Requirement for new sextupole magnet mover system

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ATF3 operation task force meeting

Tolerance evaluation by tuning simulation

Tuning simulation procedure

- Set some errors
  - Strength error of quadrupoles: relative 1E-3, Gaussian
  - Rotation of quadrupoles: 1E-4 radian, Gaussian
  - Vertical misalignment of quadrupoles (upstream of QD8X): 10 micron, Gaussian (+horizontal)

- Orbit and dispersion correction in FFOrbit correction using vertical steerings(ZV*) (+ZH*, ZX*)

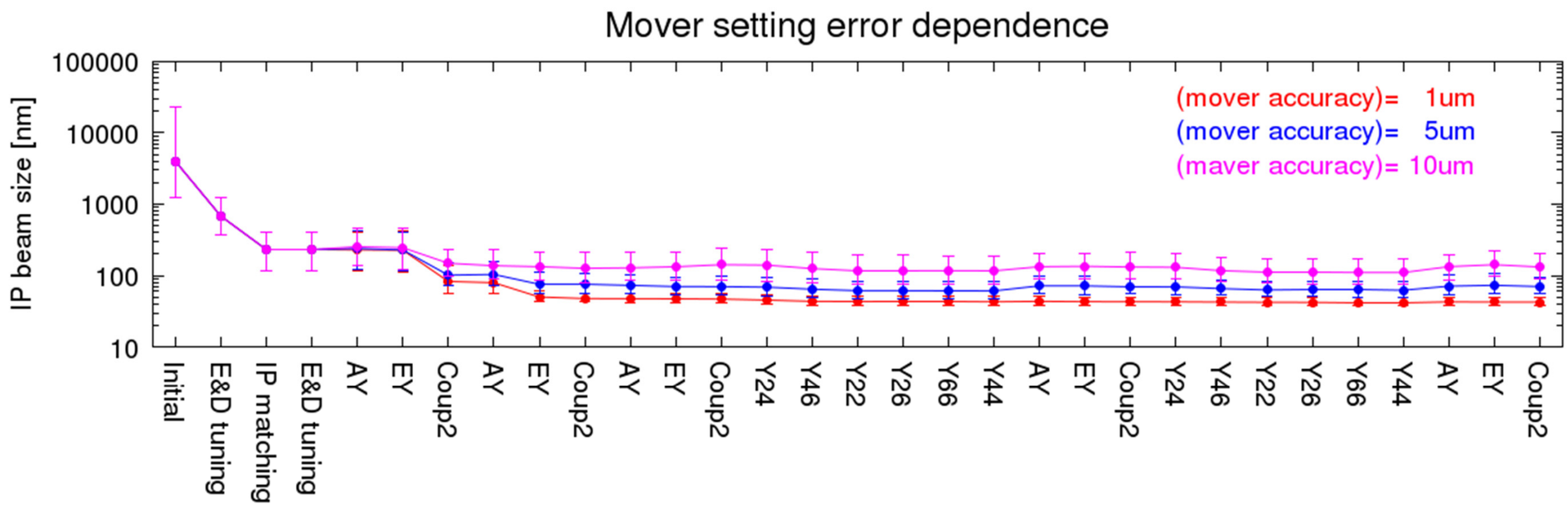
- Dispersion correction using QS1X, QS2X sum-knob (+ QF6X adjustment for horizontal)

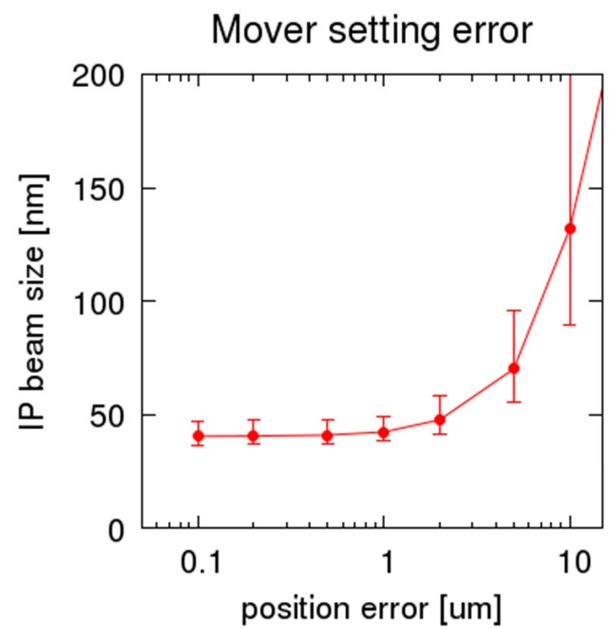
(+ IP beta matching)

