Magnets, installation and orbit control

KEKB magnet group

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1. Power Supply to-do list

Power Supplies for Quadrupole Magnets

-M.Yoshida, et.al

- Six new power supplies are needed (HER).
  ⇒By the end of March

- Two power supplies need to be modified (HER).
- Cabling work
- Polarity change (D⇔F)
  ⇒During the summer shutdown 2005

2. Magnet installation & realignment to-do list

-R.Sugahara, et al.

- Installation of 4 new magnets in LER
  ⇒"Weak bend" magnets: BSWNLP.1&2
  BSWNRP.1&2
  ⇒Cabling work from the PS building to the tunnel has been completed.

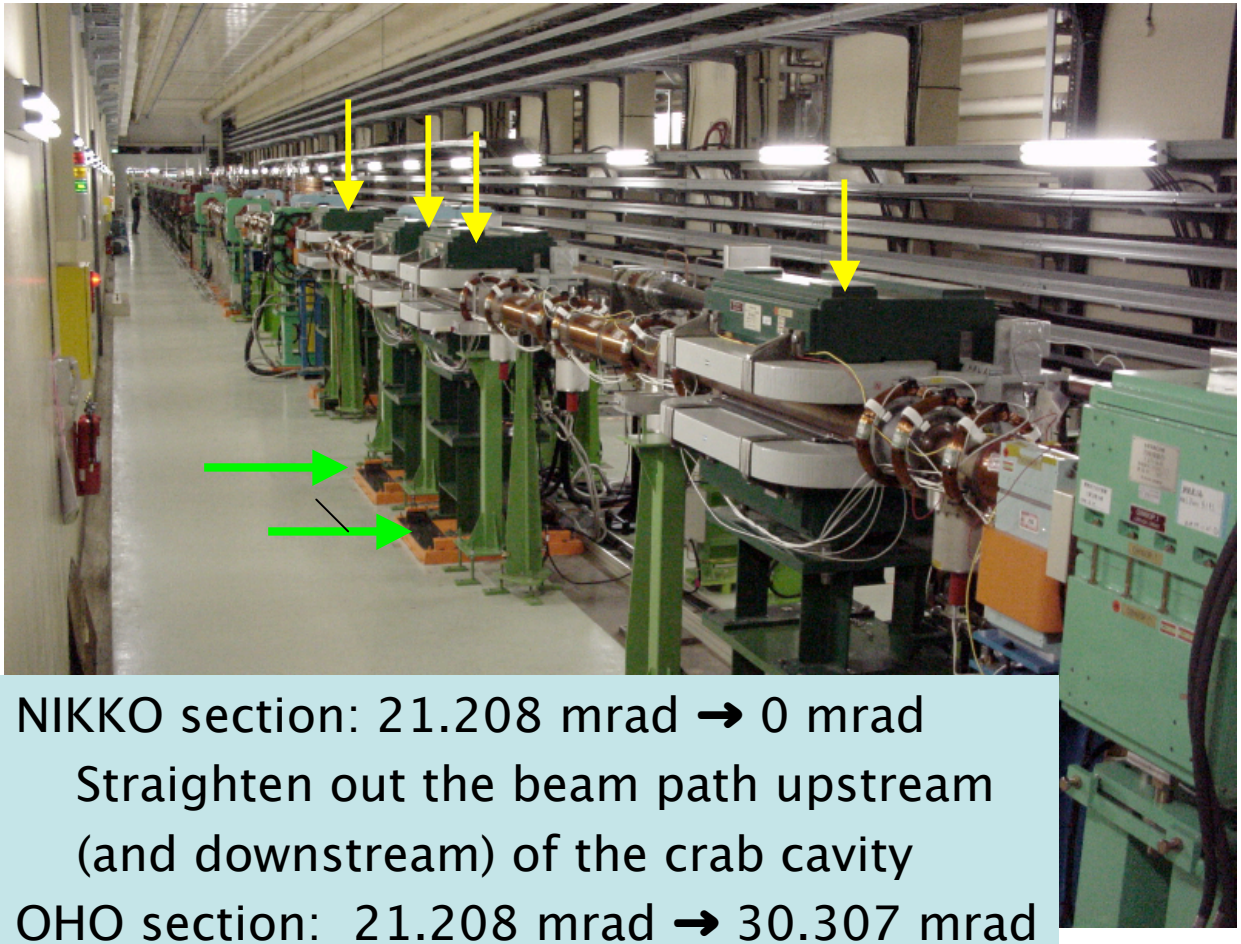
- Exchange the positions of 4 steering magnets
  ZHQS1NP.1⇔ZVQS1NP.1
  ZHQS1NP.2⇔ZVQS1NP.2

