

Axis determination of the units 21-27 of the QFM magnets

Reference system defined by survey instrument using rails identical to those used on the girders, in order to allow a reproducible placement of each unit under study.

No cooling water used, measuring current 5A

Adjust linear stages carrying the wire so as to place the wire center aligned on the nominal axis.

Track home position with Faro at each magnet

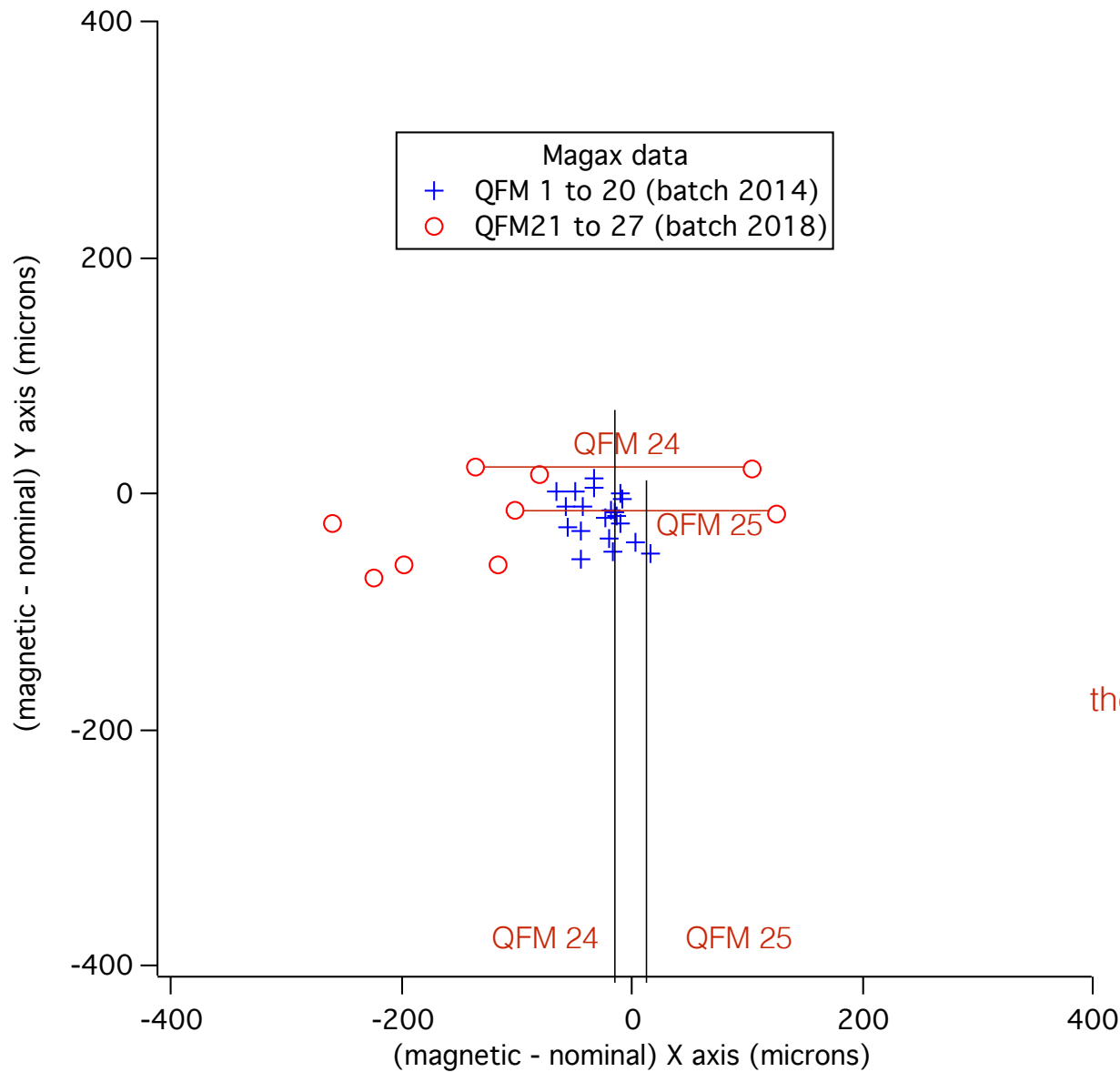
Magnet units 24 and 25 flipped to validate ref system

