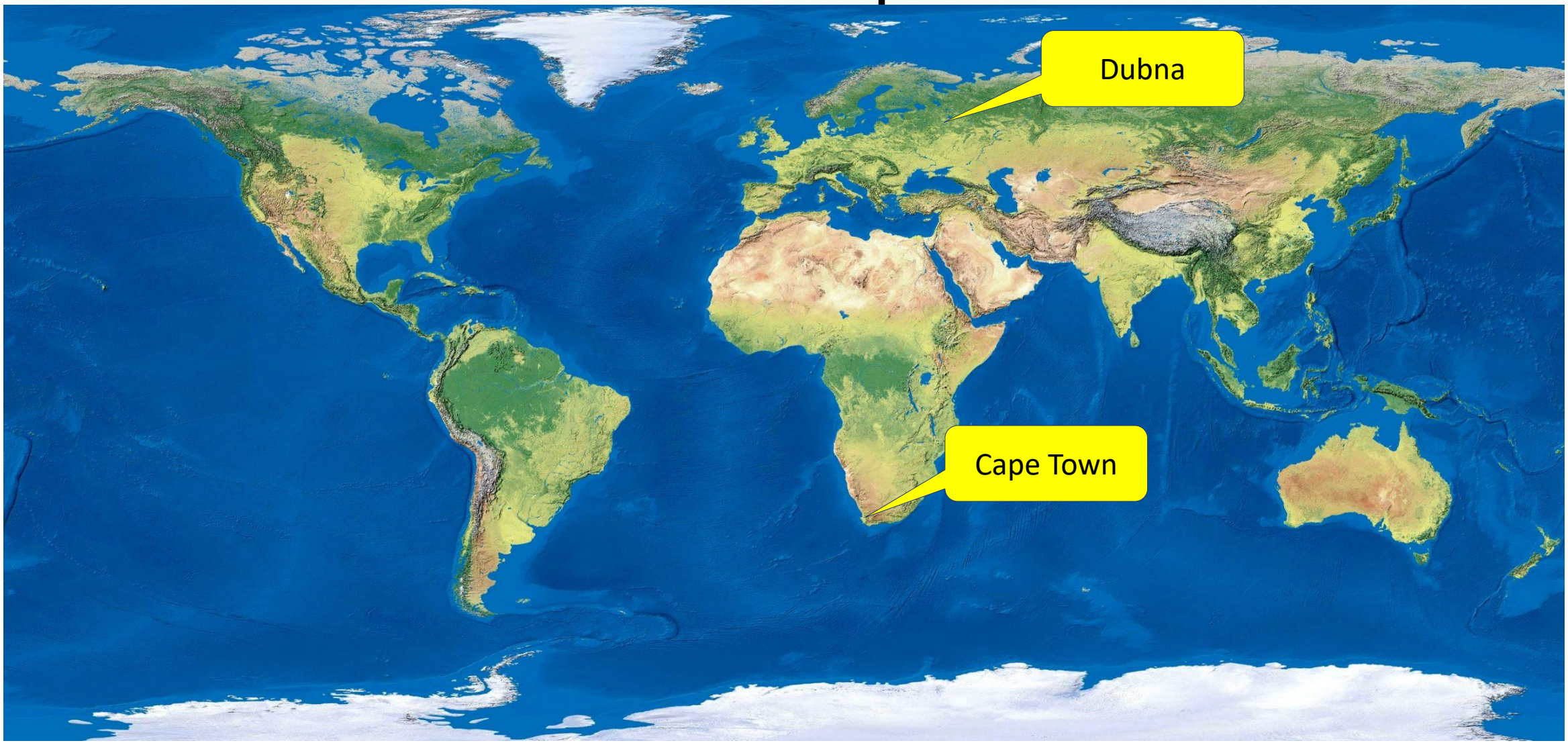
MCP-Based Detectors for Diagnostics of Circulating Beams in the NICA Accelerating Complex

Speaker: Dmitry Korovkin.
The team worked on the task: D.Korovkin, A.Baldin, P.Khariyuyzov, D.Bogoslovski, A.Beloborodov, A.Safonov, S.Chetverikov.

TIPP 2023

Dubna and Cape Town



Dubna

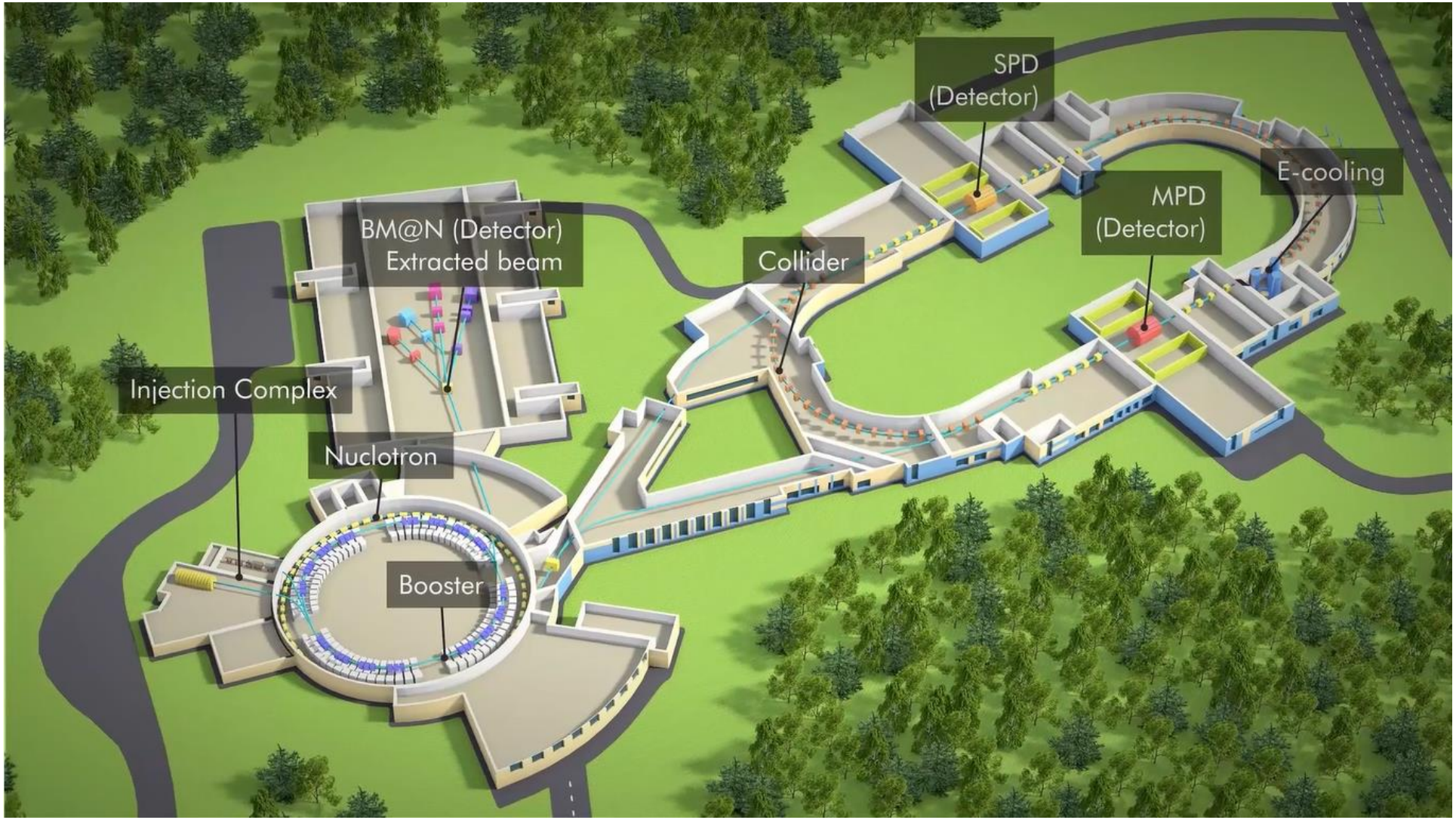
NICA Accelerating Complex

NICA - Nuclotron-based Ion Collider fAcility

NICA Collider parameters:

- $\sqrt{s_{NN}}$ = 4-11 GeV/n heavy ion beams
- luminosity L~10^{27} cm^{-2} c^{-1} (Au)