- Perform knob scans, with iterations minimizing vertical beam size at IP

(+ Perform the nonlinear knob scan)

Tolerance evaluation of the FF sextupole mover accuracies





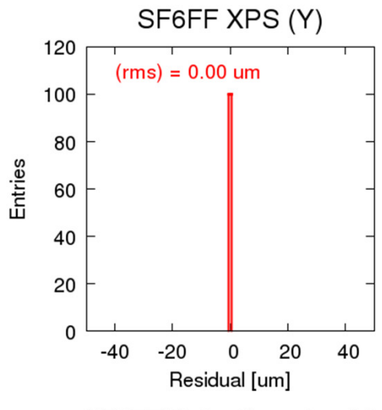
- *The position accuracy of the sextupole mover required by the ATF is about 1um (about 0.1um for the ILC).*

- *The position accuracy of the SLAC mover is 0.1um (private communication with SLAC).*

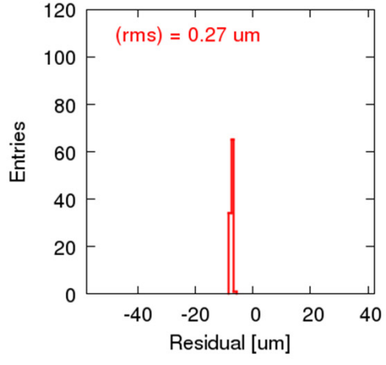
Sextupole mover repeatability test

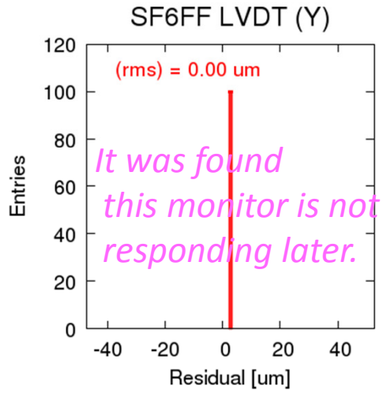
Stabilities for vertical position censors of the sextupole movers

- *Each sensor measured position 100 times every 20 seconds.*
- *All sensor readouts were stable within 1um.*

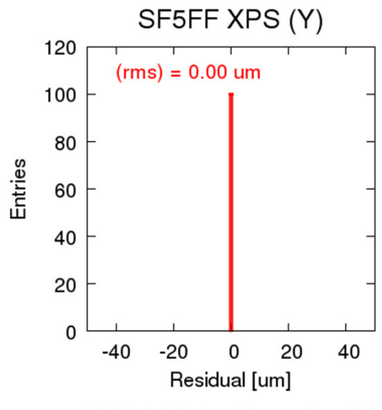


SF6FF Potentiometer (Y)