Global accuracy +/- 30 microns

data folder /afs/psi/group/magnet/meas/SwissFEL/qfm/2x, x runs from 1 to 7

summary QFM21 - 27

magnet	date last magax file	mean T (C) air / magnet	dx / dy stages (mu)	asym dx (mu)	wh1 (stages-Faro) dx / dy (mu)	wh2 (stages-Faro) dx / dy (mu)
QFM21 MAG 3463	25.07 16h05	28.8 / 26.3	-260 / -25	n/a	10 / 4	26 / 14
QFM22 MAG 3464	25.07 09h46	28.8 / 27.7	-224 / -72	n/a	5 / -17	-22 / -8
QFM23 MAG 3465	24.07 16h17	28.7 / 25.7	-197 / -61	n/a	4 / -12	-18 / -10
QFM24 MAG 3466	12.07 08h21	25.4 / 26.7	-80 / 16	-92	-16 / 4	102 / -6
QFM24 flip MAG 3466	11.07 15h05	26.6 / 25.75	+104 / 21	92	16 / 14	-21 / -15
QF25 MAG 3667	09.07 14h08	27.0 / 26.35	-101 / -14	-113	2 / 26	-24 / -15
QFM25 flip MAG 3467	09.07 18h52	28.0 / 26.	+126 / -17	113	-4 / 16	-22 / -10
QFM26 MAG 3468	25.07 12h05	28.8 / 26.5	-136 / 22	n/a	24 / 4	-26 / 0
QFM27 MAG 3469	25.07 14h19	28.4 / 26.65	-116 / -61	n/a	26 / -6	-14 / 10