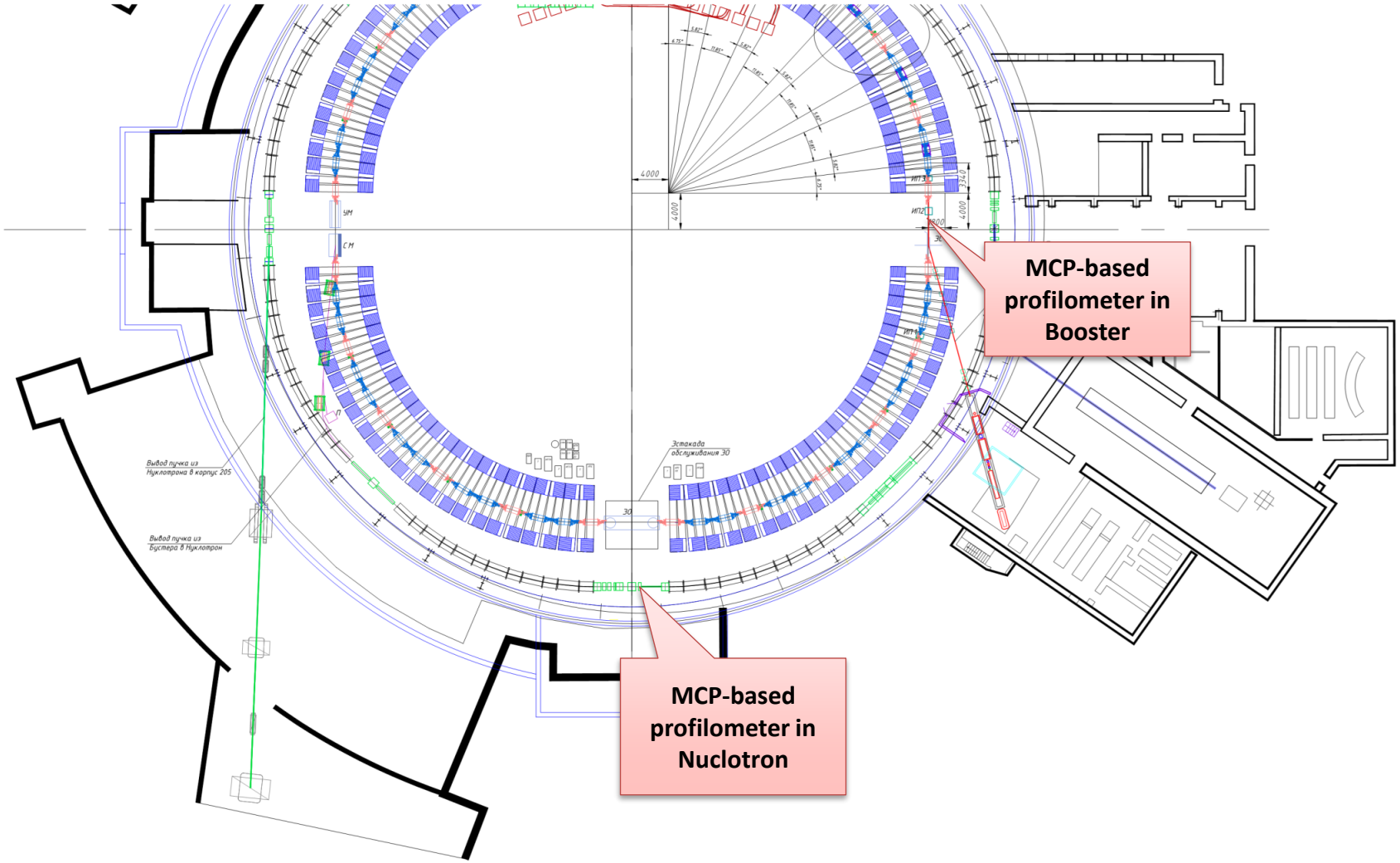
Nuclotron and Booster accelerators



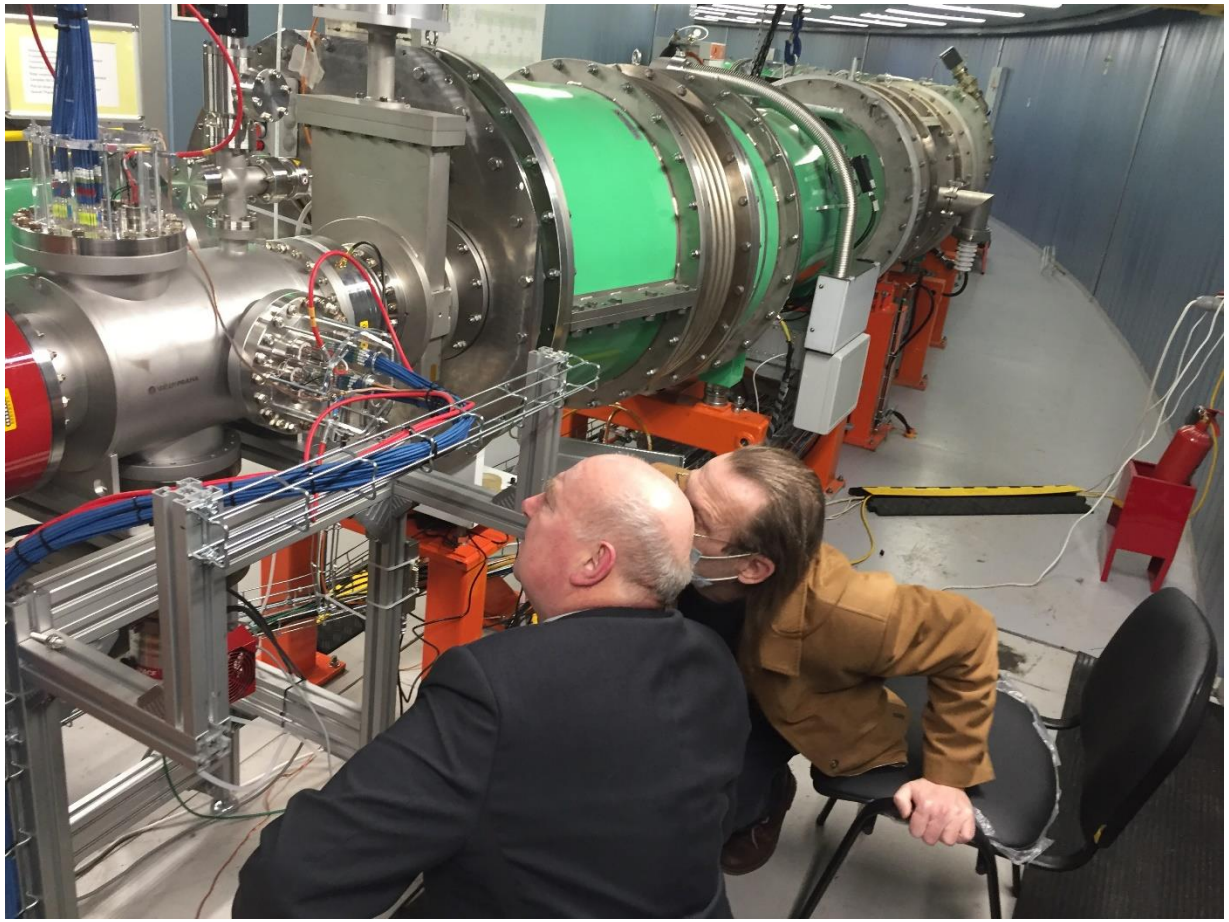
Diagnostic systems

- Nuclotron:
  Superconducting synchrotron
  Kinetic energy — 4 GeV/n
  Perimeter — 251 m
  Intensity — $1.5*10^9$

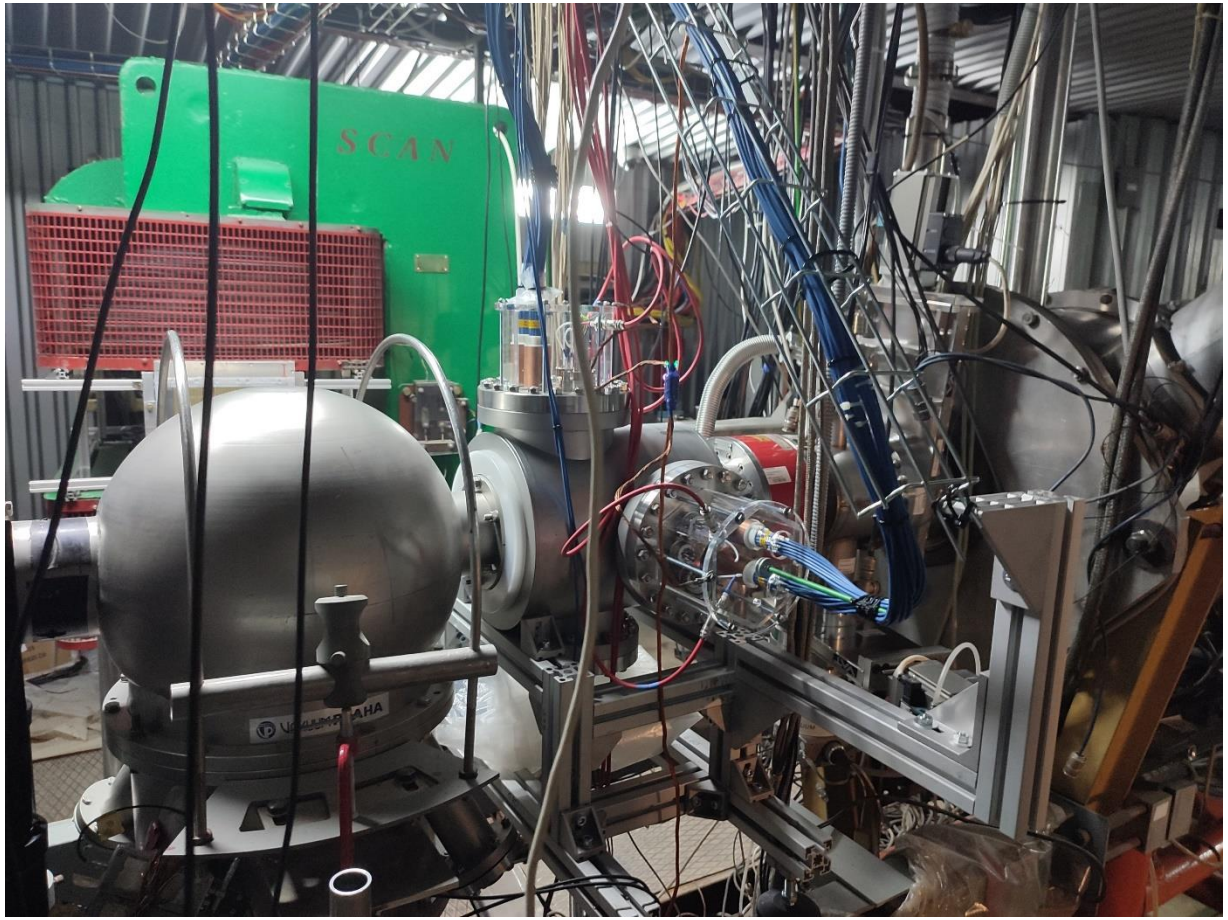
- Booster:
  Synchrotron
  Kinetic energy - 578 MeV/n
  Perimeter — 211 m
  Intensity — $2*10^9$



Location of the diagnostic system in the Booster ring



Location of the diagnostic system in the Nuclotron ring



MCP-based profilometer

- Booster:

