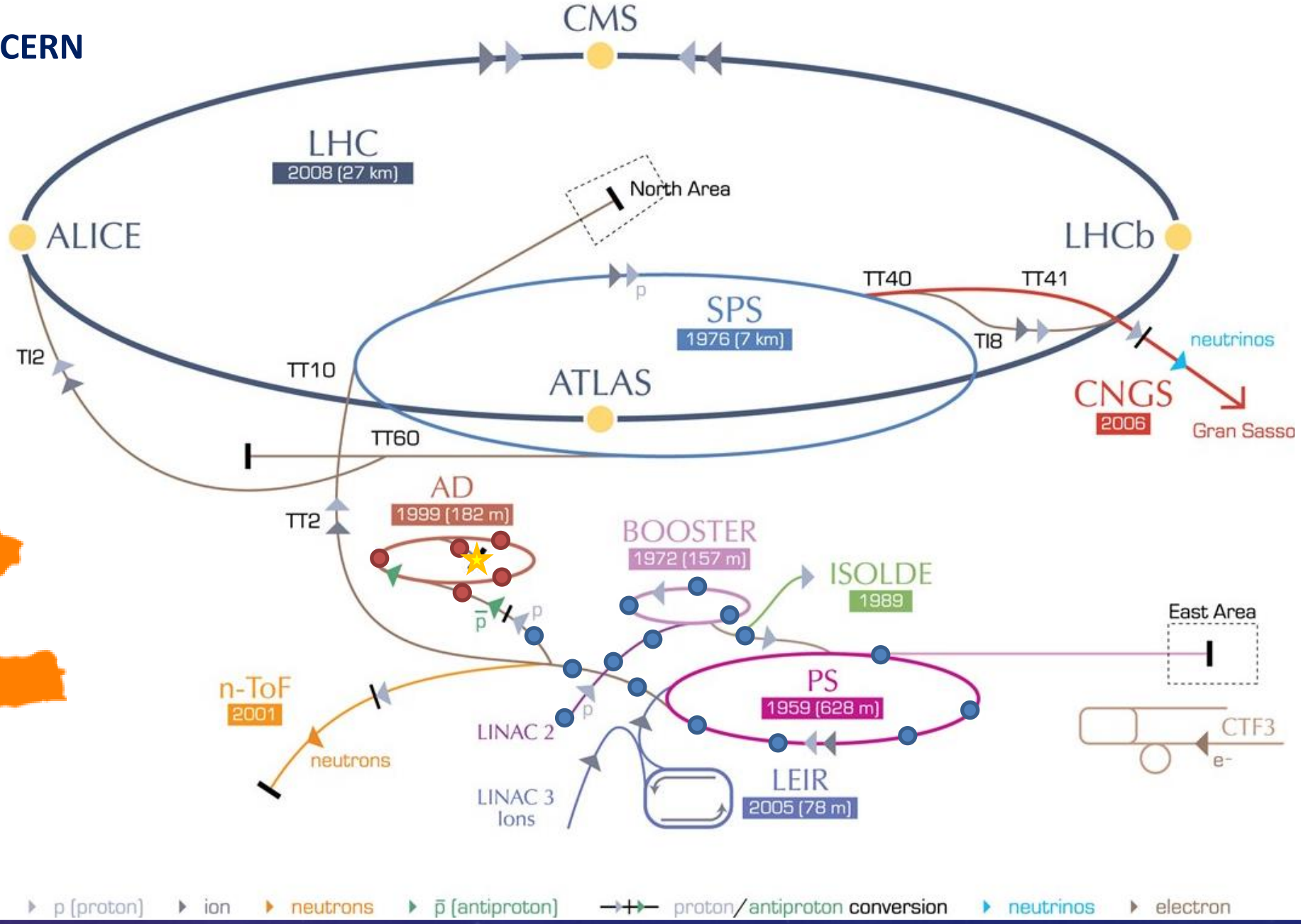
ION SOURCE INTEGRATION AT THE EXTREME LOW ENERGY RING FOR ANTIPROTONS (ELENA) AT CERN

A. Megía-Macías, R. Gebel, H-P. May, N. Rotert, A. Kieven, B. Lefort. C. Carli and F. Butin

SECOND ANNUAL MATTER AND TECHNOLOGIES MEETING
KARLSRUHE. MARCH 2016

Antiproton Decelerator at CERN

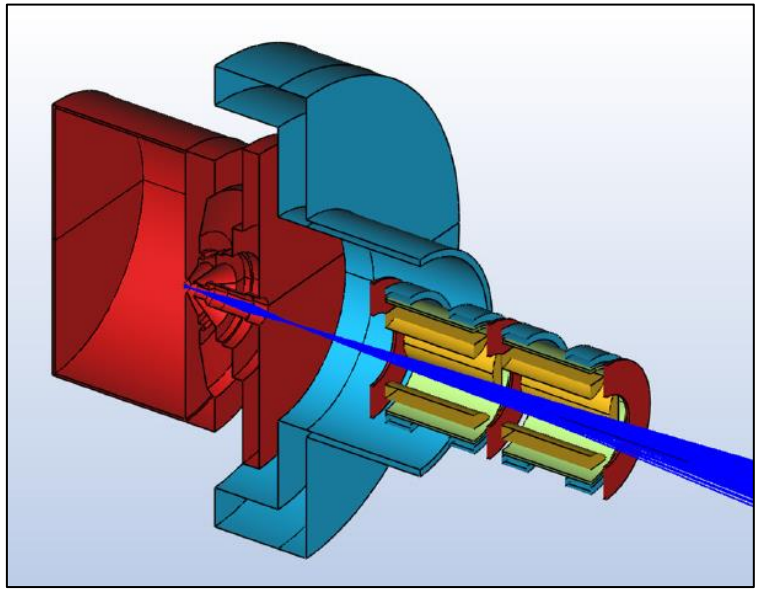


ELENA Project

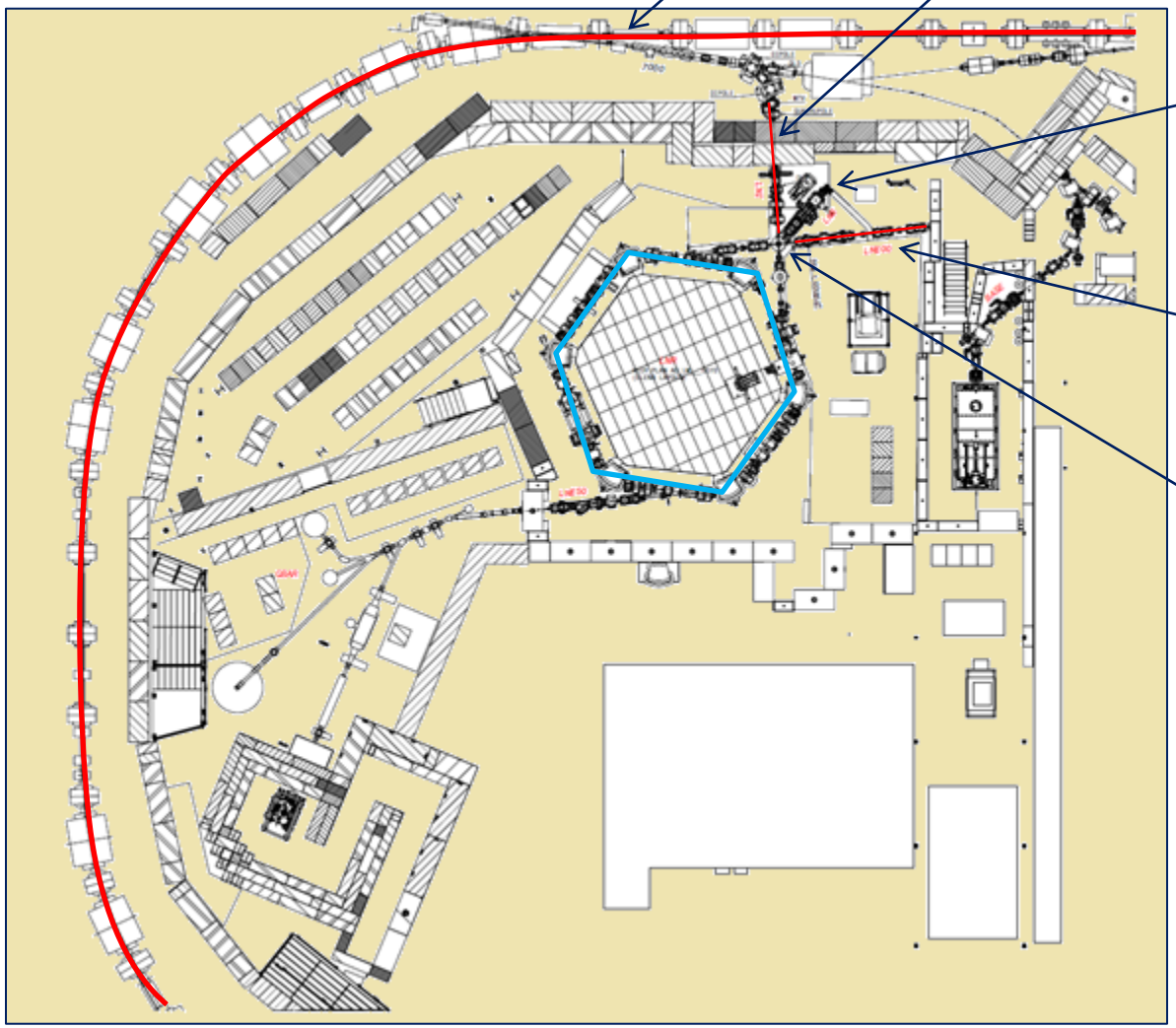
- The AD physics program is focused on trapping antiprotons in Penning traps where antihydrogen is formed after recombination with positrons.
- Ejection energy of the AD -> 5.3 MeV
- Energy suitable for trapping -> around 5 KeV.
- Currently the experiments use degrader foils to reduce the energy but 99.9 % of antiprotons are lost.
- Under this frame ELENA was designed to further decelerate the antiprotons from 5.3 MeV to 100 KeV.

