PSB orbit correction (II)

continuation from the presentation in the LIS Meeting 11.02.2008

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Thanks to T. Dobers and his team

- Summary of 2007 studies and alignment surveys during shut-down
- 2008 orbit measurements at the PSB and second iteration for H correction
- Results

Summary of last year's studies

⇒ Following M. Chanel's proposal, PSB orbits were measured in 2007 and the data were used during the shutdown to find out which QDEs could be displaced and/or tilted to improve both the horizontal and vertical orbits.

⇒ The correction algorithm took into account the way the **displacements and/or tilts of the QDs** would affect each ring

⇒The ring by ring displacements of the QDs (Δx_i, Δy_i) are not independent in the PSB, because all the QDs share the same support. The independent variables are the displacement and tilt angle of the full block (Δx, Δy, α).

⇒It could find separately the best correctors in H and V plane and evaluate the goodness of the correction

$$\begin{pmatrix} \Delta L \cdot \vec{\alpha} \\ \vec{\Delta x} \\ \vec{\Delta y} \end{pmatrix} = -\left(\bar{\mathcal{R}} \cdot \bar{\mathrm{K}}\right)^{-1} \cdot \begin{pmatrix} \vec{\Delta x}_{o1} \\ \vec{\Delta y}_{o1} \\ \vec{\Delta x}_{o2} \\ \vec{\Delta y}_{o2} \\ \vec{\Delta x}_{o3} \\ \vec{\Delta y}_{o3} \\ \vec{\Delta x}_{o4} \\ \vec{\Delta y}_{o4} \end{pmatrix}$$

Summary of last year's studies

⇒ First proposal: move 7 correctors in total, 6 for the horizontal plane (QD2, QD8, QD9, QD10, QD13, QD15) and 3 for the vertical plane (two in common with the horizontal plane, QD8, QD9, QD16).

⇒ Good horizontal correction but lose a few % in the vertical plane with respect to using the 3 best correctors

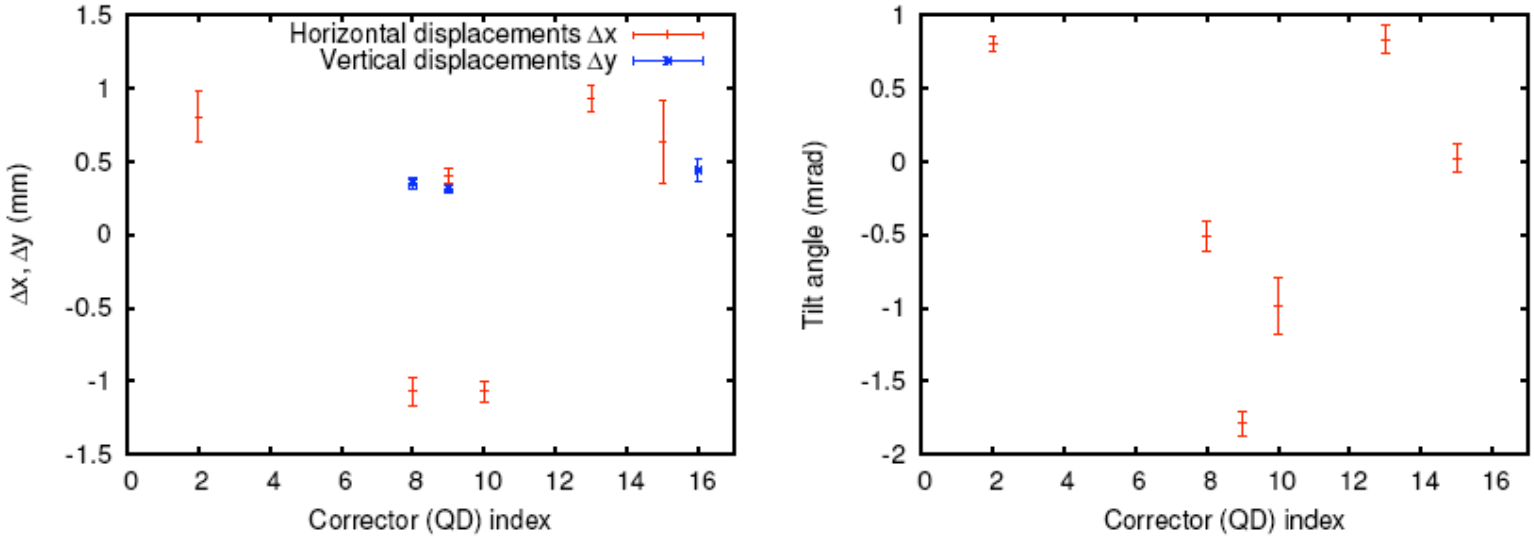
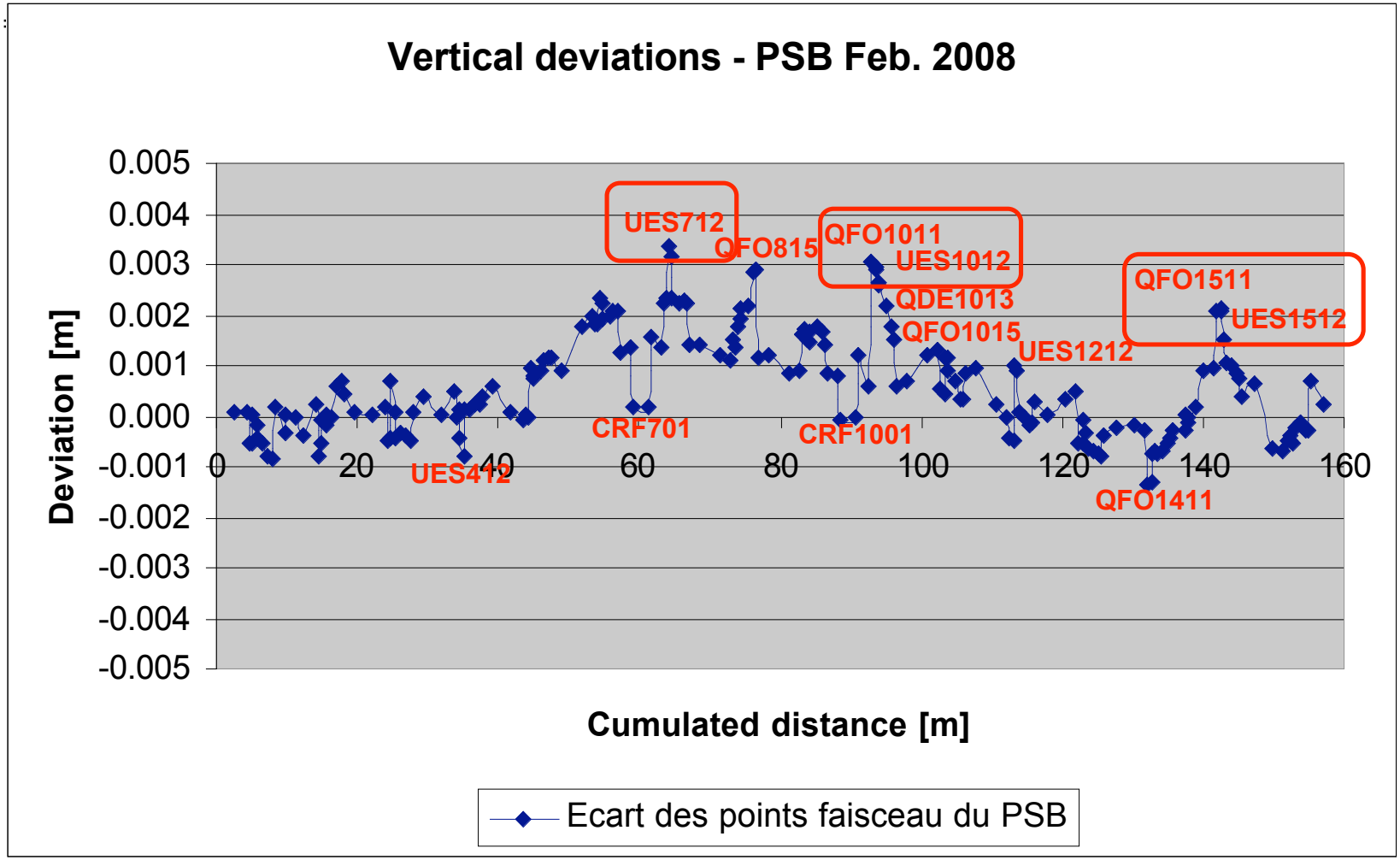


