

Introduction to caesiation

From Source review 2018 and Montreux 2019

one-shot vs continuous caesiation

Aperture and elements in the LEBT

Summary

From the review – oct 2018

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2018 CERN Linac4 Ion Source Review – Final Report ¶

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November 16th, 2018 ¶

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The document includes 8 pages and 1 appendix (magnetron_appendix.pdf) ¶

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the caesium delivery process – in particular to determine whether occasional or continuous caesiation is the preferred choice for the high current operation. The committee is leaning towards continuous caesiation as it has better potential for maintaining the current over the foreseen 10 month run cycle. CERN should also investigate possibilities to determine the caesium consumption and leakage from the source under the high-current operation. ¶

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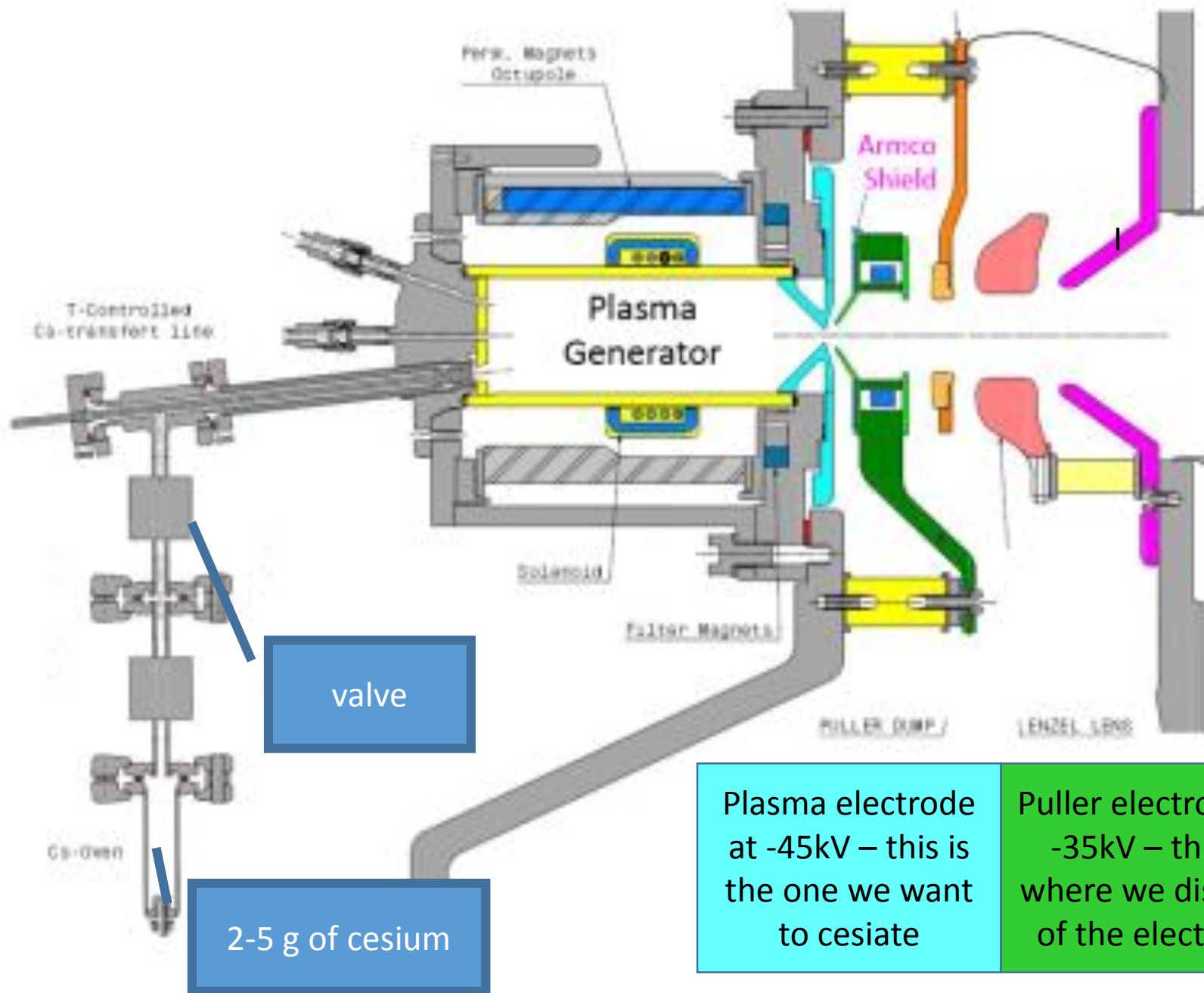


