Drive beam stability and reproducibility -current status and improvements

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The CTF3 days, 2012-10-10

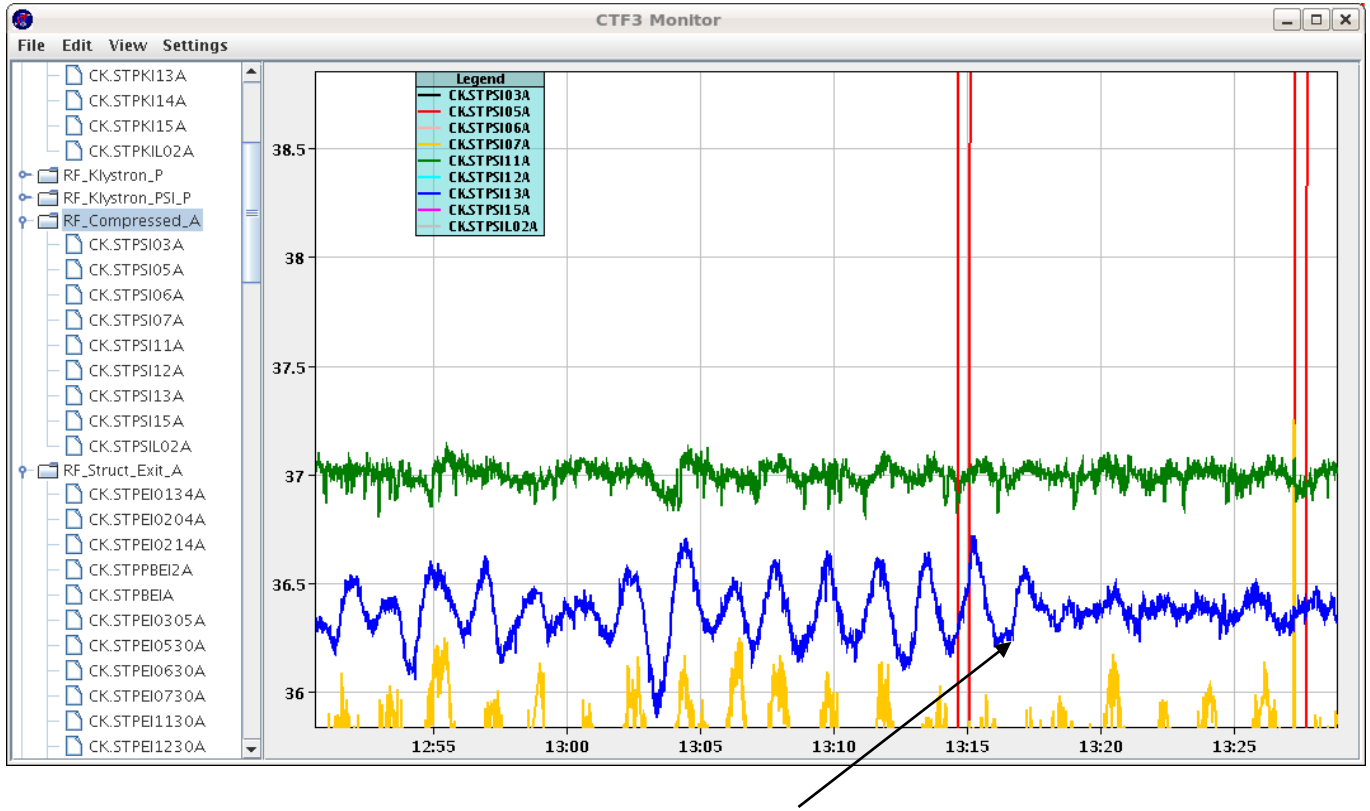
Outline

- Improvements of how the RF-amplitude flattening is done.
- Water station
- Energy Feedback
- Outlook
- Conclusion

Improvements for the flattening

- There is a user interface to turn on, off and adjust the strength of the RF-flattening.
- A new method to increase the gain of the flattening.
- Use the RF-pulse without beam for the flattening.