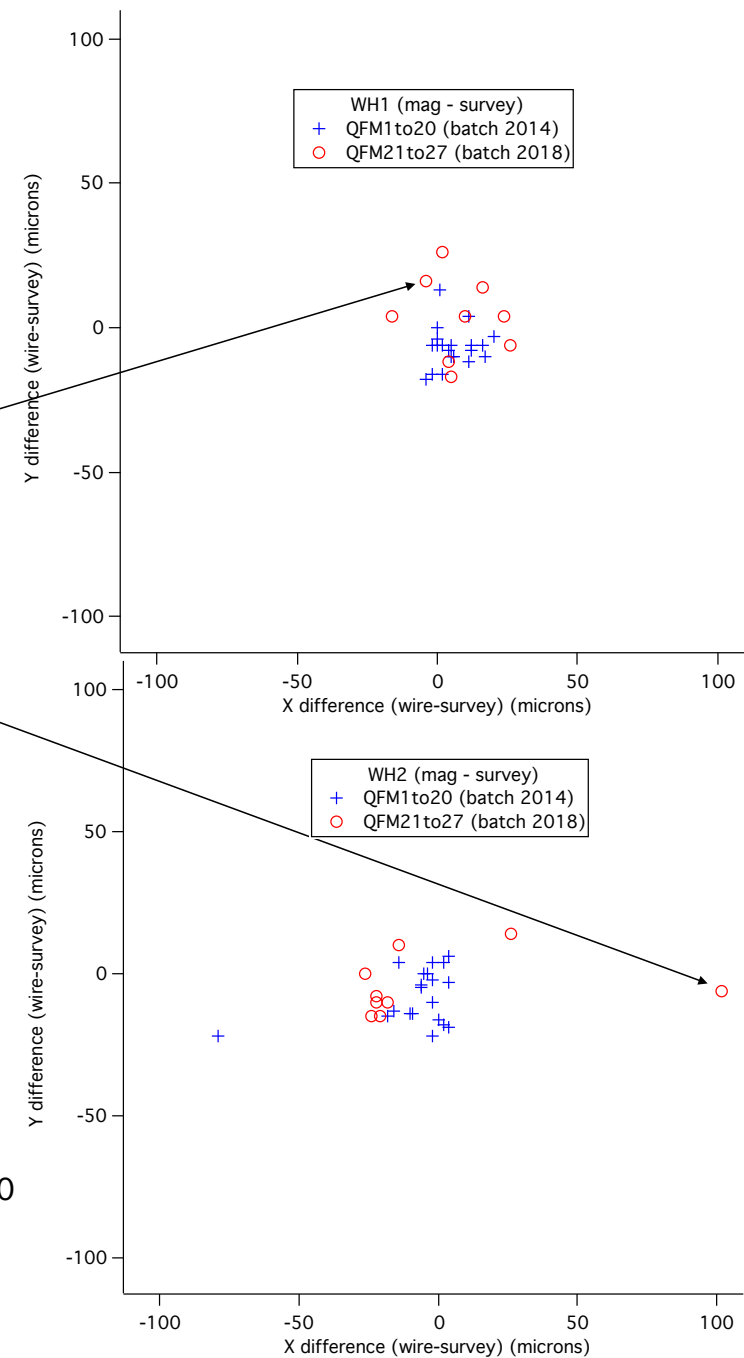
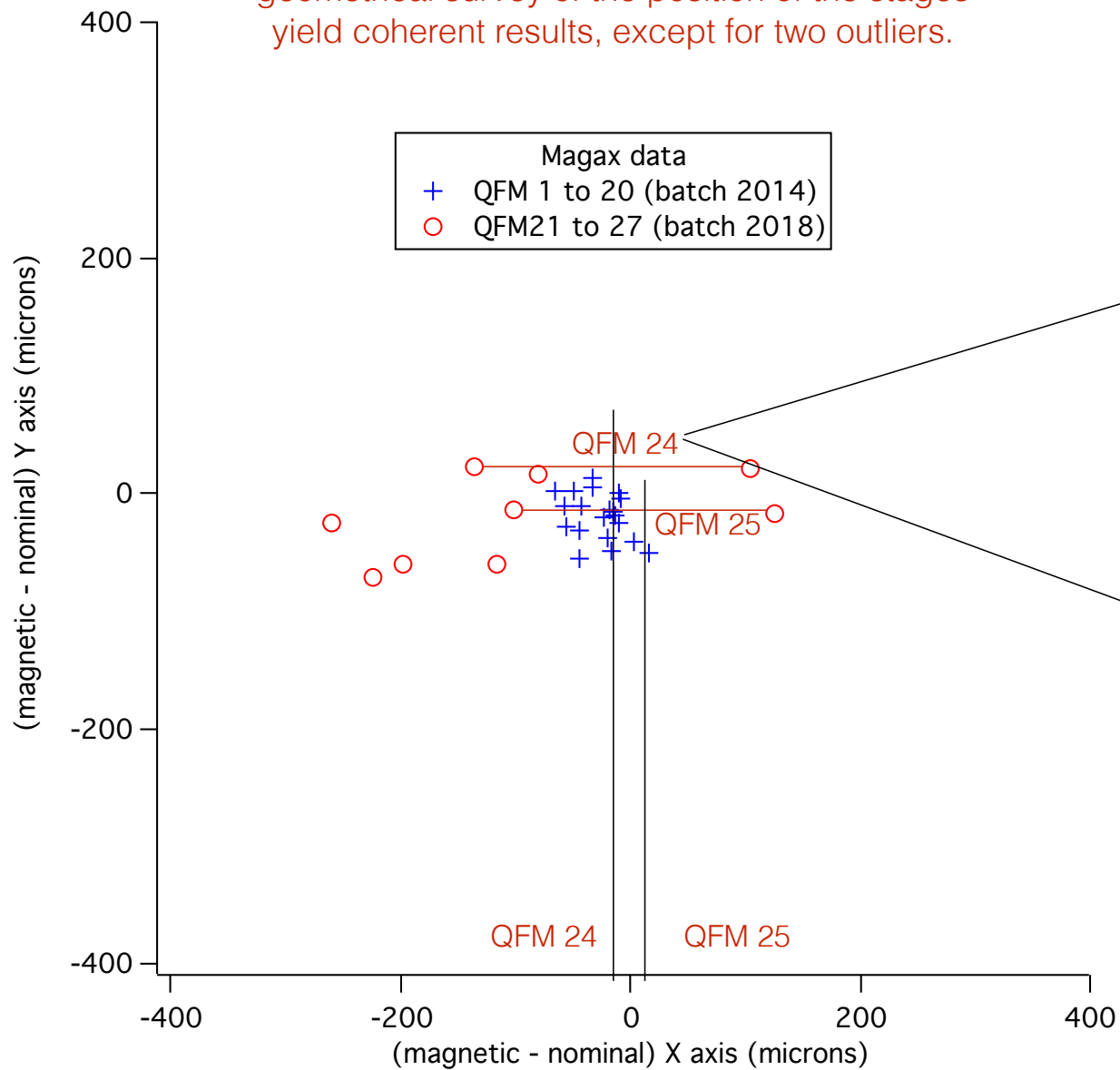


two series of 20 and 7 magnets
were investigated with the
same instrumentation and methods.

the second batch (series of 7 units 2018)
seems to have an average negative
horizontal offset as well as a larger spread.