Source for 2019 - LBE run

We will run with the 2018 source with the following improvements

All these modifications will be implemented in time for the LBE run

Modification	Expected benefit	Comments
2MHz RF amplifier : (upgrade of resistors and automatic measurement of source impedance and amplifier gain)	Improved amplifier stability and , basis for beam stability and correct functioning of autopilot and maintenance optimisation	warning when operation approaching the system limits
Autopilot – automatic tuning of RF power and gas injection.	Increased uptime, RF and gas regulated to the correct value	Effort shared ABP + OP +CO
“Continuous” cesiation	A more stable intensity vs time, long drift.	
Increase the bore radius of the plasma electrode from 6.5mm to ...8,9 mm	More current without degrading the emittance. This will allow more room for tuning and also a more reliable source as it will not run to its maximum.	Certainly 7.5mm , else 8 or 9 depending on emittance and saturation.



One-shot caesiation : we segregate the source and part of the LEBT from the rest of linac4 when the caesium valve is open and the oven hot (INTERLOCKED)



Continuous caesiation : we evaporate caesium during beam operation, i.e. the oven is hot and all the valves are open

Plasma electrode at -45kV – this is the one we want to cesiate

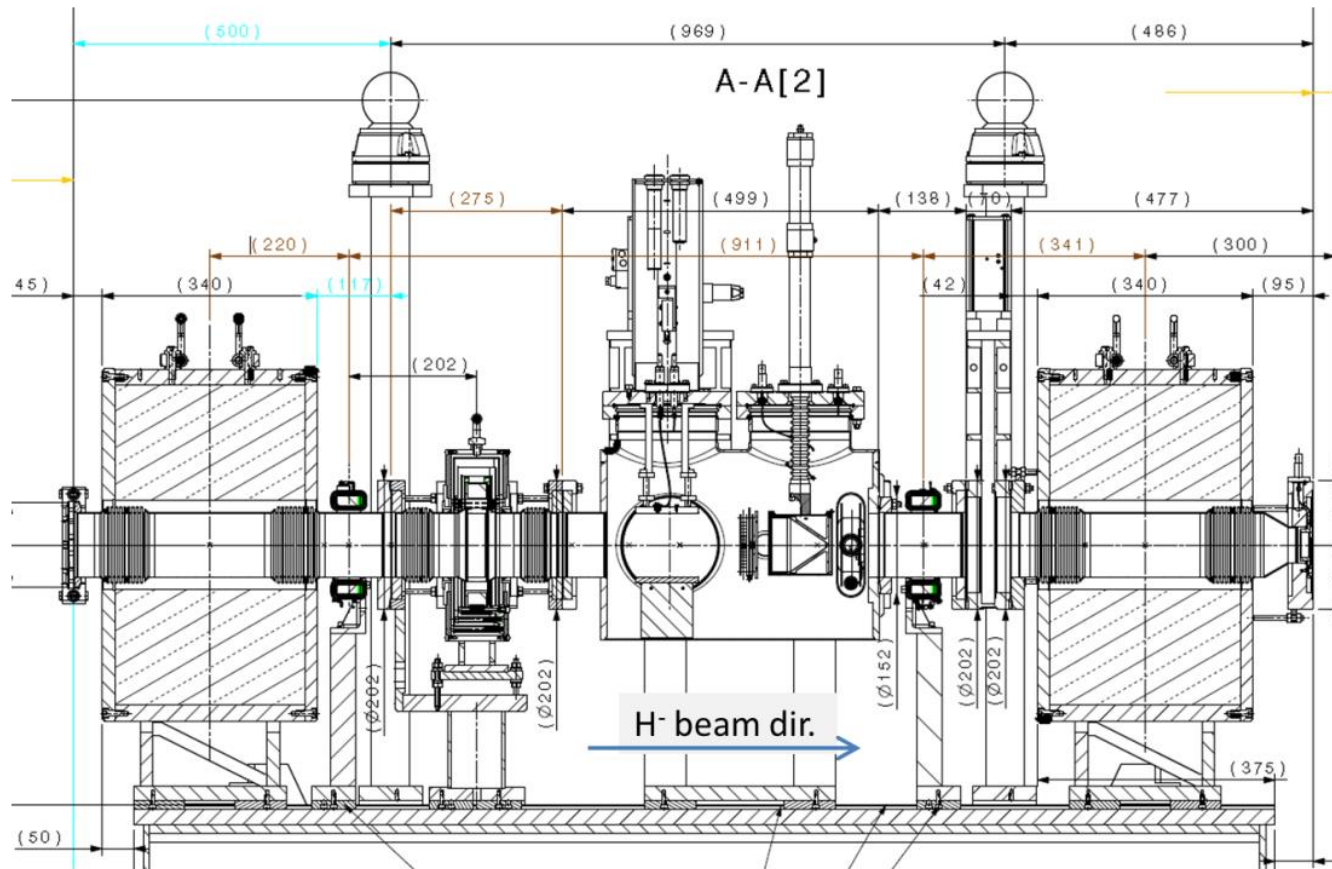
Puller electrode at -35kV – this is where we dispose of the electrons

