# Results of beam-based alignment in undulator section

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Goal:

align all quadrupoles between undulator modules

to get straight trajectory in undulator section

to increase the overlap between electrons and photons

so that the SASE process can take place in the whole undulator section

# BBA in undulator: steps (overall plan)

1) measure relative offset between quadrupoles and BPM (or wire-scanners)
2) align quadrupoles to the beam (after de-Gauss of undulator quadrupoles)
3) measure dispersion in undulator section (masking incoming dispersion) and correct

up to now: only step 1 done

Requested: 6 shifts und.BBA: 4 first step, 2 alignment

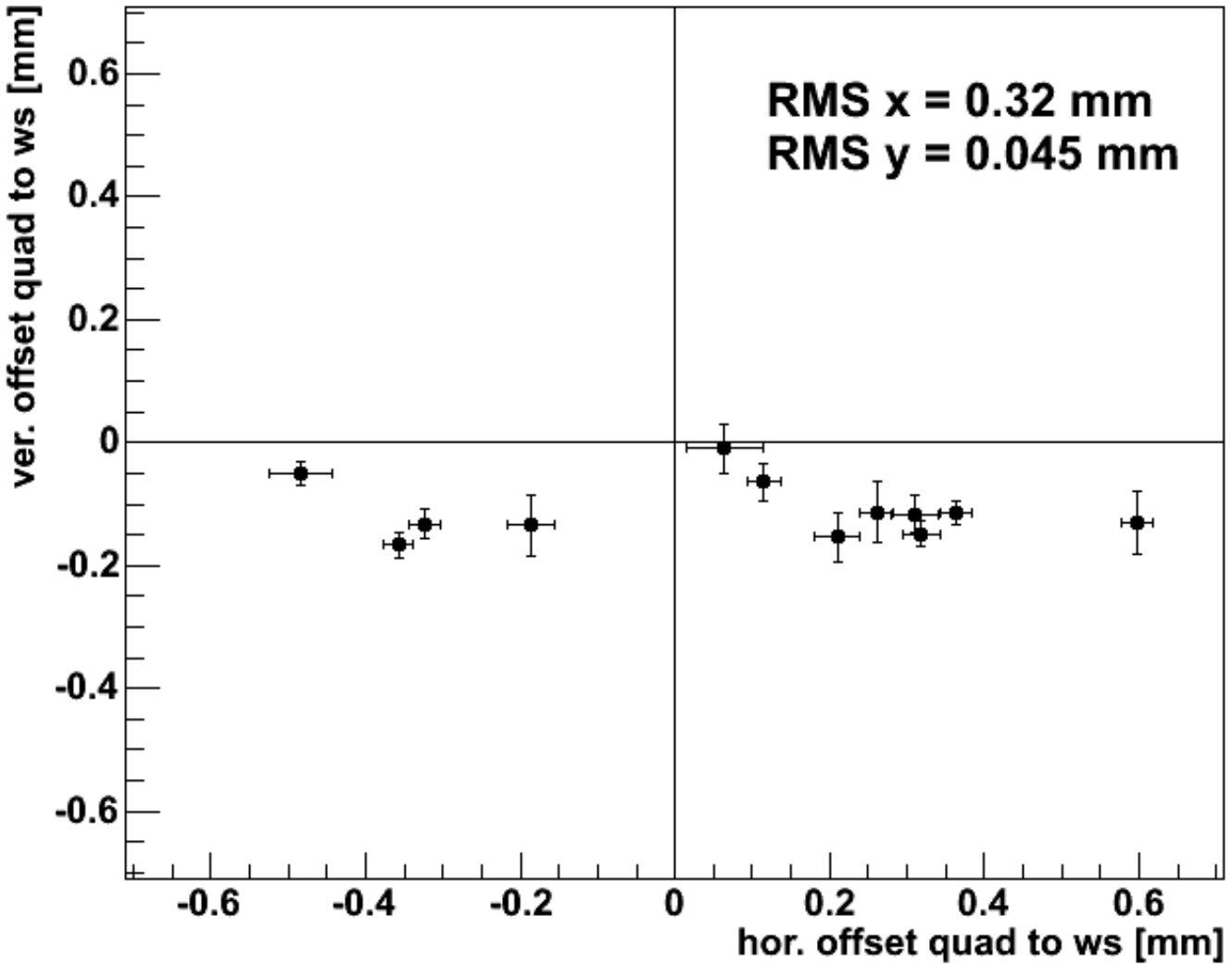
# Program: 6 shifts und.BBA

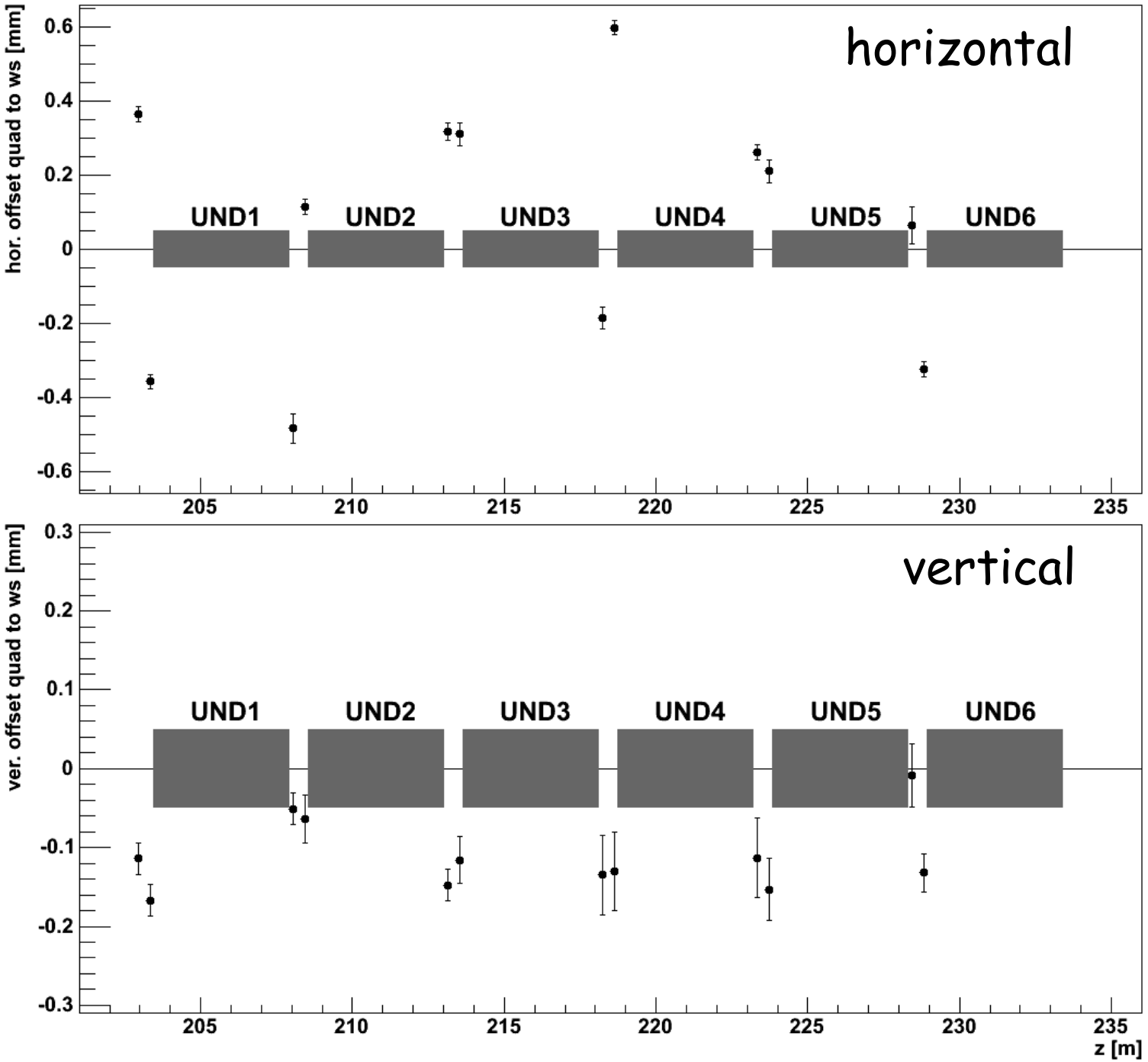
| | Previous exp. | tuning | BBA | Accum. dosis | done |
|---|---|---|---|---|---|
| 05.10_n | 8 h | - | - | - | - |
| 06.10_n | 1 h | 3 h | 4 h | 1 Gy | Q5UND2 |
| 08.10_M | 1 h | 2 h | 6 h | 1 | Q21,Q22SEED Q5UND5 |
| 09.10_a | - | 1 h | 7 h | 8+8 | Q5,Q6UND4 Q6UND2 |
| 10.10_a | - | 3 h | 5 h | 14+2 | Q5,Q6UND1 Q6UND5 |
| 11.10_a | - | 4 h | 4 h | 20+1 | Q5,6UND3 |
| total | | 13 h | 26 h | | 12 quads |

(3.2 shifts measurement time)

13 Gy in 26 h of BBA

# Offset between quad reference and wirescanner reference




horizontal
hor. offset quad to ws [mm]
