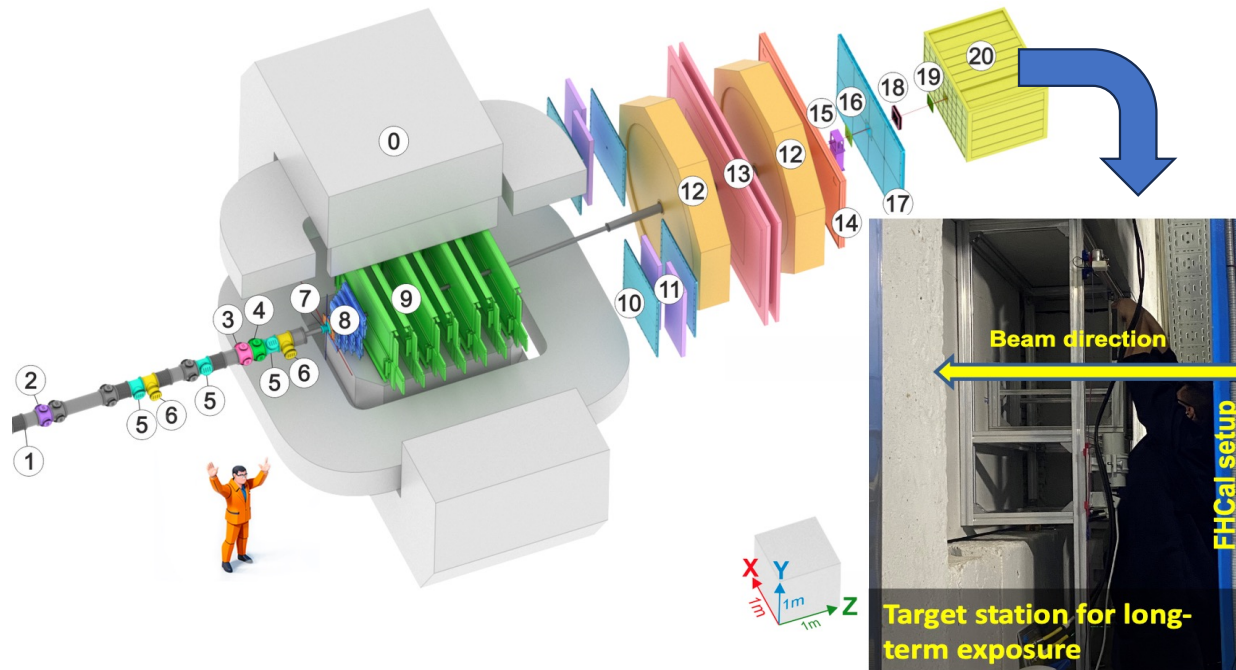


Analyzed data *BM@N with Station*

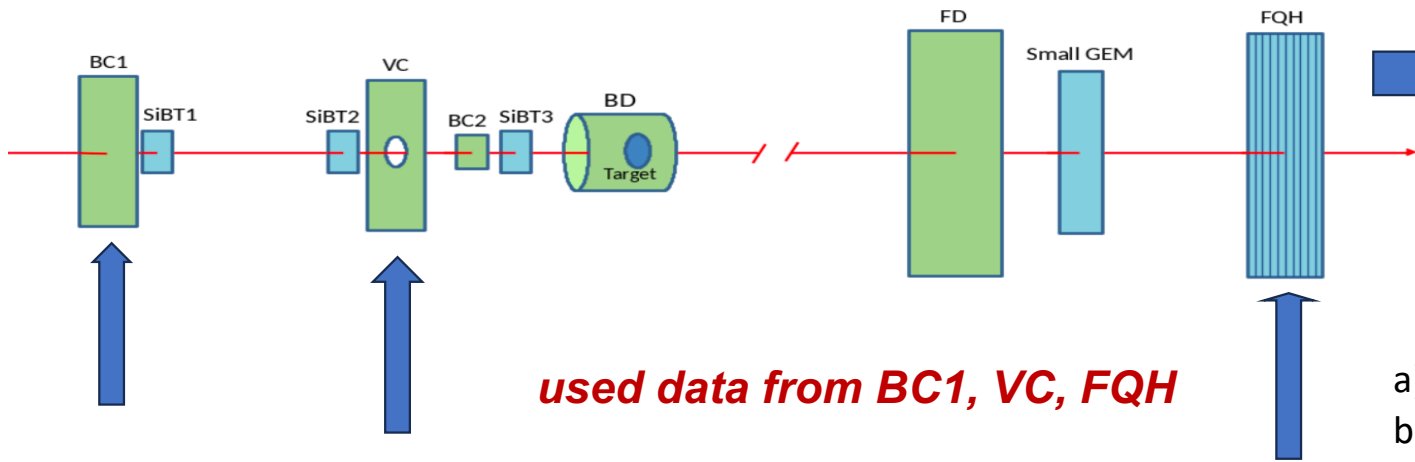
- First BM@N Physics Run
- Interaction rate: 10 kHz
- Dec 12 – Feb 02 2023

- Beam: Xe 3.8, 3.0 GeV
- Target: Csi or empty
- Detectors: FSD, GEM, ToF400, ToF700, FHCal, ...