Ground electrode

Lenz at +30kV

Ground electrode

Elements and aperture



	Position mm	Aperture mm	
Source ground	-195	8mm	Intentionally cesiated
solenoid	215	100mm	Not affected
steerer	434	100mm	Not affected
Pre-chopper	936	100mm	Spare exists
Grid	1056		Only occasionally in beamline
Faraday cup	1146	40 mm	Only occasionally in beamline
Beam stopper	1226		Not affected
steerer	1340	100mm	Not affected
Sector valve	1443		Not affected

Up to here open to hot caesium oven since 2015

solenoid	1690	100mm	
transition		To 20 mm	
RFQ	1990		See Suitbert

2018 run : 6.5mm bore/cesiated ISO3 type

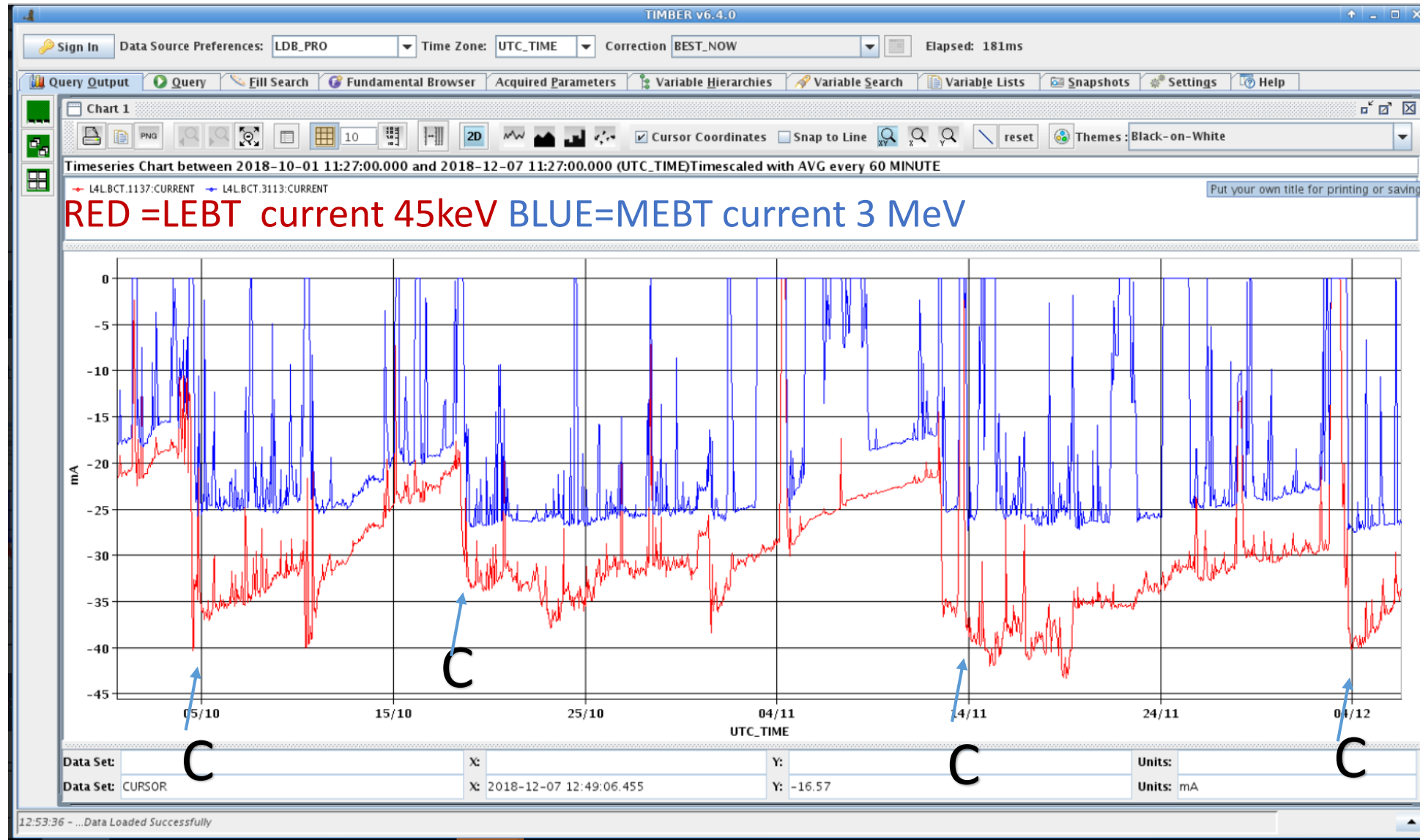
25 mA after the RFQ with currents between 30 and 40 from the source