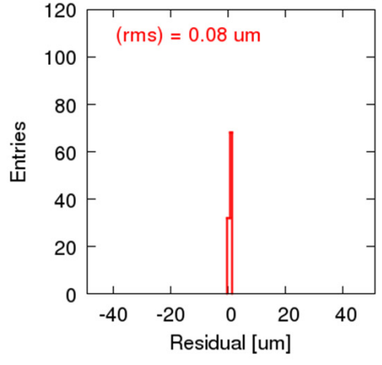


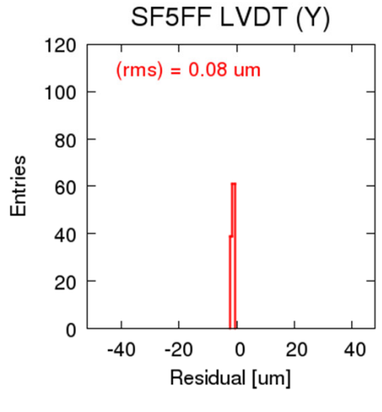


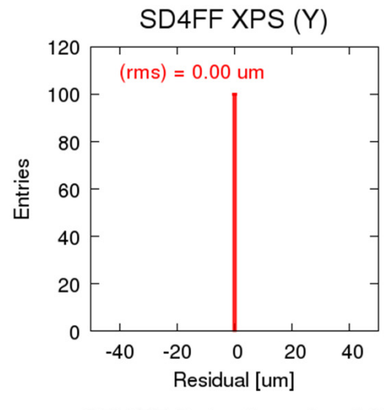
It was found this monitor is not responding later.



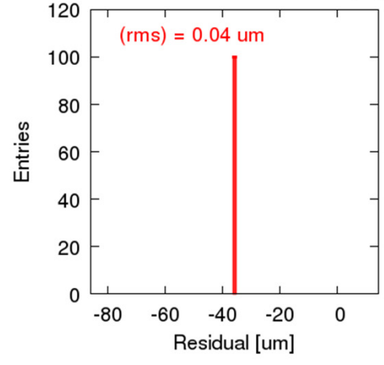
SF5FF Potentiometer (Y)

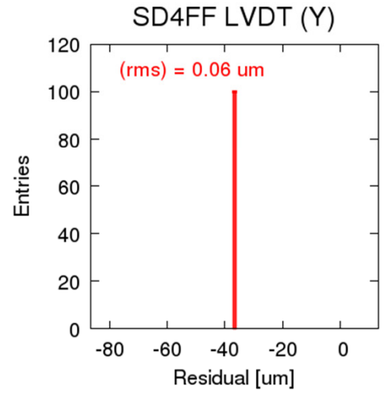


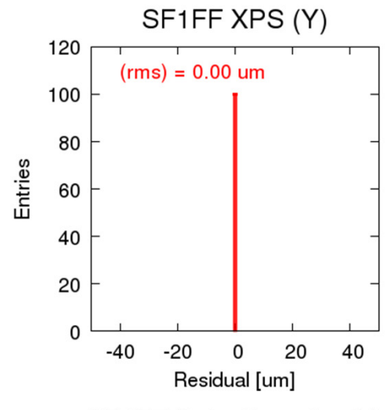




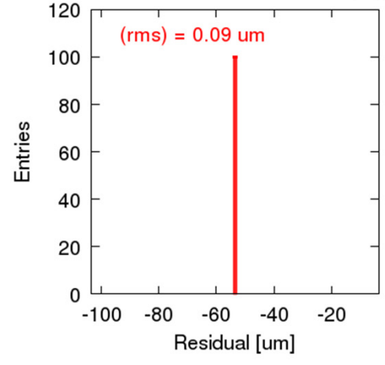
SD4FF Potentiometer (Y)

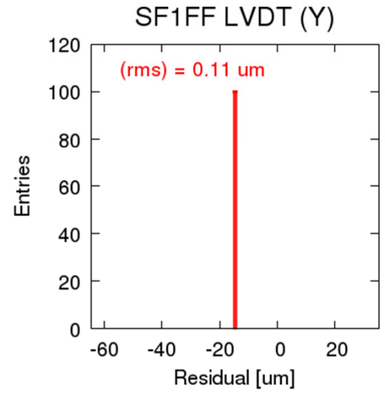


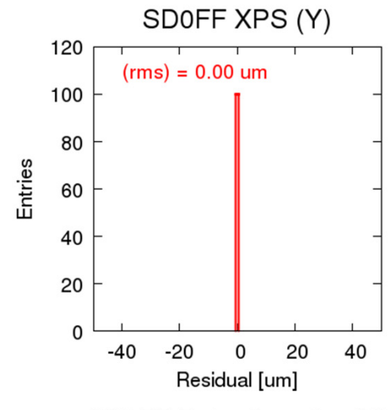




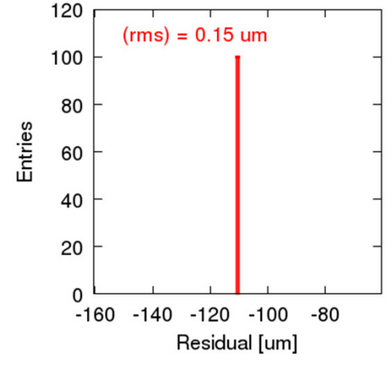
SF1FF Potentiometer (Y)

