Alignment Results of Magnets in the ATF2 Beam Line

June 9, 2009

Ryuhei Sugahara, KEK

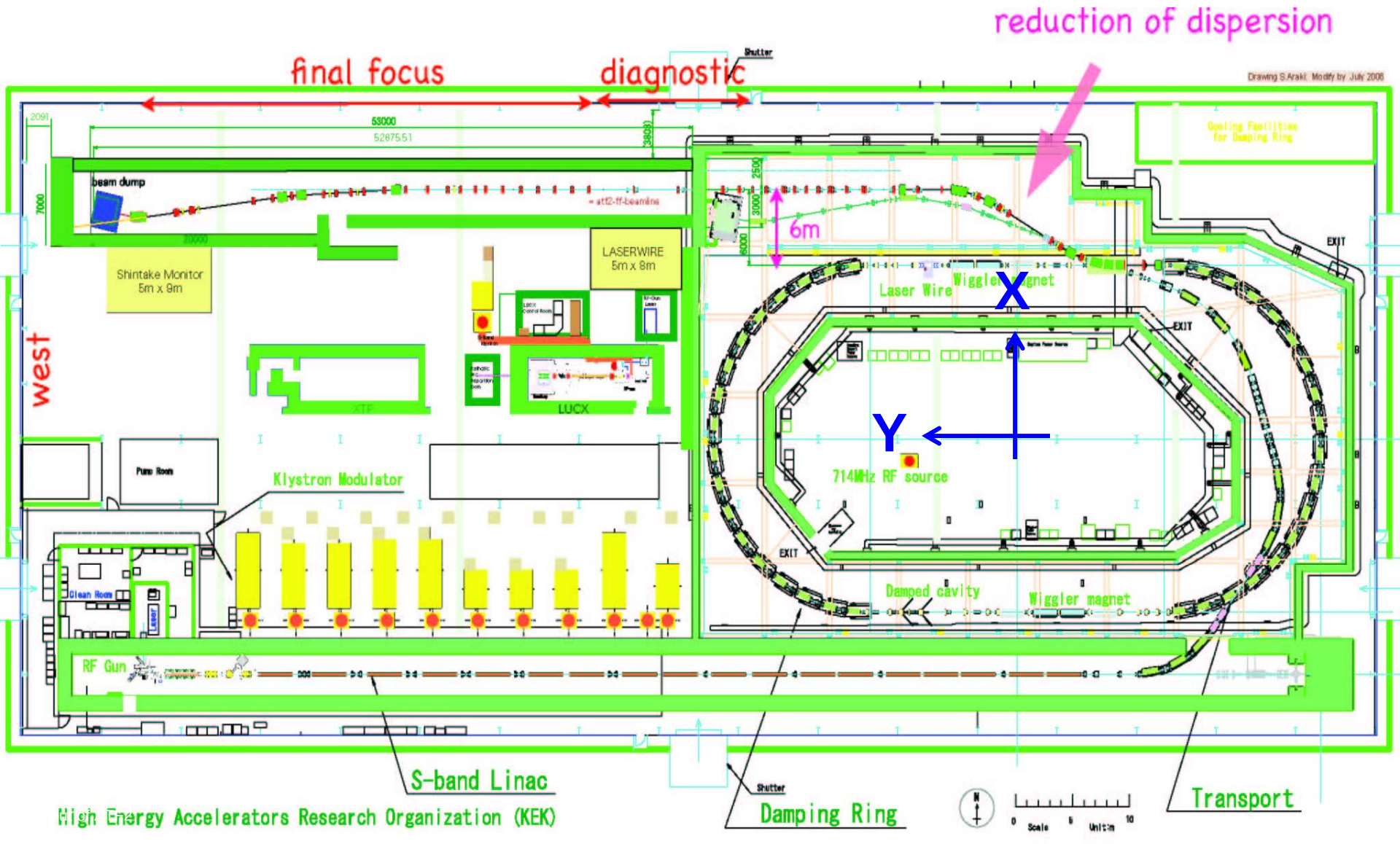
Member

[KEK] S. Araki, N. Terunuma; [Saubi Corp.] M. Takano
[Asist Engineering Co.] K. Nakamura, H. Edagawa
[SK Service Corp.] S. Kato; [Plus One Co.] T. Matsui

