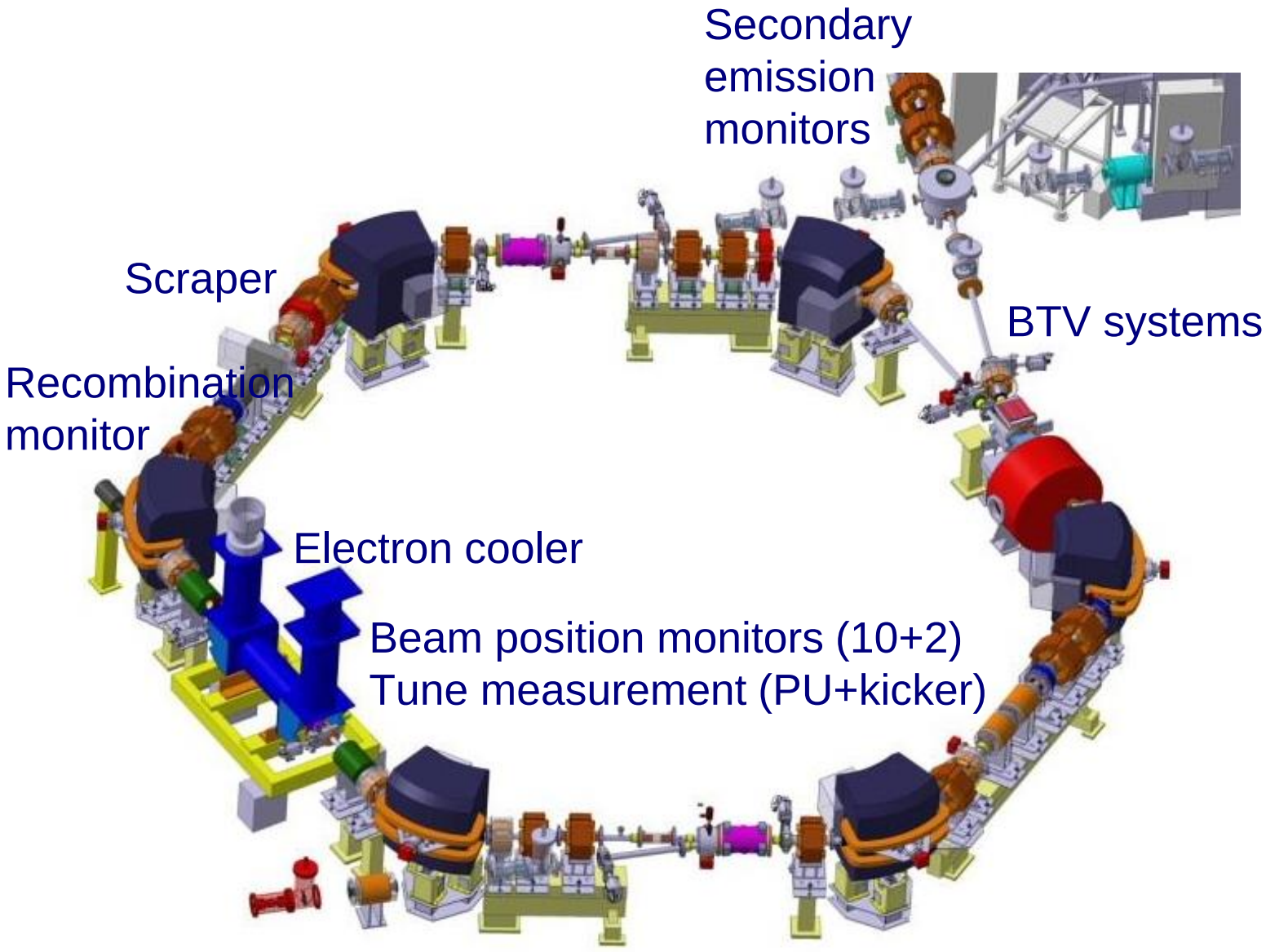
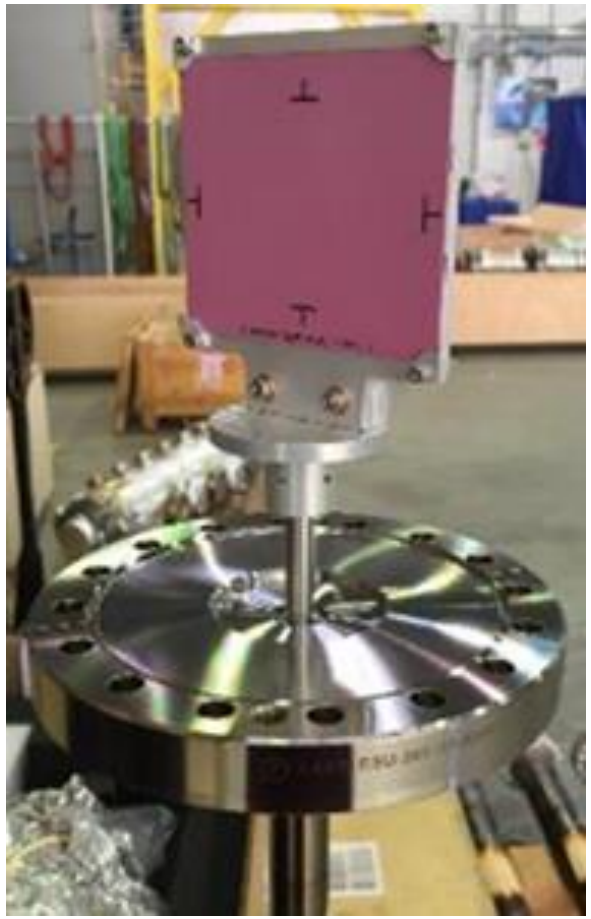
BI@ELENA

Extra Low ENergy Antiproton ring

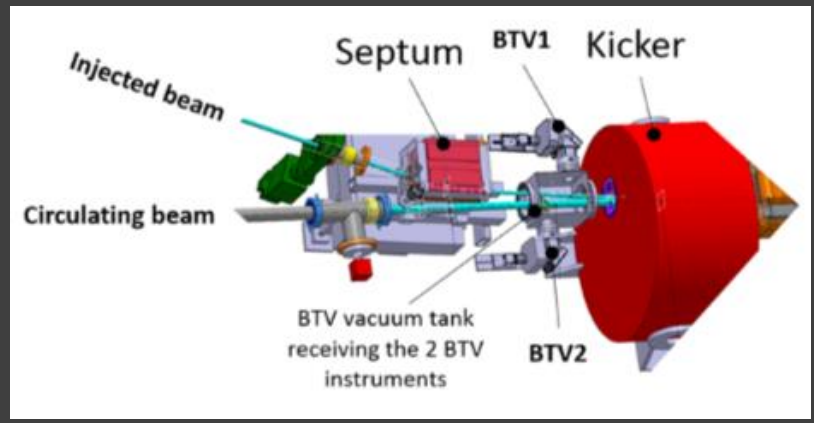
- 30.4 m circumference
- 5.3 MeV to 100 keV
- N < 2.5 x 10^{7} pbars
- Ultra high vacuum
  - 2 x 10^{-12} torr
- 30 sec cycle with electron cooling at 35 MeV/c and 13.75 MeV/c

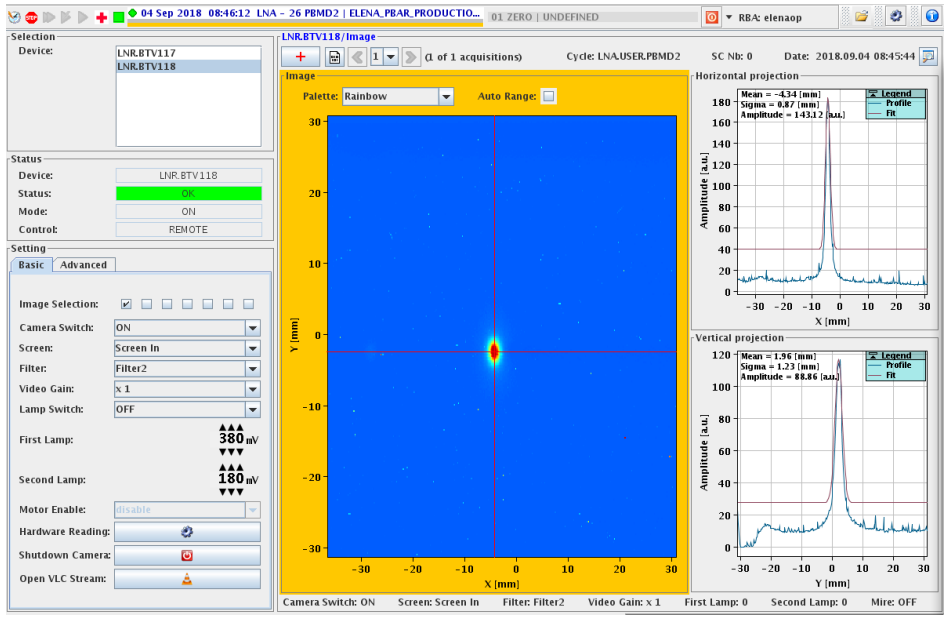


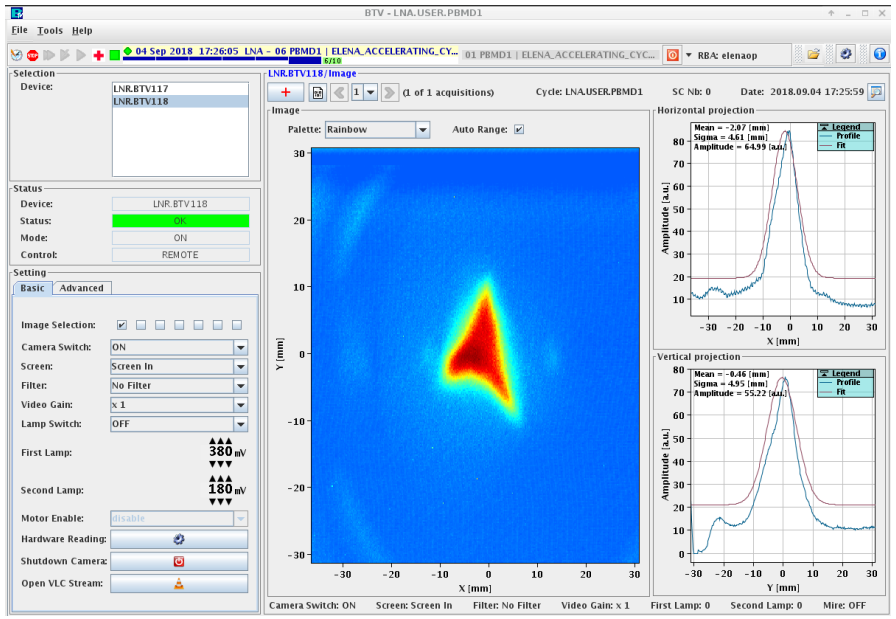


BTV

- Type Al_2O_3:CrO2
- Thickness 1mm
- Calibration marks No grid to better optimize the S/N with image digitalization
- Magnetic coupled actuator
- Resolution of 190um/px and 215um/px
- Three monitors installed – one in pbar line, two in common tank at injection

