ARIADNA: Model of experiments and method of analysis the data of applied research at NICA complex

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Nuclotron-based Ion Collider fAcility

- 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

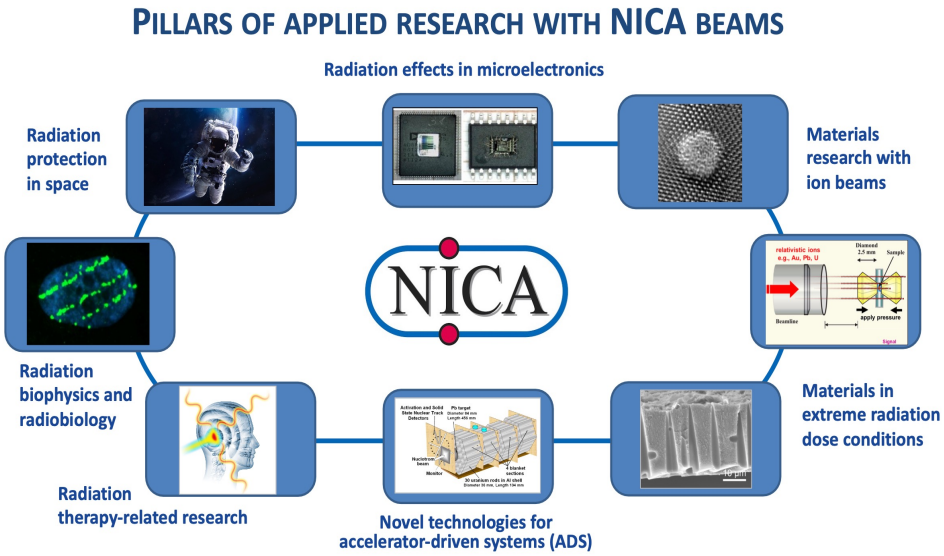
ARIADNA - The Applied Research Infrastructure for Advanced Development at NICA fAcility

*ARIADNA – **collaborations** – 30 organizations*

ARIADNA-LS in the field of *life science*

ARIADNA-MSTE *radiation materials science and radiation testing of electronics*

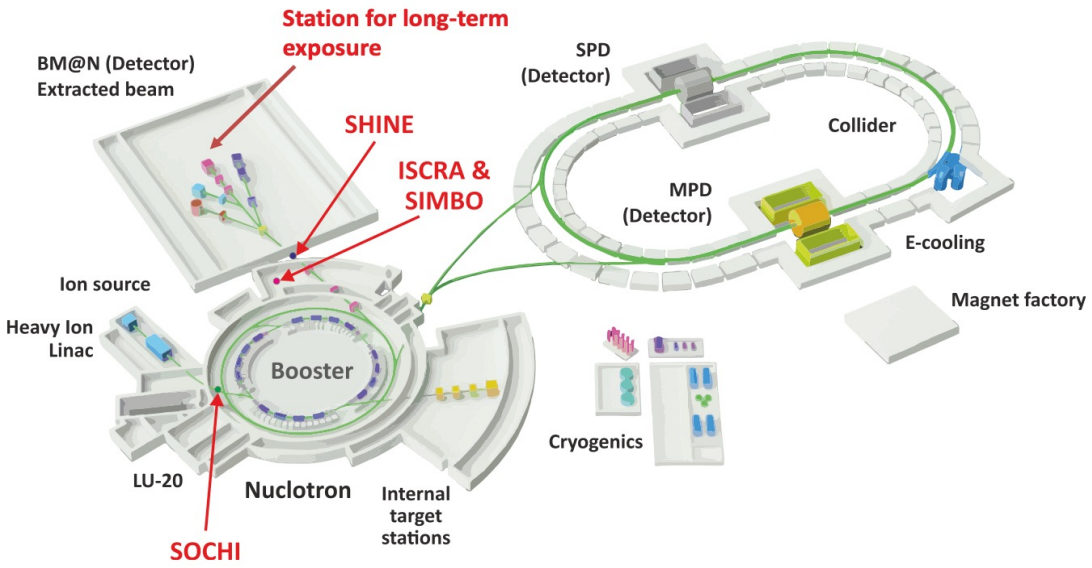
ARIADNA-ADSR *study of accelerator driven subcritical reactors*



New members: KBSU, EUG(Kazakhstan), Cuba, SA, Egipt

Applied Research Stations at NIC

Applied Research Infrastracture



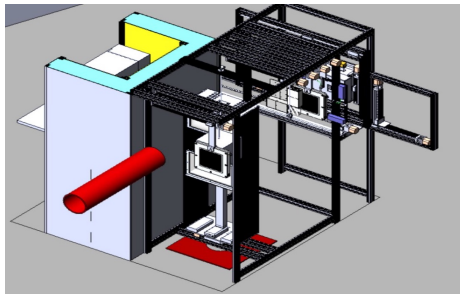
- ***SLTI –*** *Long-Term Irradiation Station, will works on material and life science*

SOCHi *- Station Of Chip Irradiation*

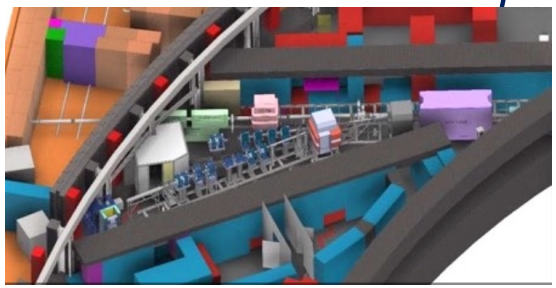
ISCRA- *Irradiation Station of Components of Radioelectronic Apparatus.*

SIMBO- *Station of Investigation of Medico-Biological Objects at the energies of 500-1,000 MeV/nucleon*

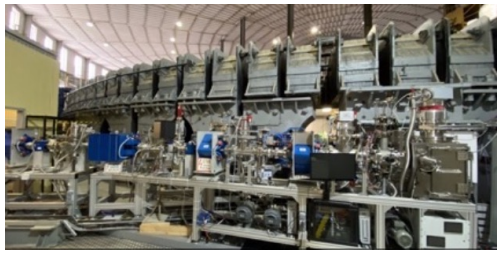
SHINE- *Station of High Energy Investigation in Nuclear Energetic, nuclear technologies related to the production of energy and nuclear waste disposal.*