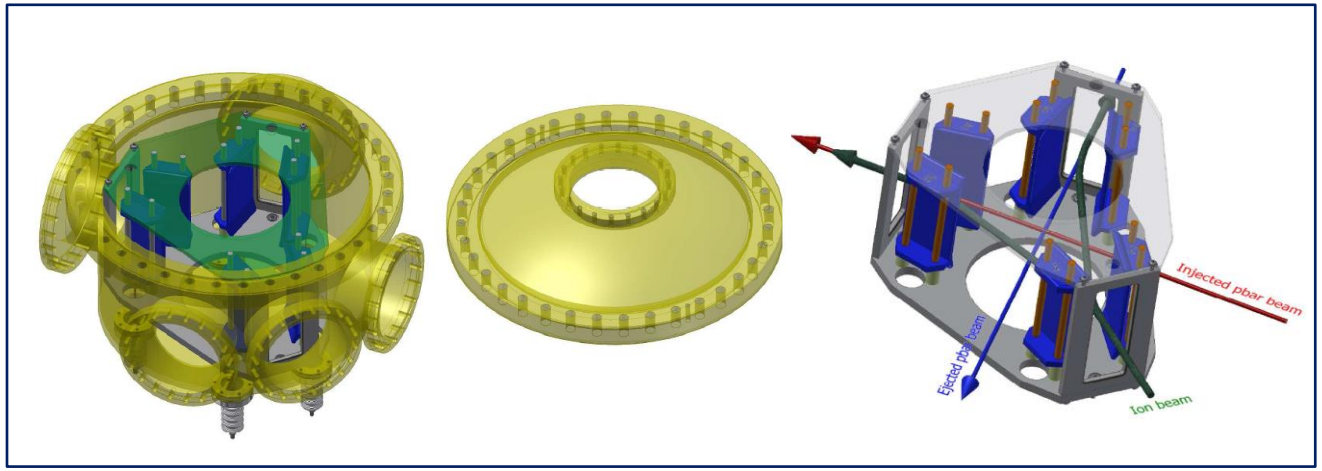
Why do we need an H^+/H^- Ion Source ?

- The Ion Source is used to commission ELENA while the experiments can still be connected to the AD and working.
- It can provide higher intensity and more frequent injections than possible with the AD. The AD cycle is 100s.
- H^+ and H^- ions can be circulated in the same direction by changing the polarity of the ring or in opposite directions keeping the same polarity.



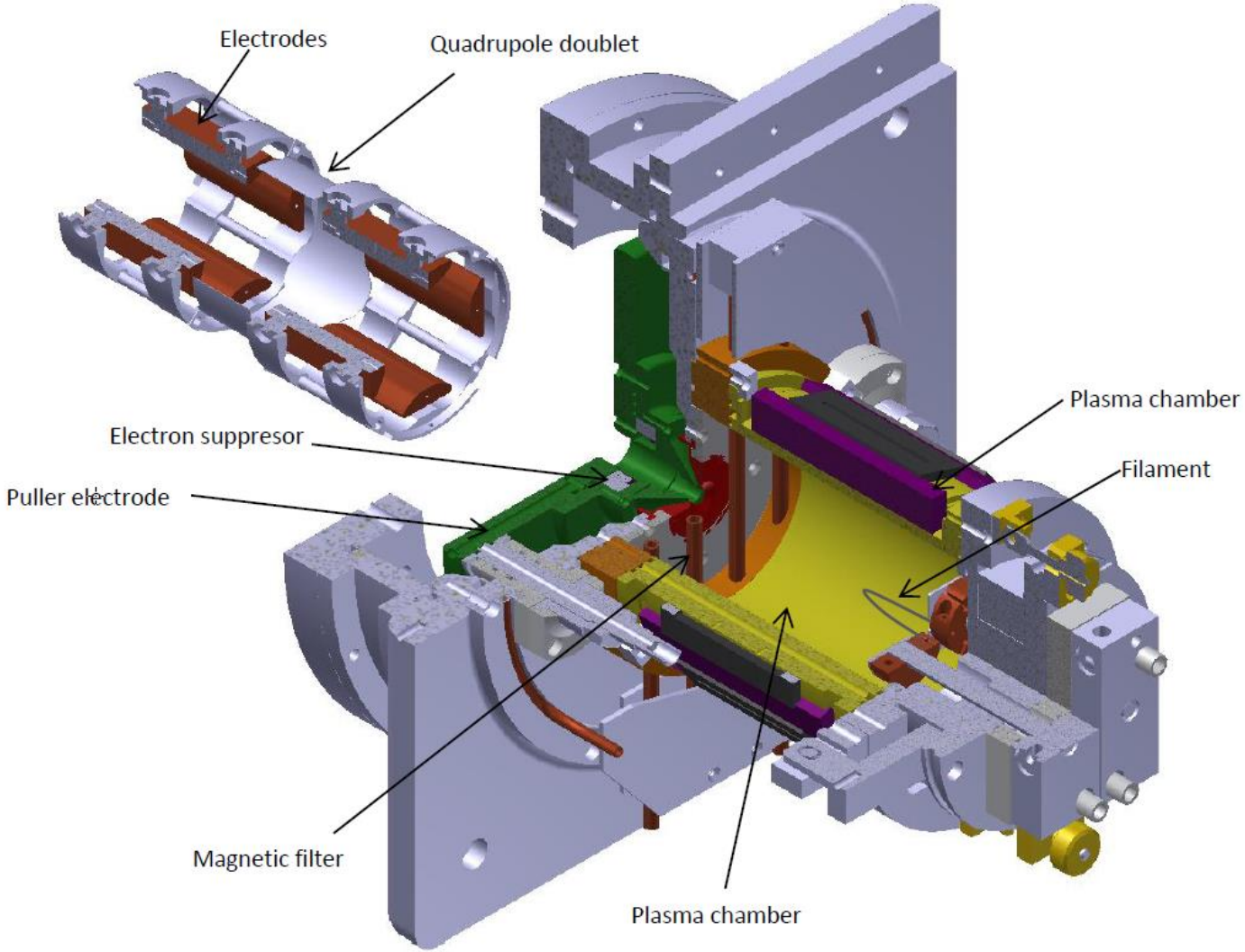
ELENA Ring Setup



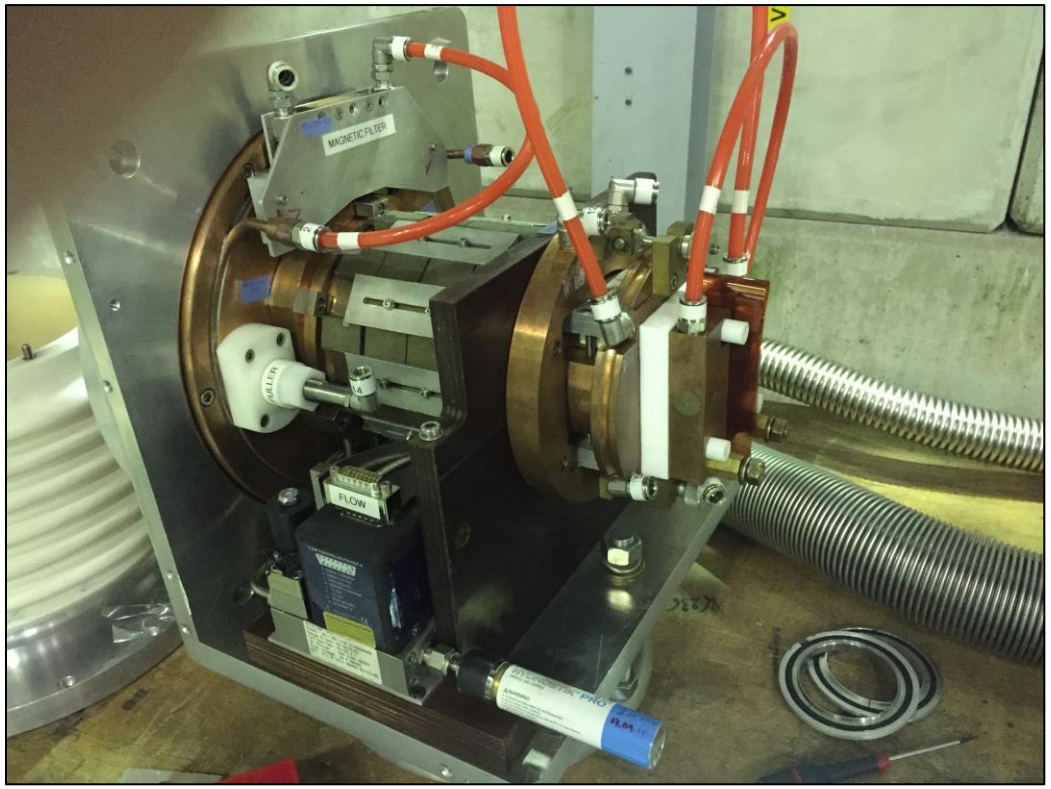


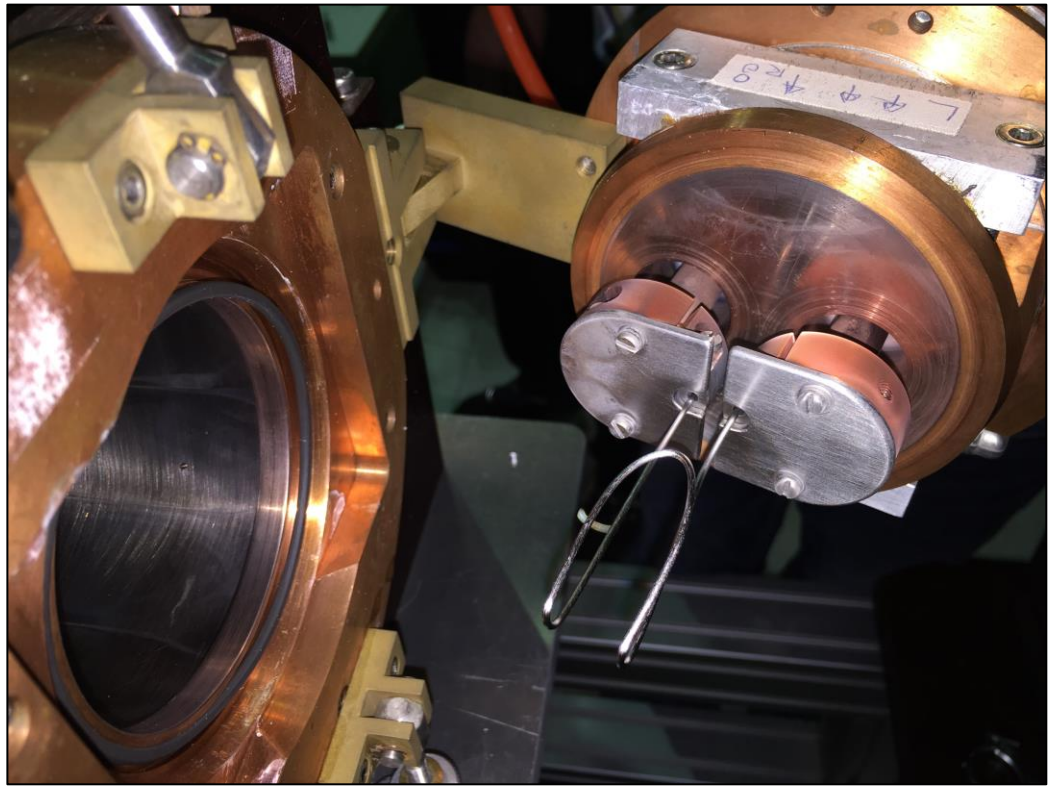
ELENA Ion Source

- The Ion Source was developed and tested at Jülich Forschungszentrum.
- In the **first stage** it was installed at CERN with the same operating configuration that it had in Jülich. April 2015
- In the **second stage** the source has been recently installed on its final position.