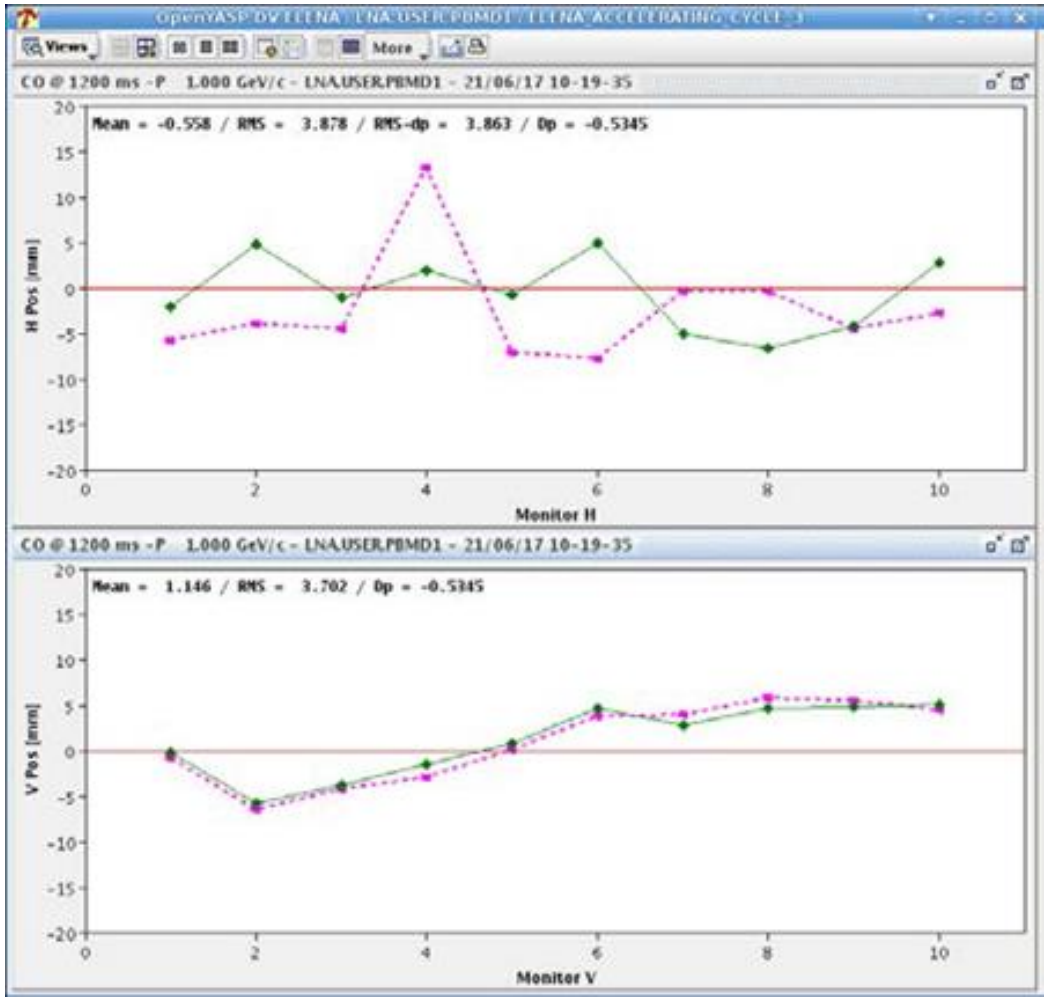


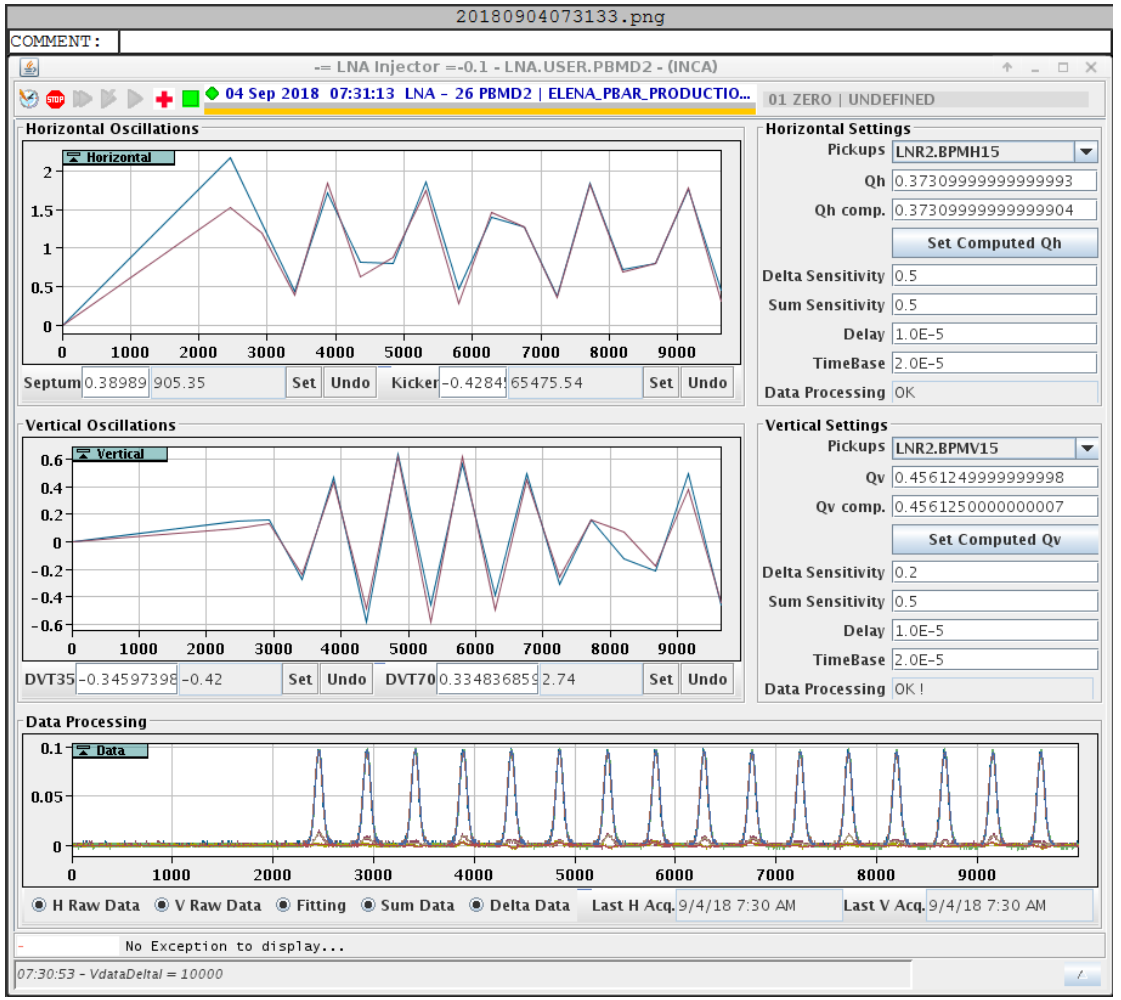

04 Sep 2018 08:46:12 LNA - 26 PBMD2 | ELENA_PBAR_PRODUCTIO...
01 ZERO | UNDEFINED
RBA: elenaop
Selection
Device:
LNR.BTV117
LNR.BTV118
Status
Device: LNR.BTV118
Status: OK
Mode: ON
Control: REMOTE
Setting
Basic
Advanced
Image Selection:
Camera Switch: ON
Screen: Screen In
Filter: Filter2
Video Gain: x 1
Lamp Switch: OFF
First Lamp: 380 mV
Second Lamp: 180 mV
Motor Enable: disable
Hardware Reading:
Shutdown Camera:
Open VLC Stream:
LNR.BTV118/Image
(1 of 1 acquisitions)
Cycle: LNA.USER.PBMD2
SC Nb: 0
Date: 2018.09.04 08:45:44
Image
Palette: Rainbow
Auto Range:
Y [mm]
X [mm]
Horizontal projection
Mean = -4.34 [mm]
Sigma = 0.87 [mm]
Amplitude = 143.12 [a.u.]
Legend
Profile
Fit
Amplitude [a.u.]
X [mm]
Vertical projection
Mean = 1.96 [mm]
Sigma = 1.23 [mm]
Amplitude = 88.86 [a.u.]
Y [mm]
Camera Switch: ON
Screen: Screen In
Filter: Filter2
Video Gain: x 1
First Lamp: 0
Second Lamp: 0
Mire: OFF


BTV - LNA.USER.PBMD1
File Tools Help
04 Sep 2018 17:26:05 LNA - 06 PBMD1 | ELENA_ACCELERATING_CY...
01 PBMD1 | ELENA_ACCELERATING_CYC...
RBA: elenaop
Selection
Device:
LNR.BTV117
LNR.BTV118
Status
Device: LNR.BTV118
Status: OK
Mode: ON
Control: REMOTE
Setting
Basic
Advanced
Image Selection:
Camera Switch: ON
Screen: Screen In
Filter: No Filter
Video Gain: x 1
Lamp Switch: OFF
First Lamp: 380 mV
Second Lamp: 180 mV
Motor Enable: disable
Hardware Reading:
Shutdown Camera:
Open VLC Stream:
LNR.BTV118/Image
(1 of 1 acquisitions)
Cycle: LNA.USER.PBMD1
SC Nb: 0
Date: 2018.09.04 17:25:59
Image
Palette: Rainbow
Auto Range:
Y [mm]
X [mm]
Horizontal projection
Mean = -2.07 [mm]
Sigma = 4.61 [mm]
Amplitude = 64.99 [a.u.]
Legend
Profile
Fit
Amplitude [a.u.]
X [mm]
Vertical projection
Mean = -0.46 [mm]
Sigma = 4.95 [mm]
Amplitude = 55.22 [a.u.]
Y [mm]
Camera Switch: ON
Screen: Screen In
Filter: No Filter
Video Gain: x 1
First Lamp: 0
Second Lamp: 0
Mire: OFF

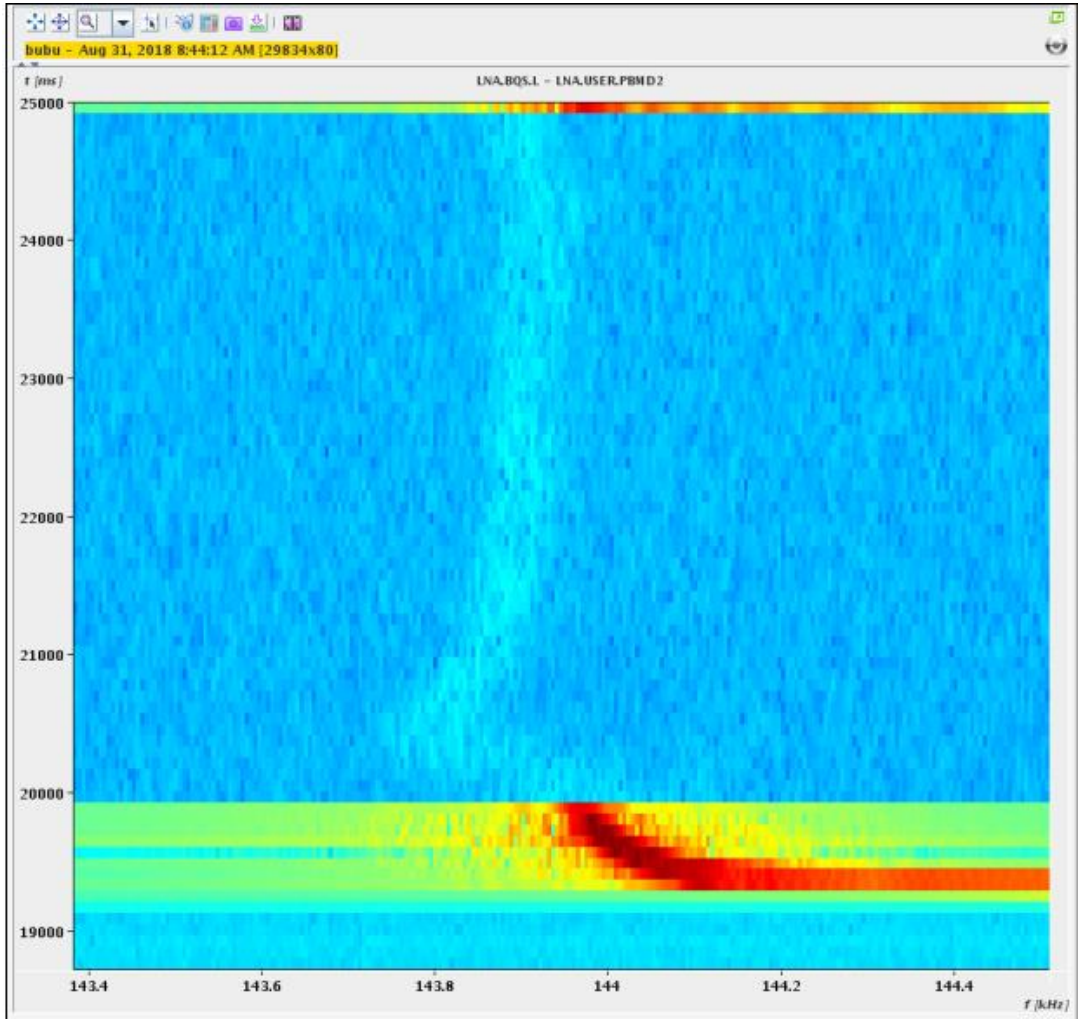
BPM

The orbit system consists of electrostatic pick-ups equipped with charge amplifiers, preamplifiers and VXS-DSP-FMC-Carriers. The charge amplifiers send sum and difference signals from the pick-ups, via preamplifiers to ADCs placed on FMC boards. The ELENA RF system sends the actual revolution frequency as an integer value via an optical gigabit link, from which the orbit system will generate its own local oscillator frequency on the wanted harmonic used for digital down mixing of the sum and difference signals. Position calculations are performed in DSP modules and the results are sent to the real-time software that makes the data available to the control room. The orbit system also computes a real-time mean radial horizontal position for the RF radial feedback. The system is only capable of producing beam position data during the times when the beam is bunched.


