Secondary Beams provided to the Experiments

Beamline for Schools 2022

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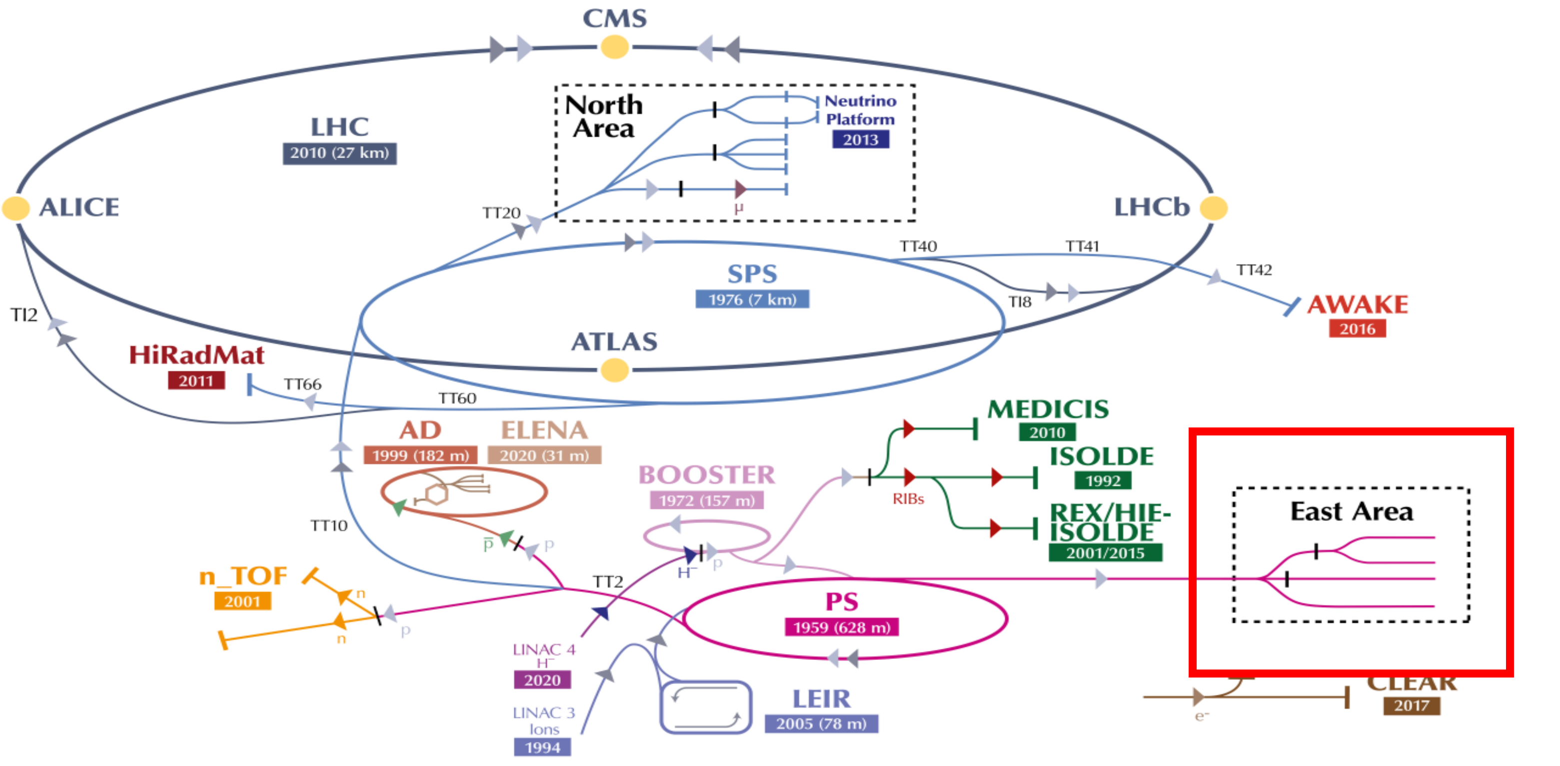
Overview

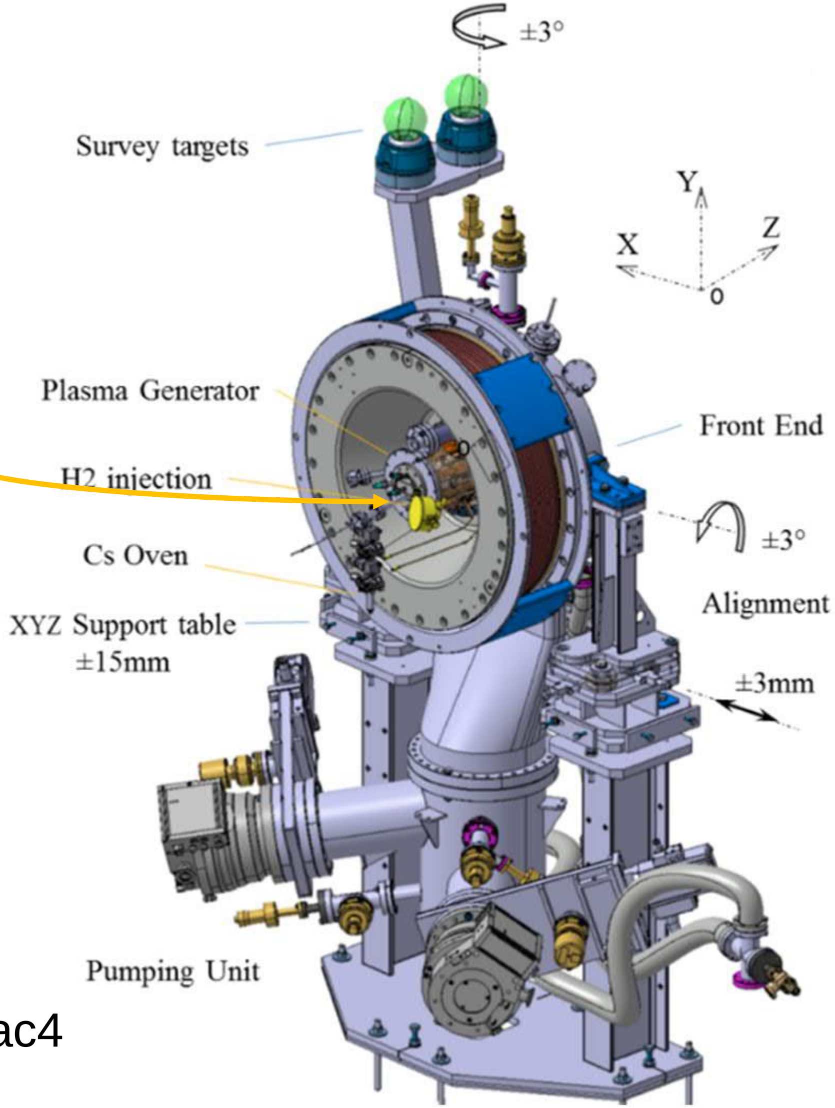
The CERN accelerator complex
Complexe des accélérateurs du CERN



H⁻ (hydrogen anions) p (protons) ions RIBs (Radioactive Ion Beams) n (neutrons) p̄ (antiprotons) e⁻ (electrons) μ (muons)

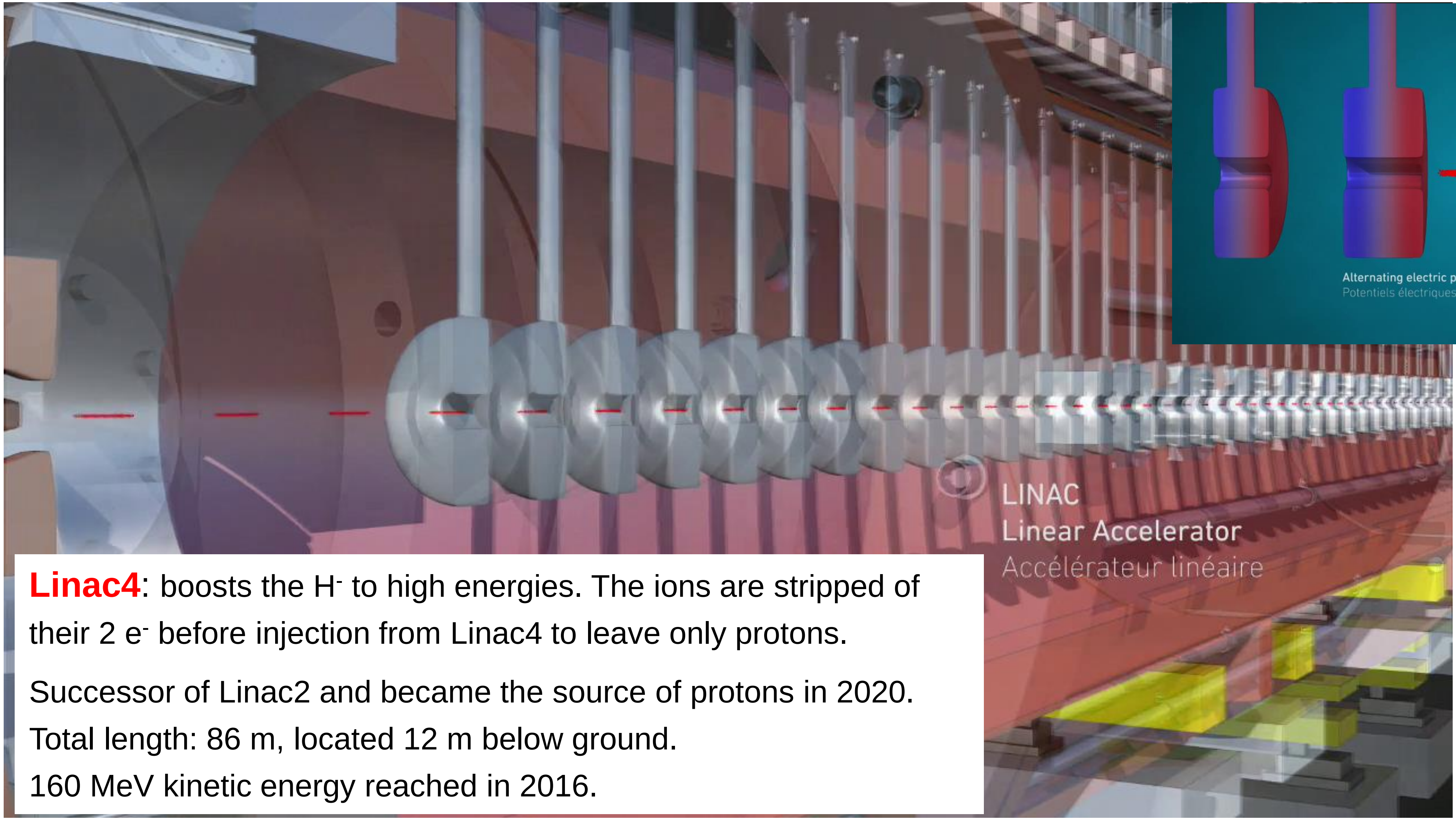
LHC - Large Hadron Collider // SPS - Super Proton Synchrotron // PS - Proton Synchrotron // AD - Antiproton Decelerator // CLEAR - CERN Linear Electron Accelerator for Research // AWAKE - Advanced WAKefield Experiment // ISOLDE - Isotope Separator OnLine // REX/HIE-ISOLDE - Radioactive EXperiment/High Intensity and Energy ISOLDE // MEDICIS // LEIR - Low Energy Ion Ring // LINAC - LINear ACcelerator // n_TOF - Neutrons Time Of Flight // HiRadMat - High-Radiation to Materials // Neutrino Platform

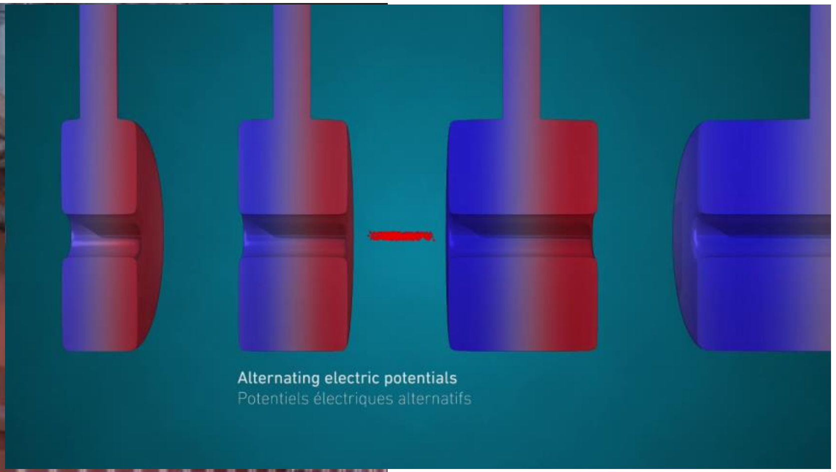
Where does the beam come from?



H^- ion source for Linac4

Where does the beam come from?



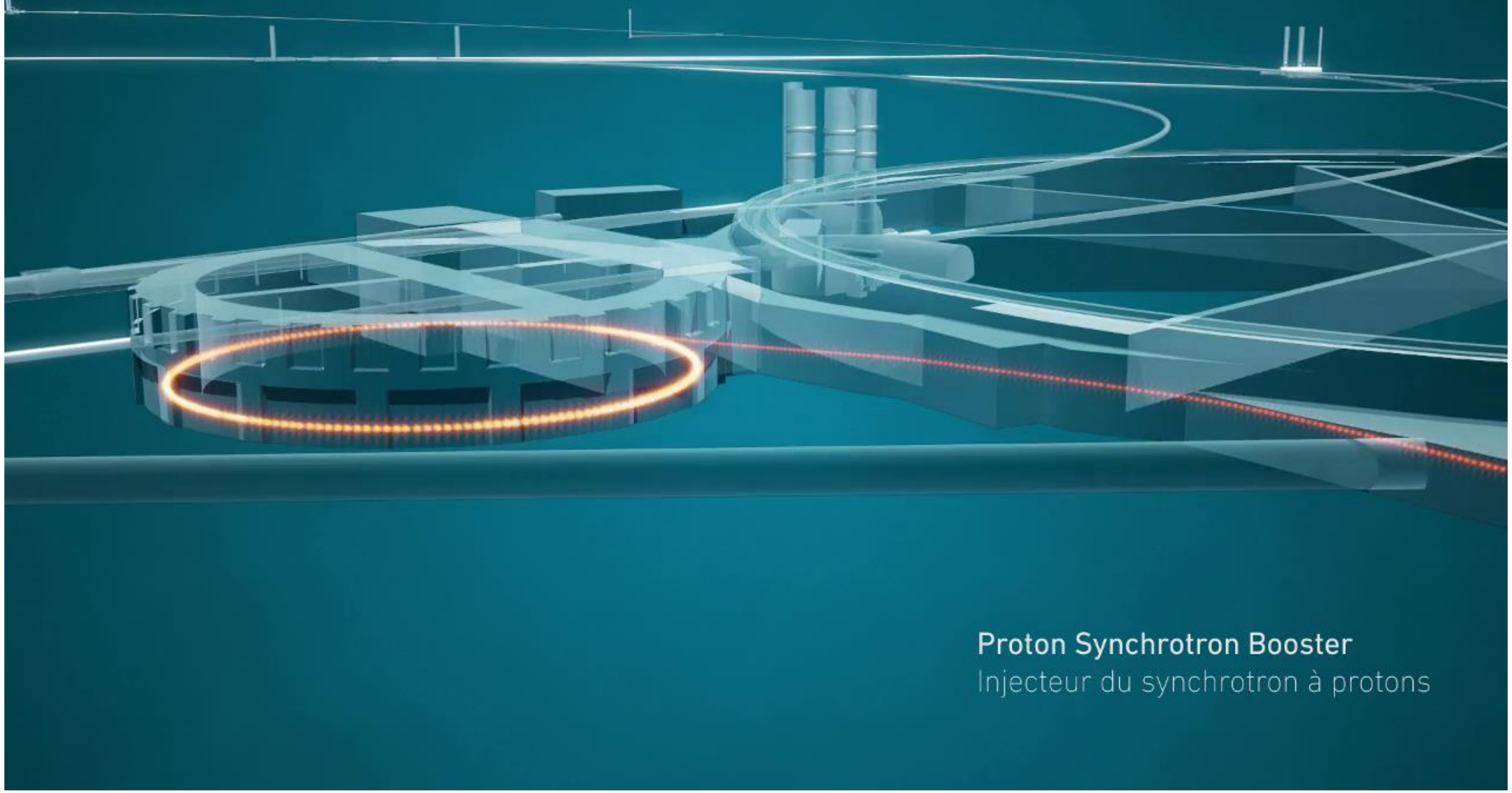


Linac4: boosts the H^- to high energies. The ions are stripped of their 2 e^- before injection from Linac4 to leave only protons.

Successor of Linac2 and became the source of protons in 2020.
Total length: 86 m, located 12 m below ground.
160 MeV kinetic energy reached in 2016.

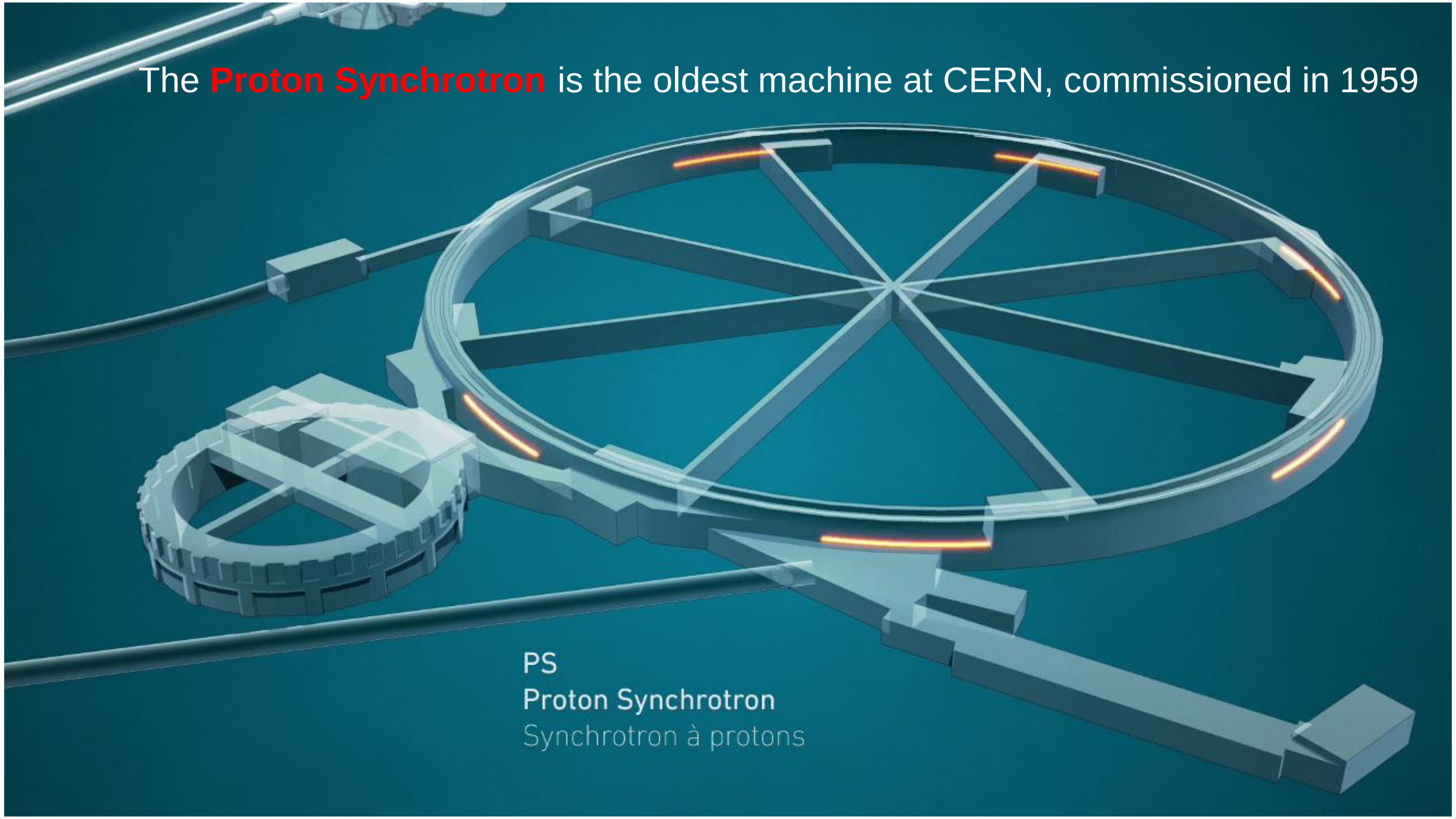
Where does the beam come from?