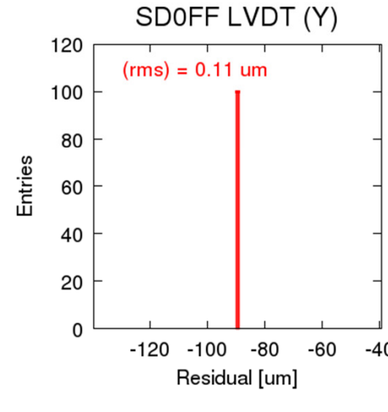






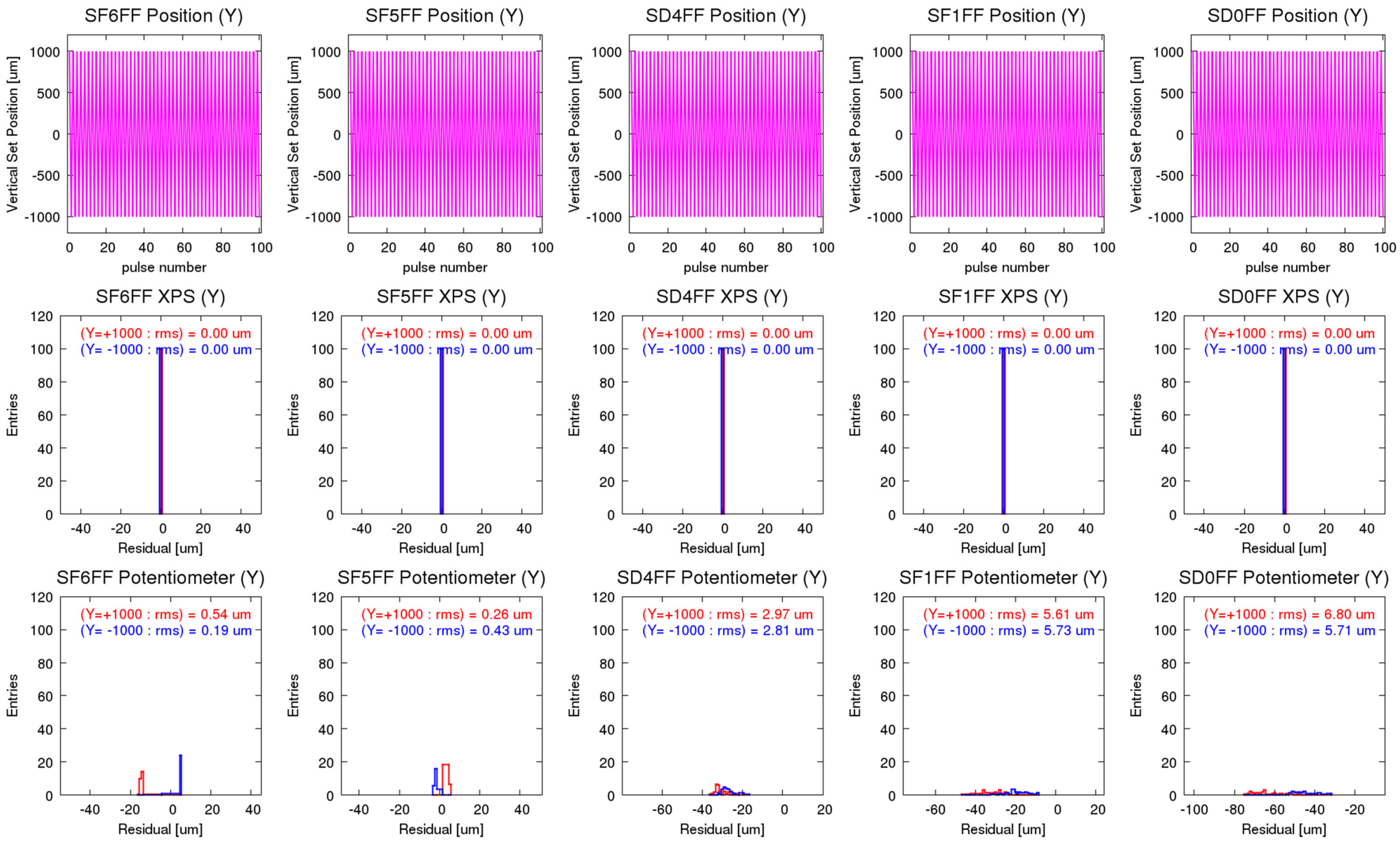
SD0FF Potentiometer (Y)