History of Alignment Work

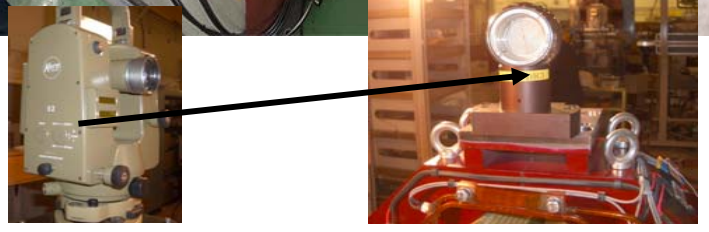
= 2008 =	
- end of June	**QEA and DEA magnets were installed in the ATF2 beam line**
- August	**Magnets were moved from old beam extraction line to the ATF2 beam line**
06 - 08 August	**Floor markers were surveyed again and their coordinates were established**
19 - 29 August	**First alignment of QEA and DEA-magnets**
September	**First alignment of magnets moved from the previous beam extraction line.**
22 - 30 September	**Second alignment (smoothing) Last three Q-mag (QF03, QD02B, QD02A) were not aligned because movers for these magnets could not be adjusted yet.**
26 - 27 November	**Height of three DEA-magnets were corrected**
22 - 25 December	**Alignment for QF3FF, QD2BFF and QD2AFF, and through survey of ATF2 beam line**
= 2009 =	
5 January	**Re-alignment of the last six magnets in the ATF2**
20 - 21 January	**Re-alignment of 7 magnets**

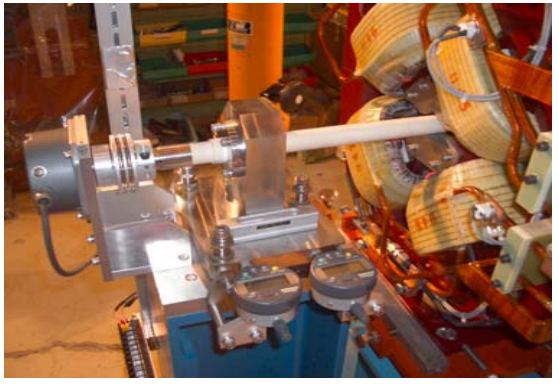
ATF-ring and ATF2 Beam Line
Definition of the coordinate