Figure 12: Corrections calculated using the 6 strongest correctors for the horizontal correction and 3 correctors for the vertical correction (two strongest ones and a third common to the horizontal plane). Data from ring 3 were not considered in this analysis.

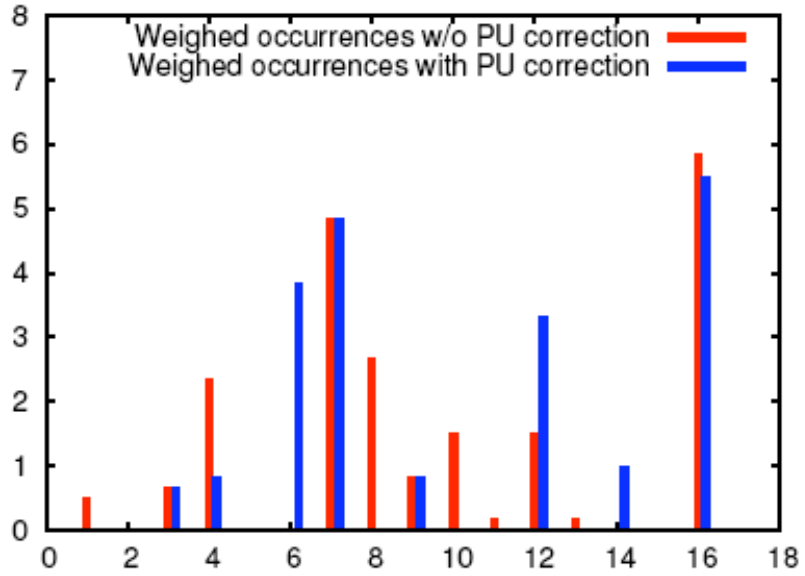
Summary of last year's studies



Summary of last year's studies

⇒ Re-calculate the strongest correctors and the optimum correction in the vertical plane using the corrected PU data. While QD16 and QD7 remain the strongest correctors to achieve a good vertical orbit correction, QD6 appears to be the third strongest.

⇒ The best 3 correctors (QD6, QD7, QD16) give residuals up to 20-30% better than the 3 correctors proposed in the previous scheme and allow gaining nearly up to 1 mm in the peak-to-peak orbit.



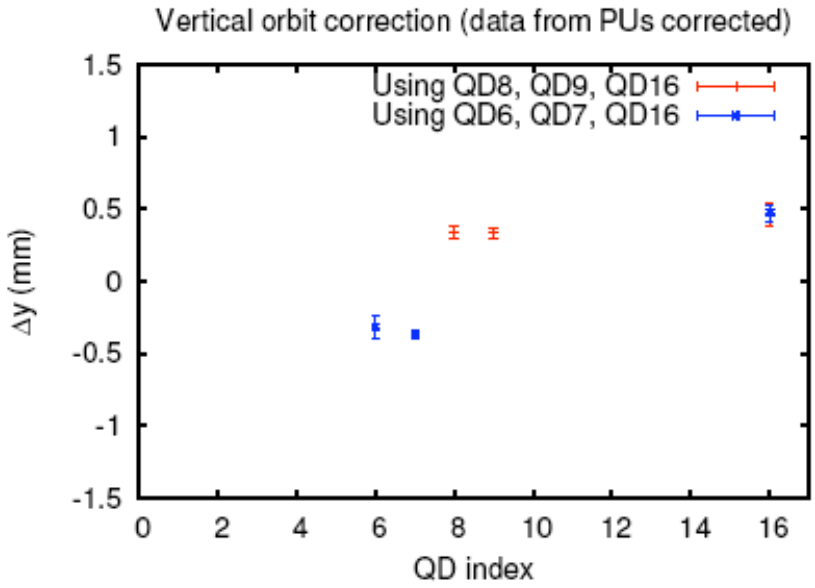


Figure 13: Corrections calculated using the 6 strongest correctors for the horizontal correction and 3 correctors for the vertical correction (two strongest ones and a third common to the horizontal plane). Data from ring 3 were not considered in this analysis.

