Feedback upgrades [A.Drago]

In the present low energy DAFNE shifts, started in last December, the machine dynamic behavior is much more critical than for the usual layout at nominal energy.

This fact has pointed out the present major limits in the beam dynamics control and suggested the following upgrade. What we can do is:

I) For the e- longitudinal feedback, **more power (+750W)** to control **separately** dipole and quadrupole motions; this can help to maintain more stable the e- beam and probably to increase the threshold of e- blow-up in collision

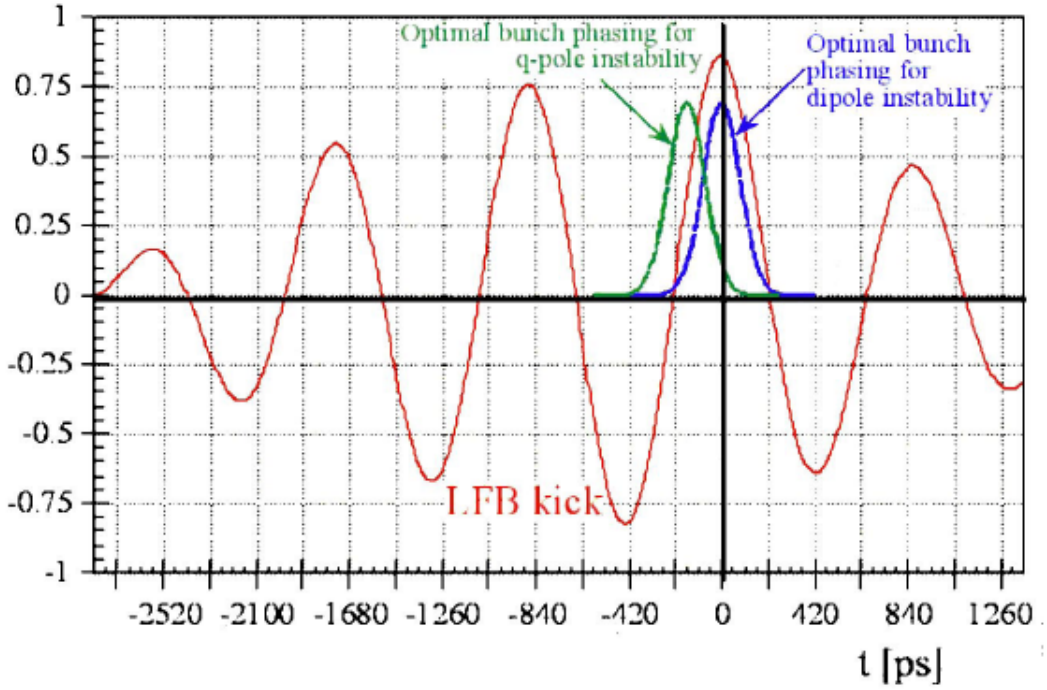
II) More feedback **selected gain** to control the transverse instabilities using the new SLAC-KEK modules FPGA based (e+ in both planes, eventually e- in both planes)

III) Complete **remote** control & monitoring of feedbacks and beam dynamics to give a faster and better diagnostics from outside DAFNE control room

Feedback upgrades / I

I.1) In the present setup, the longitudinal feedback system is used to damp the quadrupole as well the dipole oscillations using a timing scheme valid for both motions.

The backend timing is based on a compromise: damping the dipole motion as well the quadrupole by the use of a timing value in the middle of the two !



I.2) The present timing approach, based on this compromise, is not very convenient for the feedback backend section, because it uses power to damp the quadrupole motions to the detriment of the dipole damping power.

I.3) From the previous picture, it is clear that the backend timing is critical in a range of 20 psec and this value, often for the **e- beam**, this is not sufficient.

I.4) Splitting the longitudinal correction signal and doubling the backend stage (delay line + 3x250W power ampli's [+ eventually kicker]) in 2 identical sections will be possible to time one kick for dipole control as well the other kick for quadrupole control.