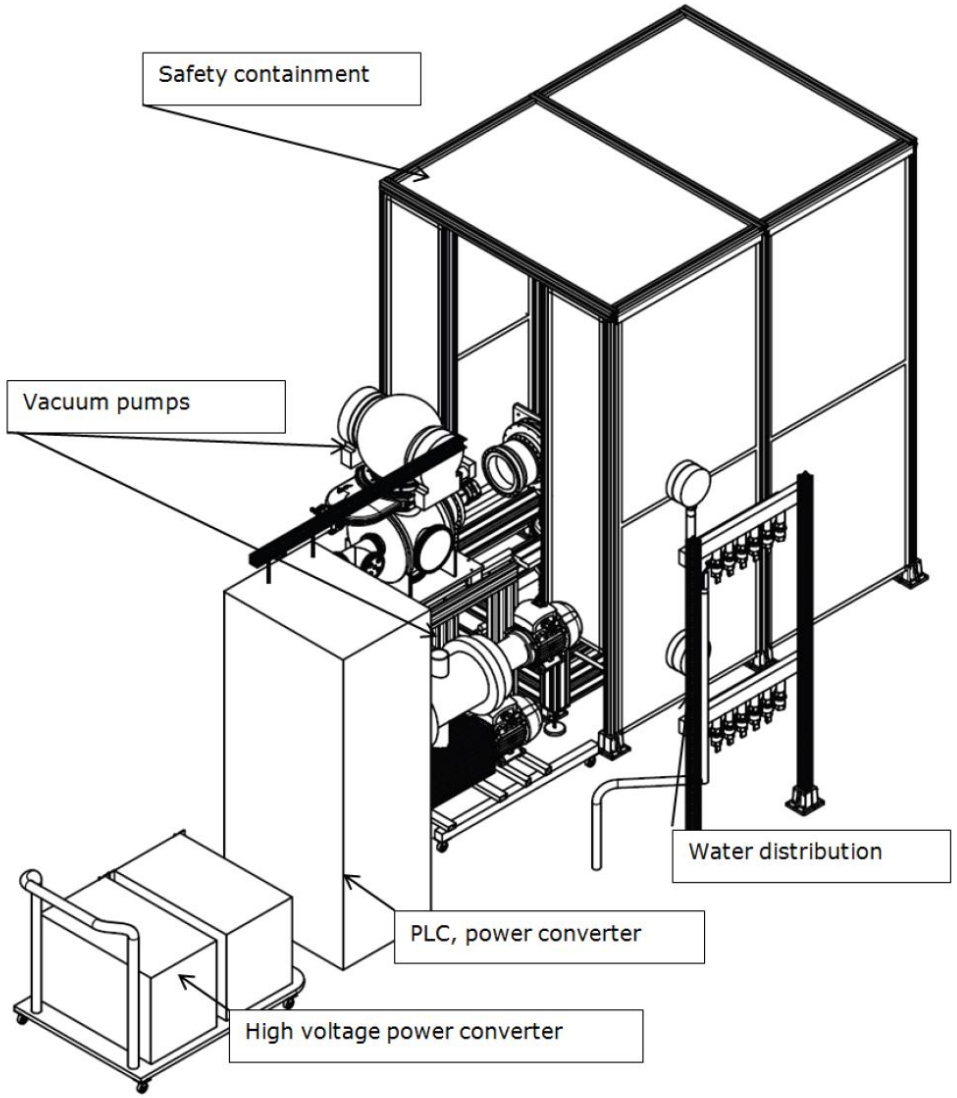


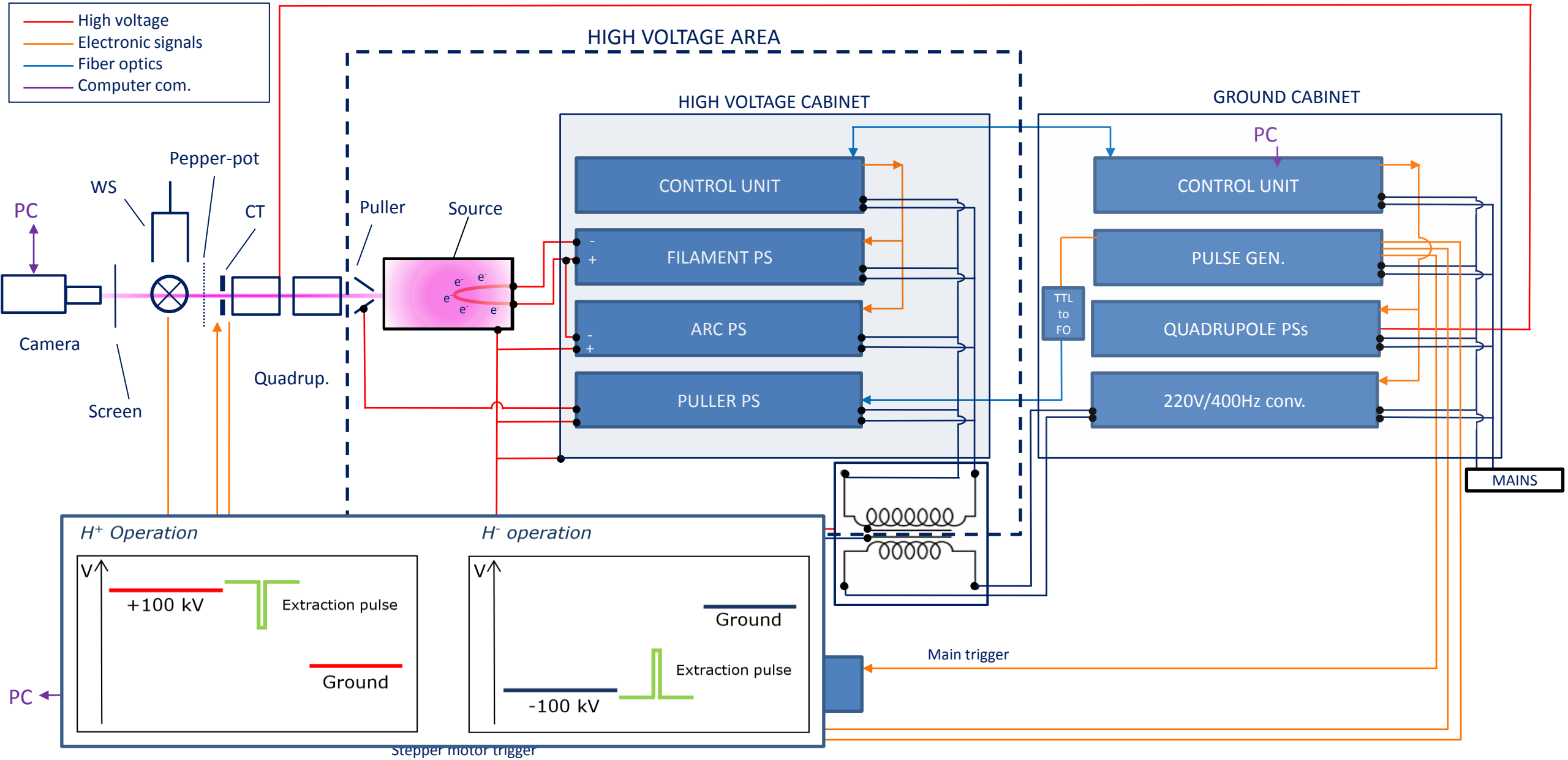
ELENA Ion Source





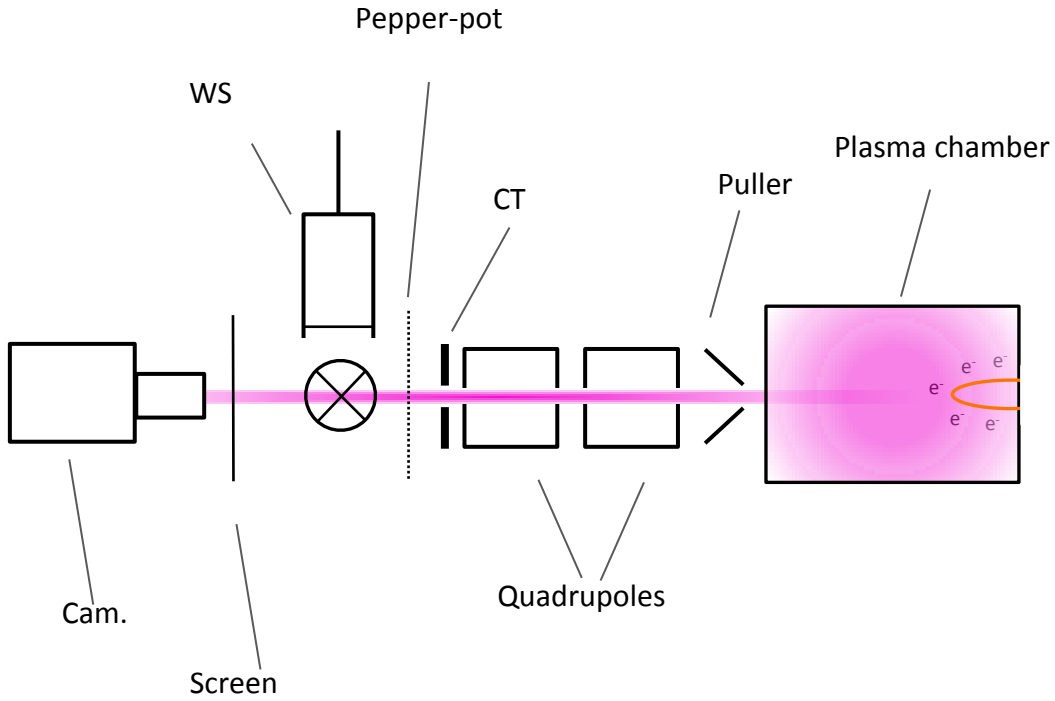
ELENA Ion Source: Stage I



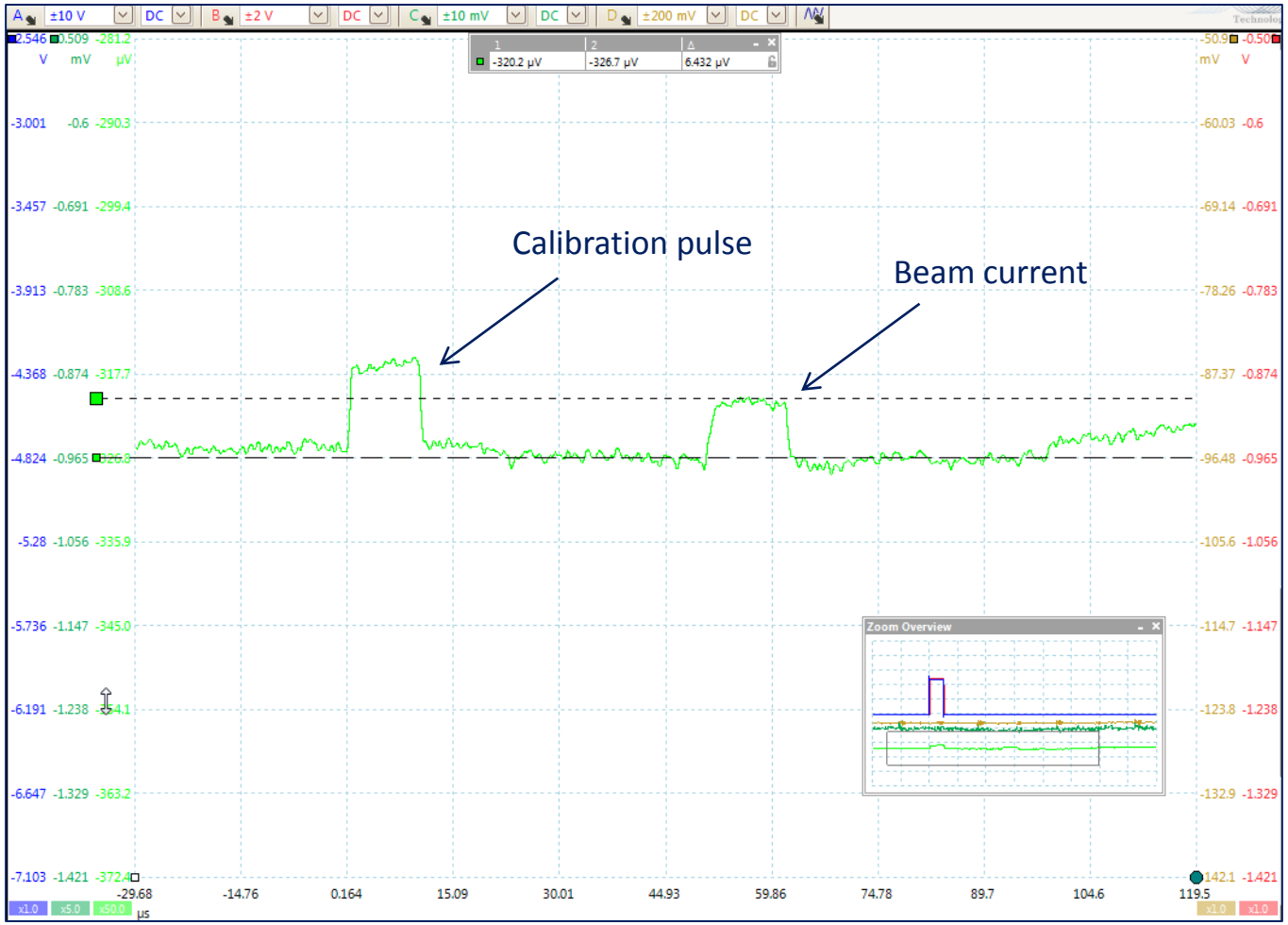

High voltage
Electronic signals
Fiber optics
Computer com.
HIGH VOLTAGE AREA
HIGH VOLTAGE CABINET
GROUND CABINET
PC
CONTROL UNIT
FILAMENT PS
ARC PS
PULLER PS
PULSE GEN.
QUADRUPOLE PSs
220V/400Hz conv.
TTL to FO
MAINS
Pepper-pot
WS
CT
Puller
Source
Camera
Screen
Quadrup.
H⁺ Operation
H⁻ operation
V
+100 kV
Extraction pulse
Ground
-100 kV
Main trigger