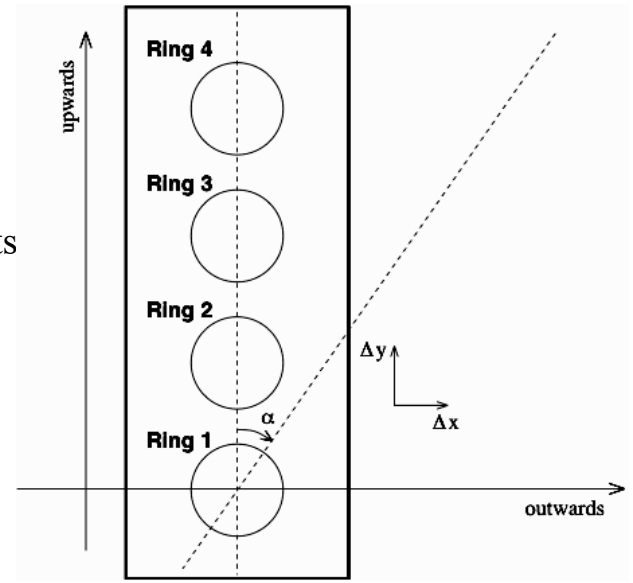
Summary of last year's studies (requested changes)

Horizontal movement of QD's (positive values go towards the outside of the ring; see our sign convention in the attached file):
QD2: +0.80 mm
QD8: -1.07 mm
QD9: +0.40 mm
QD10: -1.07 mm
QD13: +0.93 mm
QD15: +0.64 mm

Tilt (the reference ring is the bottom ring 1; positive tilt goes towards the outside of the ring):
QD2: +0.80 mrad
QD8: -0.50 mrad
QD9: -1.79 mrad
QD10: -0.98 mrad
QD13: +0.84 mrad

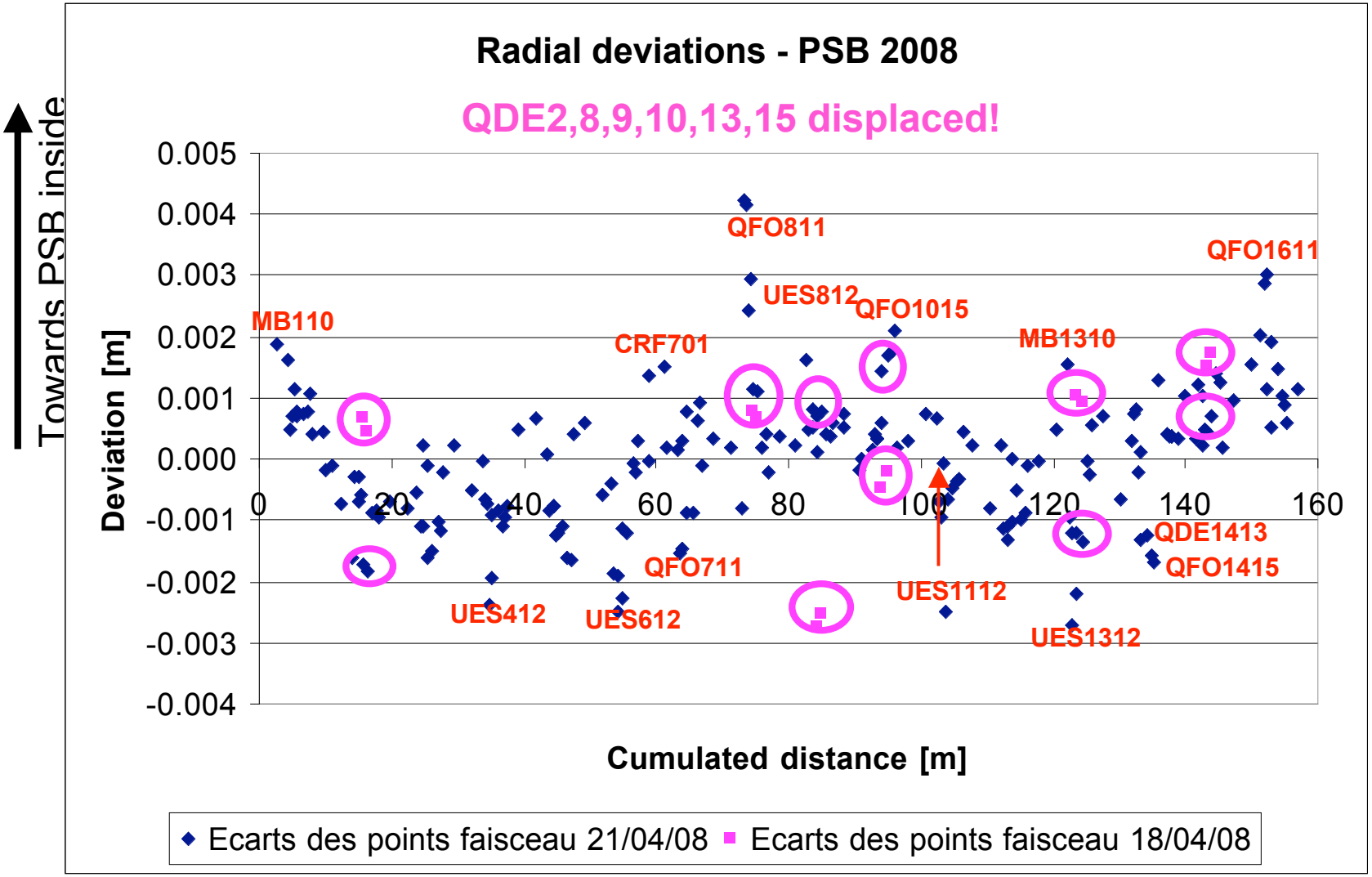
Vertical movement of QD's (positive values go upwards); 3 magnets
QD6: -0.35 mm
QD7: -0.4 mm
QD16: +0.43 mm

The correction therefore affects 9 different magnets.



