S20 BBA

Person	Review Date	Approved
APBO Management		
APBO Team Member		

Shift Date: TBD
SLAC Point of Contact: Sean Kalsi
Shift Personnel: Kalsi

Shift Goals:

- Perform Beam Based alignment on S20 FF & Spectrometer Quadrupole magnets. Implement BPM offsets(EPICS & SCP) for measured offsets >50um

Beam conditions: Stable low loss beam to FACET Dump.

Time required: 16 hrs

Short Summary

Perform Beam Based Alignment of the Sector 20 Quadrupole magnets with the hopes of reducing orbit changes due to IP configuration changes.

Shift Readiness

Diagnostics:

- Sector 20 BPMS(EPICS & SCP)
- Sect 20 Correctors used for scans: XC2460, XC3FF, YCWIGE(unit 2420), YC2FF
- List of Magnets to Align:
    - Q5FF
    - Q4FF
    - Q3FF
    - Q2FF
    - Q1FF
    - Q0FF
    - Q0D
    - Q1D
    - Q2D

Software:

- Correlation Plot Matlab App

Shift Procedure

Preliminary steps

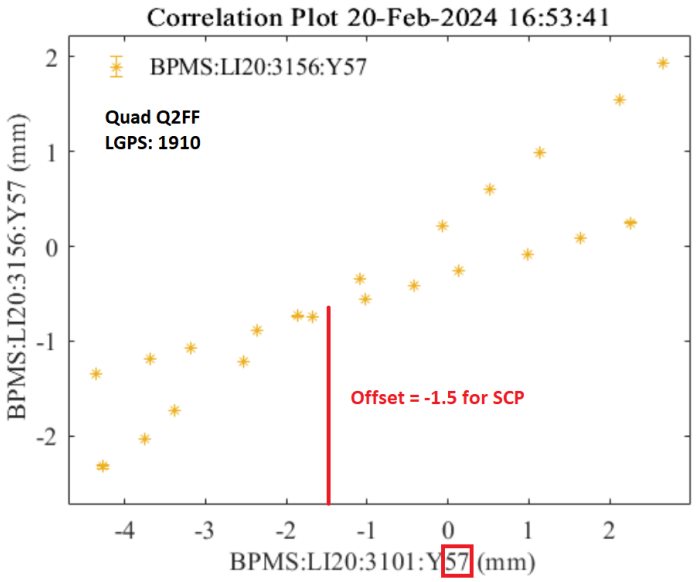
1. Before starting the scans it will be necessary to calibrate the SCP BPMs. Once the calibration is complete it will be good to check that there are no error codes for the BPMs you want to calibrate.
2. You will also want to take a reference orbit pre-BBA(Both EPICs and SCP) in order to better understand how the alignment offsets impact the orbit post BBA.
3. Additionally it is a good idea to check that the EPICs BPMs if applicable also have healthy calibration pulses, and no red/purple warnings on the panel.

Performing the BBA Scans

- For BBA on X offsets, XC2460 provides non-degenerate phase advance for the FF quads as well as the spectrometer quads. But if losses are too great for that corrector with the spectrometer quads, then you can try using XC3FF.
- For the Y offset scans, The wiggler trim(YCWIGE, unit 2420) will work for Q5FF, Q4FF & Q3FF. Downstream of that YC2FF should have non-degenerate phase advance for the remaining quad scans.
- When starting a new scan its generally a good starting point to use the correlation plot file from the last successful scan. Since the sector 20 orbit can change over time, its likely that the scanning corrector range will need to be adjusted to either minimize losses or increase measured deflection. In general the measurement data that should be collected in each scan:
    - All S20 Epics BPMs, these will have '1H' appended to the end
    - All S20 SCP BPMs, these will have '57' appended to the end
- These scans will be 2-D scans with the alignment quadrupole also being changed during the corrector scan. The 2 alignment quad values are generally chosen such that the minimum value is about +-50 kGm depending on nominal polarity, and the other point is usually chosen closer to the max operating value for the quad. But these may need to be adjusted if the particular quad setting produces large beam losses.

Implementing Offset Changes

- Once the scan is complete, you can then find the intersection point for the particular plane you are scanning. For example below, this plot shows a Y-Offset scan for BPM 3101 which is near Q2FF. This plot is showing the SCP BPMs 3101 vs 3156, and shows this intersection to be at -1.5mm in Y for BPM 3101.