SHINE

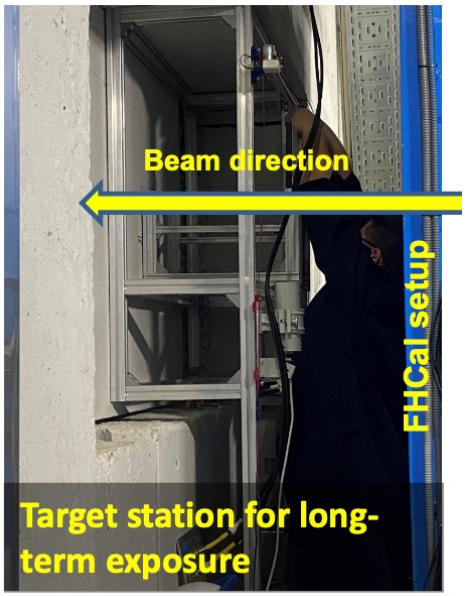


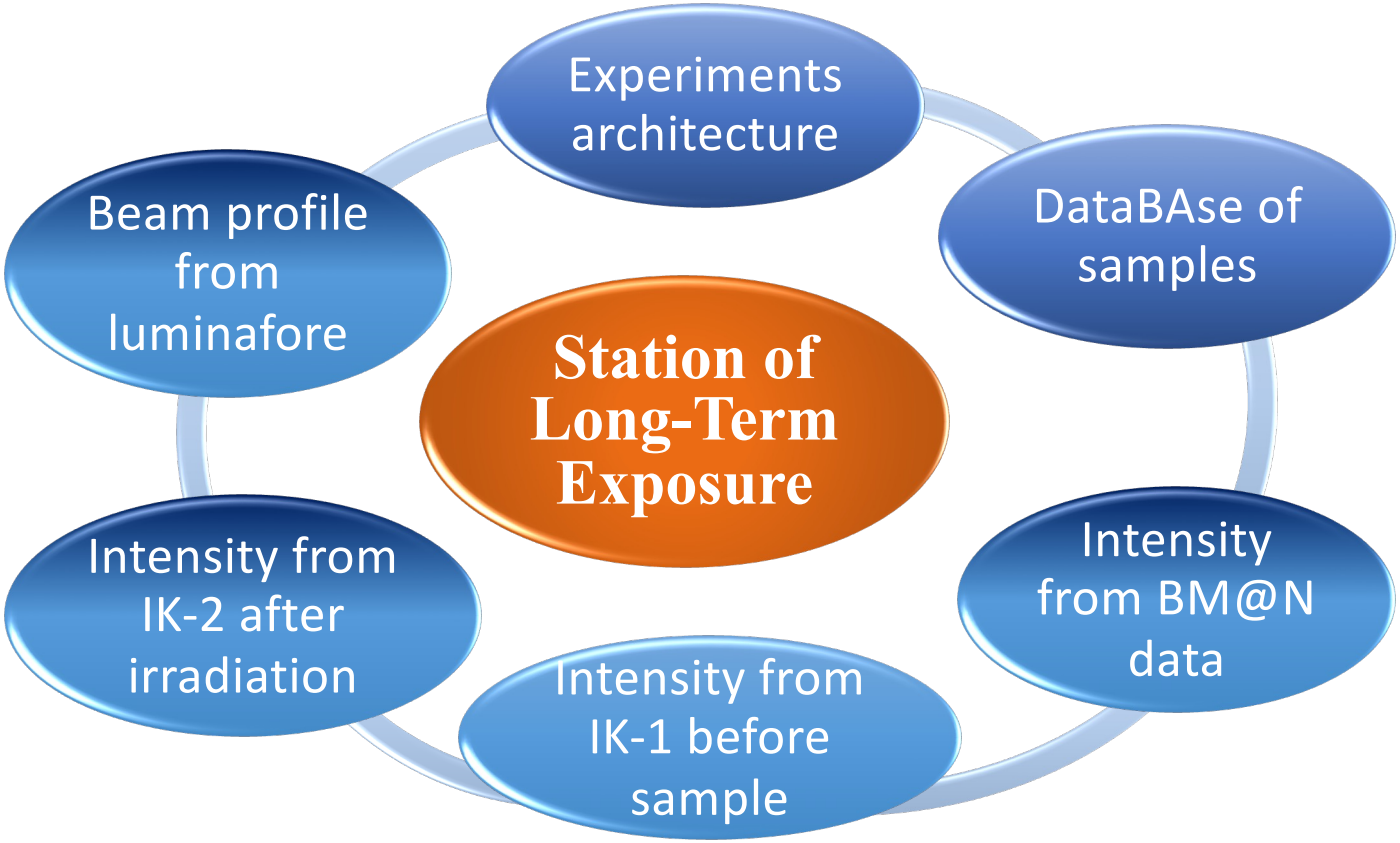
ISCRA
SIMBO



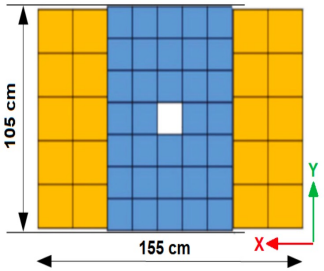
SOCHi

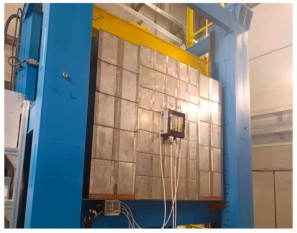
SLTE - Station for Long-Term Exposure

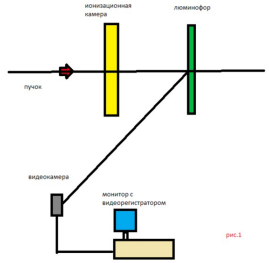


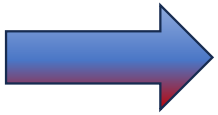


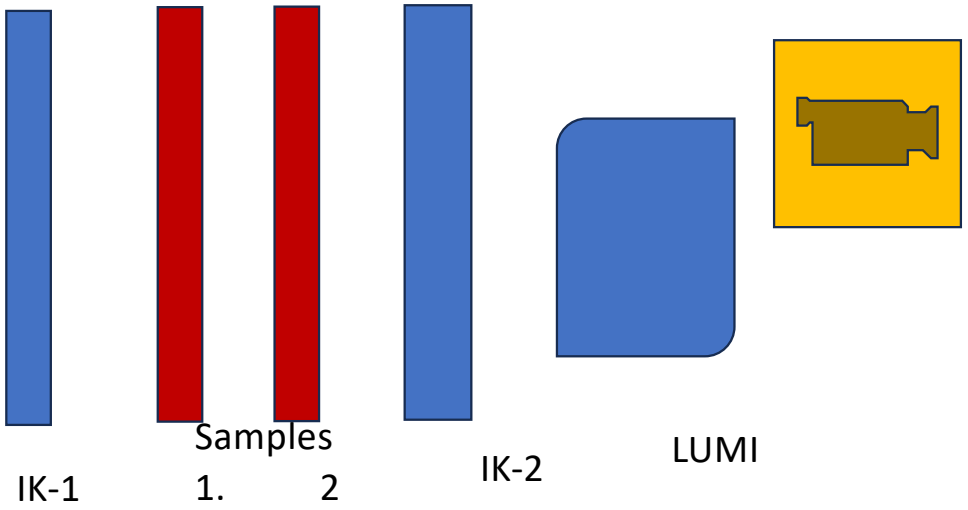
Station architecture with cameras and samples