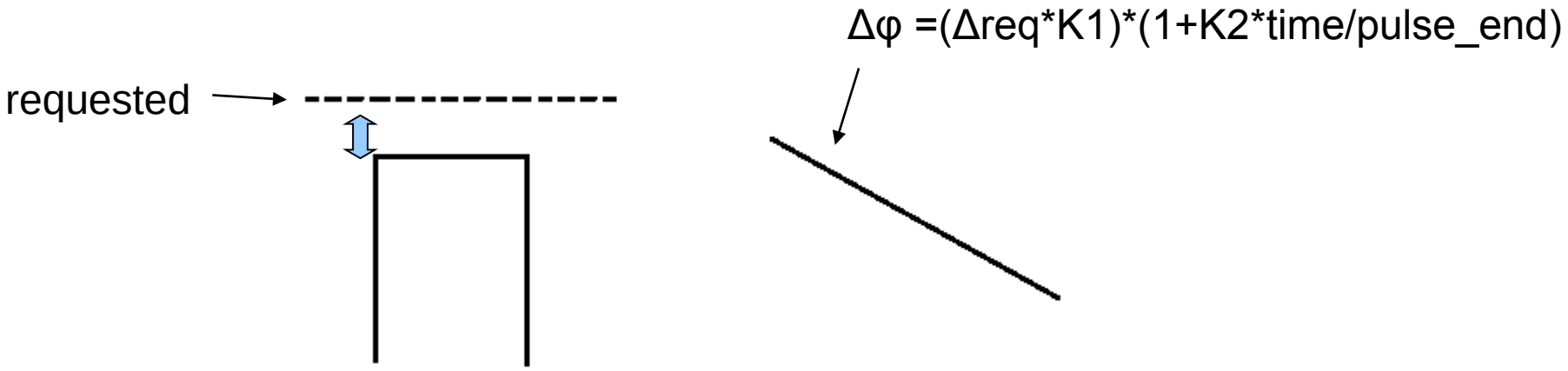
Improved flattening method



Turned it on here

How it works

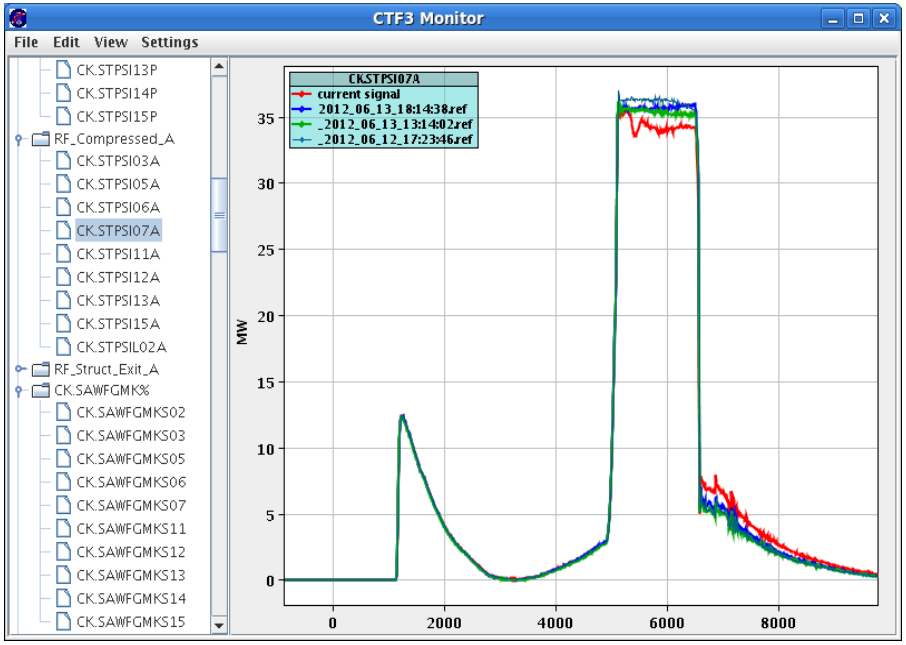
- Measures the mean value over the pulse.
  - Measuring each klystrons response (roughly)
  - Applying the predicted correction calculated from the difference in mean value.