Stepper motor trigger

ELENA Ion Source Diagnostics

- Current transformer
- Wire scanners
- Pepper-pot + viewer



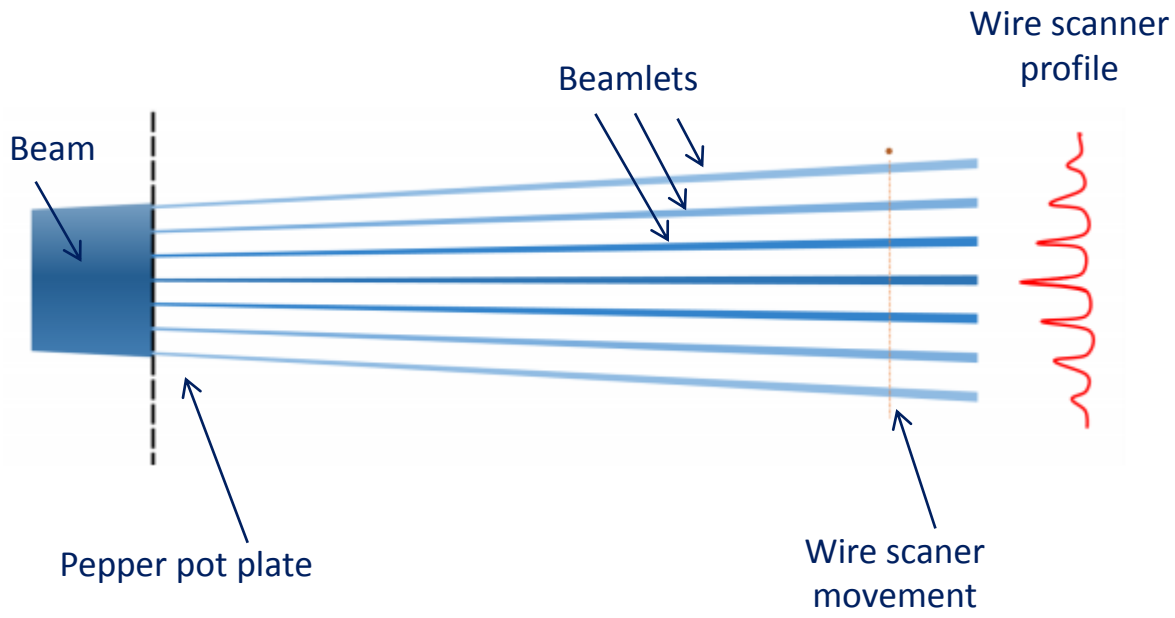
ELENA Ion Source Diagnostics: Current Transformer

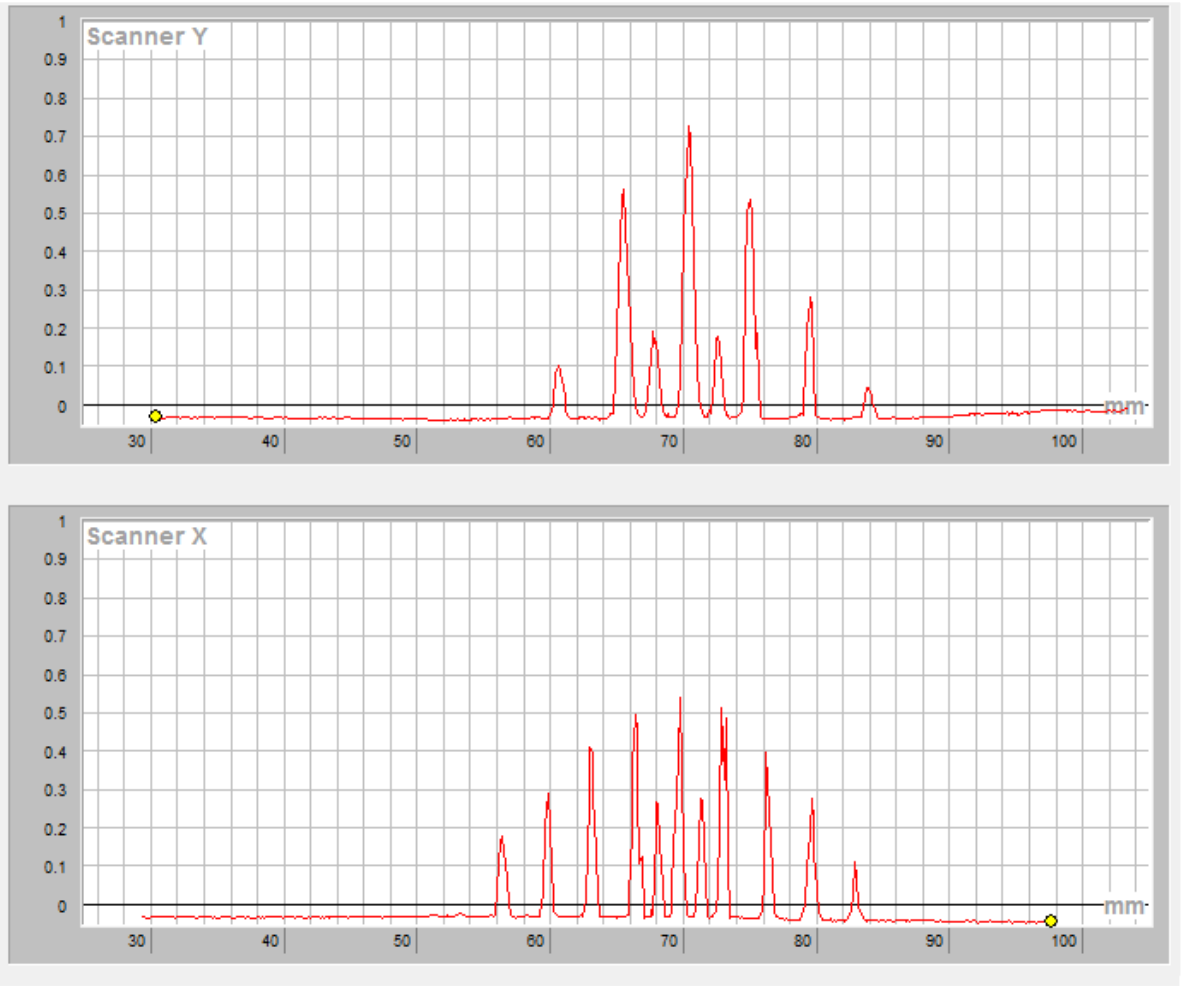


H^+, H_2^+, H_3^+ CURRENT (μA)					
		Hydrogen flow (sccm)			
		1.2	0.9	0.6	0.3
Arc current (A)	1	103.3	90	59.14	25.71
	2	204.6	181.4	109.9	51.86
	3			158.2	70.87
	4				90.77

H- CURRENT (μA)					
		Hydrogen flow (sccm)			
		1.6	1.2	0.8	0.4
Arc current (A)	1	49	45	40	24
	2	71	65	53	37
	3	98	91	62	40
	4			82	40

