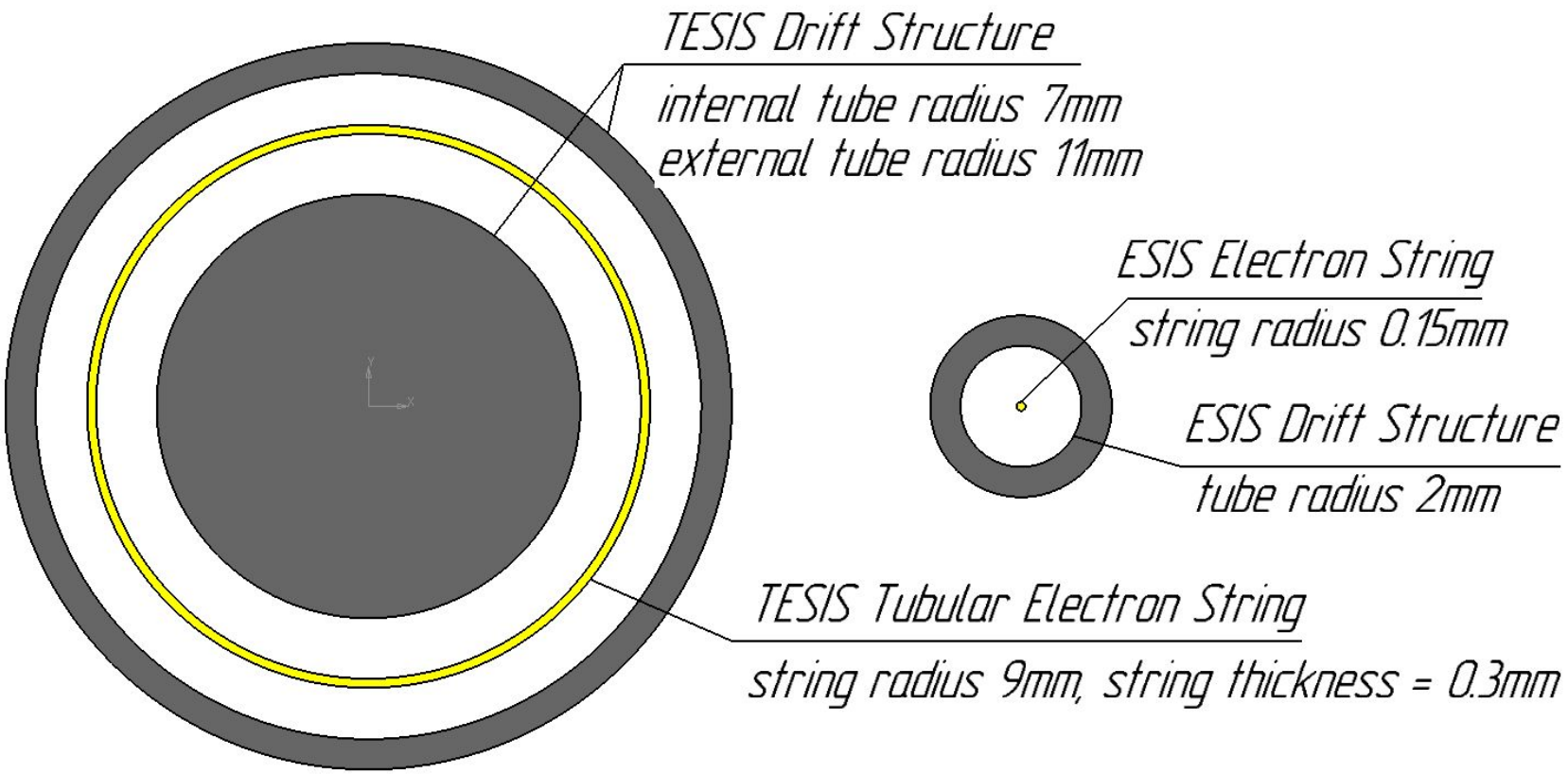
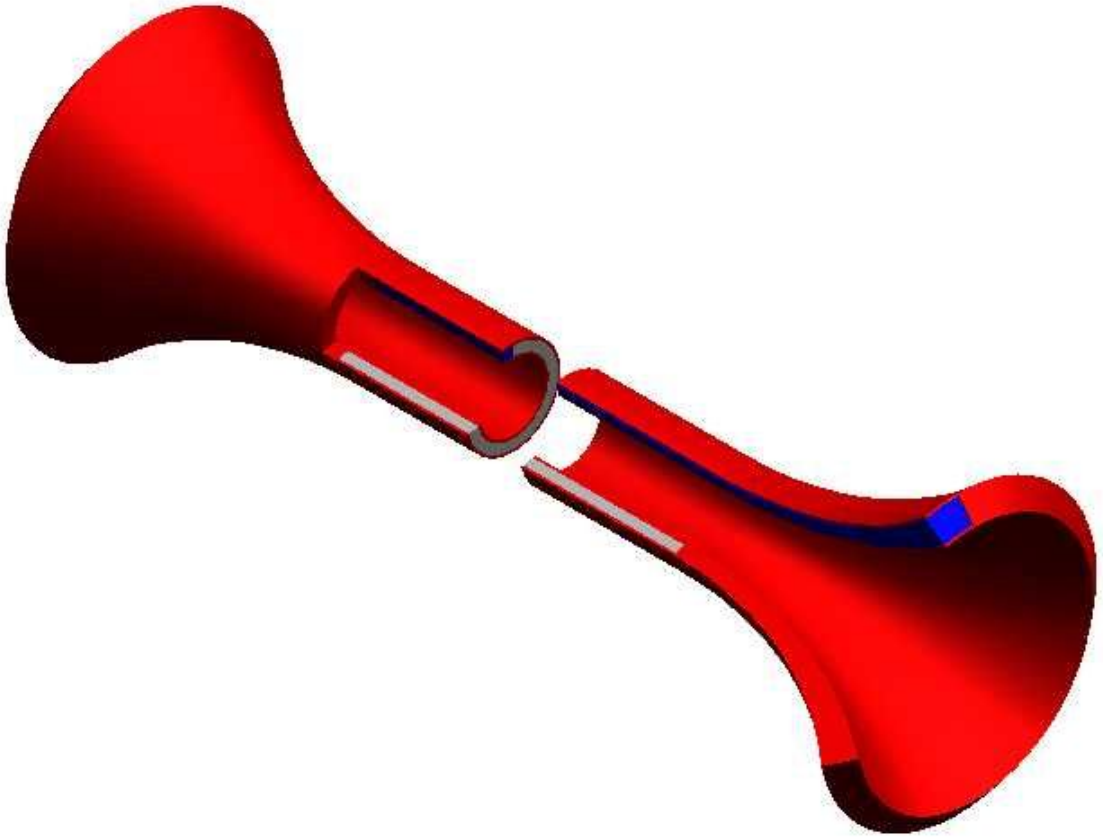
Tubular Electron String Ion Source development

Boytsov A.