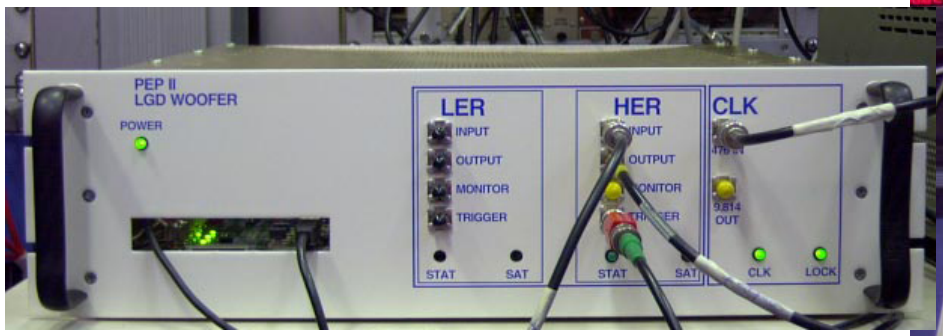
I.5) Hardware has been bought previously and is ready to be installed [99%]

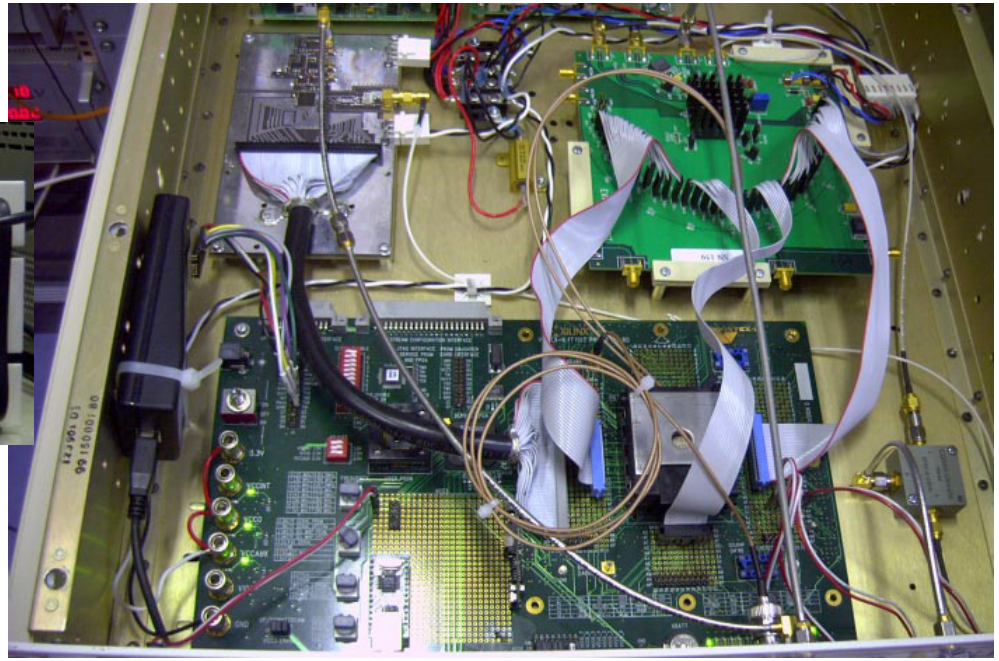
- # Feedback upgrades / II

II) More feedback **selected gain** to control the transverse instabilities using the new SLAC-KEK modules FPGA based (e+ in both planes, eventually e- in both planes)

II.1) Features:

- gain & phase digital and remote control
- possibility to manage low (any) betatron (synchrotron) tunes
- robust response to big oscillations due to injection
- real time parameter monitoring
- powerful beam diagnostics