  Sensitive area: 60x40 mm

  Channel diameter: 6 um

  Thickness: 0.8 mm

  Amplification: 10^6

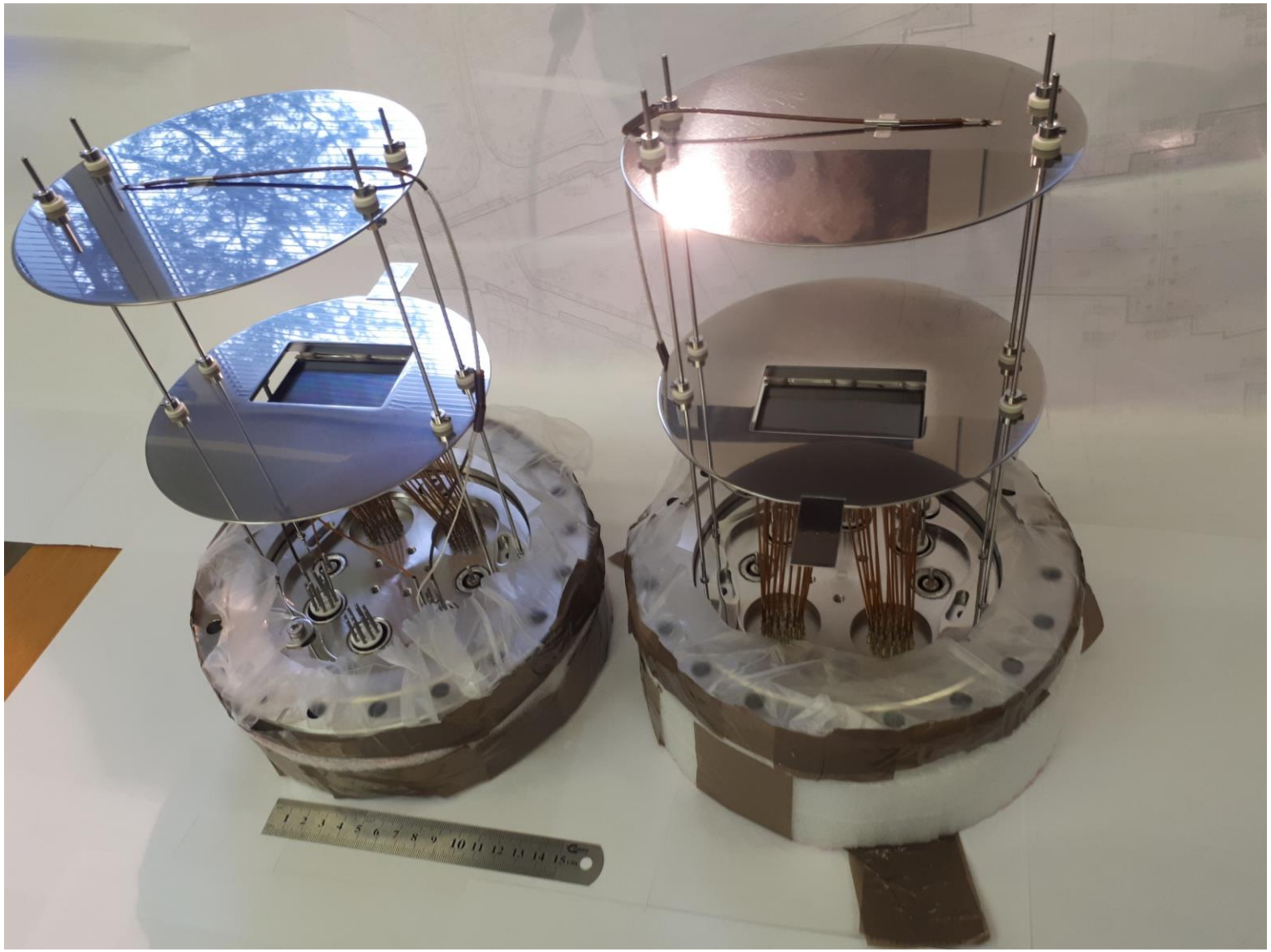
- Nuclotron

  Sensitive area: 27x54 mm

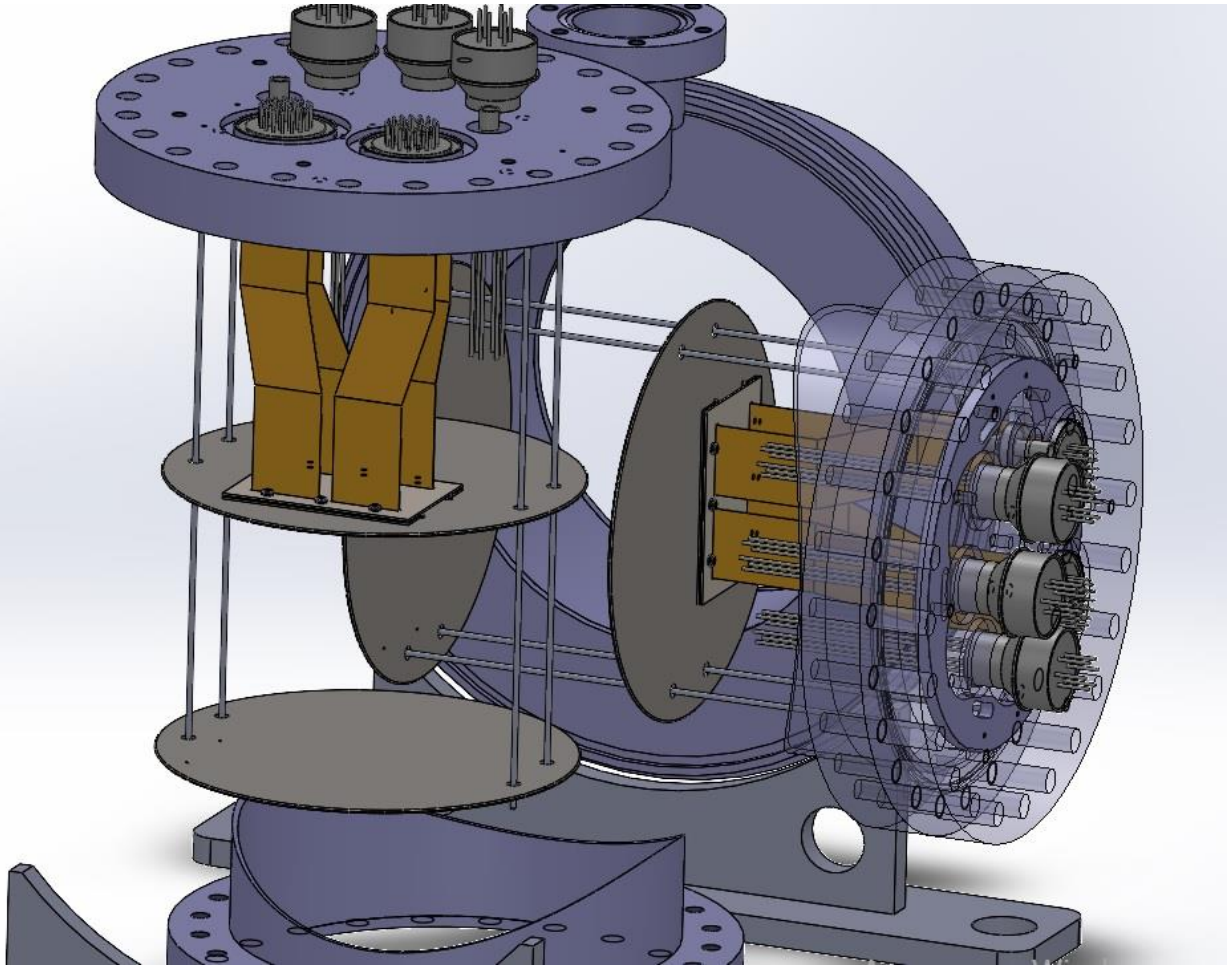
  Channel diameter:6 um

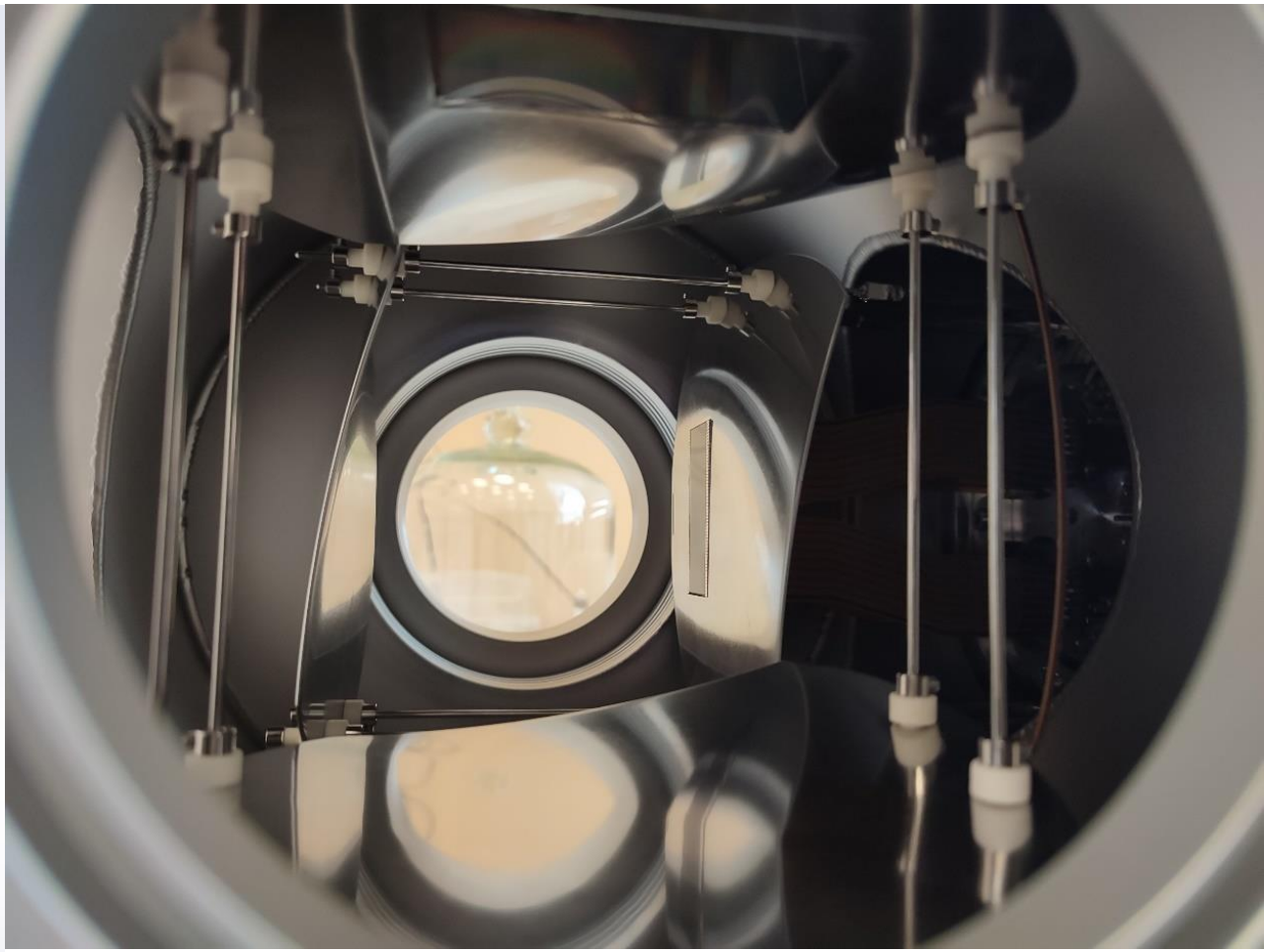
  Thickness: 0.4 mm

  Amplification: 10^6

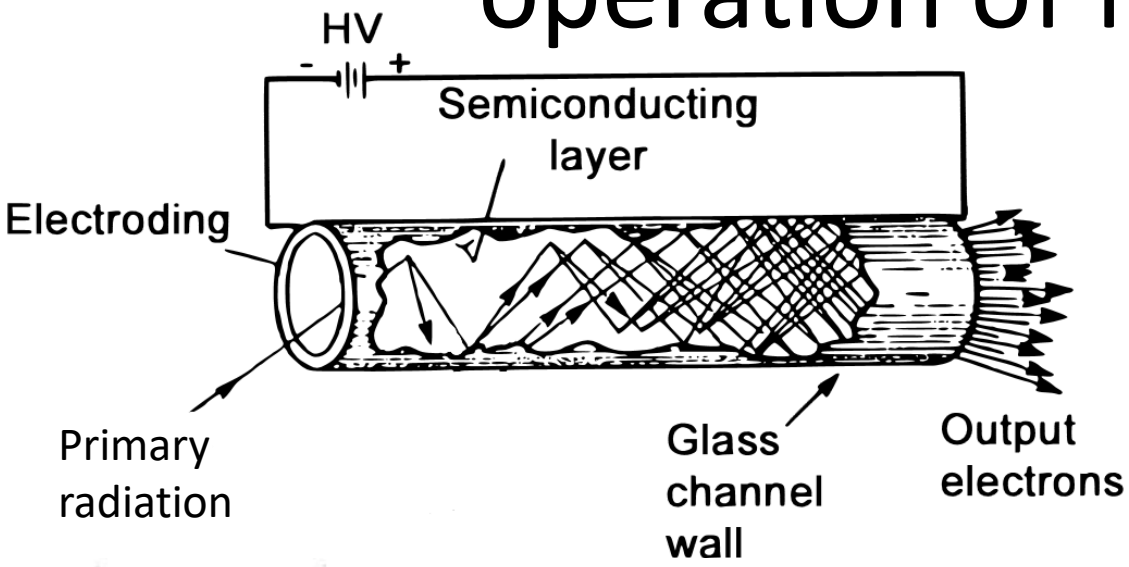


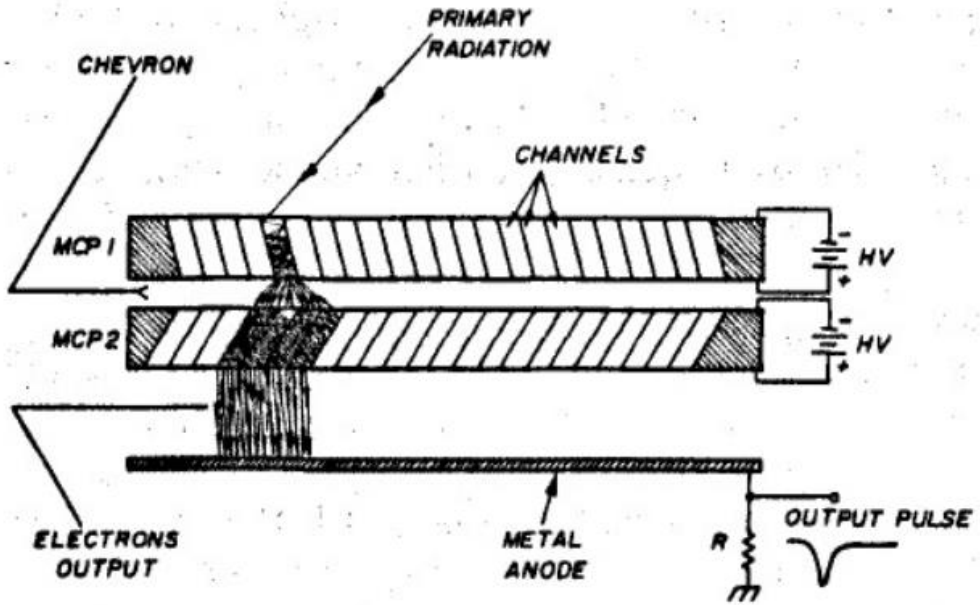
3D model and real view of profilometer

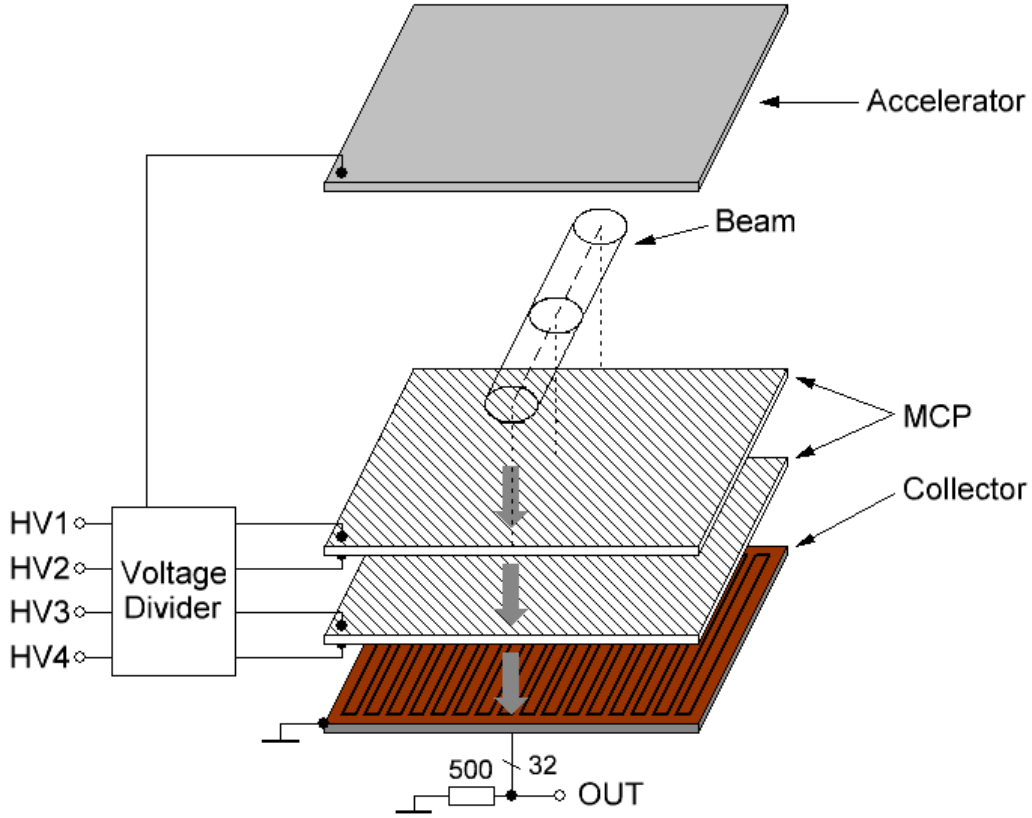




