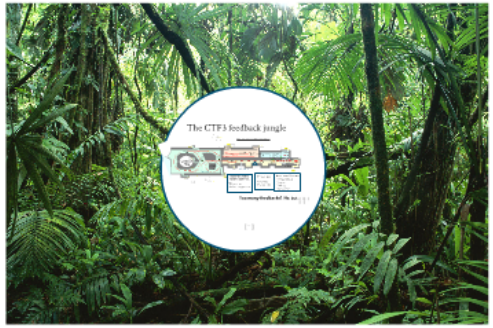
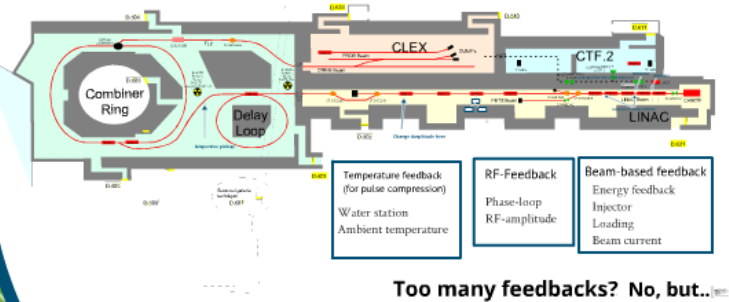
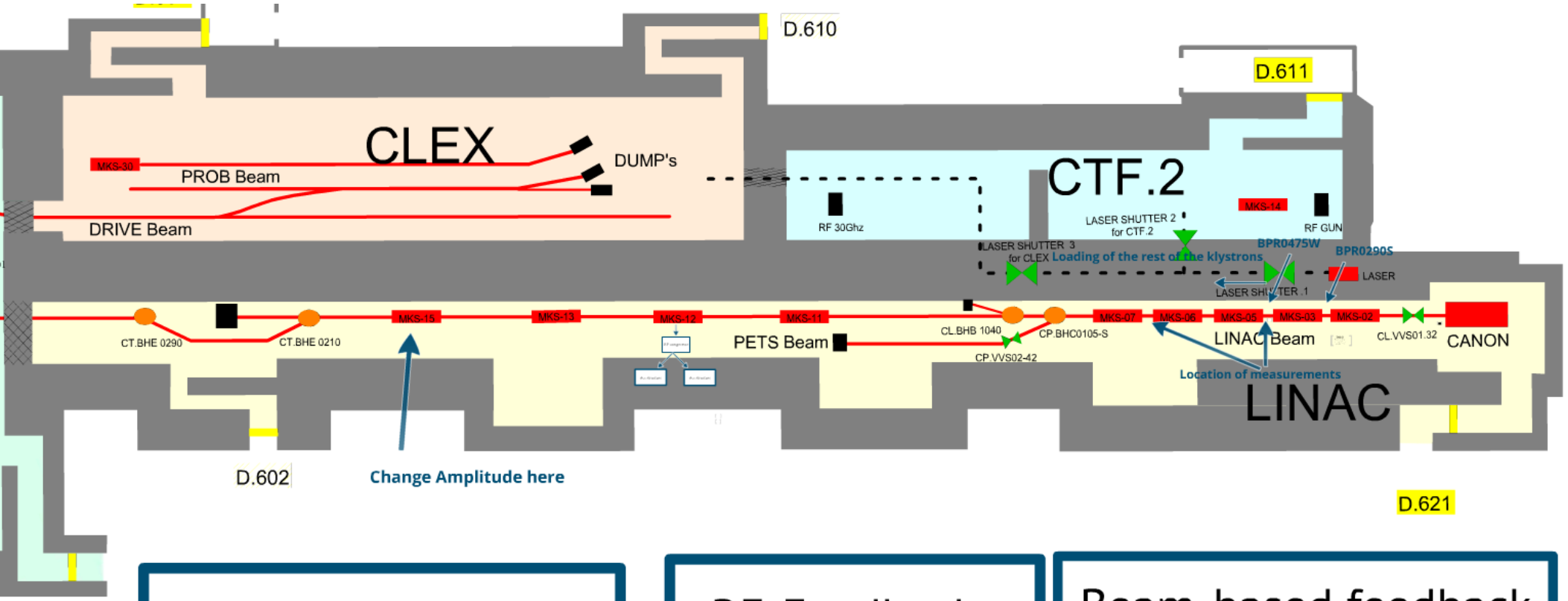

The CTF3 feedback jungle

The CTF3 feedback jungle



Temperature feedback (for pulse compression)	RF-Feedback	Beam-based feedback
Water station Ambient temperature	Phase-loop RF-amplitude	Energy feedback Injector Loading Beam current

Too many feedbacks? No, but..



Temperature feedback
(for pulse compression)

Water station
Ambient temperature

RF-Feedback

Phase-loop
RF-amplitude

Beam-based feedback

Energy feedback
Injector
Loading
Beam current

Too many feedbacks? No, but..

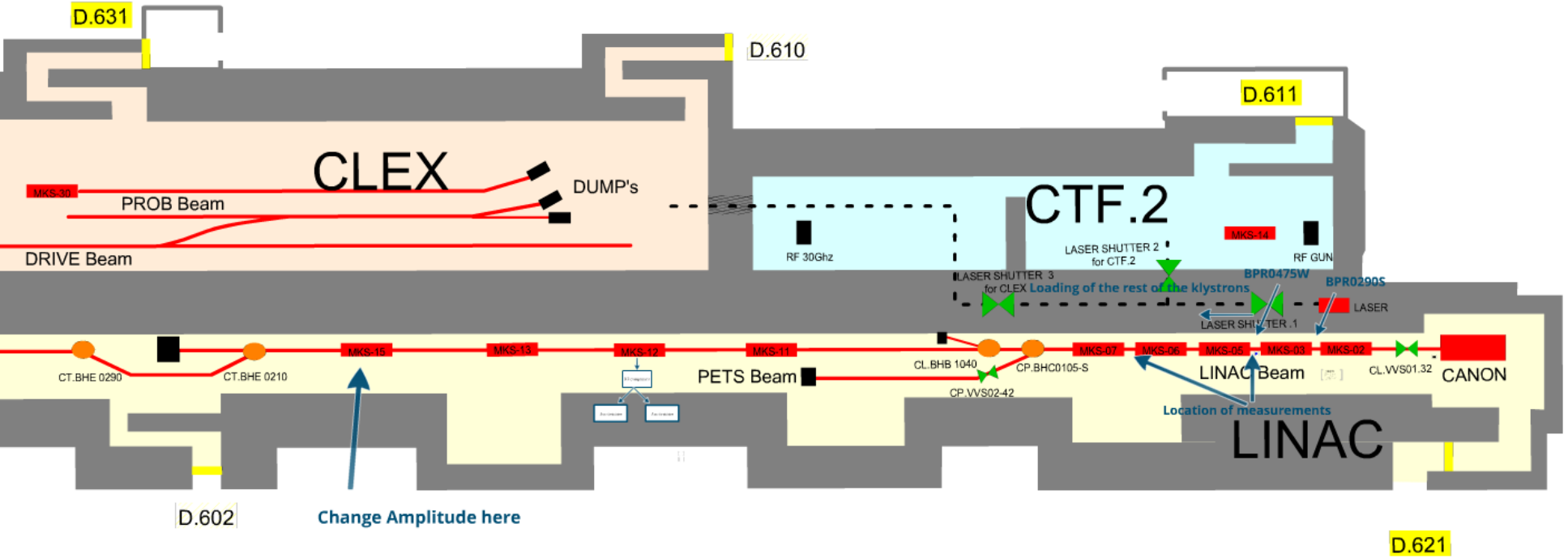
Motivation

A study launched ~2 years ago showed us that that the energy variation observed was mainly caused by the change in RF-amplitude caused by the variation in cooling water.
Two improvements have been made:

1. A feedback to change the phase program for the pulse compression to keep the RF-amplitude stable.
2. The source of the big variation in water temperature was found to be caused by the variation of the voltage coming from the general power grid. The voltage variations were linked to the AD (Antiproton Deccelerator) cycle. A solution has been implemented which has improved the situation. (Work by Alexey Dubrovskey and Frank Tecker)

3 feedback jungle

http://accelconf.web.cern.ch/accelconf/IPAC2012/papers/tuppr032.pdf



D.601

Temperature feedback
(for pulse compression)

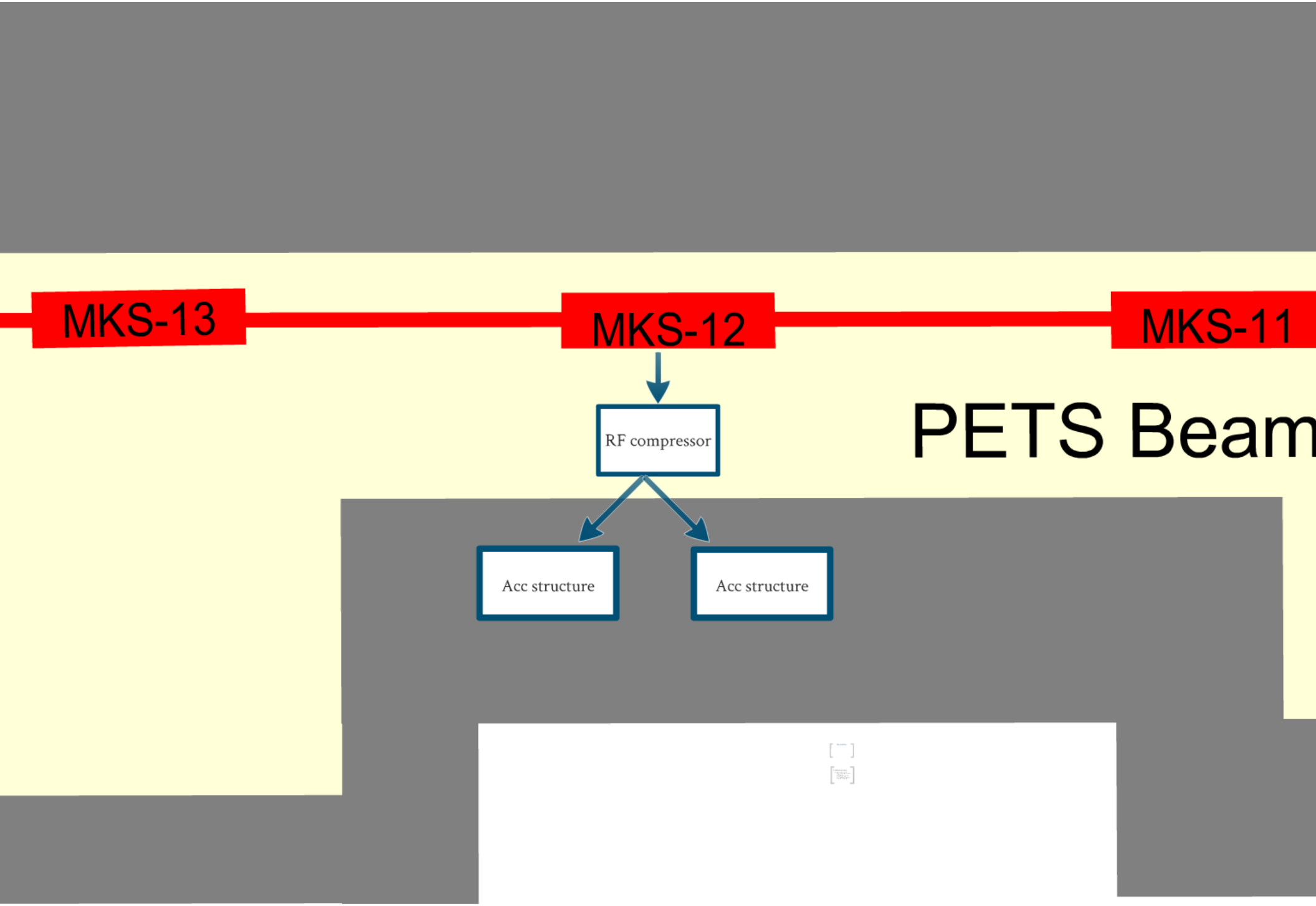
RF-Feedback

Phase-loop

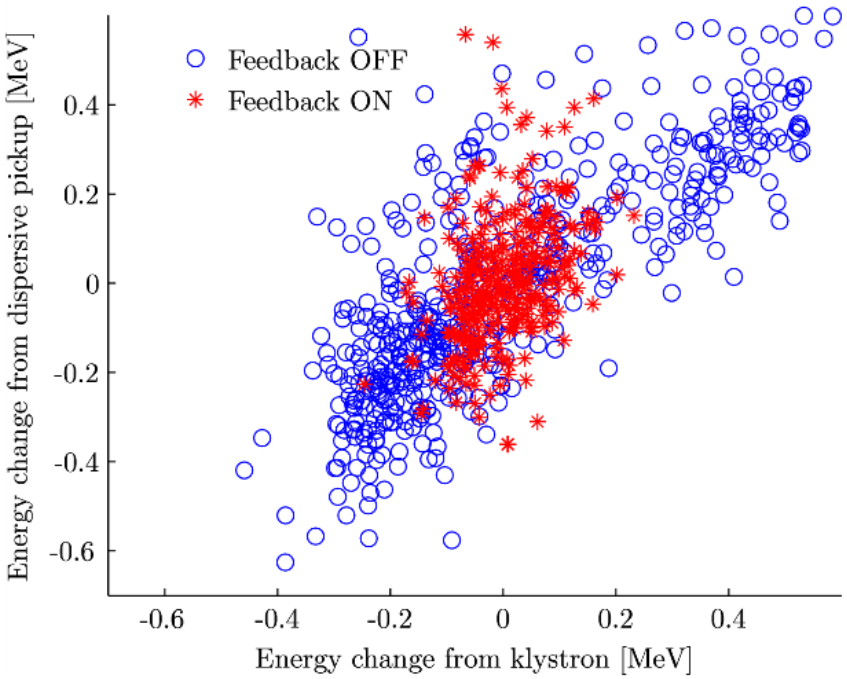
Beam-based feedback

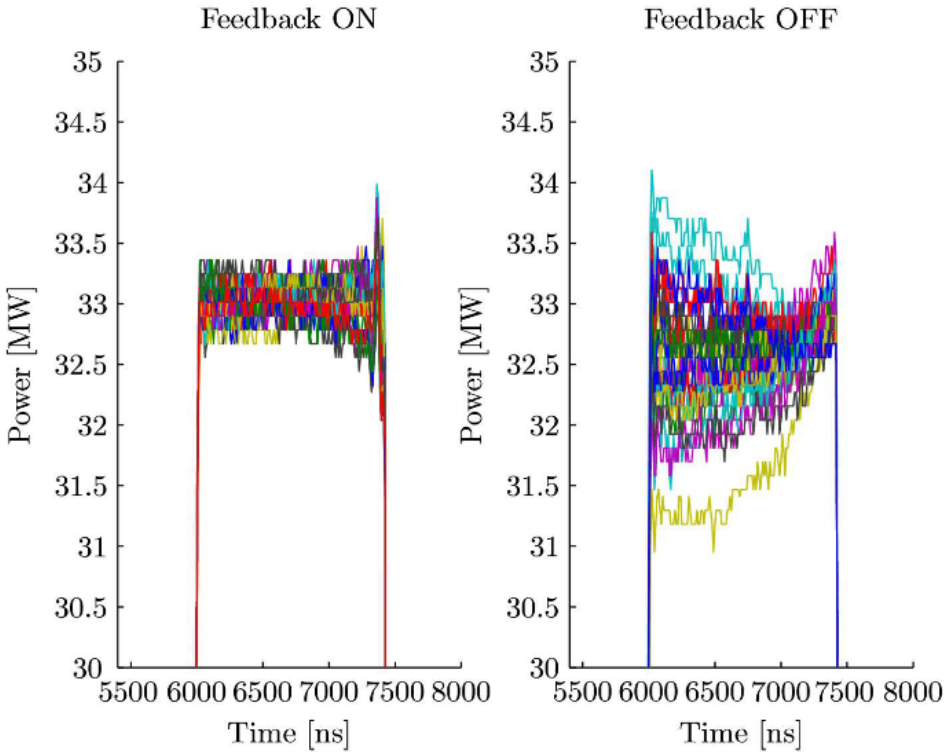
Energy feedback

Injector


MKS-13
MKS-12
MKS-11
RF compressor
PETS Beam
Acc structure
Acc structure