Views
More
CO @ 1200 ms -P 1.000 GeV/c - LNA.USER.PBMD1 - 21/06/17 10-19-35
Mean = -0.558 / RMS = 3.878 / RMS-dp = 3.863 / Dp = -0.5345
H Pos [mm]
Monitor H
CO @ 1200 ms -P 1.000 GeV/c - LNA.USER.PBMD1 - 21/06/17 10-19-35
Mean = 1.146 / RMS = 3.702 / Dp = -0.5345
V Pos [mm]
Monitor V

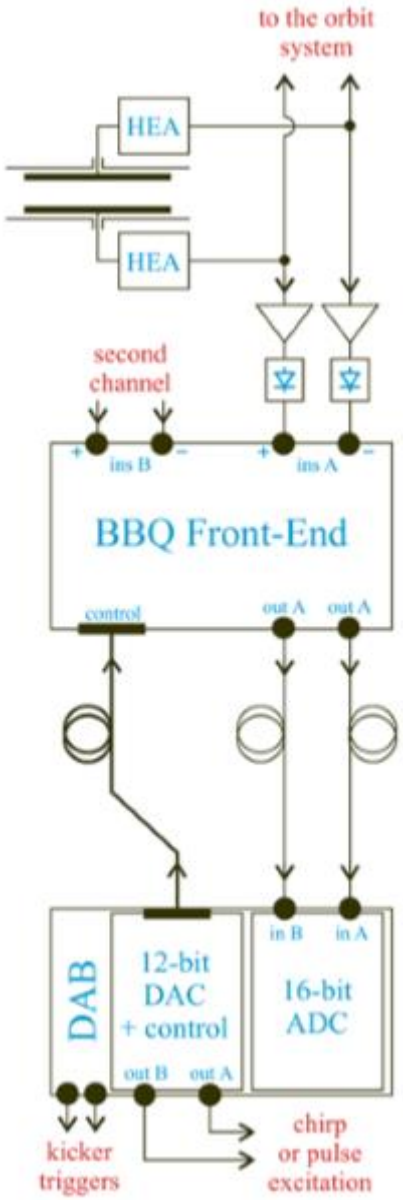

20180904073133.png
COMMENT:
-= LNA Injector =-0.1 - LNA.USER.PBMD2 - (INCA)
04 Sep 2018 07:31:13 LNA - 26 PBMD2 | ELENA_PBAR_PRODUCTIO...
01 ZERO | UNDEFINED
Horizontal Oscillations
Horizontal
Horizontal Settings
Pickups LNR2.BPMH15
Qh 0.37309999999999993
Qh comp. 0.37309999999999904
Set Computed Qh
Delta Sensitivity 0.5
Sum Sensitivity 0.5
Delay 1.0E-5
TimeBase 2.0E-5
Data Processing OK
Septum 0.38989 905.35 Set Undo
Kicker -0.4284 65475.54 Set Undo
Vertical Oscillations
Vertical
Vertical Settings
Pickups LNR2.BPMV15
Qv 0.4561249999999998
Qv comp. 0.4561250000000007
Set Computed Qv
Delta Sensitivity 0.2
Sum Sensitivity 0.5
Delay 1.0E-5
TimeBase 2.0E-5
Data Processing OK !
DVT35 -0.34597398 -0.42 Set Undo
DVT70 0.334836859 2.74 Set Undo
Data Processing
Data
H Raw Data
V Raw Data
Fitting
Sum Data
Delta Data
Last H Acq. 9/4/18 7:30 AM
Last V Acq. 9/4/18 7:30 AM
No Exception to display...
07:30:53 - VdataDeltaI = 10000

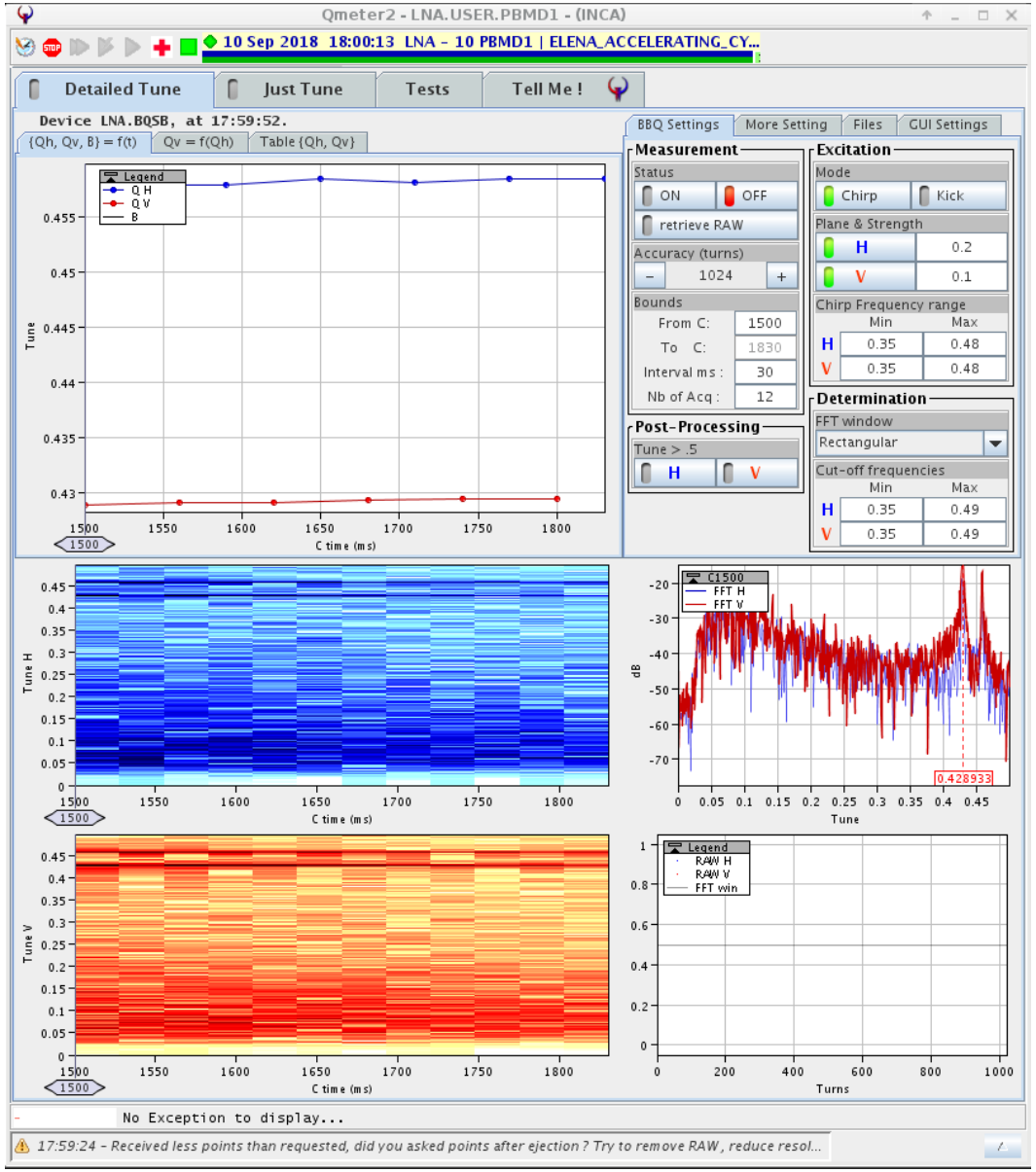

20180829115421.png
COMMENT :
LNA:PBMD2 (0) dH: 10.933us
5.511us
-5.422us
AX.SGS-TS
ON
MX.C-TRAIN
MX.C-TRAIN
26000
0
2us/div
0s
1.5V
+
C
LNR2.BPMVS15-AS
10mV/div
-35.053mV
LNR2.BPMHS15-AS
10mV/div
5.563mV
Channel 3
Sensitivity
Offset
Channel 4
Sensitivity
Offset
LNA:PBMD2 (0) dH: 2.8s
26.72s
M3
25.298s
AX.SGS-TS
ON
MX.C-TRAIN
NO CLOCK
0
0
2s/div
11.609s
1.5V
+
L
LNA.FPFREQ-DS
200kV/div
-403.439kV
LNA.VRFH1-DS
10kV/div
0V
LNA.TPU_INTSY-DS
2M/div
438.596k
LNR6.BPMVS25-AS
20mV/div
-71.053mV

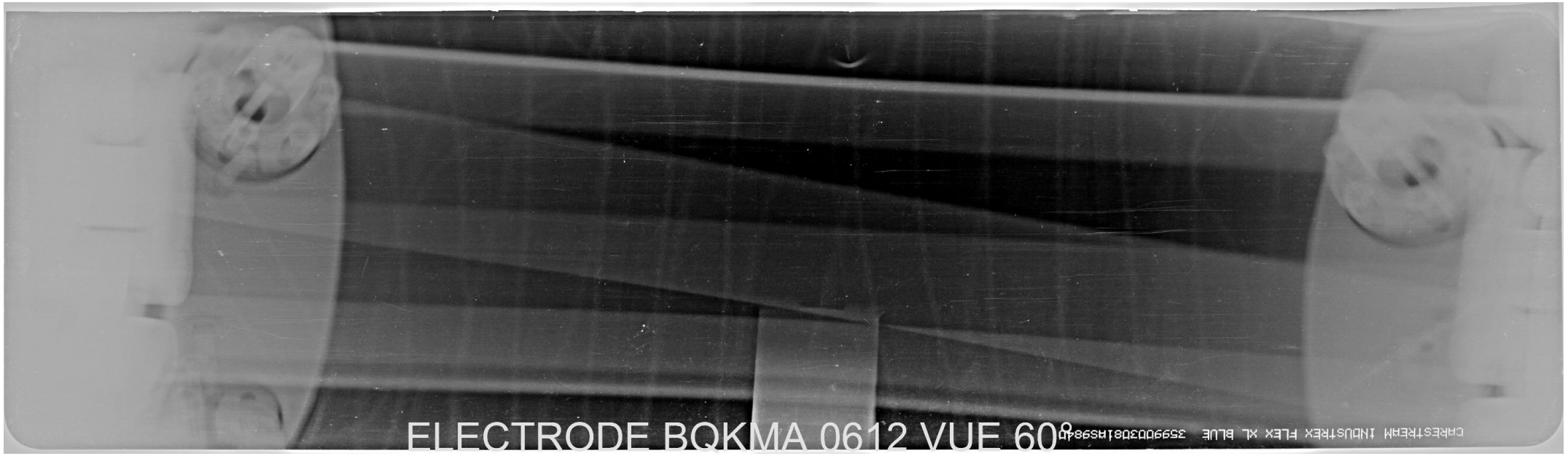

bubu - Aug 31, 2018 8:44:12 AM [29834x80]
LNA.BQS.1 - LNA.USER.PBMD2
25000
24000
23000
22000
21000
20000
19000
143.4
143.6
143.8
144
144.2
144.4

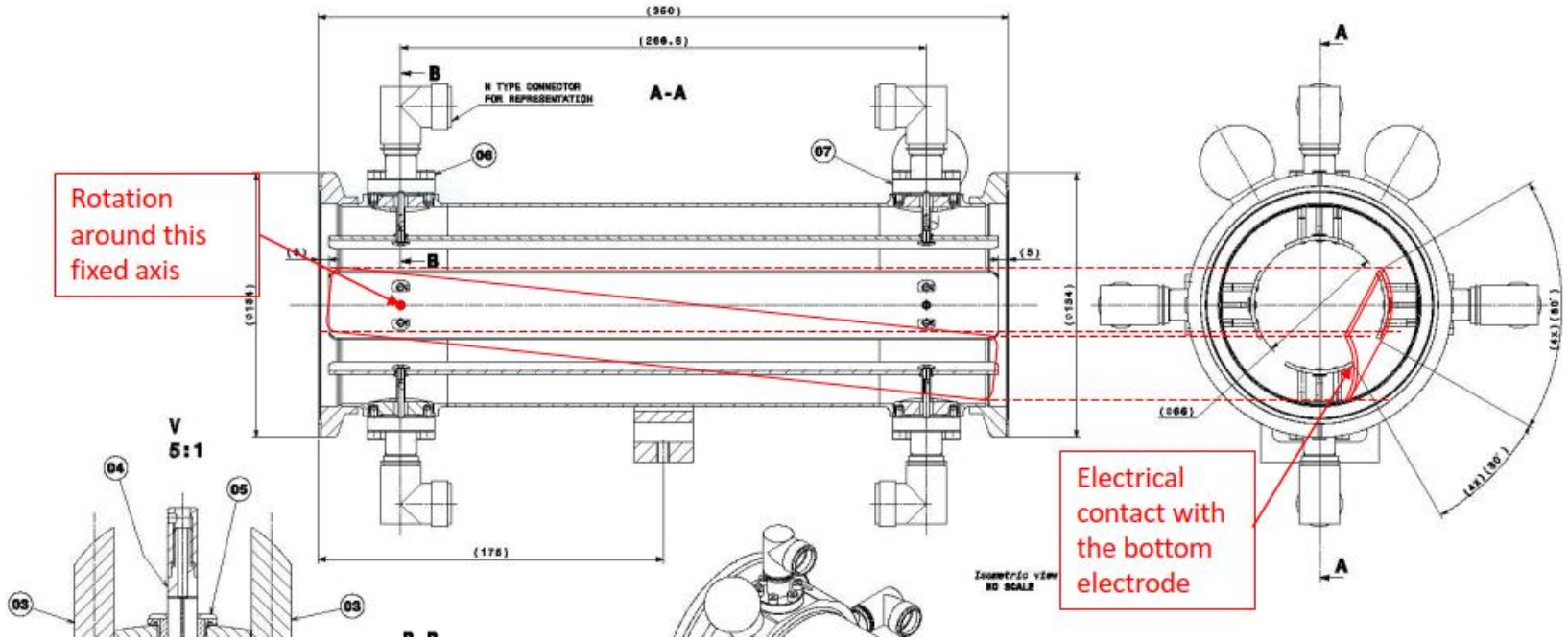
BBQ

The tune measurement system uses two identical pick-ups (PUs) with four 340 mm electrodes. One PU is used to capture beam signals and the second for beam harmonic excitation.
Beam signals from the four electrodes of the capture PU are amplified with four low noise amplifiers installed directly on the PU ports. The amplifiers have high input impedance to assure good PU response for relatively long ELENA bunches. The amplified signals are send to the tune signal processing electronics based on diode detectors, a so called Base Band Tune (BBQ) front-end. The amplified and filtered base-band horizontal and vertical tune signals are then digitized with two 16bit ADCs sampling at the 8th harmonic of the machine revolution frequency. The ADCs are accommodated on a mezzanine of an FPGA VME board, performing signal processing and beam spectra computing. The system is sensitive enough to measure tunes in favorable conditions even without beam excitation.
Chirped beam excitation signals are produced by two 12-bit DACs clocked with the same 8th harmonic of the revolution frequency. The DACs are accommodated on the second mezzanine of the FPGA board. The DAC output signals are amplified to provide currents in the order of 100 mA passing through the electrodes of the excitation PU.