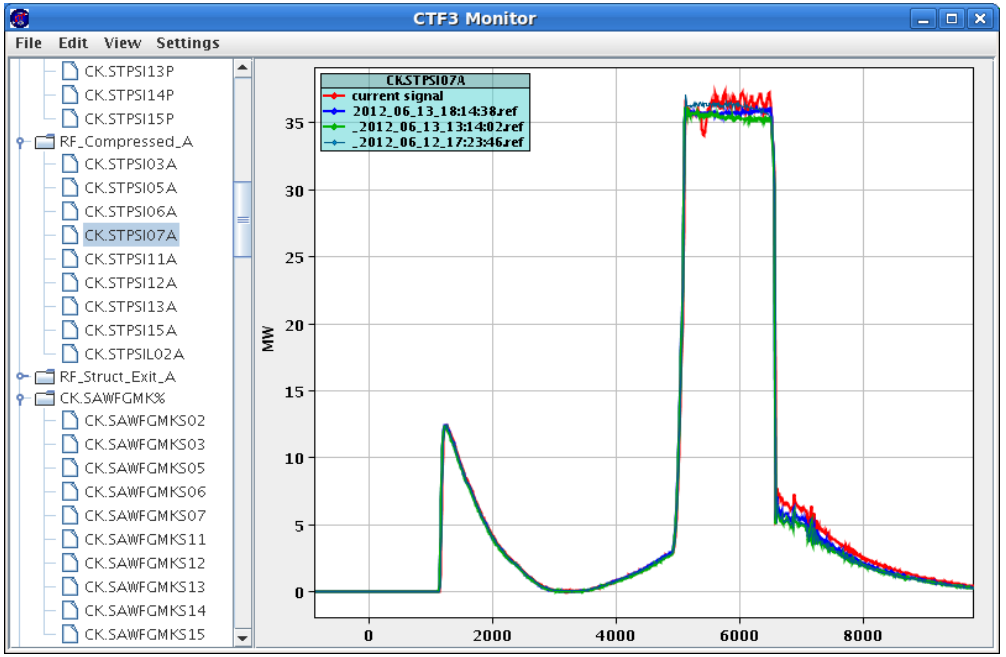
Δreq =requested – mean value

1.5 GHz beam reflections

Without beam

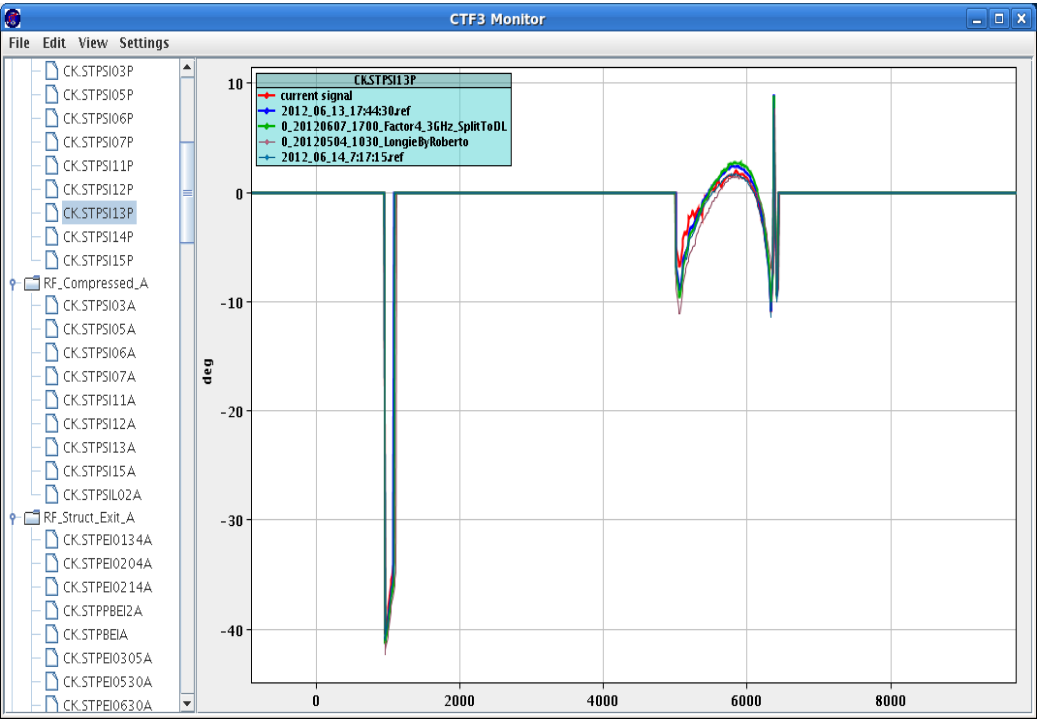


With beam

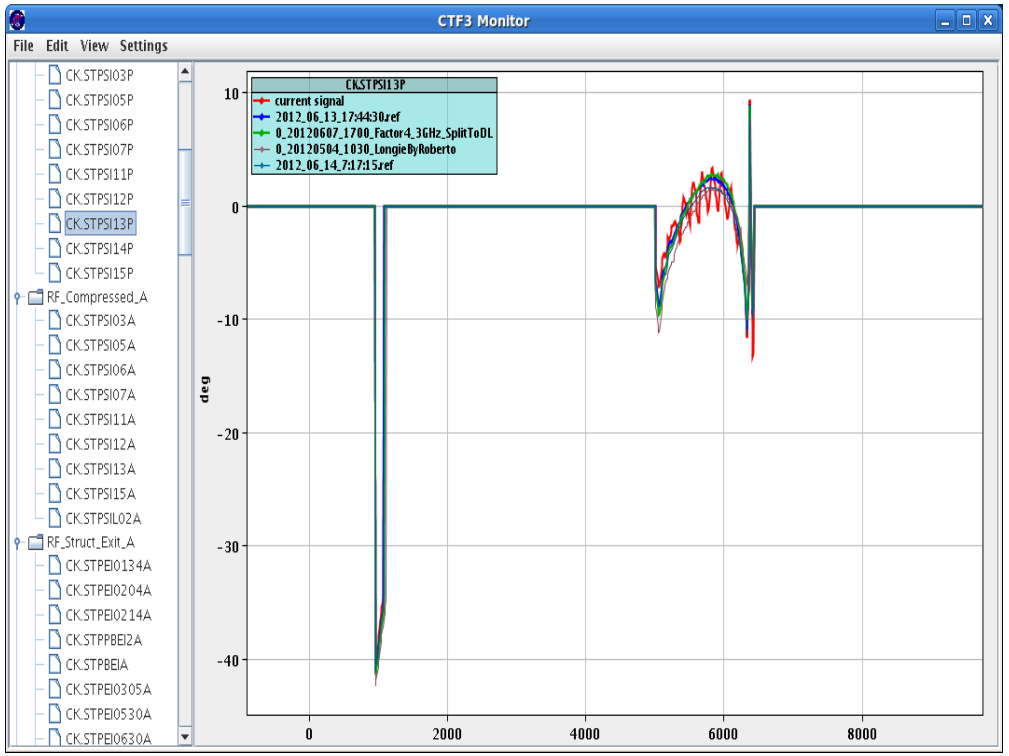


1.5GHz beam reflections

Without beam



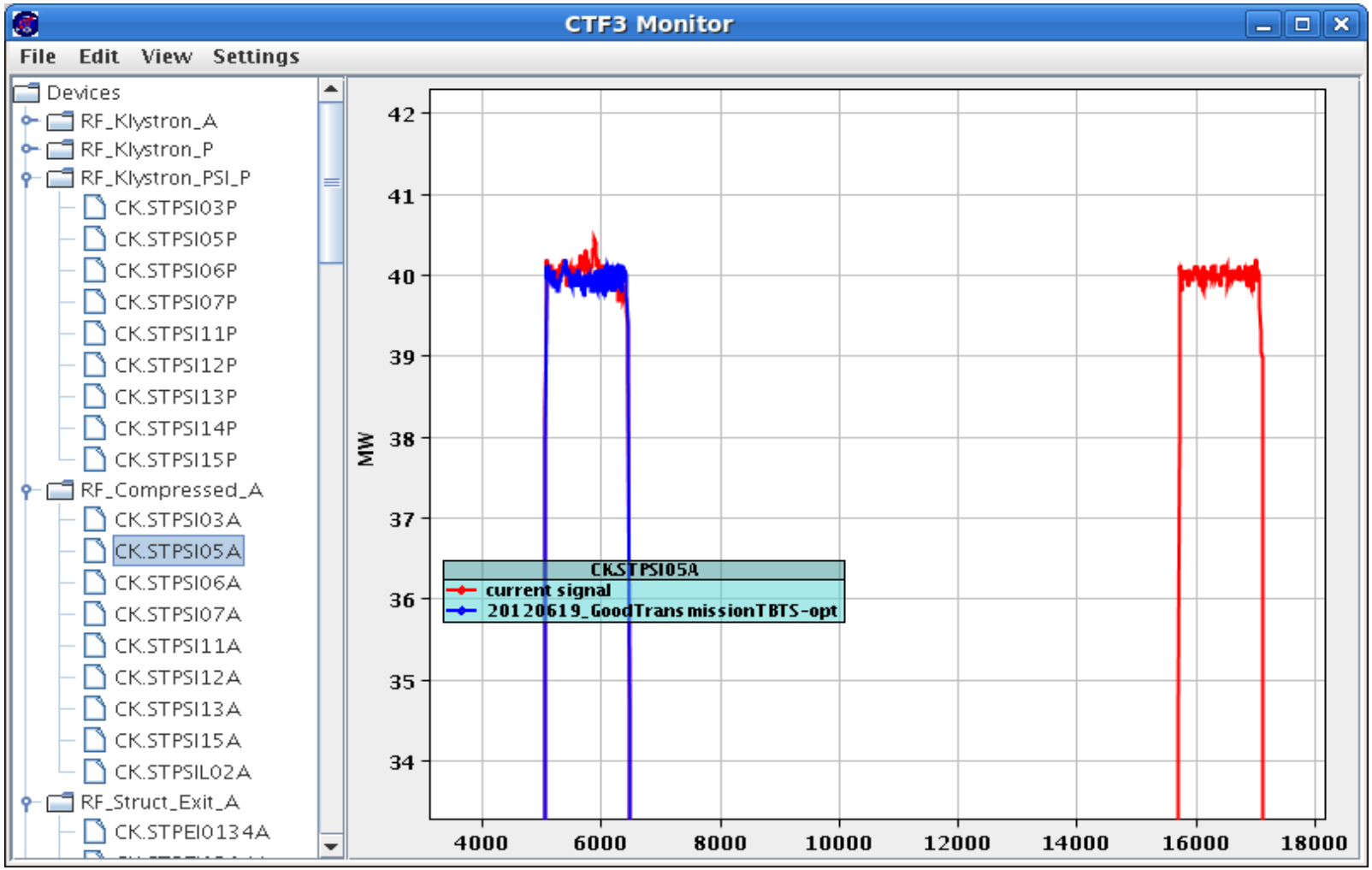