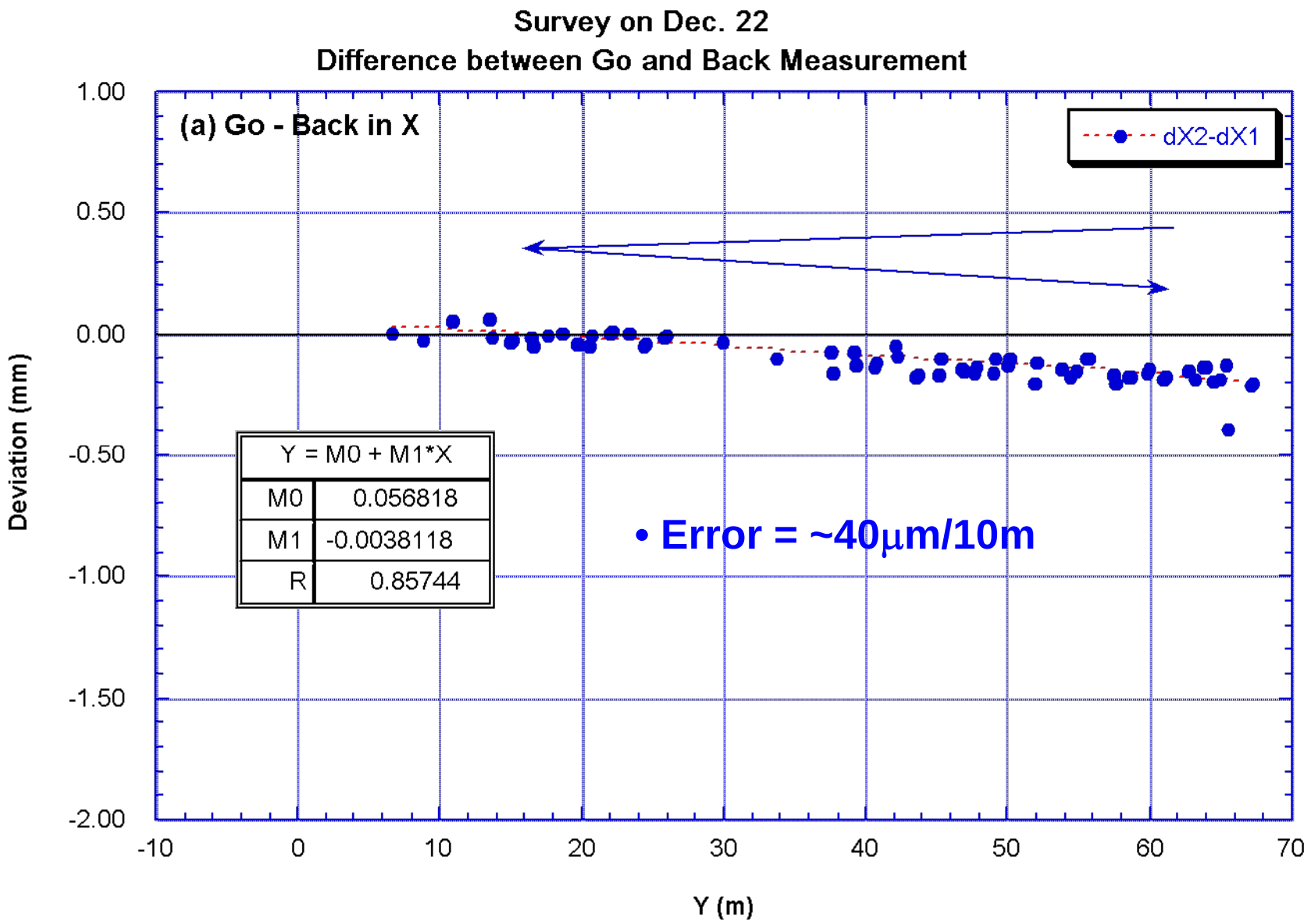


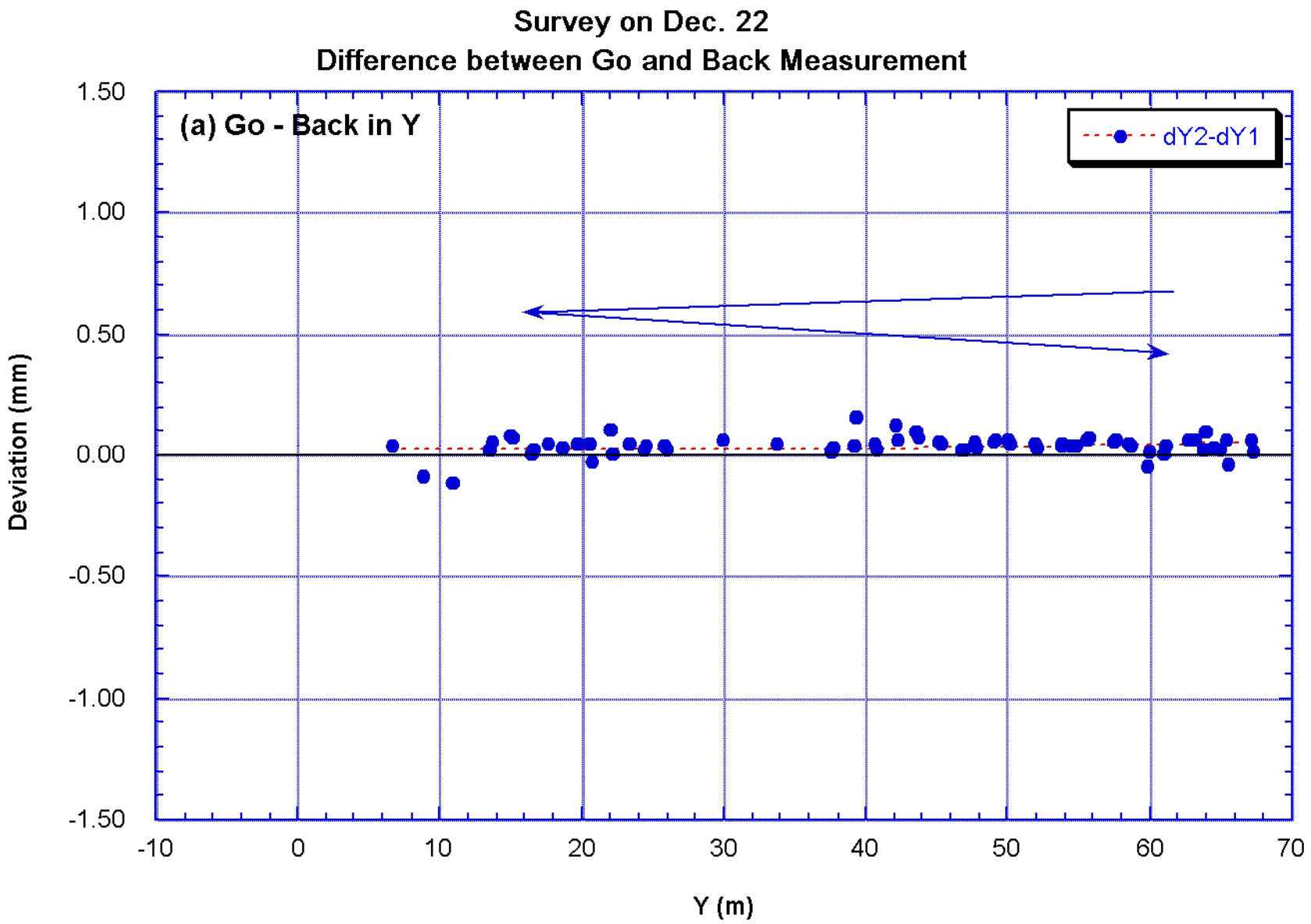
- Alignment was performed with a Laser Tracker, a Leveling telescope and an Electrick Level
- Magnetic field of QEA-mag were all measured at KEK, and their offsets, dX and dY, and Roll Angle were measured and recorded. Those errors were corrected in the alignment

Mag ID	QEA#	dX	dY	Rotation
QM14x	01	0.36	0.07	-0.072
QM15x	02	-0.45	-0.18	-1.062
QD16X	03	-0.39	-0.09	-0.652
QM11x	04	0.07	0.17	0.364
QM13x	05	-0.05	-0.29	-0.092
QF17X	06	0.06	-0.32	0.028
Spare	07	0.01	-0.13	-0.052
QD18X	08	-0.41	0.00	0.068
QM16x	09	-0.02	-0.07	0.348
QF19X	10	0.02	-0.01	0.018
QF11X	11	0.03	-0.12	0.068
QD10X	12	0.03	-0.13	-1.122
Ring:QM12R.1	13	-0.05	0.10	0.698
Ring:QM12R.2	14	0.33	0.04	0.568
QM12x	15	0.10	0.12	-0.042