Position repeatability measurement for vertical mover position change (1)

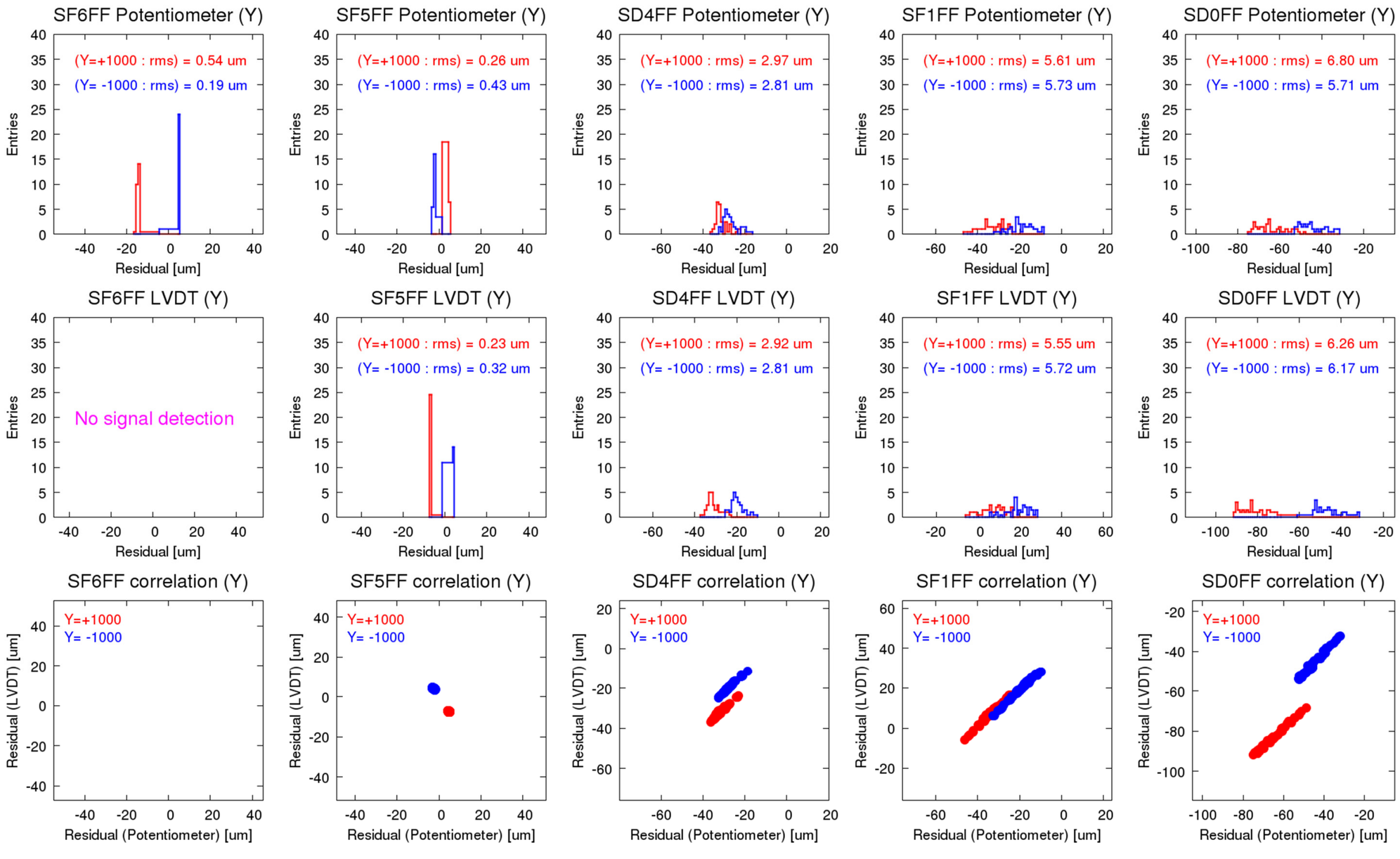
- *A total of 100 points were measured, 50 times at each point with a set value of +/-1000um.*
- *The movers are fed back by XPS, so the XPS readings are very stable.*



