FONT Meeting

Thursday 18th April 2019

Update on upstream feedback paper

Douglas BETT

Issues raised last meeting

- Infer phase advance from kicker calibrations
- Apply tracking to Okugi data set
- Feedback performance as function of resolution

Phase advance

Transfer matrix from K1 to P2 expressed as a function of the Twiss parameters and the phase advance:

$$M_{K1P2} = \begin{pmatrix} \sqrt{\frac{\beta_{P2}}{\beta_{K1}}}(\cos\Delta\psi_{K1P2} + \alpha_{K1}\sin\Delta\psi_{K1P2}) & \sqrt{\beta_{P2}\beta_{K1}}\sin\Delta\psi_{K1P2} \\ \frac{(\alpha_{K1}-\alpha_{P2})\cos\Delta\psi_{K1P2} - (1+\alpha_{K1}\alpha_{P2})\sin\Delta\psi_{K1P2}}{\sqrt{\beta_{P2}\beta_{K1}}} & \sqrt{\frac{\beta_{K1}}{\beta_{P2}}}(\cos\Delta\psi_{K1P2} - \alpha_{K1}\sin\Delta\psi_{K1P2}) \end{pmatrix}$$

This element can be deduced from kicker calibration

5 unknowns: α and β at K1 and P2, plus $\Delta\psi_{K1P2}$

Firstly- do you take account of the DR tunes when you run Mark's script- they do change a little and should be read from the control system each time you use that script.

There is no guarantee that the twiss parameters in the EXT will come out the way the model predicts. In any case, doing as you outline below will unfortunately definitely lead to the wrong estimate as to the phase advance between the FONT BPMs as you don't take into account the assumed incoming twiss that the Q1-Q10 quads were rematched for. Given that the aim is to ensure the model twiss parameters at the exit face of QD10X, and none of the quads between your BPMs are altered, the phase advance between BPMs should not change (about 60 degrees). The response of the kicker to the FONT BPMs and downstream BPMs may change some however as it is just upstream of QD10X.

The preferred procedure is to directly measure the twiss parameters (referenced at OTR0X) using the multi-OTR system. Although sometimes mismatches are left uncorrected. Whenever the emittance is calculated using the mOTR emittance GUI, a Matlab file is stored on the FS computer which contains, amongst other things, the calculated twiss parameters and errors. The files are something like "/home/atf2-fs/ATF2/FlightSim/userData/emit2dOTRp_…..mat" (I'm at the airport and can't remember exactly), just be sure to use the ones with the "p" and not the "e" (different analyses using either a 2d ellipse fit or the x/y projections).

You have to be a little careful, the measured twiss parameters are only really meaningful assuming a dispersion measurement has taken place first on the FS (dispersive contributions to beam sizes are automatically subtracted) and preferably corrected (at ~5mm level), and also that the coupling has been corrected. I advocate the following procedure: dispersion correction, coupling correction, then beta measurement and matching if BMAG>1.1. When I do the EXT setup, I always post the final OTR measurements (which include the twiss parameter data) in the log book, so this is one place to check also.

E-mail reply from Glen White to Neven, 15 Feb 2014

Tracking Okugi data

- Okugi data: ~220 urad reduced to ~50 urad with feedback
- Able to reproduce 220 urad angular jitter at IP for bunch 1 for the lowest charge case (0.1)
- At this charge, feedback on data tracks to 195 urad (~10% reduction)
- For high charge data set (0.6), angle jitter goes from ~140 urad to ~65 urad (~50% reduction)
- Angular jitter of the beam predicted at the IP decreases as a function of increasing charge

- Okugi performed two analyses of the orbit data
- First used 100 shots of BPM data taken at start and end of operation for a particular bunch charge – this is presumed to be simple logging of the EPICS data http://atf.kek.jp/twiki/bin/exit.cgi?url=http%3A%2F%2Fatf.kek.jp%2Ftwiki%2Fpub%2FATFlogbook%2FMeeting201827%2FIP_beam_size_intensity_dep.pptx
- Second used orbit data recorded in IP-BSM data set – I have no knowledge of these data sets but apparently used to generate the distributions in the PDF Okugi provided (0.4 and 0.6 settings only)

Feedback performance

- fbRun3 (07-Nov-18)

$|\Sigma_{P2}| = 1995, 1913$
$|\Sigma_{P3}| = -2210, -2024$

Jitter (corrected) = 170 nm (P2), 200 nm (P3)
Correlation (uncorrected) = 0.993 (P2), 0.991 (P3)

- fbRun14 (13-Nov-18)

$|\Sigma_{P2}| = 1599, 1681$
$|\Sigma_{P3}| = -1632, -1716$

Jitter (corrected) = 250 nm (P2), 300 nm (P3)
Correlation (uncorrected) = 0.987 (P2), 0.984 (P3)

$\sqrt{1-\rho^2} = 0.12$ (fbRun3)
$= 0.16$ (fbRun14)

Ratio of charge: 25-30% higher for fbRun3 (not consistent for P2/P3)