4 cesiation with different durations/temperatures. Source separated from the RFQ when cesiation takes place

Between 4 and 14 nov we intentionally left the current drift down : about 1mA/day if we don't tune

We could –within limits– compensate with RF power but the beam quality would not be the same and the electron current would grow as well

A continuous cesiation + autopilot will avoid the slope (as fast as 1mA/day) 6

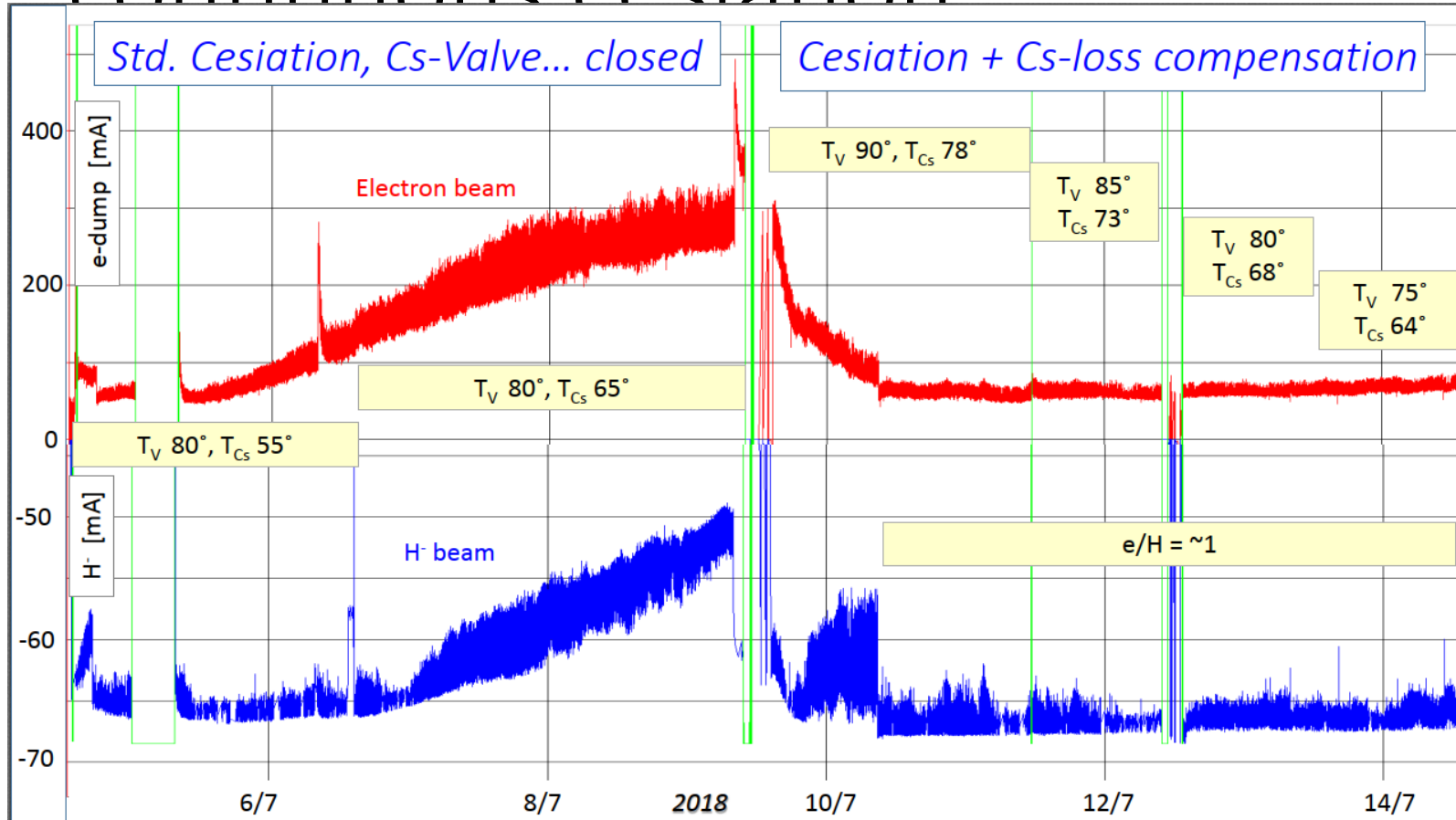


Summary

- Continuous cesiation – advantages
 - Avoid down time of 3-4 hours every 2-3 weeks
 - Provide a more stable beam (notice long-term stability not shot-to-shot)
 - “spare” the electron dump –opens possibility to new source redesign
- Continuous cesiation – changes with respect to present
 - Implies cesium oven open to the accelerator vacuum which is new for linac4
 - We have tested continuous cesiation at the LINAC4 test stand for 5 weeks
 - EM and MoN will present the measurements and measures put in place to make this change safe and operationally robust