to the orbit system
HEA
HEA
second channel
ins B
ins A
BBQ Front-End
control
out A
out A
DAB
12-bit DAC + control
16-bit ADC
out B
out A
in B
in A
kicker triggers
chirp or pulse excitation

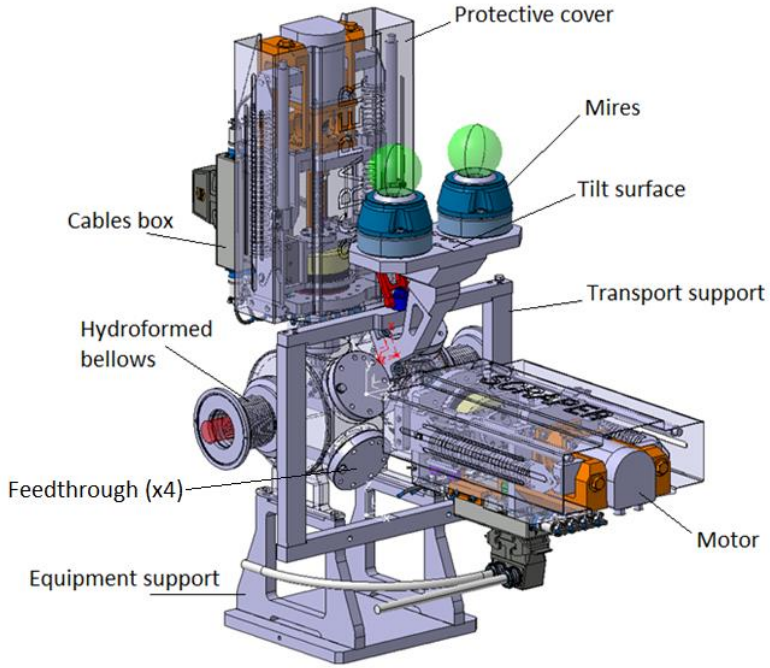

Qmeter2 - LNA.USER.PBMD1 - (INCA)
10 Sep 2018 18:00:13 LNA – 10 PBMD1 | ELENA_ACCELERATING_CY...
Detailed Tune
Just Tune
Tests
Tell Me !
Device LNA.BQSB, at 17:59:52.
{Qh, Qv, B} = f(t)
Qv = f(Qh)
Table {Qh, Qv}
Legend
Q H
Q V
B
Tune
C time (ms)
BBQ Settings
More Setting
Files
GUI Settings
Measurement
Status
ON
OFF
retrieve RAW
Accuracy (turns)
1024
Bounds
From C: 1500
To C: 1830
Interval ms : 30
Nb of Acq : 12
Post-Processing
Tune > .5
H
V
Excitation
Mode
Chirp
Kick
Plane & Strength
H 0.2
V 0.1
Chirp Frequency range
Min Max
H 0.35 0.48
V 0.35 0.48
Determination
FFT window
Rectangular
Cut-off frequencies
Min Max
H 0.35 0.49
V 0.35 0.49
Tune H
Tune V
C1500
FFT H
FFT V
dB
0.428933
Tune
Legend
RAW H
RAW V
FFT win
Turns
No Exception to display...
17:59:24 – Received less points than requested, did you asked points after ejection ? Try to remove RAW, reduce resol...

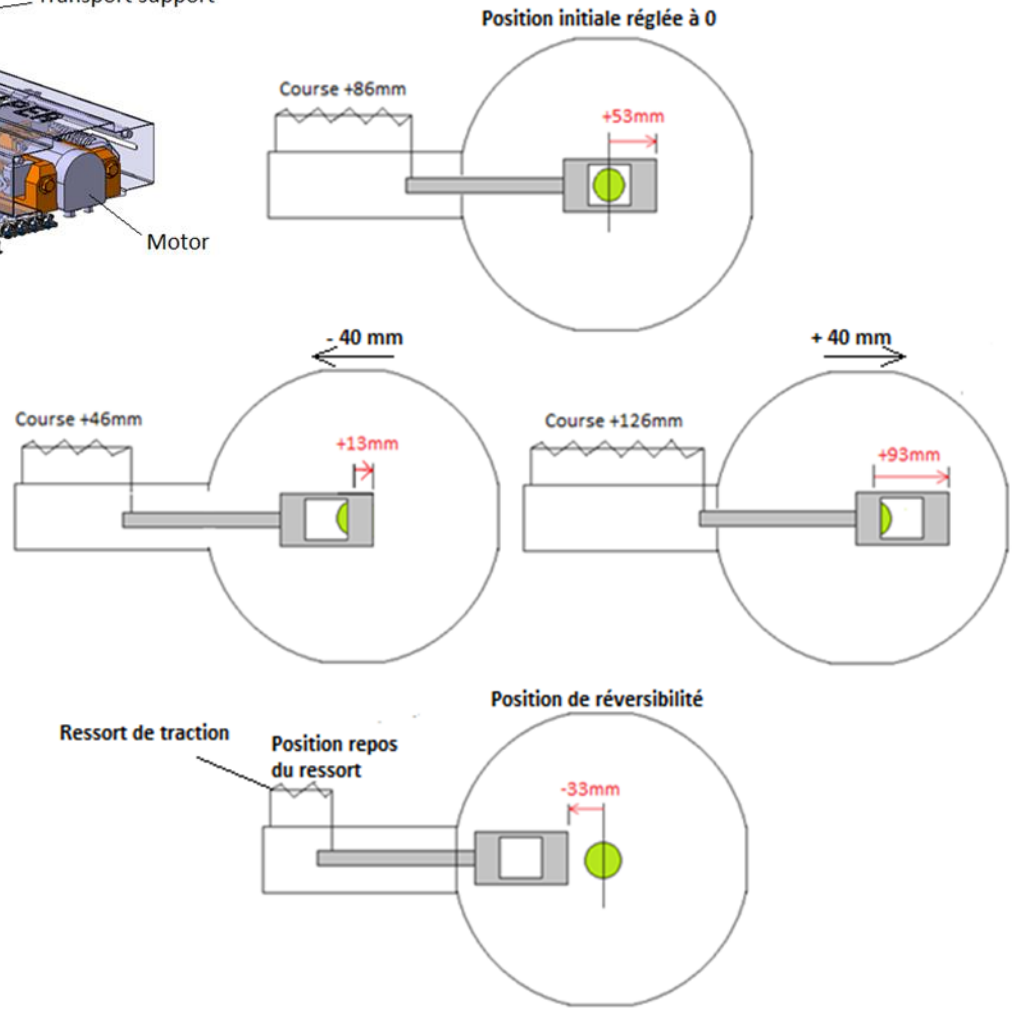

ELECTRODE BQKMA 0612 VUE 60°

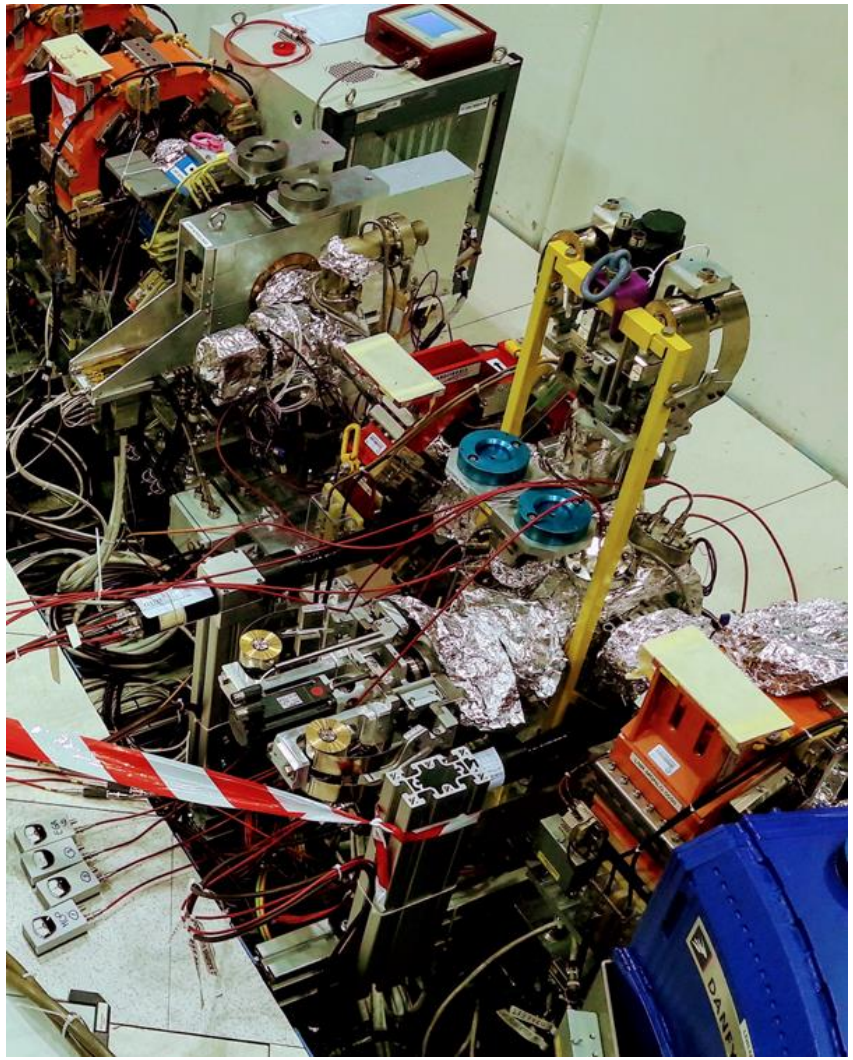

(350)
(288.8)
B
N TYPE CONNECTOR
FOR REPRESENTATION
A-A
06
07
Rotation
around this
fixed axis
(5)
(0154)
V
5:1
04
05
03
03
(175)
A
(066)
(42)(90°)
Electrical
contact with
the bottom
electrode

