



Results of the October 2023 Sextupole Studies

Primary goals

Measure misalignments for sextupoles on girders which were moved during the summer down (26W, 32W, 33W (regROUT), 36W, 43E, 34E, 43E, 34E, 16E).

Measure misalignments and calibrations for sextupoles where CBPM processors were newly re-installed on 30 September and 2/3 October 2023 (25E, 32W, 34W).

Measure misalignments and calibrations for sextupoles where BPM gain calibrations and quad centering were done (26W, 35W, 36W, 42W, 34W, 44W, 18E, 16E).

K2 scans were done with both increasing and decreasing settings to look for hysteresis effects.

Repeat measurements for sextupoles which have previously shown anomalously large misalignments (34W, 18E, 16E, 26W, 09AE). See Accelerator Group talk of 19 July 2023.

Presented today

Overview of misalignment measurements

Hysteresis study

Results for effects of summer 2023 quadrupole girder moves

Results for effects of BPM gain calibrations and quad centering

Jim Crittenden

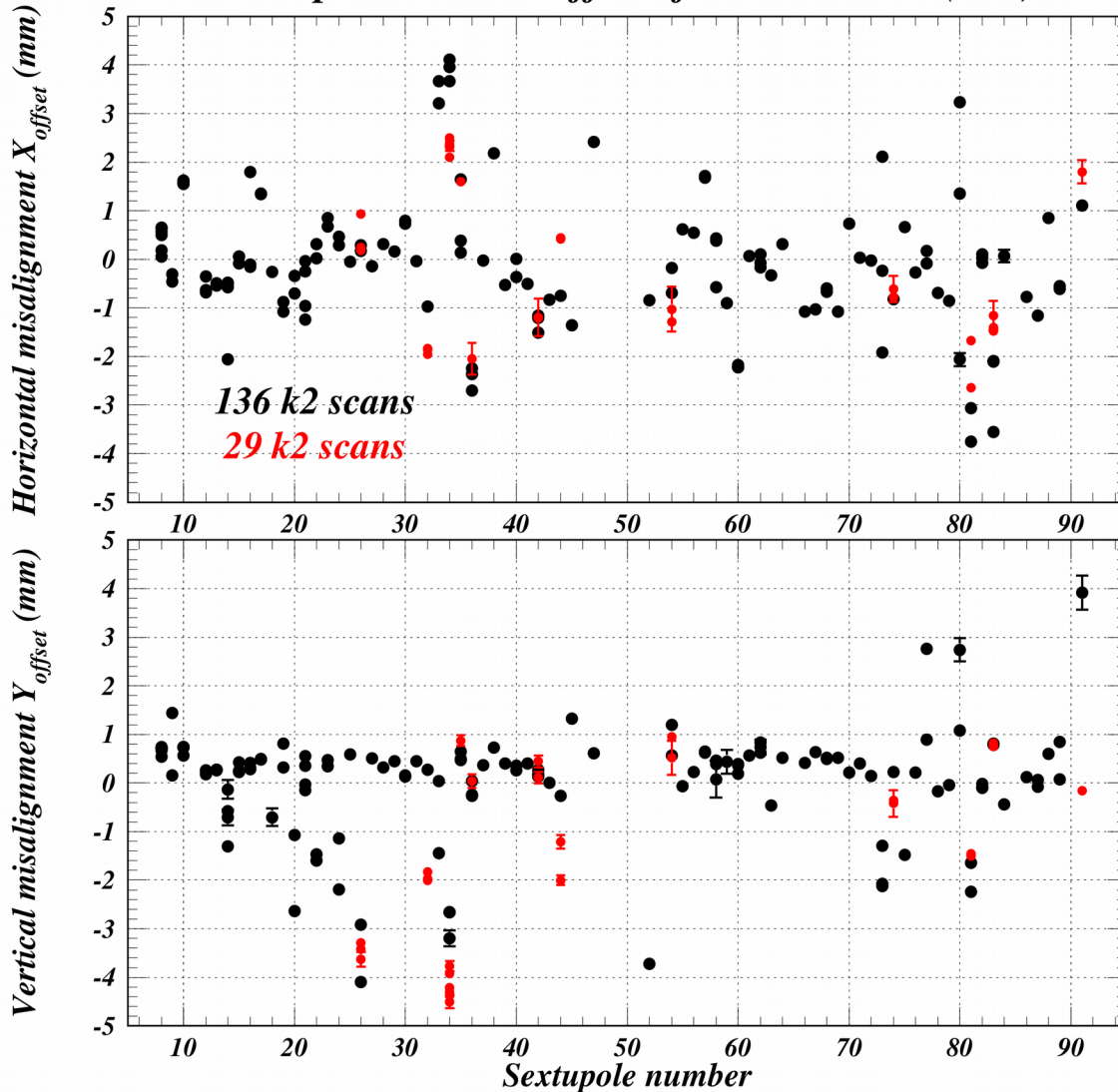
CESR Machine Studies Meeting

10 January 2024



Overview of October results

Sextupole X and Y offsets from K2 scans (mm)