The **PS Booster** was built in 1972, its circumference is ~157 metres (1/4 x PS).



- The PSB receives the beam from Linac4 and accelerates it to 2 GeV/c for injection into the PS.
- It consists of 4 parallel rings, which can be operated rather independently, e.g., 1 ring for the East Area and 1 for nTOF.
- The PSB cycle is 1.2 seconds. The intensity spans 4 orders of magnitude, up to 3.2 x 10^{13}.

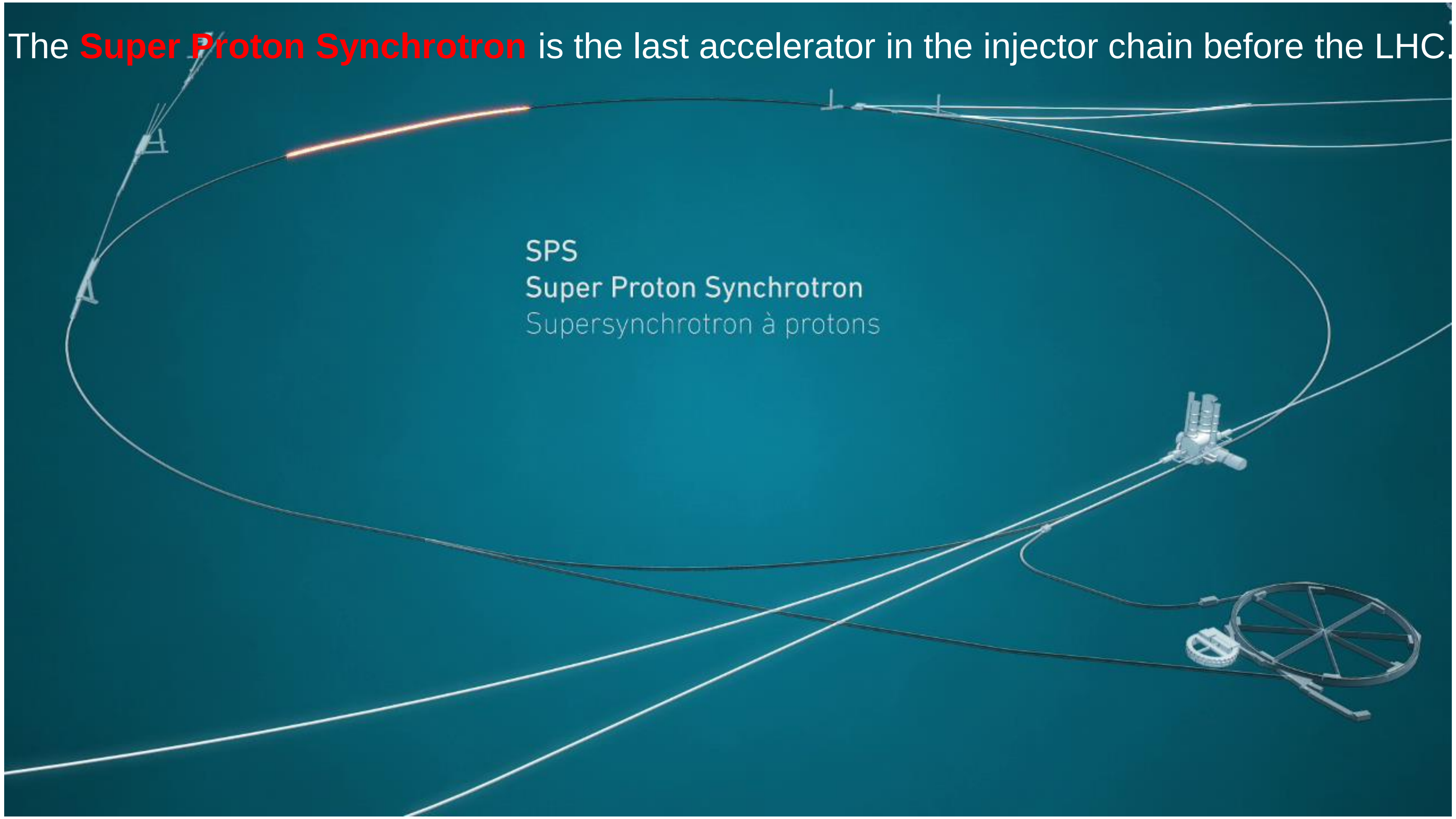
Where does the beam come from?



The PS cycle is 1.2 seconds. The PS serves many users, including the SPS North Area, the LHC, the AD, the East Area, nTOF and machine studies.

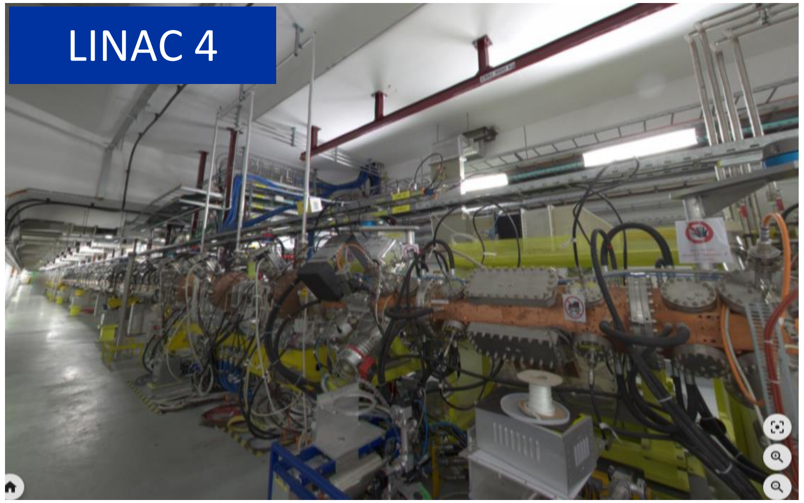
- The PS is still functioning well and even well beyond its initial specifications.
- The PS has a circumference of ~628 m and is capable to accelerate protons up to 26 GeV/c.
- Contrary to the SPS, the PS has no separate quadrupoles, but it has shaped pole faces and special coils in the main magnet units to provide the focusing. In total there are 100 main magnets and as many straight sections with special function equipment.

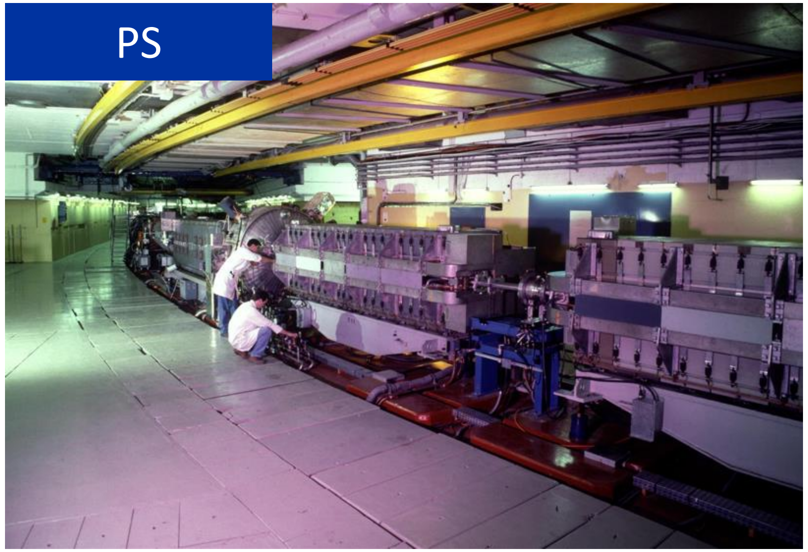
Where does the beam come from?



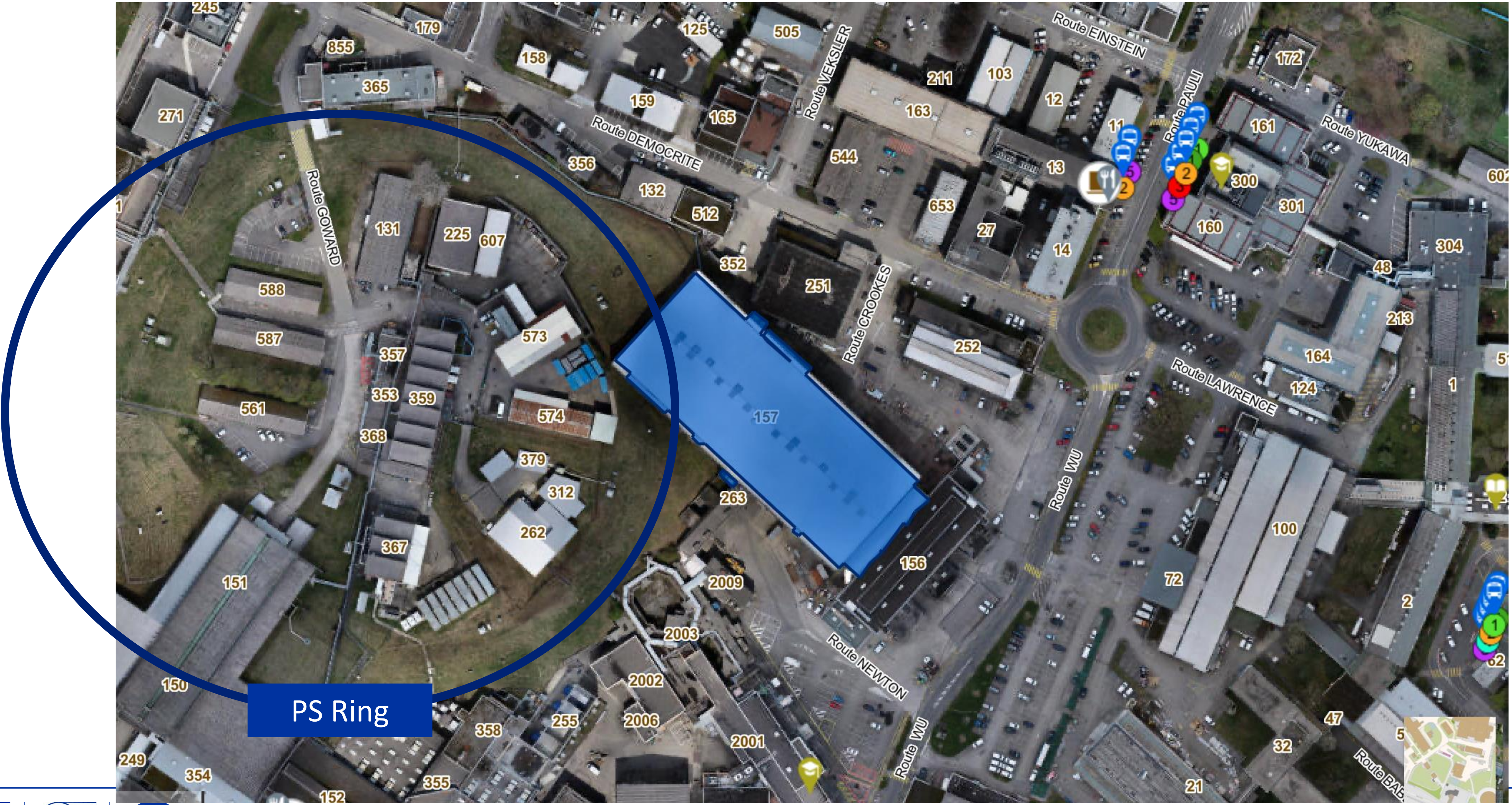
- The SPS commissioning started in 1976, but the North Experimental Area started only in 1978.
- Originally designed for fixed target proton operation at 300 GeV/c, it has operated up to 450 GeV/c for fixed target physics (and LHC filling), but also as a prestigious p-pbar collider (270 GeV/c) and as injector for LEP. It has also served the heavy ion physics programs with various ion species, up to Pb.
- The circumference of the SPS is 11 times the PS: about 6.9 km (t_{rev} = 23 ms).

Some pictures



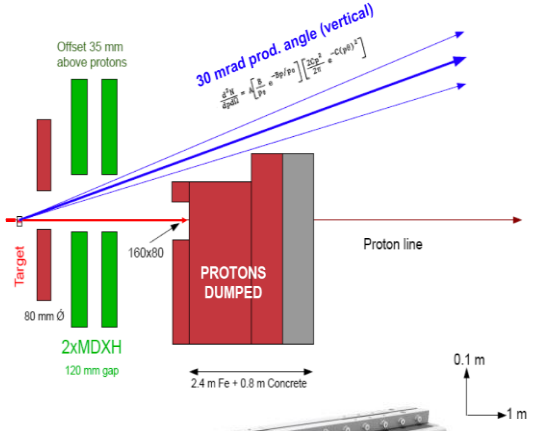


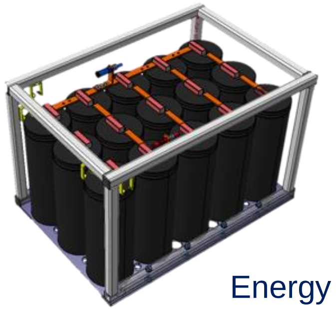
The East Area

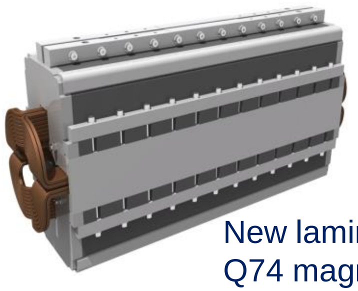


East Area Renovation

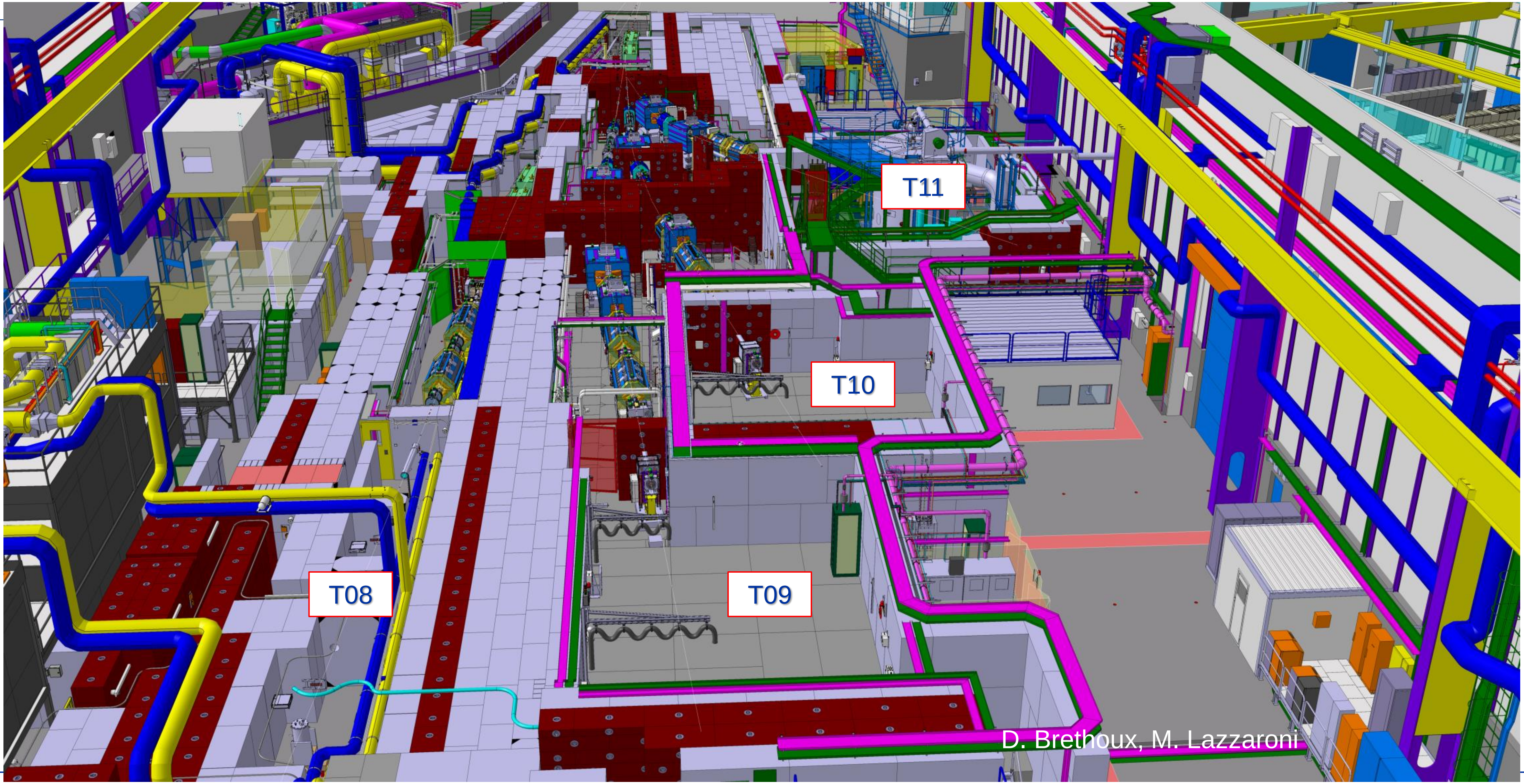
- **The East Area Renovation was completed during the LS2.**
- **The renovation included**
  - Full refurbishment of the East Hall with its beamlines and infrastructures
    - Upgrade of B157, its heating/ventilation, improved thermal insulation, wall and roof cladding (asbestos), separated cooling for primary and secondary beamlines.
  - Improved radiation protection.
    - Improved equipment accessibility and faster repair times, primary beam dump just downstream of the primary target.
  - Change in the beamline layout
    - Higher max. p and improved selectivity pf particle types.
  - Completely new magnet powering scheme
    - Cycled powering leading to reduction of annual power consumption from 11 to 0.6 GWh, less magnet types for better maintenance.