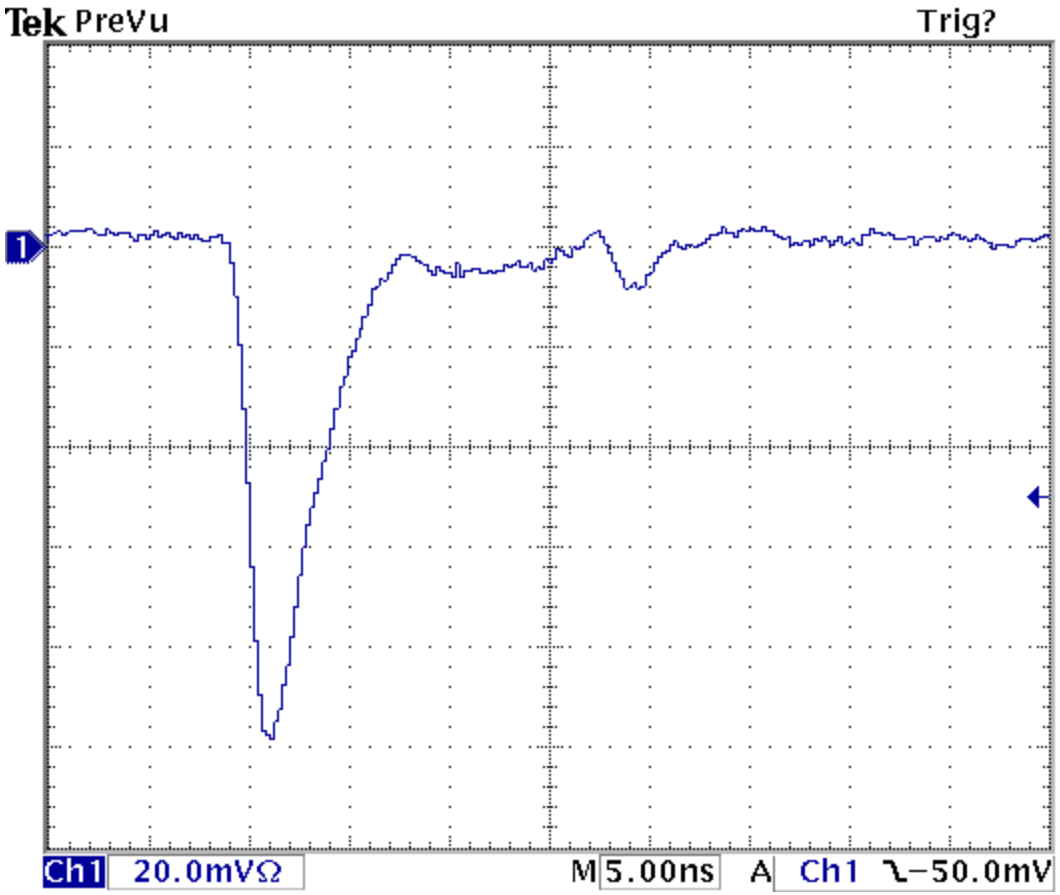
The principle of operation of MCP-based detector







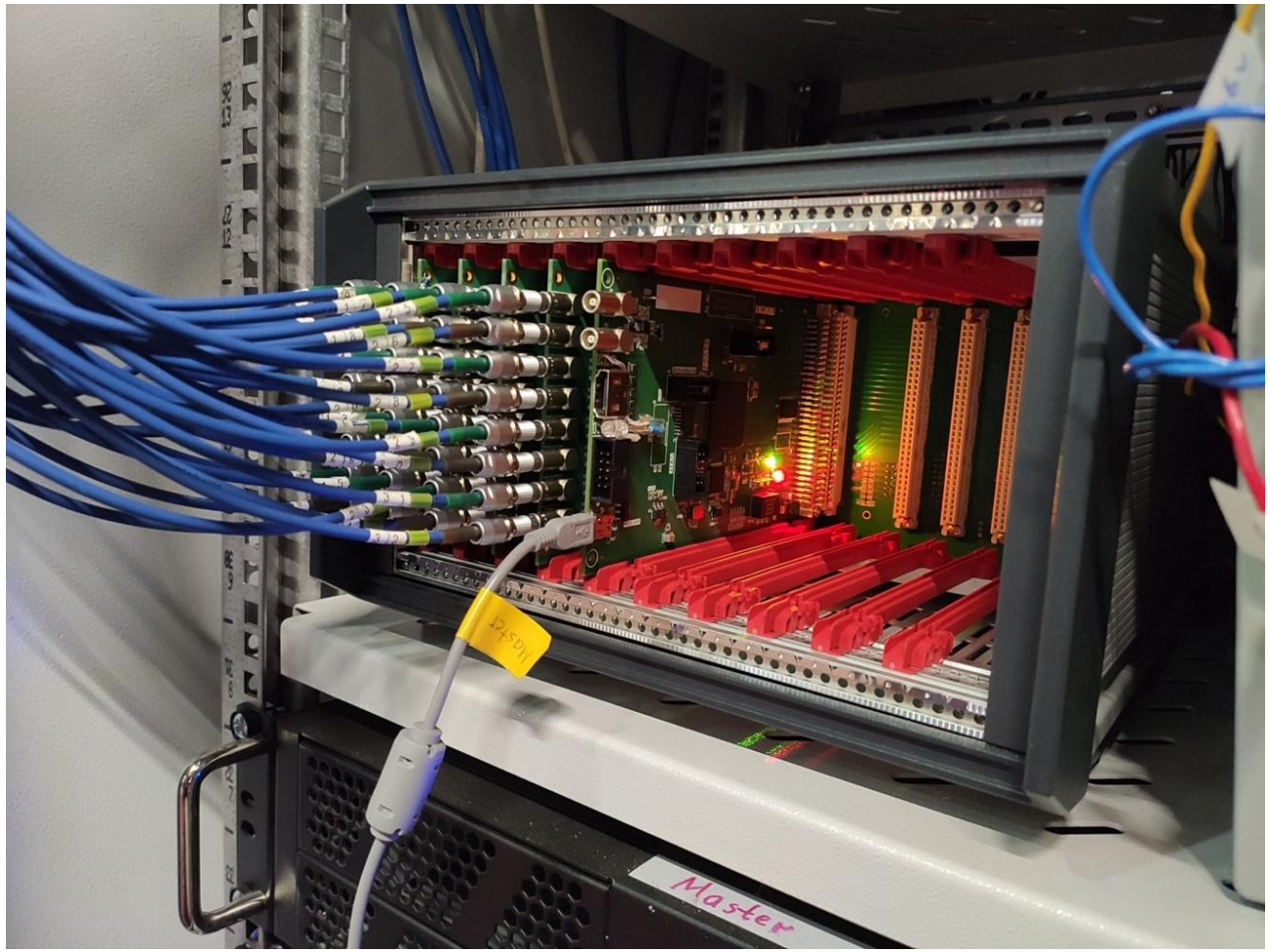
Signal from MCP



Data acquisition system

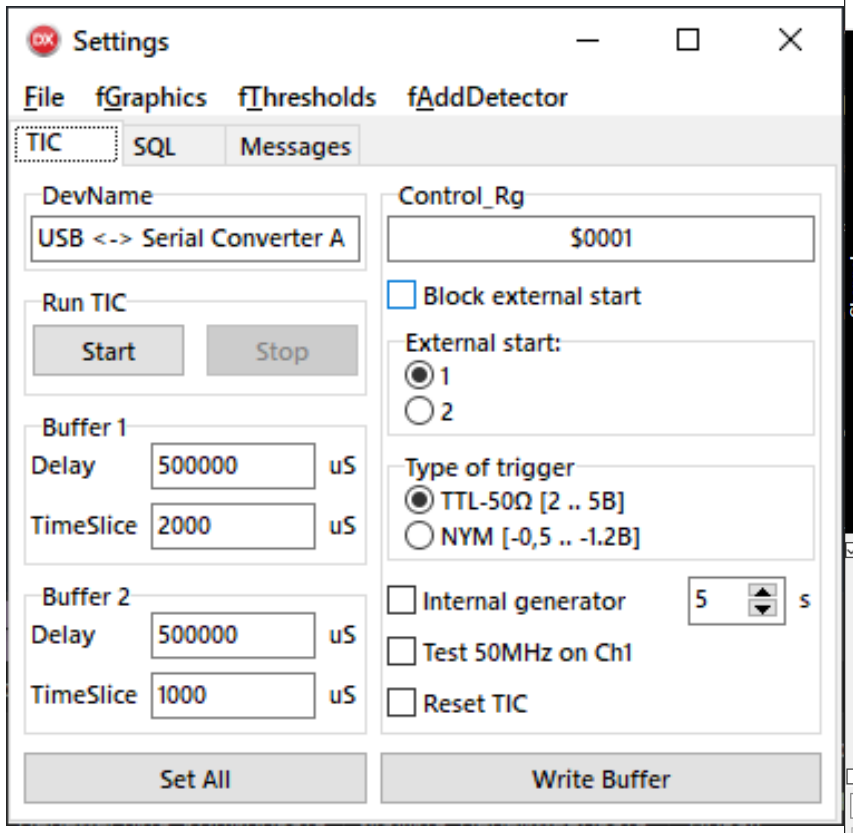
TIC64:

- 64-channel counter-discriminator
- Individual threshold for each channel.
- Width of pulse discrimination: 1.2 ns.
- Parallel recording of two buffers with different time windows and delay.
- Time windows: from 80 us to 100 s.
- Based on FPGA.
- Developed and manufactured by our group.