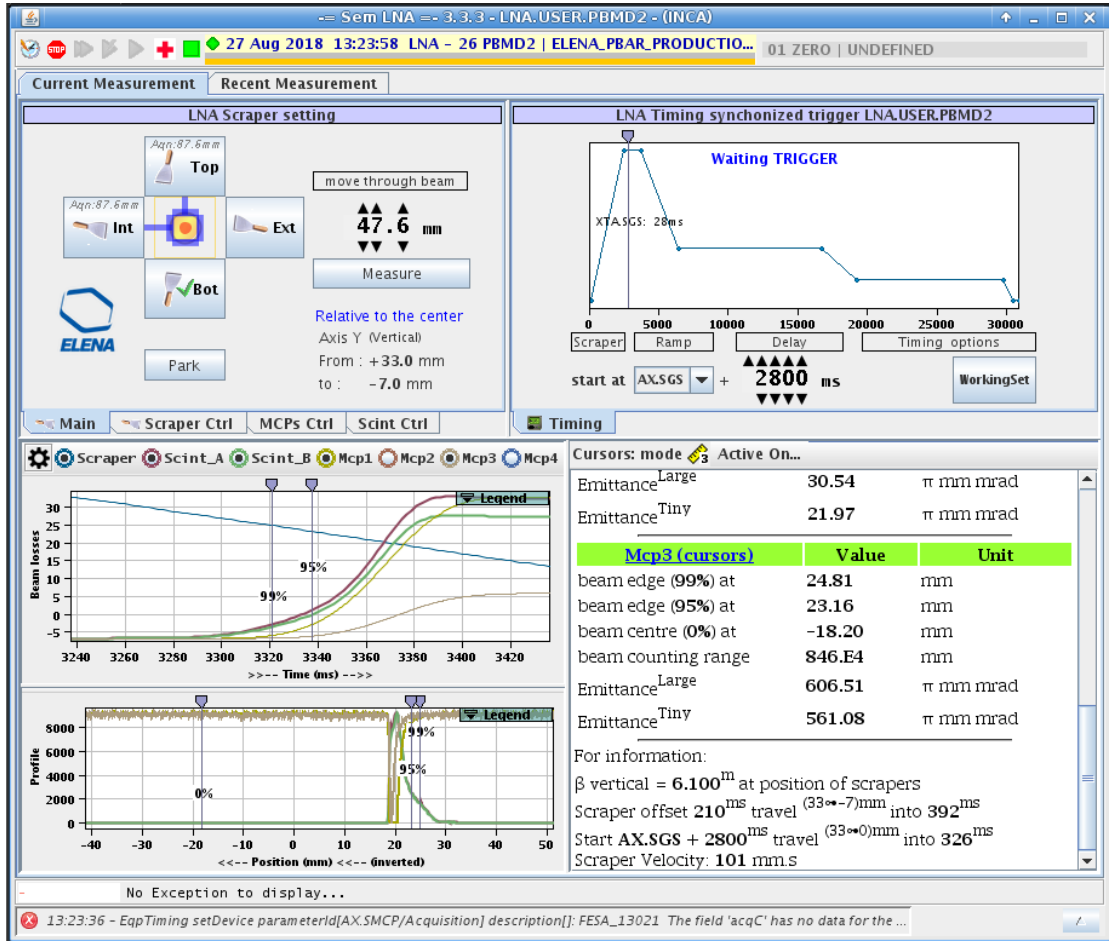
Scraper

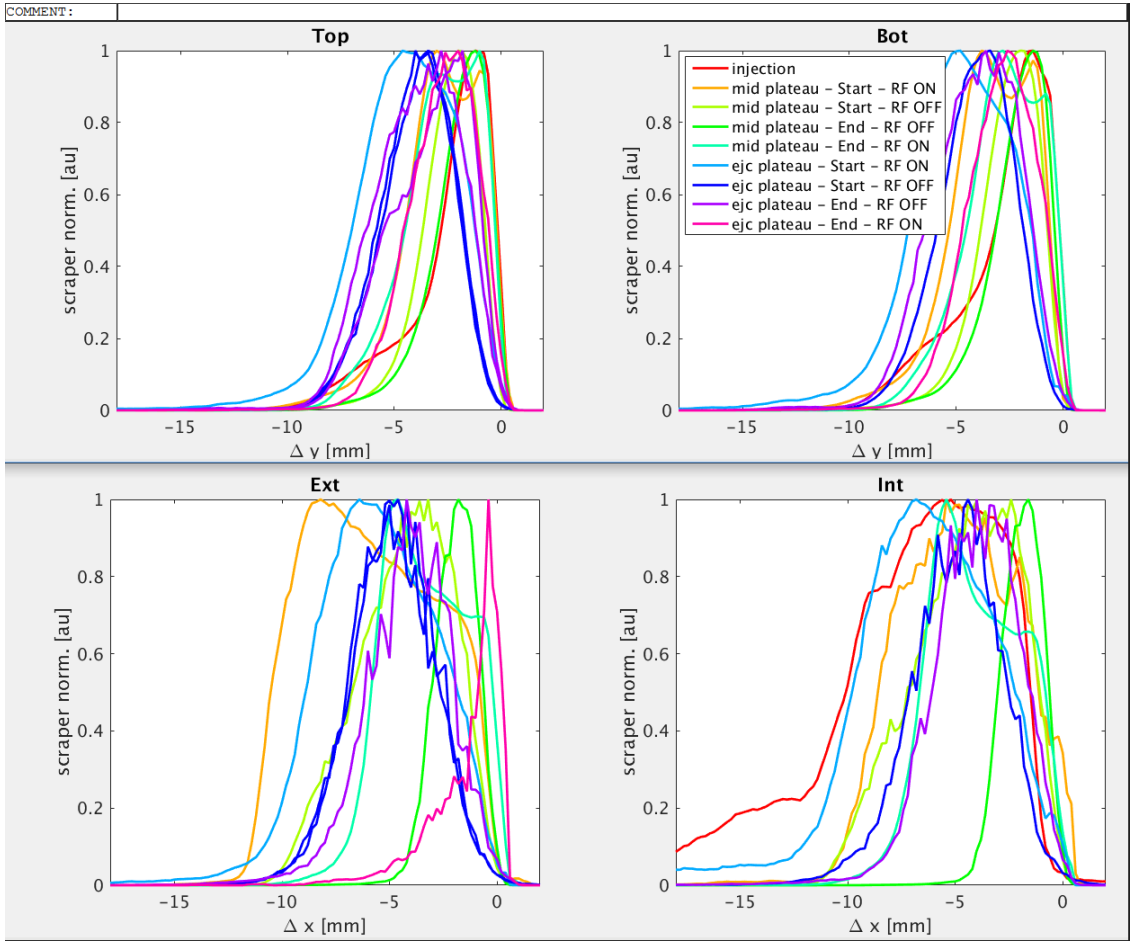
The scraper device is a destructive diagnostic device using a motorised blade as a scraping tool which is moved into the circulating beam at constant speed. Secondary particles are emitted by the interaction of the beam with the blade. The flux of secondary particles detected is proportional to the beam density, and one can reconstruct the beam profile by plotting the flux as a function of the blade position.
Two detection systems have been implemented to cover the different particle types that are available in ELENA. For antiprotons two scintillator paddles outside the vacuum chamber capture the pions created by the annihilation of the particles with the blade. For protons and H- ions, secondary electrons are measured on four micro-channel plates (MCP) installed inside the vacuum tank.


Protective cover
Mires
Tilt surface
Cables box
Transport support
Hydroformed
bellows
Feedthrough (x4)
Motor
Equipment support

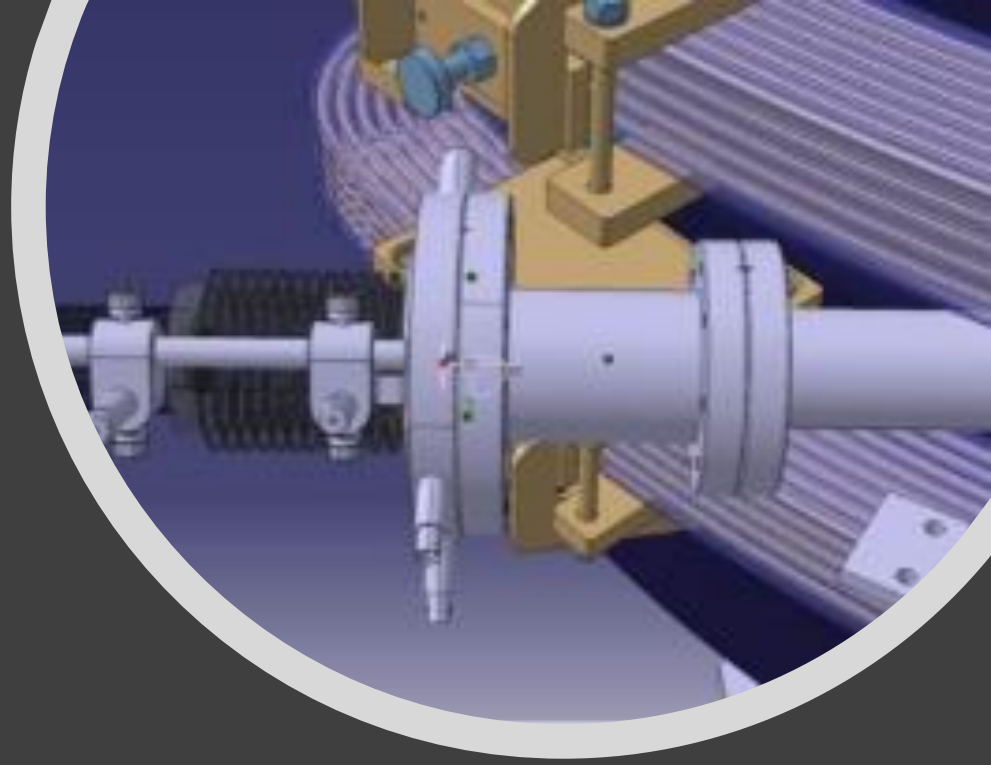

Position initiale réglée à 0
Course +86mm
+53mm
- 40 mm
+ 40 mm
Course +46mm
+13mm
Course +126mm
+93mm
Position de réversibilité
Ressort de traction
Position repos
du ressort
-33mm



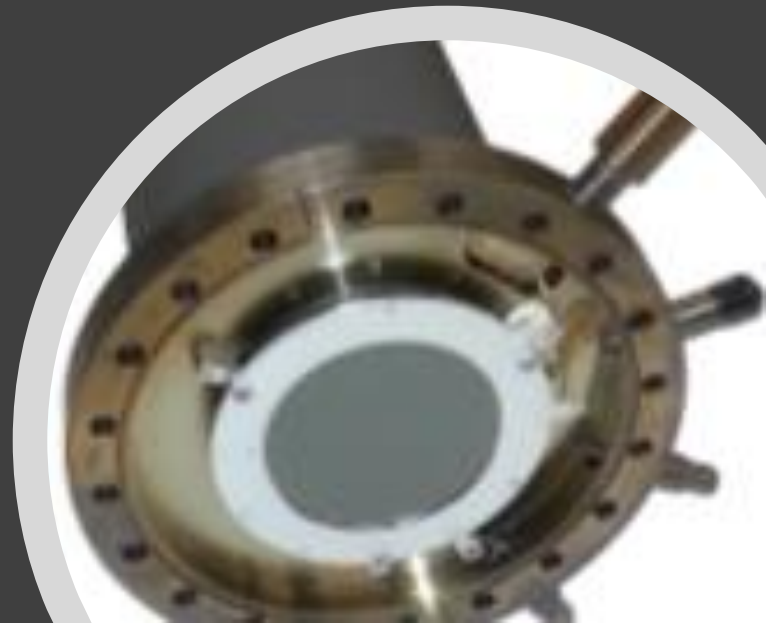

-= Sem LNA =- 3.3.3 - LNA.USER.PBMD2 - (INCA)
27 Aug 2018 13:23:58 LNA - 26 PBMD2 | ELENA_PBAR_PRODUCTIO...
01 ZERO | UNDEFINED
Current Measurement
Recent Measurement
LNA Scraper setting
Top
Int
Ext
Bot
Park
move through beam
47.6 mm
Measure
Relative to the center
Axis Y (Vertical)
From : +33.0 mm
to : -7.0 mm
LNA Timing synchonized trigger LNA.USER.PBMD2
Waiting TRIGGER
XTA.SGS: 28ms
Scraper
Ramp
Delay
Timing options
start at AX.SGS + 2800 ms
WorkingSet
Main
Scraper Ctrl
MCPs Ctrl
Scint Ctrl
Timing
Scraper Scint_A Scint_B Mcp1 Mcp2 Mcp3 Mcp4
Legend
Beam losses
95%
99%
>>-- Time (ms) -->>
Profile
99%
95%
0%
<<-- Position (mm) <<-- (inverted)
Cursors: mode Active On...
Emittance Large 30.54 π mm mrad
Emittance Tiny 21.97 π mm mrad
Mcp3 (cursors) Value Unit
beam edge (99%) at 24.81 mm
beam edge (95%) at 23.16 mm
beam centre (0%) at -18.20 mm
beam counting range 846.E4 mm
Emittance Large 606.51 π mm mrad
Emittance Tiny 561.08 π mm mrad
For information:
β vertical = 6.100 m at position of scrapers
Scraper offset 210 ms travel (33⇔-7)mm into 392 ms
Start AX.SGS + 2800 ms travel (33⇔0)mm into 326 ms
Scraper Velocity: 101 mm.s
No Exception to display...
13:23:36 - EqpTiming setDevice parameterId[AX.SMCP/Acquisition] description[]: FESA_13021 The field 'acqC' has no data for the ...

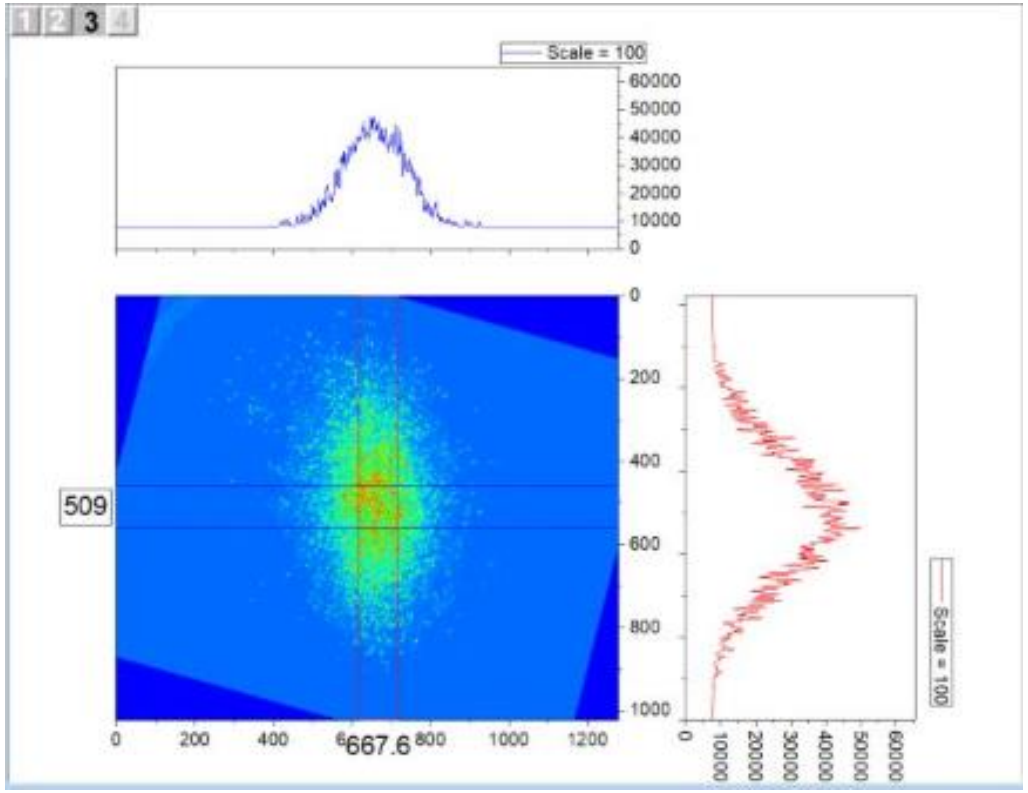

COMMENT:
Top
Bot
Ext
Int
scraper norm. [au]
Δ y [mm]
Δ x [mm]
injection
mid plateau - Start - RF ON
mid plateau - Start - RF OFF
mid plateau - End - RF OFF
mid plateau - End - RF ON
ejc plateau - Start - RF ON
ejc plateau - Start - RF OFF
ejc plateau - End - RF OFF
ejc plateau - End - RF ON