RF-amplitude feedback





We still need improvements..

In operation we still observe slow drifts.

- The beam is changing -> Implement feedback to control the beam itself.
- The normal knobs to recover has been phase of mks 02, mks 03 and beam current.
- Less frequent but also loading of other klystron and changing the energy of the machine .

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back

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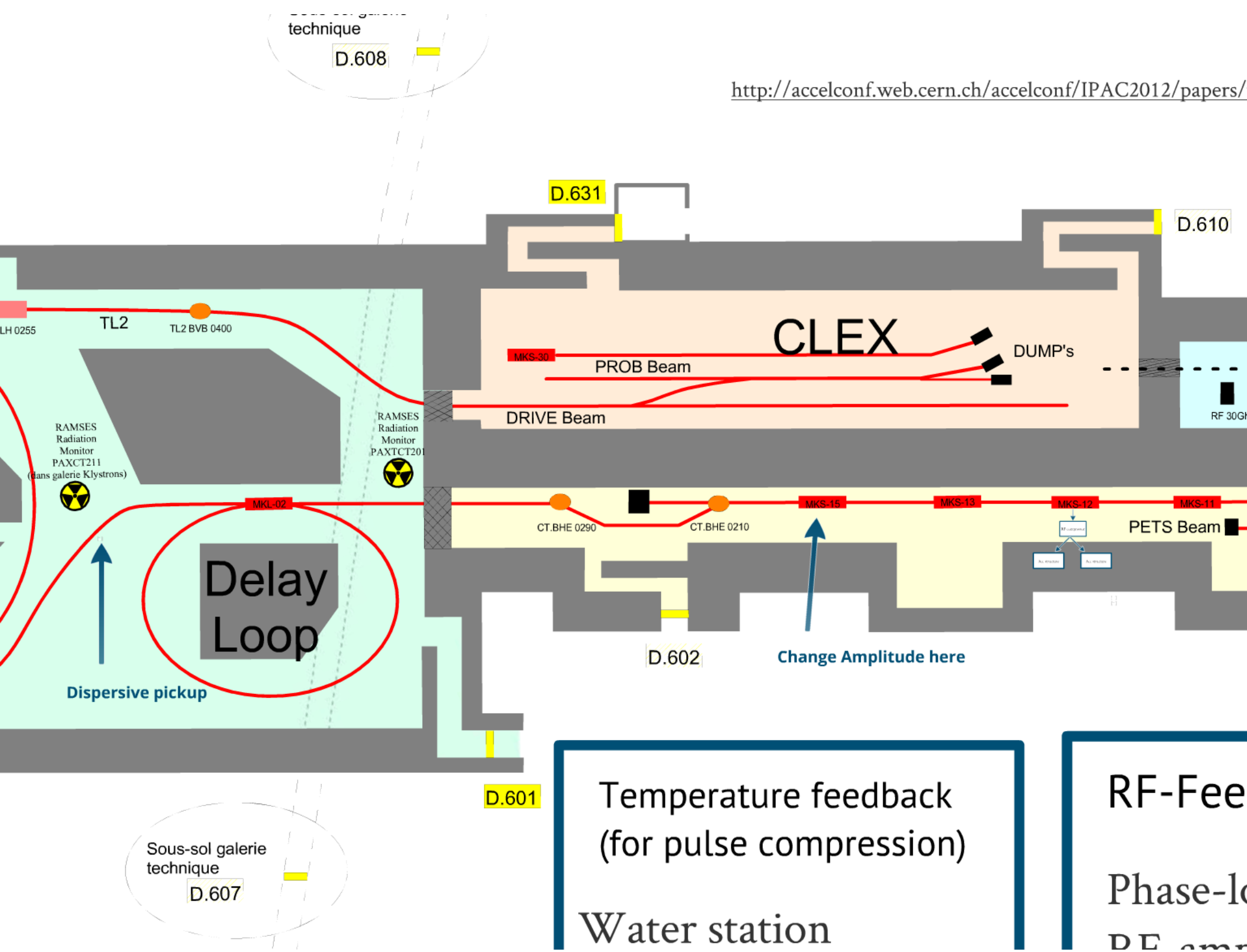
Beam-based feedback

- Energy feedback
- Injector
- Loading
- Beam current

http://accelconf.web.cern.ch/accelconf/IPAC2012/papers/



Temperature feedback
(for pulse compression)

Water station

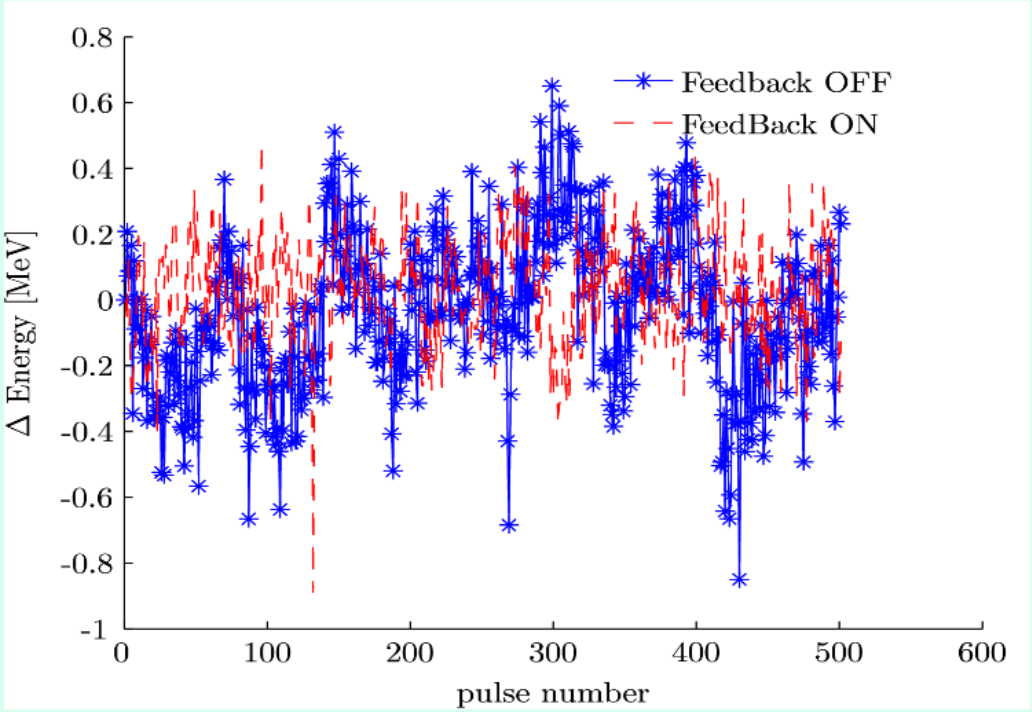
RF-Fee

Phase-l

Energy feedback

Uses a dispersive BPM and changes the RF-amplitude of MKS15 to compensate.