Realignment of the chicane magnets

4 sets of chicane magnets, each consisting of 4 bending magnets, at both sides of the NIKKO and OHO straight sections in the LER.

Originally used to compensate for the circumference difference between the LER and the HER.

They have also been used to keep the LER circumference constant since June 2001.



NIKKO section: 21.208 mrad ➜ 0 mrad
Straighten out the beam path upstream (and downstream) of the crab cavity
OHO section: 21.208 mrad ➜ 30.307 mrad

3. Orbit Control

-Y.Funakoshi & M.Masuzawa

Goal: To maintain the horizonal beam orbit at the crab cavities.

From the KEKB Review 2004,
"The horizontal position of the beam in the crab cavity must be controlled to approximately +/1mm to avoid loss of control of the crabbing mode field due to beam loading. In the HER with βx=200 m this corresponds to 0.5 beam sigma. A reliable feedback system will be needed to minimize beam aborts from exceeding this limit."

3. Orbit Control

Similar to the collision feedback system called “iBump.”

⇒Orbital feedback system at the IP, used to maintain good collision conditions.

- 12 steering magnets (8 vertical and 4 horizontal) in HER.
- Use QCS BPM readings (every 3-4 seconds) to calculate the beam-beam kick at the IP and monitor the collision.

This iBump feedback system has been working well.

3. Orbit Control

For crab orbit feedback:

- Use 4 horizontal steering magnets to make a offset bump for each ring.