In order to validate the ref system,
units 24 and 25 were flipped horizontally.
The asymmetry of the results measures the
offset in the ref system. This offset is within
the accuracy achievable by the survey instrument

the linear stages carrying the wire as well as the geometrical survey of the position of the stages yield coherent results, except for two outliers.



QFM25_3

```
[pc7455 cmd]
[INSTBASE=devl]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/25/vw/5A_repeat

file magax_2018_07_09_132455_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here
file magax_2018_07_09_134735_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here
file magax_2018_07_09_140804_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here

#====< magax >=====
#
#meas_startTime      [C]    [C]    [C]          [Hz]    [A]  [mV]    [mrad]  [mrad]    [um]  [um]    [uV]  [uV]    [uV]  [uV]
#Troom  TmagR  TmagL      freq  Iset(Vout)  roll_X  roll_Y  pos_X  pos_Y  wire_X0  wire_Y0  wire_X  wire_Y
#-----
#re-measure, due to largest (S-M) spread
9-Jul 13:24:55  27.18  26.08  26.40    214.09    5A(300.0)  -15.3   -0.2   -101.7  -14.1    3210    8302    4667    9044
9-Jul 13:47:35  26.92  26.20  26.51    214.05    5A(300.0)  -17.7   -3.2   -101.5  -13.7    3215    8289    4677    9039
9-Jul 14:08:04  27.11  26.32  26.62    214.01    5A(300.0)  -16.0    1.7   -101.4  -14.2    3218    8283    4686    9022
#=====

file FARO_2018_07_09_144818_res.txt has incorrect stages home positions - X,Y_stages adjusted by 60 um here

                                     (for QFM): geoMag_Y = midOf4_Y + 150.0 + 8.33 - 25.4/4
#====< magaxFARO >=====
#
#meas_startTime  meas_by  [H:M:S]  [C]    [C]    [Hz]    [um]    [um]    [um]    [um]    [um]
#elapsed  T(H)start  DT(DH)  freq  X,Y_stages  DX,DY_WH1  DX,DY_WH2  DX,DY_W-M  DL,DR_T
#-----
#repeat because of large spread
9-Jul 14:48:18   Lerch   0:02:02  27.58(43%) -0.23(0%)  214.10  -101.5, -14.0  2, 26  -24, -15  -75, -27  43, 31
#=====
```

axis offset given by stages

diff (Faro-stages)

*flipping magnet measures H asymmetry
+12 H from ideal axis of symmetry
H HOME definition is valid*

QFM25_3_flip

```
[pc7455 cmd]
[INSTBASE=devl]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/25/vw/5A_repeat_flip

file magax_2018_07_09_174910_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here
file magax_2018_07_09_181050_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here
file magax_2018_07_09_183129_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here
file magax_2018_07_09_185200_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here

#====< magax >=====
#
#meas_startTime      [C]      [C]      [C]      [Hz]      [A]  [mV]  [mrad]  [mrad]      [um]  [um]      [uV]  [uV]      [uV]  [uV]
#meas_startTime      Troom    TmagR    TmagL    freq      Iset(Vout)  roll_X  roll_Y    pos_X  pos_Y    wire_X0  wire_Y0    wire_X  wire_Y
#-----
#flipped magnet - checked rails&ref sys
9-Jul 17:49:10      27.77  27.21  27.44    211.22      5(300.0)    -8.5     6.7    125.3  -16.0     3203     8179     2963    8840
9-Jul 18:10:50      27.75  27.23  27.44    211.23      5(300.0)    -9.1    12.4    125.5  -16.7     3201     8169     2967    8821
9-Jul 18:31:29      27.73  27.25  27.44    211.21      5(300.0)    -7.1    10.7    126.7  -16.8     3201     8166     2969    8825
9-Jul 18:52:00      27.80  27.26  27.45    211.21      5(300.0)    -9.5    11.0    127.0  -17.2     3204     8162     2968    8806
#=====

file FARO_2018_07_10_124656_res.txt has incorrect stages home positions - X,Y_stages adjusted by 60 um here

                                     (for QFM): geoMag_Y = midOf4_Y + 150.0 + 8.33 - 25.4/4
#====< magaxFARO >=====
#
#meas_startTime  meas_by  [H:M:S]  [C]      [C]      [Hz]      [um]      [um]      [um]      [um]      [um]
#meas_startTime  meas_by  elapsed  T(H)start  DT(DH)  freq      X,Y_stages  DX,DY_WH1  DX,DY_WH2  DX,DY_W-M  DL,DR_T
#-----
#flipped unit
10-Jul 12:46:56   Lerch    0:12:55  27.00(43%)  0.34(-0%)  211.08    126.5, -17.0  -4, 16    -22, -10    -42, -16    18, 33
#=====
```