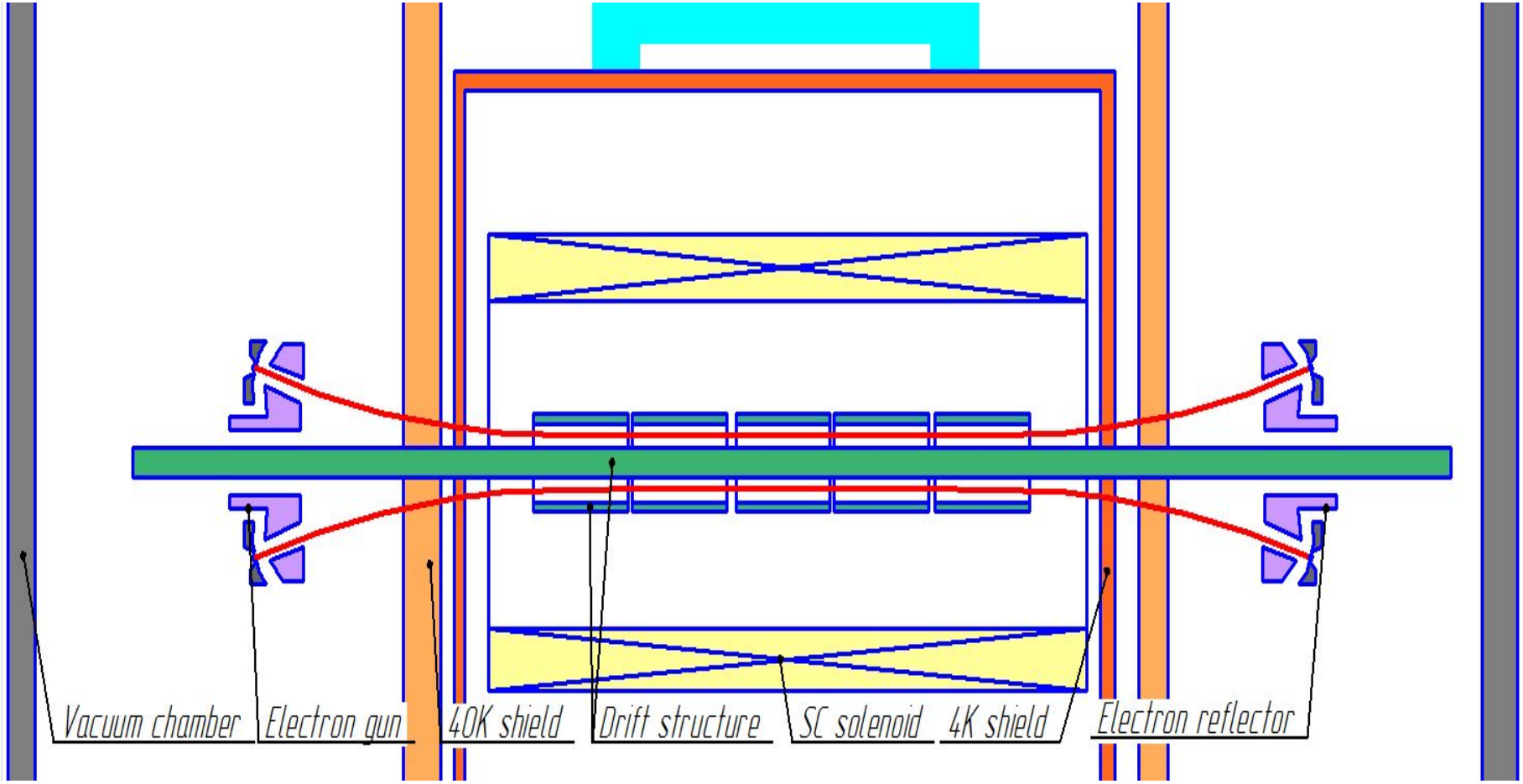
Main idea


TESIS Drift Structure
internal tube radius 7mm
external tube radius 11mm
ESIS Electron String
string radius 0.15mm
ESIS Drift Structure
tube radius 2mm
TESIS Tubular Electron String
string radius 9mm, string thickness = 0.3mm

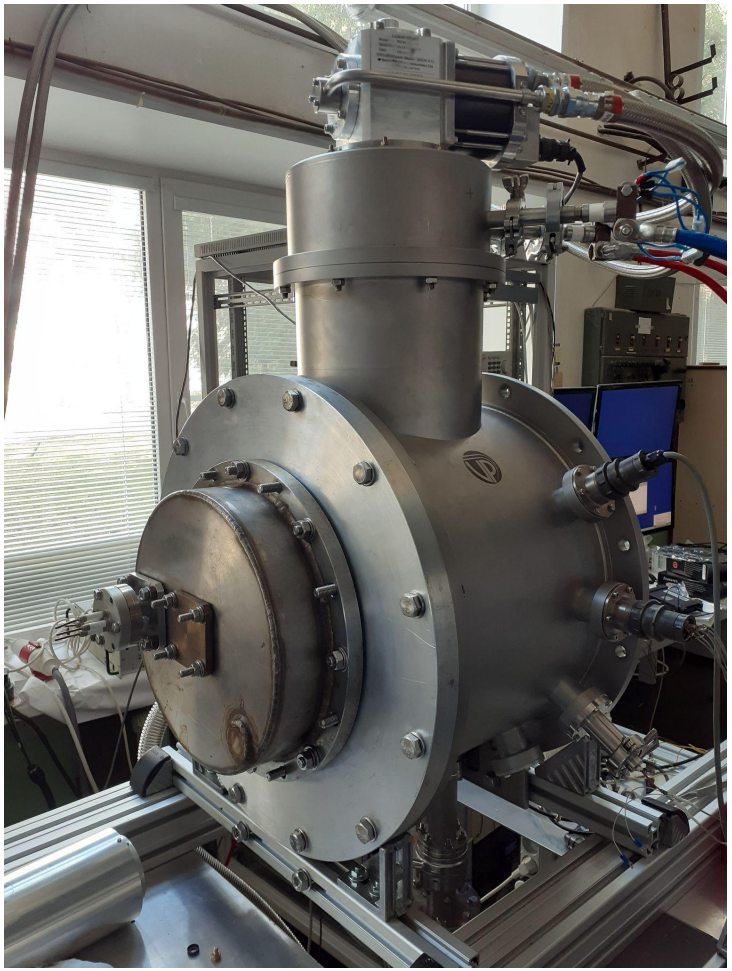
Electron beam volume



Scheme

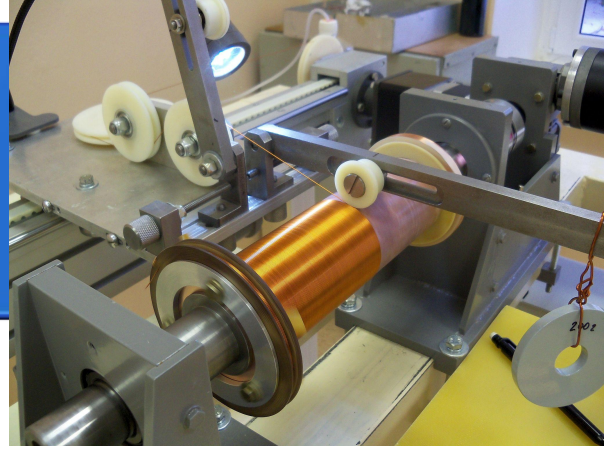

Vacuum chamber
Electron gun
40K shield
Drift structure
SC solenoid
4K shield
Electron reflector