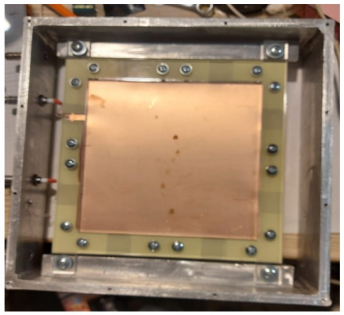


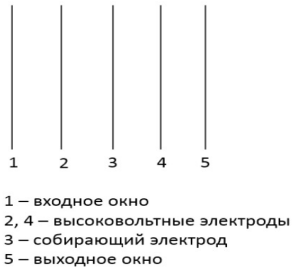






IK-1 and IK-2





а) б)

Рис.1 а) камера ИК-1, б) схема камеры.

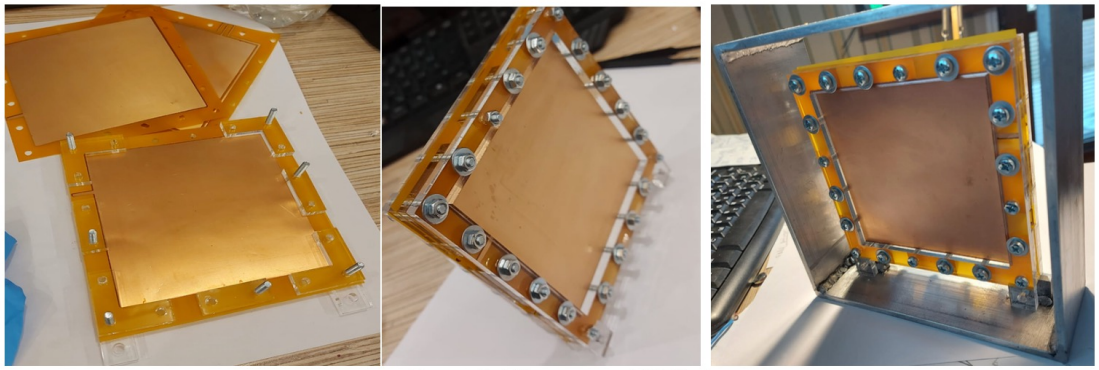


Рис.2 Камера ИК-2

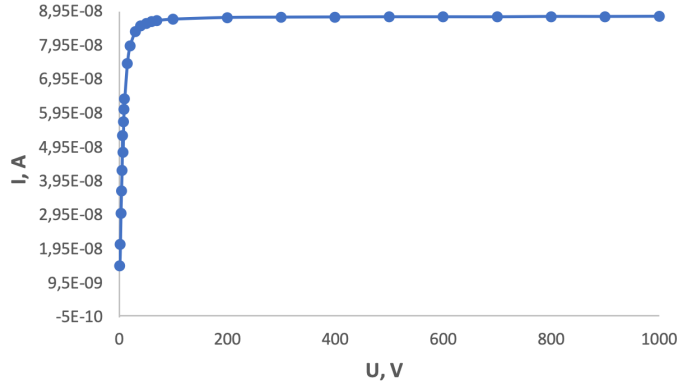


Рис. 6. ВАХ камеры ИК-2

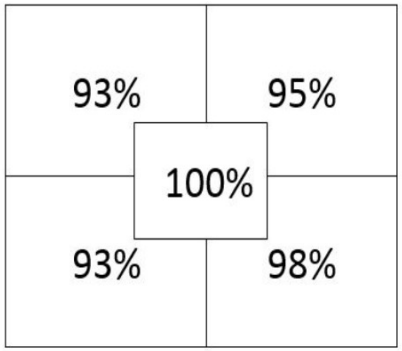
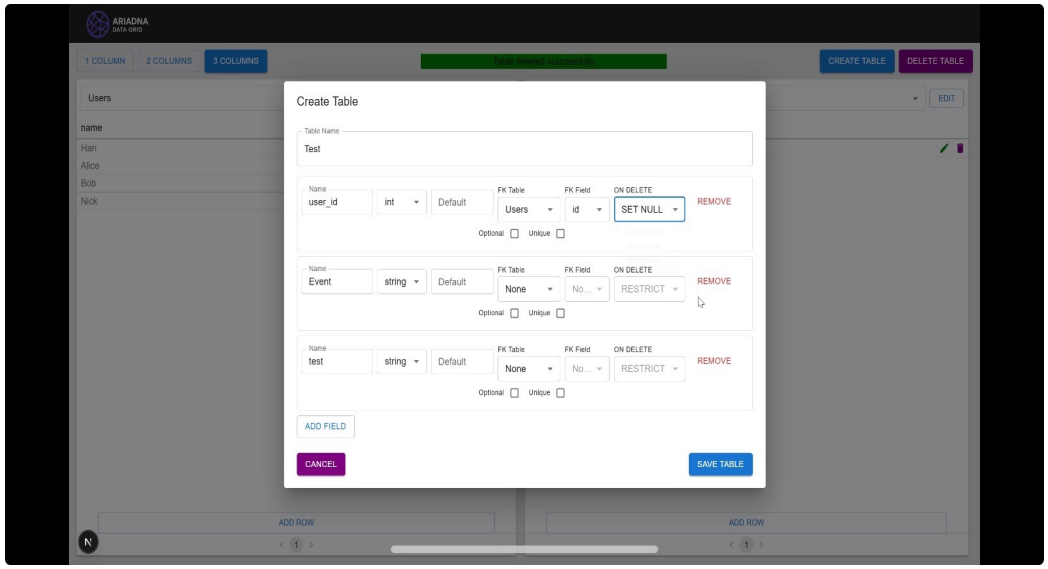