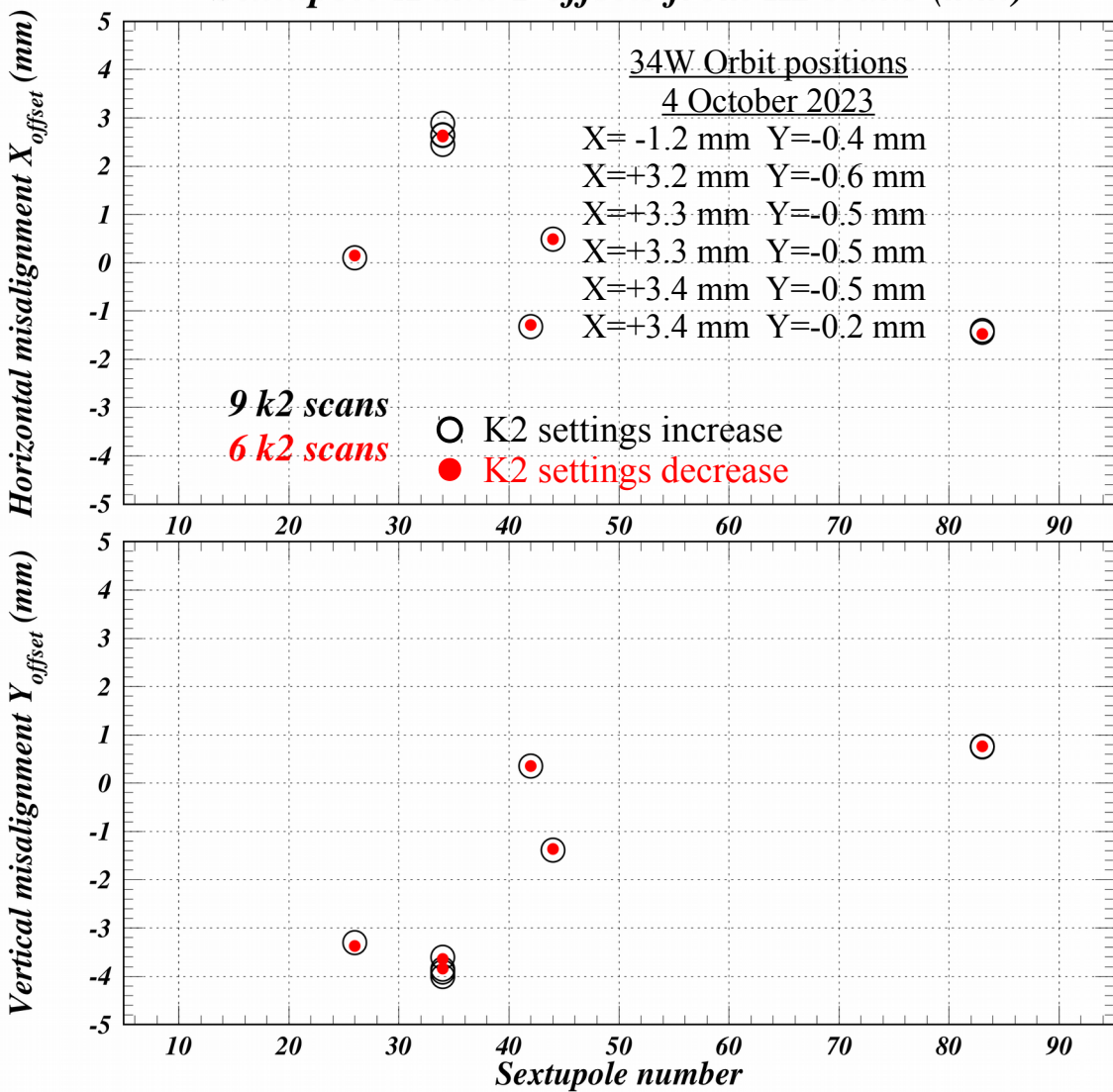
Overview of October 2023 data

Compare the new analysis of the October data using latest BPM button gain calibrations and quad centering results to the full data set analysis as of July 2023,

Data quality for 09AE much improved. MJF succeeded in getting this one working on 10/3, just in time.



Sextupole X and Y offsets from K2 scans (mm)



Hysteresis

Misalignment measurements are independent of whether the K2 settings increase or decrease.