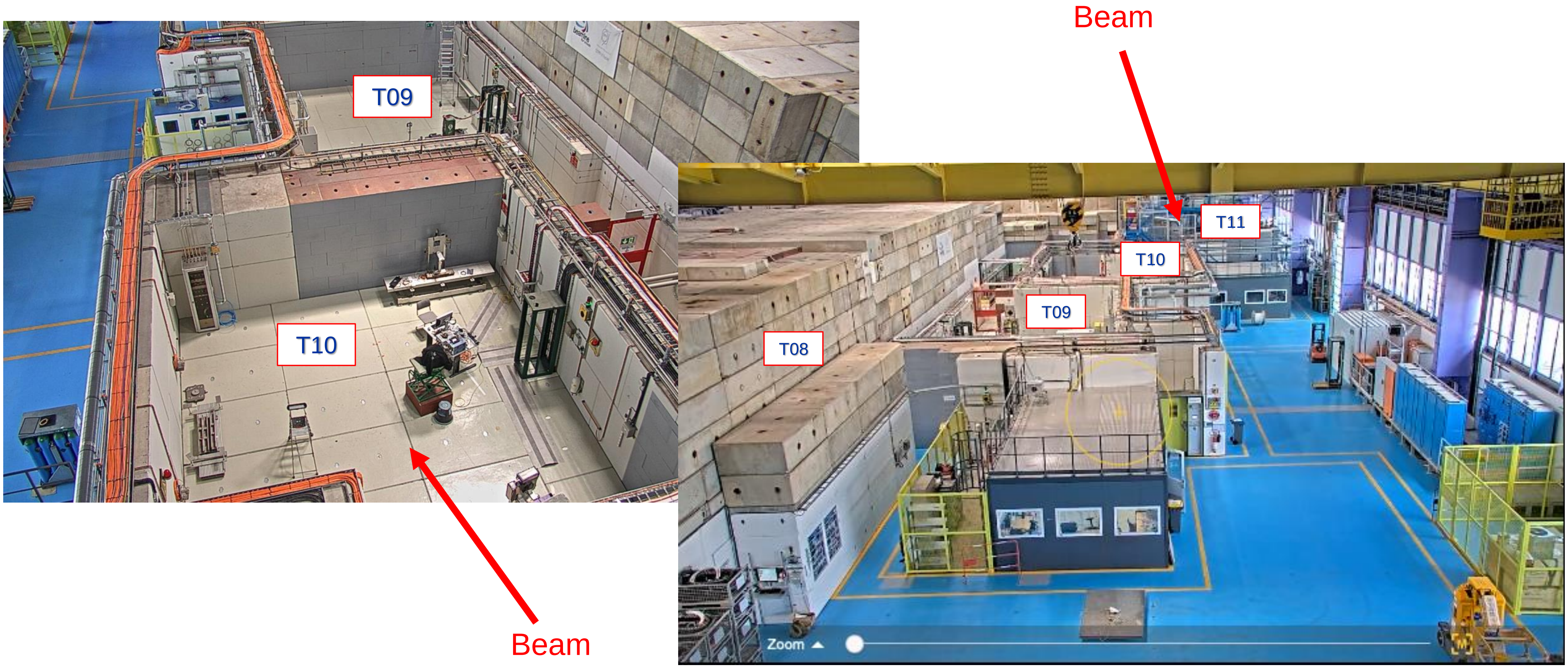

Energy storage unit


New laminated Q74 magnet

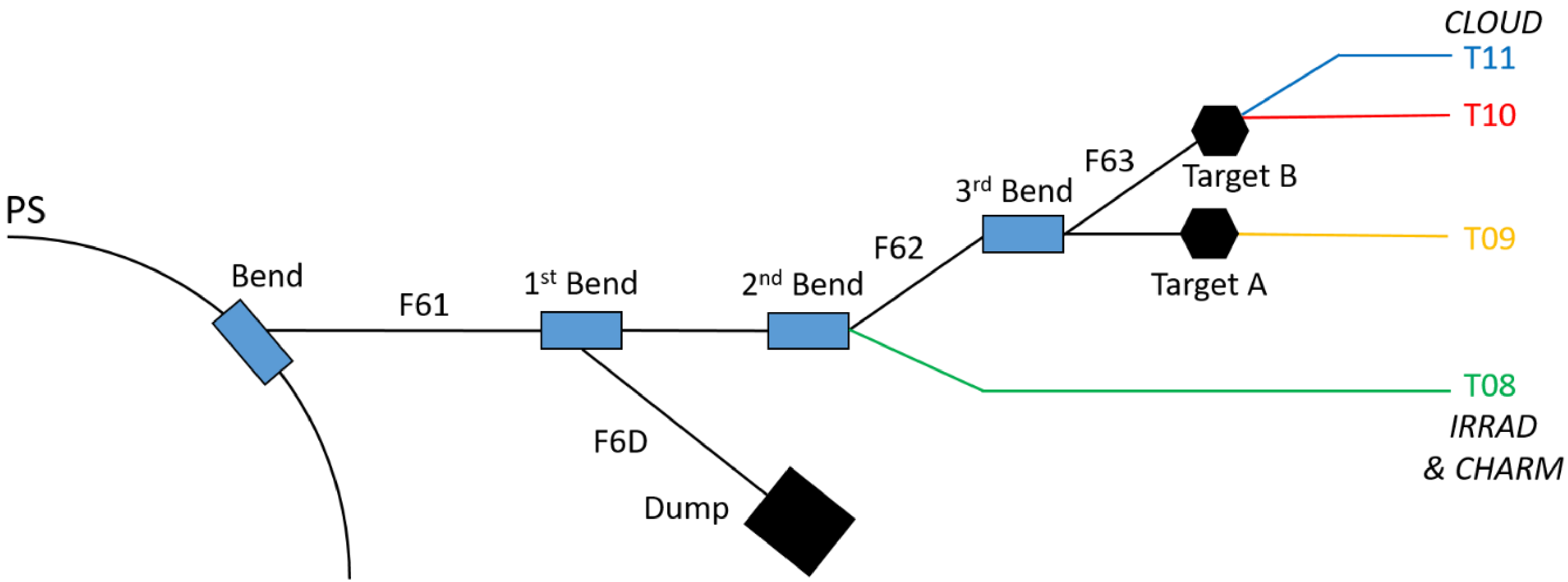
Current Layout



Current Layout

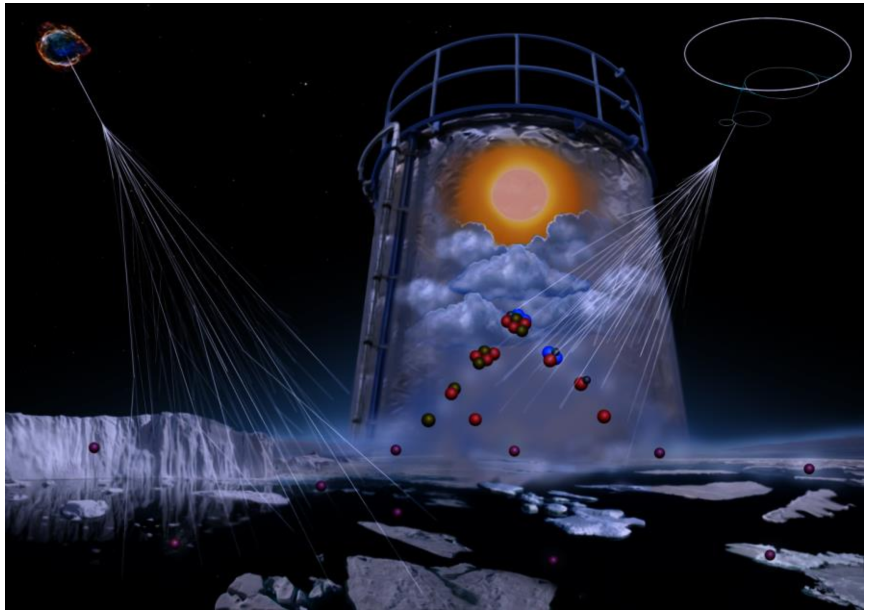


East Area Beams



Experiments: CLOUD

- Studies the influence of cosmic rays to cloud formation
- Cloud expansion chamber set-up with extensive instrumentation (mass spectrometers, particle counters, etc.)
- Uses PS beam as first and only particle beam experiment to study atmospheric and climate science
- Spectacular results achieved (several publications in Nature and Science)

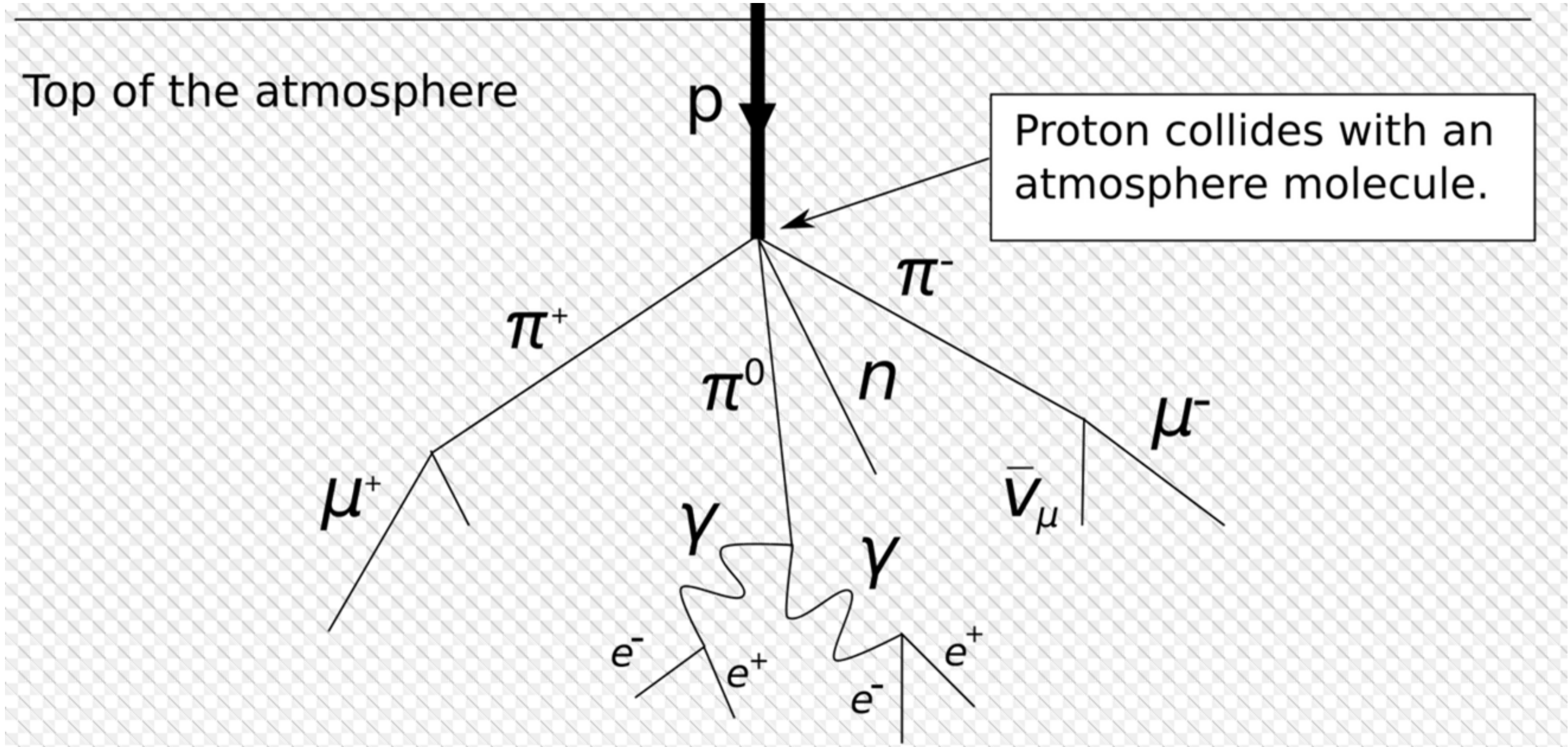


How do we produce a secondary beam ?

Targets and particle production

Principle taken from cosmic radiation

- Primary proton beam initiating hadronic shower
- Always followed by an electro-magnetic shower
- Particles are produced at once in a large momentum range



Targets and particle production

Class	Name	Symbol	Q	Mass [MeV/c²]	Mean life (τ) [s]	cτ [m]	Mean decay distance [m/GeV/c]	Decays
Leptons	Electron	e	$\pm e$	0.511	stable			
Leptons	Muon	μ	$\pm e$	105.6	2.2×10^{-6}	659.6	6.3×10^{3}	$\mu^+ \longrightarrow e^+ \bar{\nu}_e \nu_\mu$ (100%)
Hadrons / Mesons	Pion	π	$\pm e$	139.6	2.6×10^{-8}	7.8	56.4	$\pi^+ \longrightarrow \mu^+ \nu_\mu$ (100%)
Hadrons / Mesons	Kaon	K	$\pm e$	493.6	1.23×10^{-8}	3.7	8.38	$K^+ \longrightarrow \mu^+ \nu_\mu$ (63%); $\pi^0 e^+ \nu_e$ (5%); $\pi^0 \mu^+ \nu_\mu$ (3%); $\pi^+ \pi^0$ (...) (28.9%)
Hadrons / Mesons	Kaon	K^0	0	497.6	K^0_s: 8.9×10^{-11}	0.02	0.060	$K^0_S \longrightarrow \pi^0 \pi^0$ (30.7%); $\pi^+\pi^-$ (69.2%)
Hadrons / Mesons	Kaon	K^0	0	497.6	K^0_L: 5.12×10^{-8}	15.34	34.4	$K^0_L \longrightarrow \pi^\pm e^\mp \nu_e$ (40.5%); $\pi^\pm \mu^\mp \nu_\mu$ (27.0%); $3\pi^0$ (19.5%); $\pi^+\pi^-\pi^0$ (12.5%)
Hadrons / Baryons	Proton	p	$\pm e$	938	stable			
Hadrons / Baryons	Lambda	Λ	0	1115.6	2.63×10^{-10}	0.079	0.237*	$\Lambda^0 \longrightarrow p\ \pi^-$ (63.9%)
Hadrons / Baryons	Sigma Hyperons	Σ^+	$+e$	1189.3	8.02×10^{-11}	0.024	0.068*	$\Sigma^+ \longrightarrow p\ \pi^0$ (51.57%)
Hadrons / Baryons	Sigma Hyperons	Σ^-	$-e$	1197.4	1.48×10^{-10}	0.044	0.125*	$\Sigma^- \longrightarrow n\ \pi^-$ (99.84%)

(*) for 10 GeV/c

Targets and particle production

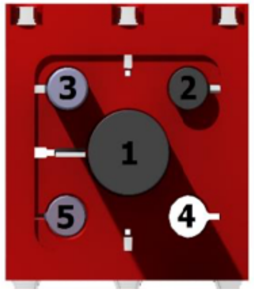
HADRON TARGET

Mainly Hadrons (p, π, K,..)

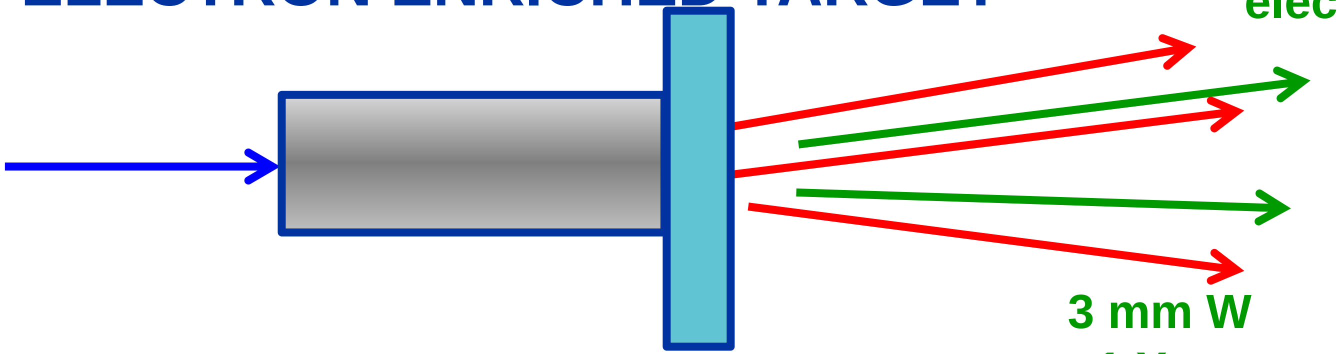
100-200 mm AL or BE, i.e. Low-Z material
Up to 1 L_{int} and 0.5 Xo

T9/T10/T11 Multitarget Configuration

Head	Material	Length (mm)	Diameter (mm)	Comments
1	Be	200	10 + Al case	Electron enriched
	W	3		
2	Al	100	10	Electron enriched
	W	3		
3	Al	200	10	Hadron
4	Air	-	-	Empty
5	Al	20	10	Hadron



ELECTRON ENRICHED TARGET



More electrons

3 mm W
+1 X_o to convert photons

$\pi^+, \pi^-, \pi^o \rightarrow \gamma + \gamma \rightarrow e^+ + e^-$

How do we build a beamline?