⇒Need 8 magnets

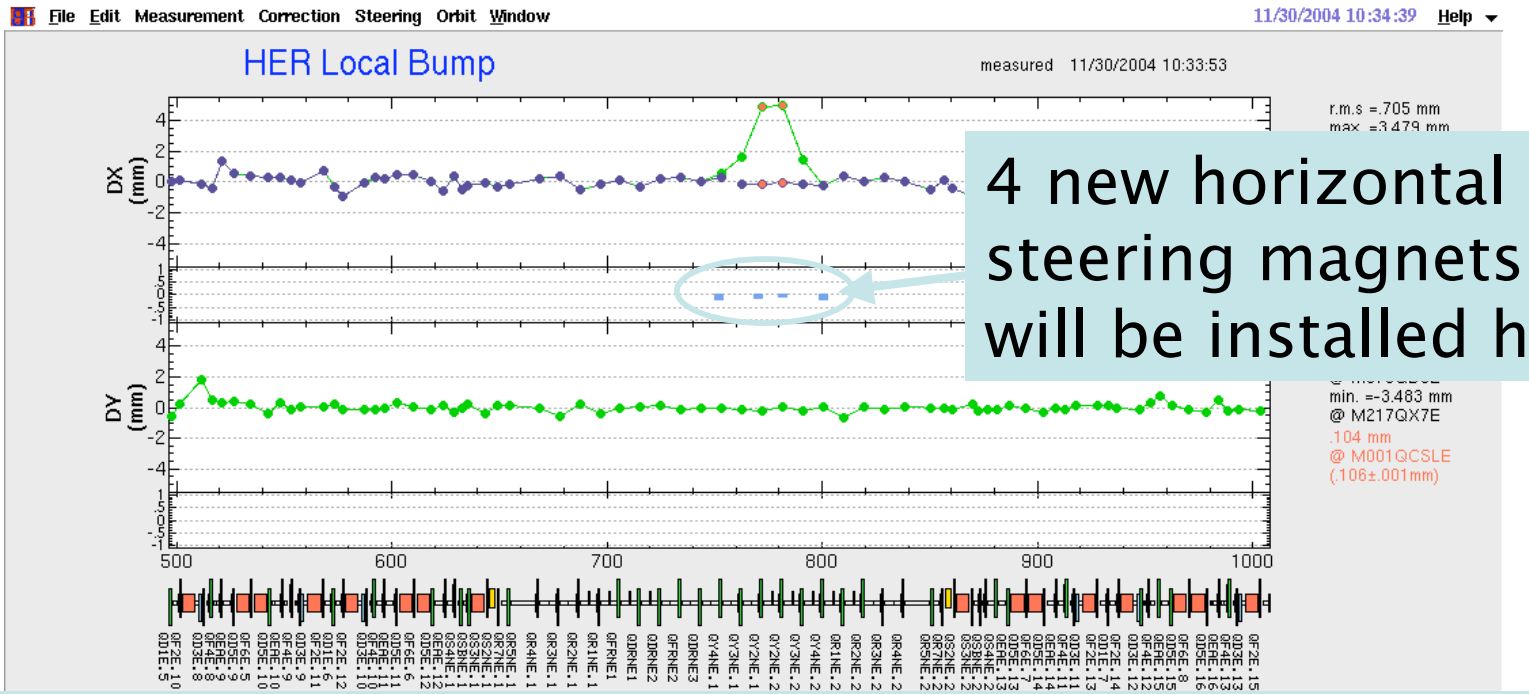
Only horizontal orbit feedback is considered at this point.

- Use BPM readings to monitor the offset at the crab cavity.

⇒2 upstream (entrance) BPMs and 2 downstream (exit) BPMs around the crab cavity. 1 Hz read-out speed

- (Or/and RF beam loading for monitoring.)

Bump Orbit (HER)