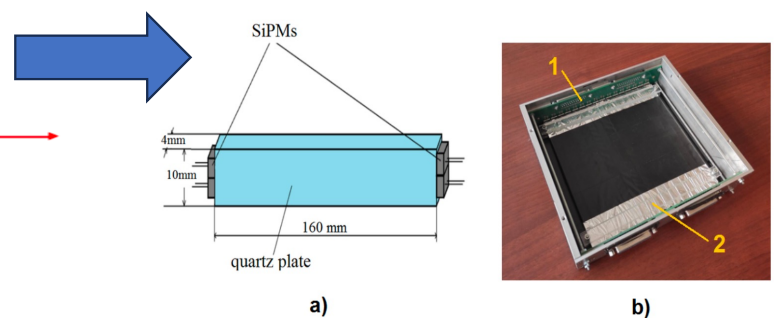
- Magnet SP-41 (0)
- Vacuum Beam Pipe (1)
- BC1, VC, BC2 (2-4)
- SiBT, SiProf (5, 6)
- Triggers: BD + SiMD (7)
- FSD, GEM (8, 9)
- CSC 1x1 m² (10)
- TOF 400 (11)
- DCH (12)
- TOF 700 (13)
- ScWall (14)
- FD (15)
- Small GEM (16)
- CSC 2x1.5 m² (17)
- Beam Profilometer (18)
- FQH (19)
- FHCal (20)
- HGN (21)



Analyzed data from BC1, VC, FQH

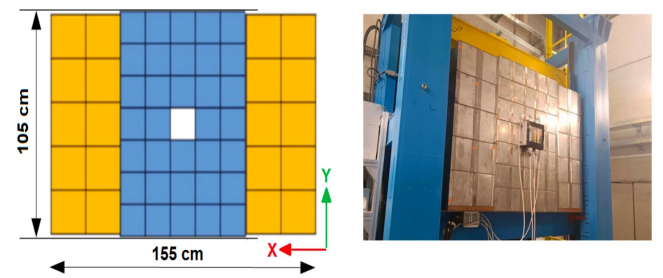


used data from BC1, VC, FQH



a) An FQH strip with SiPM photodetectors
b) The Forward Quartz Hodoscope

Detector	Z position, cm	Active area, mm × mm	Material	Thickness, mm
BC1	-422	100 × 100	Scint. BC400B	0.25
SiBT1	-283	61 × 61	Silicon	0.175
SiBT2	-183	61 × 61	Silicon	0.175
VC	-124	113 × 113 (hole ∅ 25)	Plastic Scint.	4
BC2	-104	34 × 34	Scint. BC400B	0.15
SiBT3	-84	61 × 61	Silicon	0.175
FD	+784	150 × 150	Scint. BC408	0.5
Small GEM	+793	100 × 100		
FQH	+970	160 × 160	Quartz	4