Beam lines

Experiments and test beams require “clean” beams with high purity (one particle type) and small momentum spread

Beam lines design (“optics”)

1. Collect produced particles from target
2. Select momentum
3. Select particle type
4. Transport beam to experiment
5. Select beam spot size for experiment

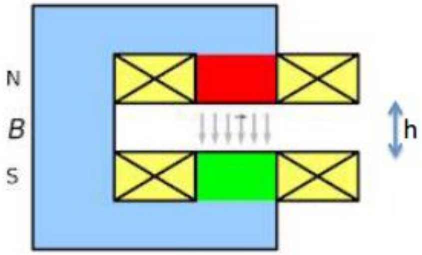
Secondary beam line - layout

Basic beam design

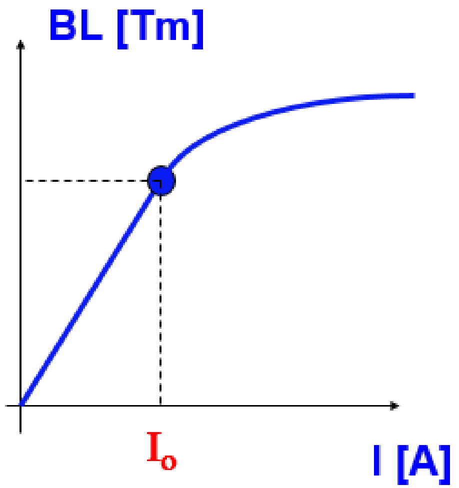
Transport and momentum selection: bending magnets

Dipole electro-magnets:

$$\boxed{\vec{F} = q \cdot \vec{v} \times \vec{B}}$$



$$B = \frac{\mu_0 n I}{h}$$



$$\theta\,[mrad] = \frac{299.79 Bl\ [T \cdot m]}{p[GeV]}$$

Dispersion = dp/p
Dipole acts like a prism

Secondary beam line - layout

Basic beam design

Transport and focus: Quadrupole Magnets

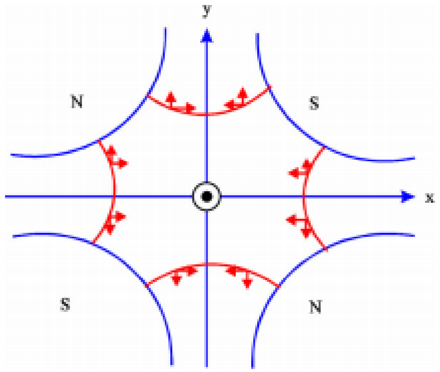
E.g. in the horizontal plane

$$F(x) = q \cdot v \cdot B(x)$$

We want a magnetic field that

$$B_y = g \cdot x \qquad B_x = g \cdot y$$

➔ Quadrupole magnet



The red arrows show the direction of the force on the particle

Gradient of quadrupole

$$g = \frac{2\mu_0 n I}{r^2}\left[\frac{T}{m}\right]$$

Normalized gradient, focusing strength

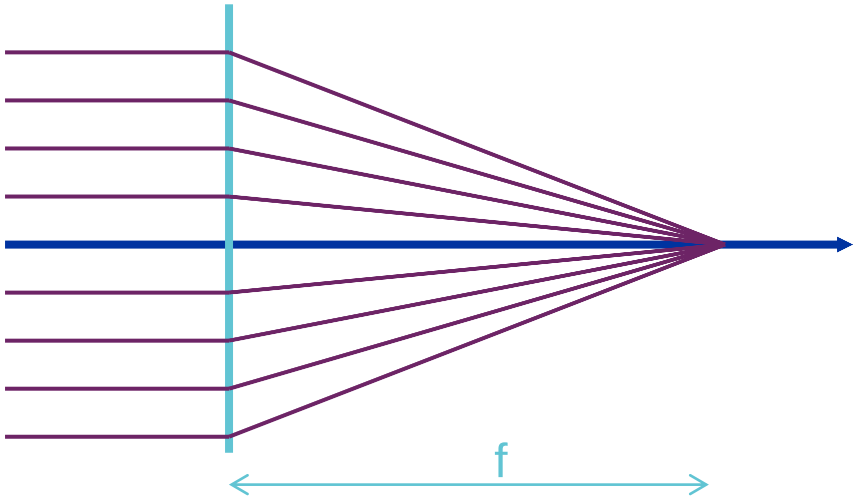
$$k = \frac{g}{p/e}[m^{-2}]$$

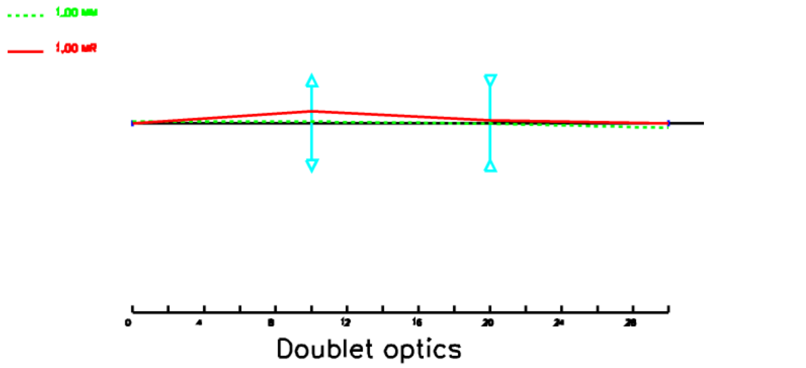
Secondary beam line - layout

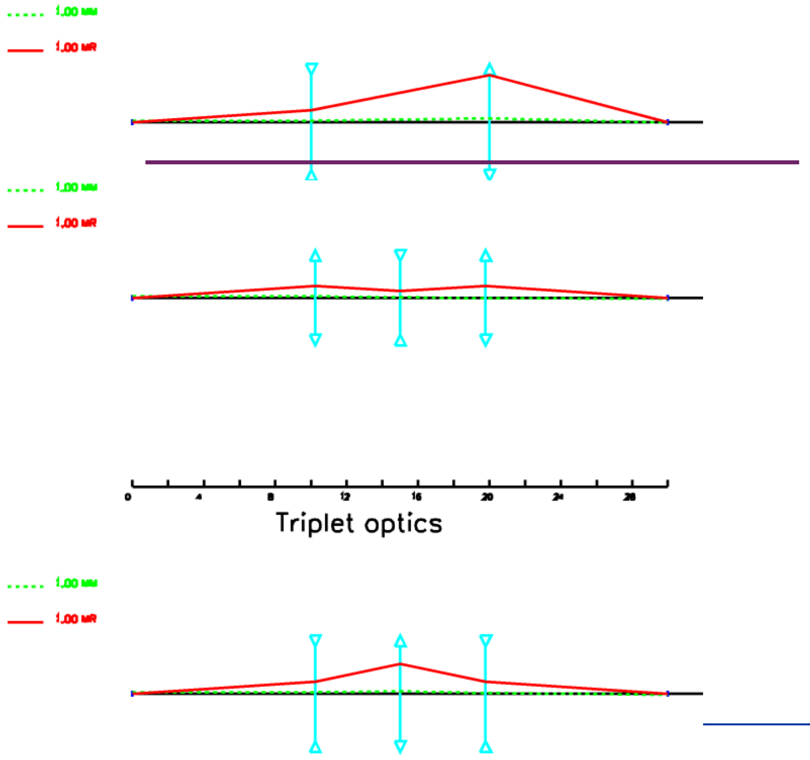
Basic beam design

Transport and focus: Quadrupoles

- Like an optical lens
- Difference: focusing in one plane and defocusing in the other plane at the same time
- Use doublets or triplets for transport and focus





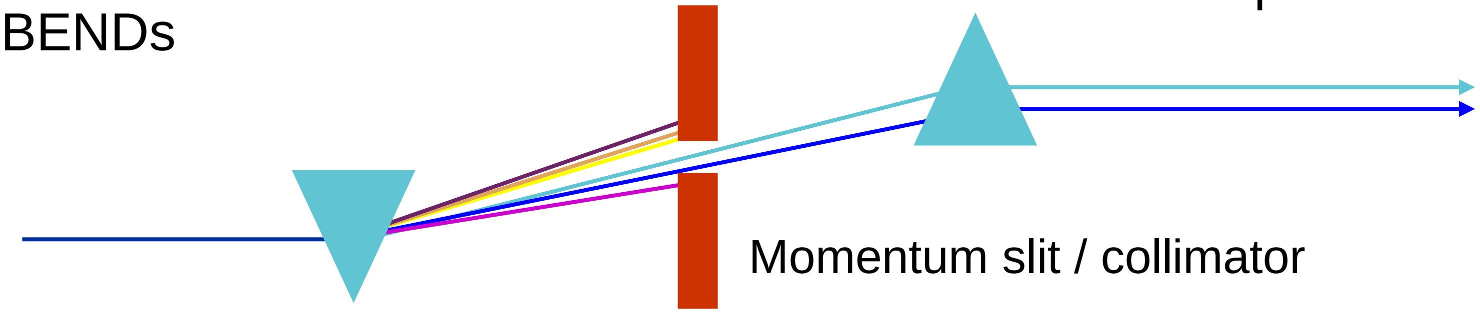


Secondary beam line - layout

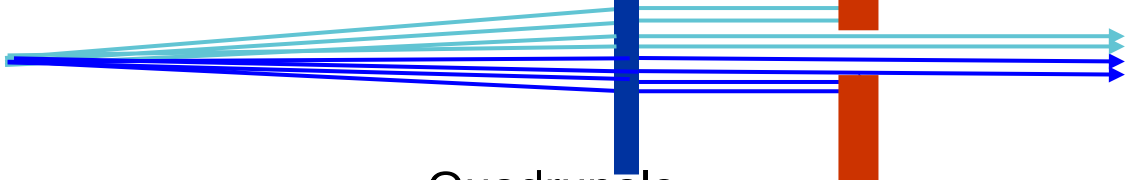
Basic beam design

Momentum selection and acceptance: collimators

- Select small momentum band in combination with dispersion from BENDs

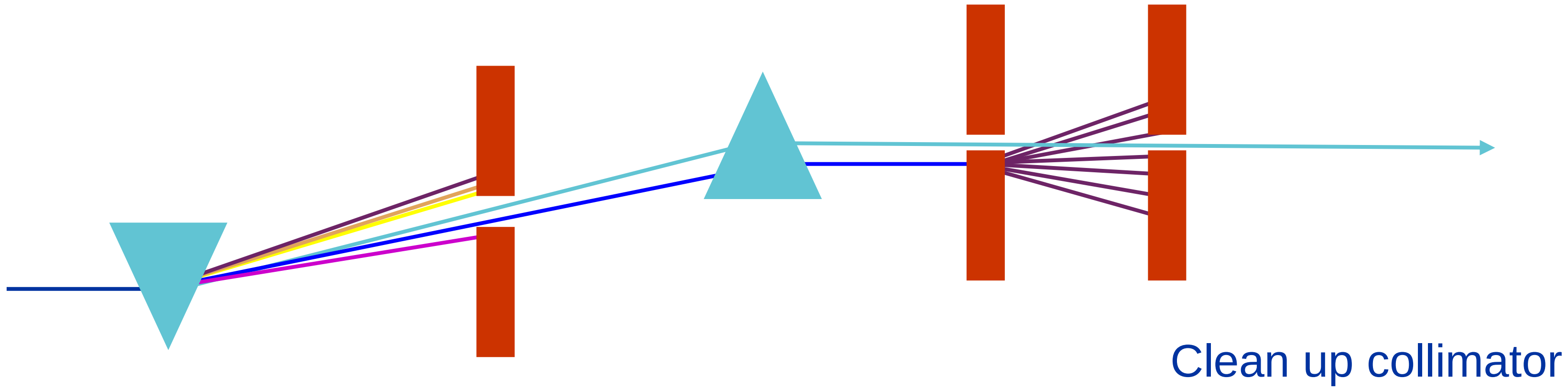


- Acceptance collimators
  - Select beam size and beam rate



Secondary beam line - layout

- **Clean up collimators**
  - Absorb secondary particles produced in acceptance collimators

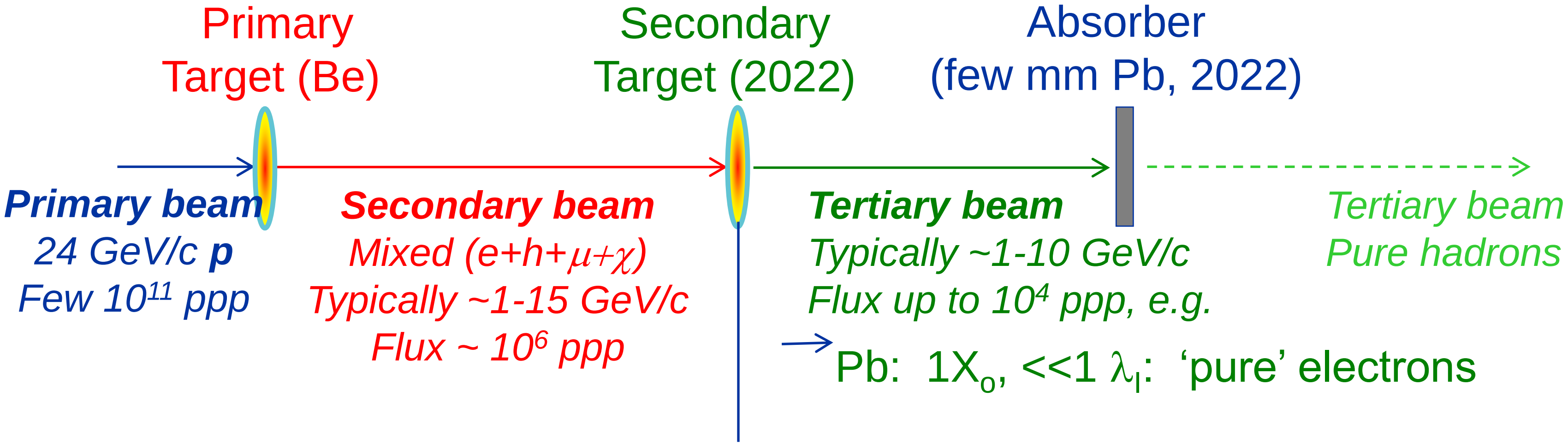


- **TAX (Target attenuator, only North Area)**
  - Define initial acceptance of the beam line

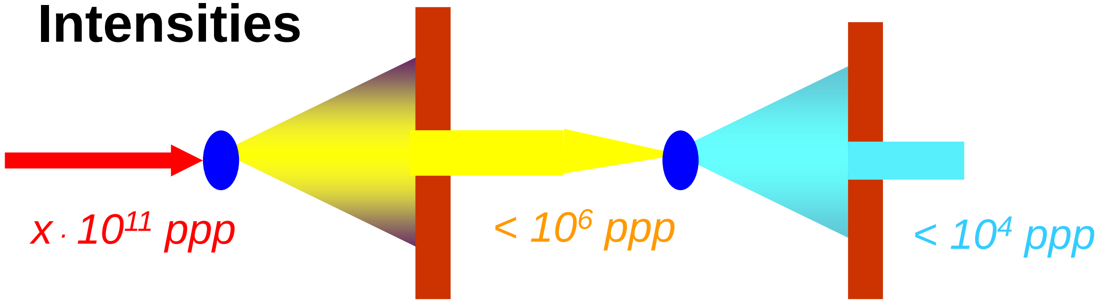
Secondary beam line - layout

Basic beam design

Selection of particle types



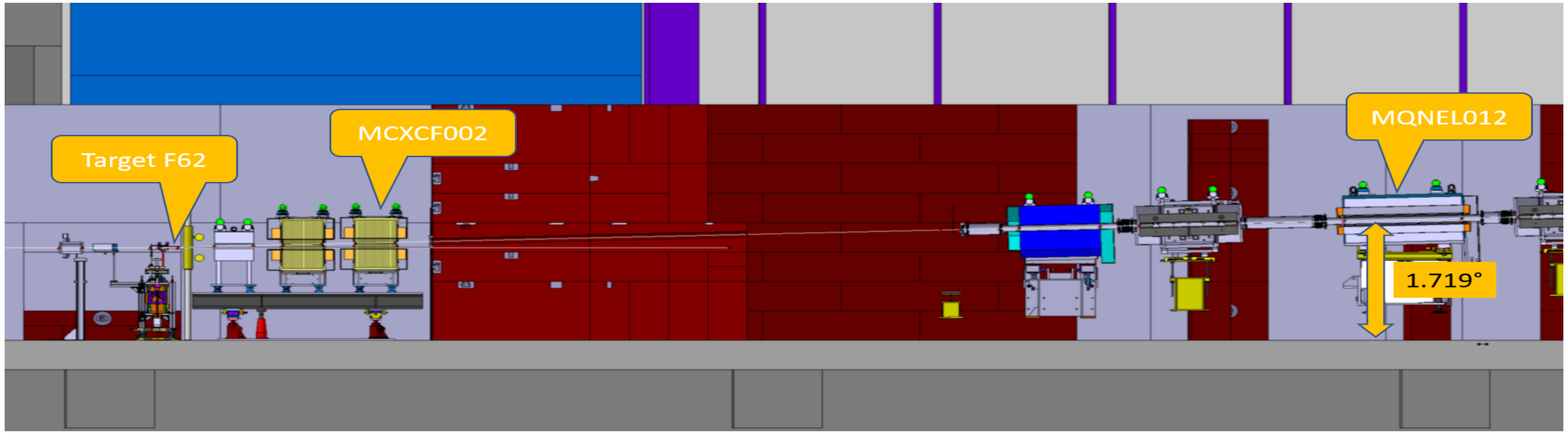
Intensities



Characteristics of the East Beams

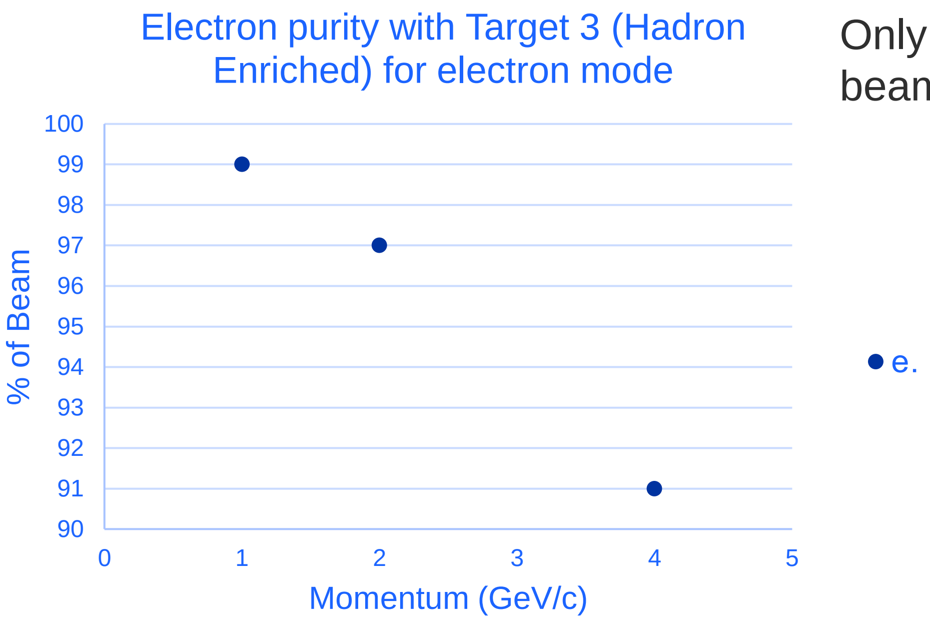
Parameter	T09 Target	T10/T11 Target	
Beam Line	T09	T10	T11
Secondary beam Max Momentum (GeV/c)	16	12	3.5
Δp/p (%)	±0.7 to ±15.0	±0.7 to ±15.0	±0.7 to ±15.0
Maximum intensity/spill (hadrons/electrons)	10^6	10^6	10^6
Available particle types	Pure electrons (T09) or mixed/pure hadrons or pure muons		