Рис. 8. Неоднородность камеры ИК-2

DataBase for infrastructure and samples



- Number of sample
- Data of accepted
- Organization
- Input parameters of sample
- simulation results
- data of irradiation
- intensity of beam and dose of irradiation

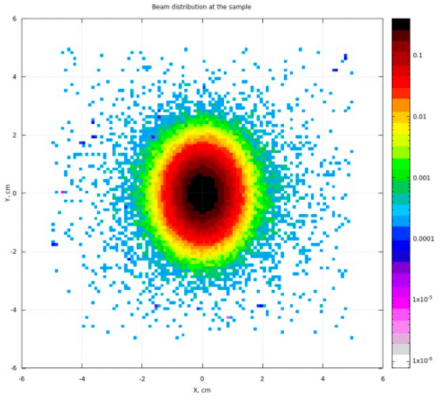
MC Simulations with GEANT and FLUKA

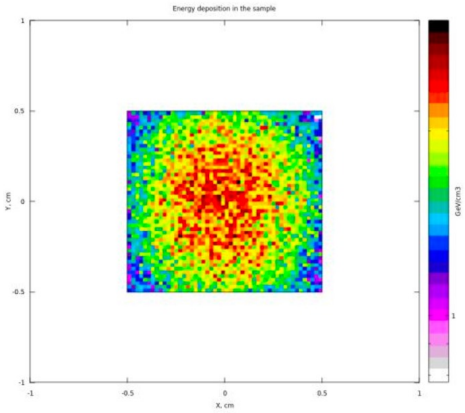
Output data

```
TITLE
Set the defaults for precision simulations
DEFAULTS                    PRECISIO
Define the beam characteristics
WARNING: Beam Energy/momentum per nucleon
BEAM                Beam: Energy    E: 3.8          Part: HEAVYION
    Δp: Flat        Δp:             Δϕ: Flat        Δϕ:
  Shape(X): Gauss   x(FWHM): 1.0    Shape(Y): Gauss y(FWHM): 1.5
Ion Definition
HI-PROPE            Z: 54.          A: 131.         Isom:
Define the beam position
BEAMPOS             x:              y:              z: -10.
                    cosx:           cosy:           Type: POSITIVE
GEOBEGIN            Accuracy:       Option:         Paren:
                    Geometry:       Out:            Fmt: COMBNAME
    Title:
     Black body
      SPH blkbody   x: 0.0          y: 0.0          z: 750.
                    R: 801.
     Void sphere
      SPH void      x: 0.0          y: 0.0          z: 750.
                    R: 800.
     TARGET
      RPP targ      Xmin: -5.       Xmax: 5.
                    Ymin: -5.       Ymax: 5.
                    Zmin: -0.05     Zmax: 0.05
     H2Osample
      RPP sample    Xmin: -0.5      Xmax: 0.5
                    Ymin: -0.5      Ymax: 0.5
                    Zmin: 1200.     Zmax: 1200.5
     FD
      RPP fd        Xmin: -7.5      Xmax: 7.5
                    Ymin: -7.5      Ymax: 7.5
                    Zmin: 784       Zmax: 784.05
     FQH
      RPP fqh       Xmin: -8        Xmax: 8
                    Ymin: -8        Ymax: 8
                    Zmin: 970       Zmax: 970.4
END
Region definition
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
SAMPreg      5 +sample
```

```
     Black hole
      REGION BLKBODY        Neigh: 5
      expr: +blkbody -void
     Void around
      REGION VOID           Neigh: 5
      expr: +void -sample -targ -fd -fqh
     TARGET
      REGION XETAreg        Neigh: 5
      expr: +targ
     Sample
      REGION SAMPreg        Neigh: 5
      expr: +sample
     fd region
      REGION FDreg          Neigh: 5
      expr: +fd
     fqh region
      REGION FQHreg         Neigh: 5
      expr: +fqh
END
GEOEND                  :
MATERIAL water          #:              ρ: 1.06
    Z:          Am:     A:              dE/dx:
COMPOUND water          Mix: Atom       Elements: 4..6
    f1: 2.0     M1: HYDROGEN    f2: 1.0     M2: OXYGEN
    f3:         M3:             f4:         M4:
    f5:         M5:             f6:         M6:
MATERIAL XENON          #:              ρ: 3.408
    Z: 54.      Am:     A: 131.         dE/dx:
MATERIAL BC408          #:              ρ: 1.032
    Z:          Am:     A:              dE/dx:
COMPOUND BC408          Mix: Atom       Elements: 4..6
    f1: 7.0     M1: CARBON      f2: 8.0     M2: HYDROGEN
    f3:         M3:             f4:         M4:
    f5:         M5:             f6:         M6:
SiO2 (quartz)
The density of SiO2 may vary from 2.3 - 2.5 g/cm3 depending on the
method of preparation. Under ion bombardment, the surface density
will change towards an equilibrium value of about 2.37.
Region definition
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
SAMPreg      5 +sample
```