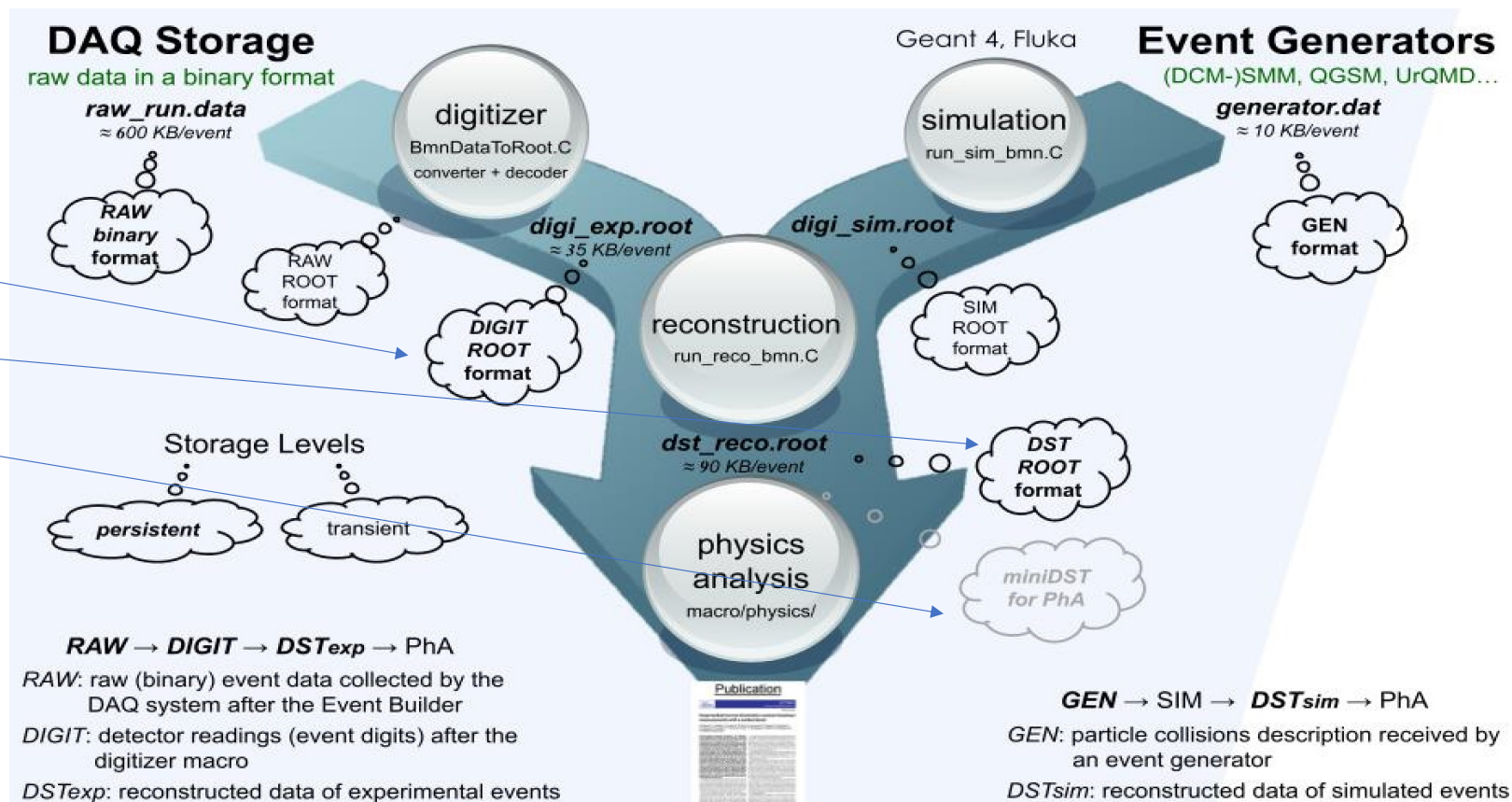


Schematic view of the FHCAL

Used: DIGIT files

:DST_exp files

Create miniDST



The intensity is measured before collision with the target that requires additional study on how the intensity decreases after passing through each detector and approximation of the intensity, which reaches a particular sample.

Calibration

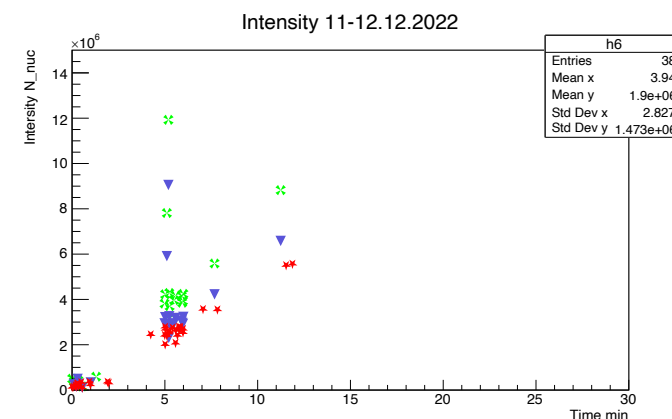
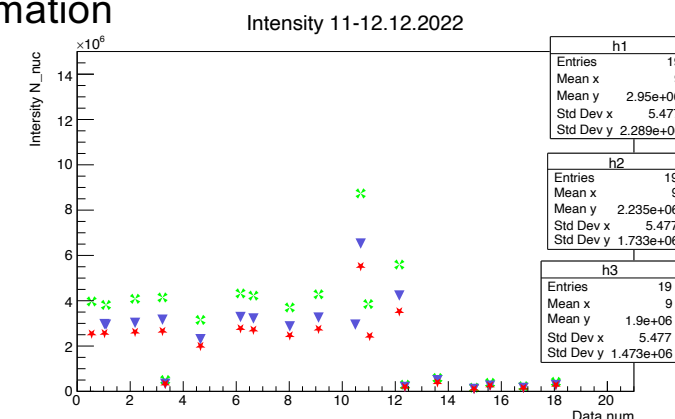
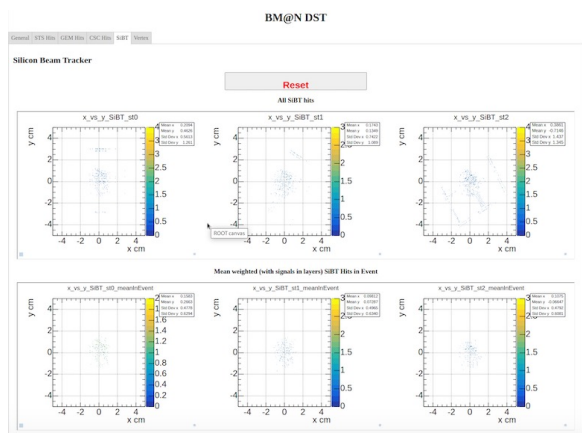
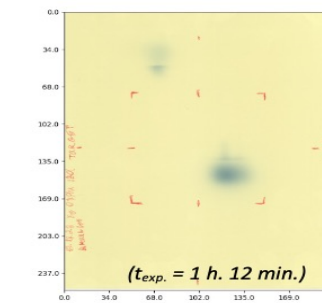
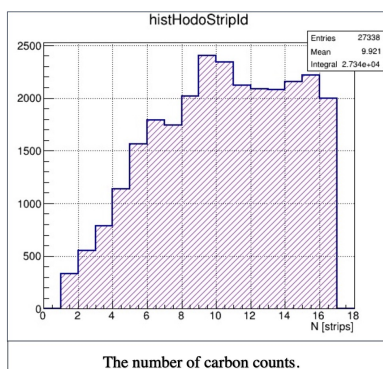
12-11 9:00 up to 2022-12-16 9:00