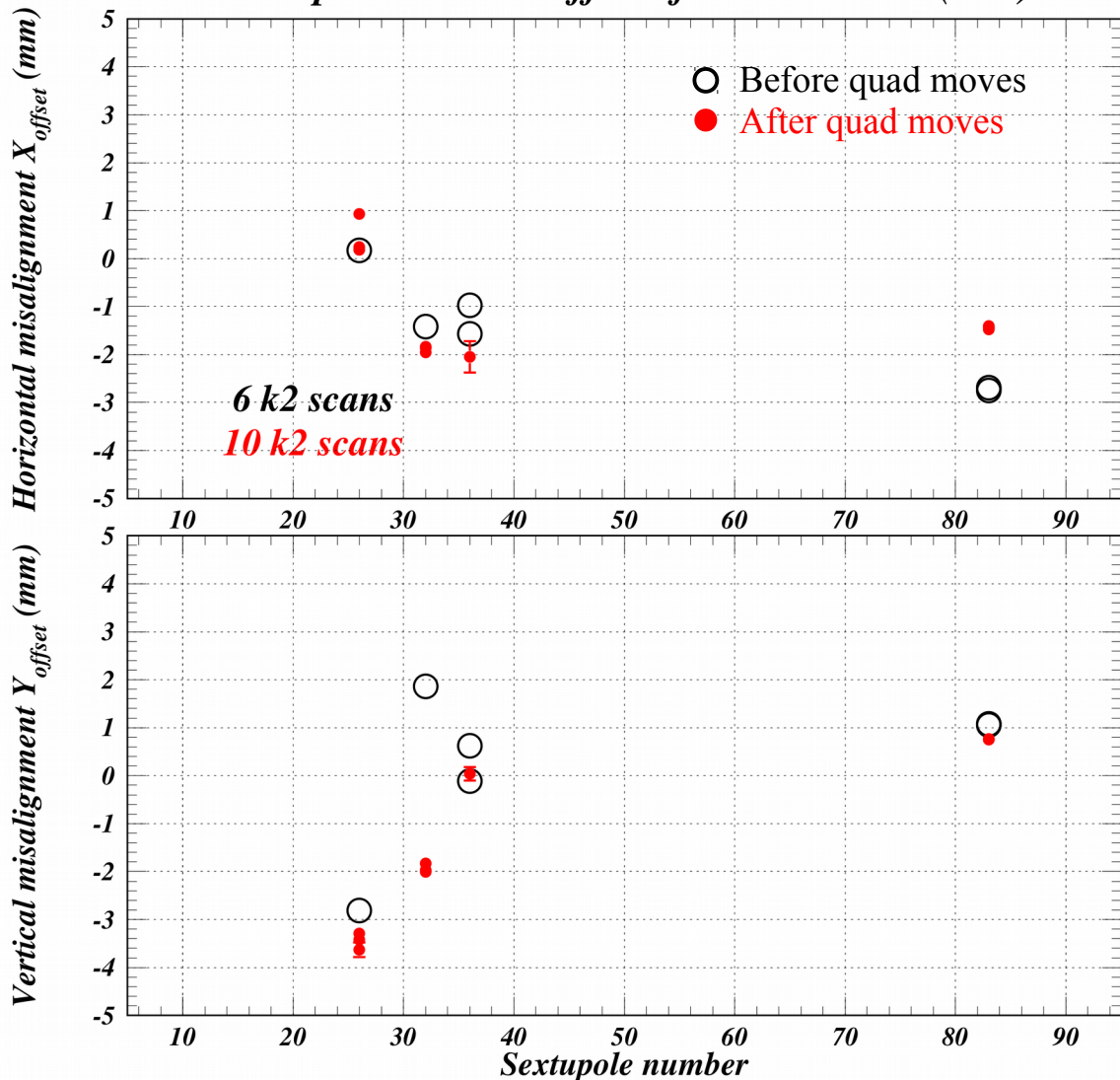
Orbit position dependence at 34W

Misalignment measurements are independent of a 4-mm horizontal orbit change at the level of 0.2 mm.



Before/after quad moves of summer 2023

Sextupole X and Y offsets from K2 scans (mm)



Change

	Roll	Pitch	X	Z	Y
Q26W	0.13	-0.16	0.000148	0.000189	-0.000144
Q32W	0.08	-0.23	0.000285	-0.000262	-0.000094
Q36W	-0.14	0.14	0.002009	-0.002316	0.000350
Q16E	0.05	0.01	0.000186	0.000552	-0.000228

Remarks

The survey coordinate system
(X, Y, Z) → CESR (S, X, Y)

