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Measurements 03/08/2009: Tests of SISMODI version with local bumps for closed orbit correction

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Results of measurements in the SIS18 carried out on the 03/08/2009 are presented. The measurements aimed to test a new implemented SISMODI closed orbit (CO) correction (P. Schütt, S. Reimann) and a calibration of the vertical steerer #11.

1 Closed orbit correction with SISMODI

The CO correction program is implemented into SISMODI and located under option `SISMODI/Orbit` Console. The correction algorithm used is based on the earlier applied local orbit bump method [1, 2]. For the correction 12 horizontal and 12 vertical steerers are available. Every 3 horizontal/vertical neighboring steerers are grouped together in 12 horizontal/vertical bumps for the CO correction. The correction algorithm is partially automatized: it needs a manual reading of the CO in POSI in order to adjust the direction and strength of a local bump correction amplitude, which is manually set in SISMODI afterwards. By monitoring CO at each BPM and setting the correction bump amplitude in SISMODI the best correction was achieved (Fig. 1). The CO correction tests were performed at injection (`11.4 MeV`) and extraction (`416.54 MeV`) energies. The SISMODI tune was set to $Q_x = 4.29$, $Q_y = 3.27$. The vertical CO was brought to a straight line with near 0 mm displacement. However, the horizontal CO correction is still restricted since 6 of the horizontal steerers used are unipolar. The polarity of their power supplies often interferes with the correction angles given by the three-steerer-local bump condition.

2 Test of calibration of the vertical steerer `S11KM2DV`

The calibration factor of the vertical steerer `S11KM2DV` was recently readjusted to make its' effect equal to those of the other steerers. There was need of an independent test of its' calibration. The tests were carried out at injection energy. The local bumps using this steerer were performed in the three following combinations: `9,10,11`; `10,11,12`

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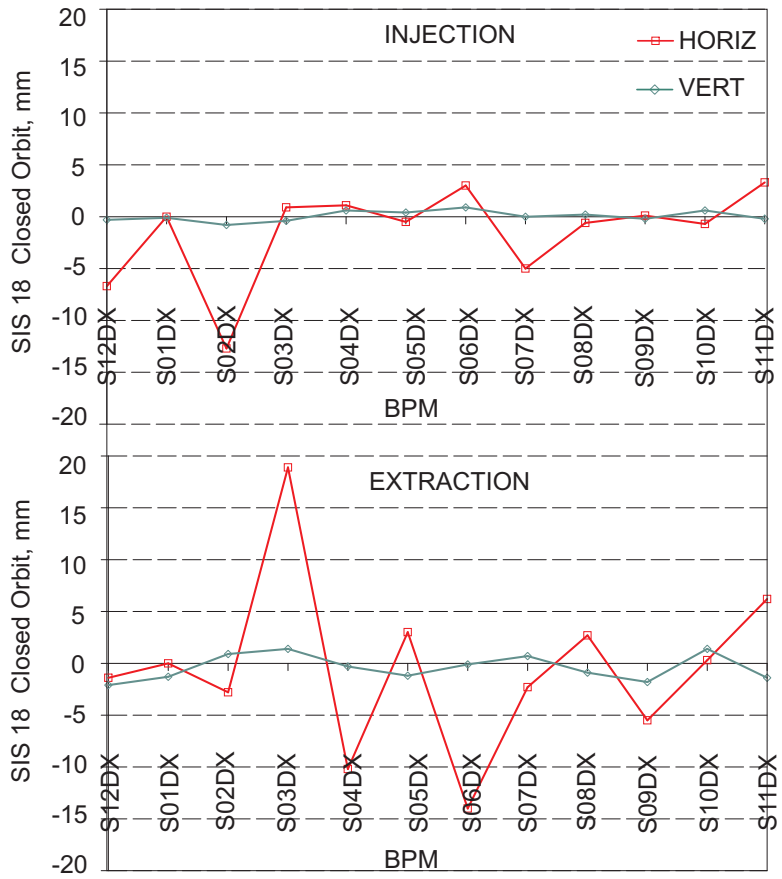

Figure 1: Closed Orbit correction performed at injection top) and extraction bottom) energies.

and `11,12,1` (see Figs.2, 3 and 4). The angles for the local bumps were chosen according to the local bump condition for any of the combinations:

$$\begin{aligned} \theta_2 &= -2\theta_1 \cos\Delta\psi \\ \theta_3 &= \theta_1\,, \end{aligned} \tag{1}$$

where θ_1 is an arbitrary angle, $\Delta\psi = 2\pi Q/N$, $N = 12$ [2]. The angle θ_1 is local bump amplitude and determines the strength of the local bump. If the calibration factors of the three steerers used are wrong the bump won't be local. Fig. 2 shows local bumps of different amplitude with $\theta_1 = \theta_9$, $\theta_2 = \theta_{10}$ and $\theta_3 = \theta_{11}$ (group `9,10,11`). The local bump angles were giving on top of the performed vertical CO correction (Fig. 1 top). The same was done for the groups `10,11,12` and `11,12,1` (Fig. 3 and 4). In all three cases the CO distortion can be considered as local in the area between the first and the third steerers used. However, there is a tiny additional distortion in the BPM `S02DX`, which still has to be understood. It might come from the asymmetry in beta-functions, which is not included into the accelerator model used in Eq. (1).