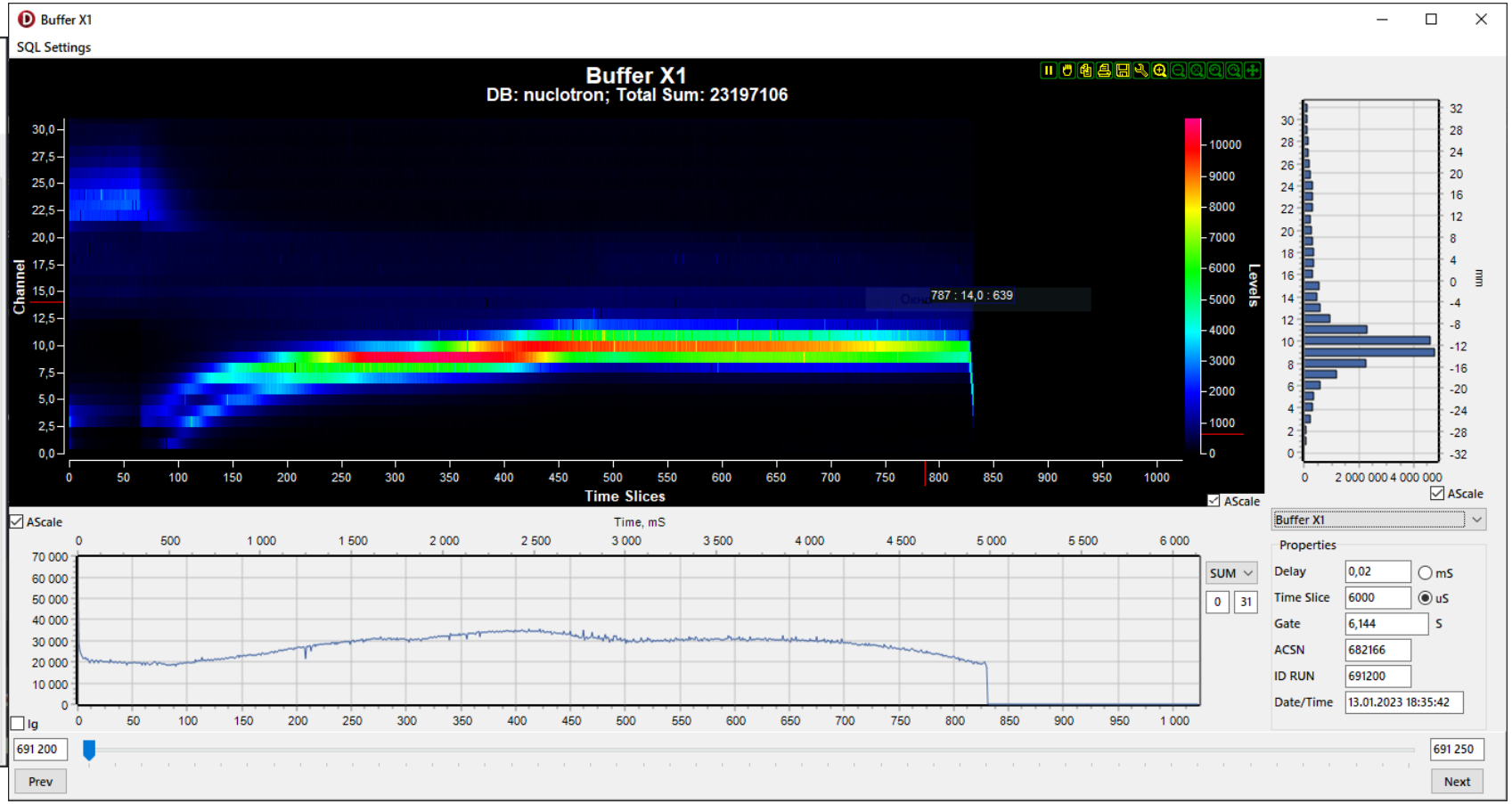


Control and visualization software

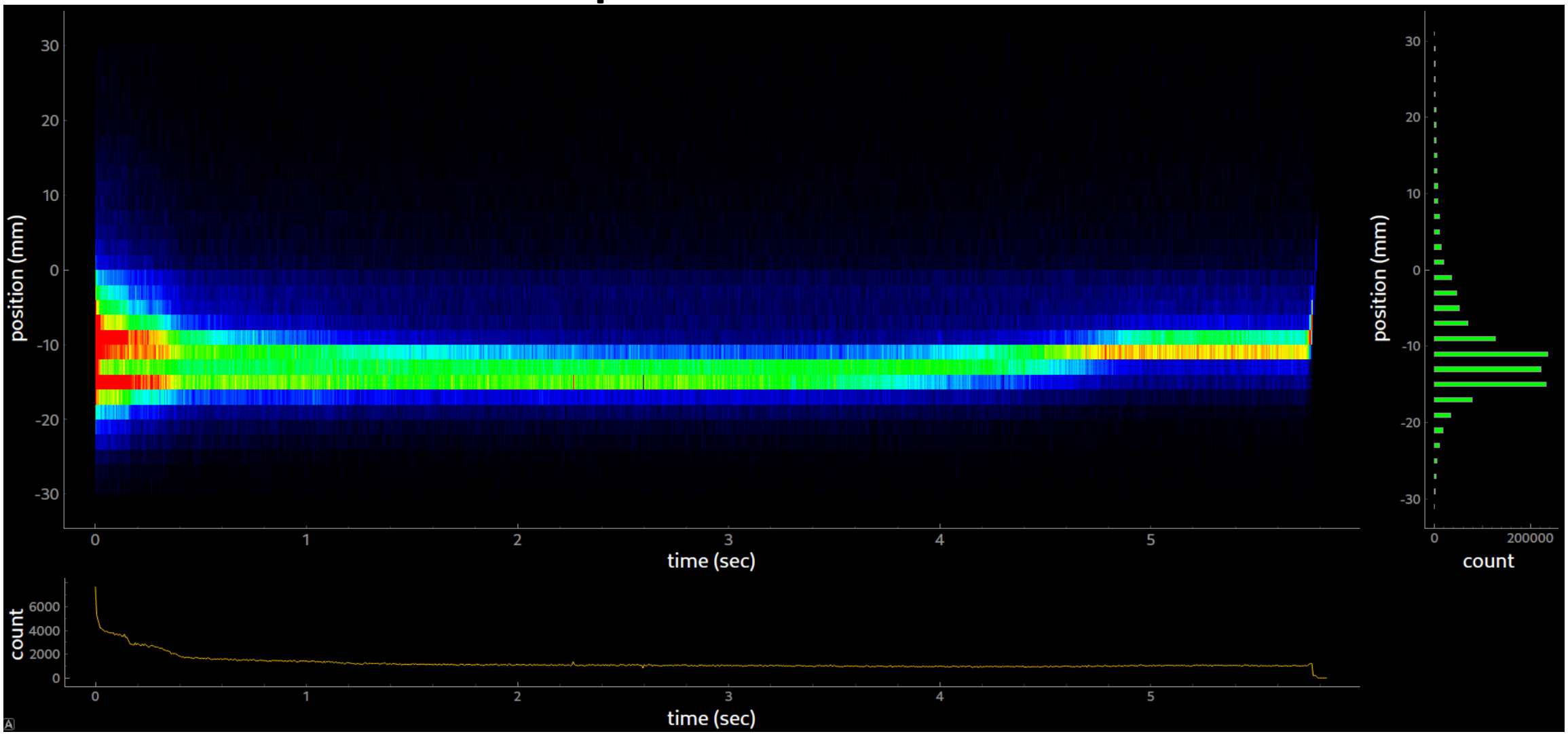
Control software



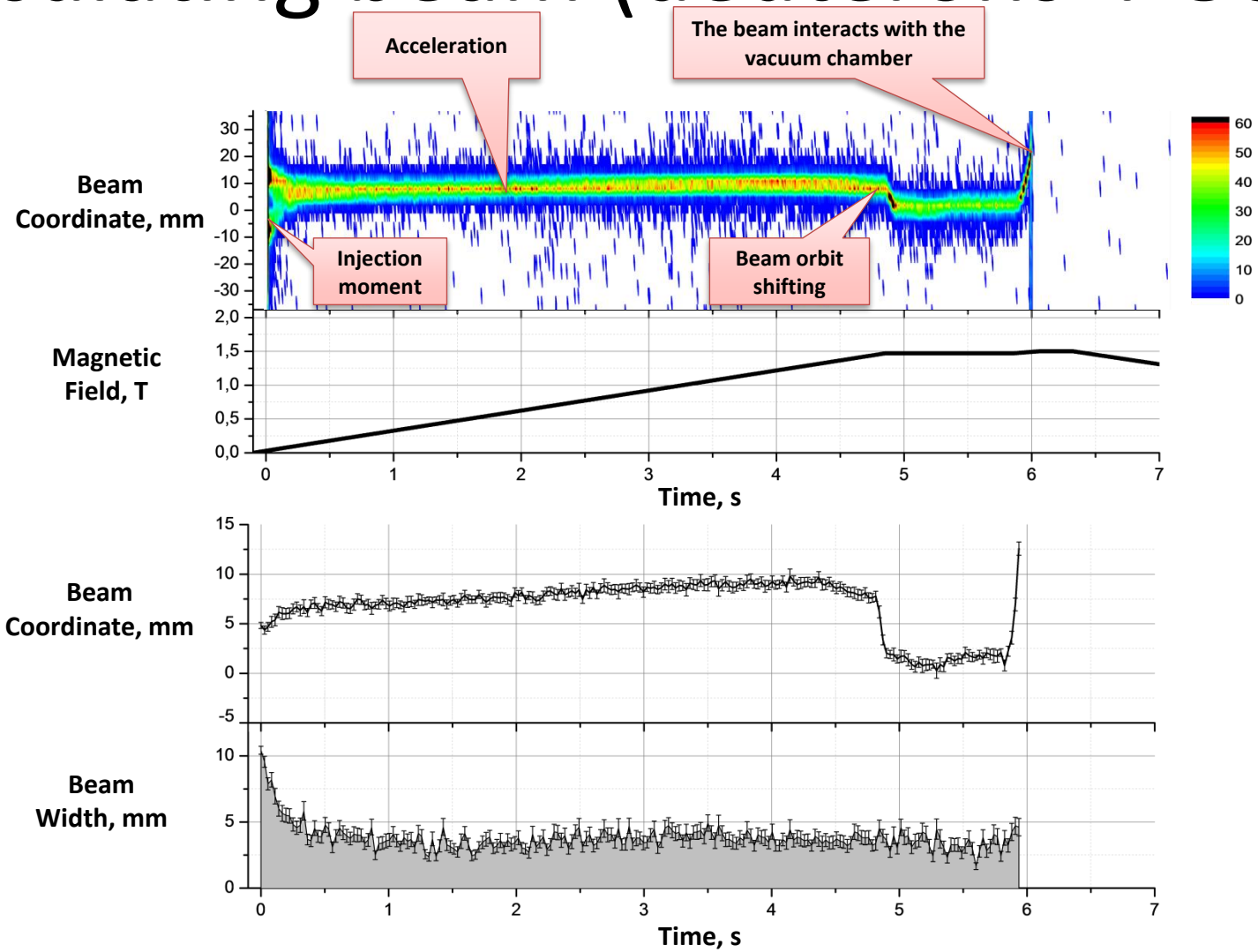
Visualization software



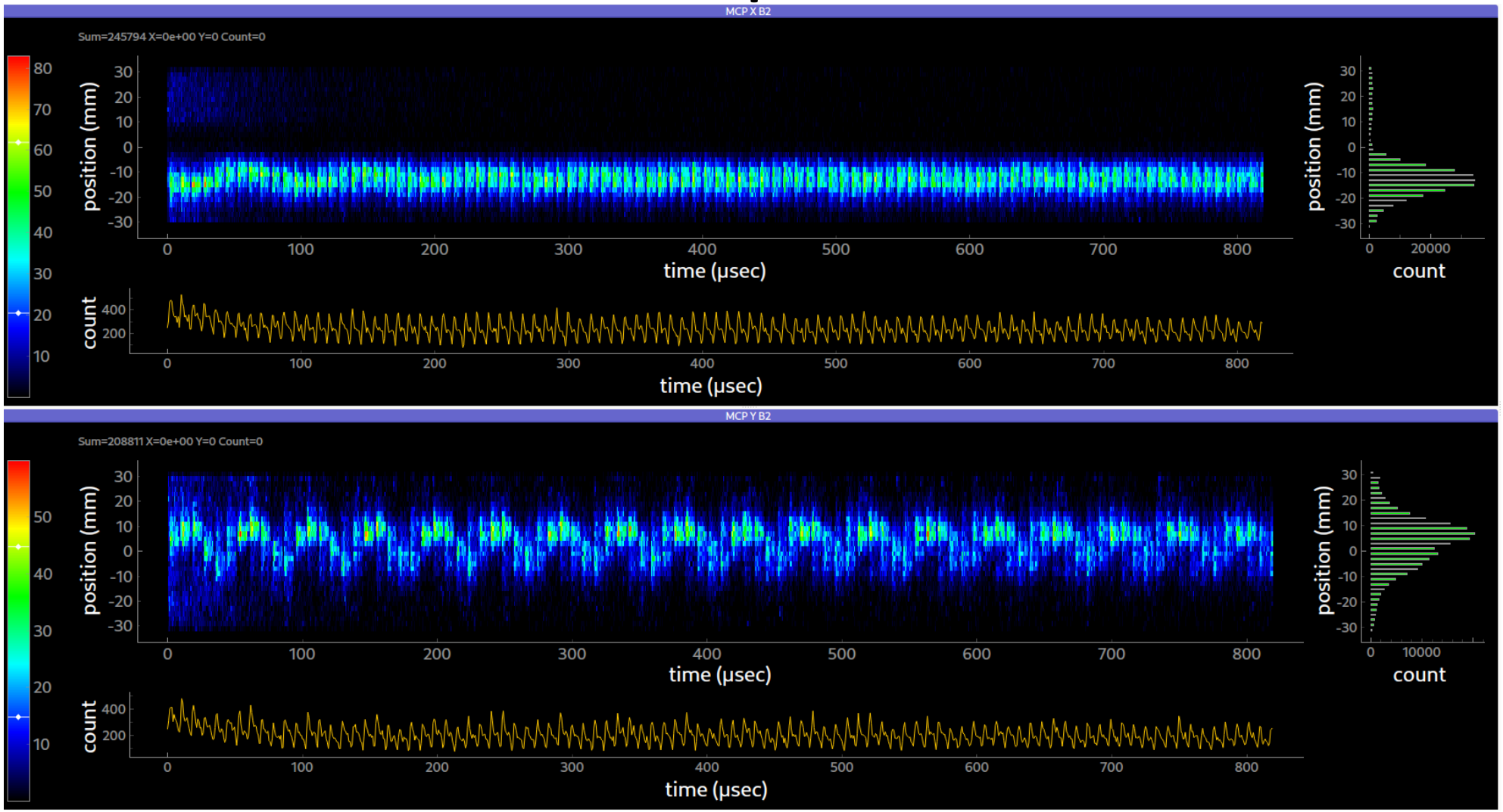
Example of data from profilometer



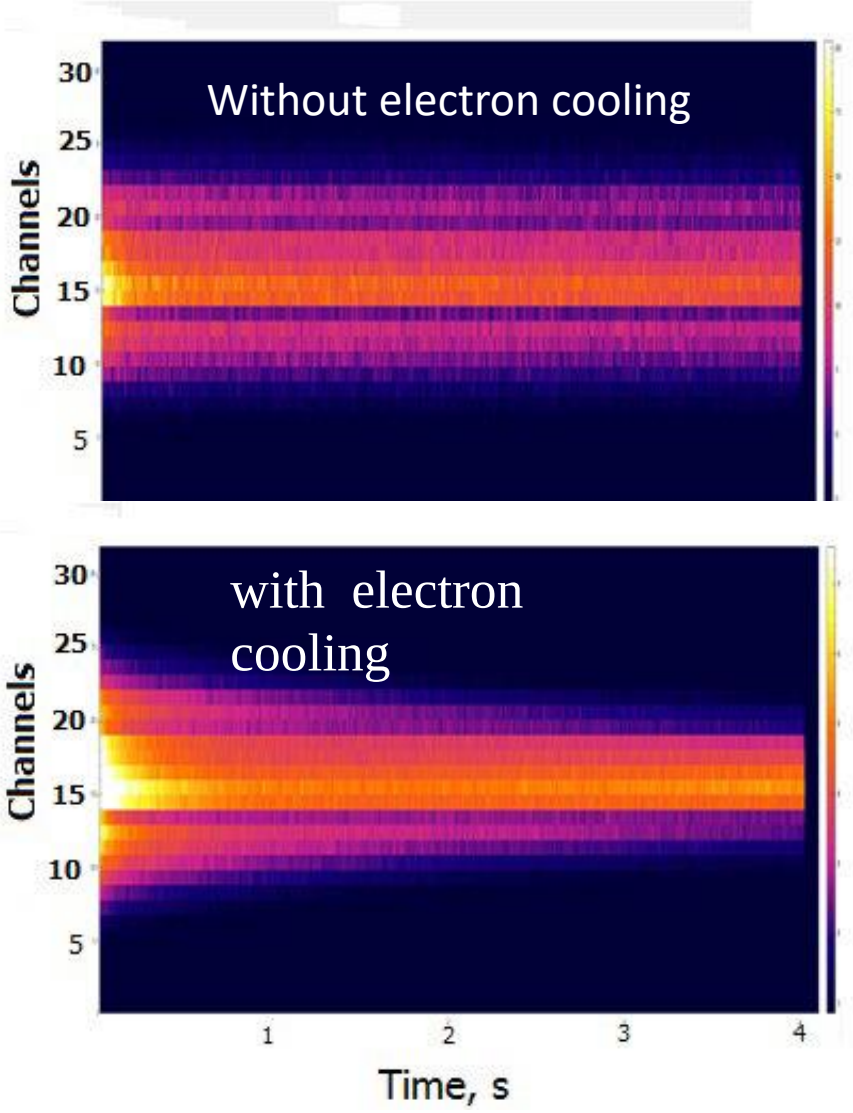
Diagnostics of circulating beam (deuterons 4 GeV/n)