Number of files = 19

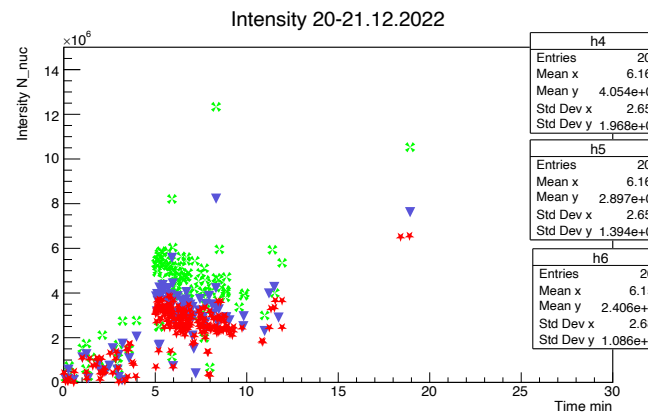
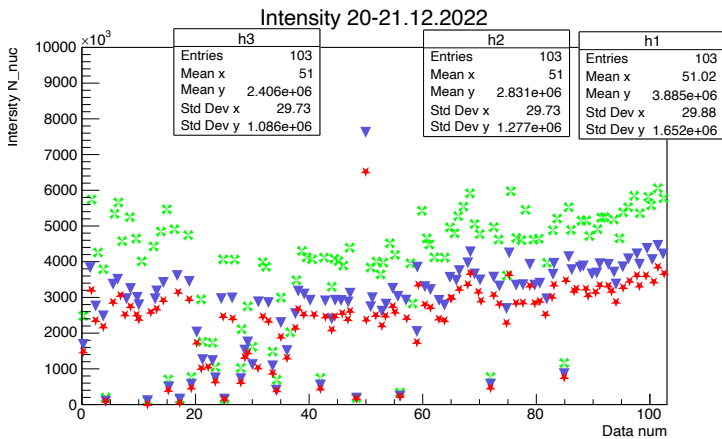
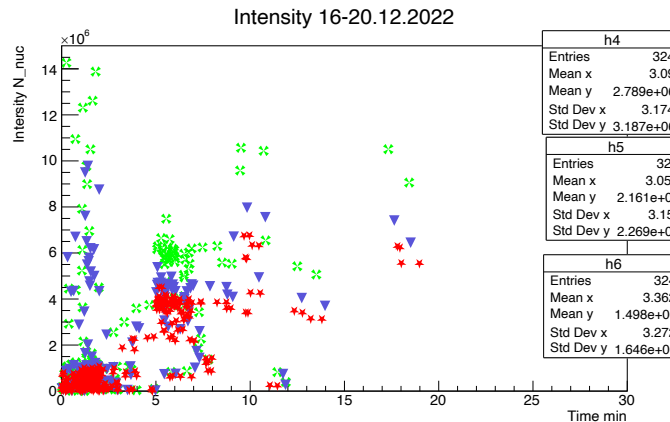
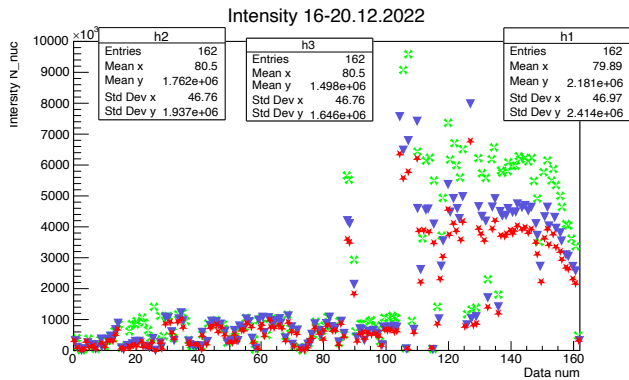
Beam. = $5.60473e+07$

In Pipe. = $5.00796e+07$

Up to FHQ = $4.24668e+07$



Results of analysis *Seeds I-II*

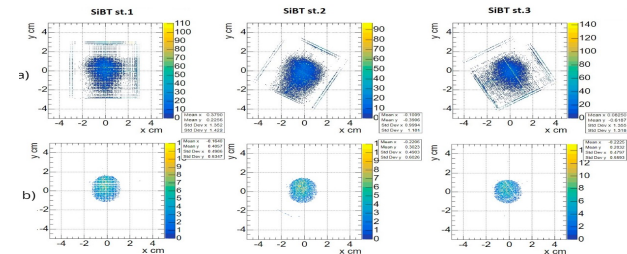


Seed I

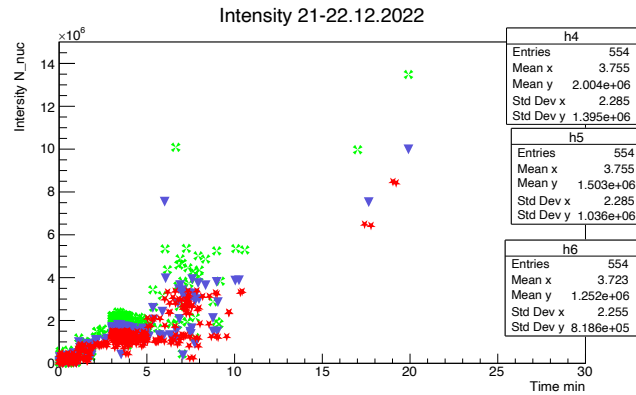
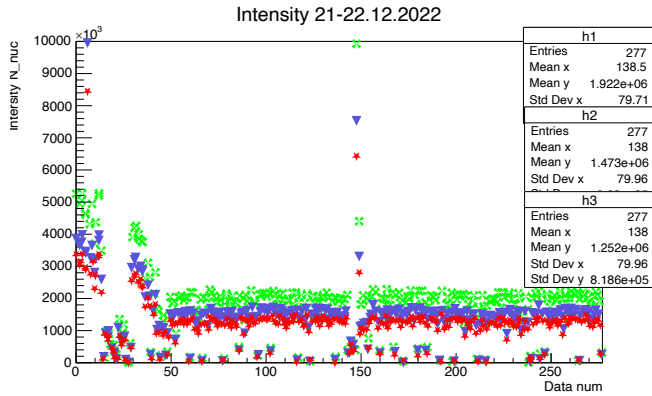
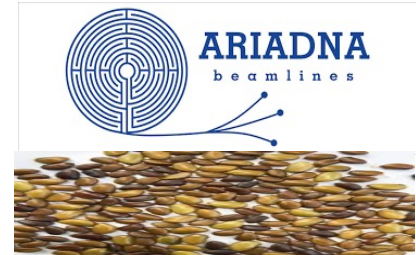
12-16 9:00 up to 2022-12-20 9:00
 Number of files = 163
 Beam = 3.78430e+08
 In Pipe = 2.85438e+08
 Up to FHQ = 2.42622e+08