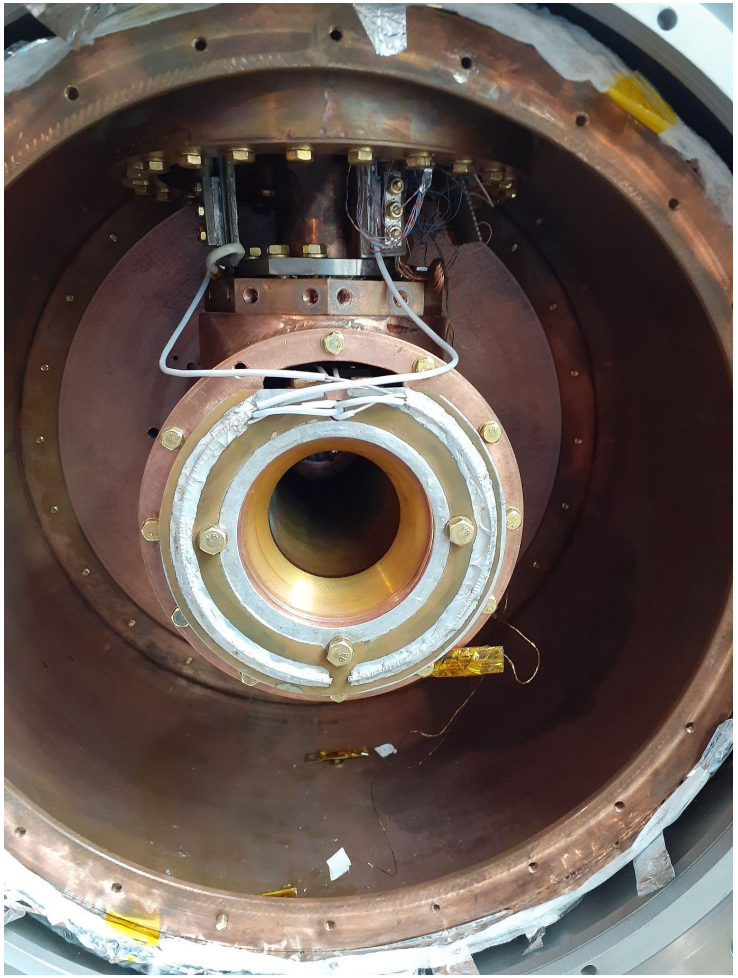
Facility



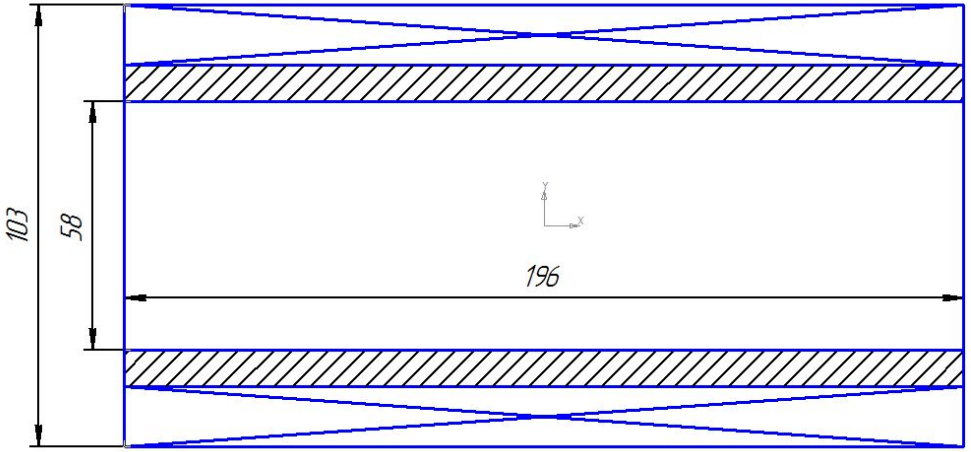
Operating pressure = 7e-8 mbar
Cryocooler Sumitomo RDK 415 1.5W
Solenoid temperature = 4.2K
HTSC current leads (4mm tape) SuperOx
Pumping and cooling time = 48h

Superconducting solenoid

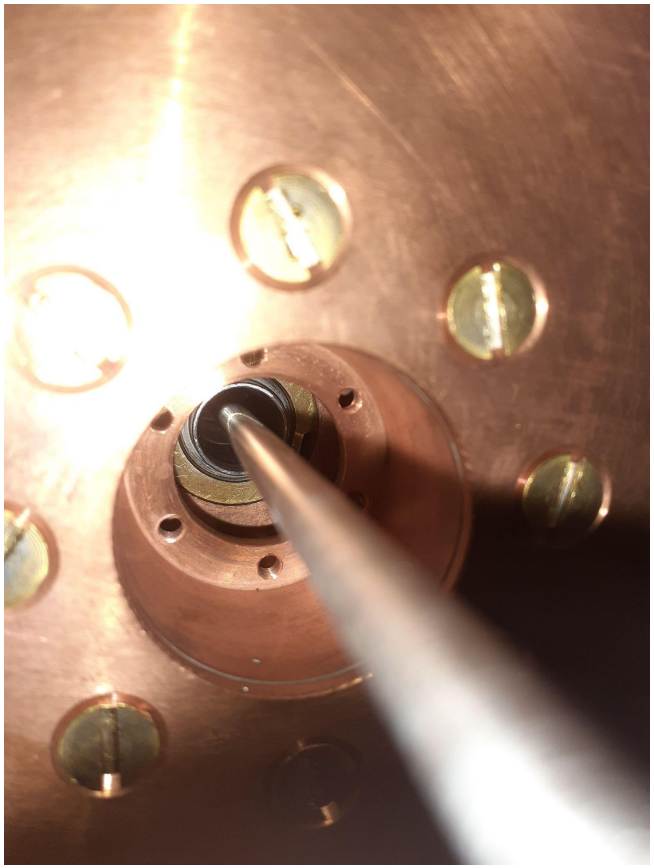




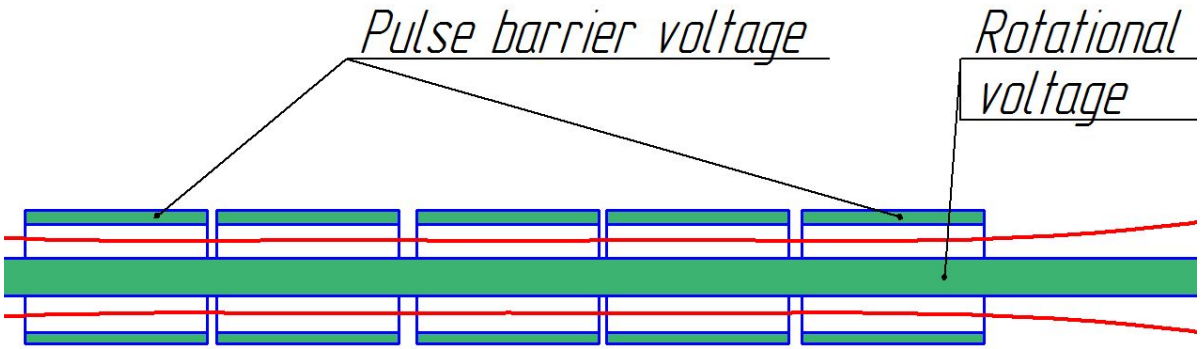
Solenoid temperature = 4.2K
NbTi wire diameter = 0.7mm
20 layers
Operating magnetic field = 3T (100A)



Drift structure



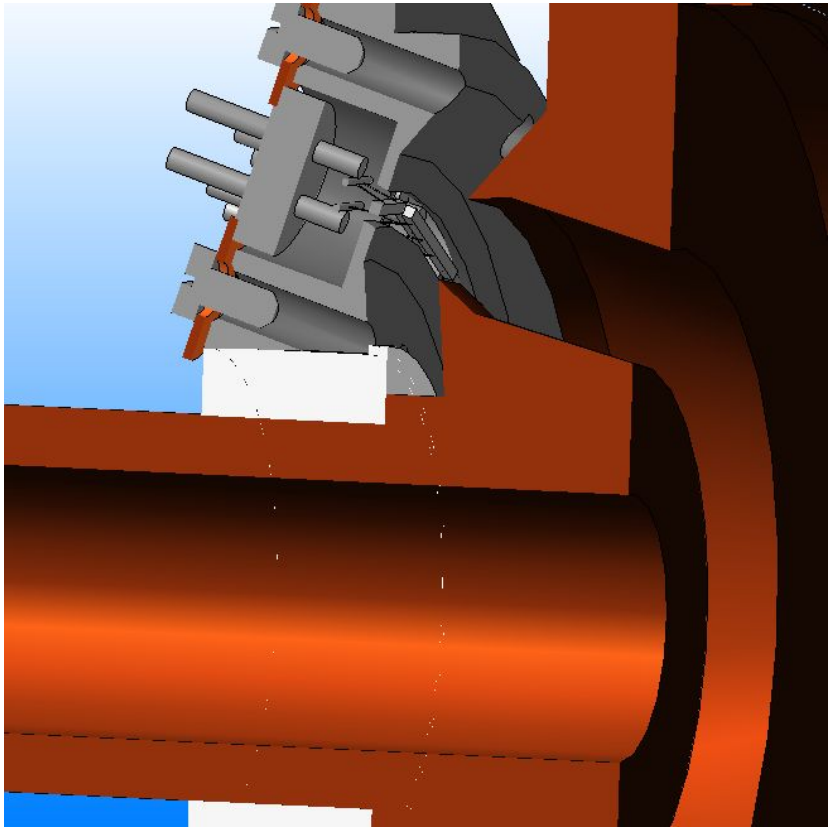
5 external tubes, diameter 16mm, length 30mm
1 central rod, diameter 6 mm
Collecting charge signal from every tubes
Pulse voltage near +1kV control for ion motion
Rotational voltage up to 500V