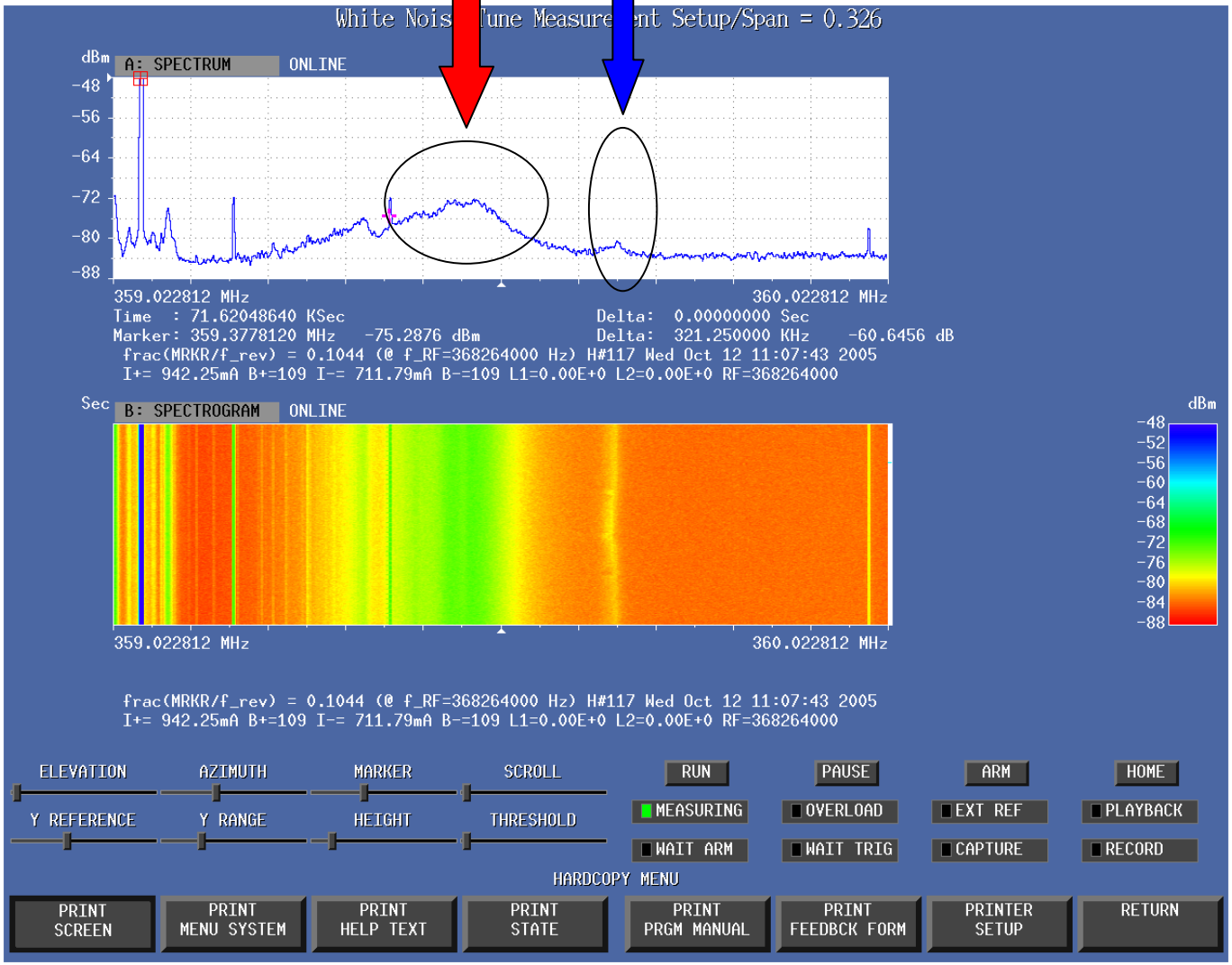




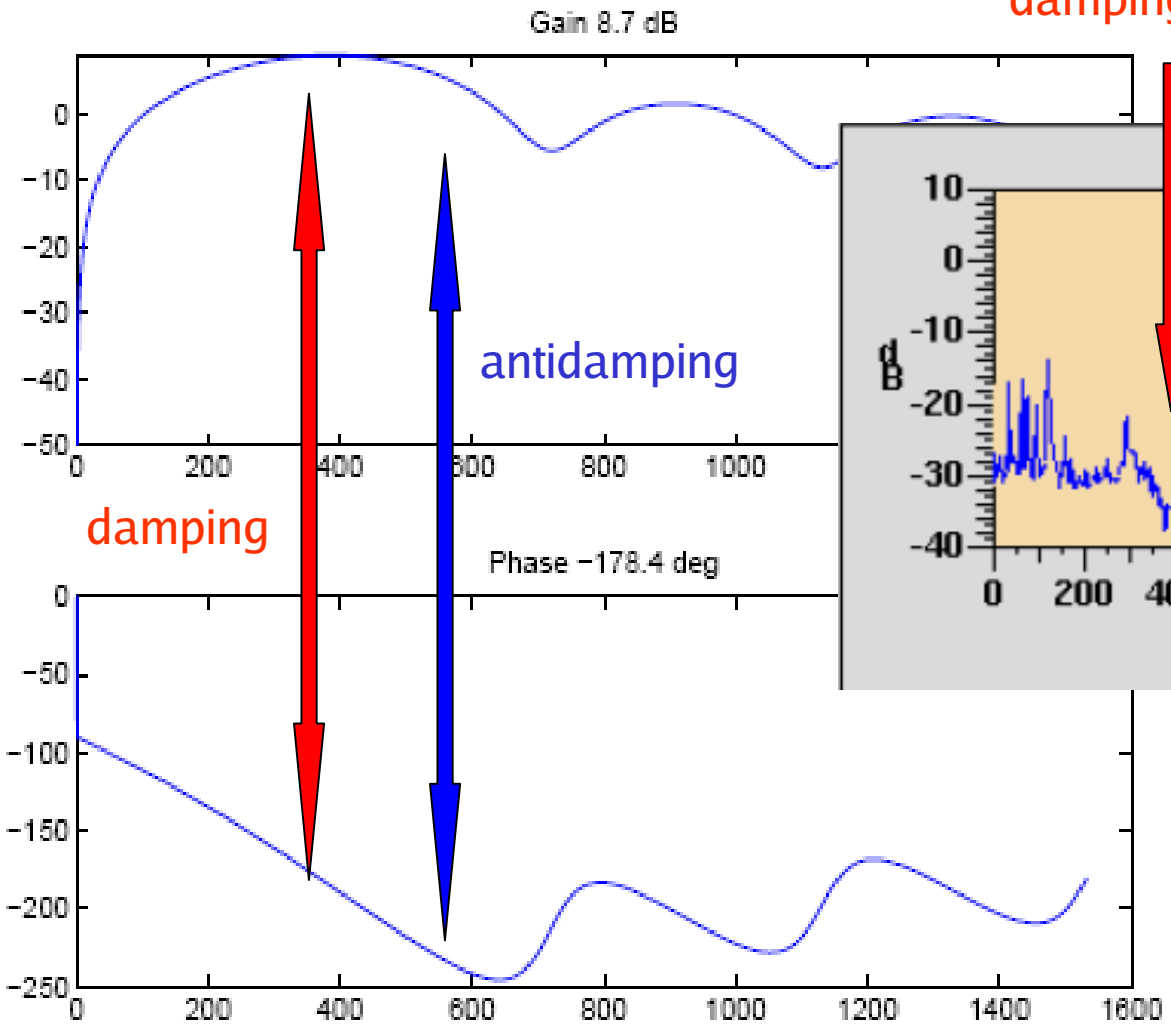
II.2) Problems to be investigated: more noisy than the analog