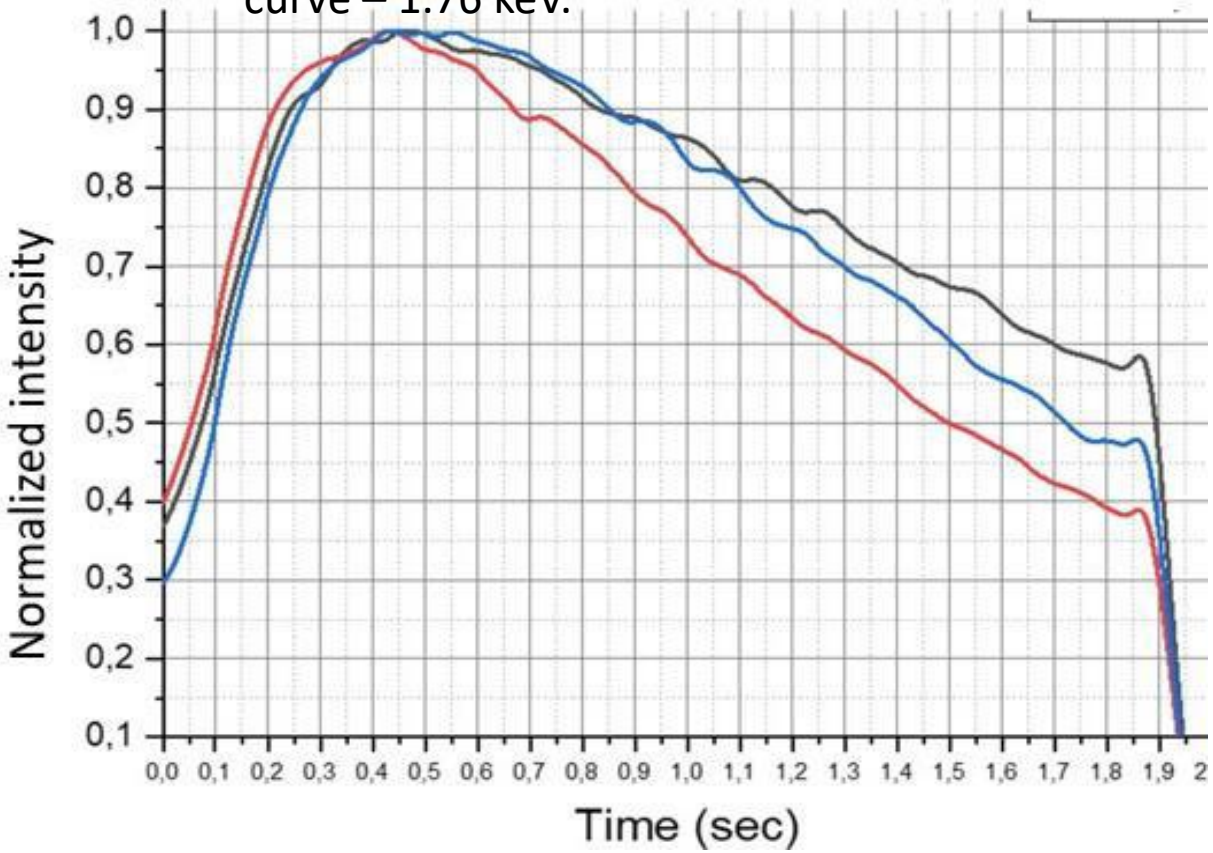
Example of data from the Booster profilometer



Electron cooling system of the Booster beam

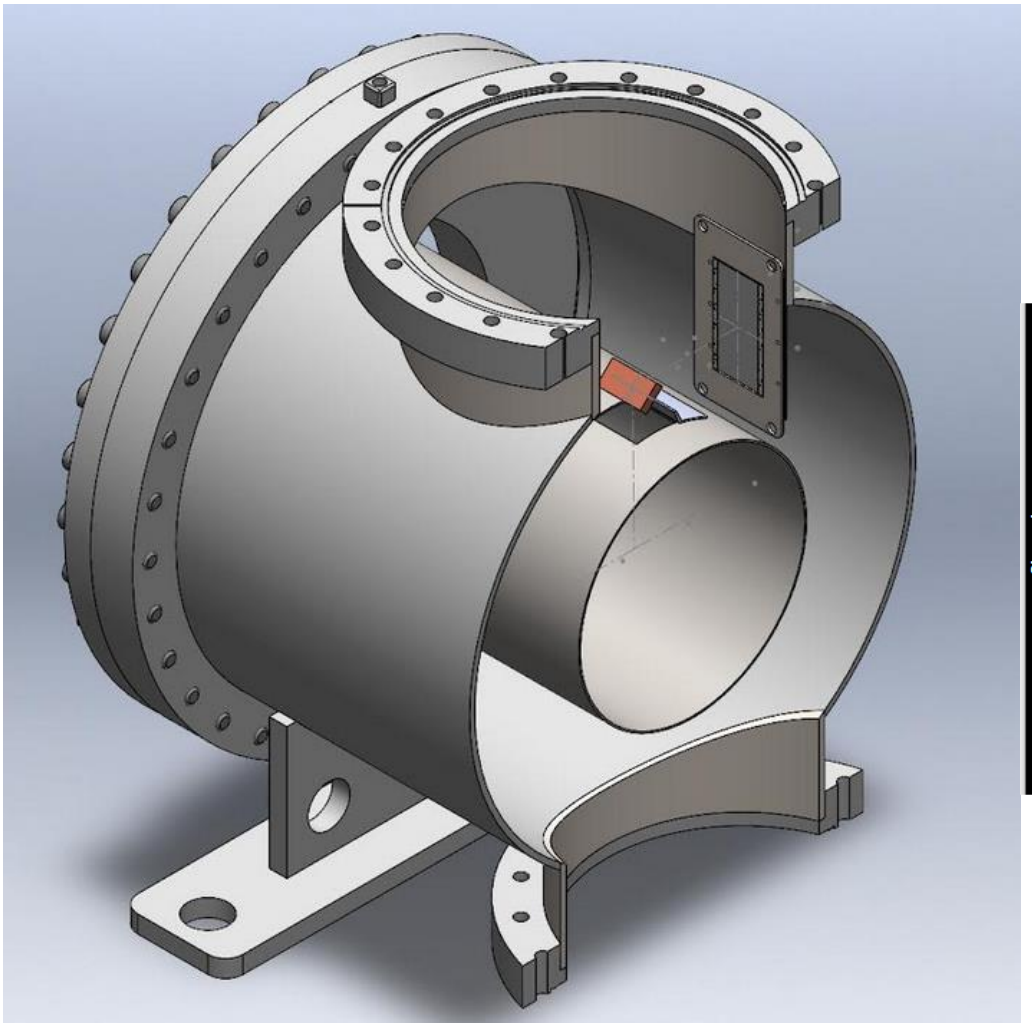


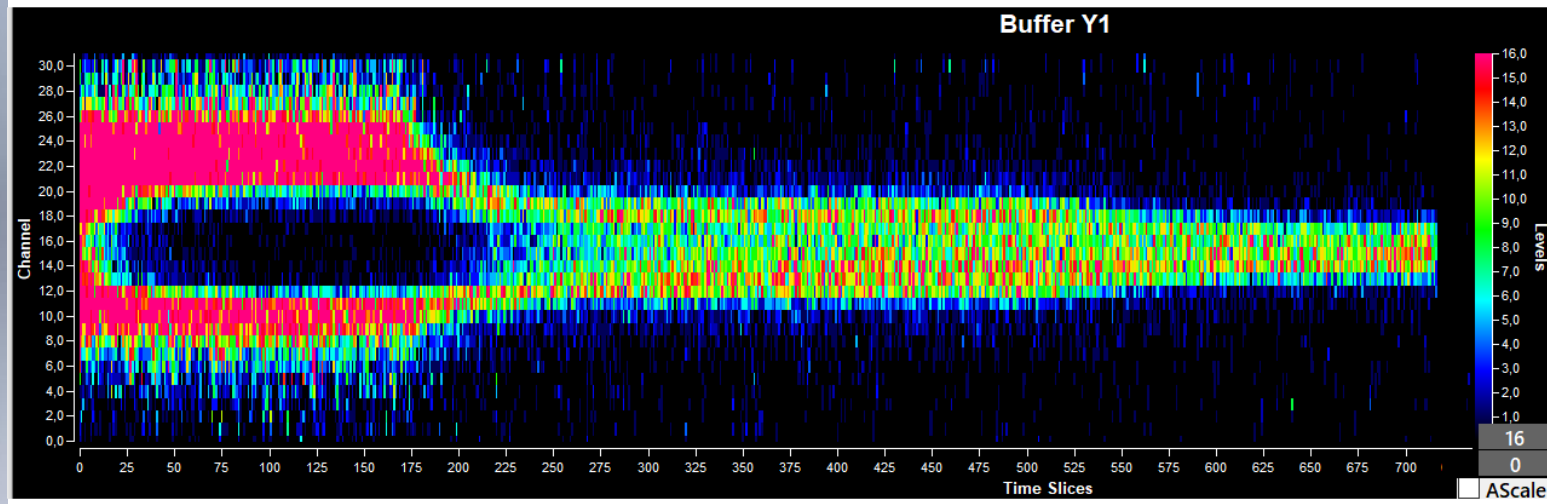
Normalized intensity for different electron energy. Black curve – 1.82 keV, blue curve – 1.72 keV, red curve – 1.76 keV.