axis offset given by stages

diff (Faro-stages)

QFM24_3_flip

```
[pc7455 cmd]
[INSTBASE=devl]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/24/vw/5A_flip

file magax_2018_07_11_143739_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here

file magax_2018_07_11_150513_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here

#====< magax >=====
#
#meas_startTime      [C]      [C]      [C]      [Hz]      [A] [mV]      [mrad] [mrad]      [um]  [um]      [uV]  [uV]      [uV]  [uV]
#                    Troom  TmagR  TmagL    freq    Iset(Vout)  roll_X roll_Y    pos_X pos_Y    wire_X0 wire_Y0  wire_X wire_Y
#-----
#repeat in flip - home validate by qfm25/flip
11-Jul 14:37:39    26.03  25.73  25.71    211.37    5(300.0)   -18.7    1.6    104.7  20.6    3257   8282    3125   9532
11-Jul 15:05:13    26.10  25.81  25.82    211.35    5(300.0)   -20.5    2.5    104.2  20.7    3249   8277    3125   9539
#=====

file FARO_2018_07_11_164845_res.txt has incorrect stages home positions - X,Y_stages adjusted by 60 um here

                                     (for QFM):  geoMag_Y = midOf4_Y + 150.0 + 8.33 - 25.4/4
#====< magaxFARO >=====
#
#meas_startTime  meas_by  [H:M:S]  [C]      [C]      [Hz]      [um]      [um]      [um]      [um]      [um]
#                elapsed  T(H)start DT(DH)  freq    X,Y_stages DX,DY_WH1 DX,DY_WH2 DX,DY_W-M DL,DR_T
#-----
#flip
11-Jul 16:48:45    Lerch   0:15:01  26.40(39%) 0.78(-1%) 211.13    104.0, 21.0  16, 14   -21, -15  -102, -5   30, 40
#=====
```

axis offset given by stages

diff (Faro-stages)

*flipping magnet measures asymmetry
-18H and +27V from ideal axis of symmetry
HOME definition is valid*

QFM24_3

```
[pc7455 cmd]
[INSTBASE=devl]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/24/vw/5A

file magax_2018_07_12_075933_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here

file magax_2018_07_12_082109_res.txt has incorrect stages home positions - pos_X and pos_Y adjusted by 60 um here

#====< magax >=====
#
#meas_startTime      [C]      [C]      [C]      [Hz]      [A] [mV]      [mrad] [mrad]      [um] [um]      [uV] [uV]      [uV] [uV]
#Troom TmagR TmagL freq Iset(Vout) roll_X roll_Y pos_X pos_Y wire_X0 wire_Y0 wire_X wire_Y
#-----
#normal position, T drop overnight
12-Jul 07:59:33 25.61 26.64 26.96 205.95 5(300.0) -8.9 13.3 -80.4 15.9 3205 8347 4226 9547
12-Jul 08:21:09 25.26 26.61 26.92 205.99 5(300.0) -10.1 10.4 -80.4 16.4 3202 8322 4214 9552
#=====

file FARO_2018_07_12_090130_res.txt has incorrect stages home positions - X,Y_stages adjusted by 60 um here

                                     (for QFM): geoMag_Y = midOf4_Y + 150.0 + 8.33 - 25.4/4
#====< magaxFARO >=====
#
#meas_startTime meas_by [H:M:S] [C] [C] [Hz] [um] [um] [um] [um] [um]
#elapsed T(H)start DT(DH) freq X,Y_stages DX,DY_WH1 DX,DY_WH2 DX,DY_W-M DL,DR_T
#-----
#smooth
12-Jul 09:01:30 Lerch 0:02:02 25.70(38%) 0.57(-1%) 206.08 -80.5, 16.5 -16, 4 102, -6 41, -45 95, 30
#=====
```

axis offset given by stages

diff (Faro-stages)