Improves the stability by a factor ~2.



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back

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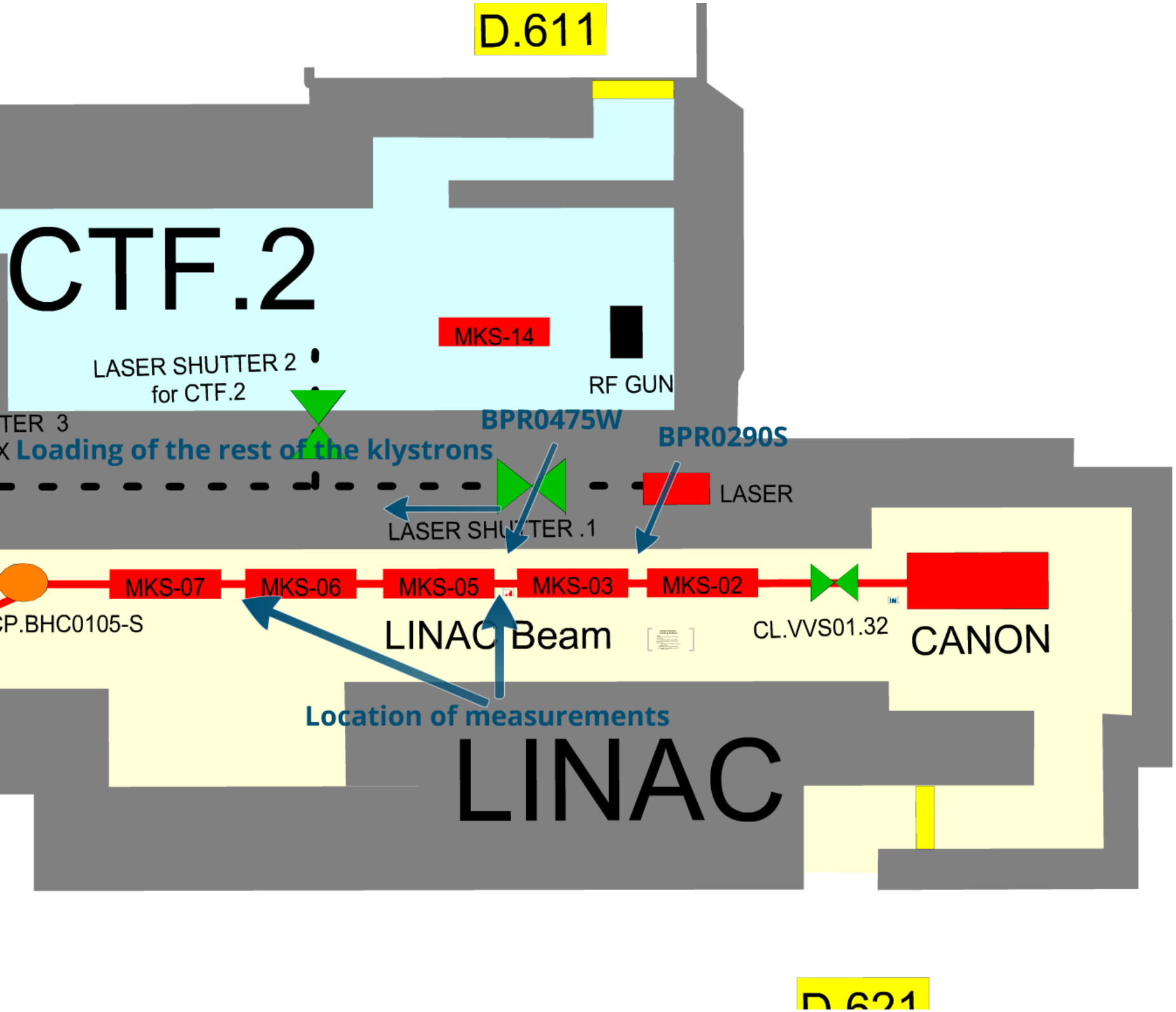
itude

Beam-based feedback

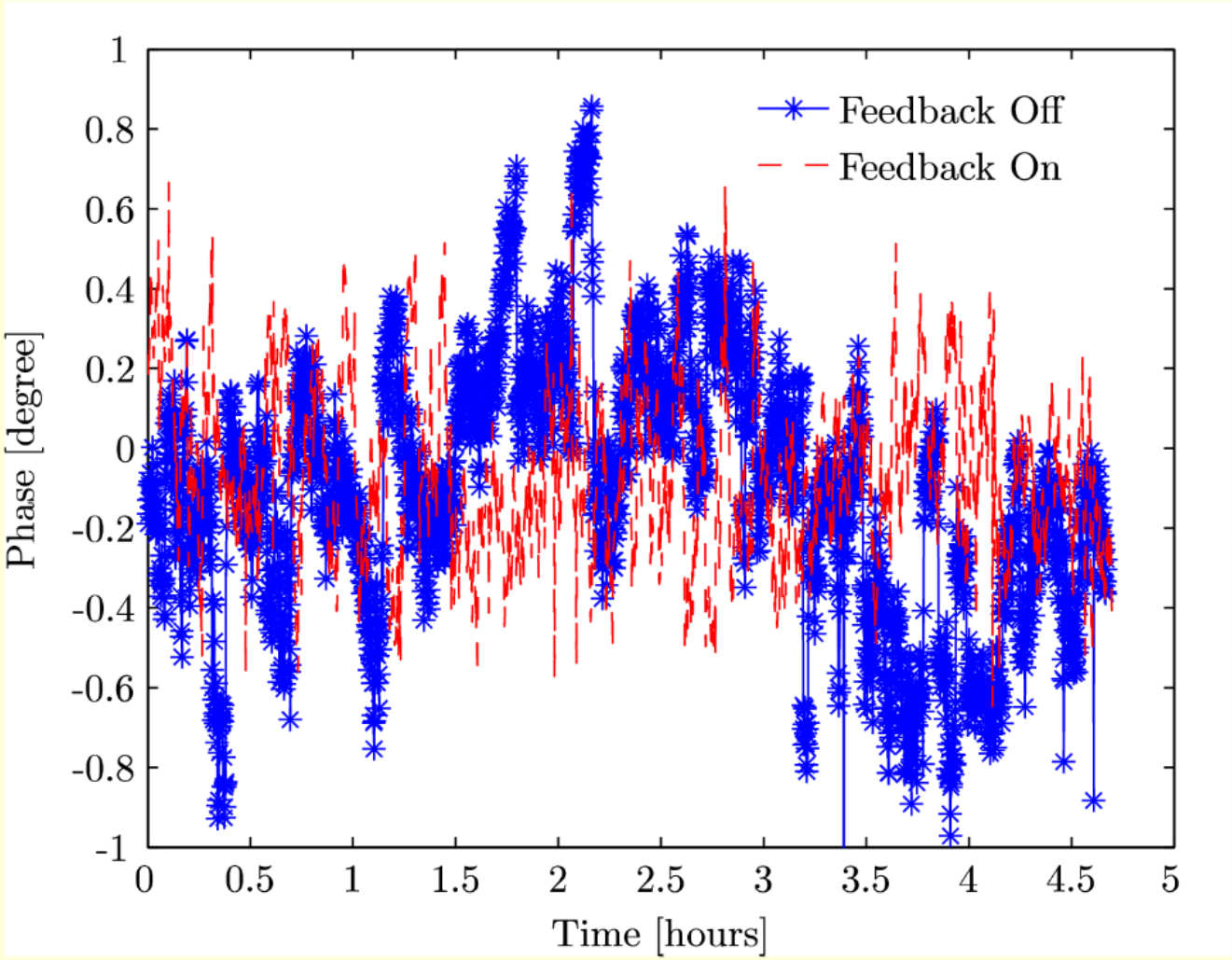
- Energy feedback
- Injector
- Loading
- Beam current

edbacks? No, but


D.611
CTF.2
MKS-14
LASER SHUTTER 2
for CTF.2
RF GUN
TER 3
X Loading of the rest of the klystrons
BPR0475W
BPR0290S
LASER
LASER SHUTTER .1
MKS-07
MKS-06
MKS-05
MKS-03
MKS-02
CP.BHC0105-S
LINAC Beam
CL.VVS01.32
CANON
Location of measurements
LINAC