30-35 mrad vertical production angle



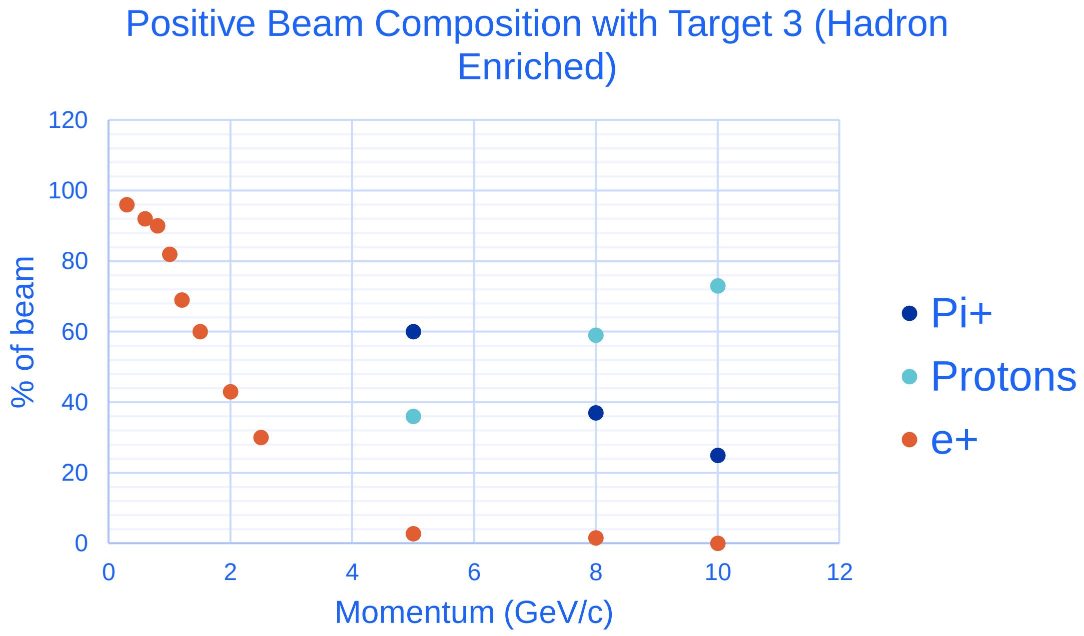
T9 Beam Modes available

- **Electron mode**
  - The charged particles from the secondary target are deflected away selecting the photons. A 5 mm Pb converts the photons into e+/e- pair.
  - Momenta 0.1 GeV/c – 4 GeV/c.
  - > 99% purity for p < 1 GeV/c

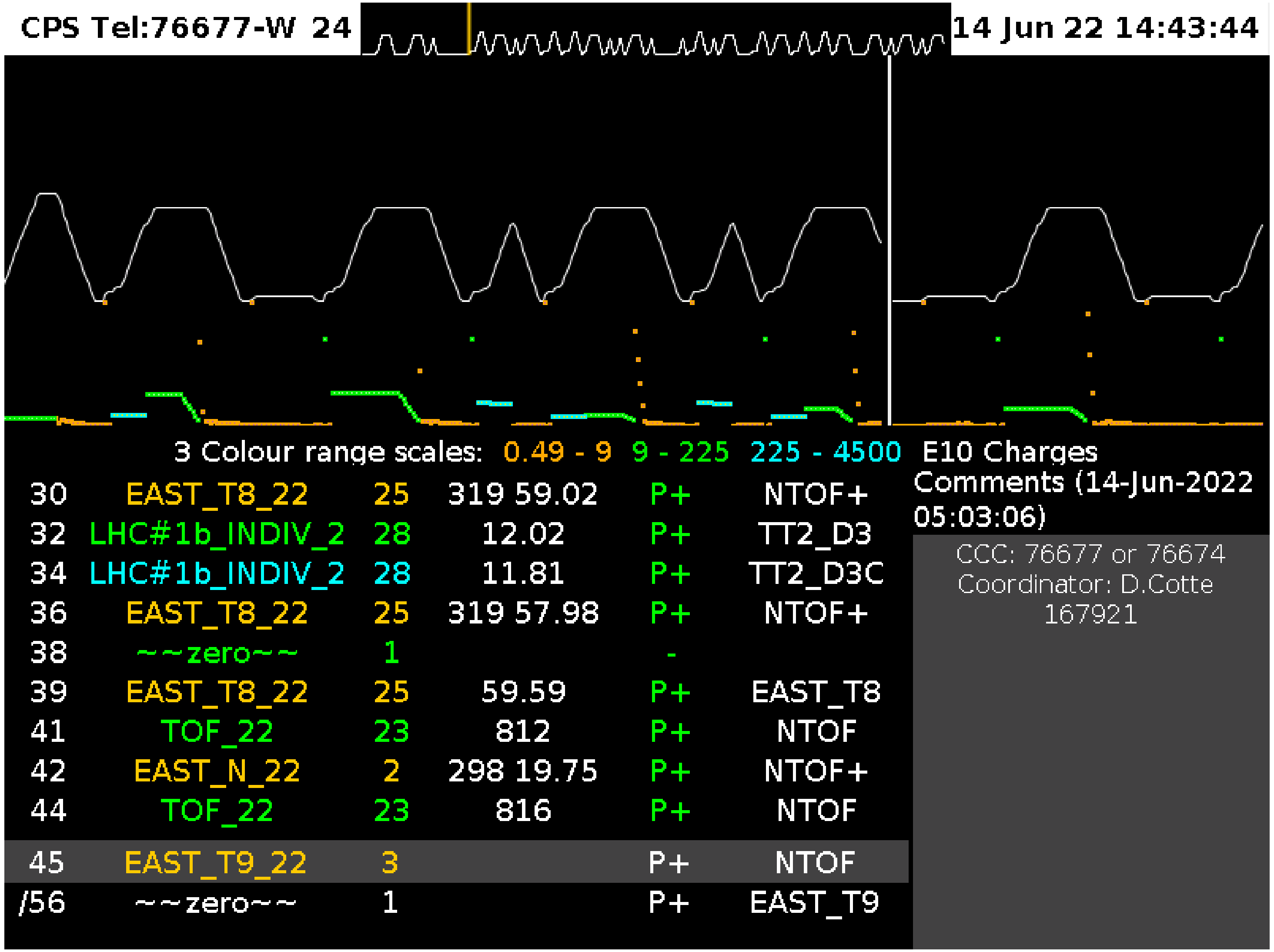


Only XCET available for beam composition data

- **Mixed hadron mode**
  - The secondary beam from protons on target can be chosen.
    - Momenta 0.1 GeV/c – 16 GeV/c.
    - At lower momenta electrons dominate.



Spill Structure

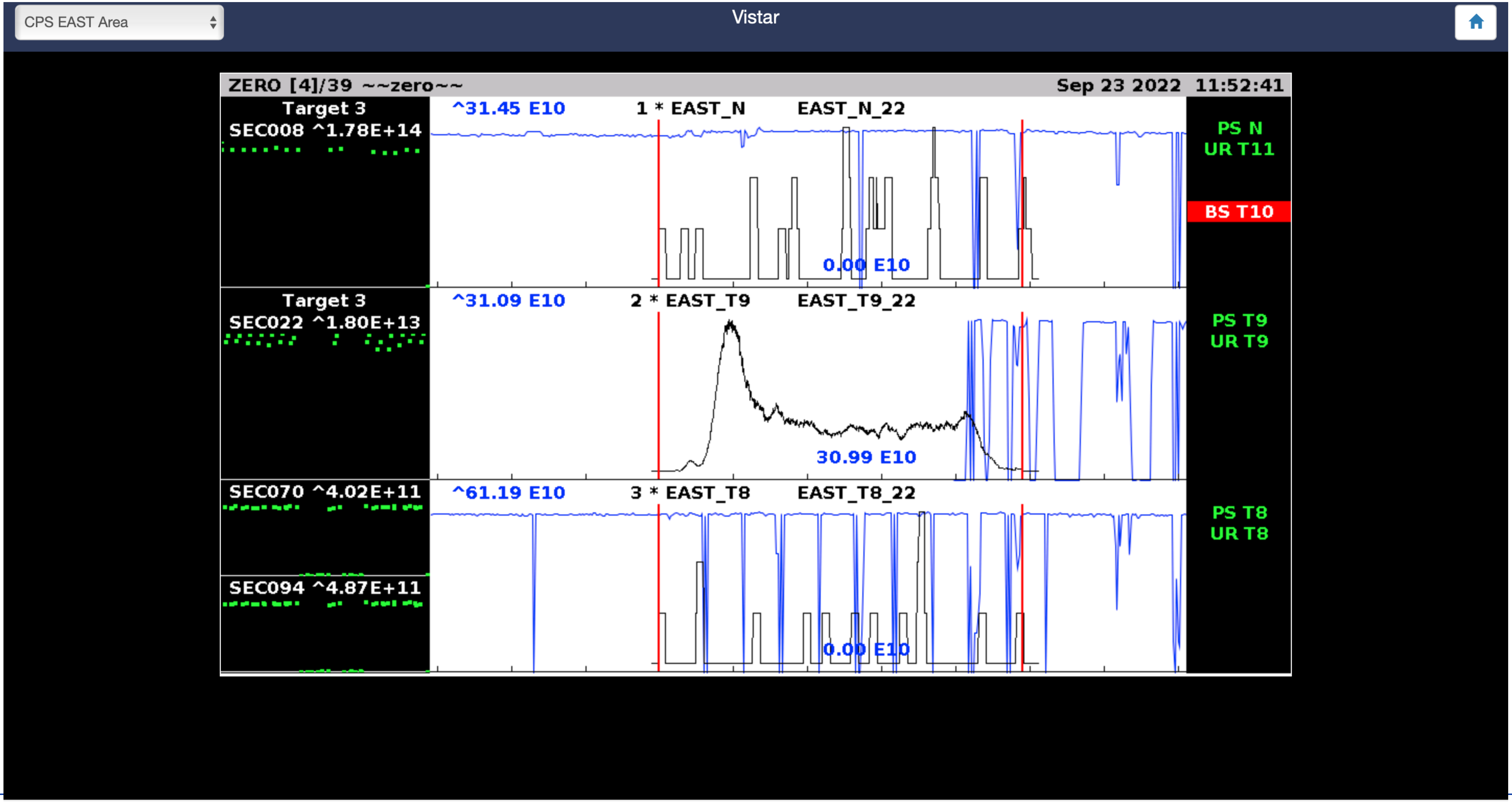


Spill duration: 0.4 second flat top
Usually : **1-2 cycles per minute per East Destination**
Max 6 East cycles / 40 seconds → RP Limit

Super-cycle structure dependent on all users (SPS, nTOF …)

New (and exciting development) in 2024 PS can now supply 15 GeV/c primaries with 0.8s flat top

Spill Structure

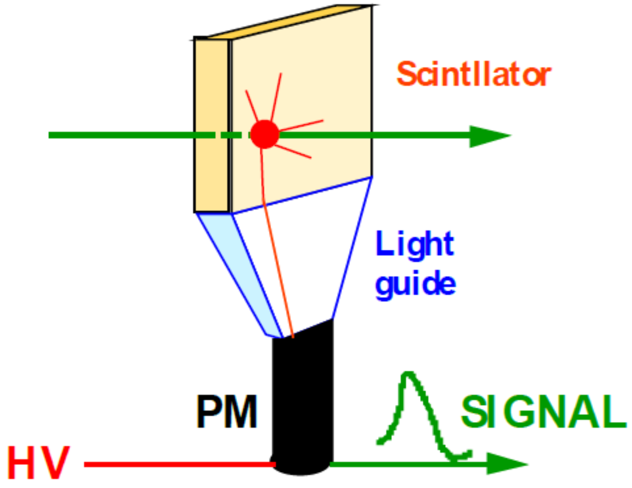


How do we see the beam?

Secondary beam line - Instrumentation

Scintillating Counter (XSCI)

- Charged particles produce light in scintillator
- Light collected and transported by light guide
- Coupled to photo multiplier tube (PM), light hits photocathode and produces electrons
- Electrons are amplified within a high voltage cascade
- Used to count particles in a range from a few particles up to rates of MHz
- Different shapes and sizes: Some can scan through a beam, other count the total rate

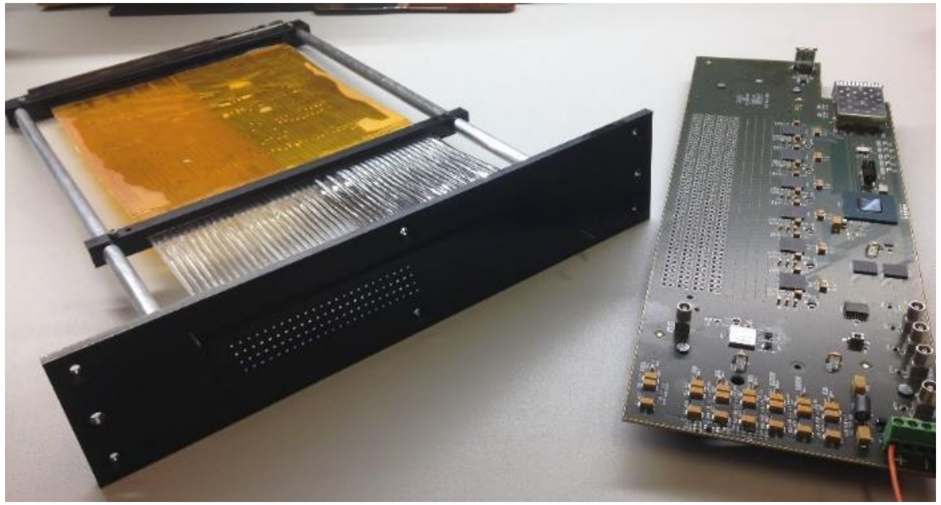


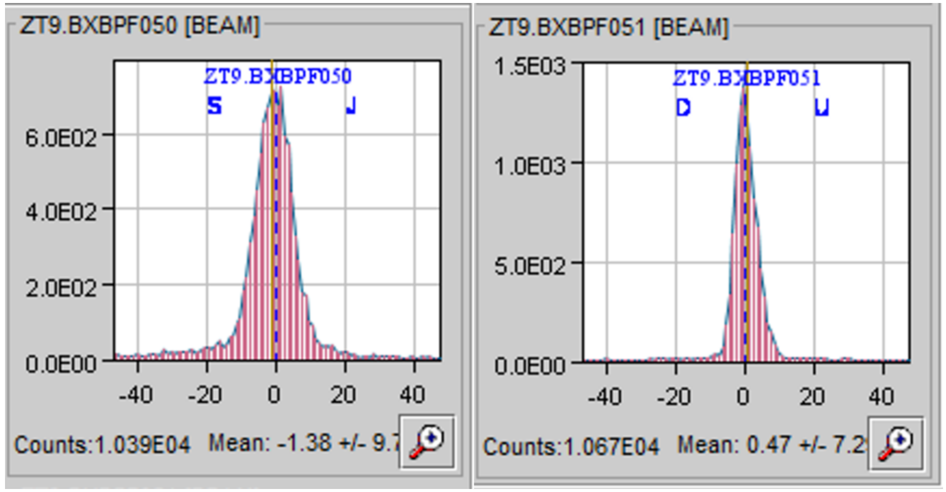
Secondary beam line - Instrumentation

Scintillating fibre hodoscopes (XBPF)

- Particle detection with scintillating fibres from the creation of scintillation light, due to the passage of a charged particle, and the transmission of this light inside the fibre by total internal reflection.

- Composed of 100 or 200 scintillating fibres of 1 mm thickness and square cross-section





Secondary beam line - Instrumentation

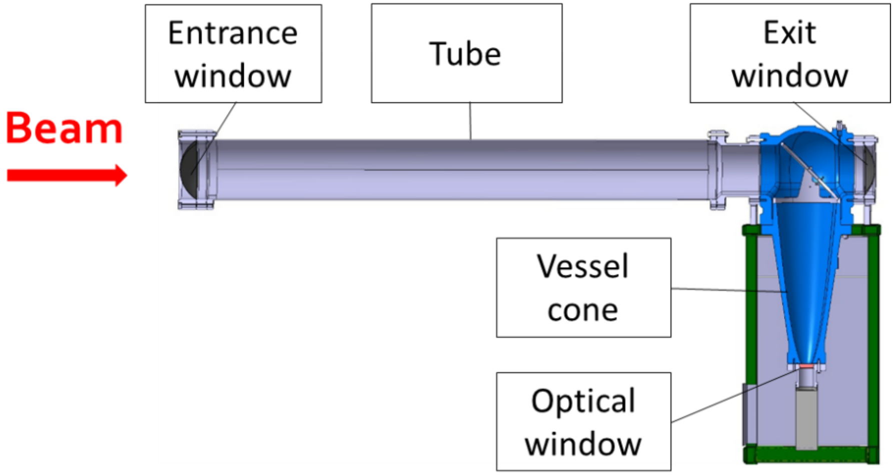
Threshold Cerenkov counters (XCET)

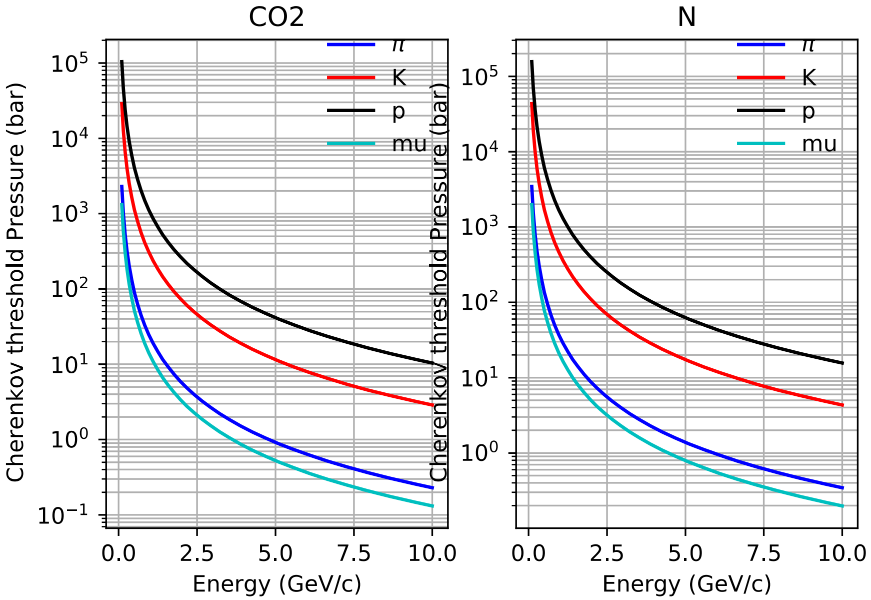
- In a medium (e.g., He or CO_2 gas) if a charged particle goes faster than light it emits Cerenkov light in a cone with half-opening angle f:

$$f^2 = 2kP - m^2/p^2$$

where k depends on the gas, P=pressure.