With beam



Solution to the problem

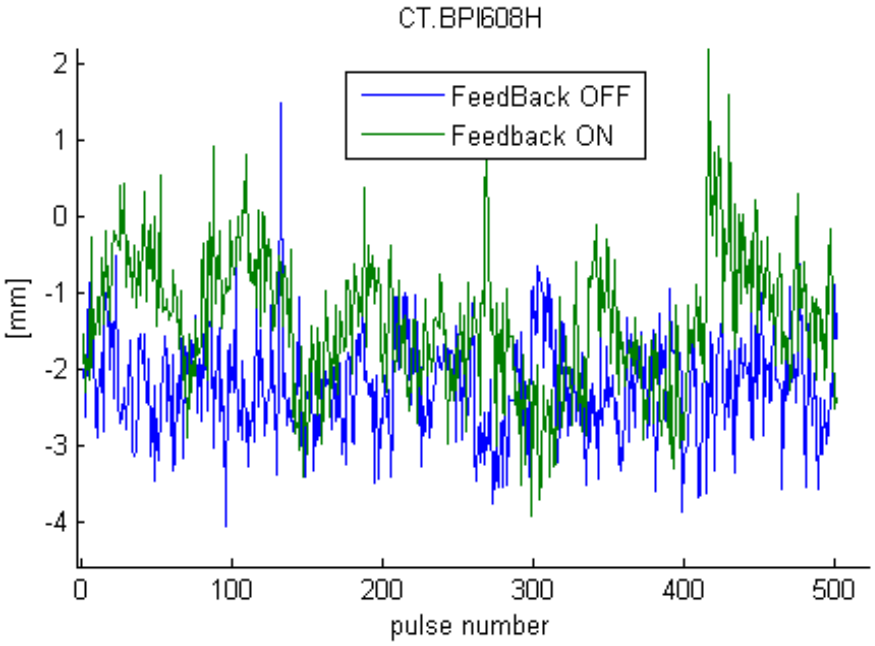
- It is hard to get rid of the reflections from the beam.
- Instead we now also sample the RF-pulse where there is no beam.
  - It is possible since we have a higher repetition rate on the klystrons then on the beam.