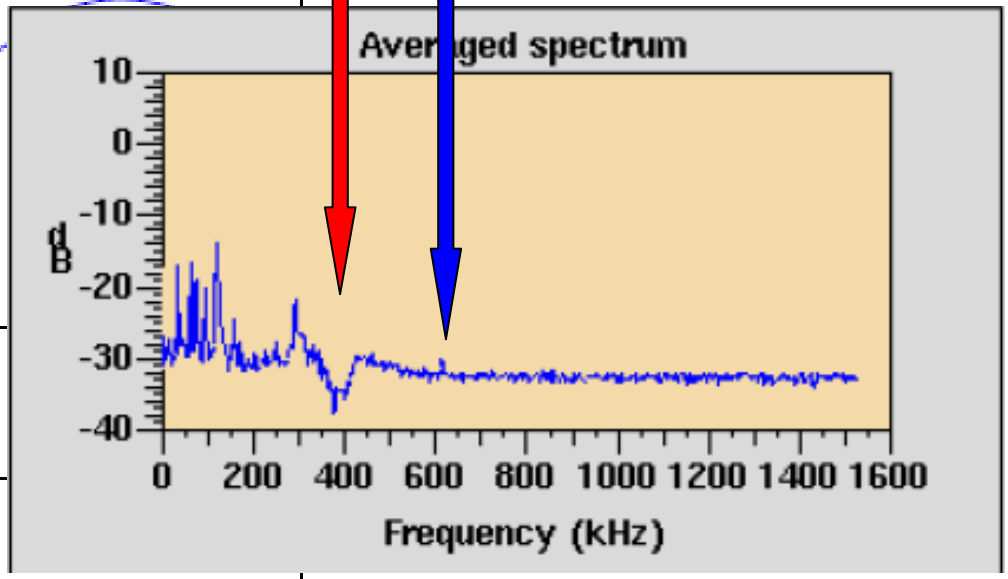
New digital feedback

Old analog feedback



- crosstalk between planes should be carefully evaluated: the new digital horizontal feedback can produce excitation on the vertical plane





FPGA feedback transfer function in real time

FPGA feedback transfer function of filter

II.2)Other Problems:

- bugs to fix
- it must be tested in vertical planes (emittance increase?)
- engineering in progress
- not all the functionality are included in the present version
- hardware / software maintenance

II.3) Costs:

- 30k–50k euro/each module, with develop outside LNF
- 5k euro if parts will be bought, assembled & tested at LNF

II.4) Important **Advantages**:

- it will permit to continue the important collaboration with the SLAC and KEK feedback teams
- It will be used for the DAFNE2 feedbacks and it **must be tested** on true accelerators before the final installation

Feedback upgrades /III

III) Complete **remote** control & monitoring of feedbacks and beam dynamics to give a faster and better diagnostics from outside DAFNE control room (e+/e- beam)

III.1) Advantages:

- increase of **integrated** luminosity due to a better and faster remote diagnostics

III.2) At the present a 30% of remote functions are implemented and currently running