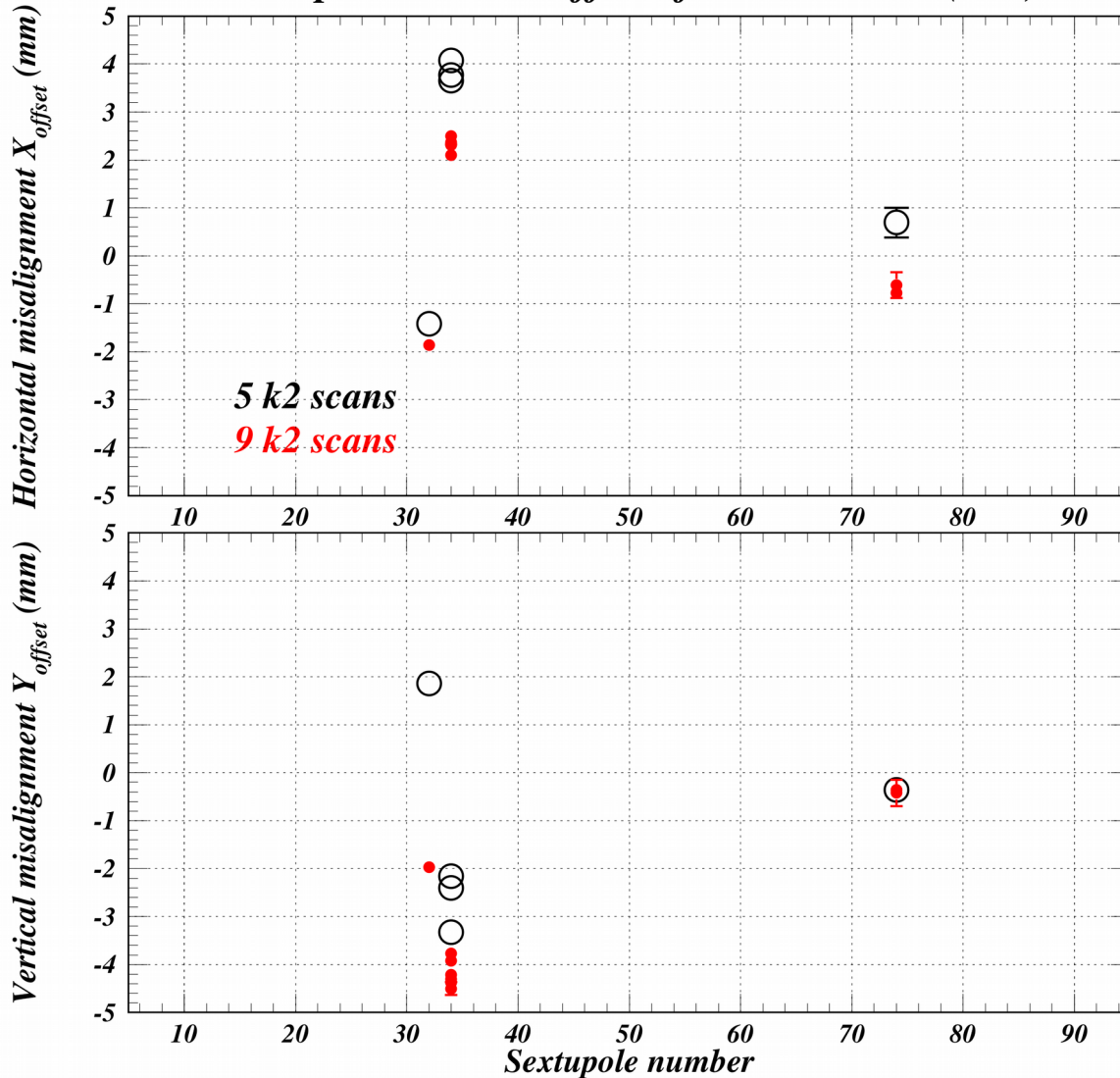
The only transverse move greater than 1 mm was 36W vertical. The measured misalignments differ by less than the 2-mm move.

The largest change in misalignment is 32W vertical. The processor was also changed in October and BPM gains and centering had not been done yet. Consider re-measuring.

The large vertical quad/sextupole misalignment at 26W was not changed by the small girder moves. See also talk of 8 November 2023.



Sextupole X and Y offsets from K2 scans (mm)



Remarks

32W: processor swapped on 10/2 early morning. No button gain calibration or quad centering done.