ELENA Ion Source Diagnostics: Wire Scanner





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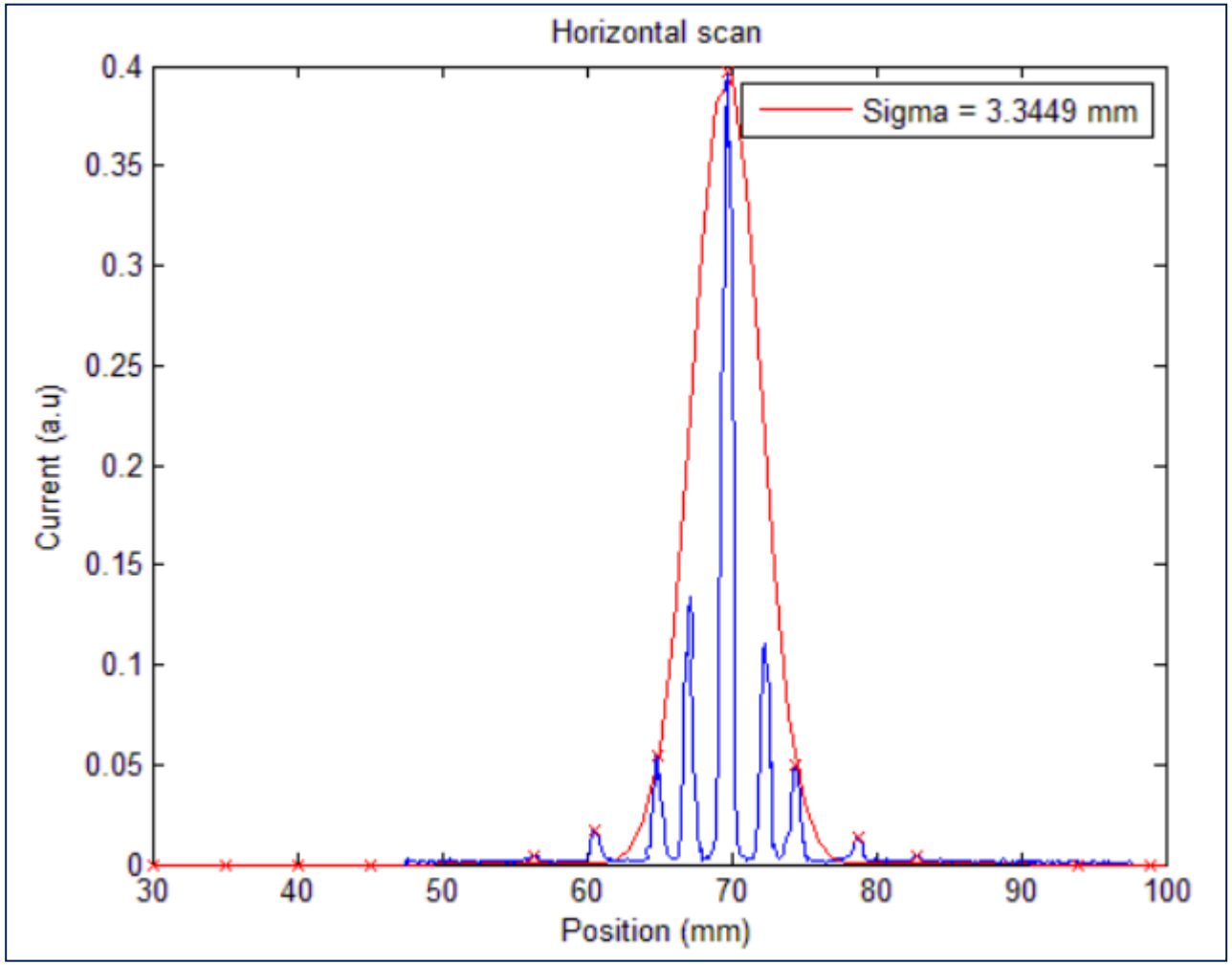

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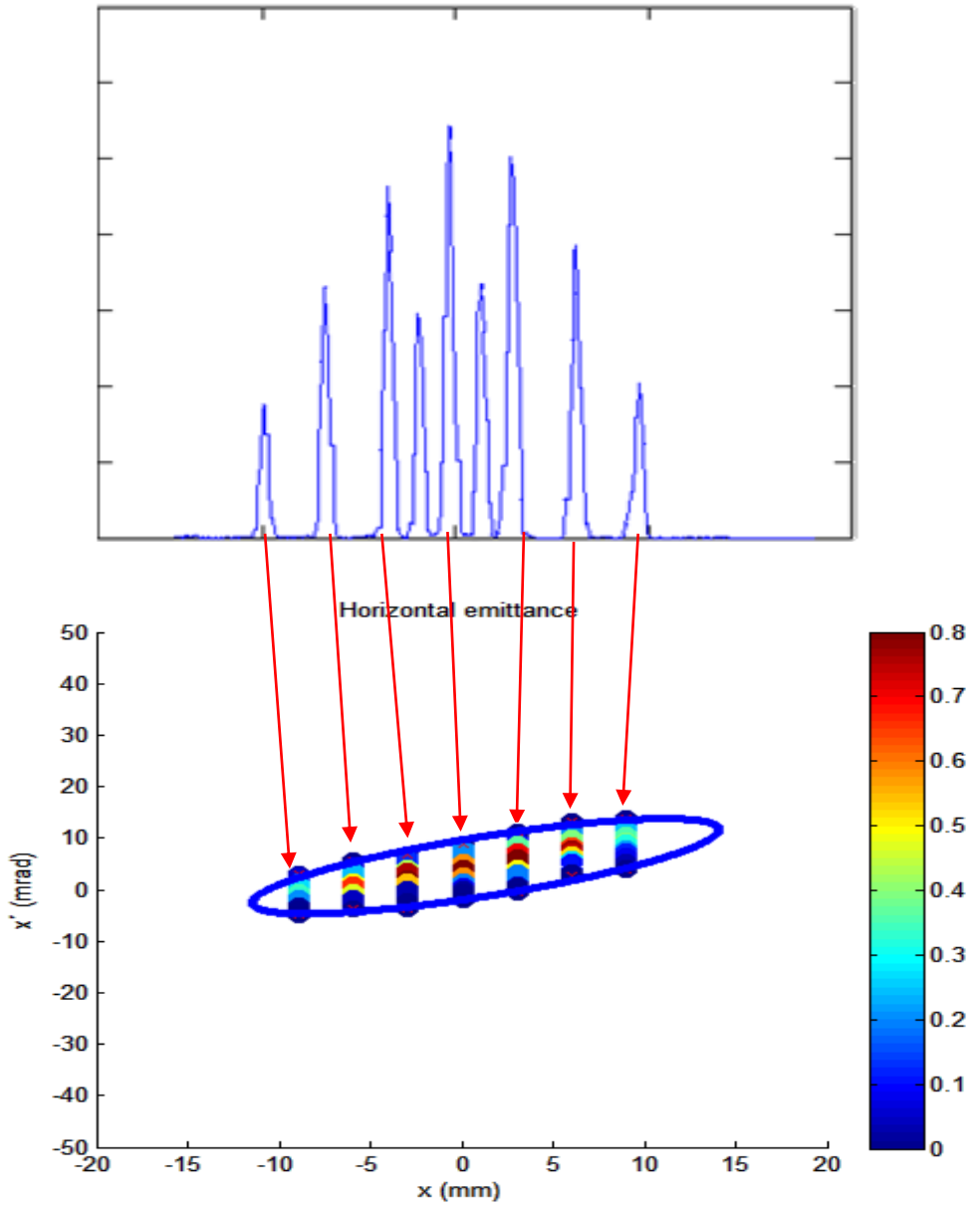

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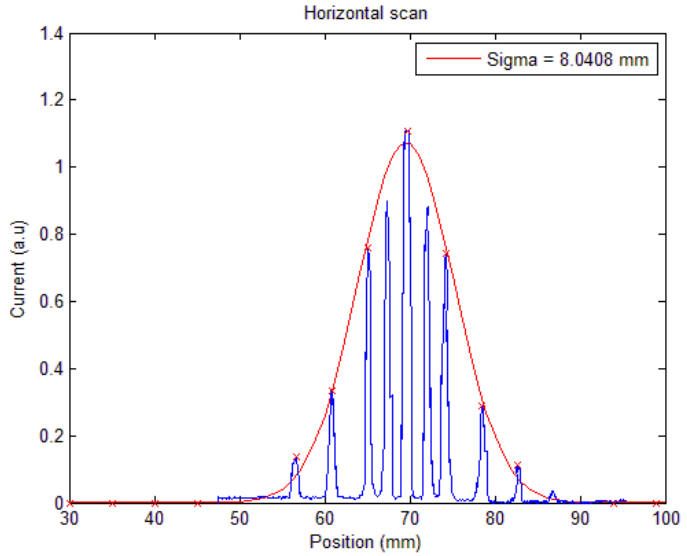
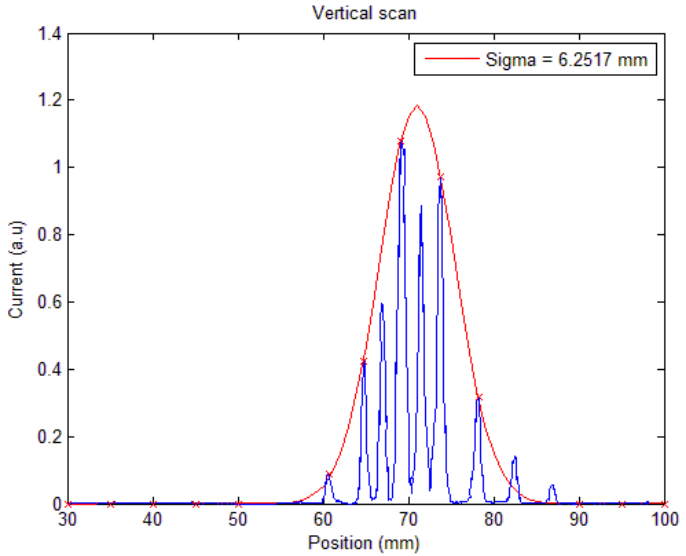
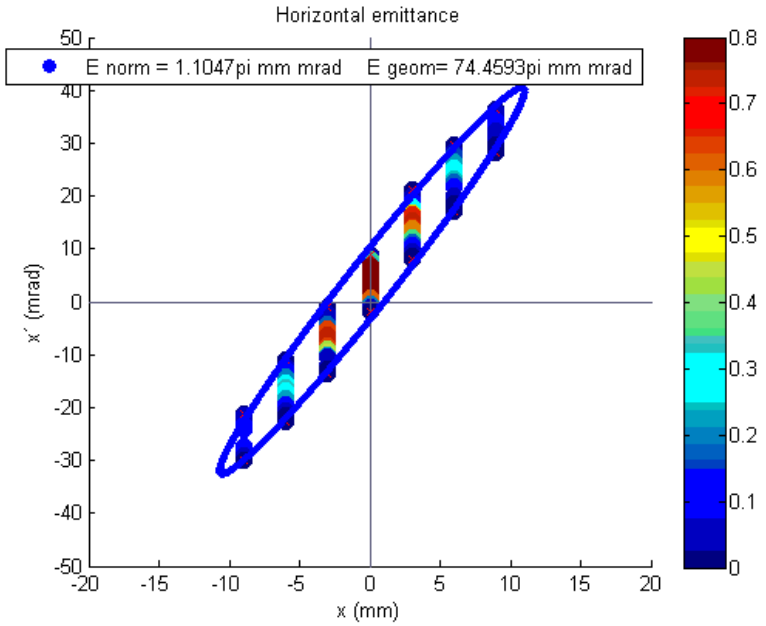
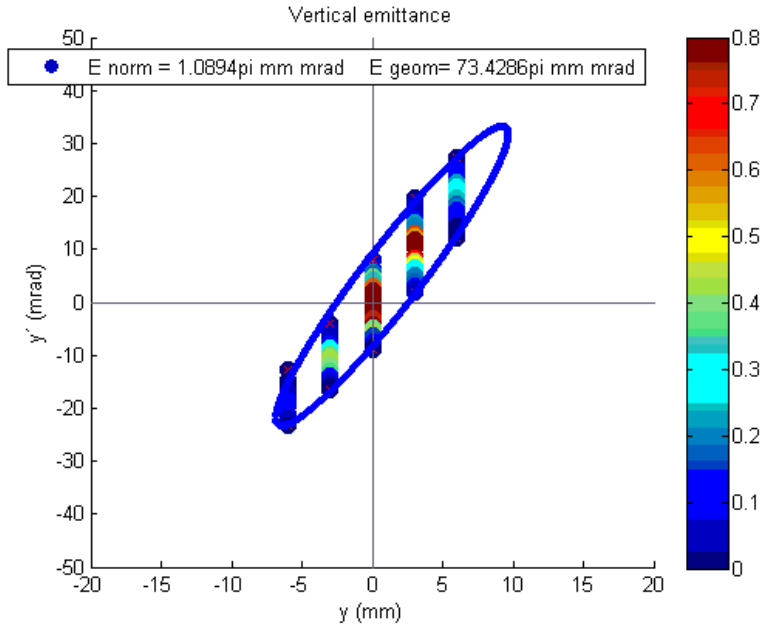