  - This setup will work up to 2.5Hz beam operation

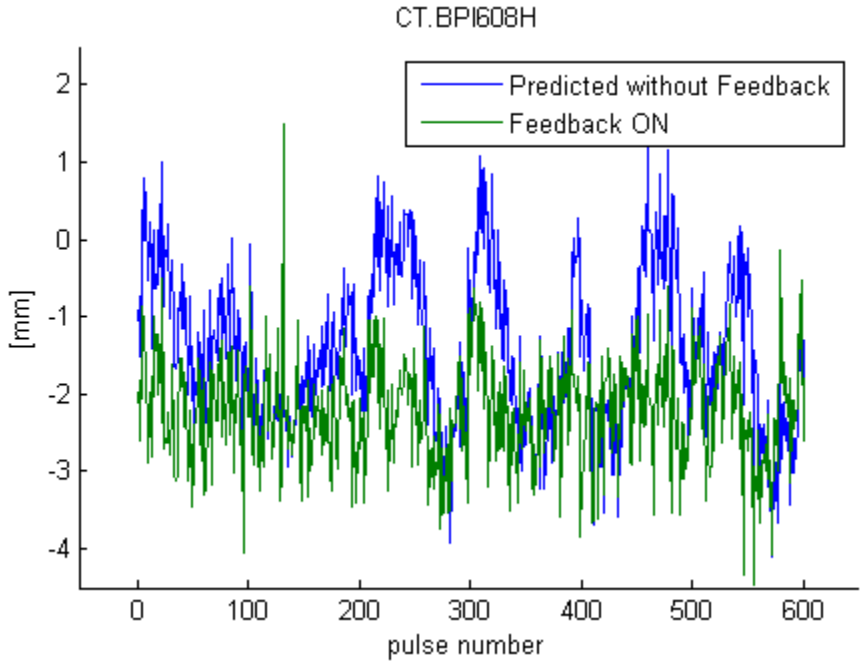
Example of how it works



Energy feedback

Requires that the beam is reasonably stable and that no big changes are done before in the machine.