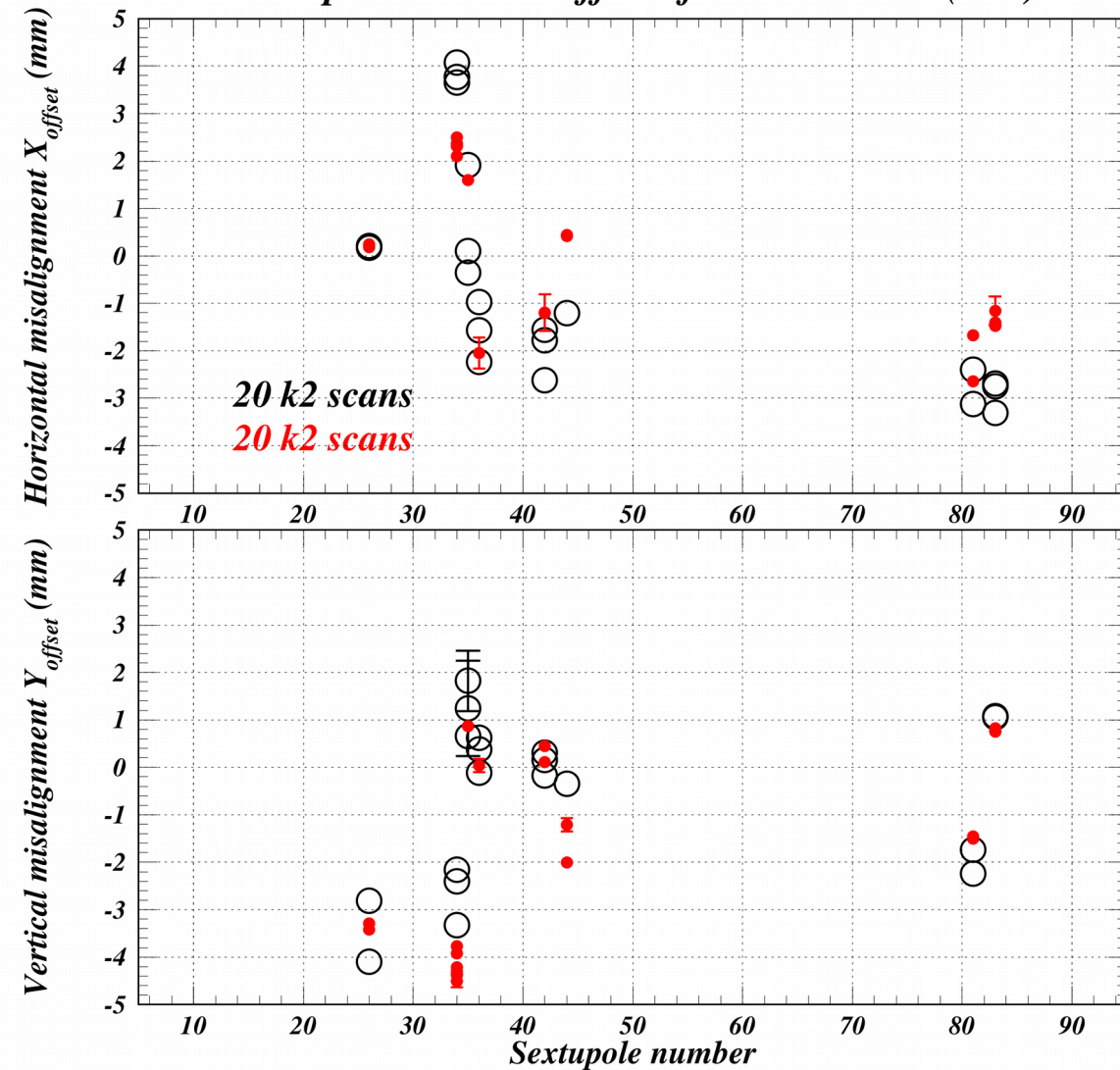
25E: processor swapped on 9/30. No button gain calibration or quad centering done.

34W: processor swapped on 10/2 early morning. Button gain calibration and quad centering done prior to the K2 scan.

34W is a prime candidate for sextupole survey measurement test with shimming.



Sextupole X and Y offsets from K2 scans (mm)



Remarks

All “before” data was recorded from February 2021 to May 2023.

34W: processor swapped on 10/2 early morning **and** button gain calibration and quad centering done prior to the K2 scan.

Corrections due to updated button gain values are generally sub-mm. This appears to be consistent with Antoine’s diagnostics when doing the calibrations.