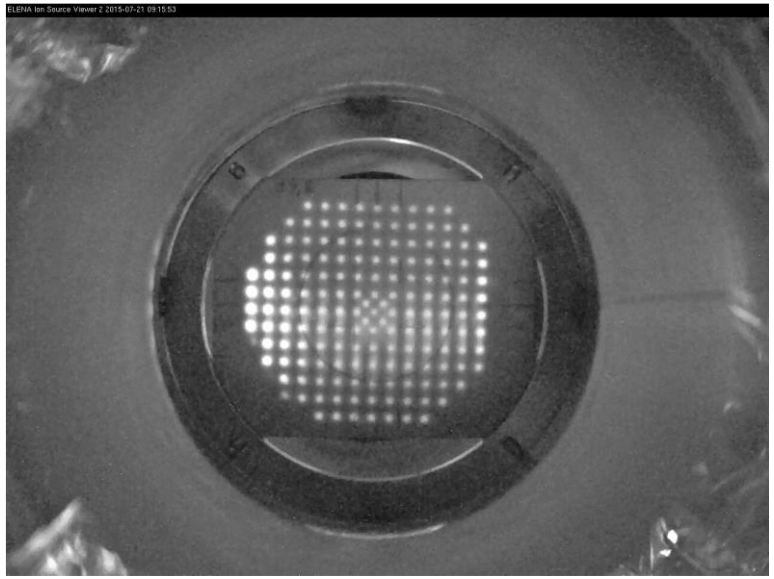




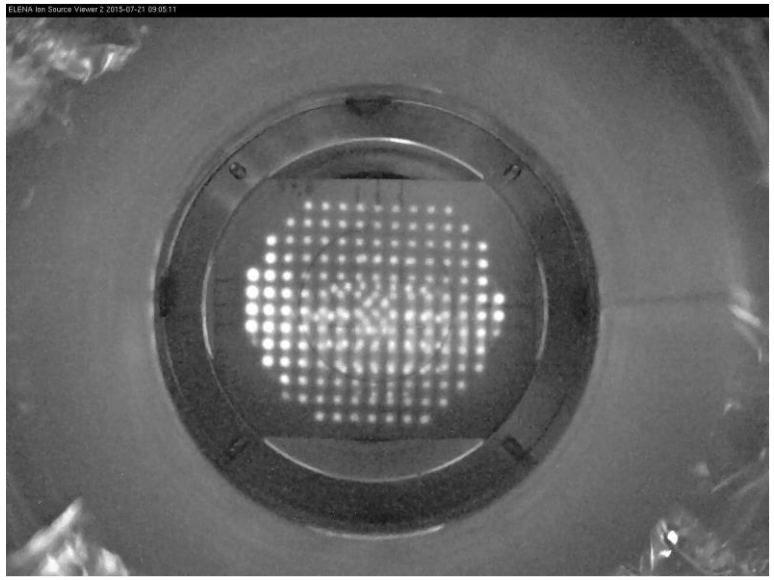


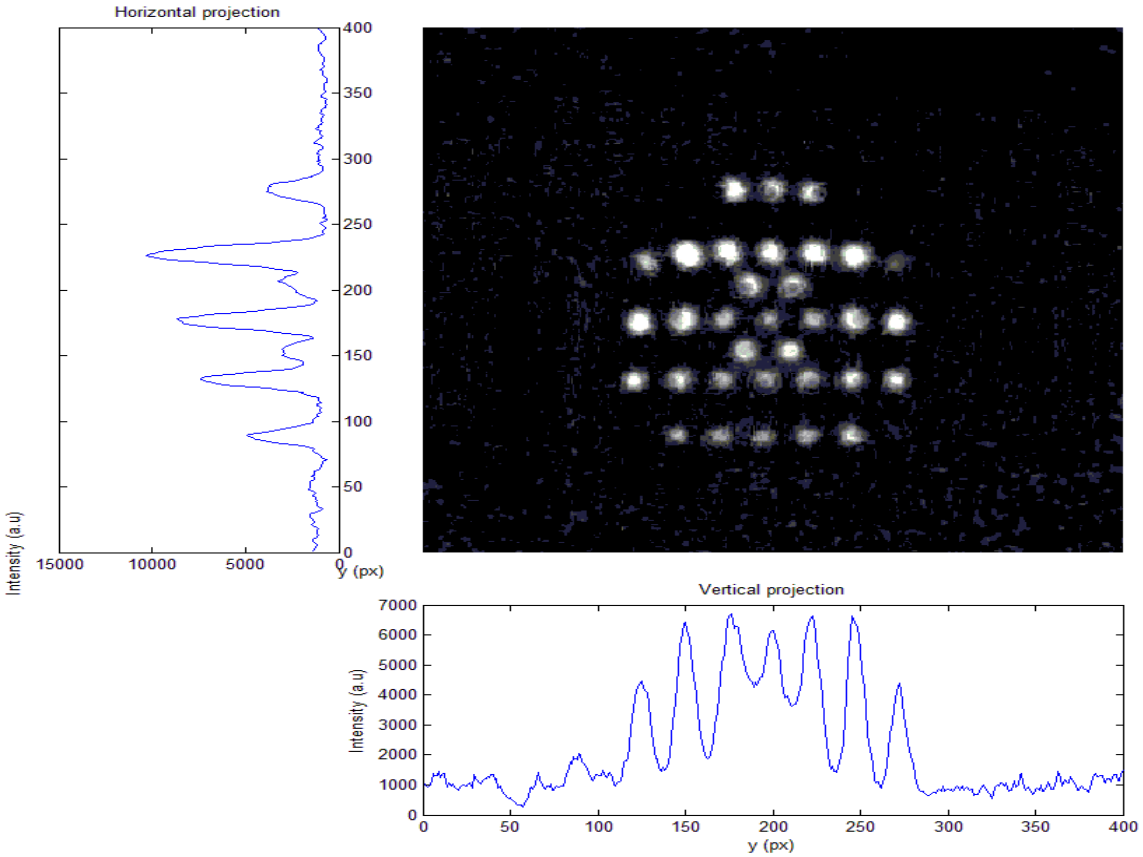
ELENA Ion Source Diagnostics: Pepper Pot