Gaussian distribution of The Xenon beam

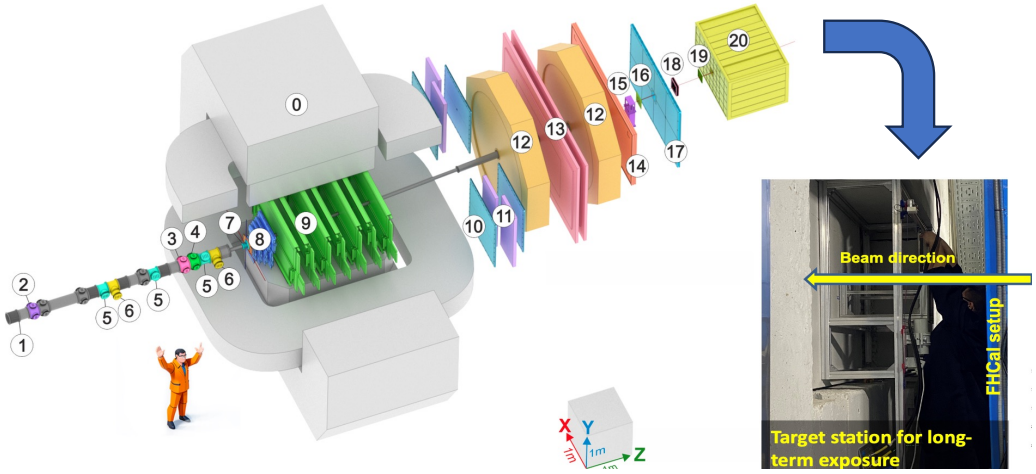


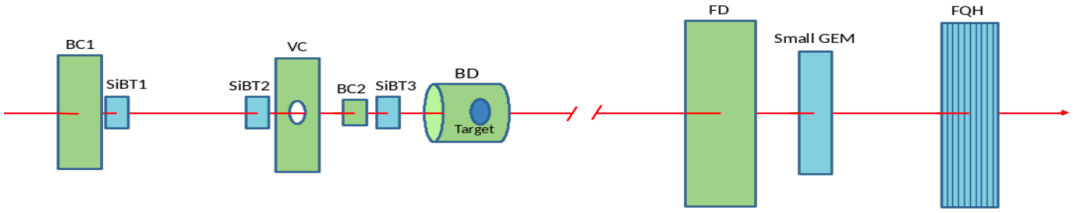


data from *BM@N for Station*

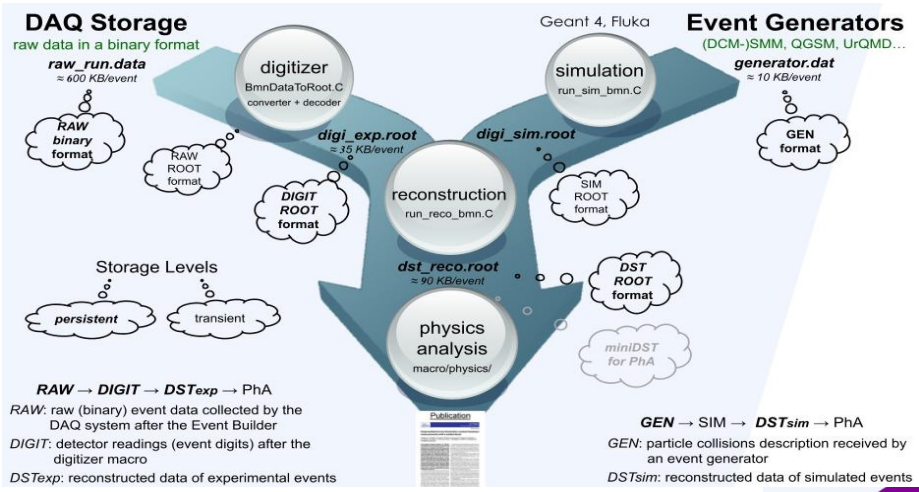
- First BM@N Physics Run
- Interaction rate: 10 kHz
- Dec 12 – Feb 02 2023

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





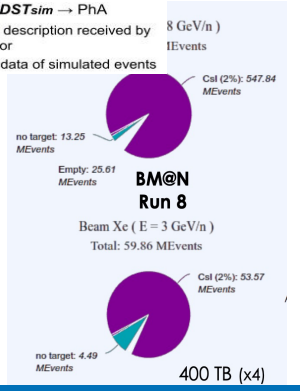
used data from BC1, VC, FQH



Used: DIGIT files

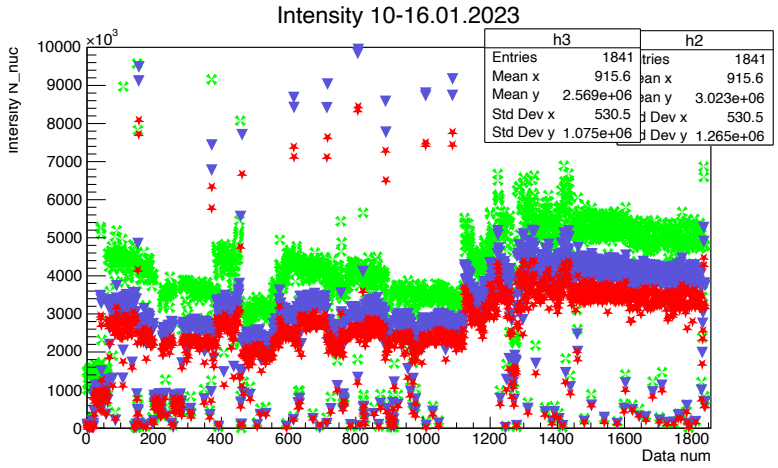
:DST_exp files

Create miniDST



Results of analysis

VI-add composite ROC + VTSP(1)



VI – add composite ROC + VTSP(1)