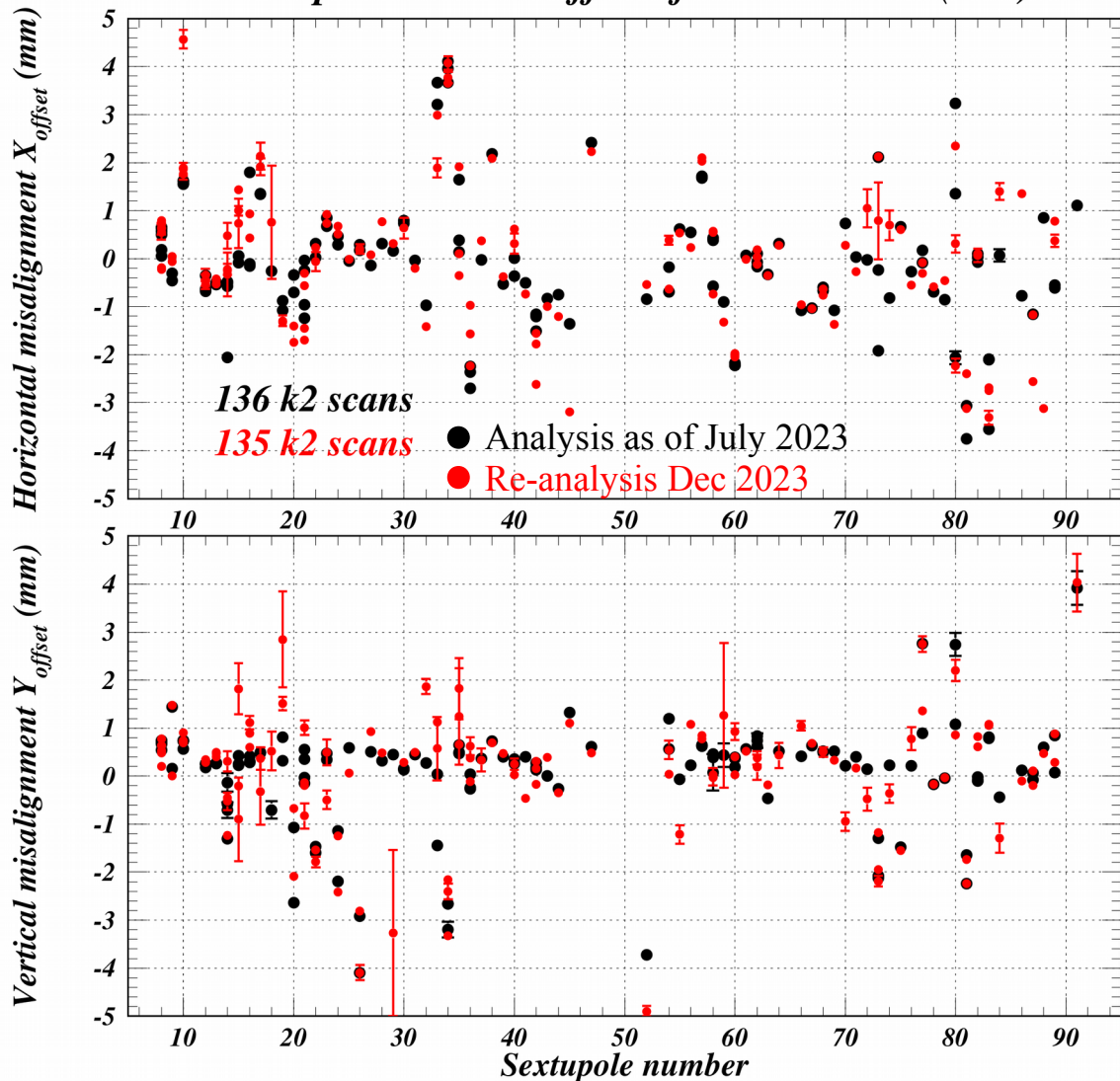
Anomalously large misalignments remain so.

So far gain calibrations and centering corrections are available for 8 sextupoles where K2 scans have been done.



Effects of re-analysis of pre-October data

Sextupole X and Y offsets from K2 scans (mm)



December updates to the analysis

Updated values for the sextupole misalignments

Updated values for the BPM gain calibrations and quad centering. (Assume that they are more correct for all 2021-2023 data than the values previously used.)

Introduce new optimization procedure with much stricter cuts on BPM data, giving much smaller residuals. Now using primarily data with updated BPM gain calibrations and quad centering constants.

Changes in results for misalignments generally minor, but need to think about how to deal with quad moves. Need offset.bpm history.