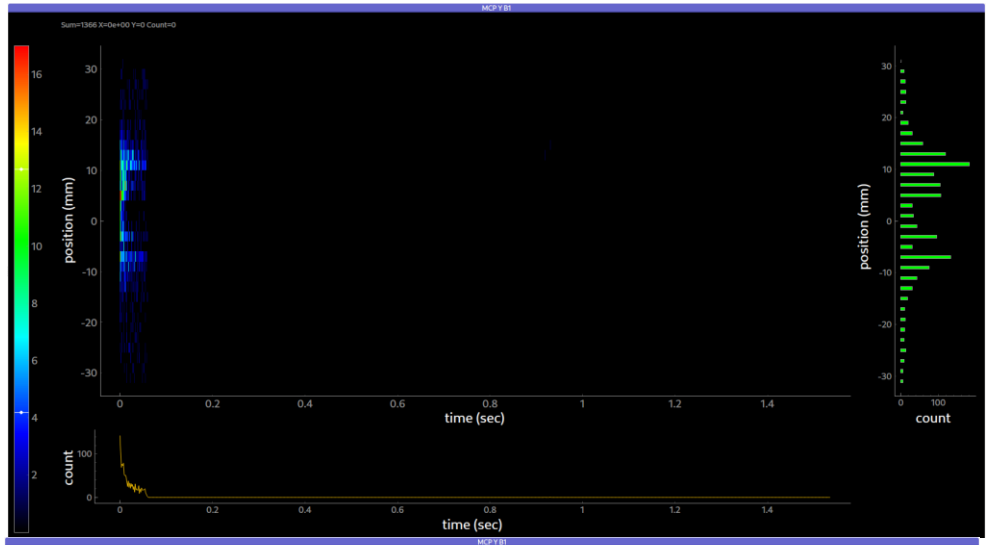
ELECTRON COOLER OF THE NICA BOOSTER AND ITS APPLICATIONS
13th Workshop on Beam Cooling and Related Topics COOL2021, Novosibirsk, Russia

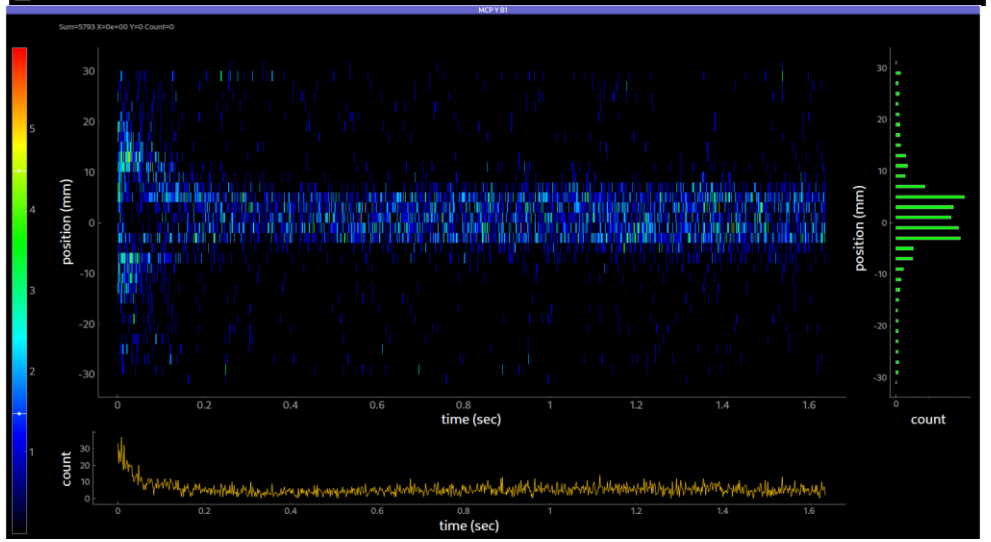
New type of MCP-based profilometer



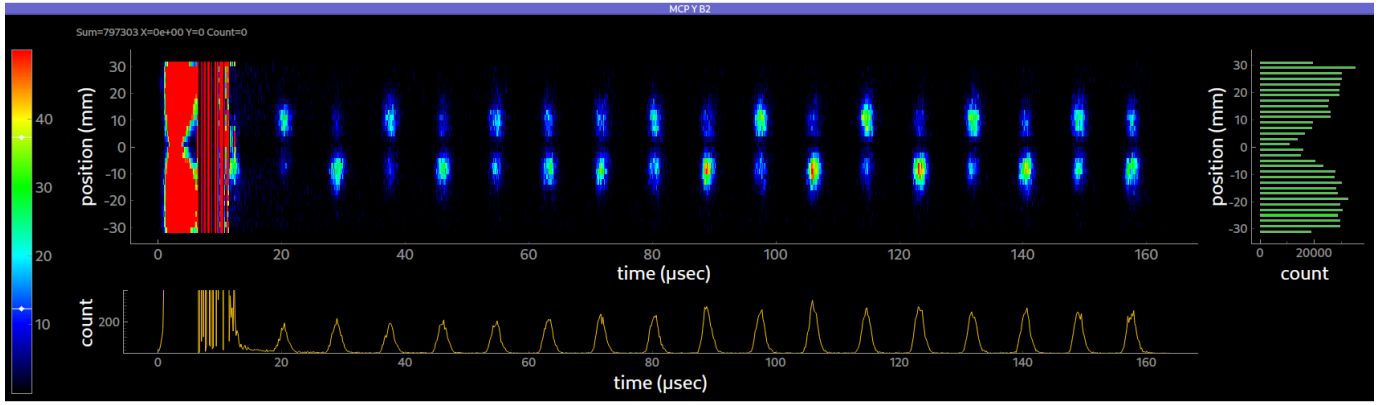


Conclusions





- MCP-based profilometer have been developed, manufactured and installed in accelerators.
- They work successfully and provide comprehensive data for the accelerator group.
- We studied characteristics and capabilities of MCP-based profilometers.
- The development of a new types of MCP-based profilometer has started.



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Thank you for your attention!

Dubna

Science brings nations together

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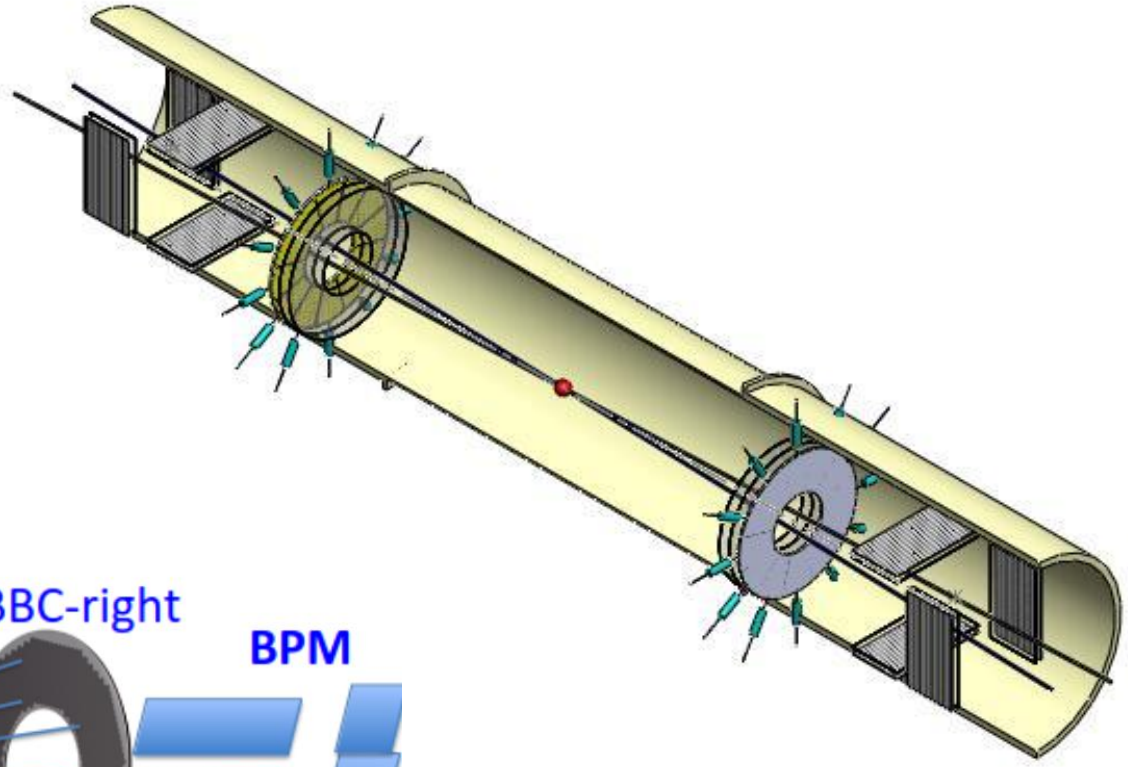
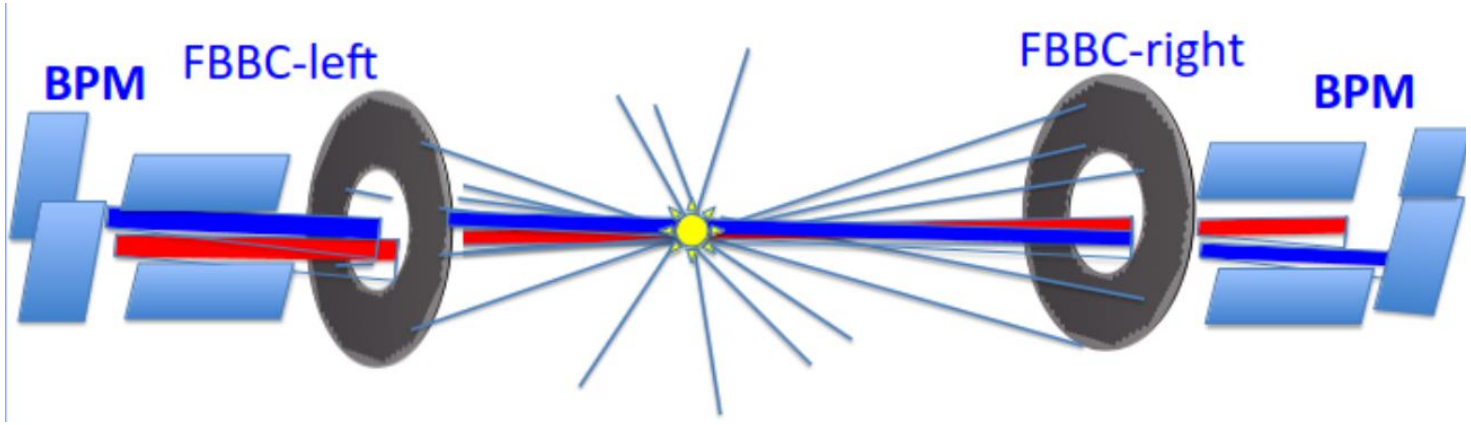
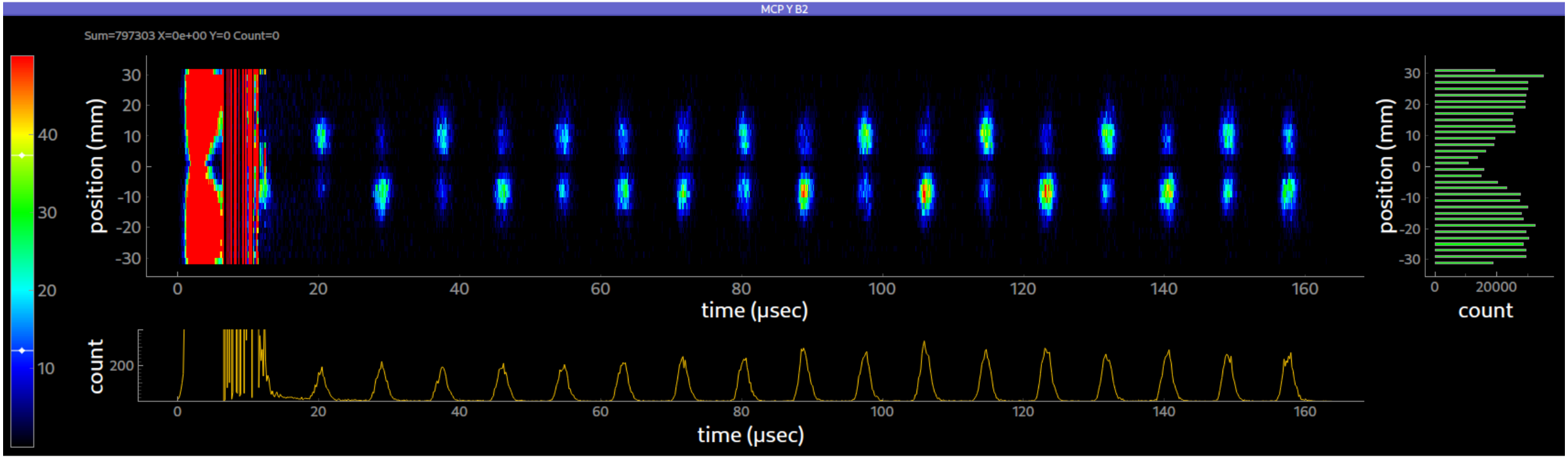
TIPP 2023