Water station

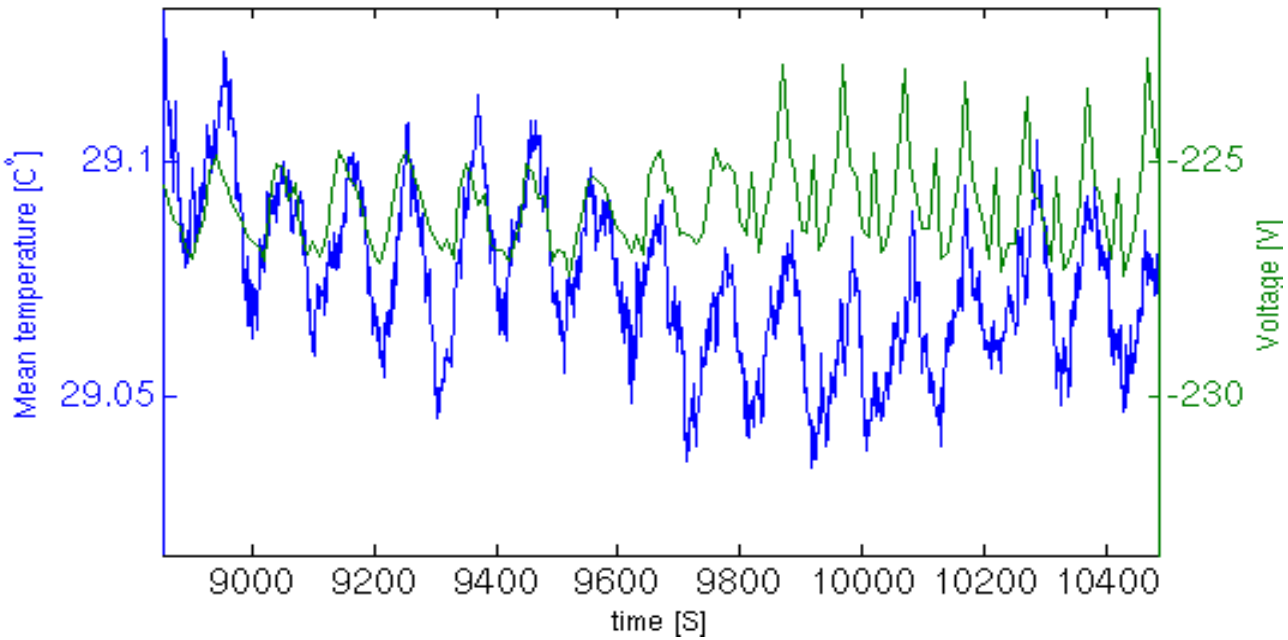
- Was very unstable during some parts of this years run.
- A lot of work has been done trying to understand the reason for the water oscillations, by Frank Tecker and Alexey Dubrovskiy
  - Deserve a presentation of it's own. Give just a very short summary.

Water station(2)