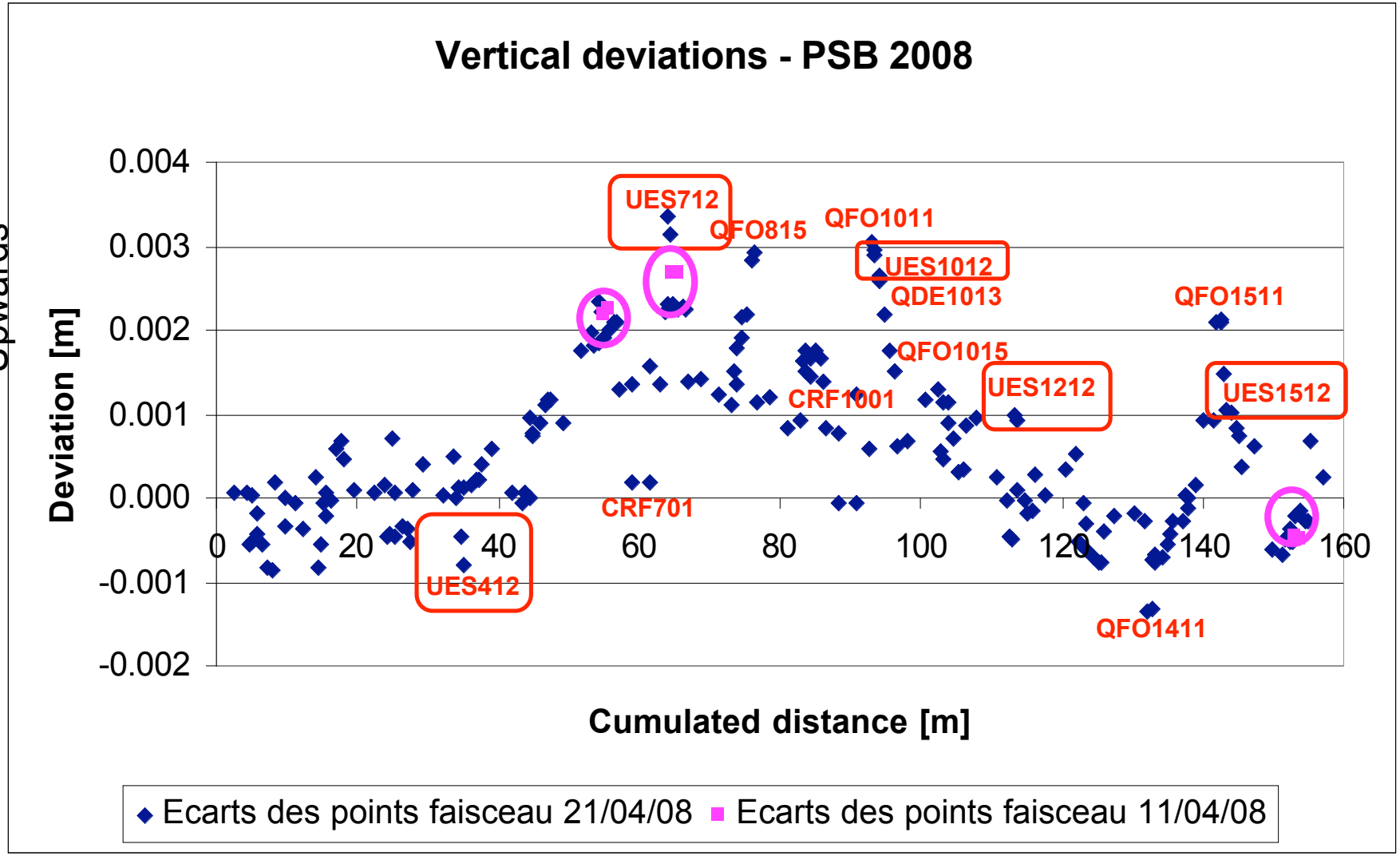
Summary of last year's studies (requested changes)

Positions measured after voluntary displacements: the offsets are much larger than requested.



Summary of last year's studies (requested changes)

Positions measured after voluntary displacements: they match with the requested offsets within tolerance



Orbit measurements on the 28.04.2008 and 04.05.2008

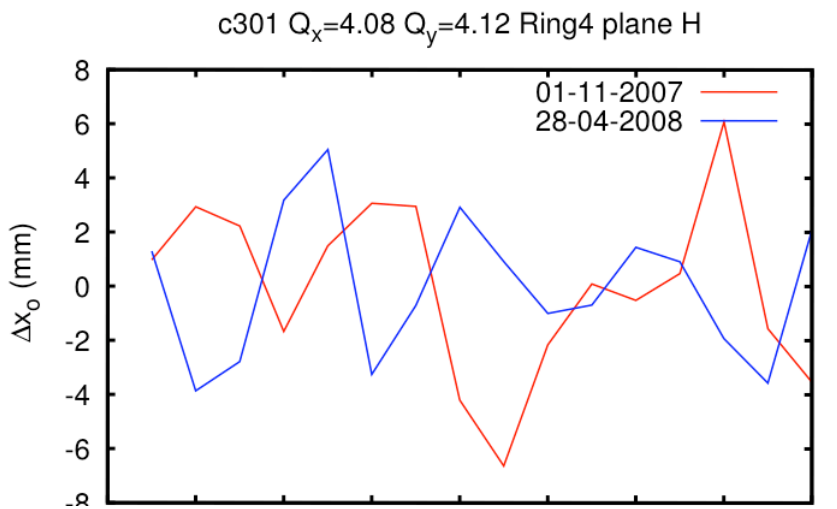
⇒ **User:** MDPSB; copy of NORMHRS (sieve, ~5e11 p/ring, vertical correction dipoles = 0, flat C02/C04 functions at measurement points)