Seed II

12-20 9:00 up to 2022-12-21 9:00
 Number of files = 103
 Beam = 4.06836e+08
 In Pipe = 2.91588e+08
 Up to FHQ = 2.47850e+08



Results of analysis *Seed III-IV*

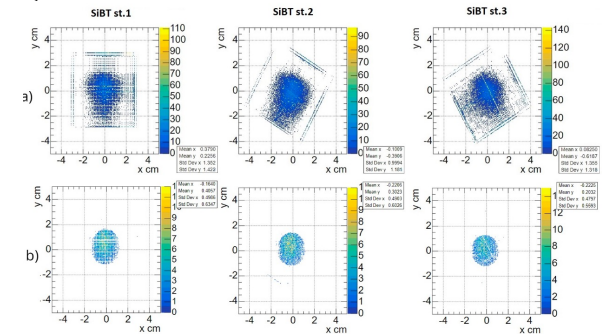
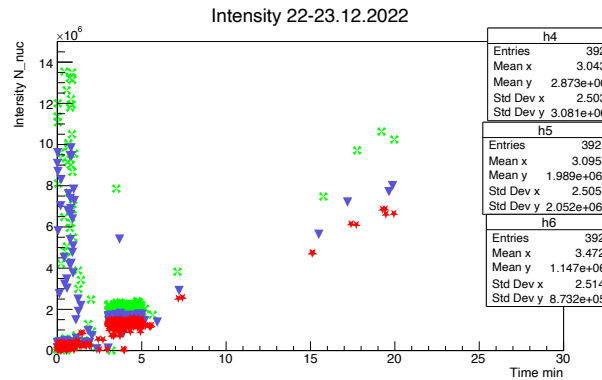
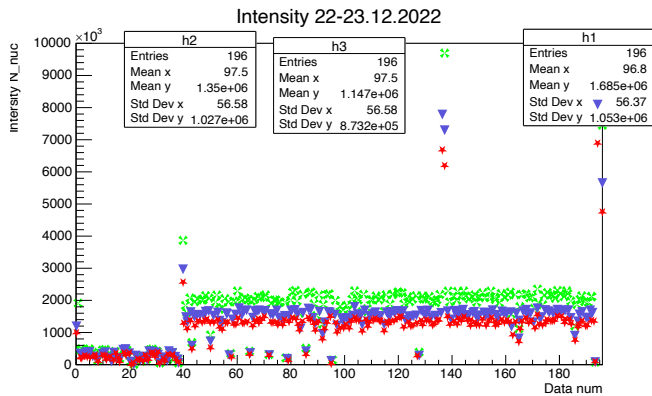


Seed III

12-21 9:00 up to 2022-12-22 9:00
 Number of files = 277
 Beam = 5.43744e+08
 In Pipe = 4.08018e+08
 Up to FHQ = 3.46815e+08

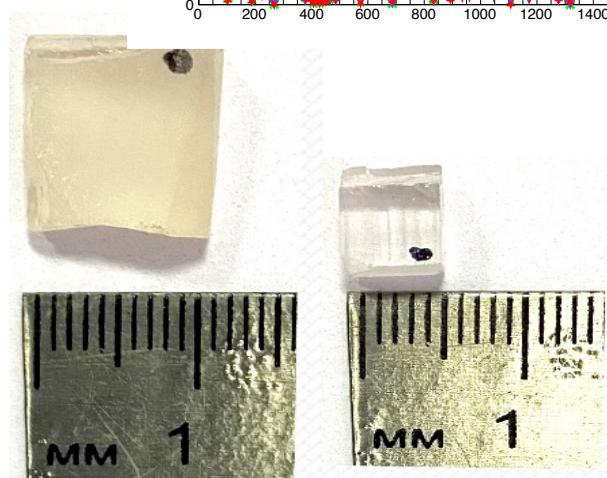
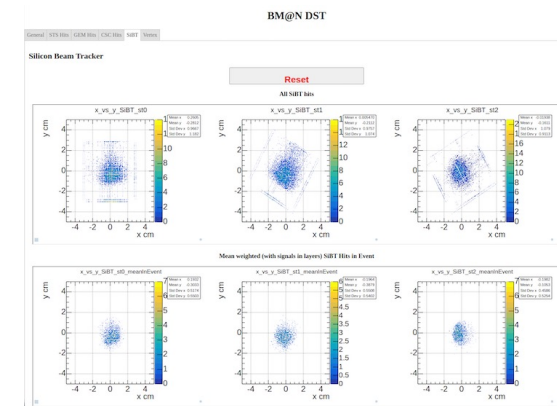
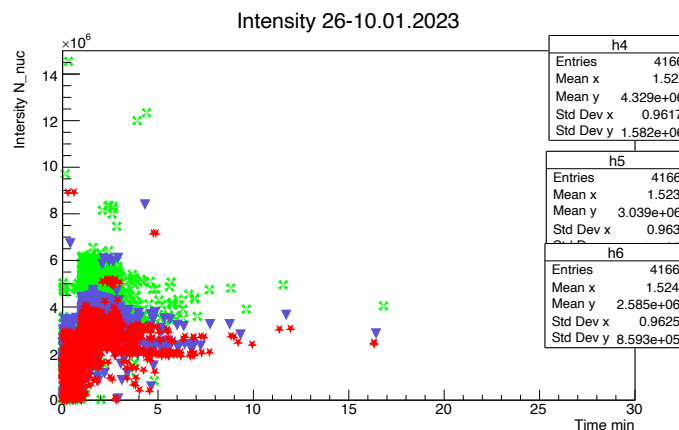
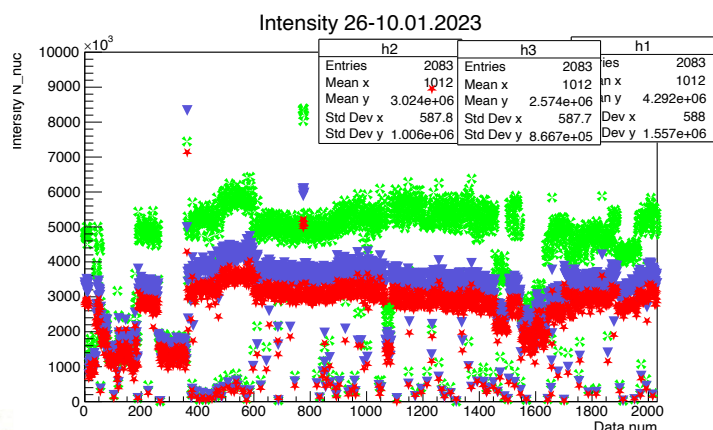
Seed IV