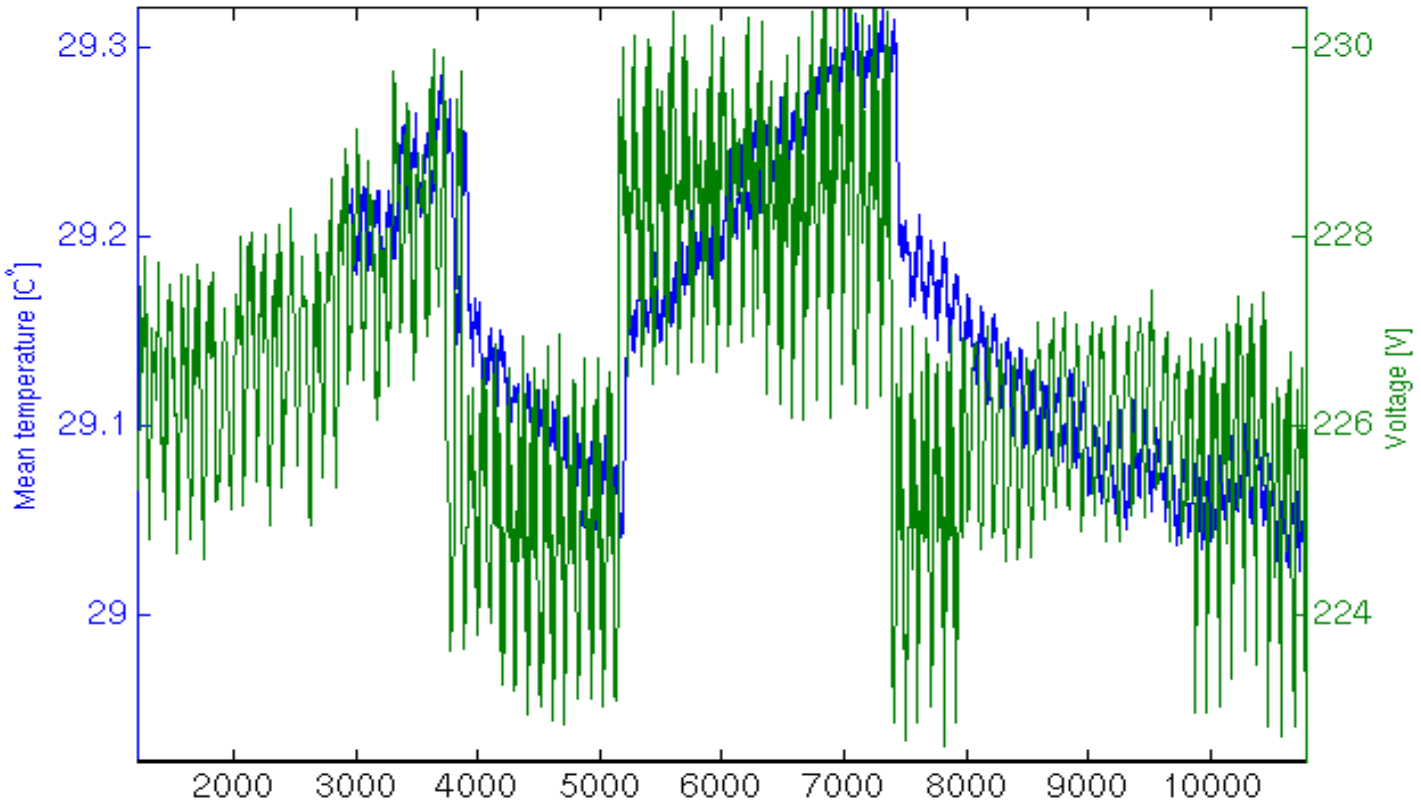
- The temperature variations have been linked to the variation in voltage on the 230V network
  - The idea now is that it is someway linked to the AD.
- The countermeasures proposed are:
  - To stabilize the voltage further.
  - Use the information of the voltage and compensate for it in the regulation of the water temperature. Alexey is currently working on this option.

Water and voltage

- The mean temperature for all the klystrons together with the voltage.
  - Note that there might be an small offset in time between the two curves.
  - The voltage is negative in order to be easier to compare the