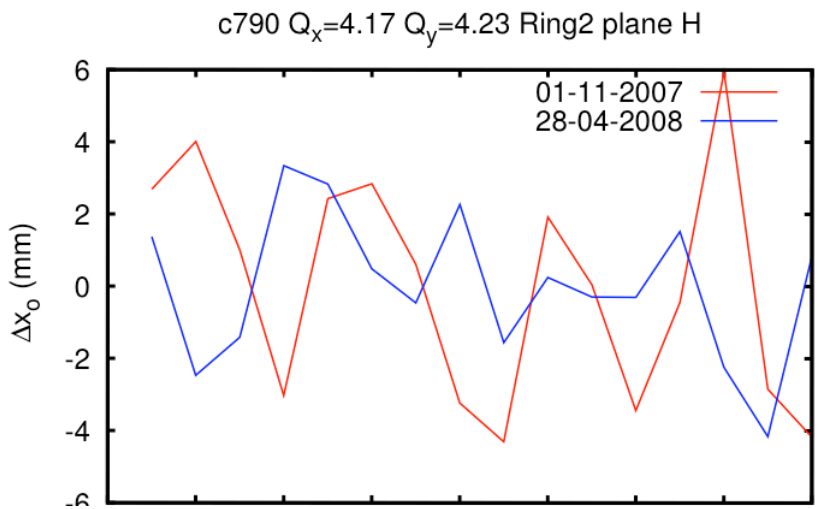
⇒ 6 measurement sets

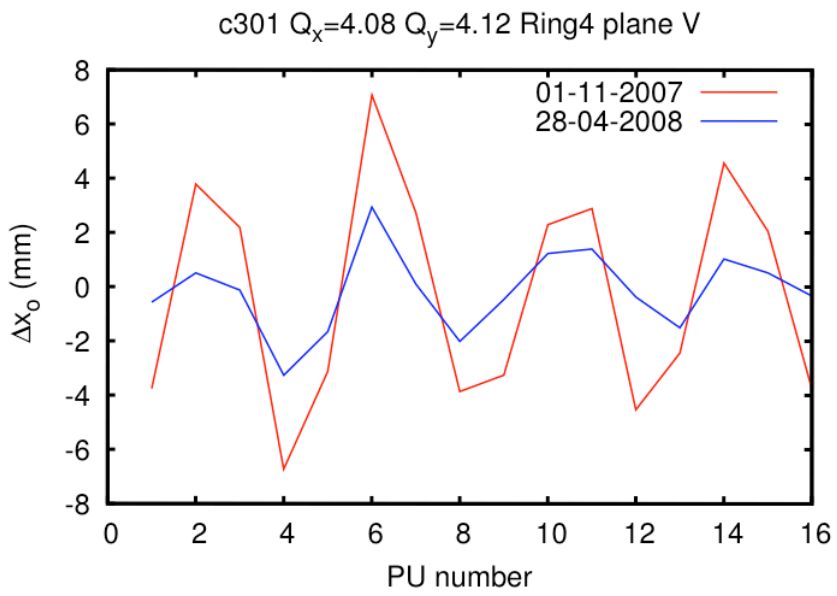
	Energy (MeV)	Q_x	Q_y
301WP1	63	4.172	4.230
301WP2	63	4.083	4.131
301WP3	63	4.212	4.304
301WP4	63	4.279	4.583
500WP1	403	4.163	4.234
790WP1	1377	4.169	4.255

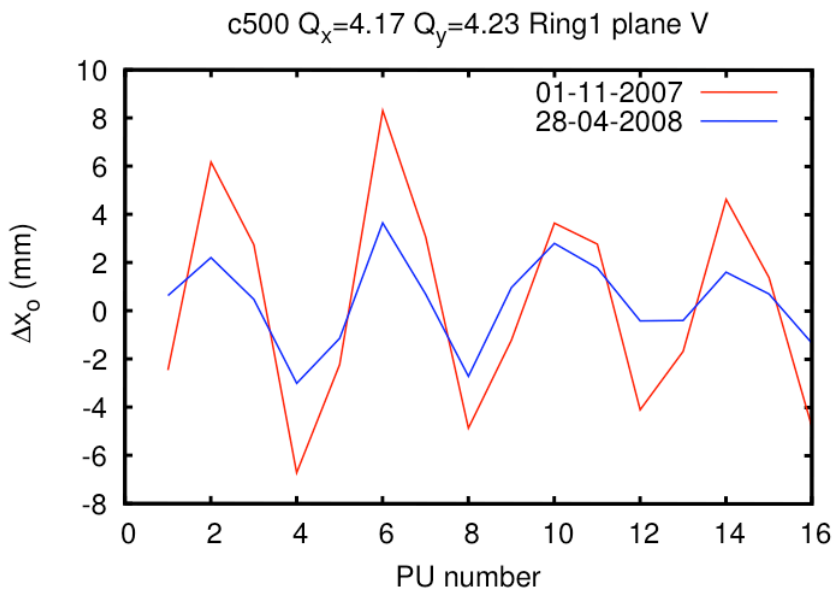
Orbit measurements: April 2008 versus November 2007