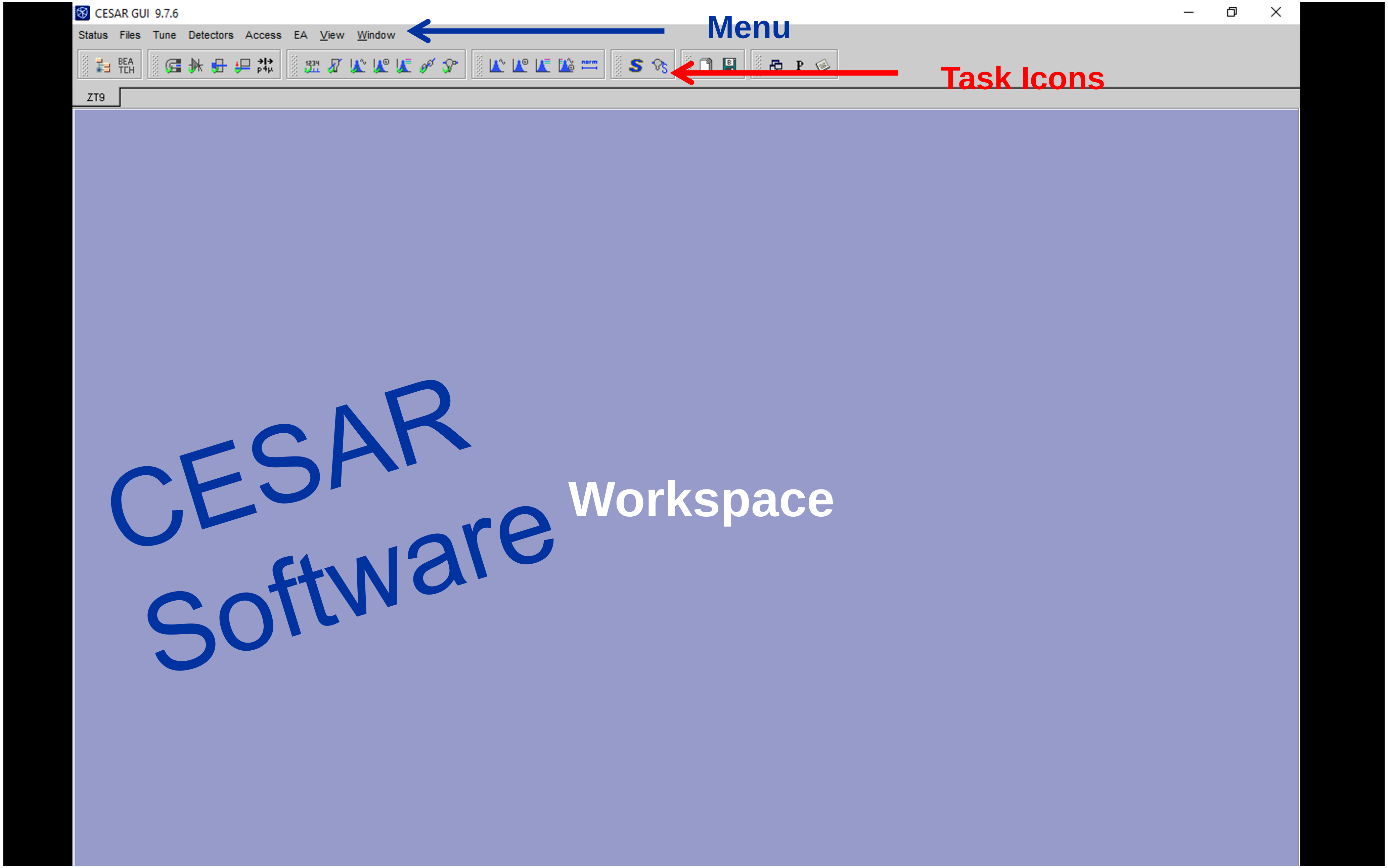
- By selecting the right operating pressure, one type of particle has good efficiency and the other gives no signal. By making a coincidence with scintillator signals, particle identification can be made.
- Two types of XCET in T09:
  - Low pressure → 0.01 – 4 bars
  - High pressure → 0.01 – 15 bars

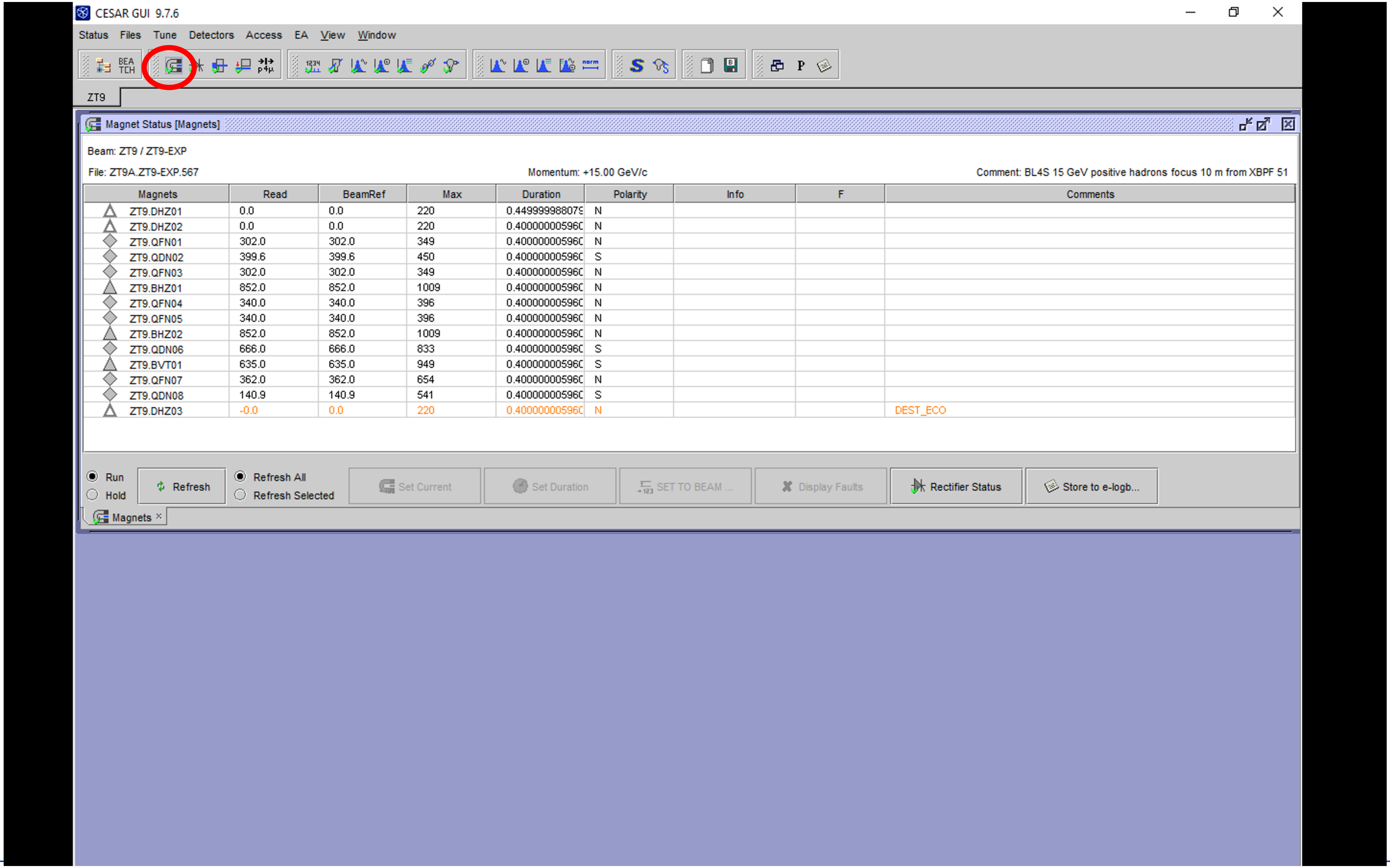




Congratulations for having won this competition and good luck for a successful experiment!
Have a wonderful time at CERN !

How do we control the beam?

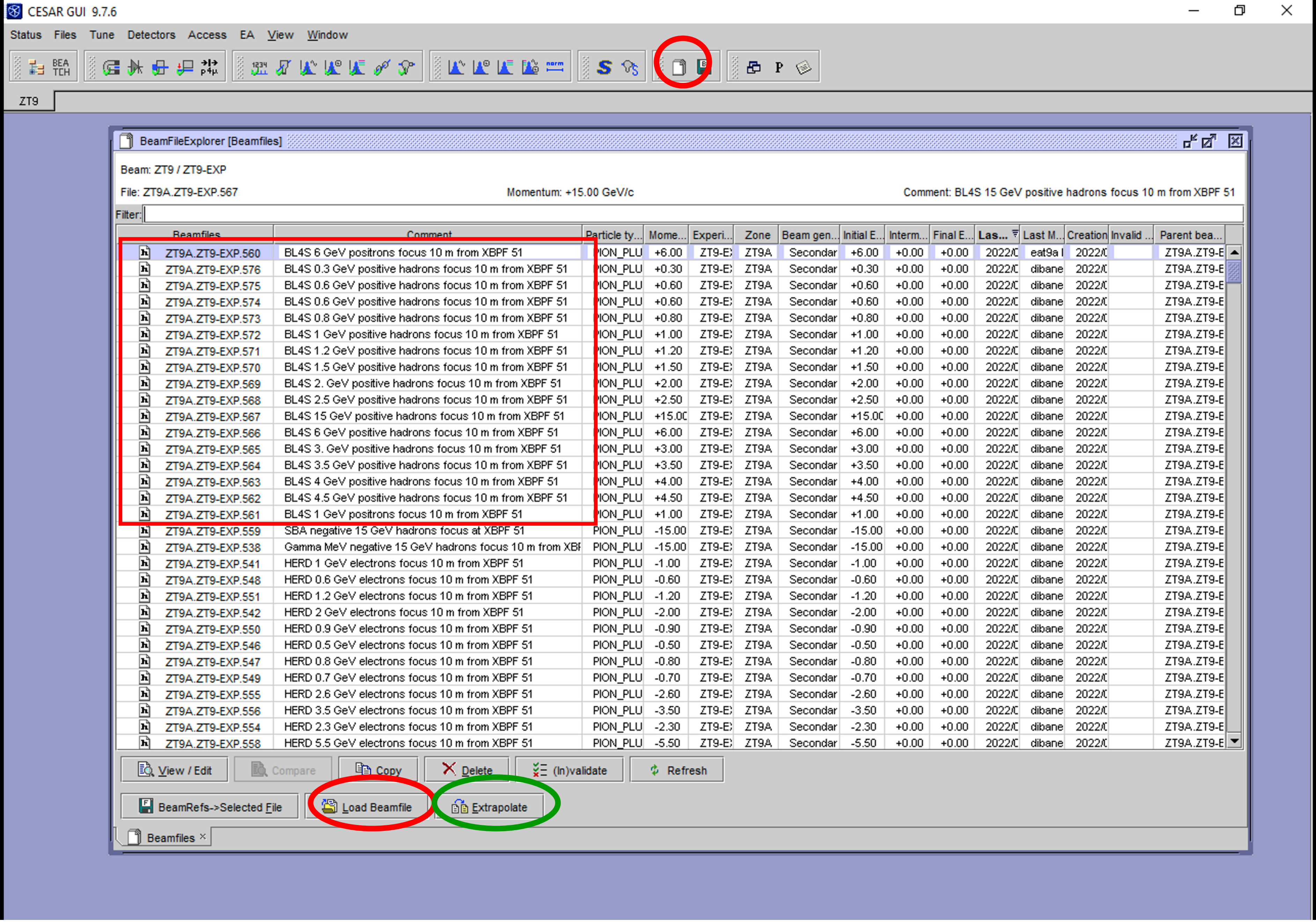

CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
Menu
Task Icons
ZT9
CESAR Software
Workspace

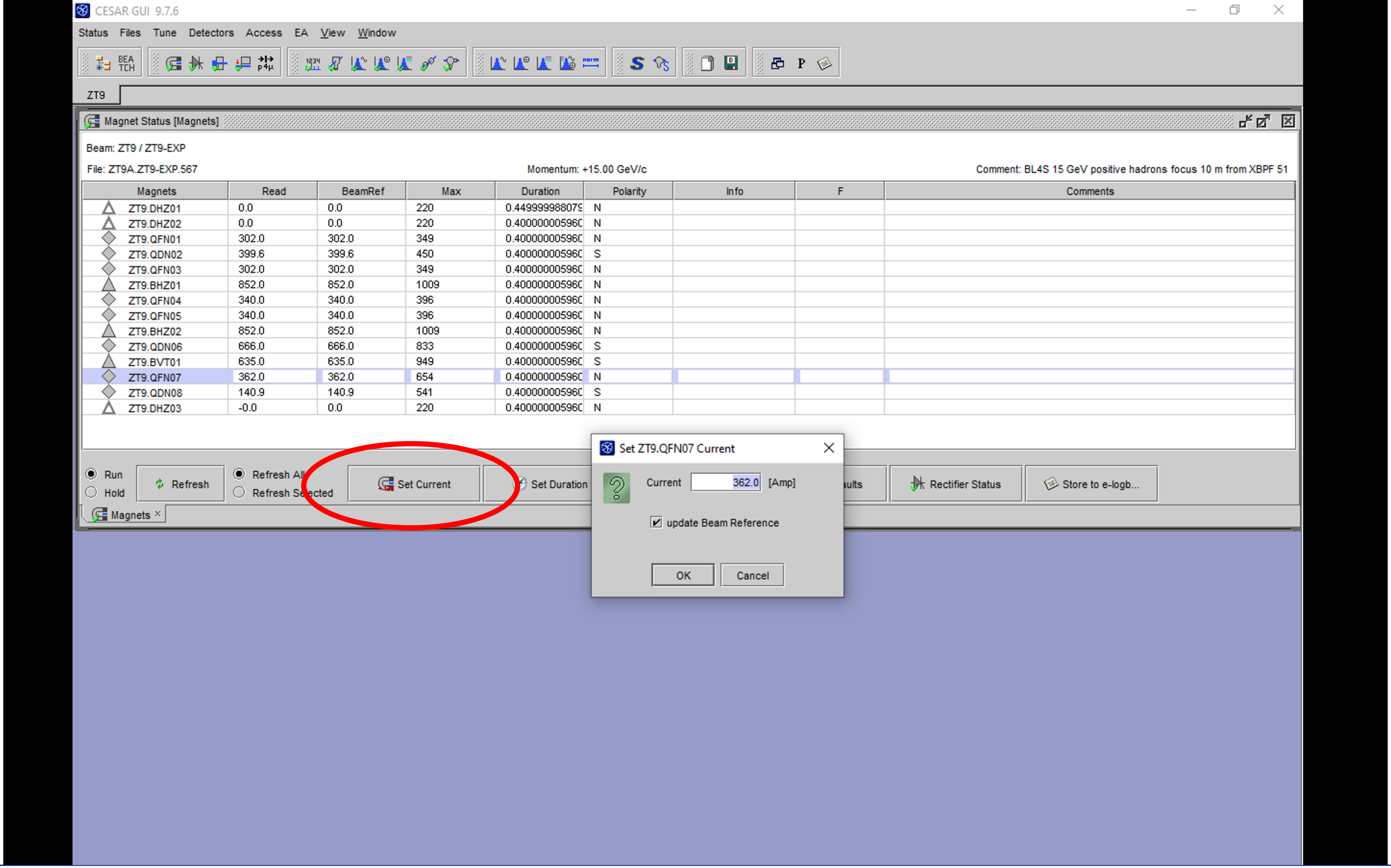


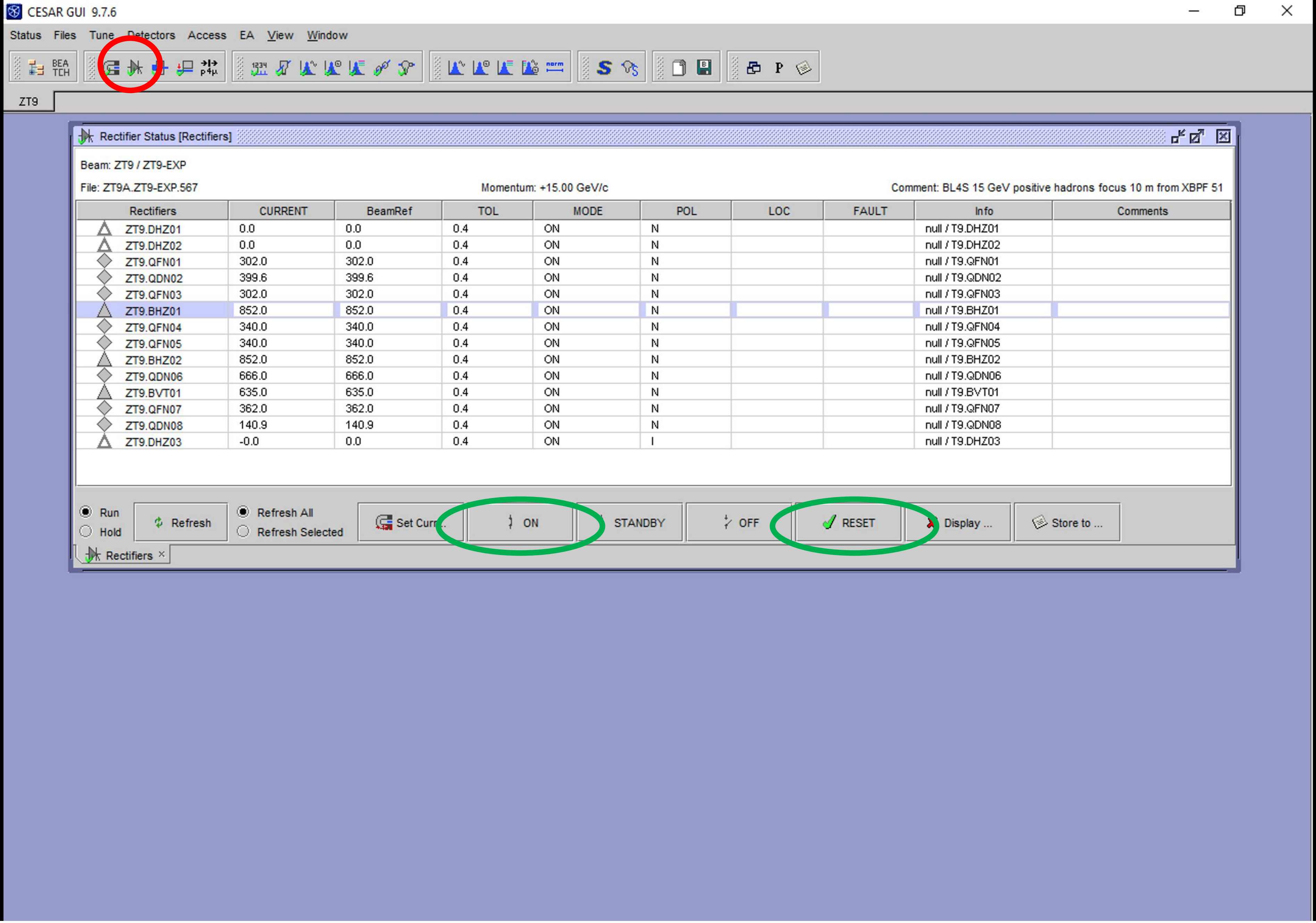
CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
Magnet Status [Magnets]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51