QFM23_3

```
[pc7455 cmd]
[INSTBASE=dev1]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/23/vw/5A

#====< magax >=====
#
#meas_startTime    [C]    [C]    [C]    [Hz]    [A] [mV]    [mrad] [mrad]    [um]    [um]    [uV]    [uV]    [uV]    [uV]
#-----
#verified ref / home start / OK
24-Jul 15:55:16    28.69  25.42  25.77    201.11    5(300.0)    -0.5    18.1    -196.9    61.4    3245    7979    5330    8975
24-Jul 16:17:21    28.60  25.64  25.98    201.08    5(300.0)    -0.6    20.3    -197.4    61.5    3243    7980    5319    8970
#=====

#====< magaxFARO >=====
#
#meas_startTime    meas_by    [H:M:S]    [C]    [C]    [Hz]    [um]    [um]    [um]    [um]    [um]
#-----
#verified ref / home start / OK
24-Jul 16:54:43    Lerch    0:09:07    28.54(42%)    1.12(-2%)    200.93    -197.5, 61.5    4, -12    -18, -10    12, 13    14, 24
#=====
```

axis offset given by stages

diff (Faro-stages)

QFM22_3

```
[pc7455 cmd]
[INSTBASE=devl]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/22/vw/5A_2

#====< magax >=====
#
#meas_startTime      [C]      [C]      [C]      [Hz]      [A] [mV]      [mrad] [mrad]      [um]      [um]      [uV]      [uV]      [uV]      [uV]
#Troom      TmagR      TmagL      freq      Iset(Vout)      roll_X      roll_Y      pos_X      pos_Y      wire_X0      wire_Y0      wire_X      wire_Y
#-----
#CAM 10 crashes, home drift dX(WH2) -39 mu dY(WH2) -39 mu
25-Jul 09:21:43      28.05      27.48      27.93      208.06      5(300.0)      -8.4      7.4      -225.1      72.5      3240      8075      5697      9213
25-Jul 09:46:23      27.98      27.51      28.01      208.09      5(300.0)      -1.3      15.7      -223.8      71.7      3235      8026      5718      9172
#=====

                                     (for QFM): geoMag_Y = midOf4_Y + 150.0 + 8.33 - 25.4/4
#====< magaxFARO >=====
#
#meas_startTime      meas_by      [H:M:S]      [C]      [C]      [Hz]      [um]      [um]      [um]      [um]      [um]
#elapsed      T(H)start      DT(DH)      freq      X,Y stages      DX,DY WH1      DX,DY WH2      DX,DY_W-M      DL,DR_T
#-----
25-Jul 10:09:09      Lerch      0:10:11      28.12(46%)      0.77(-1%)      208.32      -224.0, 72.0      5, -17      -22, -8      -73, 42      14, 25
#=====
```

axis offset given by stages

diff (Faro-stages)

QFM26_2

```
[pc7455 cmd]
[INSTBASE=devl]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/26/vw/5A_2
```



```
#====< magax >=====
```

#		[C]	[C]	[C]	[Hz]	[A]	[mV]	[mrad]	[mrad]	[um]	[um]	[uV]	[uV]	[uV]	[uV]
#	meas_startTime	Troom	TmagR	TmagL	freq	Iset(Vout)		roll_X	roll_Y	pos_X	pos_Y	wire_X0	wire_Y0	wire_X	wire_Y
#	-----														
#	#dx at WH1 -49 mu														
25-Jul	11:23:17	28.02	26.25	26.57	199.75	5(300.0)		-16.9	7.1	-136.3	23.4	3320	7983	4655	8366
25-Jul	11:44:50	28.04	26.38	26.71	199.72	5(300.0)		-9.9	14.4	-136.5	22.1	3321	7966	4617	8352
25-Jul	12:05:31	28.07	26.52	26.86	199.71	5(300.0)		-7.5	14.7	-136.2	22.4	3313	7969	4595	8357
#	=====														