⇒ Examples of measured orbits





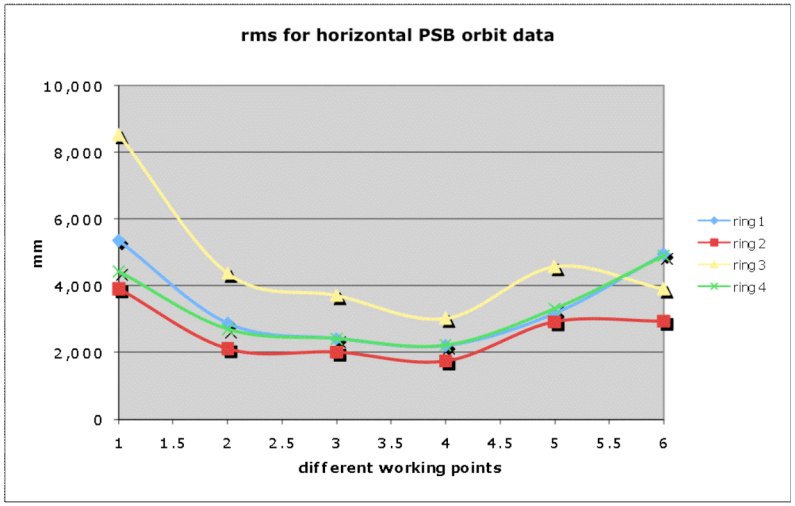


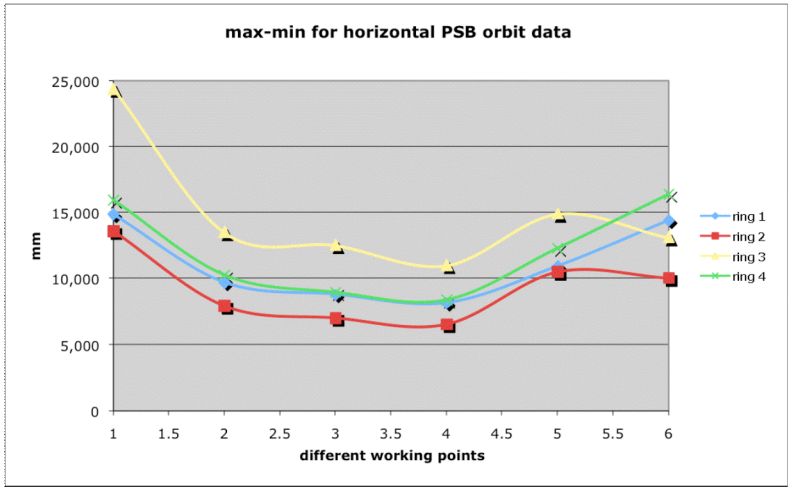


Orbit measurements: April 2008 versus November 2007

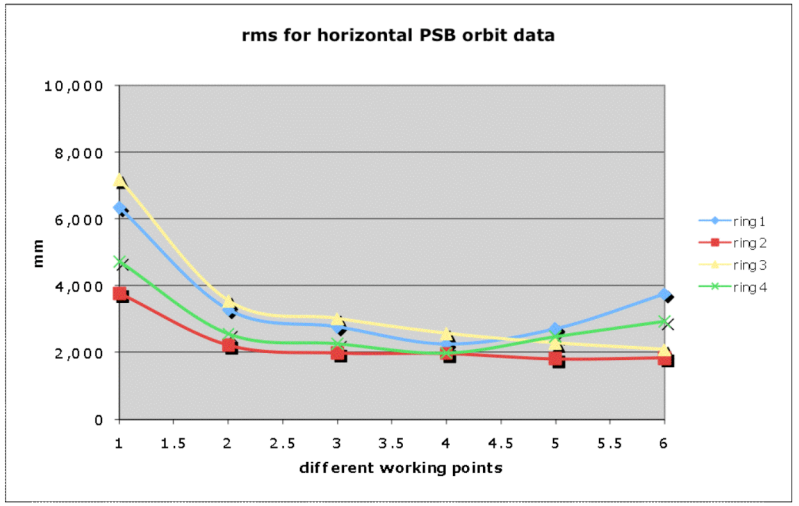
⇒ Overview on rms and peak-to-peak orbit change (horizontal plane)