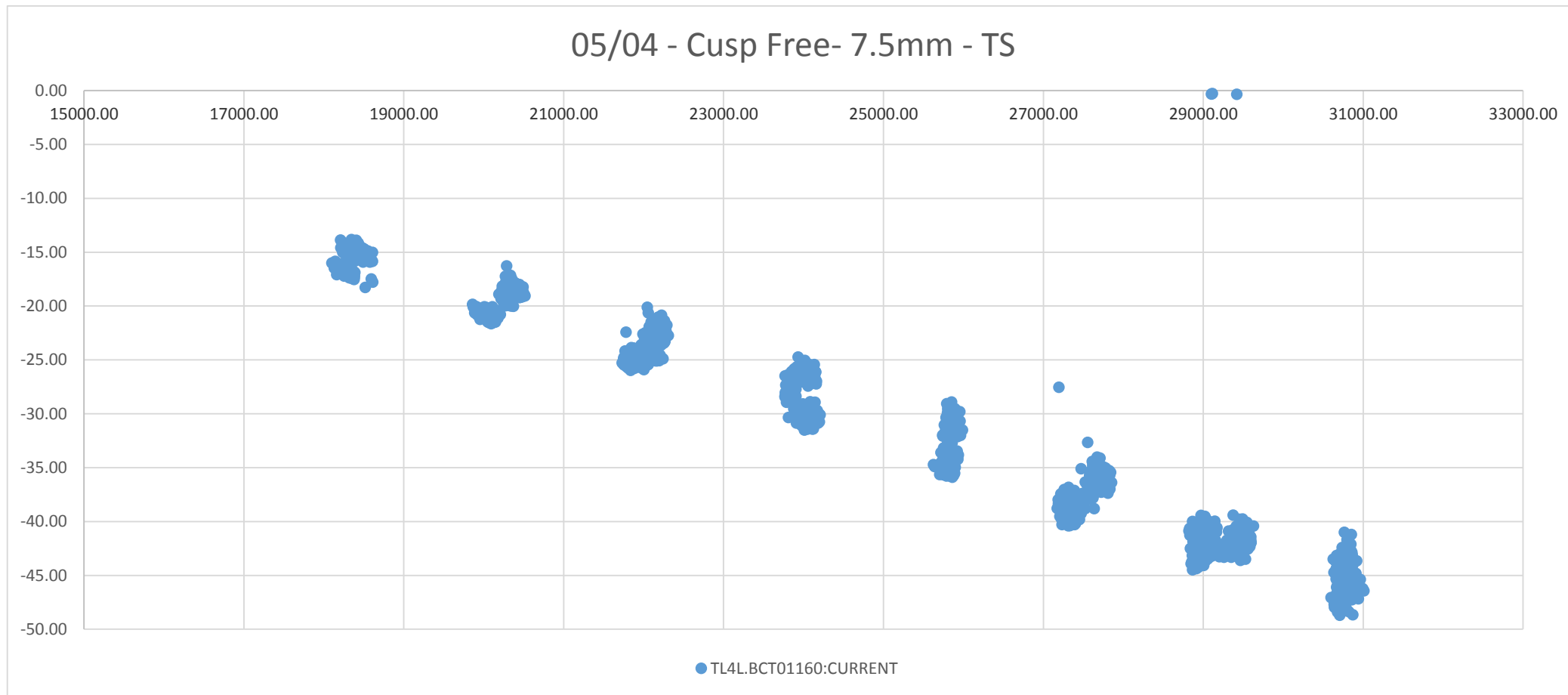
Back up

Justification for the proposed improvements : continuous cesiation

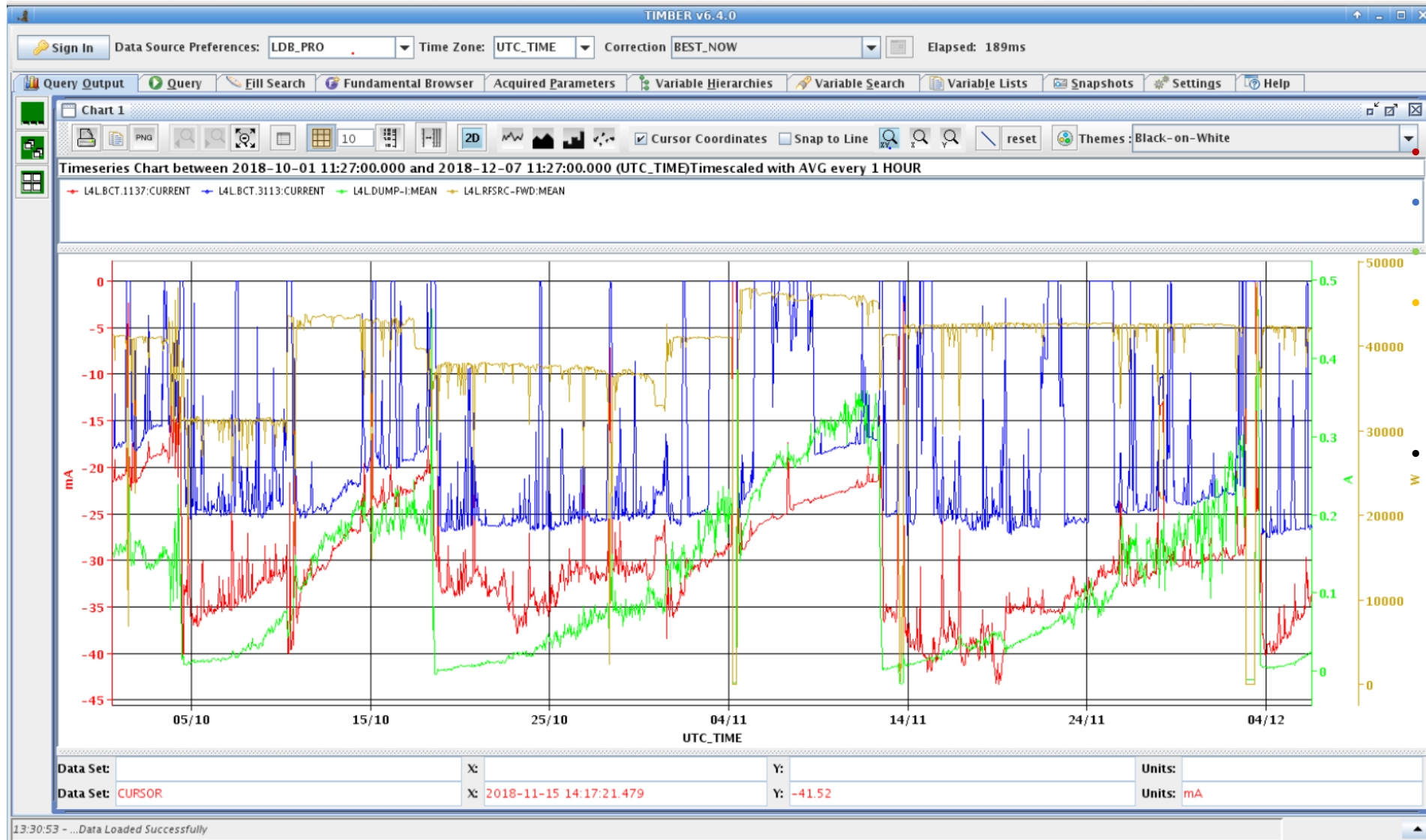


Measurements in the linac4 tunnel – July 2018

We could compensate with RF power but...1/2



We could compensate with RF power but..2/2



- RED =LEBT current 45keV
- BLUE=MEBT current 3 MeV
- Green e current
- Yellow =RF power
- Same as previous page averaged over one hour

Source LEBT and RFQ during cesiation

