Beam Position Reconstruction for g_2^p

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1 Unrastered Beam Position Reconstruction

This method used for just using 2 BPMs to get the position in target. Because BPM is slow in low current, if just care about the average position, then this method is enough. This procedure don't need to do for each configuration.

Steps:

1.1 BPM Calibration

1. Change the chicane setting to straight beamline, turn off target field, chicane field, septum field
2. Use 2 harps to get the absolute position in 2 harps in hall A coordinate
3. Calculate the absolute position in 2 BPMs in hall A coordinate
4. Use surveyed BPM hardware position to get relative position , center is BPM's center
5. Get the relationship between the relative position and ADC value, update the configuration file in database.

1.2 Calculate Beam Position in target

Because there has a chicane in beamline and a 2.5~5T target field, position in 2 bpms and target is not linear, we can not just simply calculate the target beam position by just using 2 BPMs and extend it to target. Here is the steps:

1. Use BdL to get a crop of tracks from the first BPM to target, get the position in 2 BPMs(x_1, y_1, x_2, y_2) and target(x, y, θ, ϕ), save it to a file as mudifi input format
2. Use mudifi fit to get the relationship between (x_1, y_1, x_2, y_2) and (x, y, θ, ϕ), save the fit data to a configuration file and copy it to database
3. Use this fit data(it is a fit function) to calculate the target beam position by using 2 BPMs information

4. Note everytime changes the BPM's hardware position, target's hardware position, target field, chicane setting, this fit procedure is needed to do again

2 Rastered Beam Position Reconstruction

Because BPM is slow, we need both raster and BPM information to reconstruct the beam position. The general formula is :

$$X = < X > + X(I_{sr}) + X(I_{fr})$$

$< X >$is average position in 1000~2000 events gotten from BPM, $X(I_{sr})$ is slow raster position offset, $X(I_{fr})$ is fast raster position offset

Steps:

2.1 BPM delay time(phase) check

Because BPM receiver have a large delay time due to low bandwidth, we need to check BPM delay time. This procedure just need to be done while BPM receiver's bandwidth changed.

This procedure can be done after BPM calibration and in straight beamline setting.

1. After BPM calibration, remain beamline setting, i.e., straight beamline, turn off target field, chicane field, septum field
2. turn off fast raster
3. turn off Y, set $X = sin(\omega t)$, frequency is 500Hz, higher is better, but do not be too high
4. take run, analyse phase different, then get phase difference
5. turn off X and turn on Y for double check

2.2 Slow Raster Calibration(non linearity check)

This procedure should do for each configuration, the purpose is to know the relationship between slow raster magnet current and position offset in 2 BPMs.

1. turn off fast raster
2. turn off slow raster Y, set $X = sin(\omega t)$, frequency is 10~30Hz, lower is better.
3. take run, get relationship between current and position in 2 BPMs.
4. turn off slow raster X, set $Y = sin(\omega t)$, do the same thing
5. update database

2.3 Fast Raster Calibration

Because fast raster's frequency is higher than BPM's bandwidth, BPM can not get fast raster's information. Also fast raster is small ,its nonlinearity is much smaller than slow raster's. We just do the same thing as before.

- close slow raster, ask mcc just change fast raster X, leave Y and take run, get relationship between X's magnitude and 2 BPM's position magnitude:

x(mm)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
y(mm)	2	2	2	2	2	2	2	2	2	2	2

- samething as Y, update database

x(mm)	2	2	2	2	2	2	2	2	2	2	2
y(mm)	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2