Dispersion Measurements at the VUV-FEL

Accelerator Studies – Week 14 2006

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XFEL Beam Dynamics Meeting, 10 April 2006
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Overview

INTERMEDIATE GOAL
Obtain a dispersion in the undulator smaller than 1 cm in both planes

GOAL of WEEKS 14&16
- Measurement of orbit and dispersion response for all the steerers and quads
- Measure and correct dispersion

DIFFICULTIES (week 14)
- Charge instability
- Losses in the undulator

ACHIEVEMENTS (week 14)
- Successful test of on-crest phase measurement (ACC1)
- Measured orbit & dispersion response for 18 steerers (up to ACC2)
Beam jitter too high during part of the shift...

100 pulses: Data/2006-04-05T173803/
q(3GUN) = 0.99±0.06 nC; q(9DUMP) = 0.91±0.04 nC
On-crest phase measurement

- The idea is to make a phase scan and look at the orbit response in the BPM's.
- For each BPM a 2nd order fit is done, and maximum/minimum is derived.
- Maximum/minimum corresponds to the on-crest phase.
- This method is very reliable since all BPM's in the machine can be used.
On-crest phase measurement (ACC1)
On-crest phase measurement (ACC1)
On-crest phase measurement (ACC1)
Orbit and dispersion response measurements

Orbit response

\[ O_{i,j} = \frac{\Delta x_i}{\Delta \theta_j} \]

Dispersion response

\[ D_{i,j} = \frac{\Delta D_i}{\Delta \theta_j} \]

\[ \frac{\Delta x_i}{\Delta D_i} \quad \text{---------} \quad \text{change of the orbit / dispersion at the BPM } i \]

\[ \frac{\Delta \theta_j}{\Delta \theta_j} \quad \text{---------} \quad \text{change of the kick angle of the steerer } j \]

We measured the response for the following correctors:

- H10ACC1 - H1UBC2 - H1DBC2 - H2DBC2 - H4DBC2 - H5DBC2 - H8DBC2 - H9DBC2 - H11DBC2
- V10ACC1 - V1UBC2 - V1DBC2 - V2DBC2 - V4DBC2 - V6DBC2 - V8DBC2 - V10DBC2 - V11DBC2
Orbit and dispersion response measurements
example: H10ACC1

Orbit Response for H10ACC1

Dispersion Response for H10ACC1
Orbit and dispersion response measurements
example: H4DBC2
Orbit and dispersion response measurements example: V10ACC1

Orbit Response for V10ACC1

Dispersion Response for V10ACC1
Difference between measurements and simulations (horizontal case)

Difference between simulated and measured orbit response (2)

Difference between simulated and measured dispersion response (2)
Difference between measurements and simulations (vertical case)

Difference between simulated and measured orbit response (V10ACC1, V1UBC2, V1DBC2, V2DBC2, V4DBC2, V6DBC2, V8DBC2, V10DBC2, V11DBC2)

Difference between simulated and measured dispersion response (V10ACC1, V1UBC2, V1DBC2, V2DBC2, V4DBC2, V6DBC2, V8DBC2, V10DBC2, V11DBC2)
Summary & next measurements

- Successful test of on-crest phase measurement using the orbit response in the BPMs

- Measured orbit & dispersion response for 18 steerers. Still remaining about 40 steerers and 20 quad movers.

- Next steps:
  - Analyze obtained data (J. Keil)
  - Measure response for the rest of steerers and quads (~1.5 shifts)
  - Measure and correct dispersion along the machine (3 x ½ shifts)
Thank you!