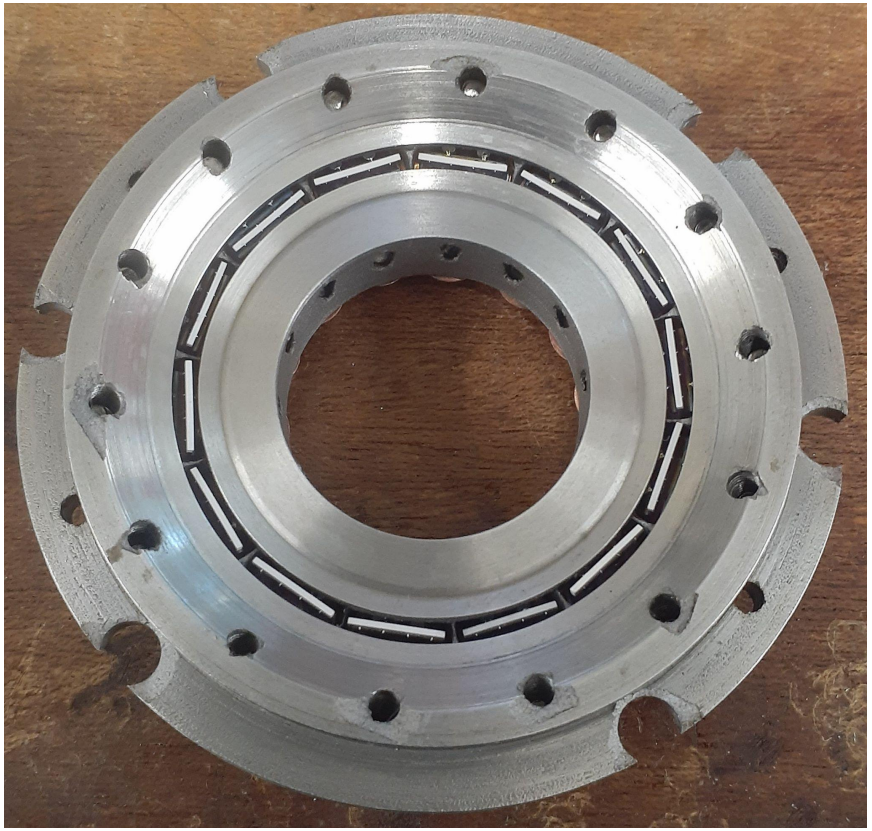


Cathode

IrCe cathode
Emission rectangle surface 0.5x8mm
WRe heater

Electron gun





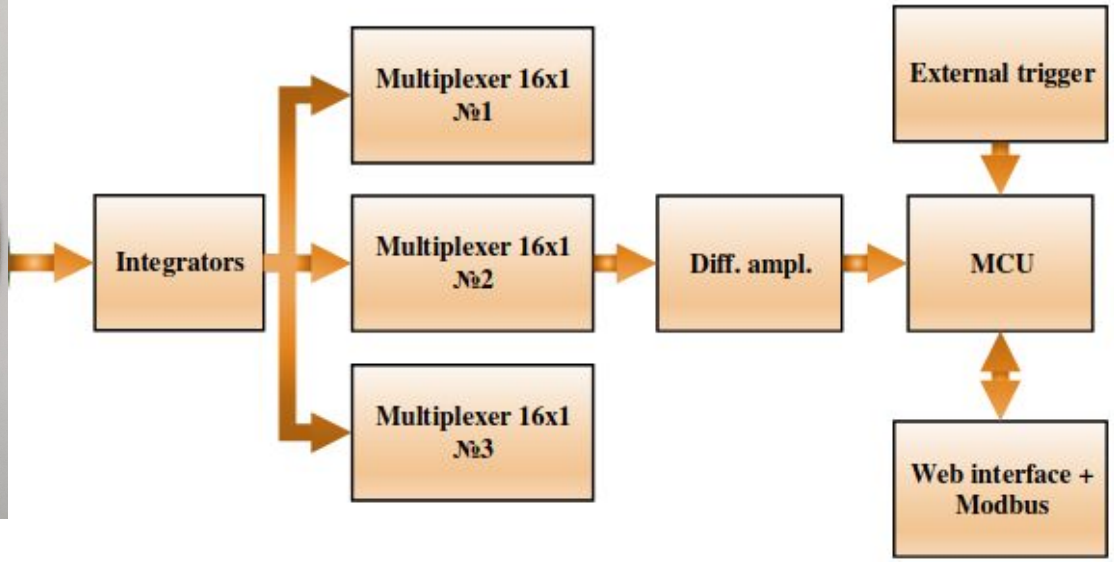
14 IrCe cathodes, ring diameter = 40mm

Electron gun test bench

7 heating power supply for every 2 serial connected cathodes
Every cathode in pair has similar U/I characteristic
Copper connection reduce voltage drop on wire
Cathode heating under high voltage of false cathode