12-22 9:00 up to 2022-12-23 9:00
 Number of files = 196
 Beam = 3.47916e+08
 Veto = 2.64596e+08
 FHQ = 2.24907e+08



Results of analysis

V – Sapphire +Films + Al



V – Sapphire +Films + Aluminum

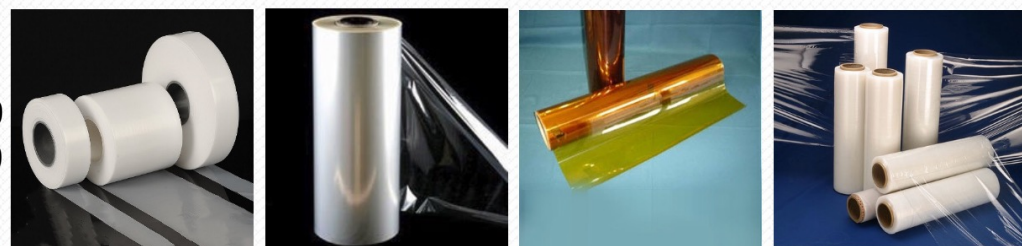
12-26 9:00 up to 2023-01-10 9:00

Number of files = 2031

Beam = $9.73094e+09$

In Pipe = $6.81593e+09$

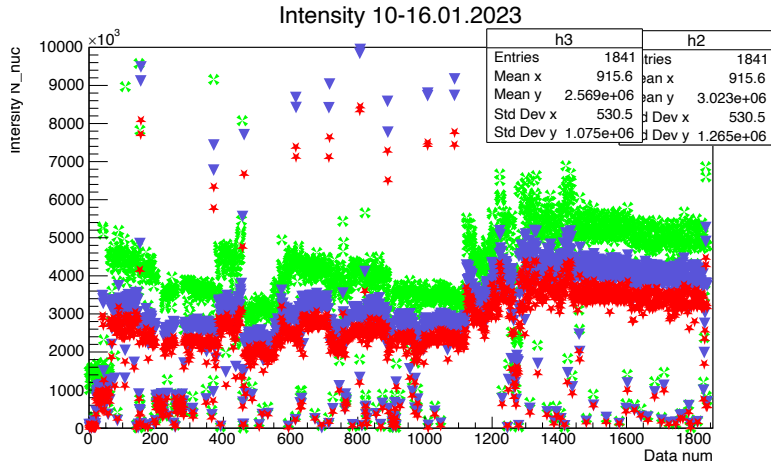
Up to FHQ = $5.79354e+09$



PTFE, PET, PE and PI films of 12, 20, 40, 50, 80 μm thick

Results of analysis

VI-add composite ROC + VTSP(1)



VI – add composite ROC + VTSP(1)