Background

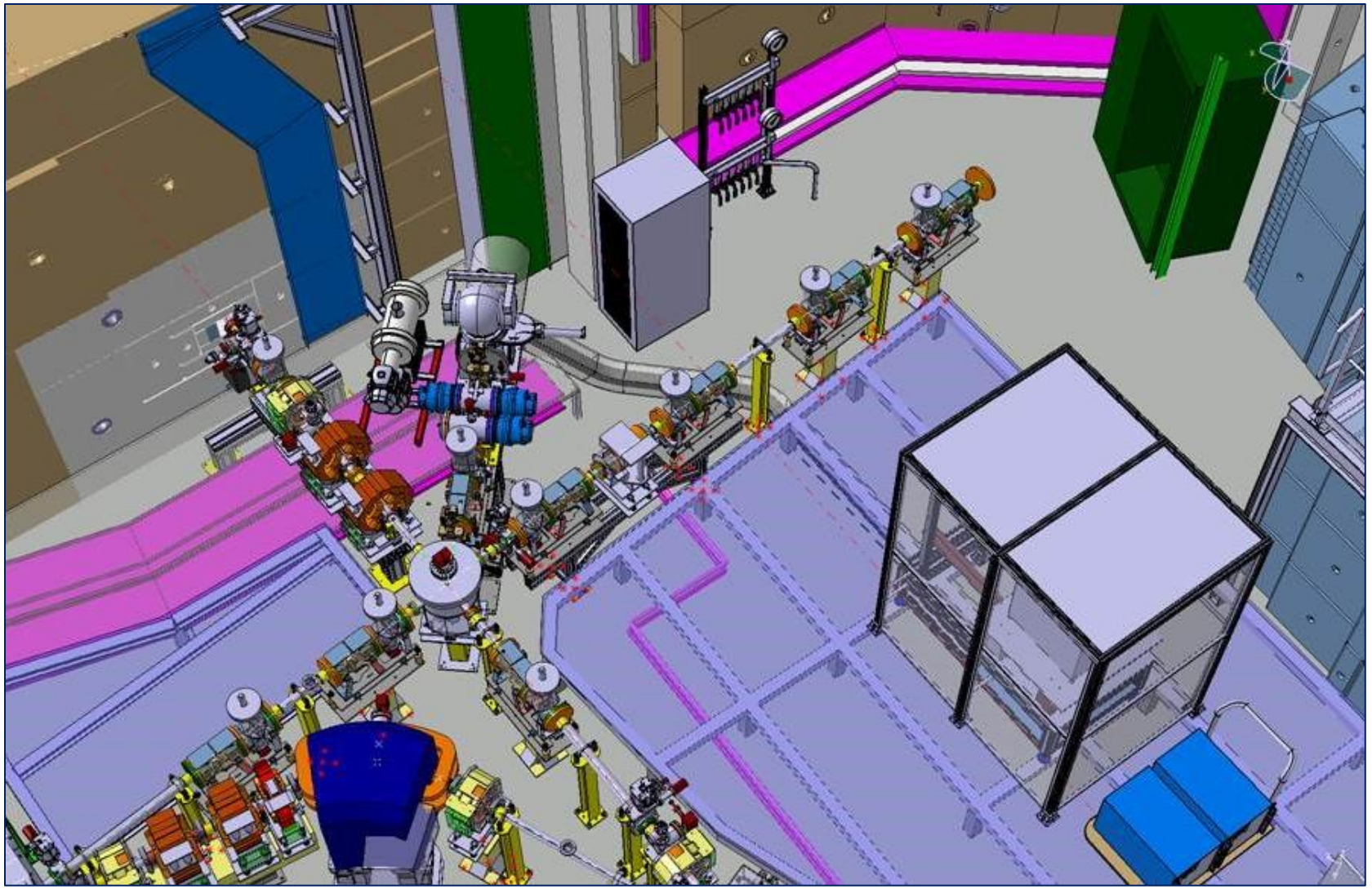


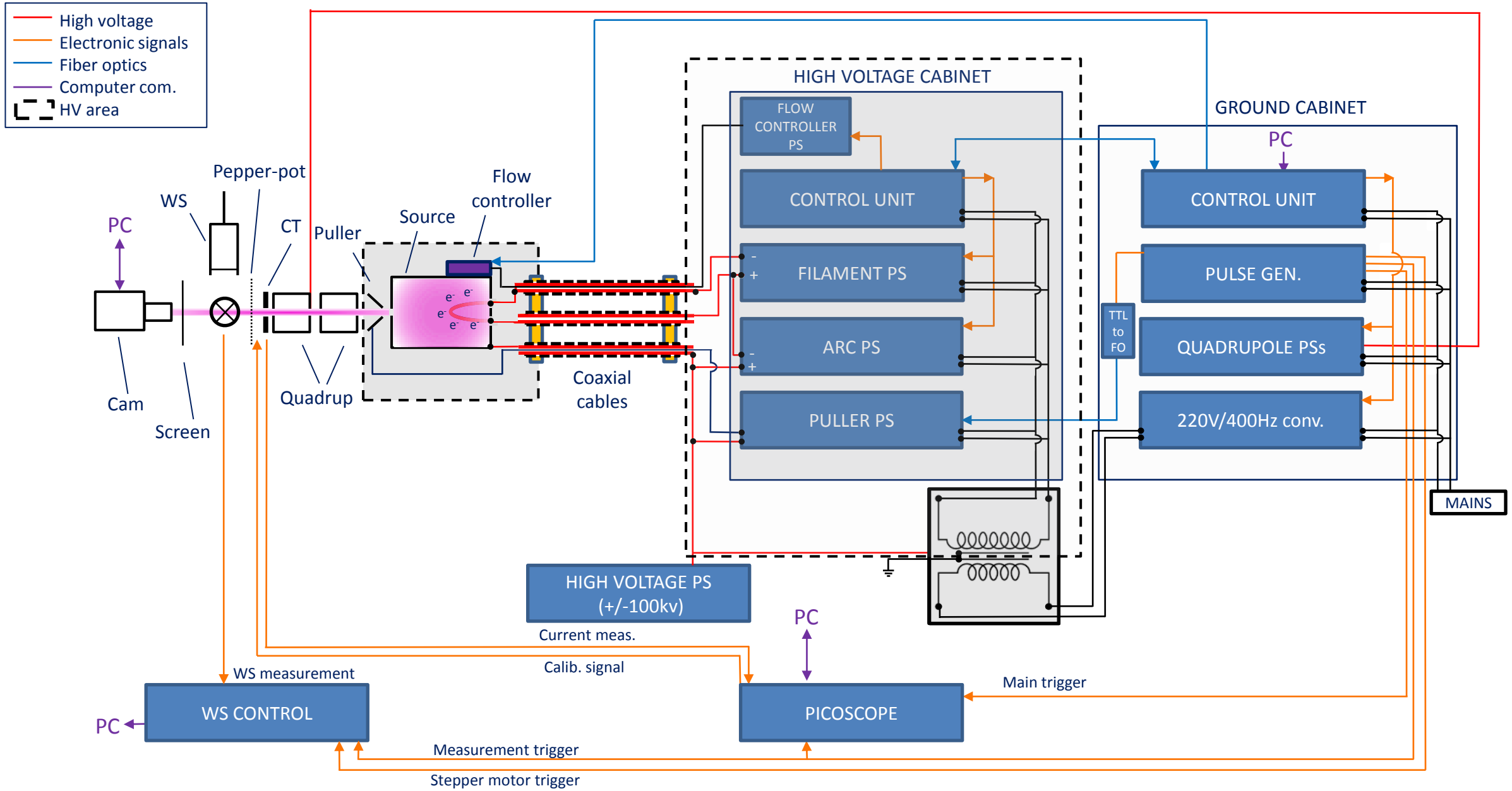
Beam



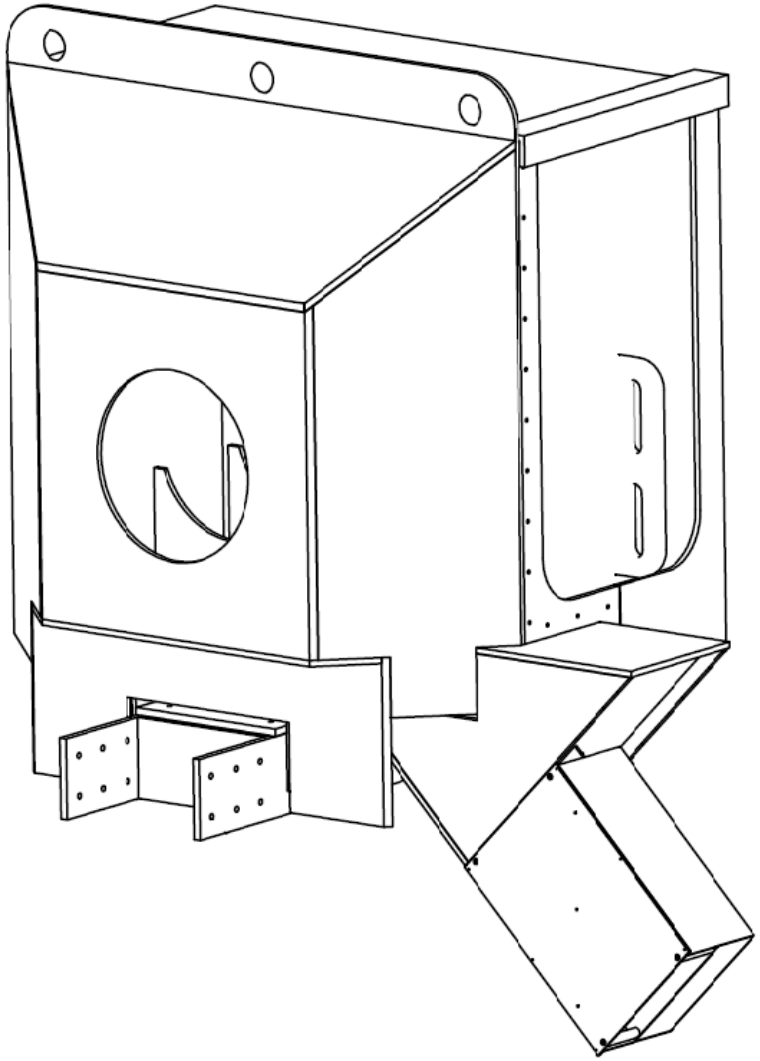


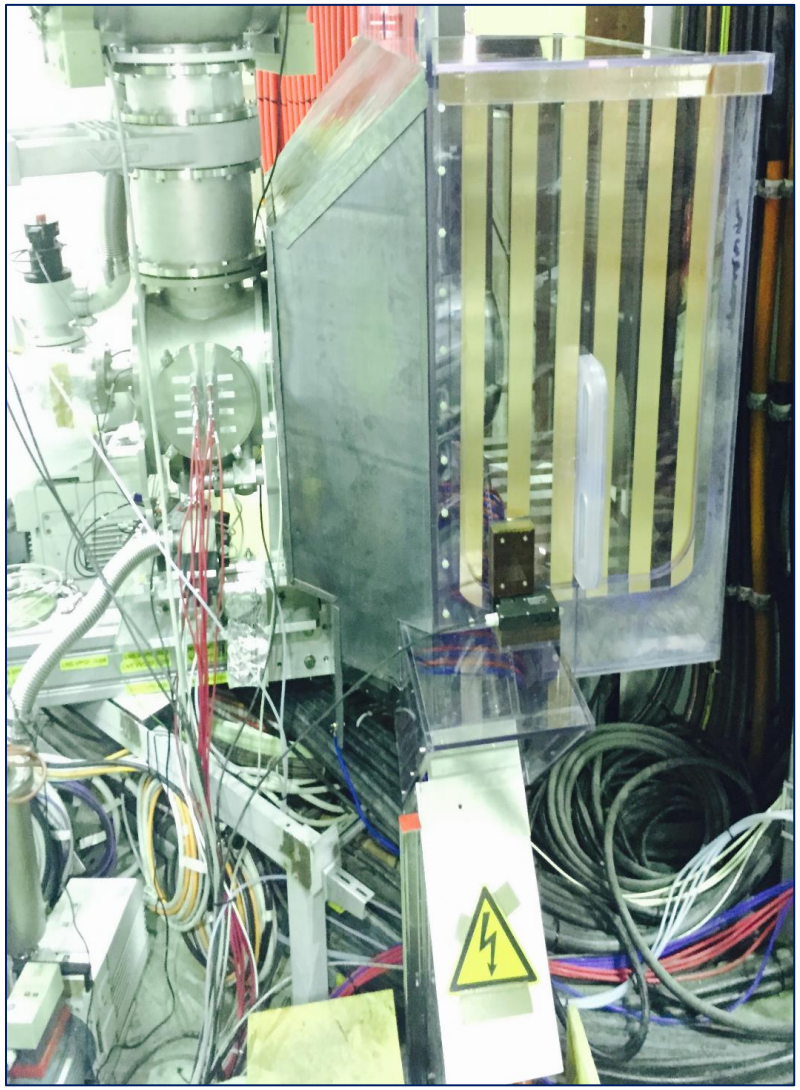
ELENA Ion Source: Stage II




High voltage
Electronic signals
Fiber optics
Computer com.
HV area
HIGH VOLTAGE CABINET
FLOW CONTROLLER PS
CONTROL UNIT
FILAMENT PS
ARC PS
PULLER PS
GROUND CABINET
PC
CONTROL UNIT
PULSE GEN.
QUADRUPOLE PSs
220V/400Hz conv.
TTL to FO
MAINS
PC
WS
Pepper-pot
CT
Puller
Source
Flow controller
Cam
Screen
Quadrup
Coaxial cables
HIGH VOLTAGE PS (+/-100kv)
Current meas.
PC
Calib. signal
WS measurement
Main trigger
PC
WS CONTROL
PICOSCOPE
Measurement trigger
Stepper motor trigger