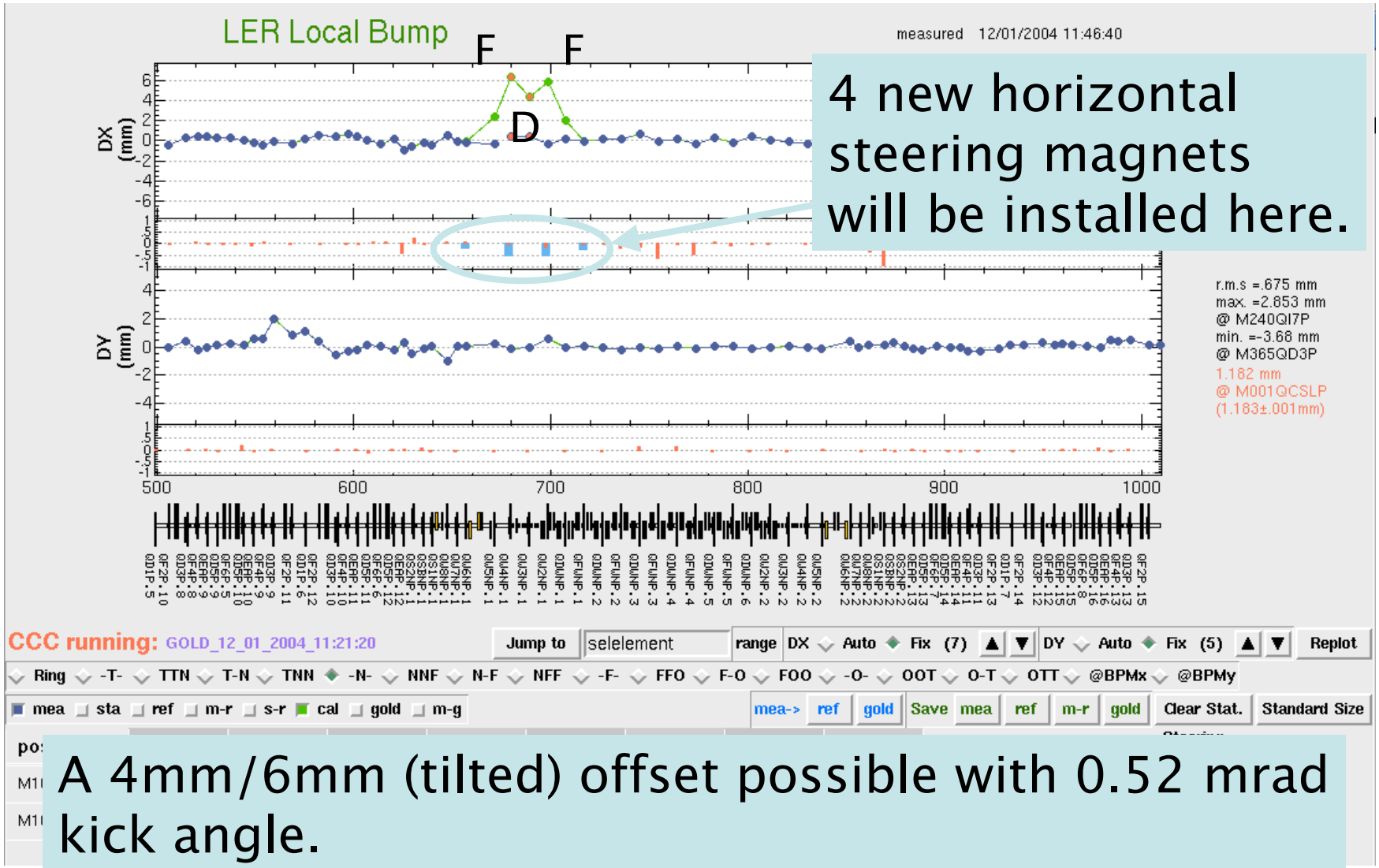


4 new horizontal steering magnets will be installed here.

If Δx at crab cavity is measured to be +1 mm, create a -1 mm bump using these 4 steering magnets. (5 mm offset bump with 0.2 mrad kick angle possible)

⇒The idea is to make a bump which cancels the unwanted offset at the crab cavity.