Position repeatability measurement for vertical mover position change (2)

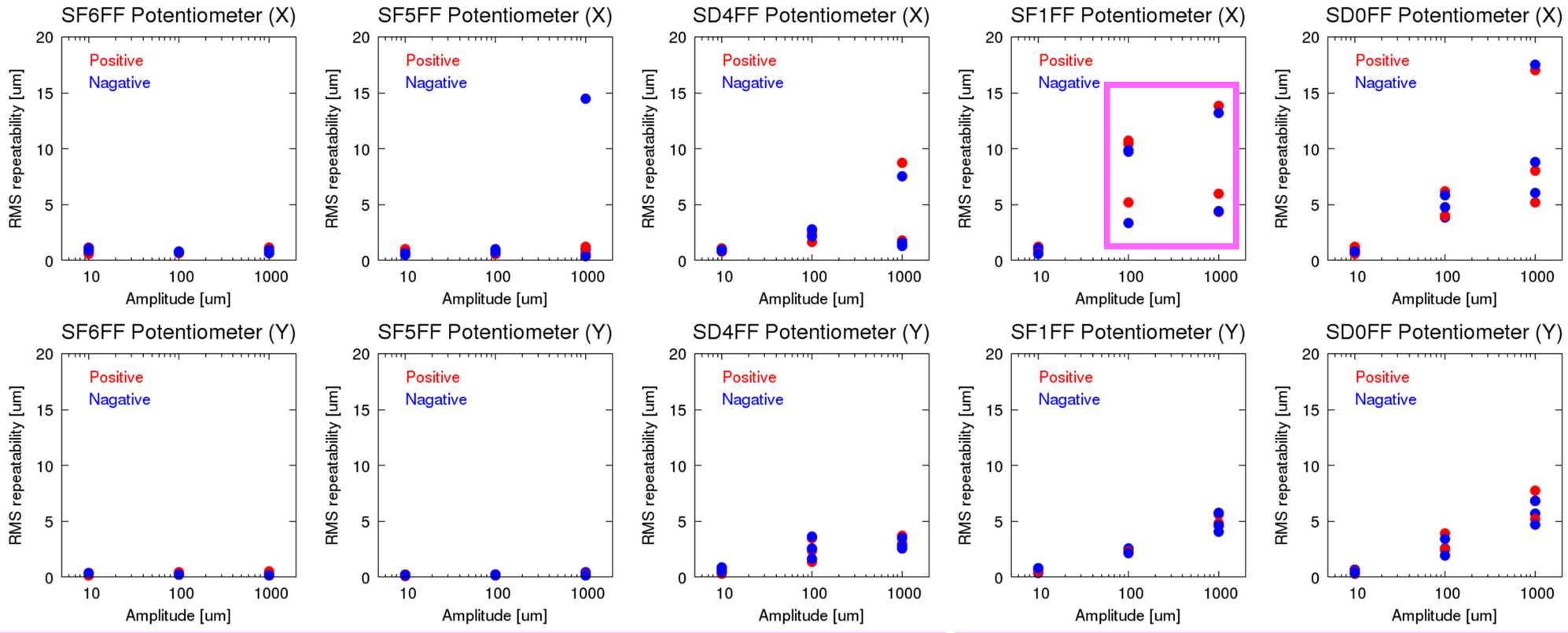
Vertical position readouts (potentiometer and LVDT) from the magnet movers.