Beam-beam collisions counter for experiments at NICA



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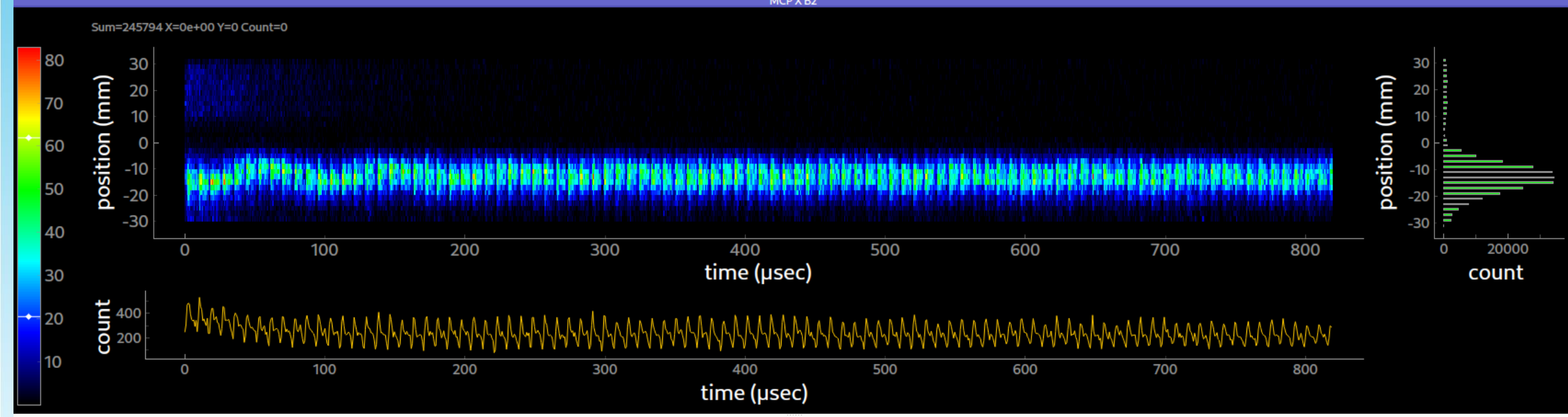
time (μsec)
count
position (mm)
count
time (μsec)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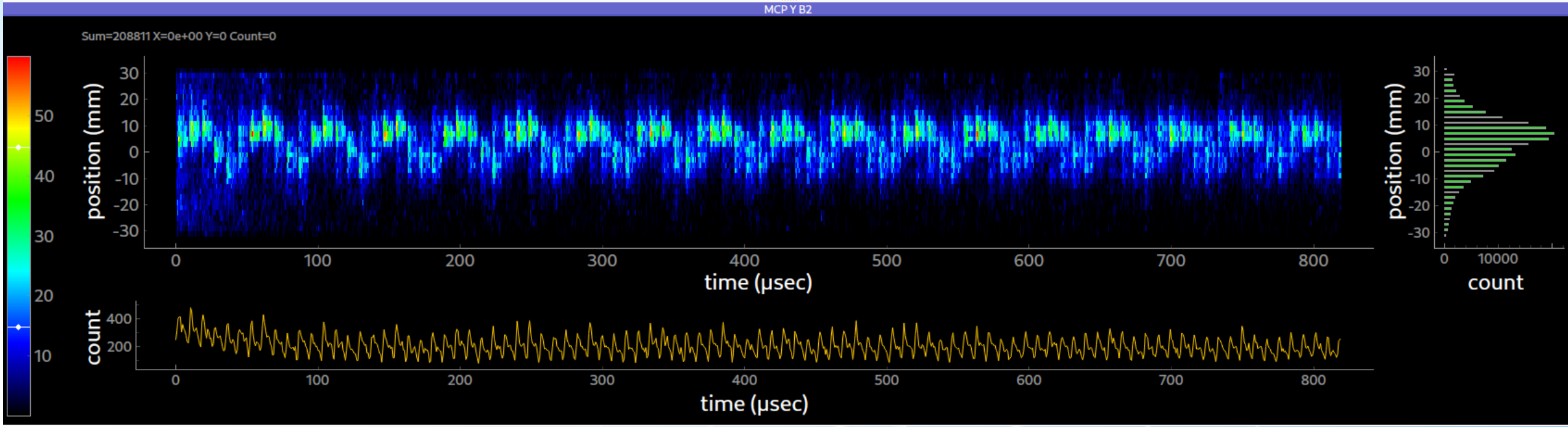
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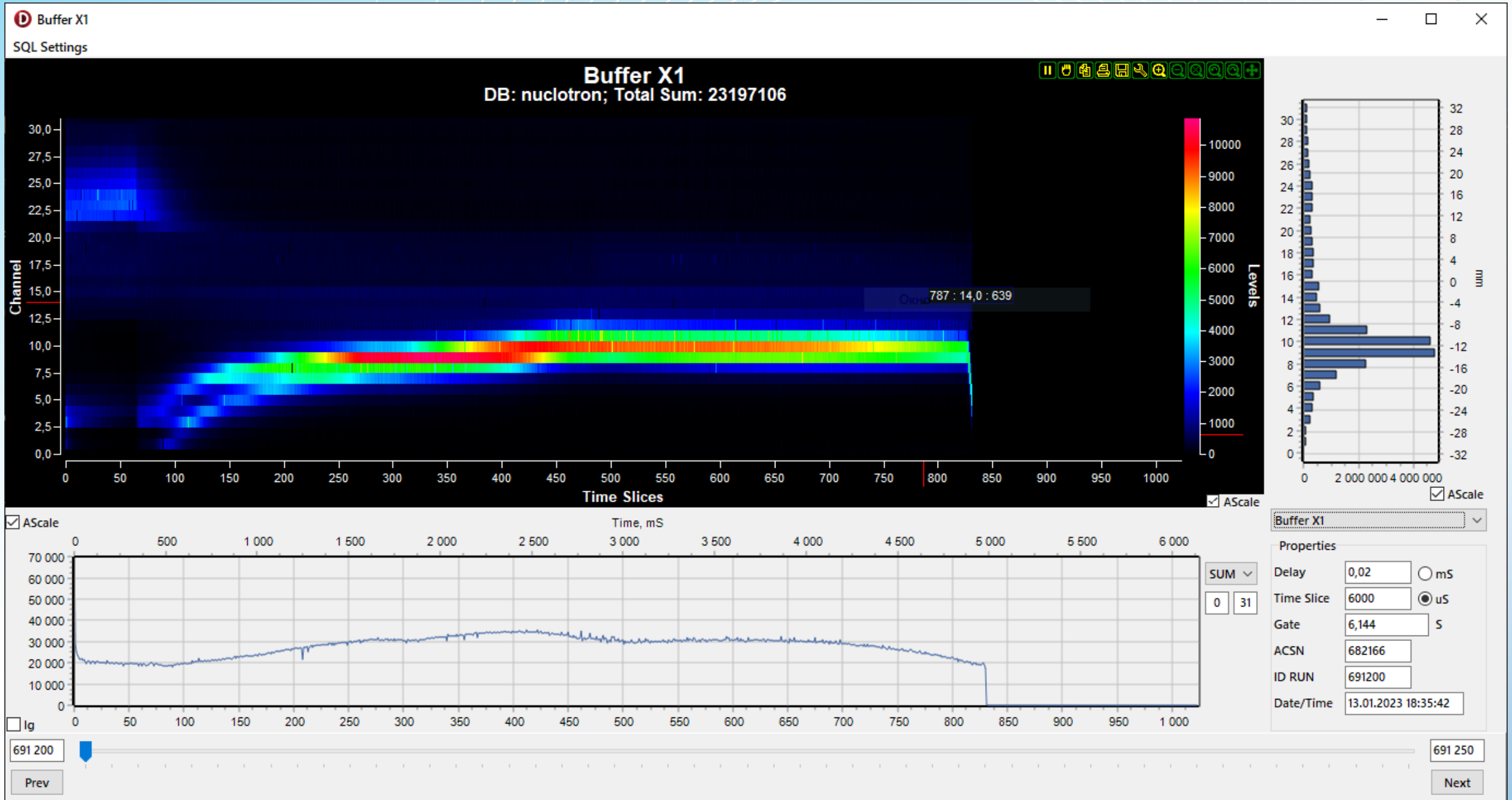
count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SQL Settings
Buffer X1
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Time Slices
Levels
787 : 14,0 : 639
AScale
mm
AScale
Time, mS
lg
SUM
0
31
Buffer X1
Properties
Delay
0,02
mS
Time Slice
6000
uS
Gate
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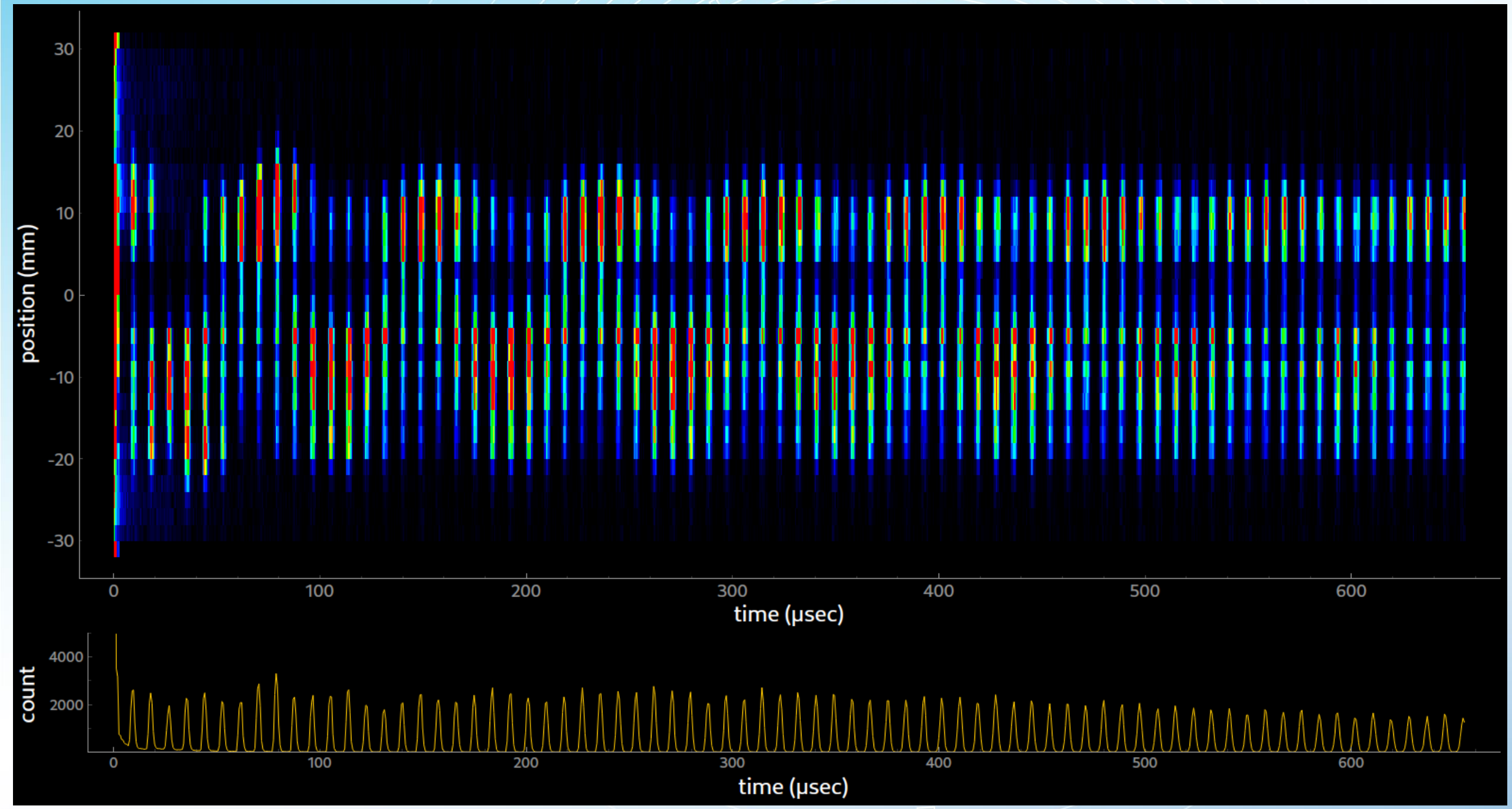
Prev
Next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time (μsec)
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count
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400
500
600
time (μsec)