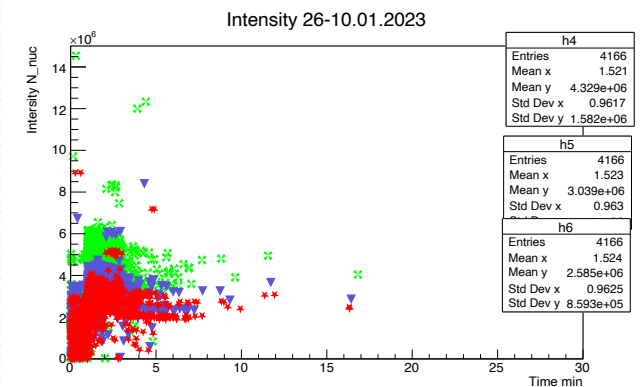
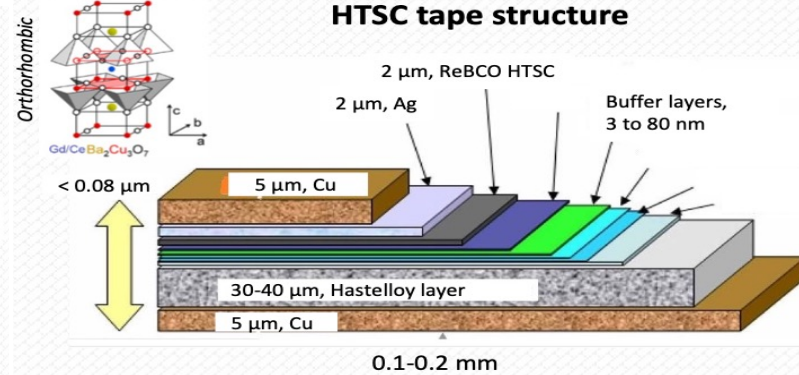
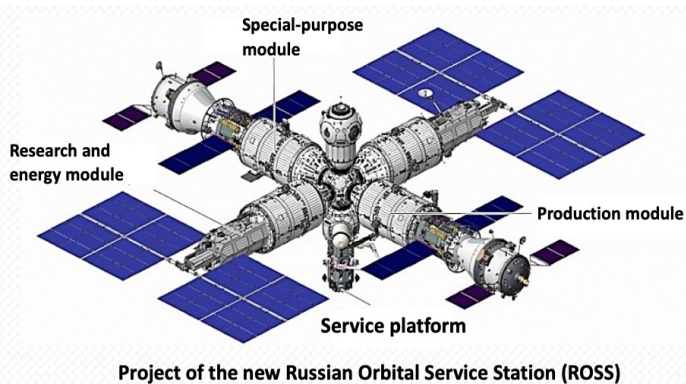
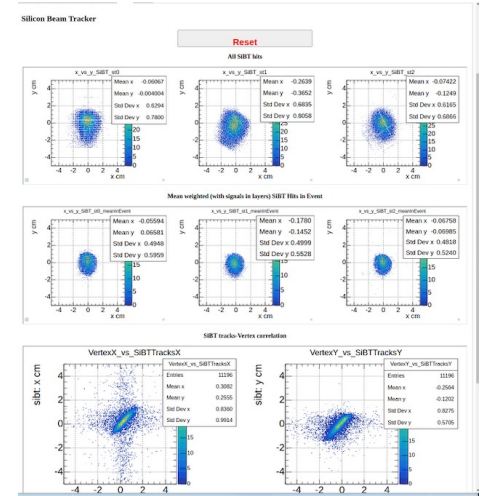
01-10 9:00 up to 2023-01-16 9:00

Number of files = 1857

Beam = 7.56554e+09

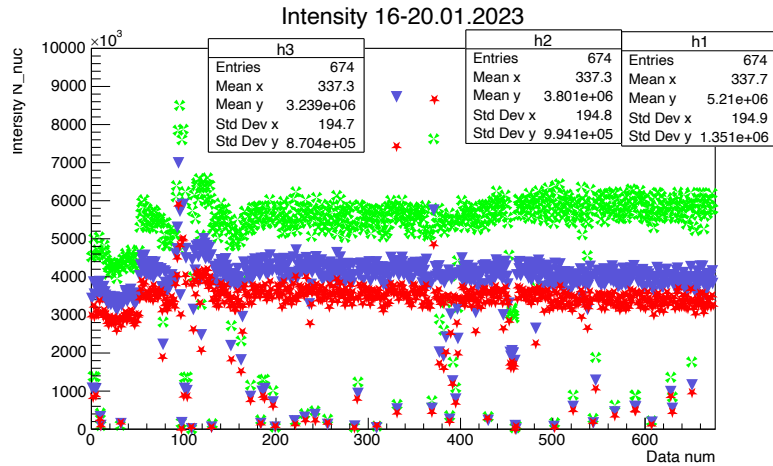
In Pipe = 5.72300e+09

Up to FHQ= 4.86455e+09



Results of analysis

VII- add composite MCS + VTSP(2)



VII — add composite MCS + VTSP(2)