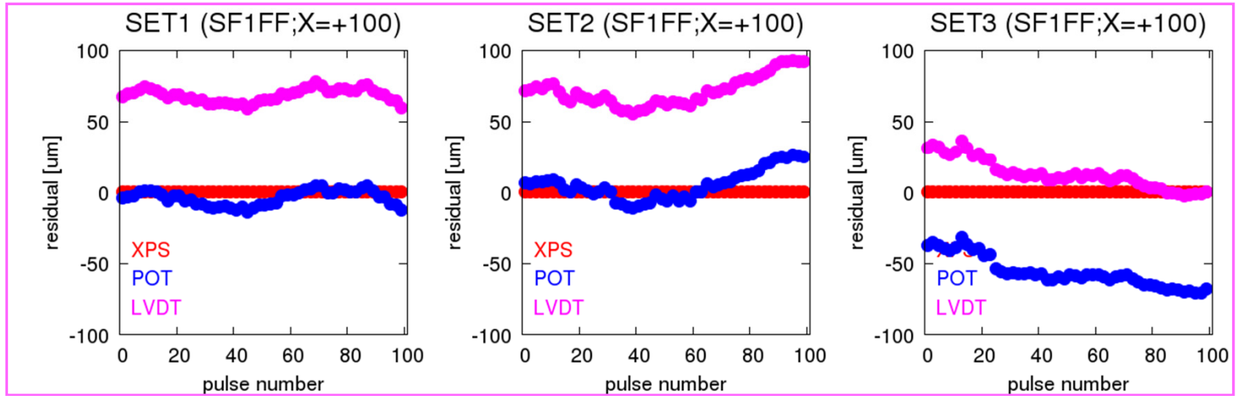
- *The clear correlation of potentiometer and LVDT was observed.*

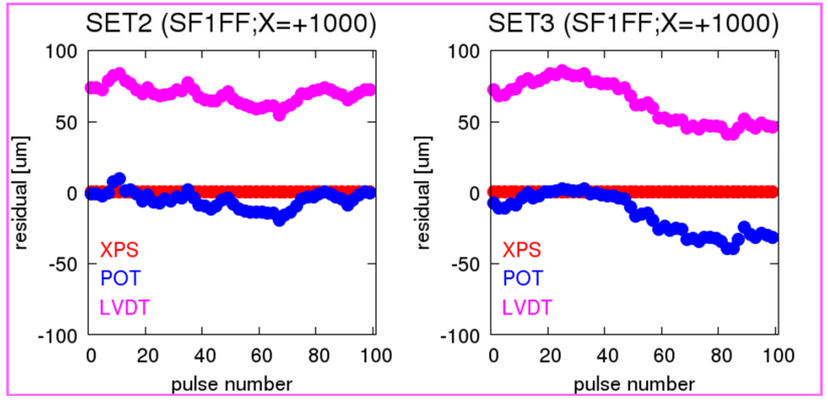


Measurements were taken multiple times at different amplitudes

- *3 measurements (amplitude of 10um, 100um and 1mm) for X and Y directions were taken at each point.*
- *The deviation from the set value is larger the larger the amplitude, which is not random and behaves like a drift.*







Summary of magnet mover issues

- The accuracy of the mover control of the sextupole magnet is important for beam control in ATF2.
- The current ATF2 sextupole magnet mover is controlled by an XPS driver.
- Each mover is equipped with three readouts: XPS readout, potentiometer, and LVDT.
- When the magnet is repeatedly moved to the same position by XPS, the absolute values of potentiometer and LVDT are not only shifted, but also the position is not reproduced well.
- Since the correlation between potentiometer and LVDT is good, it seems that the repeatability of the control in XPS is not good.
- As reported by Konstantin, LVDT seems to be better than potentiometer in absolute value accuracy for X&Y readings.
- When considering a new mover control system, the position control of the sextupole magnets is important and should be controlled to match the LVDT reading if possible.
- But, LVDT for SF6FF seemed not to work well.