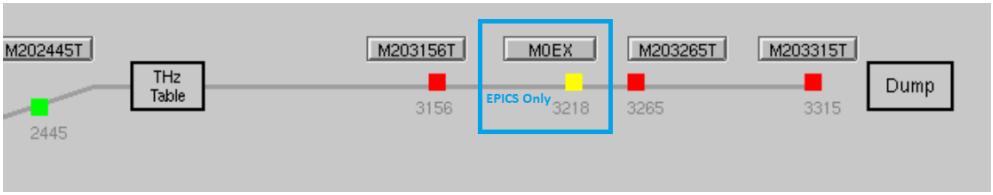
- SCP BPM offsets are changed in an SLC database file by performing a DBEDIT. Here is an MCC Wiki article on how to performs DBEdits: https://aosd.slac.stanford.edu/wiki/index.php/DBEDIT
- New implementations for offsets are just additive to the existing offsets. The following screenshot shows how the offsets have changes from measurement to measurement over time.
- Its also important to note that **SCP offsets are added to the previous offsets** as measured with the correlation plot. For the example below you can see how the previous offset was erroneously subtracted, and had to be taken out and then added on.

```
!
! BPMQFF4 (M3FF)
<:BPMS:LI20,3101; !serial number: 207
     @:BPMSDEFFA:;
     !:Z   : = %ZLI20+55.4636;
      :Z   : = 1988.15; !mws 5/27/21 per FACET-II D.Storey
     !:OFFS: = 0.0 + 0.0, 0.1107 + 0.0; !MDW 25-AUG-2011
     !:OFFS: = +0.1811 , +0.5048; ! nate 04may12
     !:OFFS: =  +0.3930 , +0.3690; ! cmelton 19mar13
     !:OFFS: = +0.1174  +0.3526;  ! nate BBA 24 oct 2013
     !:OFFS: =  0.3308, 0.3863; !MWoodley 25Nov13
     !:OFFS: = +0.3519 , +0.3166;  ! nate 21-Feb-2013 LI20 3101
     !:OFFS: = +0.1019 , +1.8166;  ! spk 21-Feb-2024 LI20 3101
      :OFFS: = +0.6019 , -1.1834;  ! spk 22-Feb-2024 LI20 3101
     !:PCMM: = 6.800; ! Temporary
      :PCMM: = 11.474; !from V. Smith 27-JUN-2011
      :PPTR: = 3101,3102;
      :HSTA: = 24; !rotated+dead
      :MUXT: = 1;       ! Temporary
     !:MBIT: = 00000001,00000001,00000000,00000000,00000000; !e-
      :MBIT: = 00000001,00000100,00000000,00000000,00000000; !e+
      :TWSP: = %TWM01U05 + 123, 0;
      :HNRM: = 1.6 * 3.16; ! 8/18/11 HVS add 10db atten (3.16) per Traller
!      :ANGL: = 45.0;   ! BLT 06/23/11
      :ANGL: = 45 - 0.26; !JSY 09sep11 0.26 CW roll
      :XTOL: = 5.0,5.0;   ! JSY 17mar12
>
!
! BPMQFF5  (M4FF)
<:BPMS:LI20,3120; !serial number: 1-5
     @:BPMSDEFFA:;
     !:Z   : = %ZLI20+57.8835;
      :Z   : = 1989.73; !mws 5/27/21 per FACET-II D. Storey
     !:OFFS: =  0.000  +  0.803, 0.000  -  0.135; !Sampson 4SEP11
     !:OFFS: =  -0.2234 , -0.4545; ! cmelton 19mar13
     !:OFFS: = -0.4426, -0.6750;  ! nate BBA 24 oct 2013
     !:OFFS: = -0.1177 , -0.4523;  ! nate 21-Feb-2013 LI20 3120
     !:OFFS: = +0.1437 , -0.5386;  ! nate 17-feb-2015
```

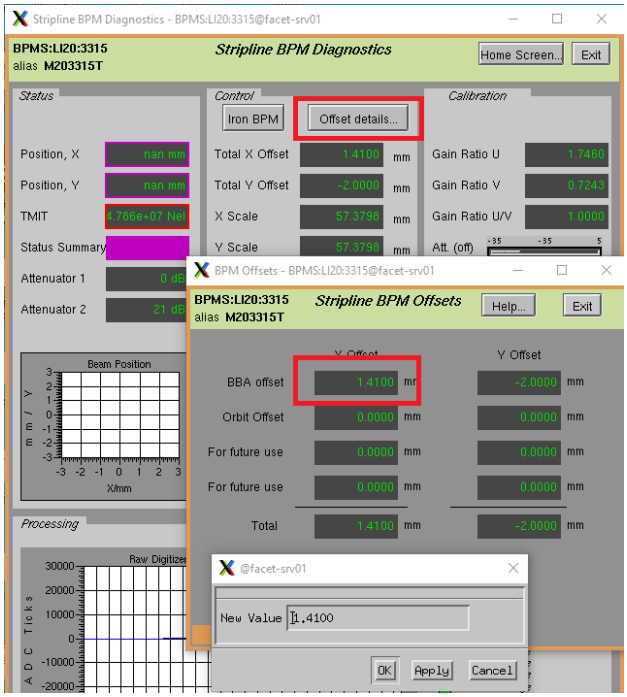
- Note: For EPICS BPMs you need to make sure you sample the '1H' BPMs in order to measure the respective offset for those separately from the SCP BPMs. Also note

that **EPICS offsets are subtracted from the previous offset value**. This is the opposite for the case with the SCP BPMs.

- The following screenshot shows the BPMs in EPICS. Note, BPM 3218 is only in EPICS, and not in the SCP. Its important to make sure when doing a BBA scan for BPMS 2445, 3156, 3265, & 3315, that both the EPICs, and SCP bpms are sampled, and that both offsets get applied separately. **Do NOT apply SCP offsets to EPICS BPMs and vice versa!**



- You can change the EPICS BPM offsets from the epics panels directly.



Checking the results after implementing a change

- After implementing the offsets, it is a good idea to check your orbit, both epics, and SCP, and also with respect to your previously saved reference orbits to ensure that the offsets you applied had the intended effect.

Restore nominal machine conditions if necessary

- Check that all magnets moved were restored to their original settings before the BBA scan

Post-shift Tasks

- For all offsets that are made permanent be sure and update the BBA confluence page with the last quad alignment information: FACET BBA

Necessity for Actual Magnet Re-Alignment

Since the goal of the BBA is to provide obit reproducibility for multiple IP magnet configurations, various magnet configurations should be implemented to check and see if the obit remains stable after the changes. If the orbit does not reproduce, and requires significant corrector changes, or correctors are unable to compensate for the changes, then a physical shift of the magnet should be implemented.

- Contact the Alignment group to arrange magnet moves
- Establish the correct sign convention for the moves before giving the data to the alignment group
- After physical moves are made repeat the above BBA steps to check that the desired orbit robustness was achieved