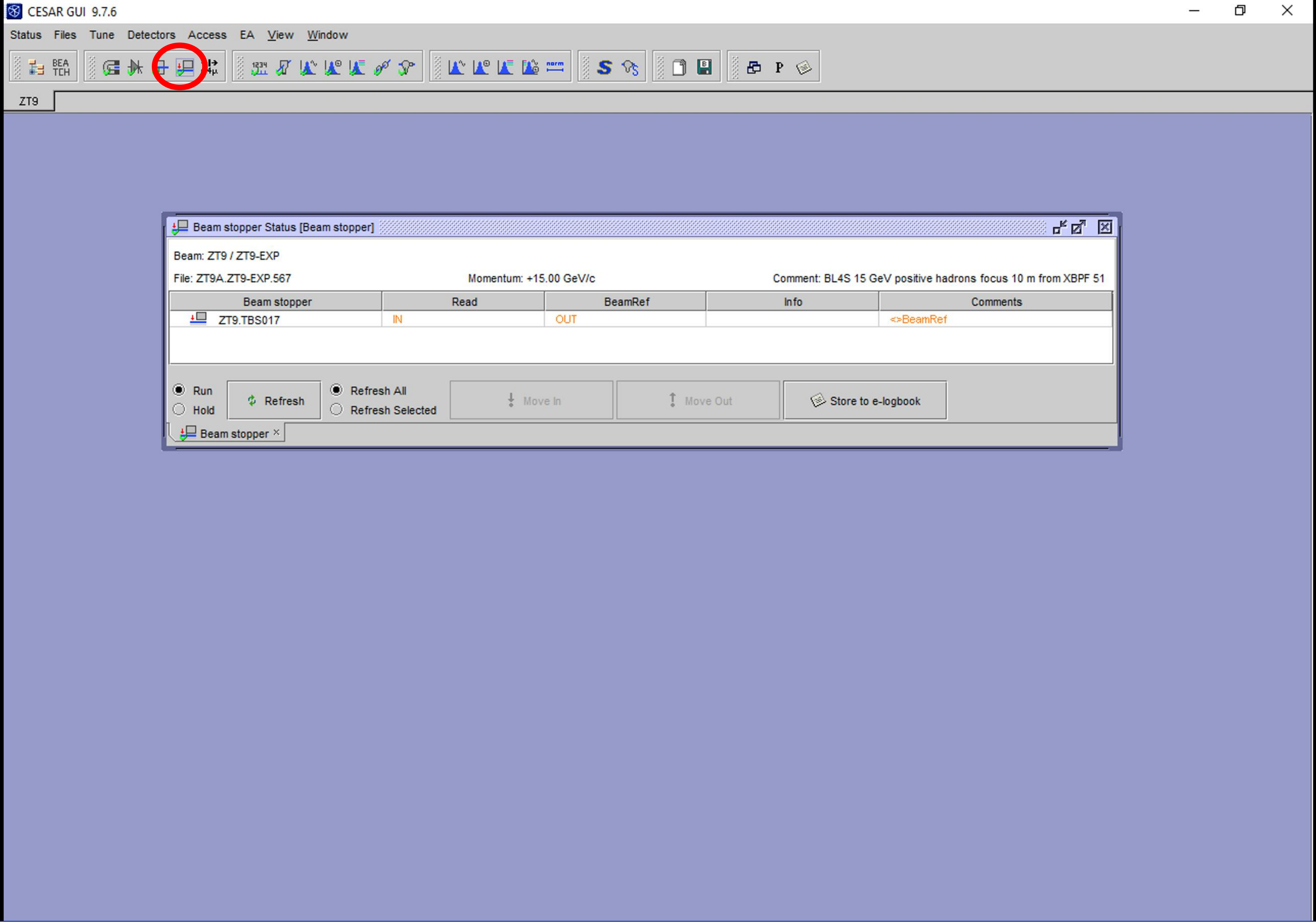
Magnets	Read	BeamRef	Max	Duration	Polarity	Info	F	Comments
ZT9.DHZ01	0.0	0.0	220	0.44999998807	N			
ZT9.DHZ02	0.0	0.0	220	0.40000000596	N			
ZT9.QFN01	302.0	302.0	349	0.40000000596	N			
ZT9.QDN02	399.6	399.6	450	0.40000000596	S			
ZT9.QFN03	302.0	302.0	349	0.40000000596	N			
ZT9.BHZ01	852.0	852.0	1009	0.40000000596	N			
ZT9.QFN04	340.0	340.0	396	0.40000000596	N			
ZT9.QFN05	340.0	340.0	396	0.40000000596	N			
ZT9.BHZ02	852.0	852.0	1009	0.40000000596	N			
ZT9.QDN06	666.0	666.0	833	0.40000000596	S			
ZT9.BVT01	635.0	635.0	949	0.40000000596	S			
ZT9.QFN07	362.0	362.0	654	0.40000000596	N			
ZT9.QDN08	140.9	140.9	541	0.40000000596	S			
ZT9.DHZ03	-0.0	0.0	220	0.40000000596	N			DEST_ECO

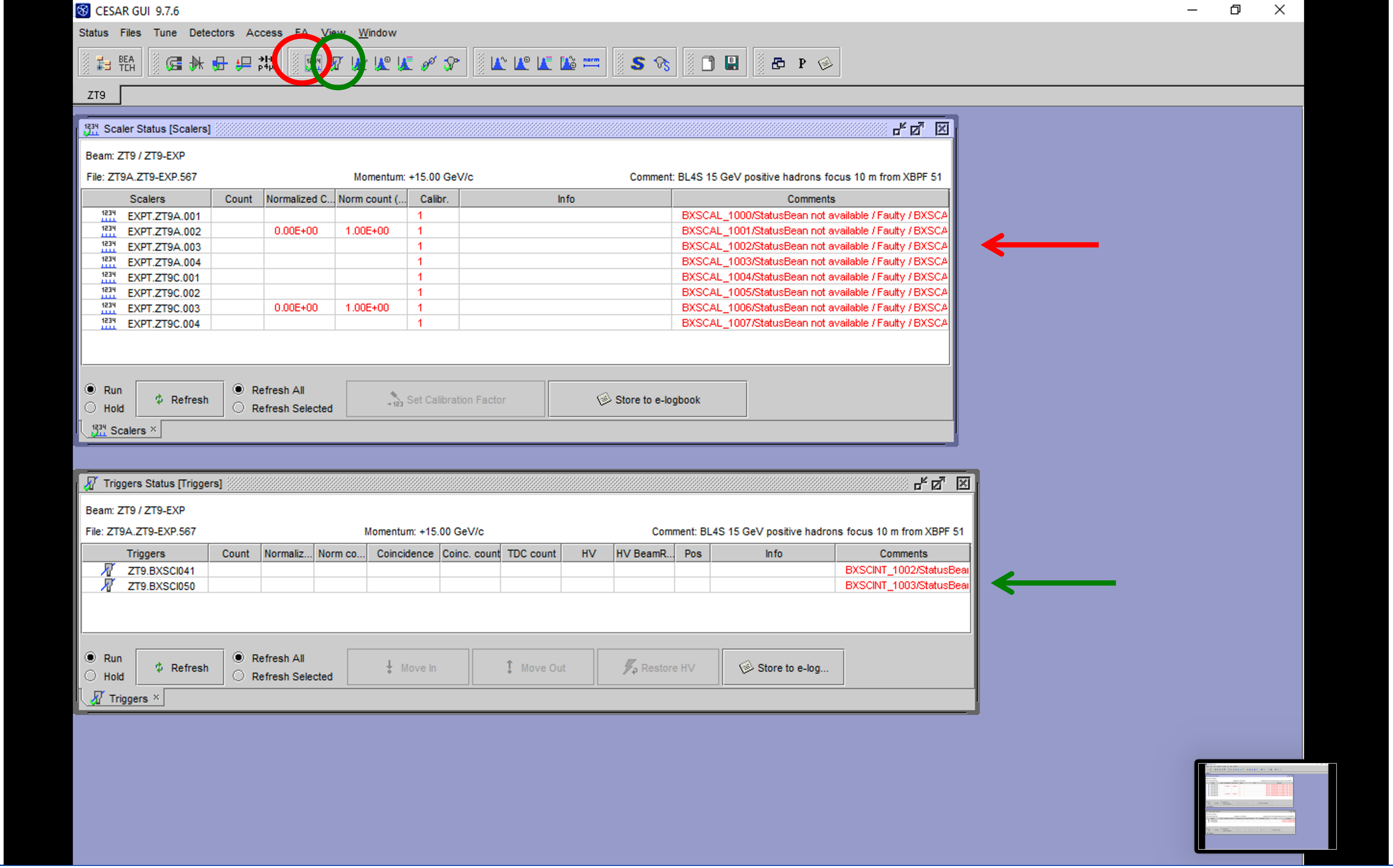
Run
Hold
Refresh
Refresh All
Refresh Selected
Set Current
Set Duration
SET TO BEAM ...
Display Faults
Rectifier Status
Store to e-logb...
Magnets

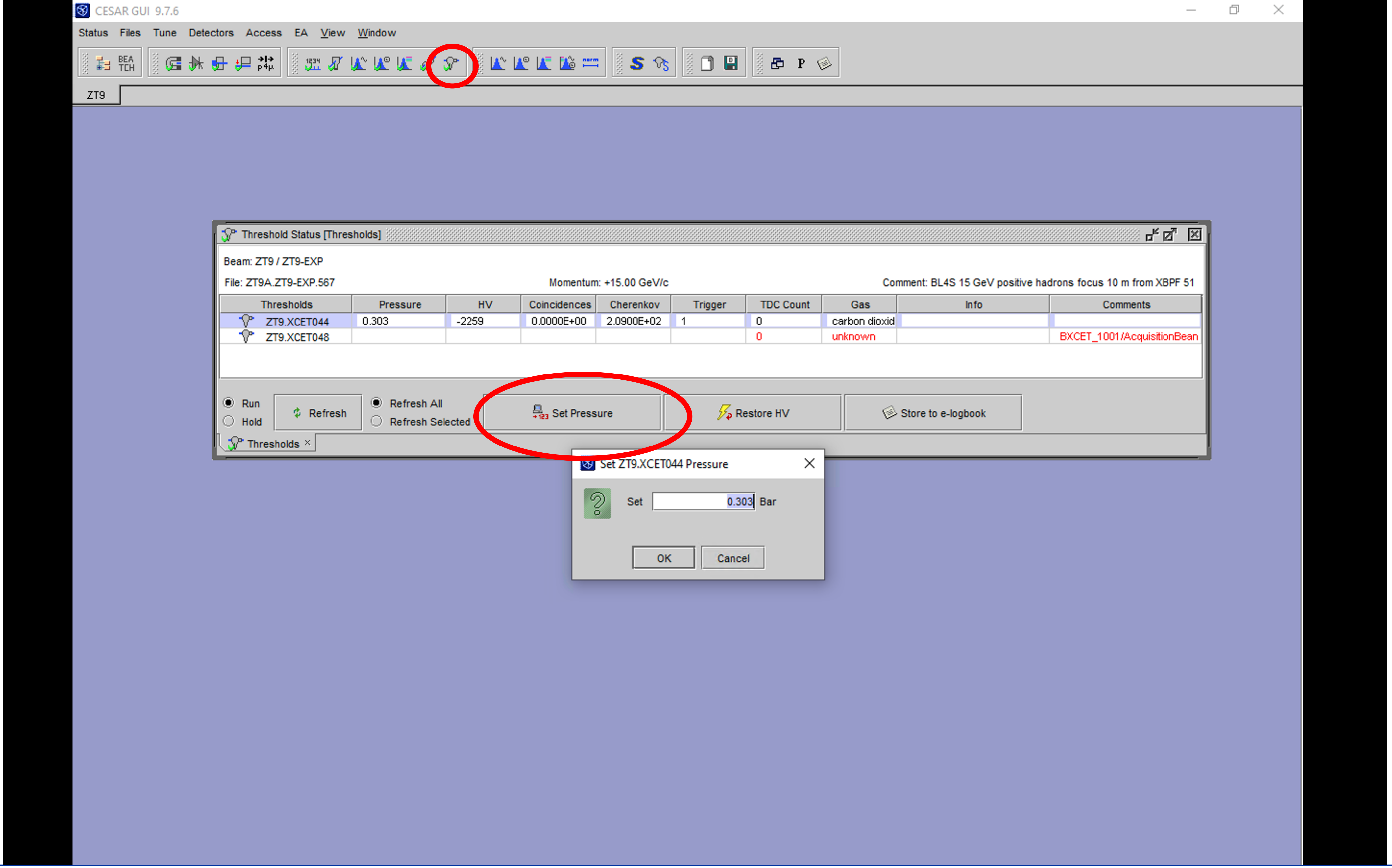

CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
BeamFileExplorer [Beamfiles]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Filter:
Beamfiles Comment Particle ty... Mome... Experi... Zone Beam gen... Initial E... Interm... Final E... Las... Last M... Creation Invalid ... Parent bea...
ZT9A.ZT9-EXP.560 BL4S 6 GeV positrons focus 10 m from XBPF 51 +6.00
ZT9A.ZT9-EXP.576 BL4S 0.3 GeV positive hadrons focus 10 m from XBPF 51 +0.30
ZT9A.ZT9-EXP.575 BL4S 0.6 GeV positive hadrons focus 10 m from XBPF 51 +0.60
ZT9A.ZT9-EXP.574 BL4S 0.6 GeV positive hadrons focus 10 m from XBPF 51 +0.60
ZT9A.ZT9-EXP.573 BL4S 0.8 GeV positive hadrons focus 10 m from XBPF 51 +0.80
ZT9A.ZT9-EXP.572 BL4S 1 GeV positive hadrons focus 10 m from XBPF 51 +1.00
ZT9A.ZT9-EXP.571 BL4S 1.2 GeV positive hadrons focus 10 m from XBPF 51 +1.20
ZT9A.ZT9-EXP.570 BL4S 1.5 GeV positive hadrons focus 10 m from XBPF 51 +1.50
ZT9A.ZT9-EXP.569 BL4S 2. GeV positive hadrons focus 10 m from XBPF 51 +2.00
ZT9A.ZT9-EXP.568 BL4S 2.5 GeV positive hadrons focus 10 m from XBPF 51 +2.50
ZT9A.ZT9-EXP.567 BL4S 15 GeV positive hadrons focus 10 m from XBPF 51 +15.0
ZT9A.ZT9-EXP.566 BL4S 6 GeV positive hadrons focus 10 m from XBPF 51 +6.00
ZT9A.ZT9-EXP.565 BL4S 3. GeV positive hadrons focus 10 m from XBPF 51 +3.00
ZT9A.ZT9-EXP.564 BL4S 3.5 GeV positive hadrons focus 10 m from XBPF 51 +3.50
ZT9A.ZT9-EXP.563 BL4S 4 GeV positive hadrons focus 10 m from XBPF 51 +4.00
ZT9A.ZT9-EXP.562 BL4S 4.5 GeV positive hadrons focus 10 m from XBPF 51 +4.50
ZT9A.ZT9-EXP.561 BL4S 1 GeV positrons focus 10 m from XBPF 51 +1.00
ZT9A.ZT9-EXP.559 SBA negative 15 GeV hadrons focus at XBPF 51 -15.00
ZT9A.ZT9-EXP.538 Gamma MeV negative 15 GeV hadrons focus 10 m from XBI -15.00
ZT9A.ZT9-EXP.541 HERD 1 GeV electrons focus 10 m from XBPF 51 -1.00
ZT9A.ZT9-EXP.548 HERD 0.6 GeV electrons focus 10 m from XBPF 51 -0.60
ZT9A.ZT9-EXP.551 HERD 1.2 GeV electrons focus 10 m from XBPF 51 -1.20
ZT9A.ZT9-EXP.542 HERD 2 GeV electrons focus 10 m from XBPF 51 -2.00
ZT9A.ZT9-EXP.550 HERD 0.9 GeV electrons focus 10 m from XBPF 51 -0.90
ZT9A.ZT9-EXP.546 HERD 0.5 GeV electrons focus 10 m from XBPF 51 -0.50
ZT9A.ZT9-EXP.547 HERD 0.8 GeV electrons focus 10 m from XBPF 51 -0.80
ZT9A.ZT9-EXP.549 HERD 0.7 GeV electrons focus 10 m from XBPF 51 -0.70
ZT9A.ZT9-EXP.555 HERD 2.6 GeV electrons focus 10 m from XBPF 51 -2.60
ZT9A.ZT9-EXP.556 HERD 3.5 GeV electrons focus 10 m from XBPF 51 -3.50
ZT9A.ZT9-EXP.554 HERD 2.3 GeV electrons focus 10 m from XBPF 51 -2.30
ZT9A.ZT9-EXP.558 HERD 5.5 GeV electrons focus 10 m from XBPF 51 -5.50
View / Edit
Compare
Copy
Delete
(In)validate
Refresh
BeamRefs->Selected File
Load Beamfile
Extrapolate
Beamfiles


CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
Magnet Status [Magnets]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Magnets Read BeamRef Max Duration Polarity Info F Comments
ZT9.DHZ01 0.0 0.0 220 0.44999998807S N
ZT9.DHZ02 0.0 0.0 220 0.40000000596C N
ZT9.QFN01 302.0 302.0 349 0.40000000596C N
ZT9.QDN02 399.6 399.6 450 0.40000000596C S
ZT9.QFN03 302.0 302.0 349 0.40000000596C N
ZT9.BHZ01 852.0 852.0 1009 0.40000000596C N
ZT9.QFN04 340.0 340.0 396 0.40000000596C N
ZT9.QFN05 340.0 340.0 396 0.40000000596C N
ZT9.BHZ02 852.0 852.0 1009 0.40000000596C N
ZT9.QDN06 666.0 666.0 833 0.40000000596C S
ZT9.BVT01 635.0 635.0 949 0.40000000596C S
ZT9.QFN07 362.0 362.0 654 0.40000000596C N
ZT9.QDN08 140.9 140.9 541 0.40000000596C S
ZT9.DHZ03 -0.0 0.0 220 0.40000000596C N
Run
Hold
Refresh
Refresh All
Refresh Selected
Set Current
Set Duration
Rectifier Status
Store to e-logb...
Magnets
Set ZT9.QFN07 Current
Current 362.0 [Amp]
update Beam Reference
OK
Cancel