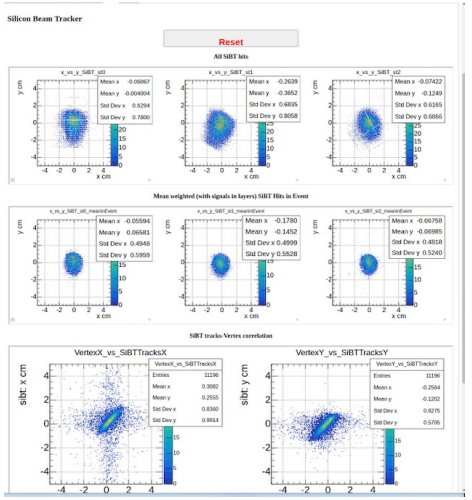
01-10 9:00 up to 2023-01-16 9:00

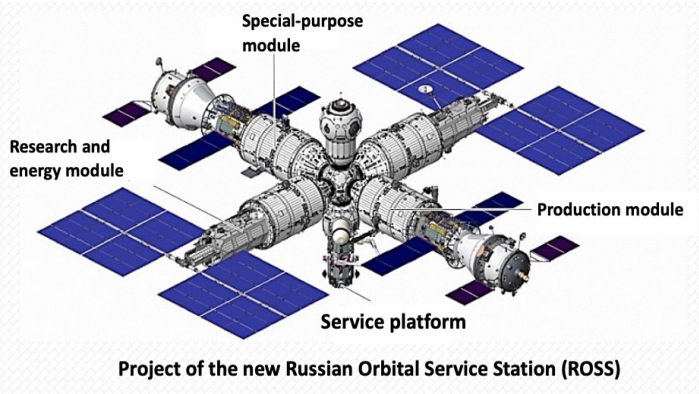
Number of files = 1857

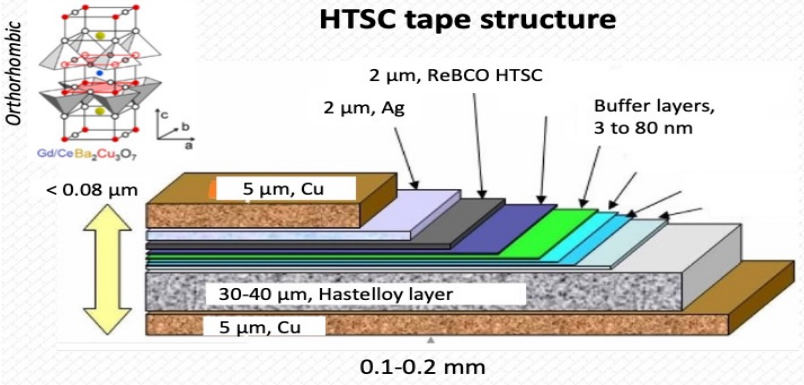
Beam = 7.56554e+09

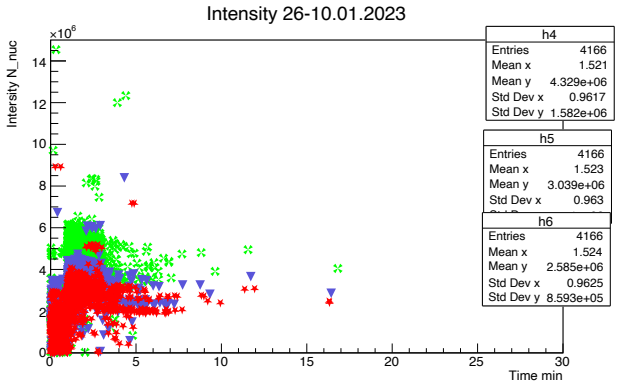
In Pipe = 5.72300e+09

Up to FHQ= 4.86455e+09



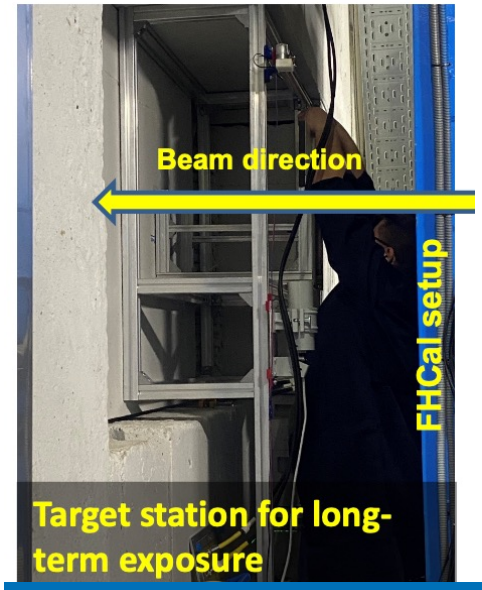


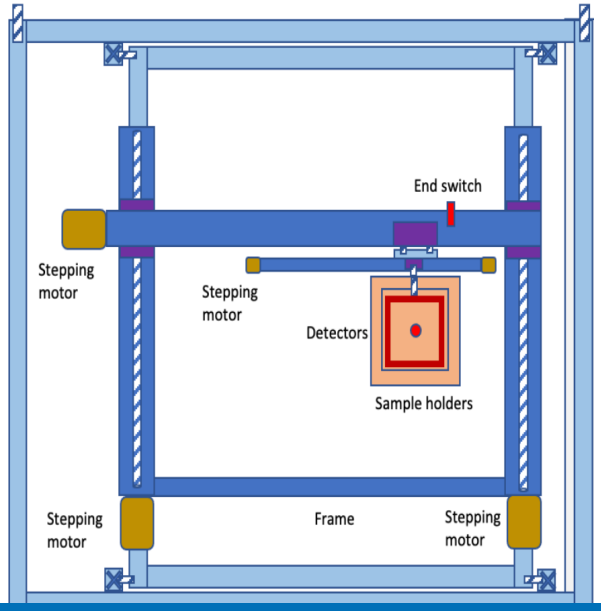


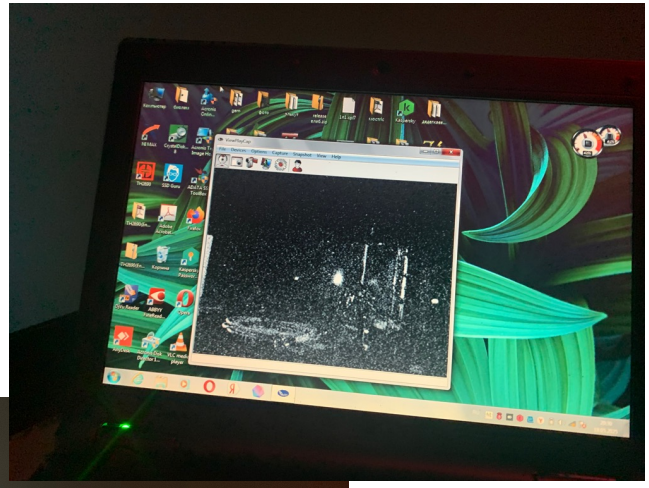


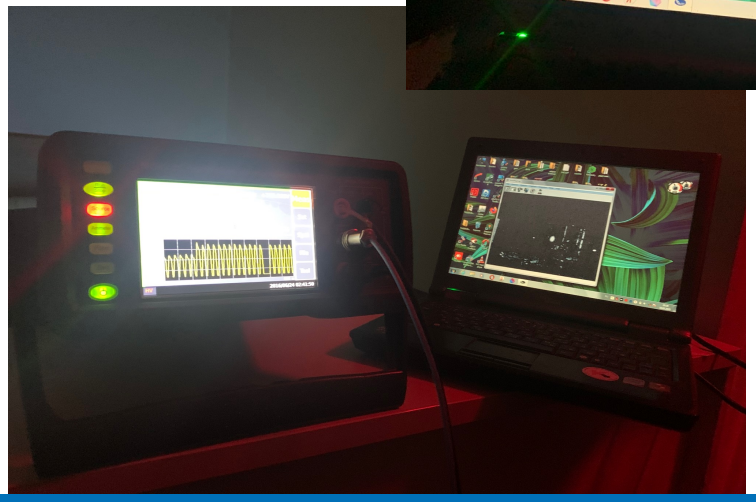
Data from detectors of SLTE

- Data collecting and written at DST