ELENA Ion Source: Stage II





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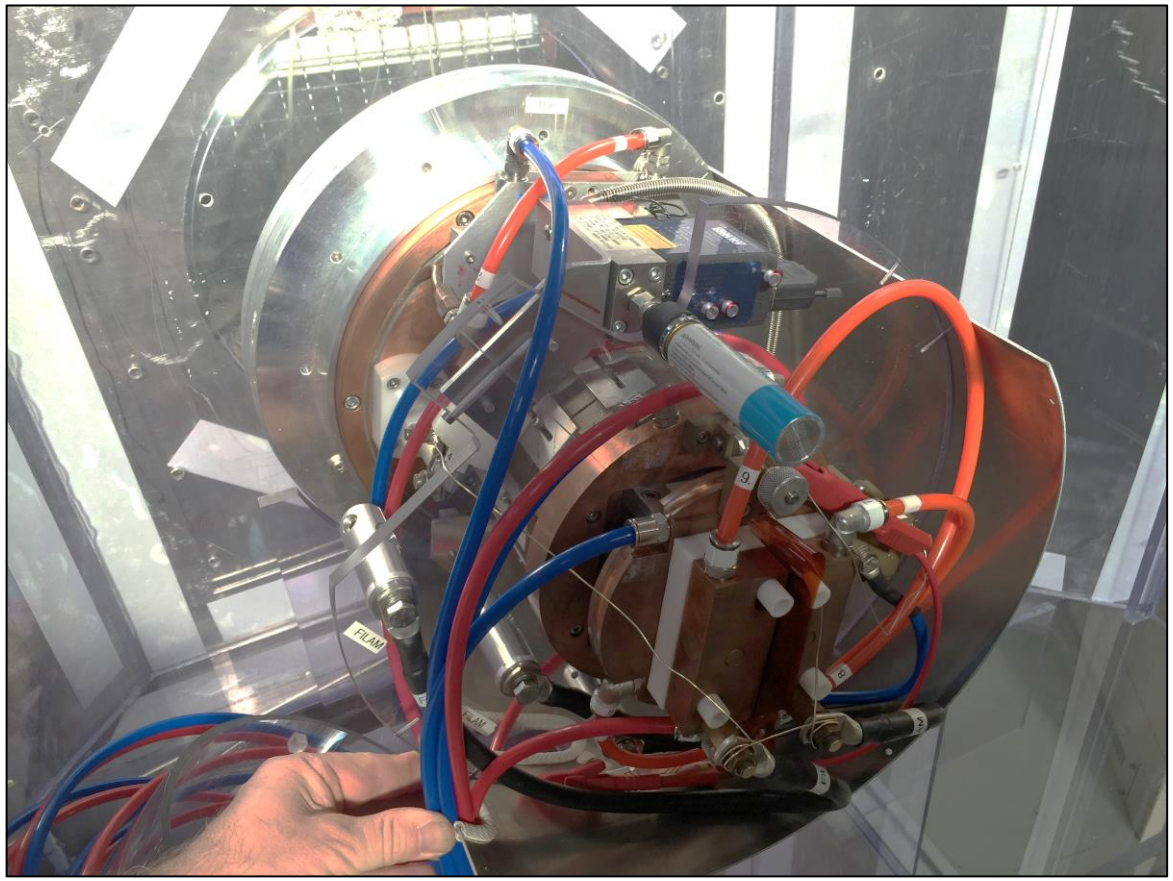
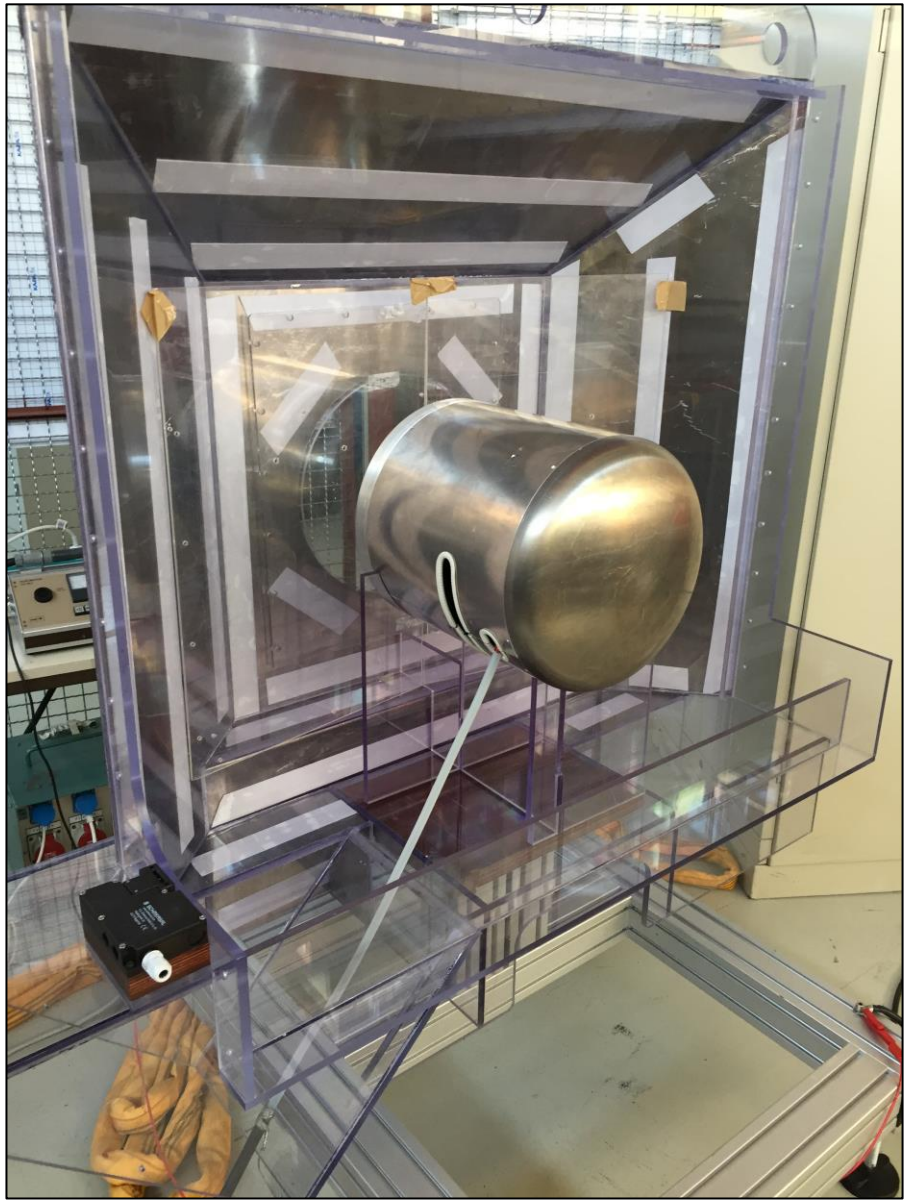
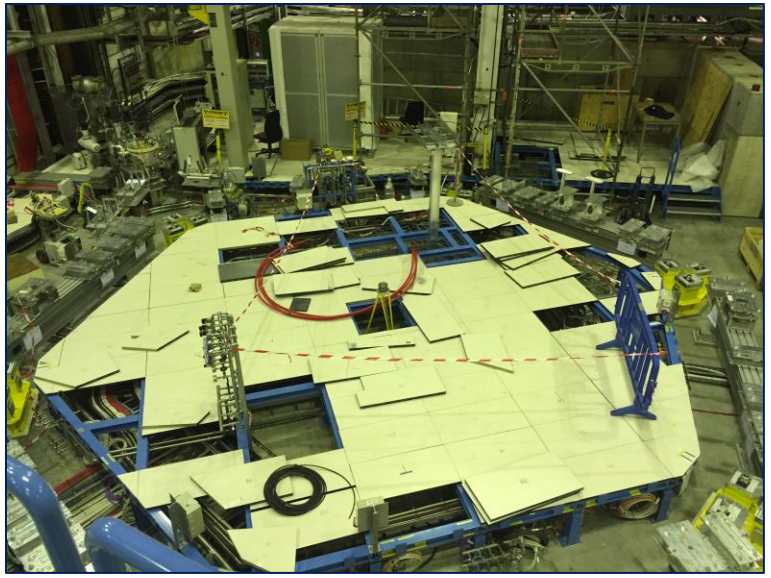
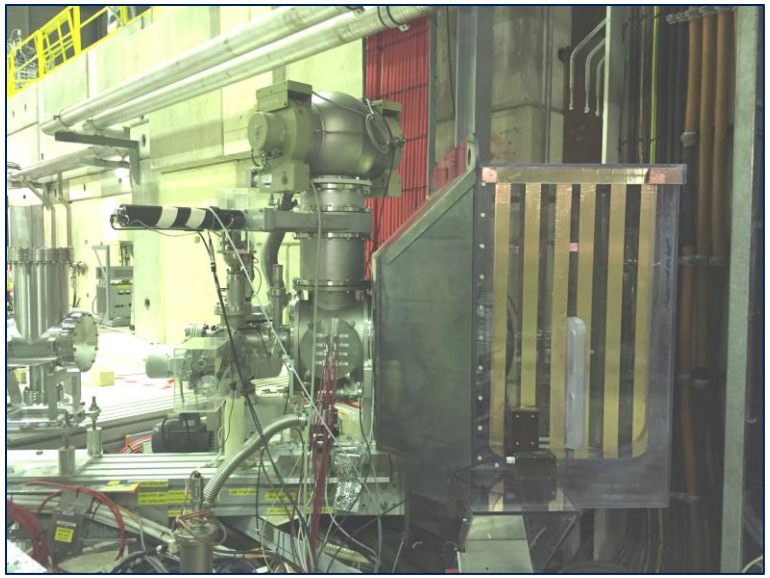


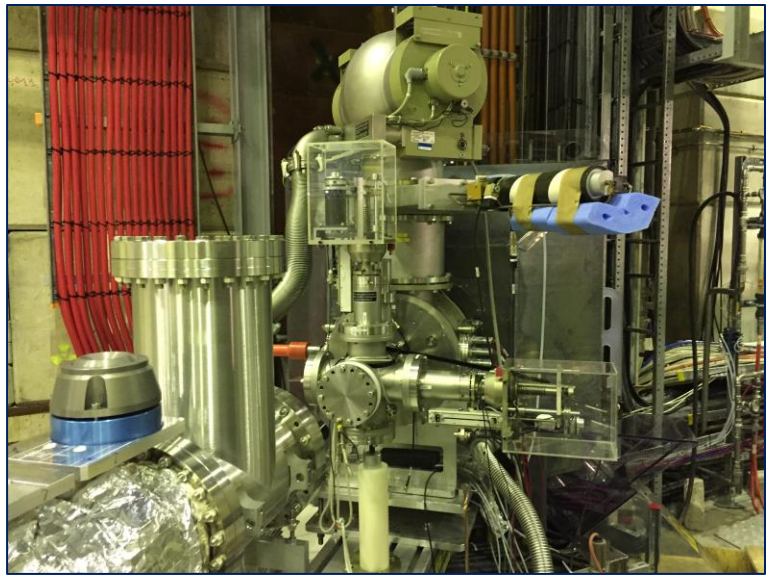


Current Status of ELENA Project

- Supports and alignment tables installed.
- Cabling campaign finished.
- Cooling pipes installed.
- Ion source installed and operational.
- Ion switch installed.
- LNS line on installation
- First bending magnets to be installed in the coming weeks.







THANKS FOR YOUR ATTENTION