Recombination Monitor



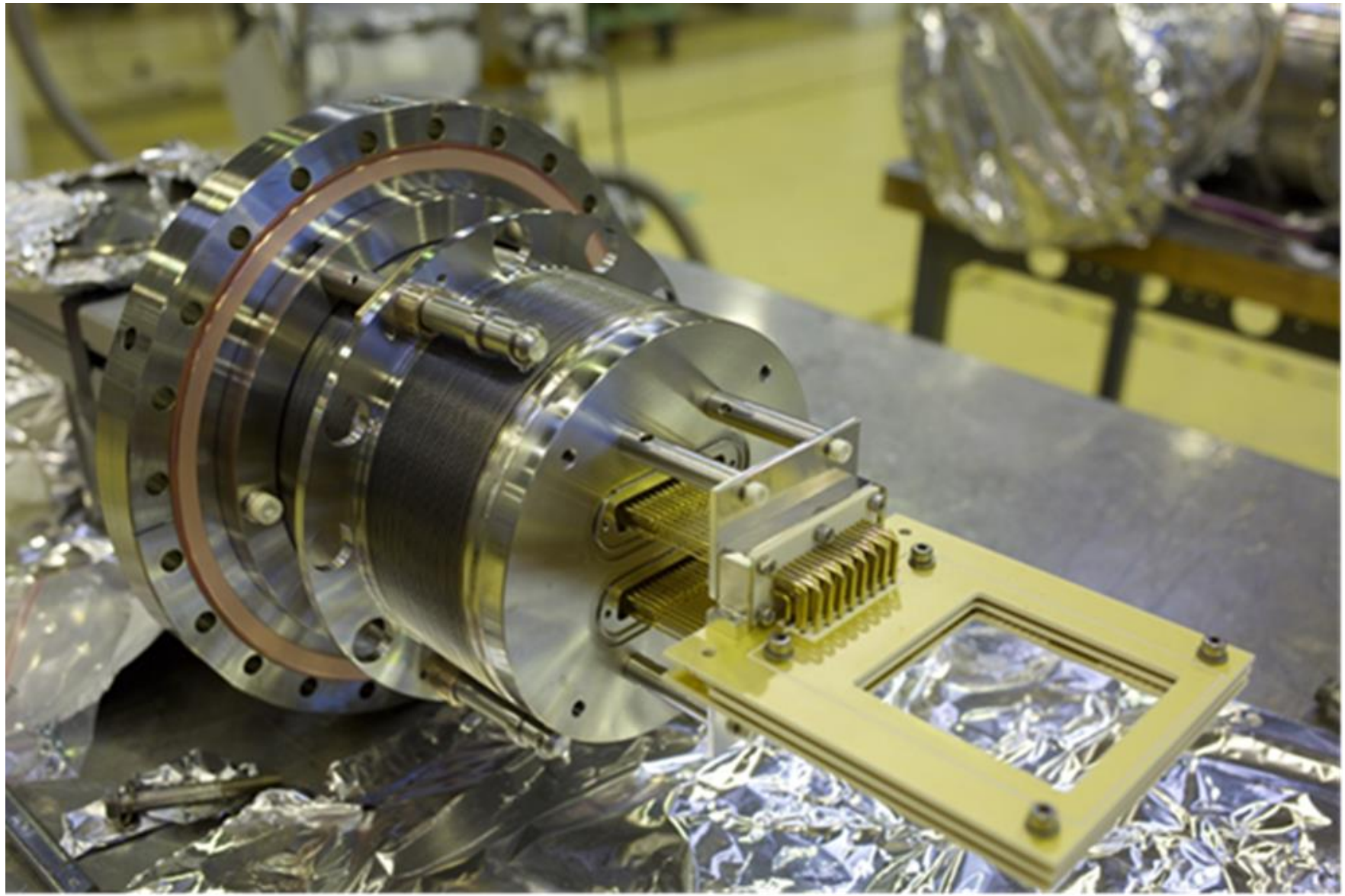
Neutral hydrogen atoms, created either by the striping of the loosely bound electron of the H- ion by the residual gas molecules or the recombination of protons with the electrons of the cooler device, can be detected in the extension of the downstream bending magnet. The monitor consists of a chevron mounted MgO coated MCP coupled to a P43 phosphor screen. The image, acquired by a CMOS camera connected to a PC, is a direct image of the circulating beam from which the transverse profiles can be inferred. During beam cooling, the integral of the signal is proportional to the recombination rate from which the transverse energy of the electron beam can be evaluated. It will be a good means to correct any angular deviations between the electron and ion beams.

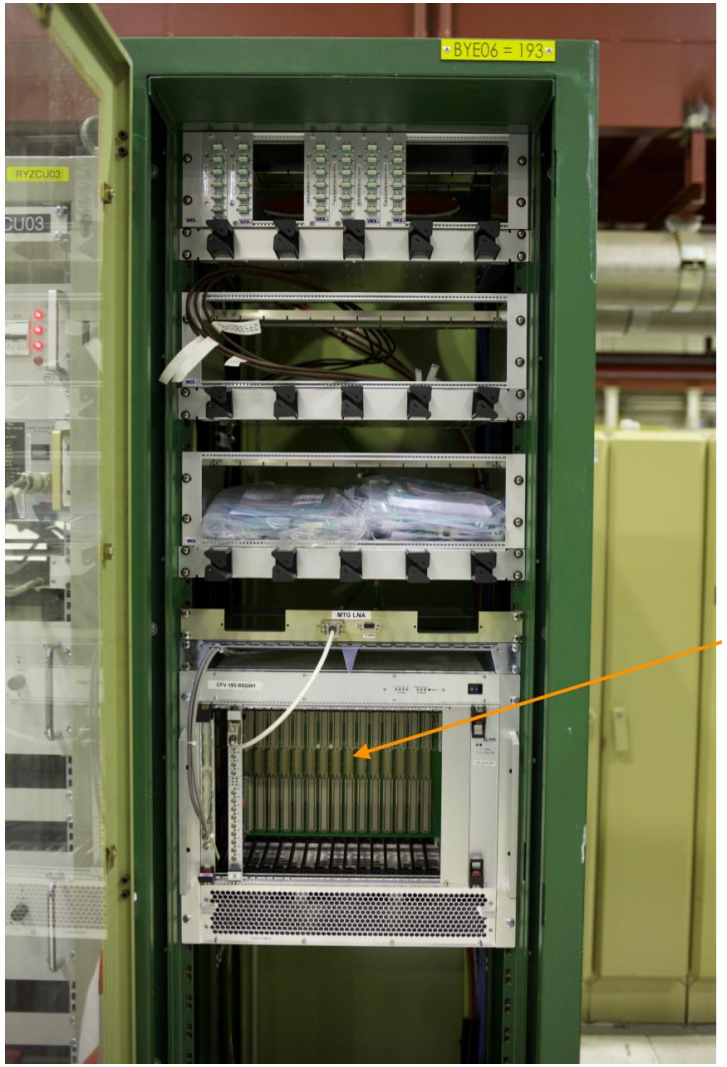


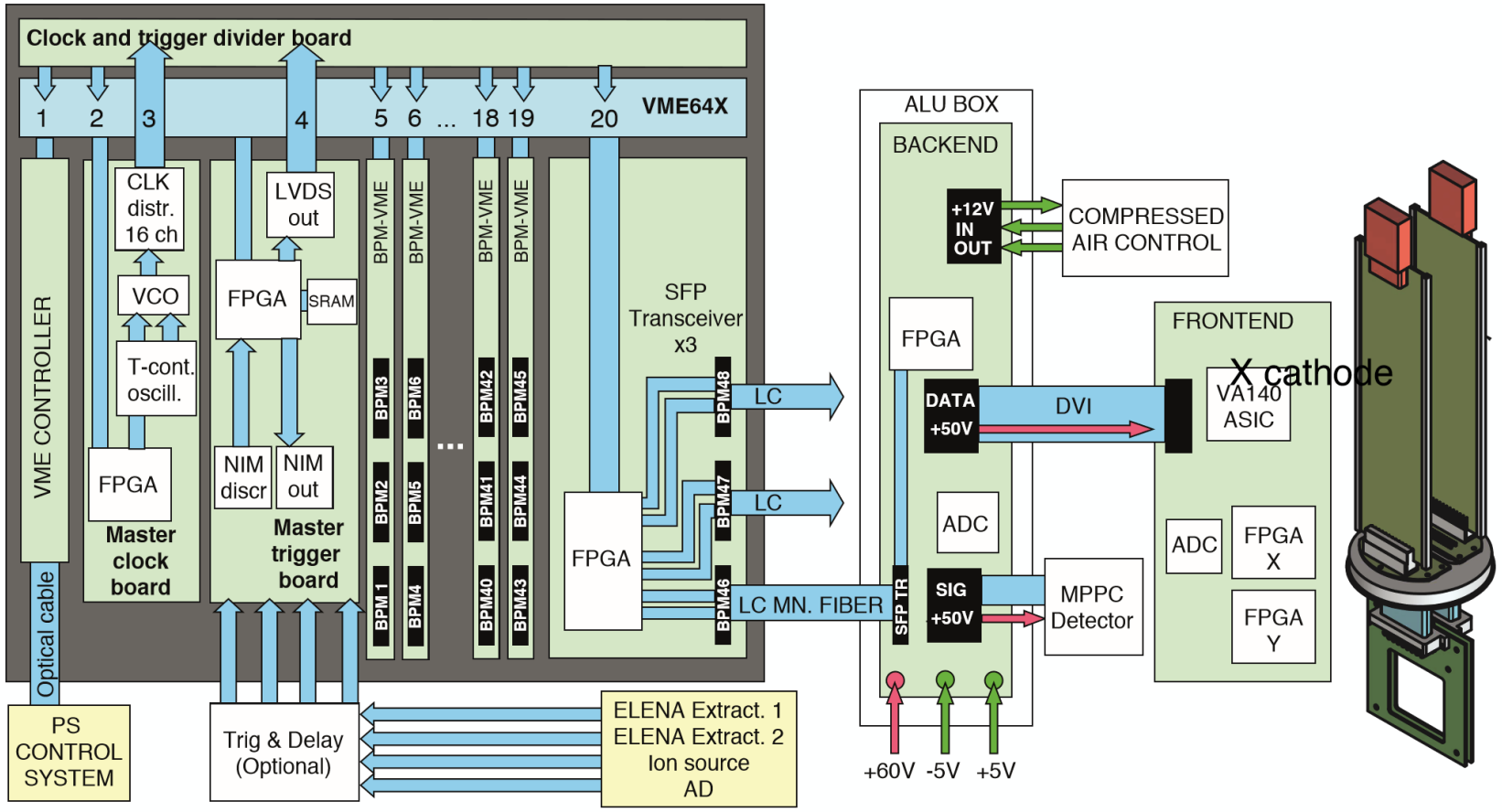

1 2 3 4
Scale = 100
60000
50000
40000
30000
20000
10000
0
509
0
200
400
600
800
1000
1200
667.6
Scale = 100

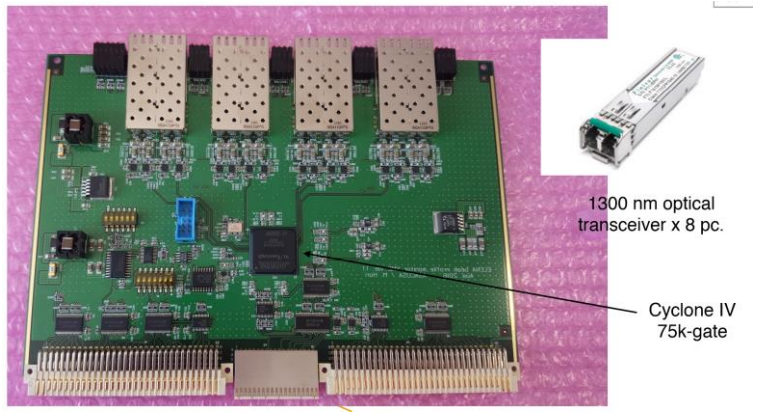
SEM (μwire monitor)

- Semi-non-destructive monitor allows most of the particles to pass through without any degradation, while the small portion (1-3%) intercepted by the wires produces the signal.
- The device is sensitive to antiproton, proton, and H- beams of energies between E =10 keV and 5.3 MeV.
- It consists of two position-sensitive photocathode grids providing the X- and Y- projections of the beam, sandwiched between three anode grids with a distance of 2 mm between them.
- Each grid consists of 48 gold-coated tungsten wires of diameter of 10 um stretched over a ceramic frame, with a pitch of 1.0 mm between neighbouring wires.
- The cathode grids at ground potential are irradiated by the beam, and the secondary electrons emitted from them are accelerated toward the anode grids biased at 50 V.
- The beam profile is obtained by using charge-sensitive preamplifiers to measure the charge Qi ejected from the cathode wires on the X- and Y-grids with high sensitivity.