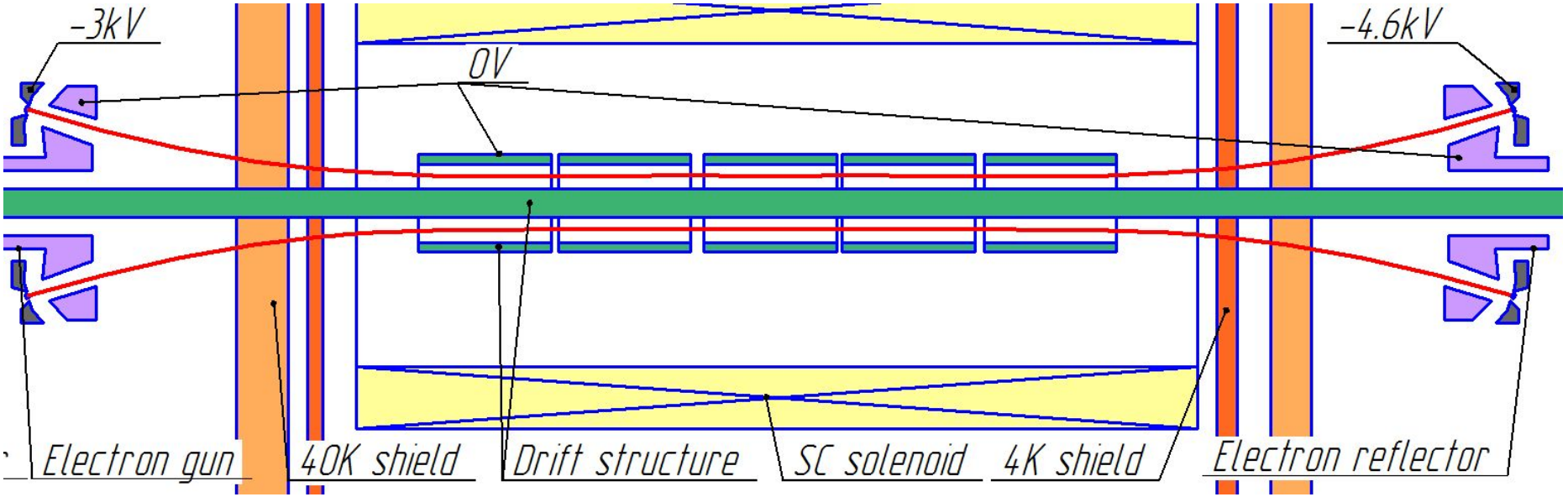
Tracing beam

Copper PCB for new electron gun
Installed after electron reflector



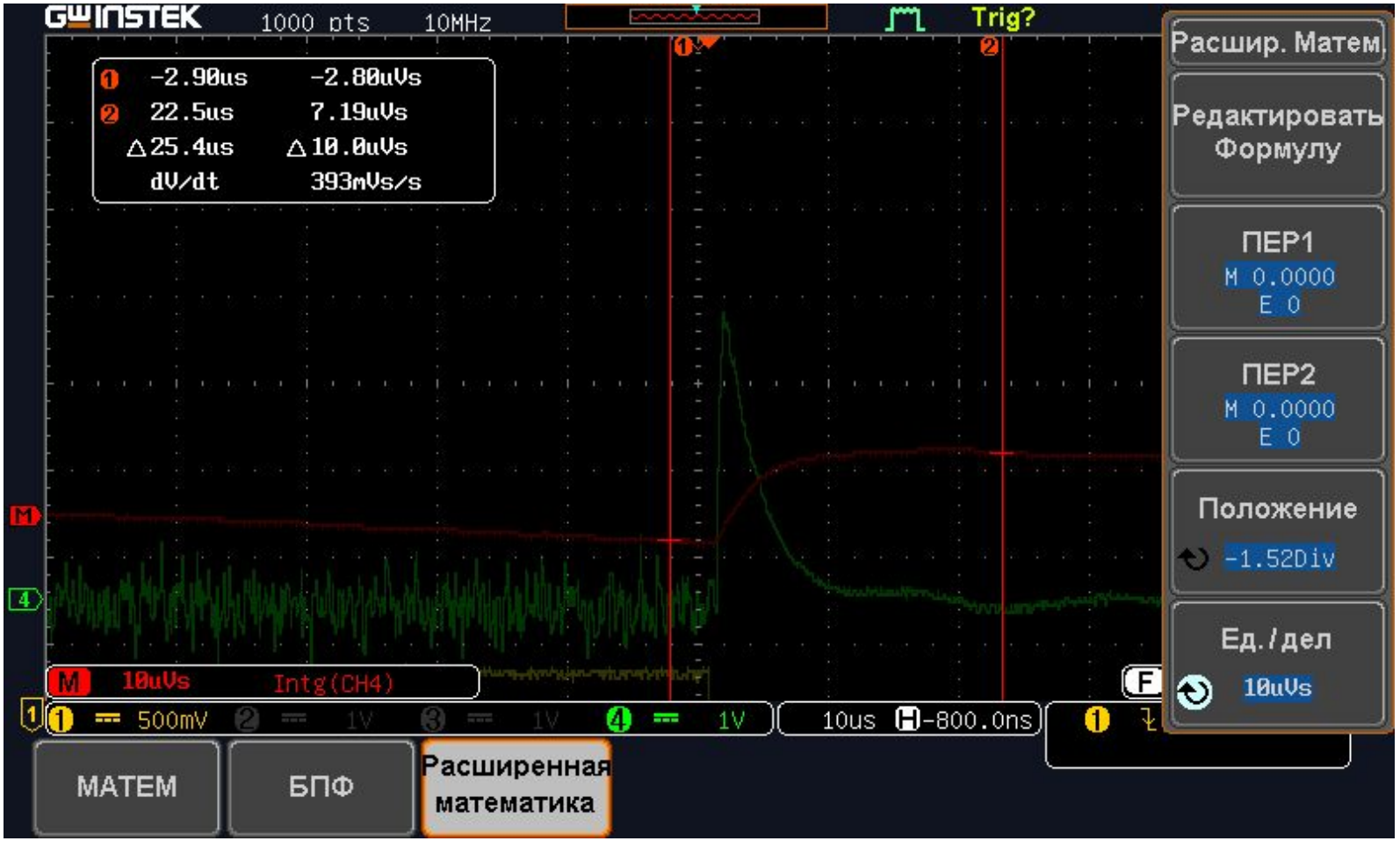
String mode

Pulse time = 300us
Time period = 1s

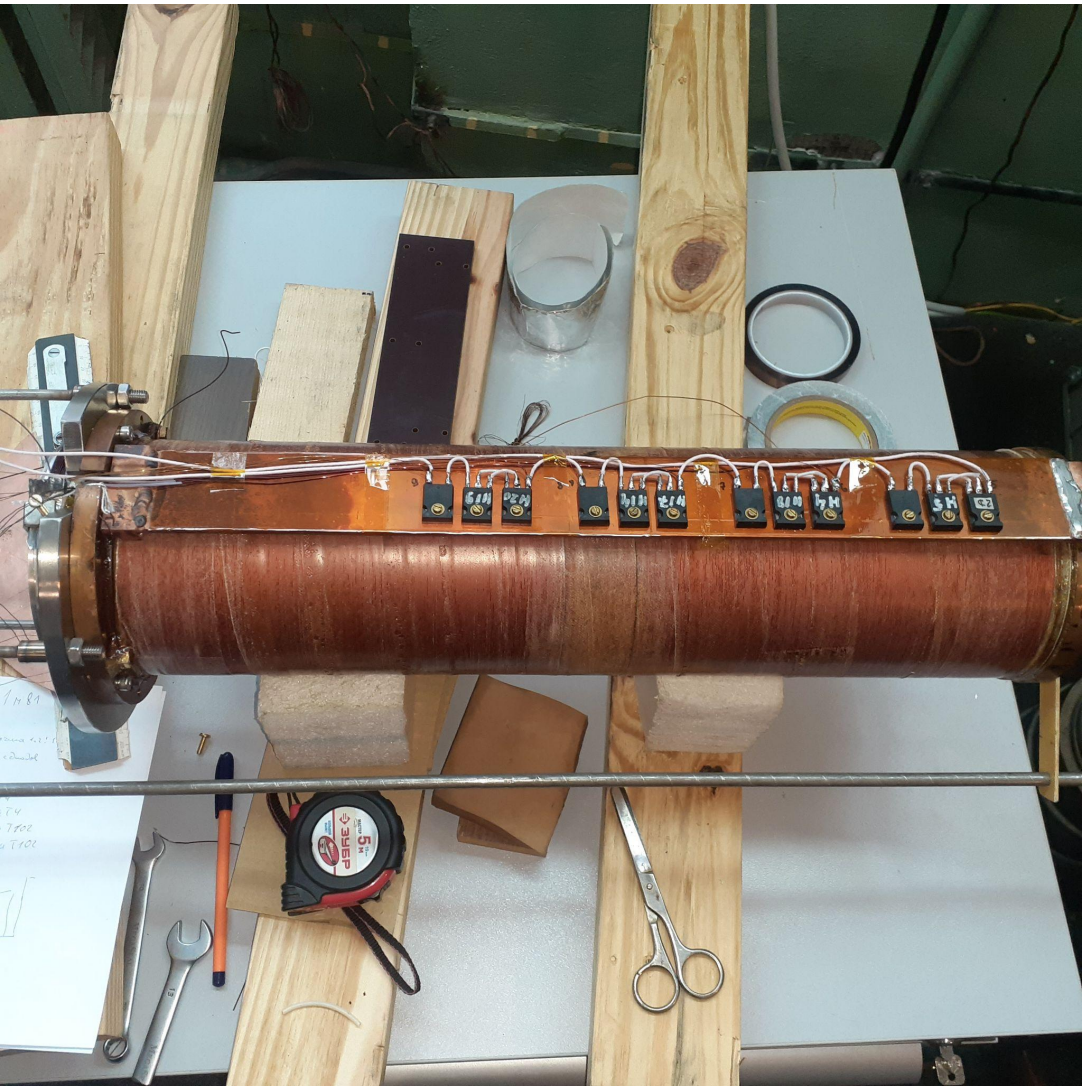