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
UND1
UND2
UND3
UND4
UND5
UND6
205
210
215
220
225
230
235
vertical
ver. offset quad to ws [mm]
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
UND1
UND2
UND3
UND4
UND5
UND6
205
210
215
220
225
230
235
z [m]

# Next steps (14-27 Nov.):

1) measure relative offset between quadrupoles and BPMs (or wire-scanners)

   done

2) align quadrupoles center to the beam center (after de-Gauss of undulator quadrupoles)

   2 shifts

3) search + improve SASE with aligned quads

   1 shift

# Procedure

- Step 2:

  Preparation: de-Gauss all undulator quads (3 hours, no beam in undulator)

  Get beam through undulator with small losses

  Align the quads to the beam

- Step 3:

  Prefered: after a SASE run (to know which RF settings we need)

  De-Gauss + set aligned quads

  Get SASE: change incoming orbit + change RF settings

  (do NOT change quad positions)

# Beam requirements

- minimum 1 bunch, 5 or 10 preferable
- on-crest acceleration in all ACC (for stable beam orbit and to get good beam profiles)
- all slow orbit feedback OFF

# Hardware requirements

- wire-scanners in undulator section
- BPMs in undulator section

# Software requirements

- program to de-Gauss quads: ready+tested
- program to analyse wirescans: ready+tested
- program to display difference orbit in undulator: ready+tested