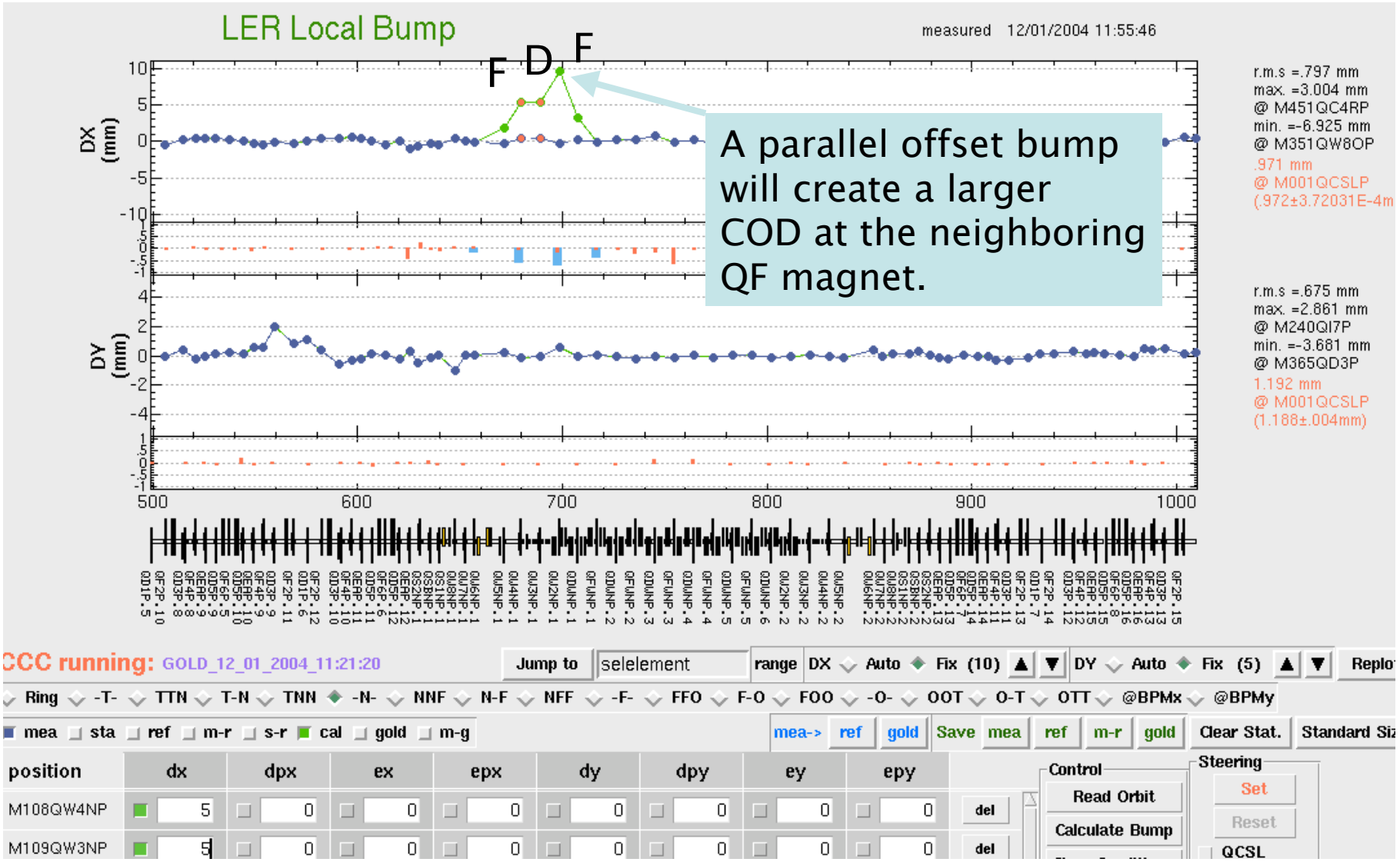
Bump Orbit (LER)



4 new horizontal steering magnets will be installed here.

A 4mm/6mm (tilted) offset possible with 0.52 mrad kick angle.

Bump Orbit (LER)



Orbit feedback magnets & power supplies

- Use spare magnets and magnets not being heavily used (horizontal steering magnets at defocusing quadrupole magnets, for example).

⇒New fabrication not needed.

- Same type of power supplies as the iBump (collision feedback) system.

We have not had any serious problems with the above components since the start of the beam commissioning and we are comfortable with them.