Accumulated charge

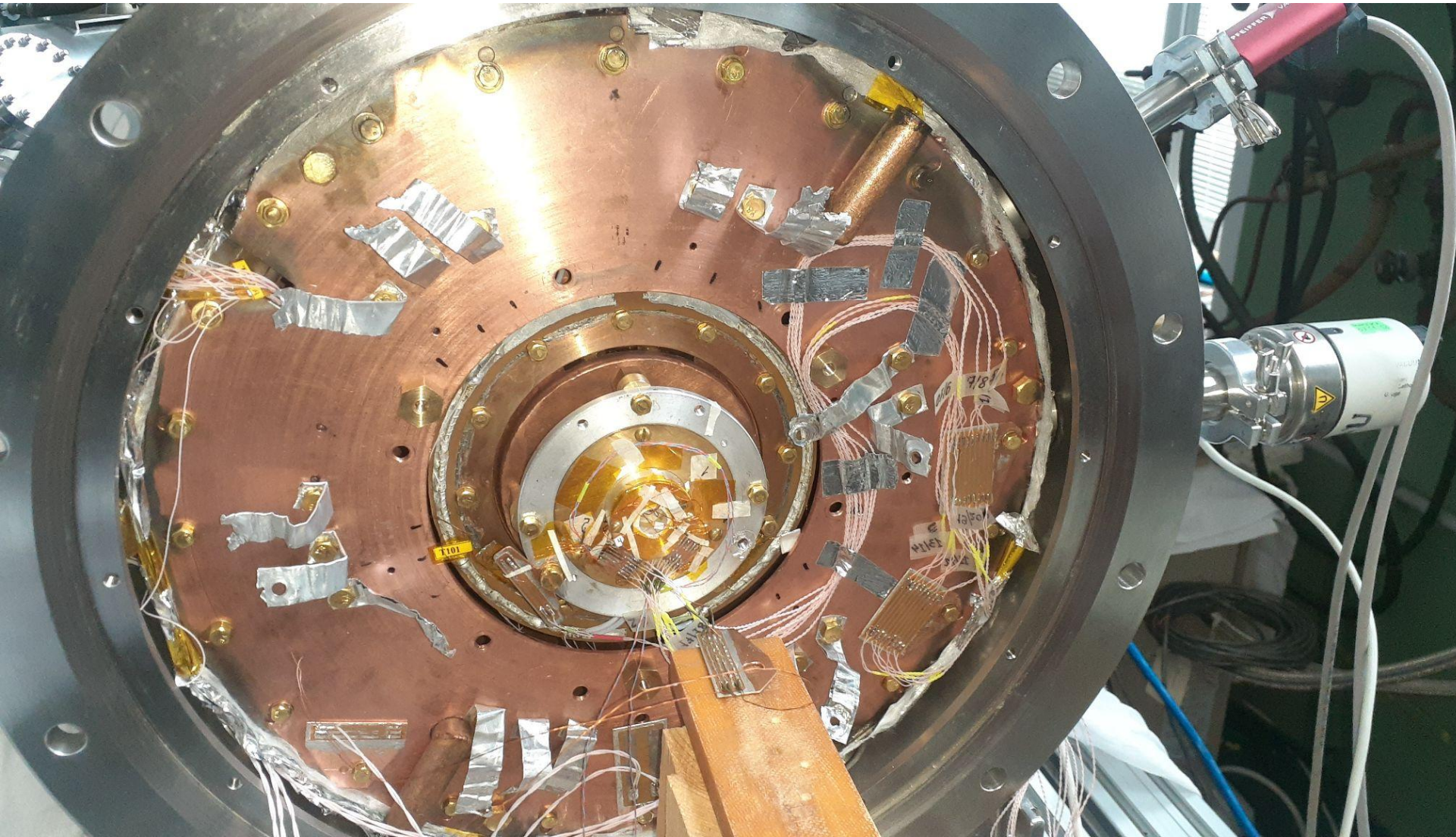
Qe=10nC



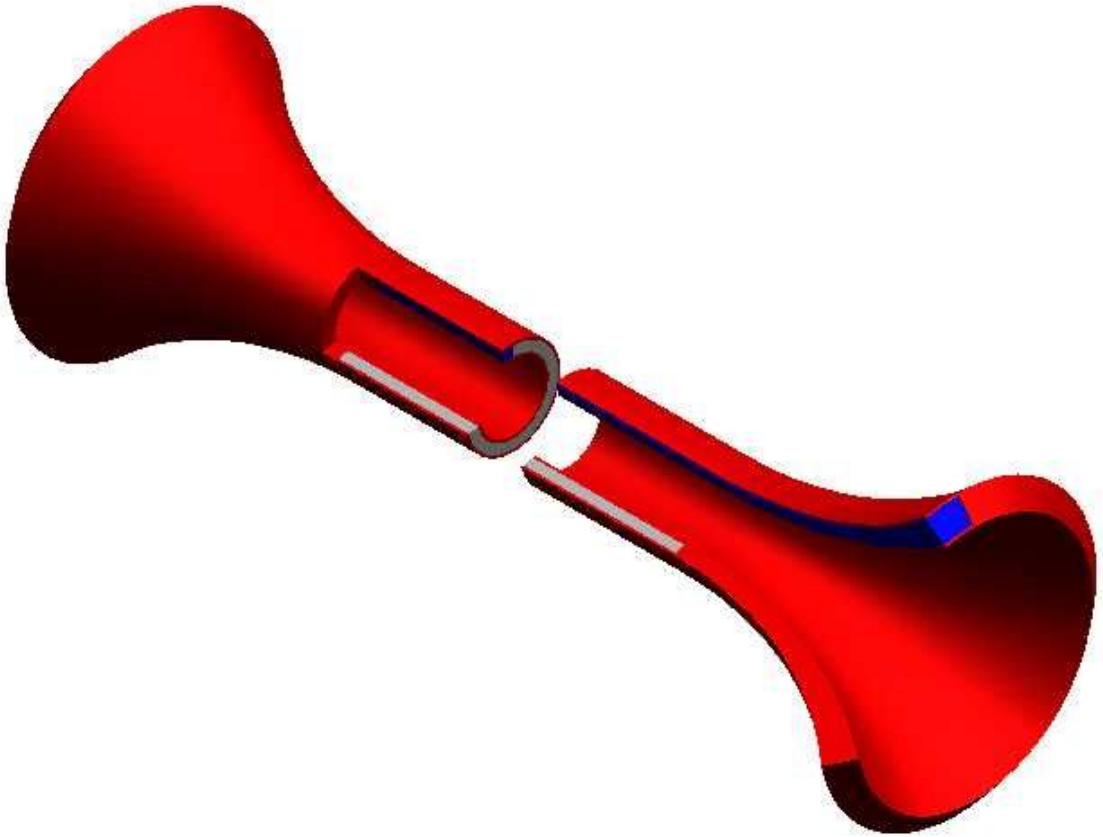
Solenoid testing

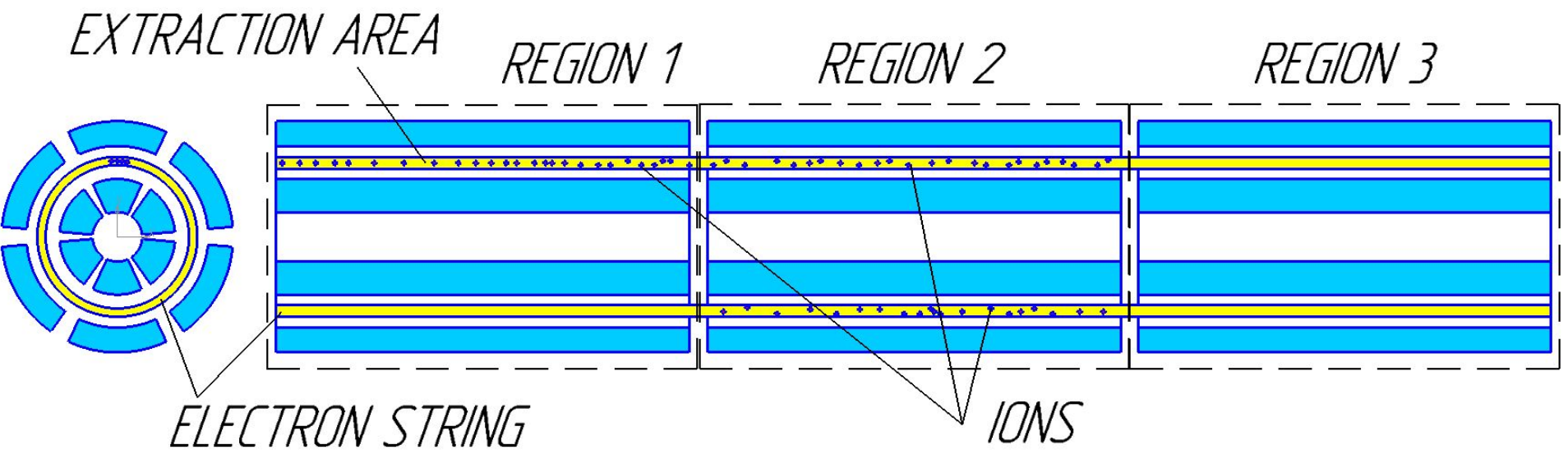


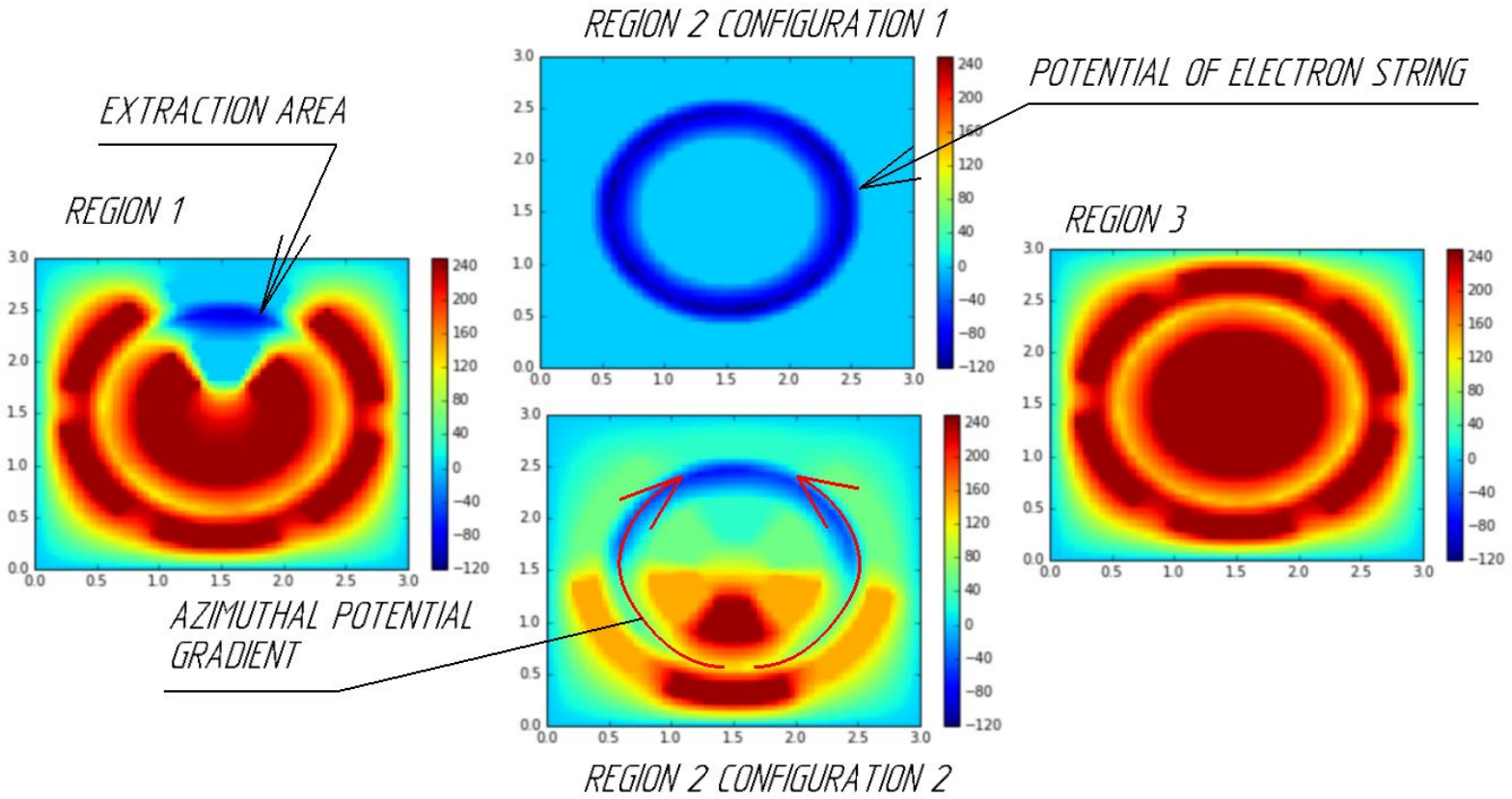
HTSC screen