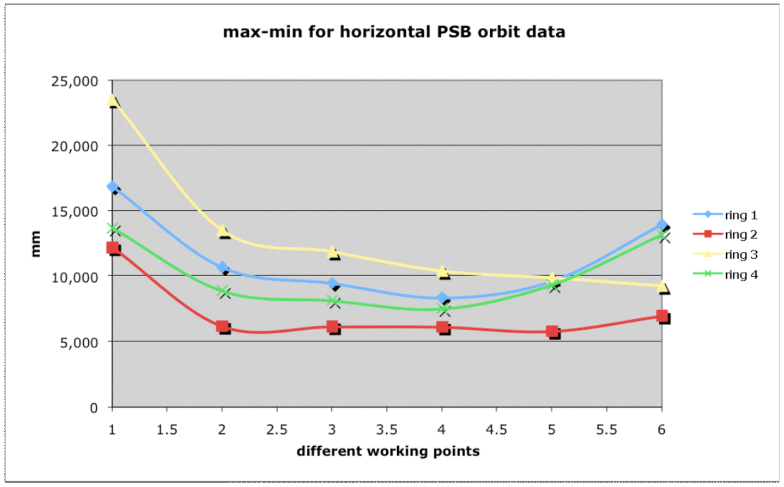
2007





2008

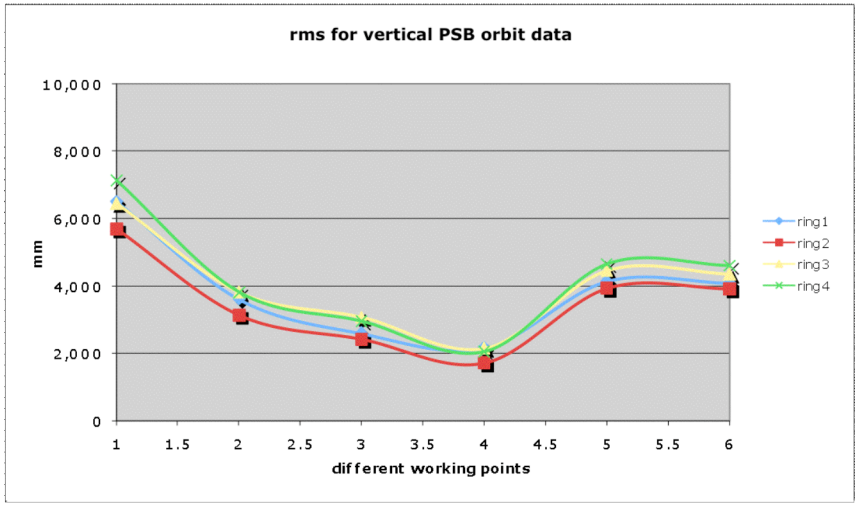


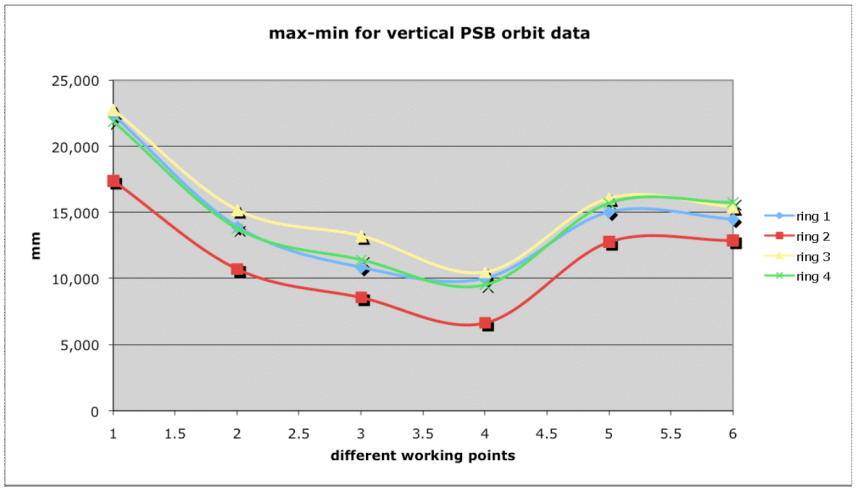


Orbit measurements: April 2008 versus November 2007

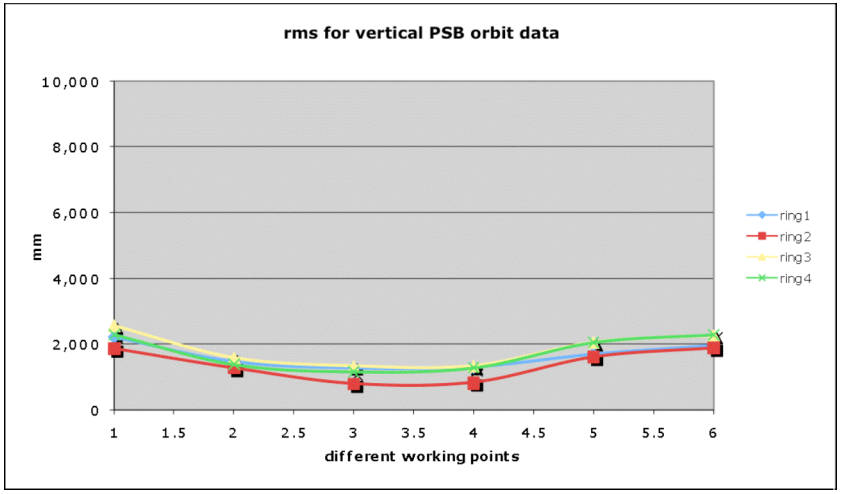
⇒ Overview on rms and peak-to-peak orbit change (vertical plane)

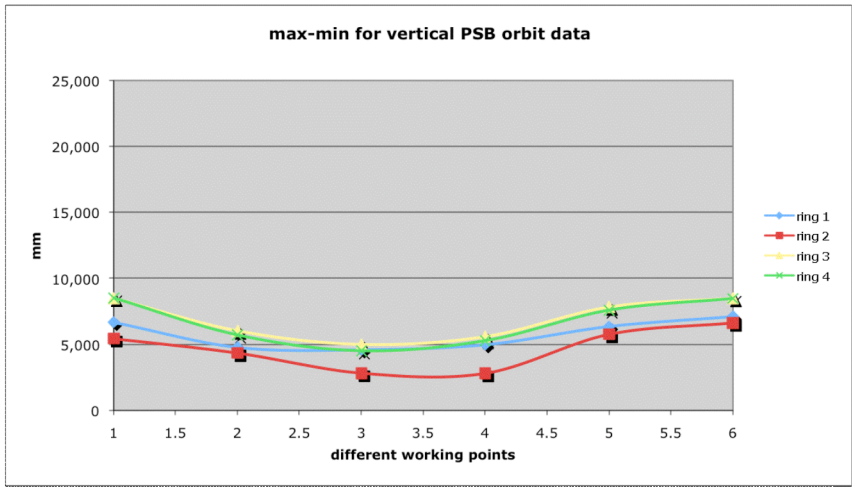
2007





2008

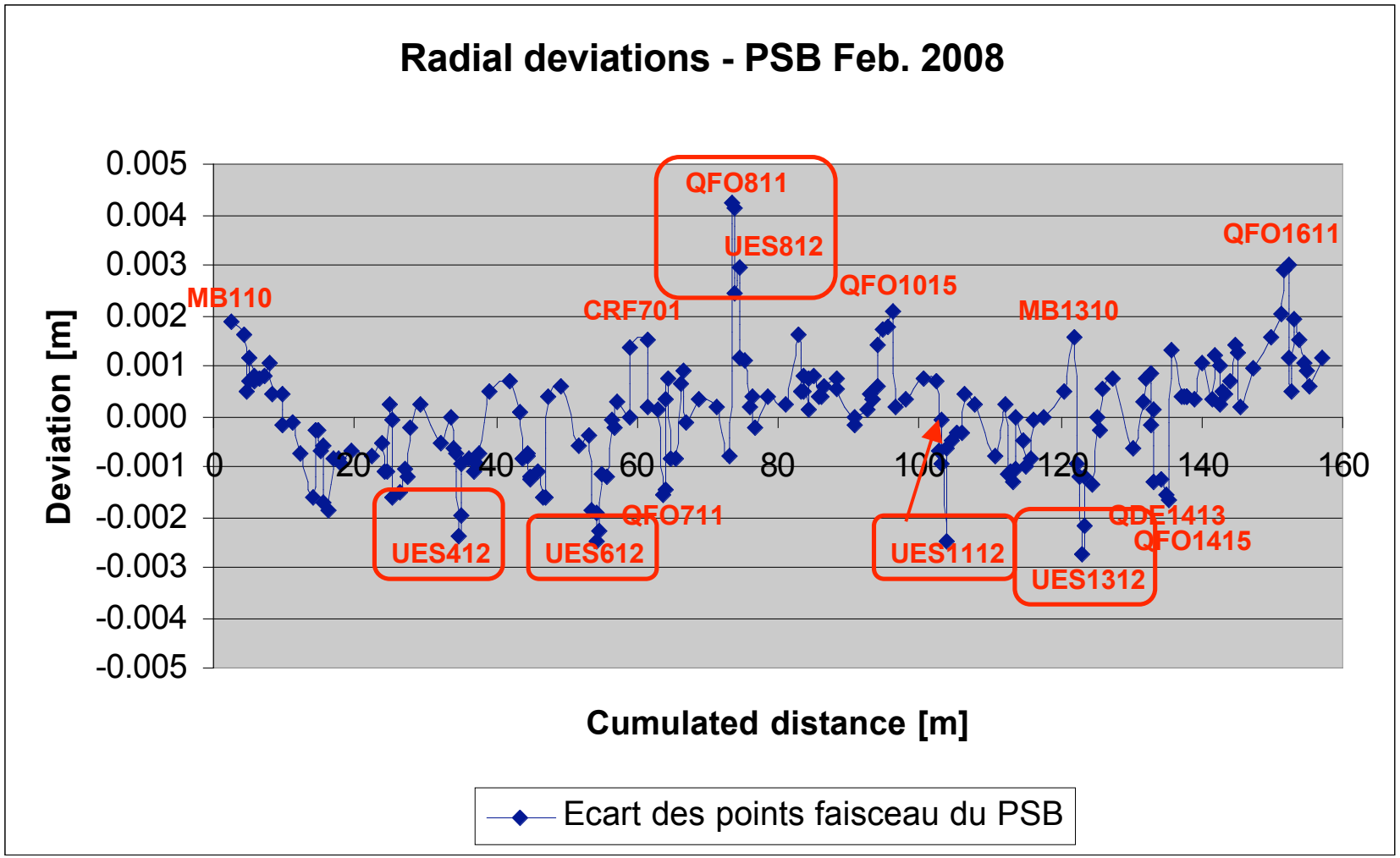




Orbit measurements: April 2008

⇒ We want to use the 2008 orbit measurements to try to get a better orbit correction