Results from injector feedback

Phase of MKS03 is locked to the CL.BPR0475W.
The y-axis is in degrees of MKS03 assuming that this is the only cause of the error.



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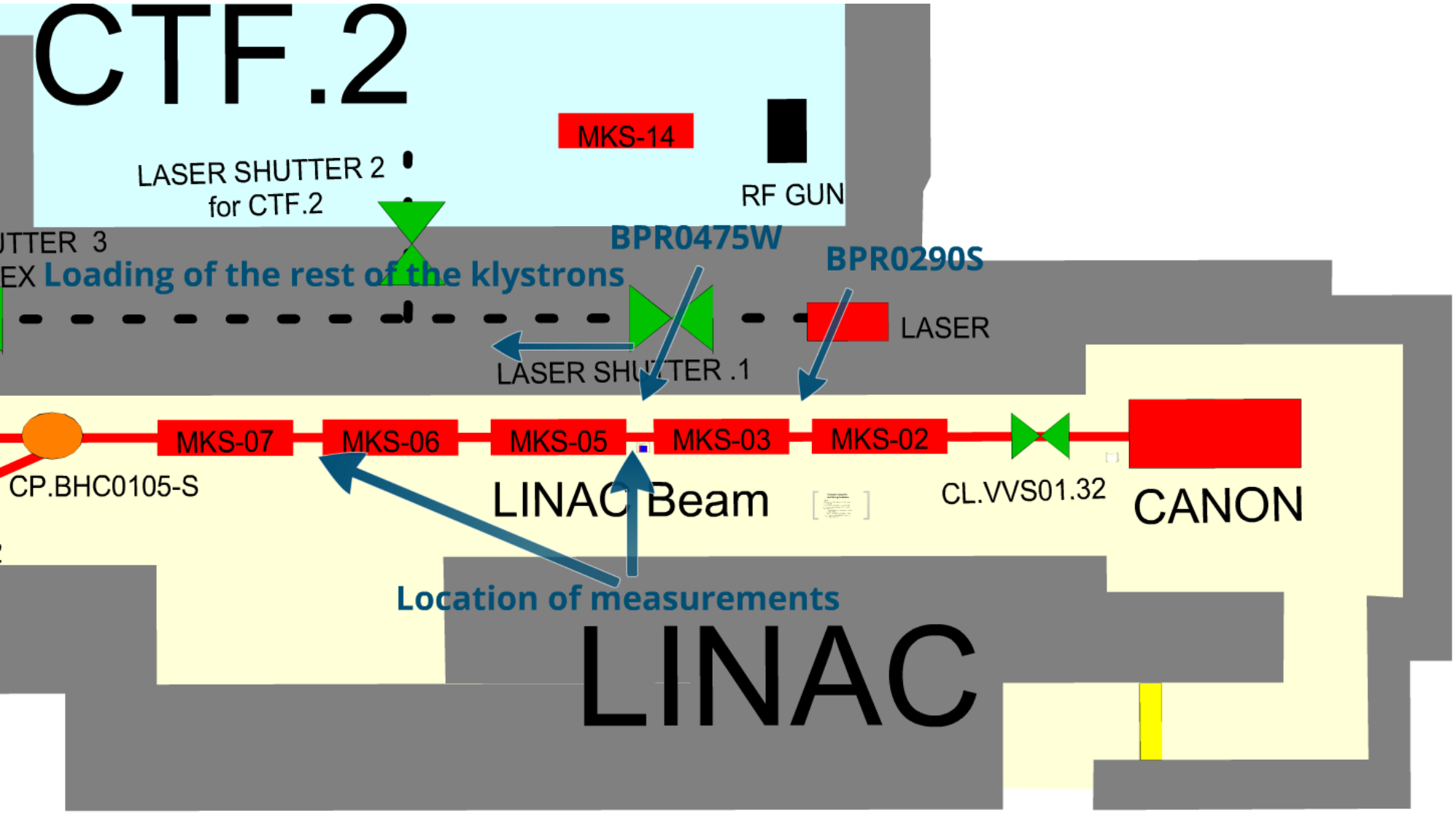
Beam-based feedback