Orbit feedback : Control system

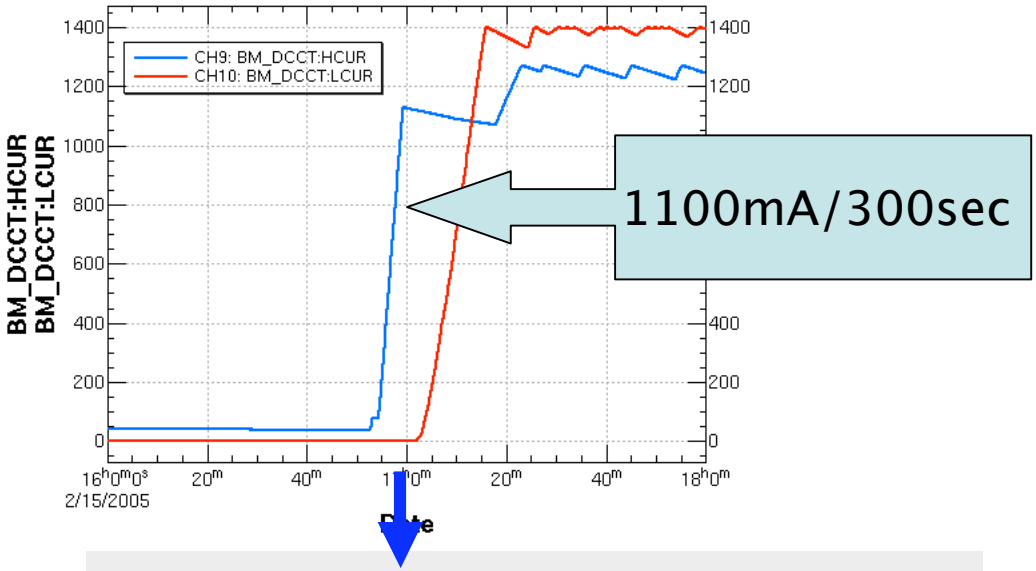
- Epics based control system will be used.
- System design (VME? PLC? etc) is under way, with the help of the KEKB control group (T.Nakamura, et.al).
- System will be tested before the summer shutdown.

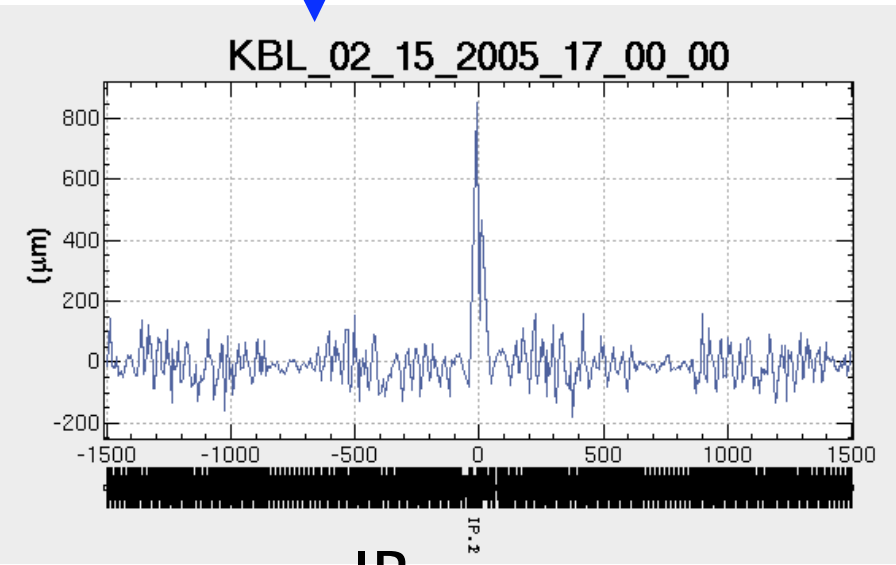
Check list

- Can the feedback system suppress sudden changes in the horizontal orbit?
- What kind of sudden orbital changes need to be taken care of by this system alone?
- A big/sudden orbit change has occurred during injection from 0 mA, for example.

- Speed: BPM read-out time, magnet response time…
- Size of the orbit bump: Max. kick angle big enough or too much?

Example of COD after aborts





IP

- CCC, global orbit correction, corrects the COD every 10-20 seconds.
- We have seen rather large COD after the aborts.
- Crab orbit feedback is expected to correct the local orbit much faster than CCC.

Horizontal COD 180μm in the arc section where βx ~20m.
With βx ~200m @ crab
Sqrt[200/20]*180μm
~ 600 μm

Orbit Feedback: Schedule

- Test of the control system planned in spring.
- Installation of the magnets will be done during summer 2005.
- The feedback system will be debugged and tested from the fall beam operation.
- No crab cavities in the beam line yet in the fall, however we will be running the machine with “crab optics”.

⇒Good opportunity for testing the feedback system.

⇒Feedforward into design modifications.