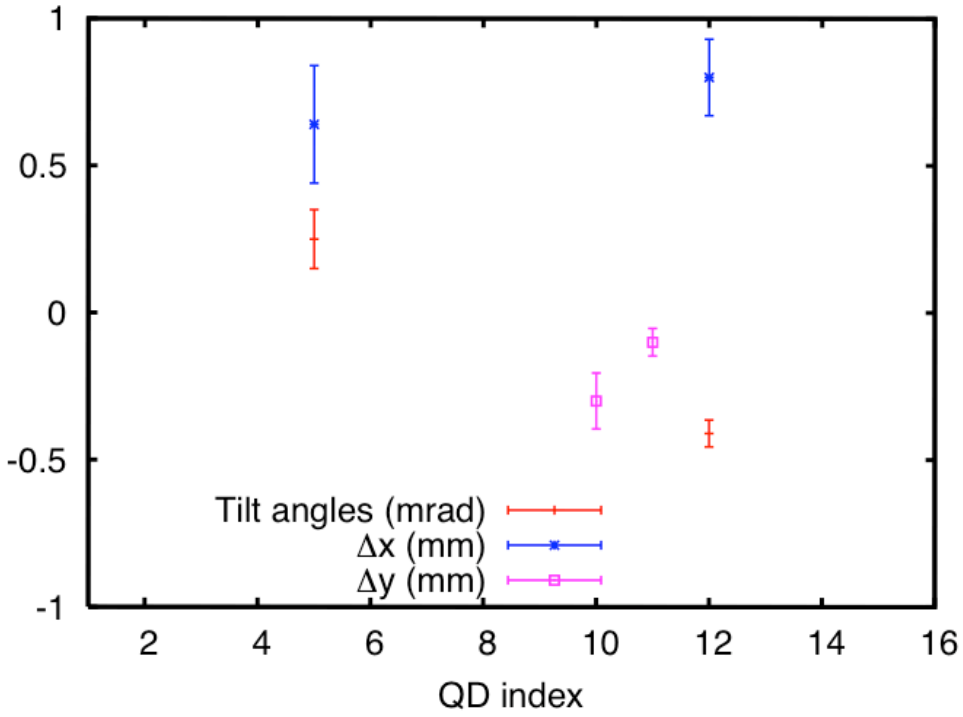
⇒ This time we also knew the horizontal offsets of the PUs



Orbit measurements: April 2008

⇒ Based on the 2008 orbit measurements, possible further corrections were calculated

⇒ The strongest correctors were QDE5 and QDE12 in the horizontal plane, QD10 and QD11 in the vertical plane



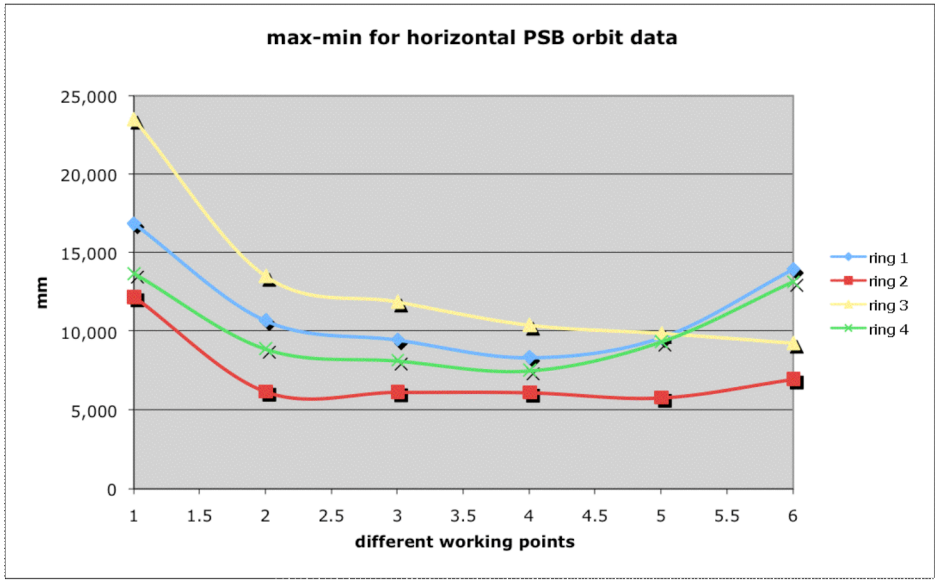
However:

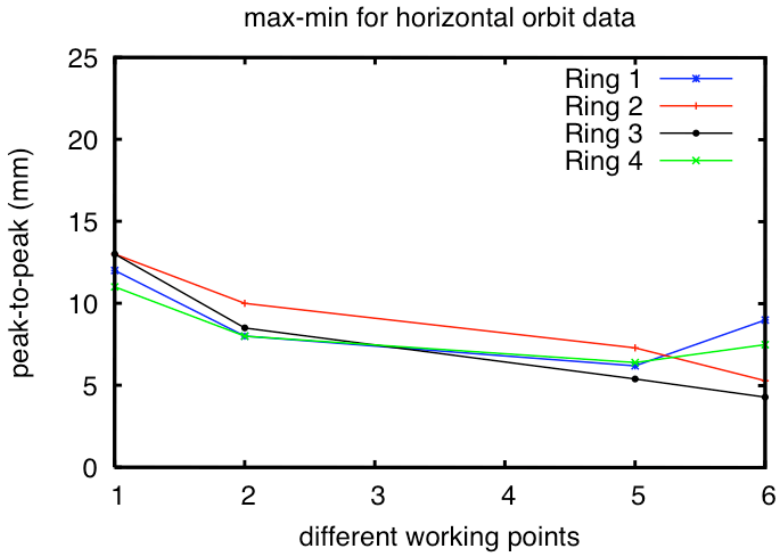
- the required vertical displacements turned out to be too small to be implemented
- we decided to try to improve the horizontal orbit correction.

Orbit measurements: 2 May 2008 versus 28 April 2008

⇒ QDE5 and QDE12 were moved on the 30th April. Orbits were re-measured on the 2 May

Preliminary





- The horizontal orbit (peak-to-peak) appears in general improved by about a factor 1.5-2
- In particular, the orbit of Ring 3 has become like that for the other rings
- The vertical orbit has not changed, as expected.