(for QFM): geoMag_Y = midOf4_Y + 150.0 + 8.33 - 25.4/4

```
#====< magaxFARO >=====
```

#	#meas_startTime	meas_by	[H:M:S]	[C]	[C]	[Hz]	[um]	[um]	[um]	[um]	[um]
#			elapsed	T(H)start	DT(DH)	freq	X,Y_stages	DX,DY_WH1	DX,DY_WH2	DX,DY_W-M	DL,DR_T
#	-----										
25-Jul	12:34:57	Lerch	0:09:58	28.09(47%)	0.74(-1%)	199.71	-136.5, 22.5	24, 4	-26, -0	-27, 23	30, 27
#	=====										

axis offset given by stages

diff (Faro-stages)

QFM27_3

```
[pc7455 cmd]
[INSTBASE=dev1]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/27/vw/5A_3
```

#	[C]	[C]	[C]	[Hz]	[A]	[mV]	[mrad]	[mrad]	[um]	[um]	[uV]	[uV]	[uV]	[uV]
#meas_startTime	Troom	TmagR	TmagL	freq	Iset(Vout)		roll_X	roll_Y	pos_X	pos_Y	wire_X0	wire_Y0	wire_X	wire_Y
#=====														
#remeasure / doubts on Y offset /incoherence in magax_res.py output														
25-Jul 13:24:18	28.36	25.46	25.80	201.19	5(300.0)		-34.4	37.5	-113.0	-58.0	3341	7963	4438	7102
#PLL failure, repeat														
25-Jul 14:19:39	28.40	25.99	26.34	201.17	5(300.0)		4.6	37.3	-116.2	-61.9	3331	7987	4366	7068
#=====														

(for QFM): $\text{geoMag_Y} = \text{midOf4_Y} + 150.0 + 8.33 - 25.4/4$

#	[H:M:S]	[C]	[C]	[Hz]	[um]	[um]	[um]	[um]	[um]	
#meas_startTime	meas_by	elapsed	T(H)start	DT(DH)	freq	X,Y stages	DX,DY_WH1	DX,DY_WH2	DX,DY_W-M	DL,DR_T
#=====										
25-Jul 14:41:33	Lerch	0:06:27	28.47(43%)	0.72(-1%)	201.14	-116.5, -61.5	26, -6	-14, 10	41, -76	30, 36
#=====										

axis offset given by stages

diff (Faro-stages)

QFM21_2

```
[pc7455 cmd]
[INSTBASE=dev1]$ magax_res.py
>>> Directory (must exist): /afs/psi/group/magnet/meas/SwissFEL/qfm/21/vw/5A_2

#====< magax >=====
#
#meas_startTime      [C]      [C]      [C]      [Hz]      [A] [mV]      [mrad] [mrad]      [um]      [um]      [uV]      [uV]      [uV]      [uV]
#                    Troom    TmagR    TmagL    freq      Iset(Vout)  roll_X  roll_Y    pos_X    pos_Y    wire_X0   wire_Y0   wire_X   wire_Y
#-----
#dX WH1 +25 mu / dX WH2 - 24 mu / third run like that
25-Jul 15:42:40      28.90   25.87   26.20     203.77      5(300.0)   -5.7    18.4    -259.8   -25.3     3364     7924     6367    7585
25-Jul 16:05:24      28.69   26.05   26.40     203.72      5(300.0)   -4.1    17.6    -260.3   -25.5     3344     7927     6349    7587
#=====

#====< magaxFARO >=====
#
#meas_startTime  meas_by  [H:M:S]  [C]      [C]      [Hz]      [um]      [um]      [um]      [um]      [um]
#                    elapsed  T(H)start  DT(DH)    freq      X,Y_stages  DX,DY_WH1  DX,DY_WH2  DX,DY_W-M  DL,DR_T
#-----
25-Jul 16:26:07    Lerch    0:07:23  28.67(42%) 0.72(-1%) 203.49    -260.5, -25.5  10, 4    26, 14    -35, -14    52, 29
#=====
```

(for QFM): $\text{geoMag_Y} = \text{midOf4_Y} + 150.0 + 8.33 - 25.4/4$

axis offset given by stages

diff (Faro-stages)