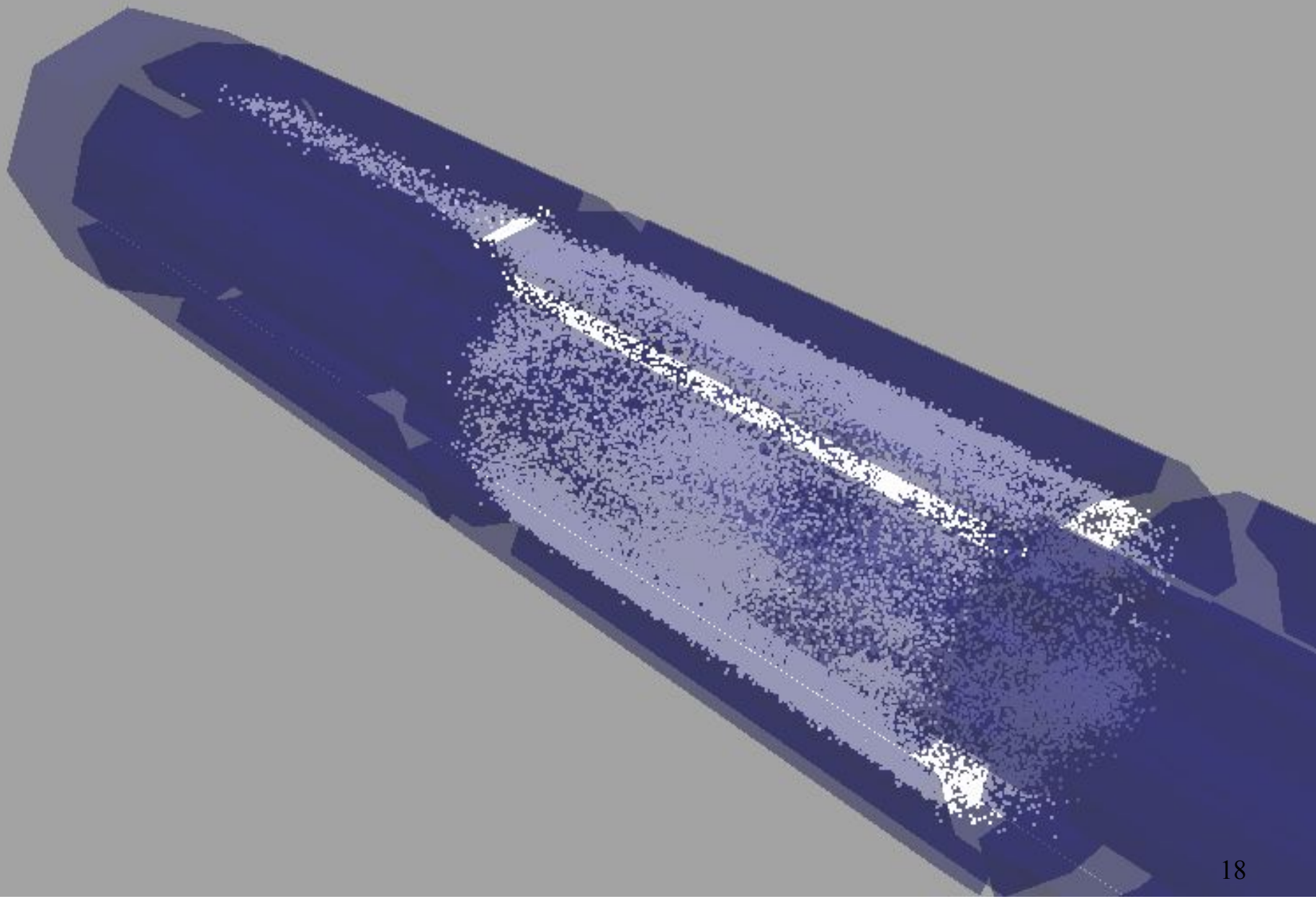


Tubular beam

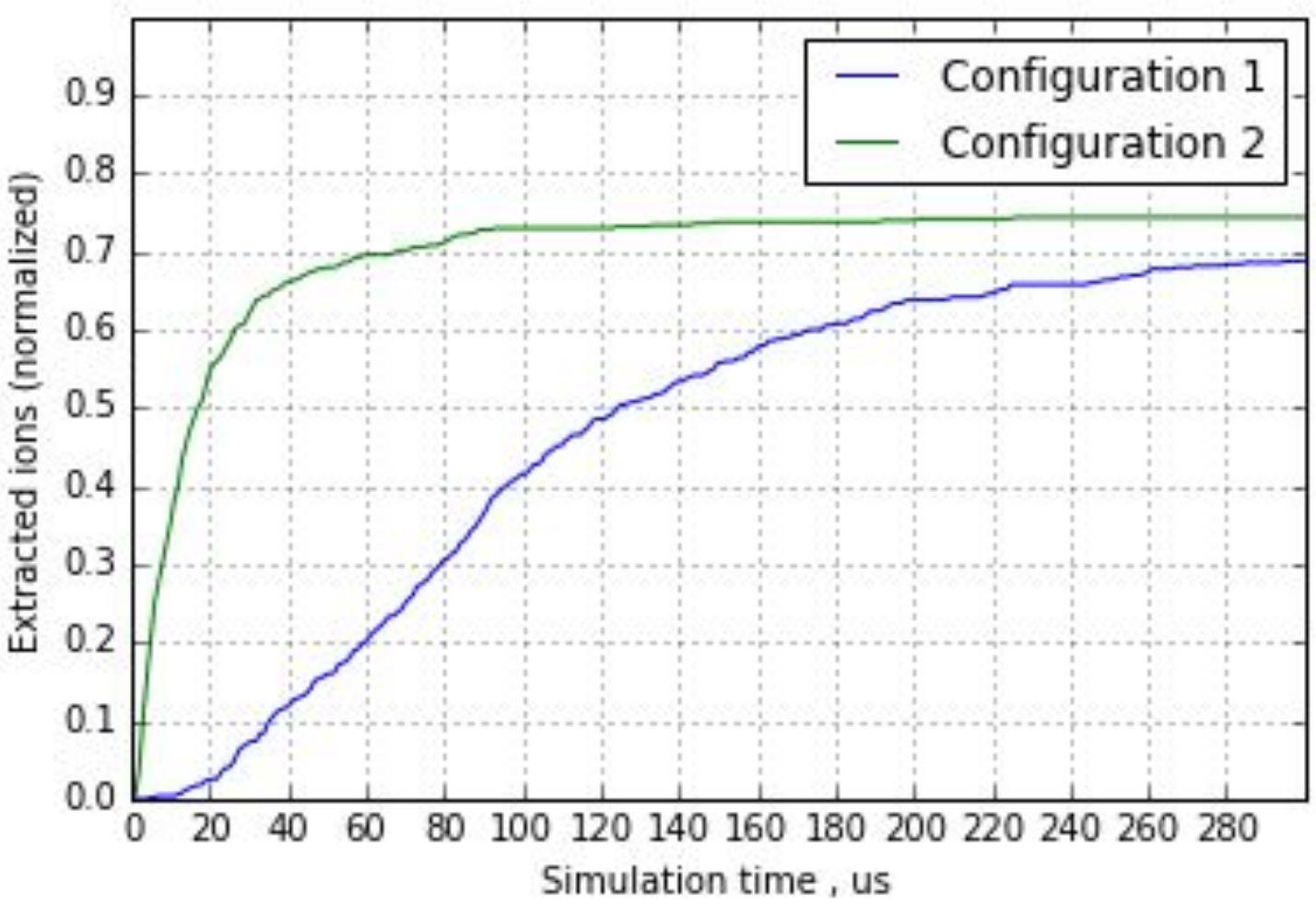


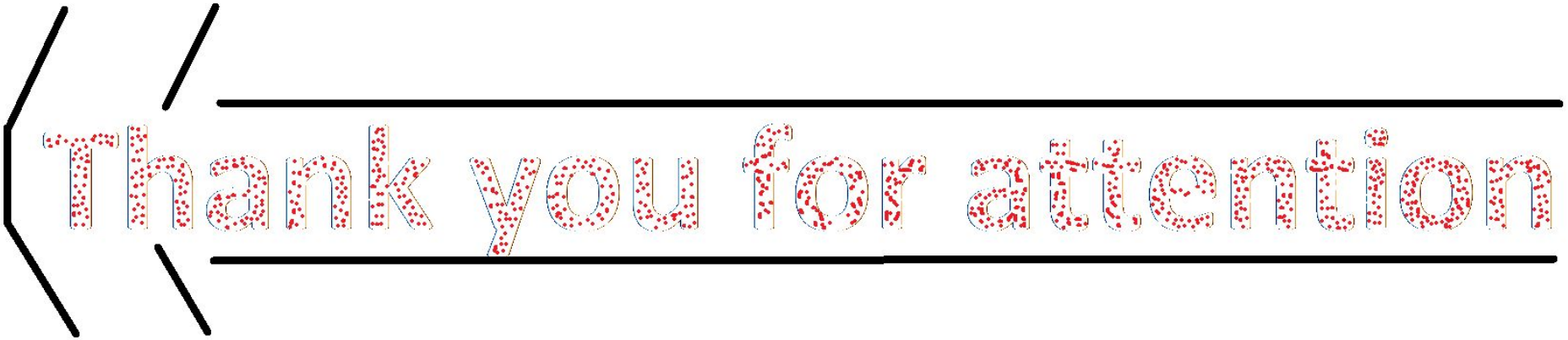

EXTRACTION AREA
REGION 1
REGION 2
REGION 3
ELECTRON STRING
IONS


REGION 2 CONFIGURATION 1
POTENTIAL OF ELECTRON STRING
EXTRACTION AREA
REGION 1
REGION 3
AZIMUTHAL POTENTIAL GRADIENT
REGION 2 CONFIGURATION 2



Results


Configuration 1
Configuration 2
Extracted ions (normalized)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
Simulation time , us


Thank you for attention