- Energy feedback
- Injector
- Loading
- Beam current


CTF.2
MKS-14
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EX Loading of the rest of the klystrons
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LINAC Beam
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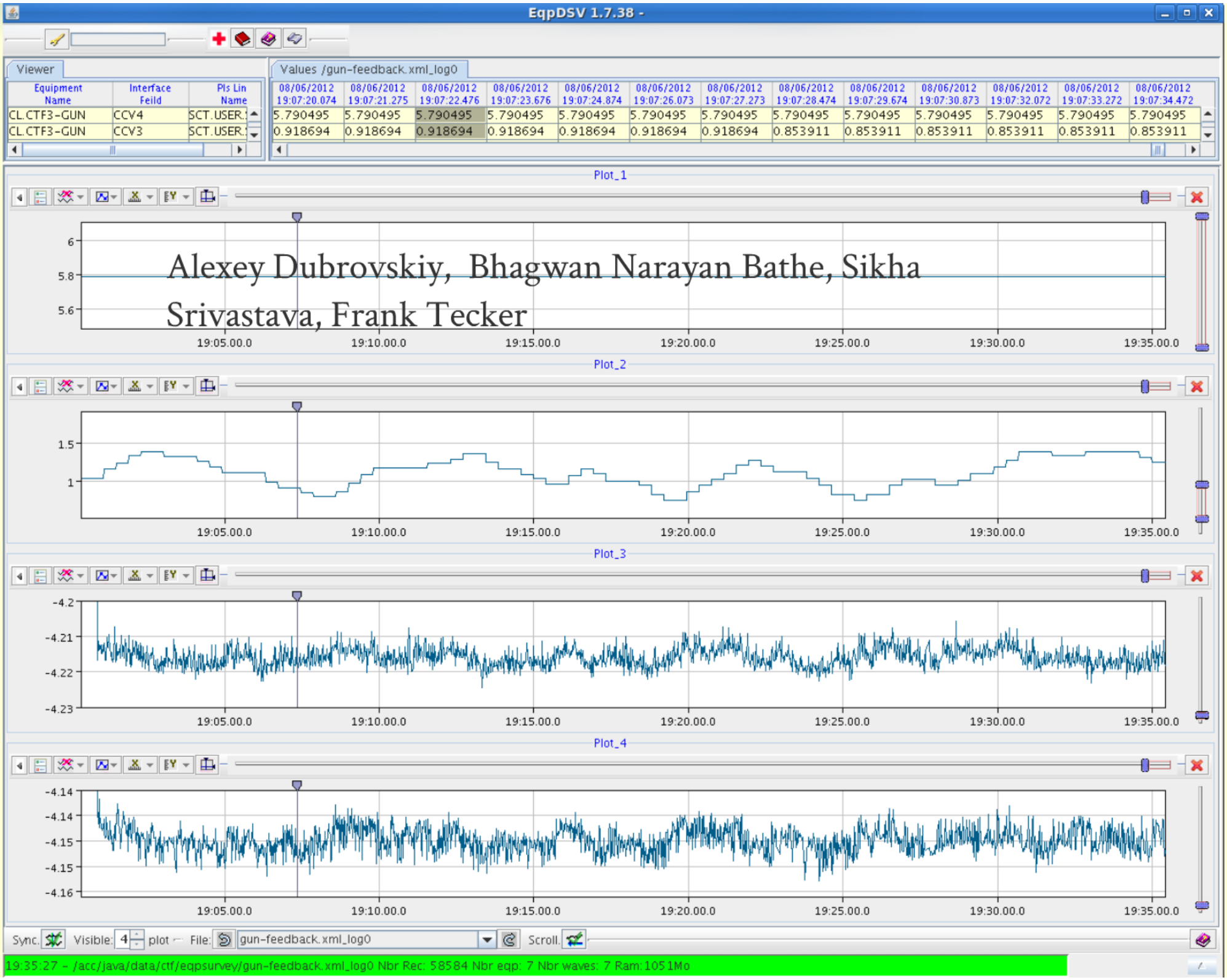
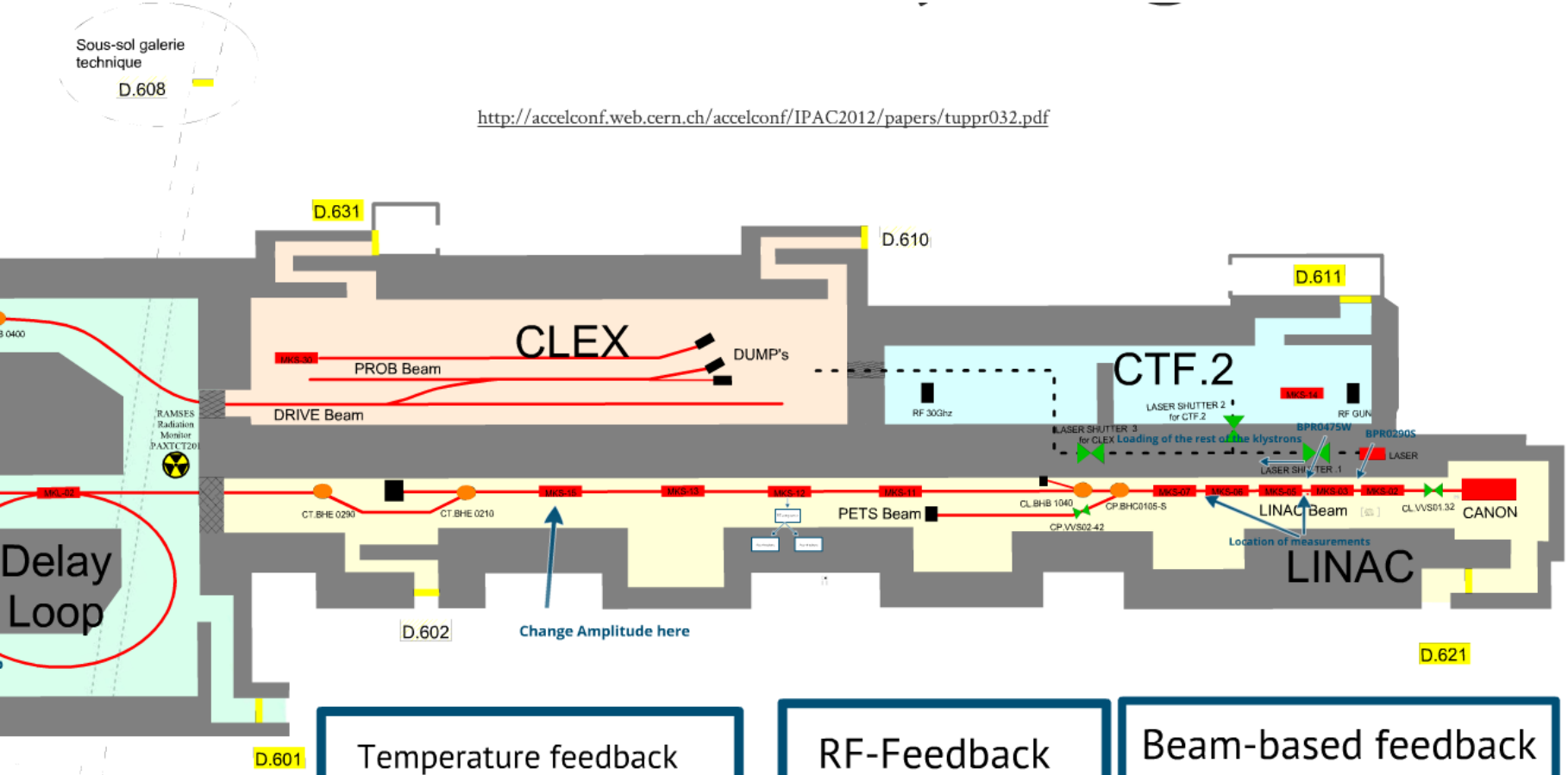
D.621


EqpDSV 1.7.38 -
Viewer
Equipment Name
Interface Feild
Pls Lin Name
CL.CTF3-GUN
CCV4
CL.CTF3-GUN
CCV3
Values /gun-feedback.xml_log0
08/06/2012 19:07:20.074
08/06/2012 19:07:21.275
08/06/2012 19:07:22.476
08/06/2012 19:07:23.676
08/06/2012 19:07:24.874
08/06/2012 19:07:26.073
08/06/2012 19:07:27.273
08/06/2012 19:07:28.474
08/06/2012 19:07:29.674
08/06/2012 19:07:30.873
08/06/2012 19:07:32.072
08/06/2012 19:07:33.272
08/06/2012 19:07:34.472
5.790495
0.918694
0.853911
Plot_1
Plot_2
Plot_3
Plot_4
19:05.00.0
19:10.00.0
19:15.00.0
19:20.00.0
19:25.00.0
19:30.00.0
19:35.00.0
Alexey Dubrovskiy, Bhagwan Narayan Bathe, Sikha Srivastava, Frank Tecker
Sync.
Visible:
plot
File:
gun-feedback.xml_log0
Scroll.
19:35:27 - /acc/java/data/ctf/eqpsurvey/gun-feedback.xml_log0 Nbr Rec: 58584 Nbr eqp: 7 Nbr waves: 7 Ram:1051Mo

http://accelconf.web.cern.ch/accelconf/IPAC2012/papers/tuppr032.pdf



Temperature feedback
(for pulse compression)