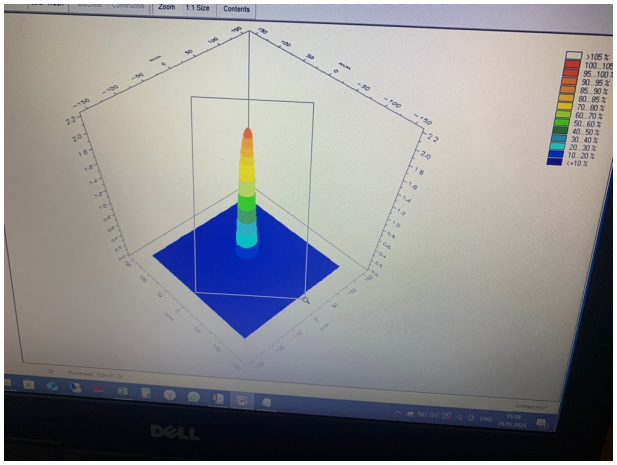


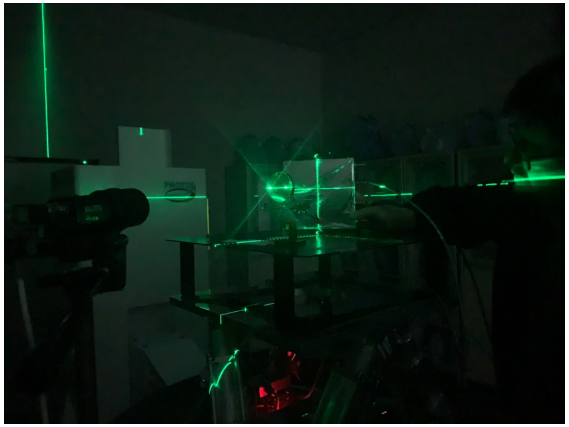


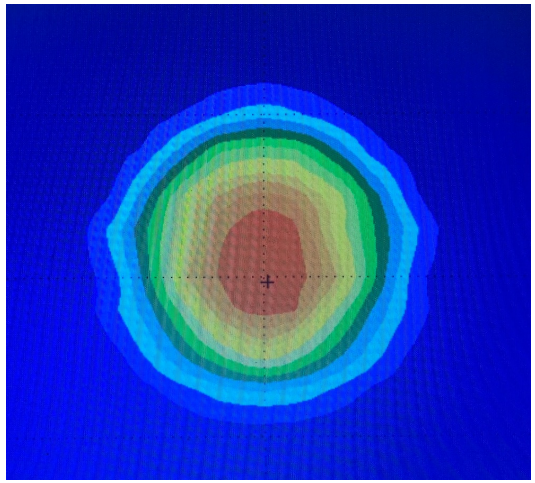


Irradiation of MCP

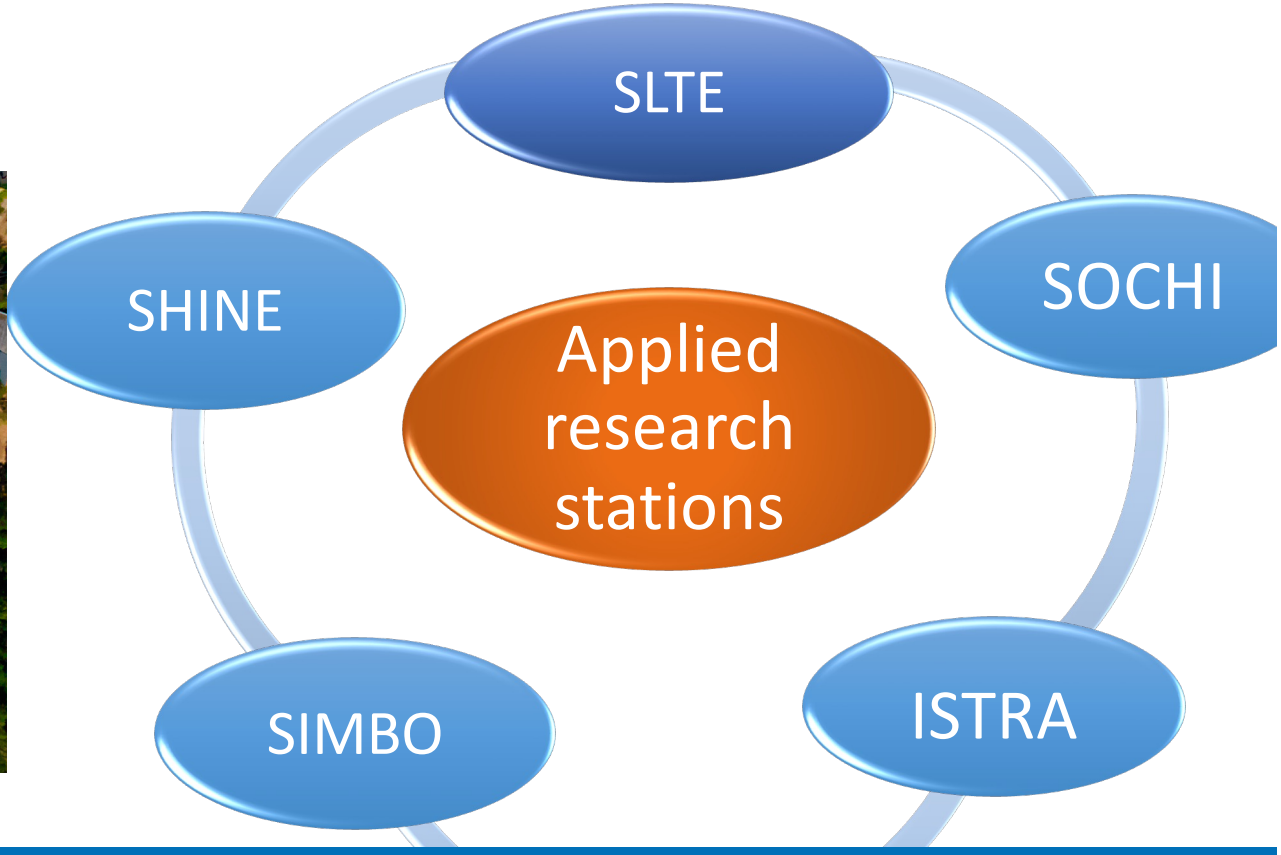
- MCP after irradiation changed colore
- And are being restored







DATABASE for STATIONS



NICA

Thanks for your attention

ARIADNA beamlines

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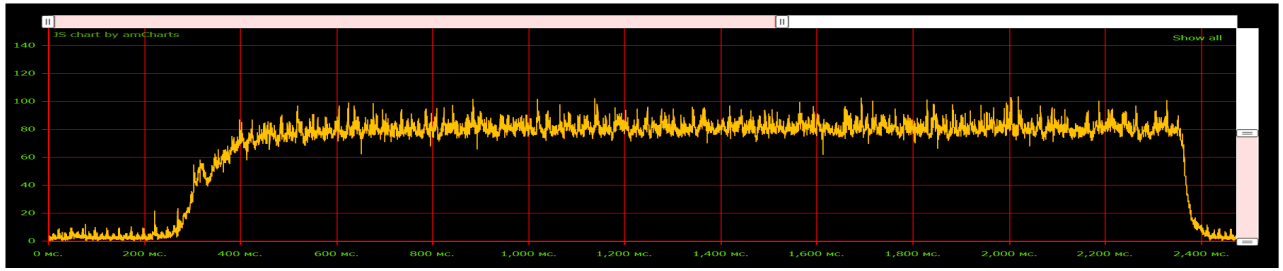
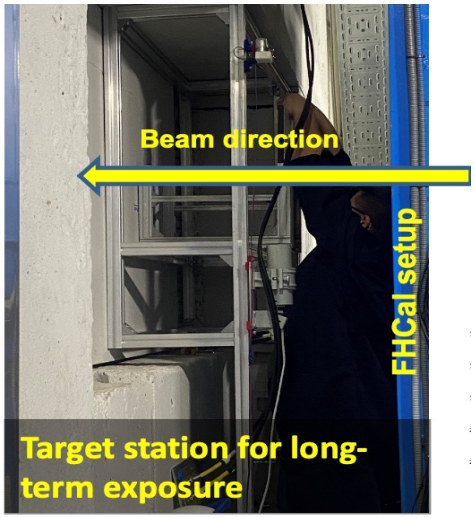
Analyzed data *samples*

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 Spiil ->