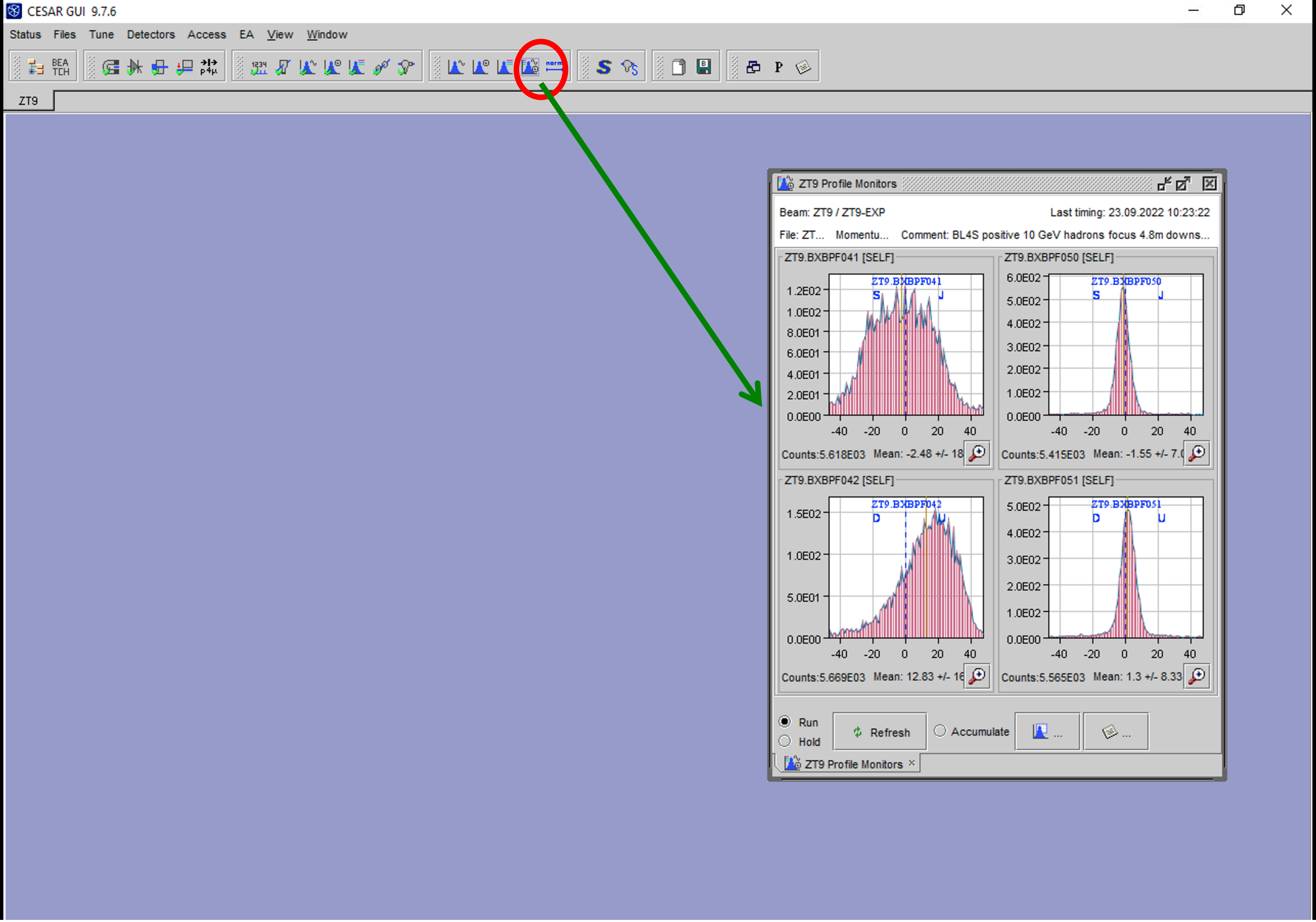

CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
Rectifier Status [Rectifiers]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Rectifiers CURRENT BeamRef TOL MODE POL LOC FAULT Info Comments
ZT9.DHZ01 0.0 0.0 0.4 ON N null / T9.DHZ01
ZT9.DHZ02 0.0 0.0 0.4 ON N null / T9.DHZ02
ZT9.QFN01 302.0 302.0 0.4 ON N null / T9.QFN01
ZT9.QDN02 399.6 399.6 0.4 ON N null / T9.QDN02
ZT9.QFN03 302.0 302.0 0.4 ON N null / T9.QFN03
ZT9.BHZ01 852.0 852.0 0.4 ON N null / T9.BHZ01
ZT9.QFN04 340.0 340.0 0.4 ON N null / T9.QFN04
ZT9.QFN05 340.0 340.0 0.4 ON N null / T9.QFN05
ZT9.BHZ02 852.0 852.0 0.4 ON N null / T9.BHZ02
ZT9.QDN06 666.0 666.0 0.4 ON N null / T9.QDN06
ZT9.BVT01 635.0 635.0 0.4 ON N null / T9.BVT01
ZT9.QFN07 362.0 362.0 0.4 ON N null / T9.QFN07
ZT9.QDN08 140.9 140.9 0.4 ON N null / T9.QDN08
ZT9.DHZ03 -0.0 0.0 0.4 ON I null / T9.DHZ03
Run
Hold
Refresh
Refresh All
Refresh Selected
Set Curr...
ON
STANDBY
OFF
RESET
Display ...
Store to ...
Rectifiers


CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
Beam stopper Status [Beam stopper]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Beam stopper
Read
BeamRef
Info
Comments
ZT9.TBS017
IN
OUT
<>BeamRef
Run
Hold
Refresh
Refresh All
Refresh Selected
Move In
Move Out
Store to e-logbook
Beam stopper

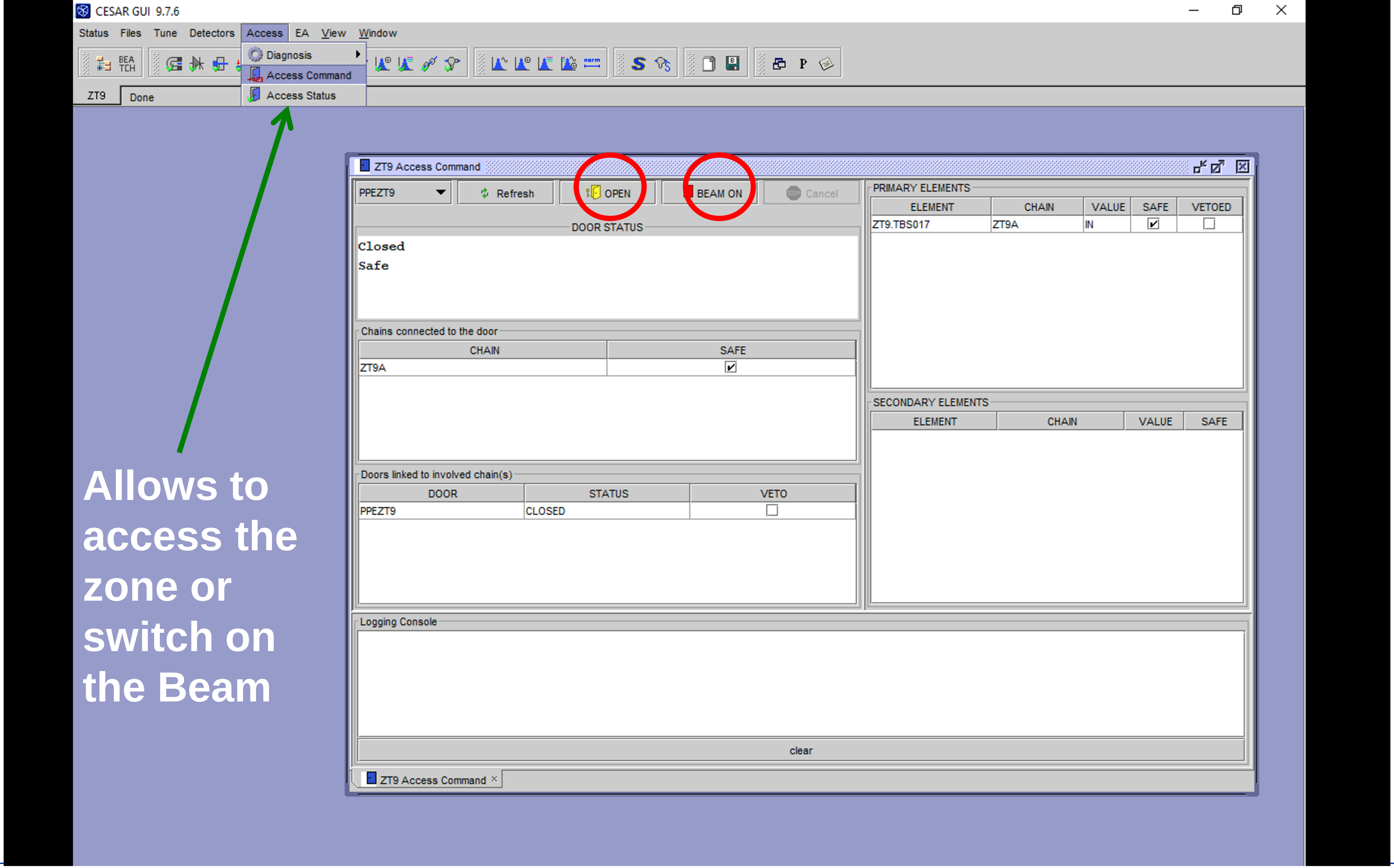

CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
Scaler Status [Scalers]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Scalers
Count
Normalized C...
Norm count (...
Calibr.
Info
Comments
EXPT.ZT9A.001
EXPT.ZT9A.002
EXPT.ZT9A.003
EXPT.ZT9A.004
EXPT.ZT9C.001
EXPT.ZT9C.002
EXPT.ZT9C.003
EXPT.ZT9C.004
0.00E+00
1.00E+00
BXSCAL_1000/StatusBean not available / Faulty / BXSCA
BXSCAL_1001/StatusBean not available / Faulty / BXSCA
BXSCAL_1002/StatusBean not available / Faulty / BXSCA
BXSCAL_1003/StatusBean not available / Faulty / BXSCA
BXSCAL_1004/StatusBean not available / Faulty / BXSCA
BXSCAL_1005/StatusBean not available / Faulty / BXSCA
BXSCAL_1006/StatusBean not available / Faulty / BXSCA
BXSCAL_1007/StatusBean not available / Faulty / BXSCA
Run
Hold
Refresh
Refresh All
Refresh Selected
Set Calibration Factor
Store to e-logbook
Scalers
Triggers Status [Triggers]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Triggers
Count
Normaliz...
Norm co...
Coincidence
Coinc. count
TDC count
HV
HV BeamR...
Pos
Info
Comments
ZT9.BXSCI041
ZT9.BXSCI050
BXSCINT_1002/StatusBeai
BXSCINT_1003/StatusBeai
Run
Hold
Refresh
Refresh All
Refresh Selected
Move In
Move Out
Restore HV
Store to e-log...
Triggers



CESAR GUI 9.7.6
Status Files Tune Detectors Access EA View Window
ZT9
Threshold Status [Thresholds]
Beam: ZT9 / ZT9-EXP
File: ZT9A.ZT9-EXP.567
Momentum: +15.00 GeV/c
Comment: BL4S 15 GeV positive hadrons focus 10 m from XBPF 51
Thresholds Pressure HV Coincidences Cherenkov Trigger TDC Count Gas Info Comments
ZT9.XCET044 0.303 -2259 0.0000E+00 2.0900E+02 1 0 carbon dioxid
ZT9.XCET048 0 unknown BXCET_1001/AcquisitionBean
Run
Hold
Refresh
Refresh All
Refresh Selected
Set Pressure
Restore HV
Store to e-logbook
Thresholds
Set ZT9.XCET044 Pressure
Set 0.303 Bar
OK
Cancel

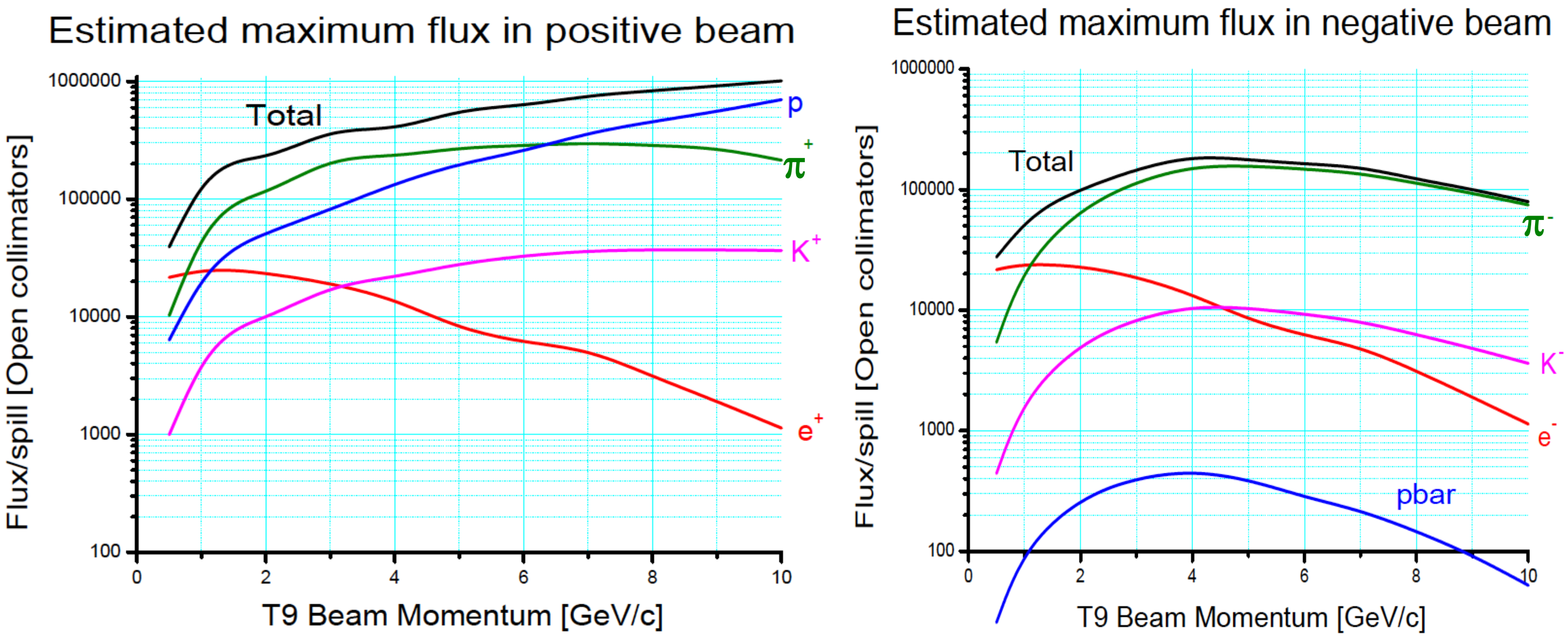


CESAR GUI 9.7.6
Status
Files
Tune
Detectors
Access
EA
View
Window
ZT9
ZT9 Profile Monitors
Beam: ZT9 / ZT9-EXP
Last timing: 23.09.2022 10:23:22
File: ZT...
Momentu...
Comment: BL4S positive 10 GeV hadrons focus 4.8m downs...
ZT9.BXBPF041 [SELF]
ZT9.BXBPF050 [SELF]
Counts:5.618E03
Mean: -2.48 +/- 18
Counts:5.415E03
Mean: -1.55 +/- 7.0
ZT9.BXBPF042 [SELF]
ZT9.BXBPF051 [SELF]
Counts:5.669E03
Mean: 12.83 +/- 16
Counts:5.565E03
Mean: 1.3 +/- 8.33
Run
Hold
Refresh
Accumulate
ZT9 Profile Monitors



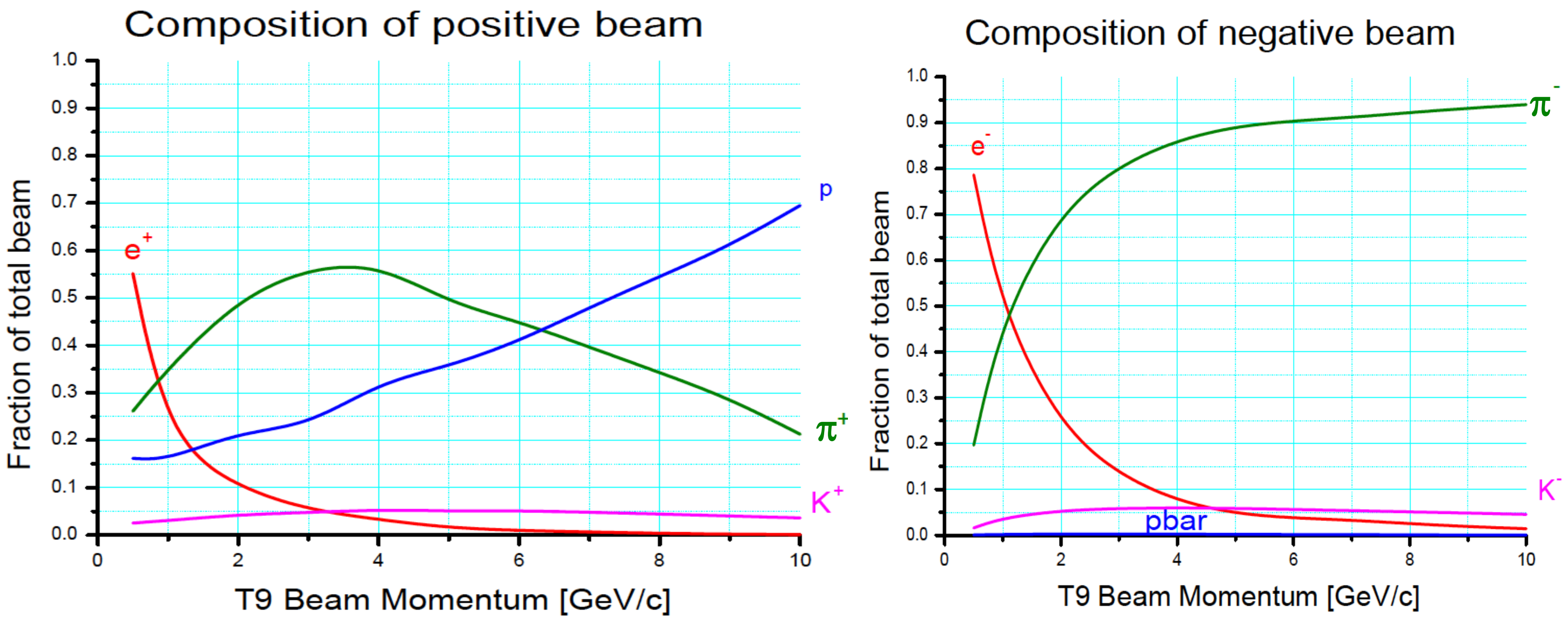
Allows to access the zone or switch on the Beam

Beam rates



For wide open collimators, i.e. $dp/p \approx \pm 7.5\%$ (Theoretical Calculation)

Beam composition



With electron enriched target (otherwise e± strongly reduced) (Theoretical Calculation)