Water station

Ambient temperature

RF-Feedback

Phase-loop

RF-amplitude

Beam-based feedback

Energy feedback

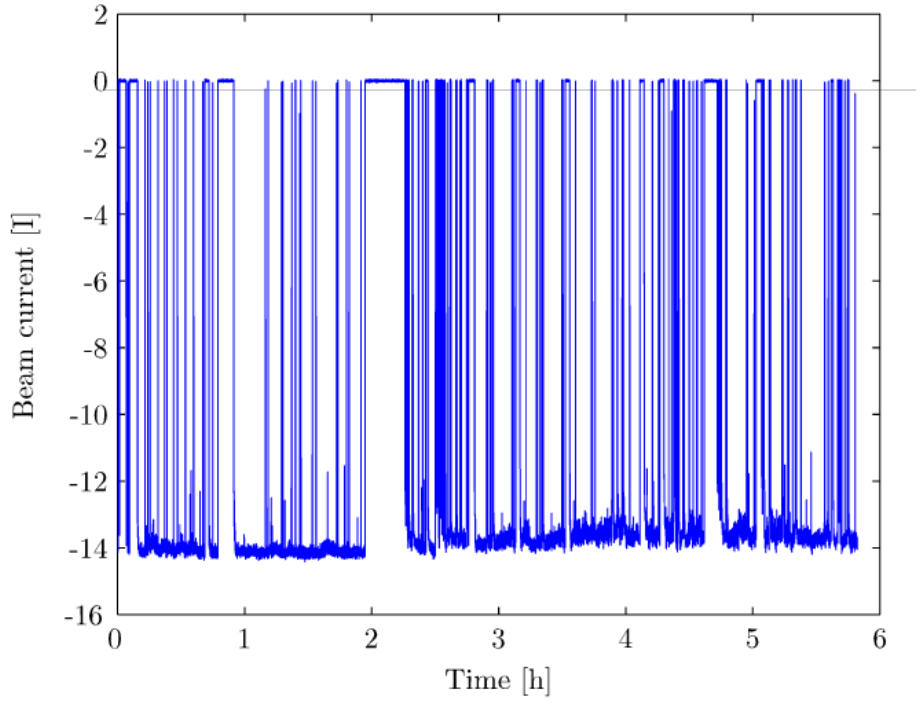
Injector

Loading

Beam current

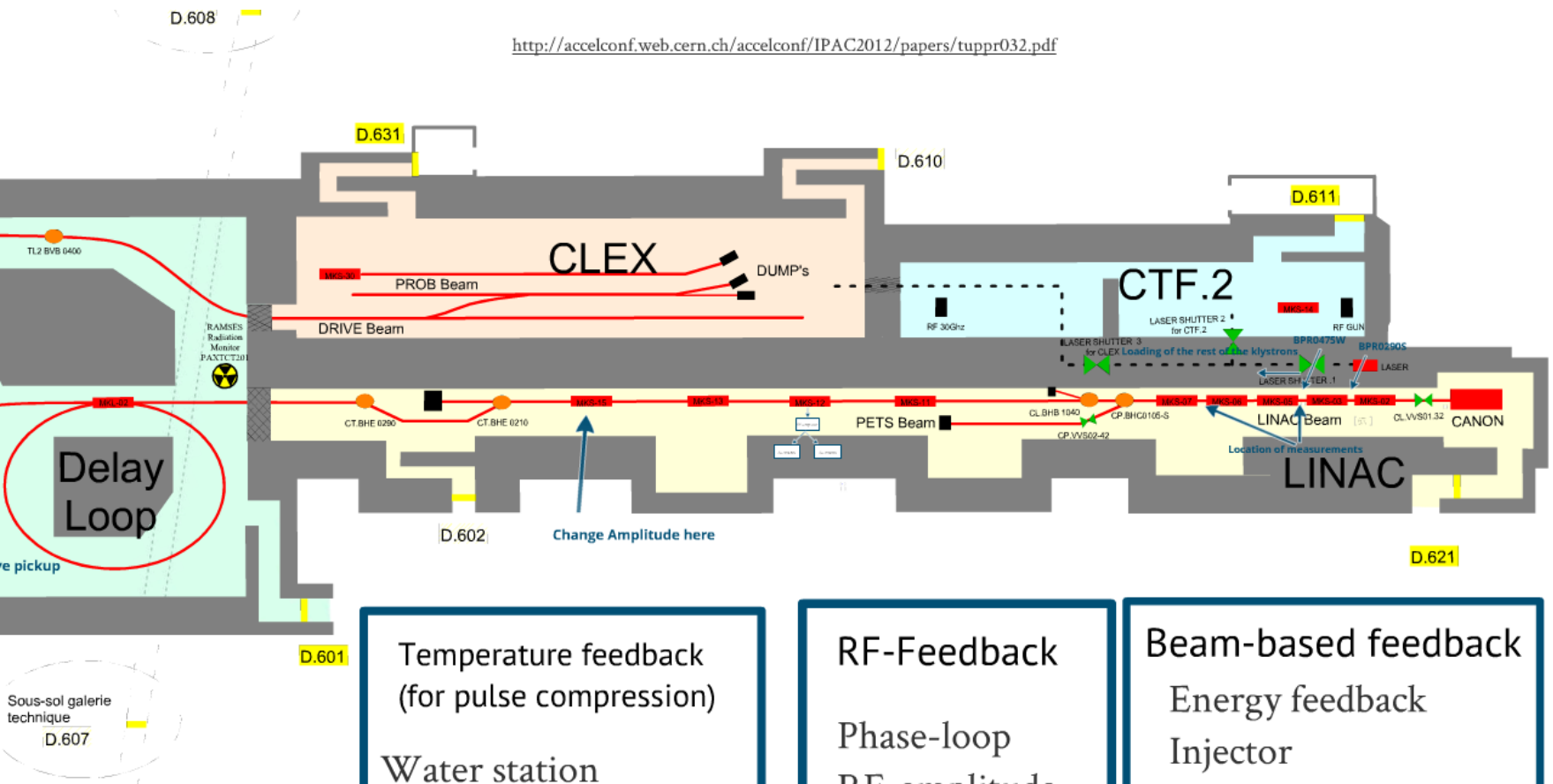
Too many feedbacks? No, but..

We can with the help of the feedbacks run without any major degradation of the beam



A plot of the beam current measured in a BPM in TBTS

http://accelconf.web.cern.ch/accelconf/IPAC2012/papers/tuppr032.pdf



Temperature feedback (for pulse compression)

Water station

Ambient temperature

RF-Feedback

Phase-loop

RF-amplitude

Beam-based feedback

Energy feedback

Injector

Loading

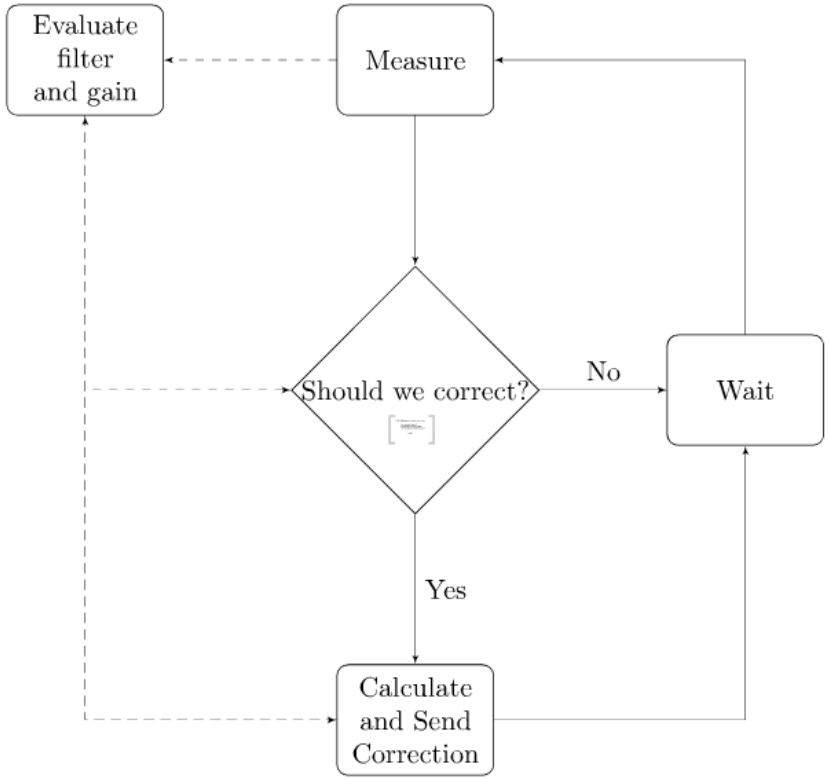
Beam current

Too many feedbacks? No, but..