3 Outlook and Suggestions

- There is a need to have a remotely controlled change of the *POSI trigger* for measurements at injection or extraction energy. The possibility of CO measurements

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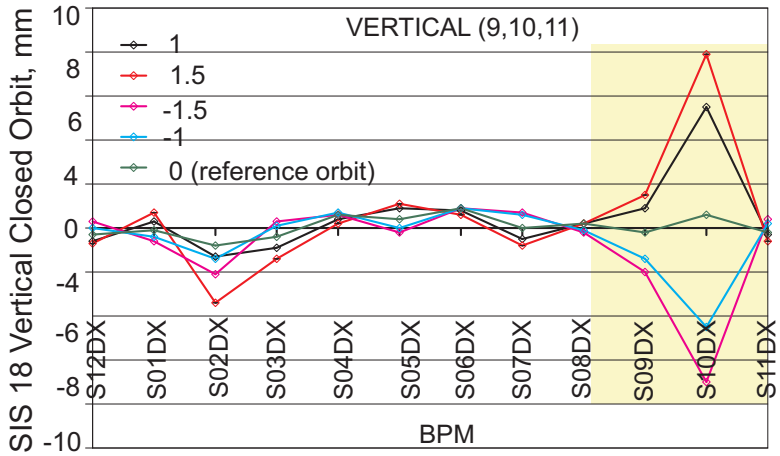

Figure 2: Local vertical CO distortion of different strength measured at 12 BPMs in POSI created by the three vertical steerers S09KM2DV, S10KM2DV and S11KM2DV (black curve - θ_9= 1.0 mrad; red curve - θ_9= 1.5 mrad; magenta curve - θ_9= -1.5 mrad; blue curve - θ_9= -1.0 mrad; green curve is the reference orbit with θ_9= 0.0 mrad).

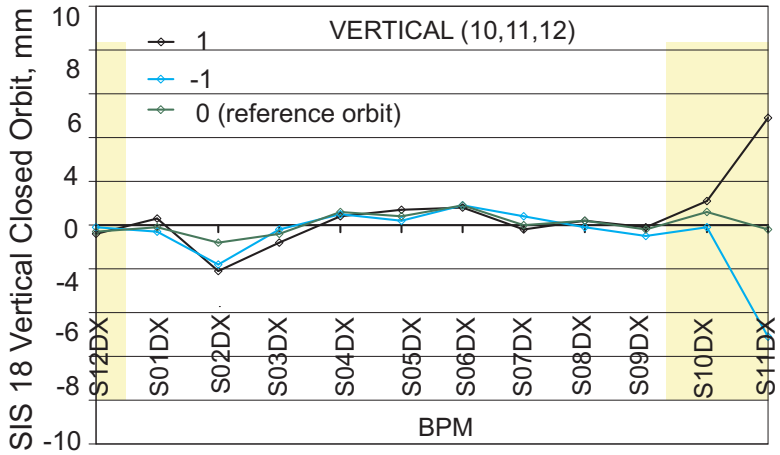

Figure 3: Local vertical CO distortion of different strength measured at 12 BPMs in POSI created by the three vertical steerers S10KM2DV, S11KM2DV and S12KM2DV (black curve - θ_{10}= 1.0 mrad; blue curve - θ_{10}= -1.0 mrad; green curve is the reference orbit with θ_{10}= 0.0 mrad).

at the both energies and fast switching between them is important for the SIS18 operation.

- Replacement of the 6 unipolar horizontal steerer power supplies is needed for the improvement of the horizontal CO correction.

References

[1] S.Y. Lee, "Accelerator Physics" Second Edition, World Scientific Publishing Co. Pte. Ltd. 2004, pp.124.

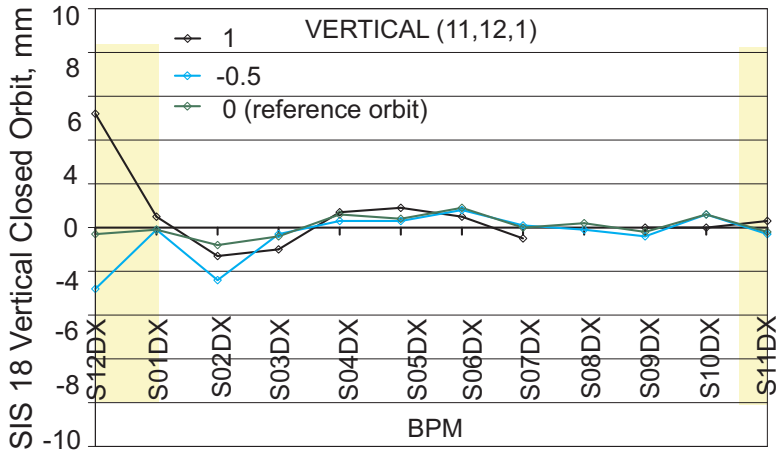

Figure 4: Local vertical CO distortion of different strength measured at 12 BPMs in POSI created by the three vertical steerers S11KM2DV, S12KM2DV and S01KM2DV (black curve - θ_{11}= 1.0 mrad; blue curve - θ_{11}= -0.5 mrad; green curve is the reference orbit with θ_{11}= 0.0 mrad).

[2] A. Parfenova, G. Franchetti, B. Franczak, M. Kirk, C. Omet "SIS18 closed orbit correction using a local bump method", Text. Note, GSI-Acc-note-2006-11-001, GSI, Darmstadt, `http://www.gsi.de/documents/DOC-2007-Oct-33-1.pdf`.