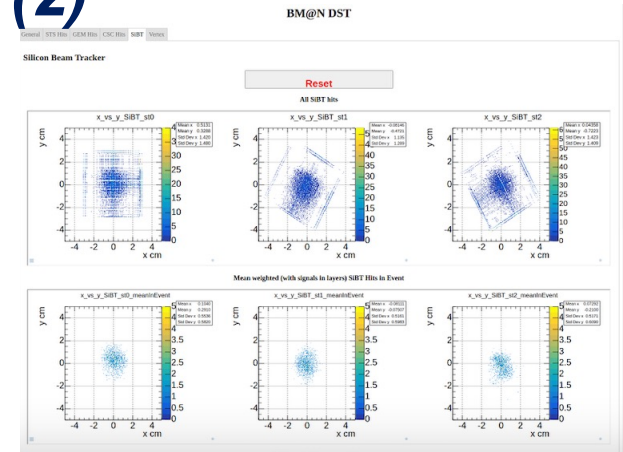
01-16 9:00 up to 2023-01-20 9:00

Number of files = 721

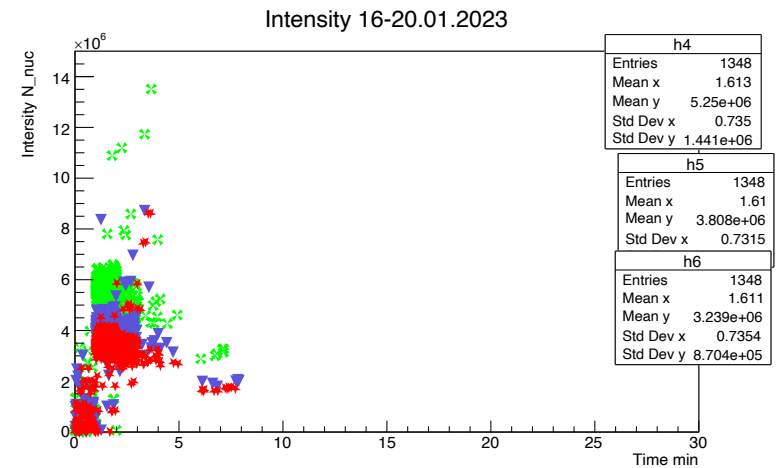
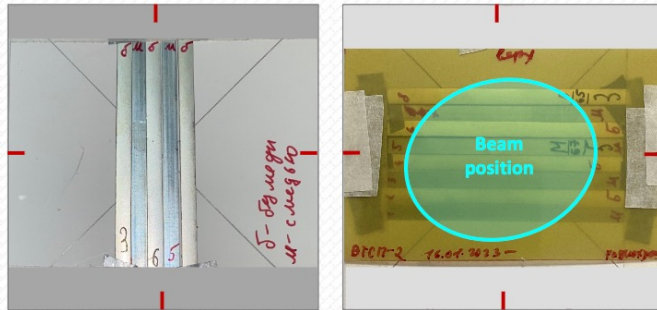
Beam = 3.76358e+09

Beam in Pipe = 2.82269e+09

Beam up FHQ = 2.39928e+09

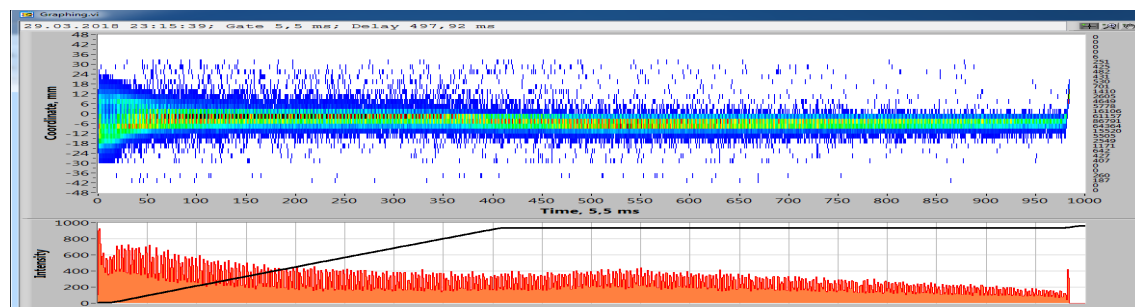


Irradiation of vertically and horizontally arranged HTSC tapes with and without copper content





First results for study of irradiated samples from Nuclotron beam data at 3.8 AGeV



- *Full data of Run8 ~ 550 mill events Analyzed*
- *Software was developed for investigation of intensity and profile of the beam*
- *Compered duration of each run with integral of intensity*
- *Investigated which fraction of beam could achieve till area of station*
- *Integral of intensity and profile of beam for each samples are measured*
- *The beam profile and intensity distributions together with overall intensity and duration of radiation exposure are analyzed for the set of samples of different geometry and chemical composition.*
- *Study under going, continue and ready for new data taking*

Measured intensity and profile per samples

- Calibration
- Sample I – seed
- Sample II – seed
- Sample III – seed
- Sample IV – seed
- Sample V – Sapphire +Films + Aluminum
- Sample VI – add composite ROC + VTSP(1)
- Sample VII – add composite MCS + VTSP(2)

$N_{files} = 19$, Intensity = $4.24668e+07$ nucl

$N_{files} = 163$, Intensity = $2.42622e+08$ nucl

$N_{files} = 103$, Intensity = $2.47850e+08$ nucl

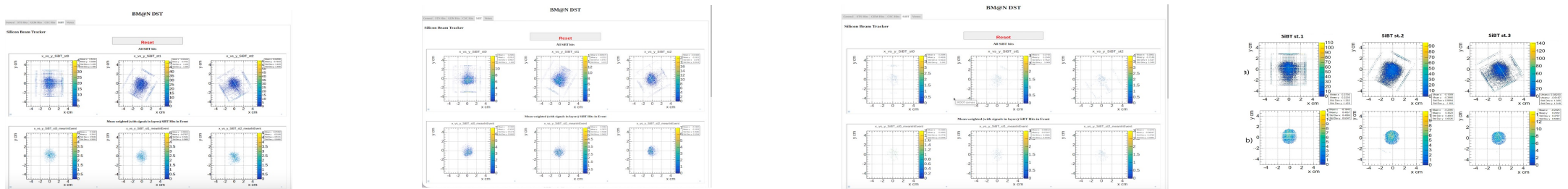
$N_{files} = 277$, Intensity = $3.46815e+08$ nucl

$N_{files} = 196$, Intensity = $2.24907e+08$ nucl

$N_{files} = 2031$, Intensity = $5.79354e+09$ nucl

$N_{files} = 1857$, Intensity = $4.86455e+09$ nucl

$N_{files} = 721$, Intensity = $2.39928e+09$ nucl





Thanks for your attention