BYE06 = 193


Clock and trigger divider board
1
2
3
4
5
6
...
18
19
20
VME64X
VME CONTROLLER
Optical cable
CLK distr. 16 ch
VCO
T-cont. oscill.
FPGA
Master clock board
LVDS out
FPGA
SRAM
NIM discr
NIM out
Master trigger board
BPM-VME
BPM-VME
BPM-VME
BPM-VME
BPM3
BPM2
BPM 1
BPM6
BPM5
BPM4
BPM42
BPM41
BPM40
BPM45
BPM44
BPM43
SFP Transceiver x3
FPGA
BPM48
BPM47
BPM46
LC
LC
LC MN. FIBER
SFP TR
ALU BOX
BACKEND
+12V IN OUT
COMPRESSED AIR CONTROL
FPGA
DATA +50V
DVI
ADC
SIG +50V
MPPC Detector
FRONTEND
VA140 ASIC
ADC
FPGA X
FPGA Y
X cathode
+60V
-5V
+5V
PS CONTROL SYSTEM
Trig & Delay (Optional)
ELENA Extract. 1
ELENA Extract. 2
Ion source
AD

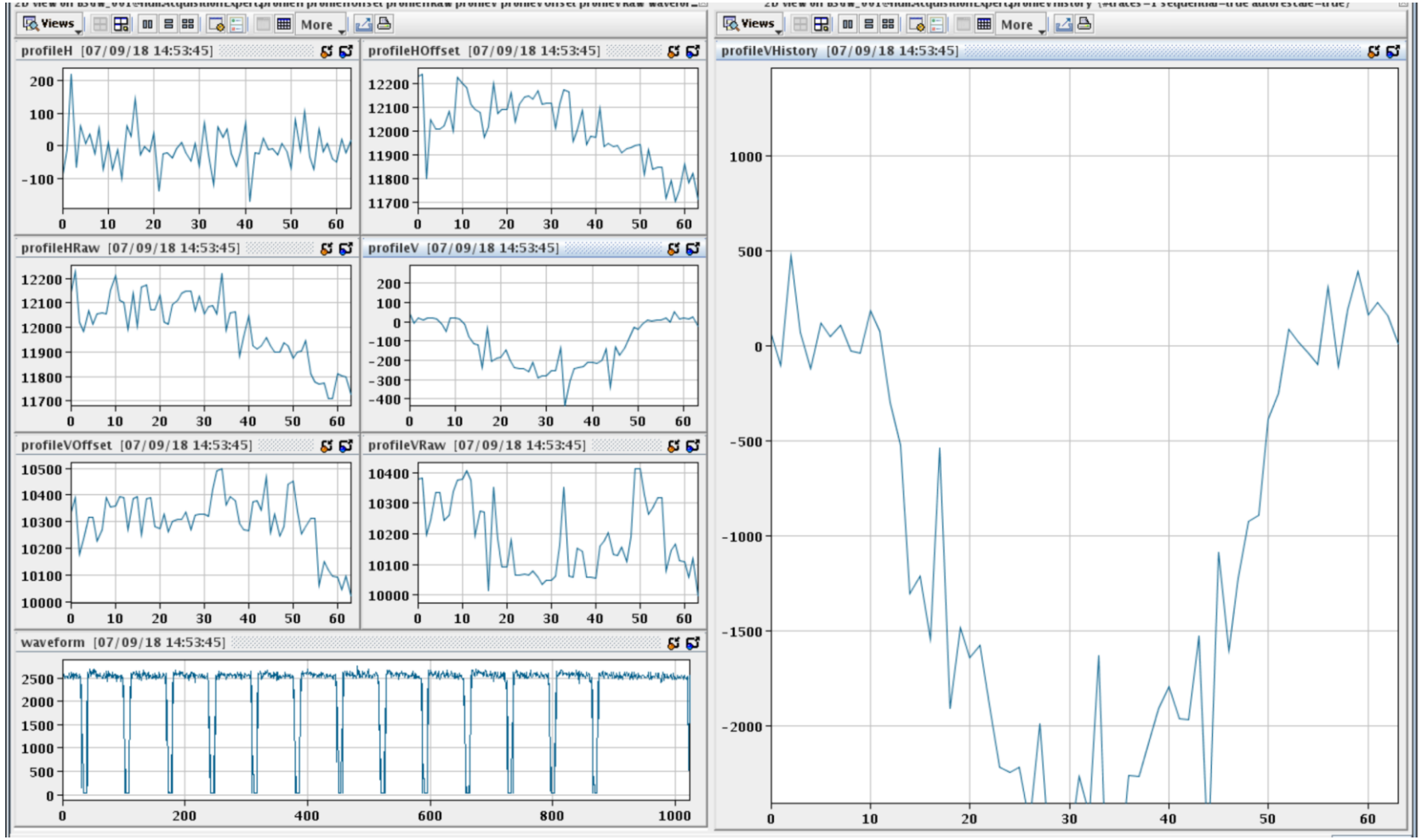

1300 nm optical transceiver x 8 pc.
Cyclone IV 75k-gate

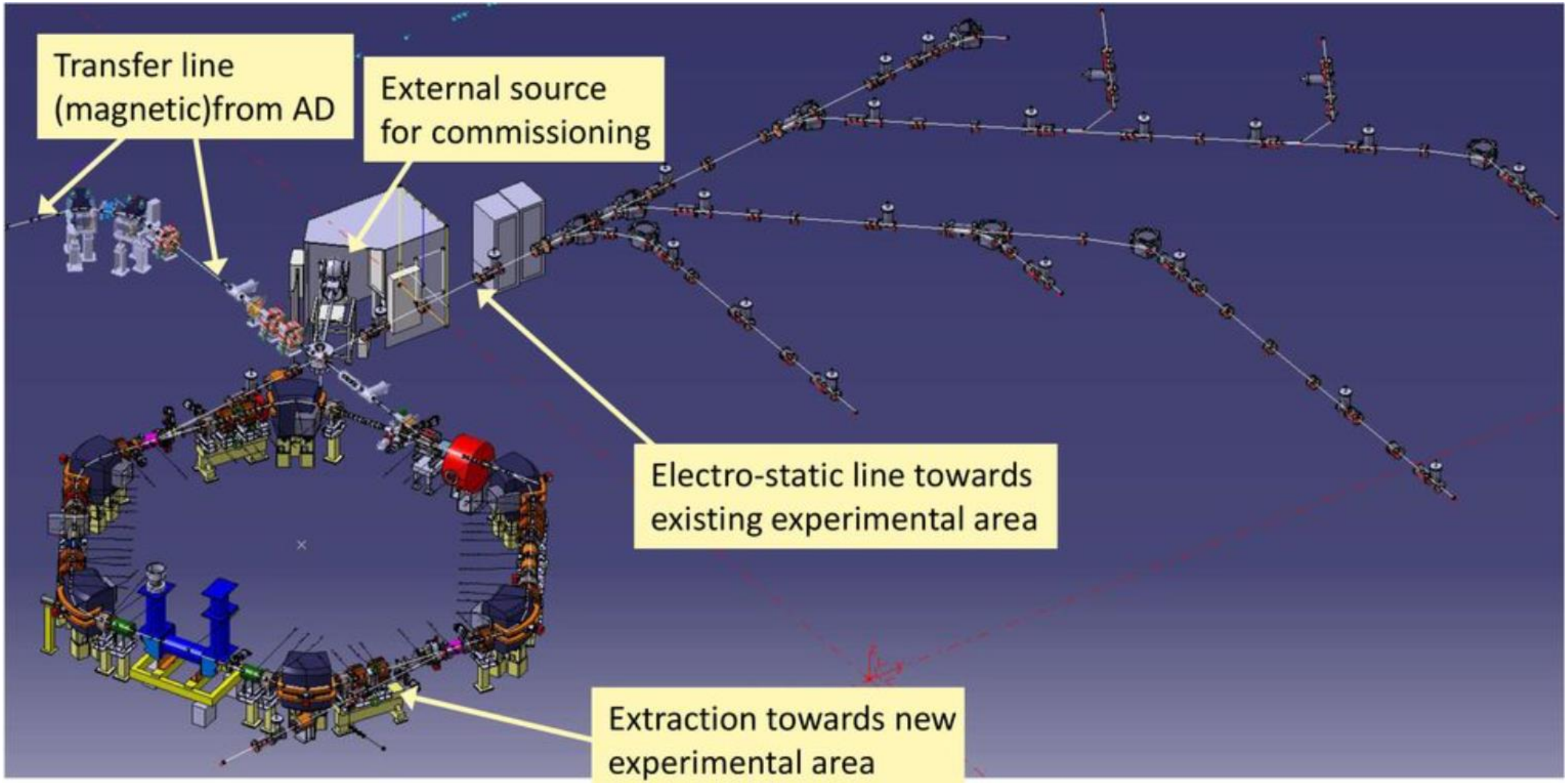

4-channel trigger input TTL, NIM, etc.
Cyclone IV 75k-gate
LVDS trigger distribution

8 monitors installed during 2017-18 shutdown.

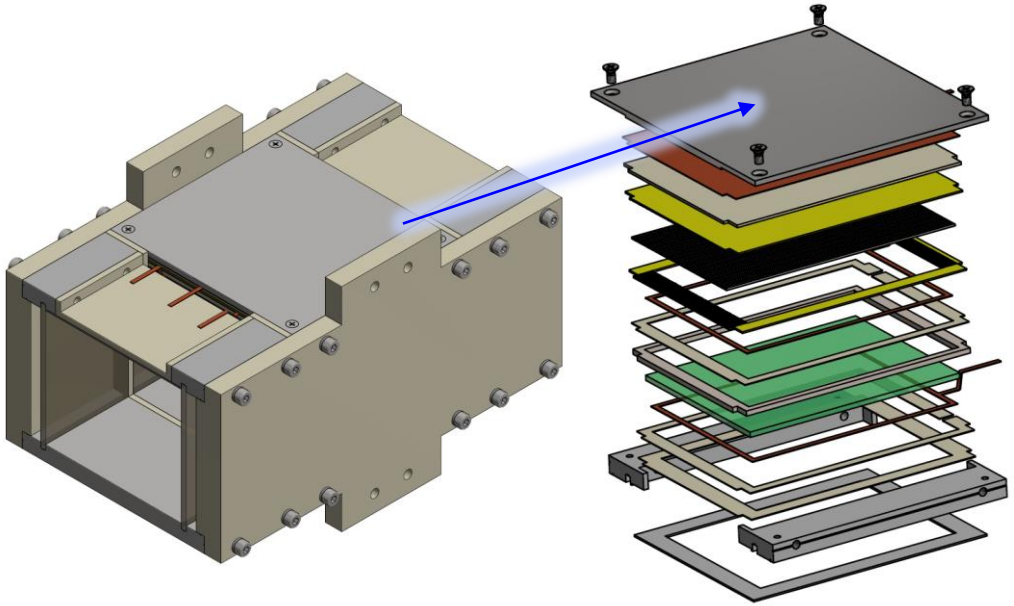
36 more to install during LS2!!!!

Electronics not fully debugged. Only one functional set available at the moment.

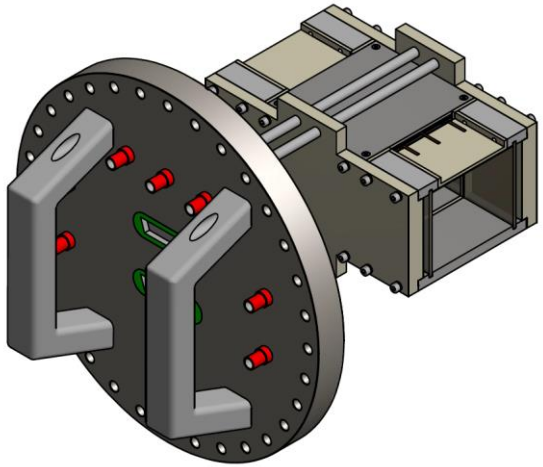



Transfer line
(magnetic)from AD
External source
for commissioning
Electro-static line towards
existing experimental area
Extraction towards new
experimental area

