DRIFT CONTROL ENGINES STABILIZE TOP-UP OPERATION AT BESSY II
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Motivation

**Transversal Tune Feedback**

Beam quality depends on pointing stability and stable shape and size of synchrotron beam. These parameters transform to electron beam orbit and tune stability.

Other systems need tunes to be kept stable:
- RF Knockout system - Single bunch purity
- Bunch-by-bunch feedback systems
- Pulse picking by resonant excitation (PPRE)

**Pathlength Correction — Master Oscillator Feedback**

Adjusting the RF master oscillator to the real pathlength of the beam is a central measure to keep beam energy stable at the desired value.

Transversal Tune Feedback

**Standard ID-gap Feedforward**

1st order correction of ID-induced tune shift made by interpolating empirically produced tune-feedforward tables (27 tune-shifting-parameters × max. 49 quadrupole magnets → 1059 active tables).

**Multi-Source Tune determination from general Beammotion**

- Diagonal Striplines
- Pickup Electrode

Horizontal corrector settings and the resulting RF frequency. Shown are the sum of the weighted excess average strength of horizontal corrector families.

Error Handling

**Bad correction**

- Two consecutive ineffective corrections

**Measurement Error**

- Measurement delivers unstable data or tune is undeterminable

**Too much to correct**

- Measured tune is outside of configured window of allowed automatic corrections

Applying correction “with caution”

No corrections if
- Bunch-by-bunch Feedback not running
- Minimum ring current not reached
- Too close to injection
- Variation of tune too high

Pathlength Correction

**Slow Orbit Feedback**

- Horizontal Correctors
- Path Length

**Fast Orbit Feedback**

- Master Oscillator
- Path Length

**Horizontal Correctors**

- Beam Position

Straight forward implementation of SOFB schema for modifying master oscillator is not possible for FOB!

Instead, excess values accumulate in setpoints of horizontal corrector families.

Master oscillator frequency change is calculated from excess average strength of horizontal corrector settings according to previously observed relations

\[ \text{RF change} = \frac{\text{RF}_{\text{now}} - \text{RF}_{\text{previous}}}{} \times \text{RF}_{\text{previous}} \]

As frequency change is applied, FOB reduces corrector settings accordingly.

No corrections if...
- Fast orbit feedback is not running
- Minimum ring current not reached
- Too close to injection

Error Handling

**Bad correction**

- Ineffective correction detected

Left:

- Plot of ~ 400 pathlength corrections over 5 days after one week of low current low-epsilon operation. Shown are the sum of the weighted excess corrector settings and the resulting RF frequency. BPM RMS and mean values are stable within 5%