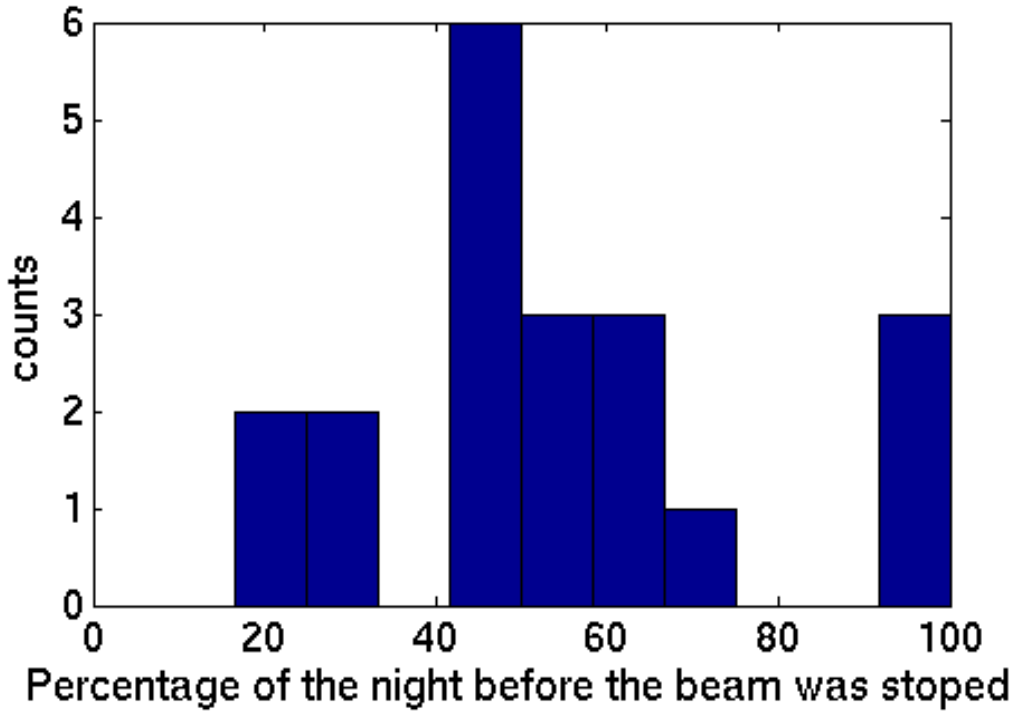


Water and Voltage

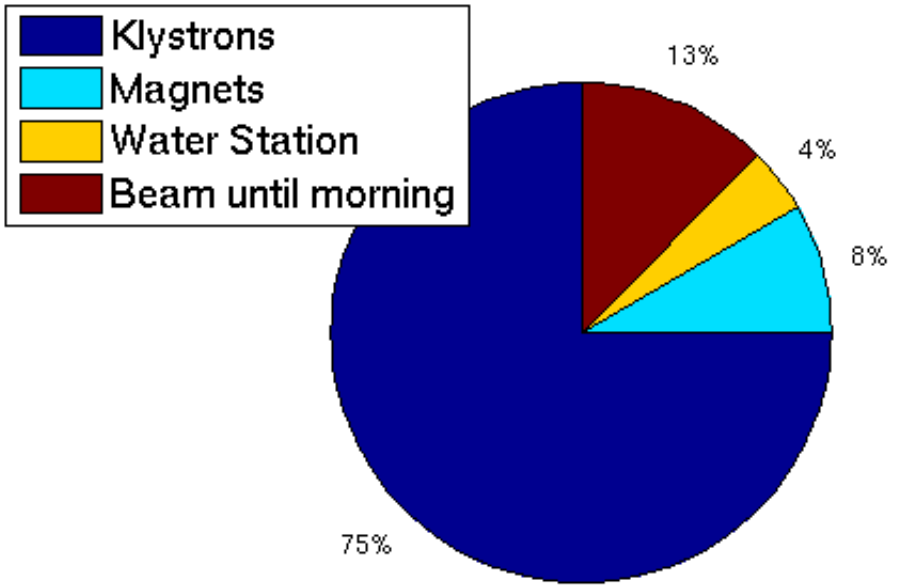


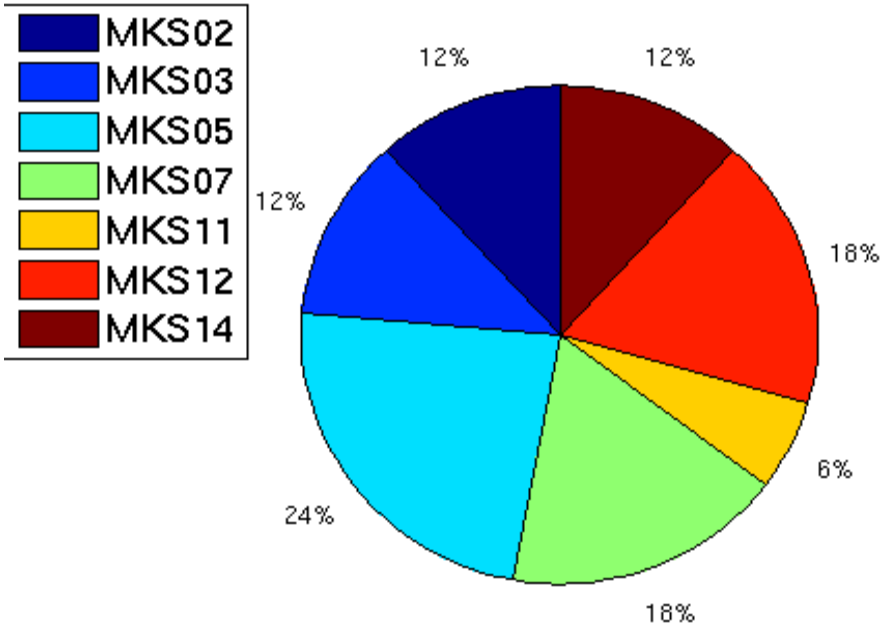
Over night operation

- Data taking from 1 of June until yesterday.
- On average 6.5h before the beam was stopped during night operation.



Why was the beam stopped ?





- ~80% of the problems with the klystrons could be solved by the normal operators.
  - Teach the operators in the CCC how to do this or a more “advance” automatic restart?

δῶς μοι πᾶ στῶ καὶ τὰν γᾶν κινάσω

Give me a fixed point and I will move the world, Aristotelse.

Give me a fixed point and I will decrease the emittance! , CTF3

Outlook

- A feedback to stabilize the injector is one it's way.
  - Will change the phase of 2 and 3 in order to stabilize loading and BPRs.
- Software to give clear warnings what has drifted.
  - When it will be more mature it will be turned into slow feedback.
- The idea is here not to stabilize the machine on the minute time scale but instead free up time for the operators to focus on other optimization.

Conclusion

- A lot of work has been done and more is ongoing to improve the stability of the machine.
- Beam current stability is not only about RF. We need to work on optics, orbit, closure, alignment etc to increase the acceptance.
- Not any new beam current stability records yet this year but with the new feedback in place and an improvement with the water stabilization I think we are in a good situation for the rest of the year.

Thank you for your attention!