Requirements of the feedback

- The feedbacks need to be robust, not ever make the situation considerably worse.
- According to me it have to be automatically adaptable to changes in the machine and from the operator.
- If we have feedbacks running at the same time we need to analyze their influence on each other.
- In order not to disturb each other they have to be either:
  - Orthogonal
  - Work on different time scales
- Otherwise the corrections have to be scheduled for optimal performance.

Generic layout of the beam based feedback

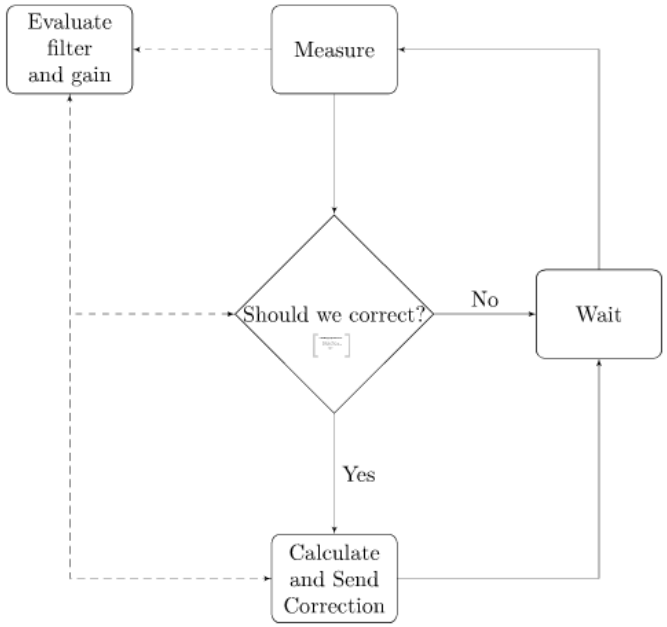


If the followings requirements are met:

- Is the standard deviation ok?
- Is it within the range of the feedback?
- Is the setpoint unchanged by the operator?
- .....

Correct!

Generic layout of the beam based feedback



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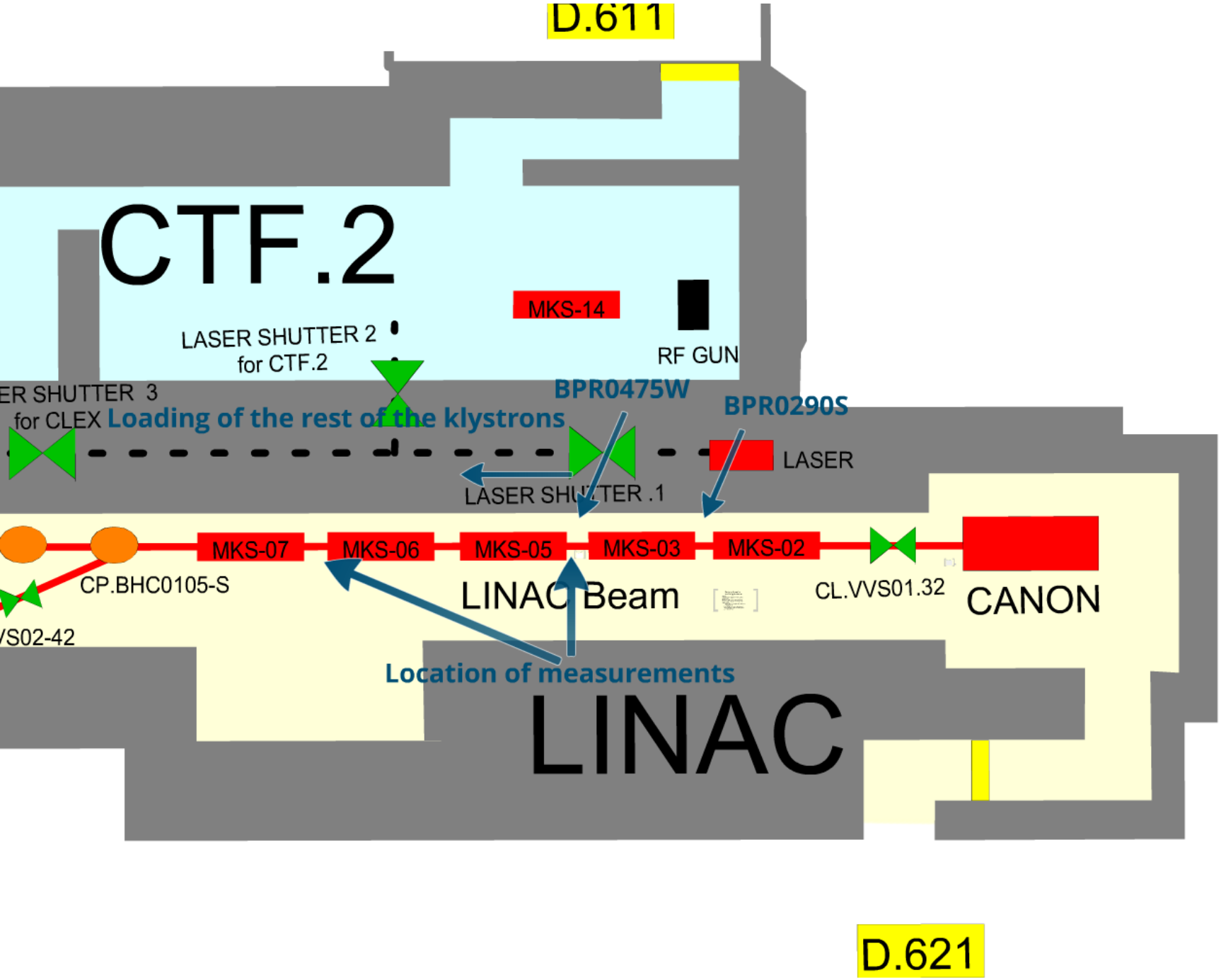
D.611
CTF.2
MKS-14
LASER SHUTTER 2
for CTF.2
RF GUN
ER SHUTTER 3
for CLEX
Loading of the rest of the klystrons
BPR0475W
BPR0290S
LASER
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MKS-07
MKS-06
MKS-05
MKS-03
MKS-02
CP.BHC0105-S
LINAC Beam
CL.VVS01.32
CANON
VS02-42
Location of measurements
LINAC
D.621

Example of possible conflicting feedbacks

Example:
Stabilizing bpr475W with phase of MKS03 and beam current feedback.
BPR475W is sensitive to beam current and the beam current is sensitive to the phase of MKS03 due to the capture efficiency.

If the feedbacks are out of phase they could give an oscillating behavior.

However, in this case we can see that the normal current variation has a small effect on the bpr475w
==> Locally orthogonal

Requirements of the feedback

- The feedbacks need to be robust, not ever make the situation considerably worse.
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- In order not to disturb each other they have to be either:
  - Orthogonal
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- Otherwise the corrections have to be scheduled for optimal performance.

Conculsion and Outlook

- The feedbacks have been proven to improve the stability of the machine.
- More work is needed to make some of them fully operational.
  - A new technical student will work on the implementation of the feedbacks since some are still only possible to run from matlab.
  - The idea is to have a single working set with all the feedbacks.
  - The possibility to restart and monitor them from Diamon
- The feedbacks will help the operator to focus on the beam development instead of chasing drifts.