IPM



External dimensions: 206 x 140 x 128 mm
Beam aperture: 82 x 70 mm

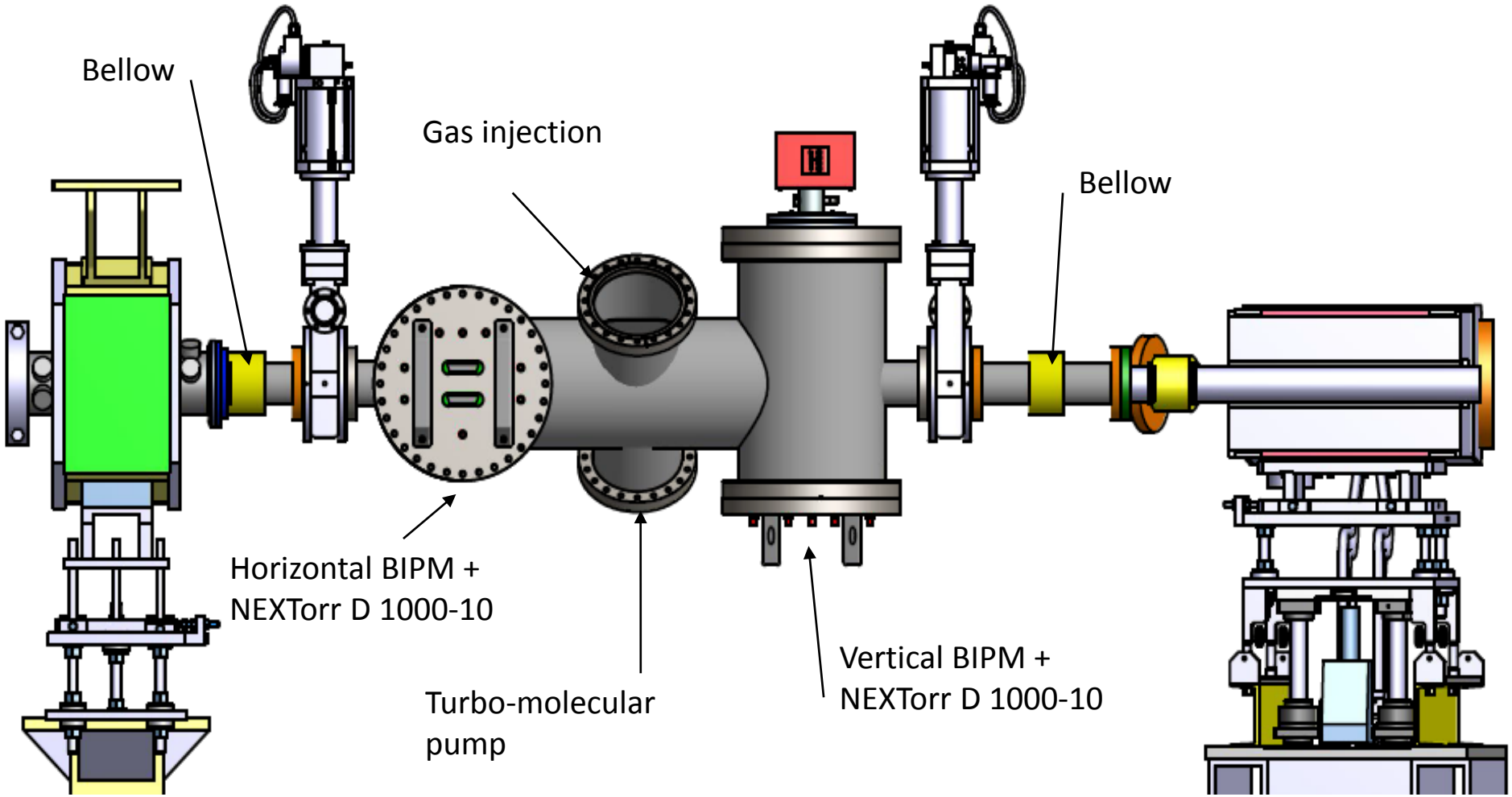


Design based on AD and LEIR IPM

- Double MCP
- Read-out : stainless steel tubes
- XHV material compatible only

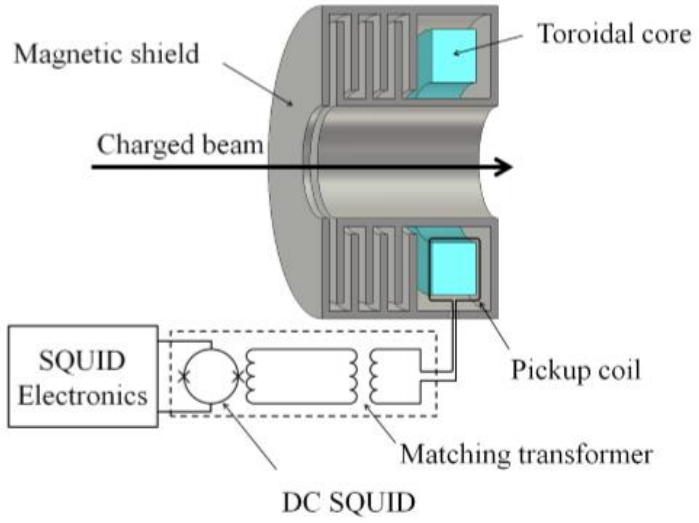
Two orbit correction electrodes
Long detection length : 80mm

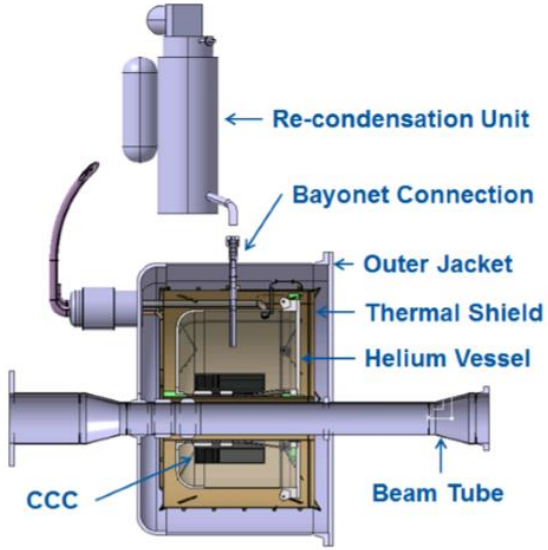
integration in ELENA

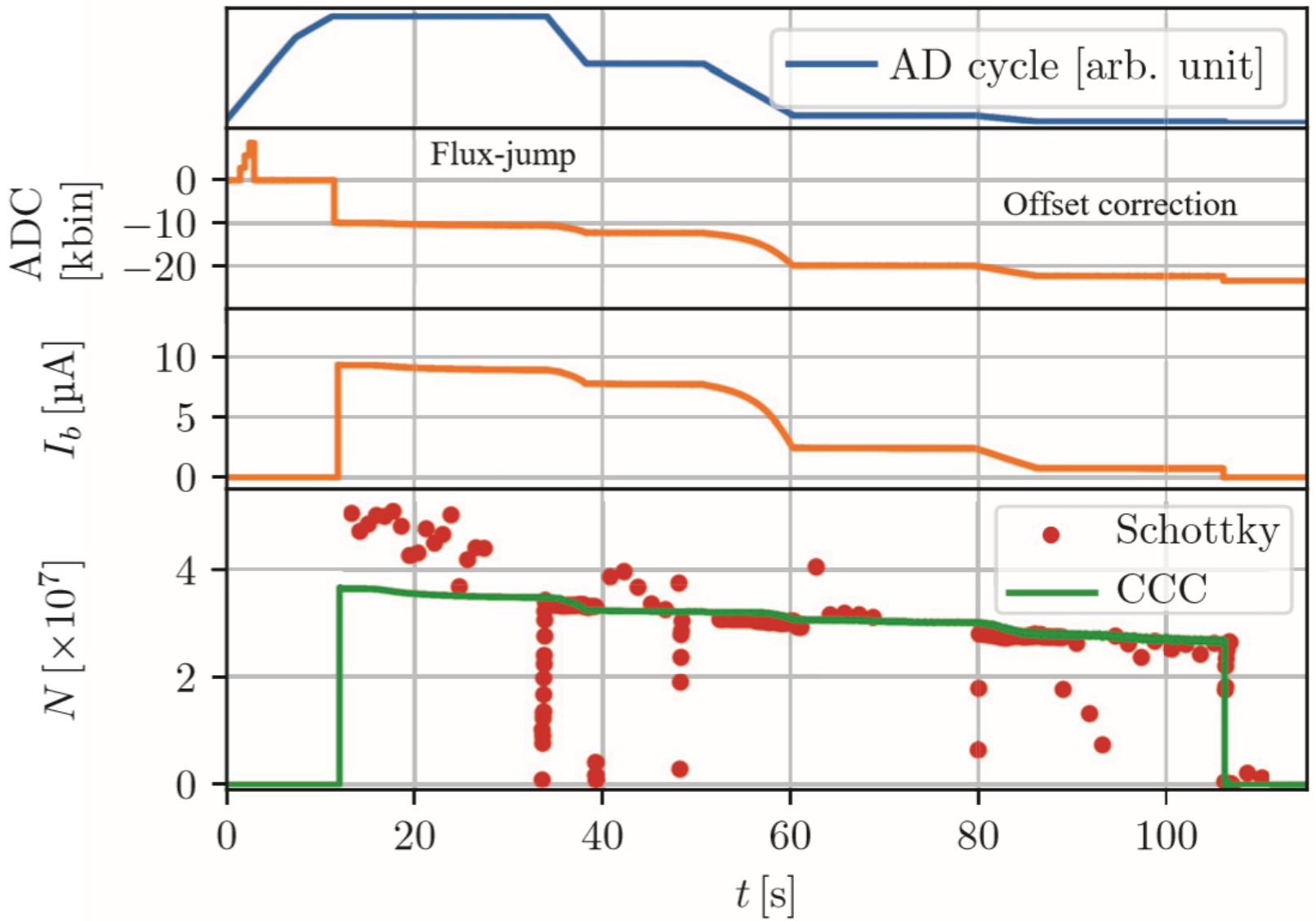


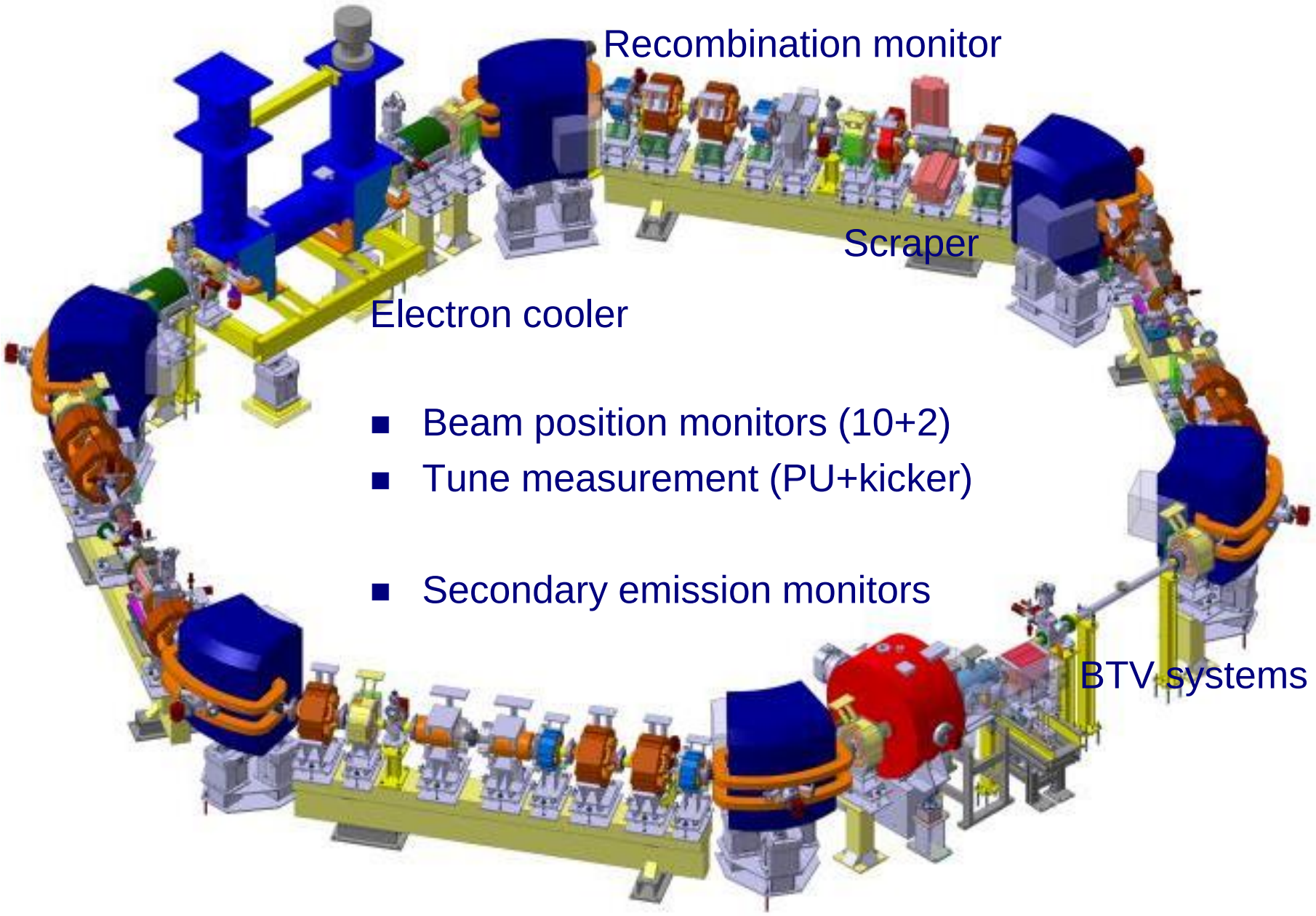
Cryogenic Current Comparator

The CCC works by measuring the magnetic field induced by the particle beam current. This field is concentrated in a high-permeability ferromagnetic pickup core, from which it is coupled into a SuperconductingQUantumInterferenceDevice(SQUID).Theseare highly sensitive magnetic flux sensors that permit sensing the weak fields created by the beam. A superconducting magnetic shield structure around the pickup-core renders the coupled magnetic field nearly independent of the beam position and makes the system practically immune to external magnetic field perturbations.






AD cycle [arb. unit]
Flux-jump
Offset correction
ADC [kbin]
0
−10
−20
I_b [µA]
10
5
0
N [$\times 10^7$]
4
2
0
Schottky
CCC
0
20
40
60
80
100
t [s]



- Beam position monitors (10+2)
- Tune measurement (PU+kicker)

- Secondary emission monitors