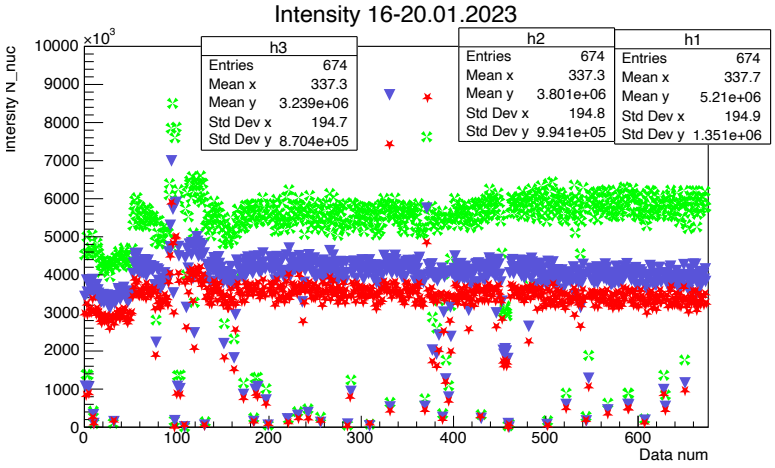


- Calibration 2022-12-11 to 2022-12-15
- Sample I – seed 2022-12-16 to 2022-12-20
- Sample II – seed 2022-12-20 to 2022-12-21
- Sample III – seed 2022-12-21 to 2022-12-22
- Sample IV – seed 2022-12-22 to 2022-12-23
- Sample V – Sapphire +Films + Aluminum 2022-12-26 to 2023-01-20
- Sample VI – add composite ROC + VTSP(1) 2023-01-10 to 2023-01-16
- Sample VII – add composite MCS + VTSP(2) 2023-01-16 to 2023-01-20
- Sample VIII – Cobalt 2023-01-29 to 2023-01-30



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