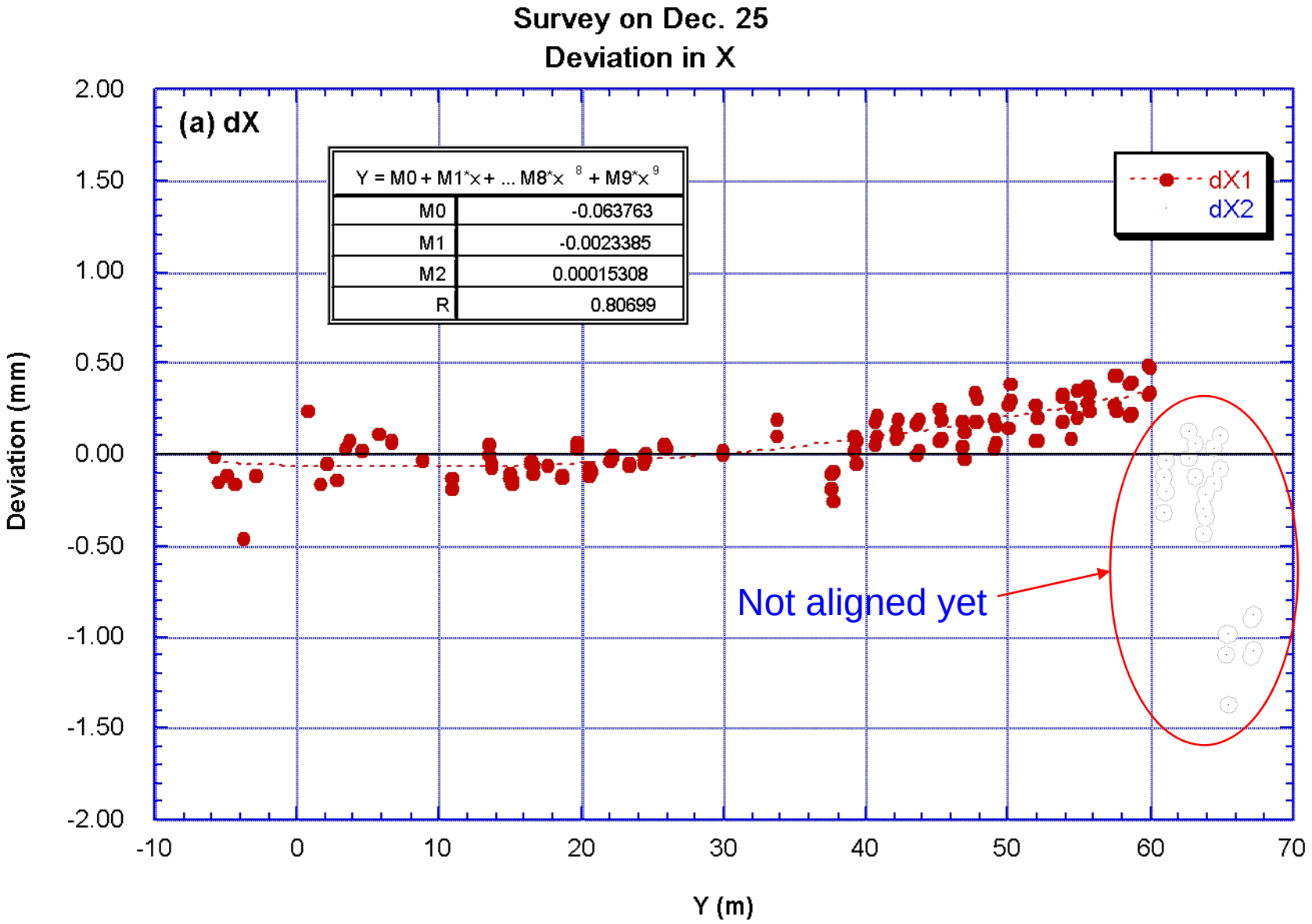




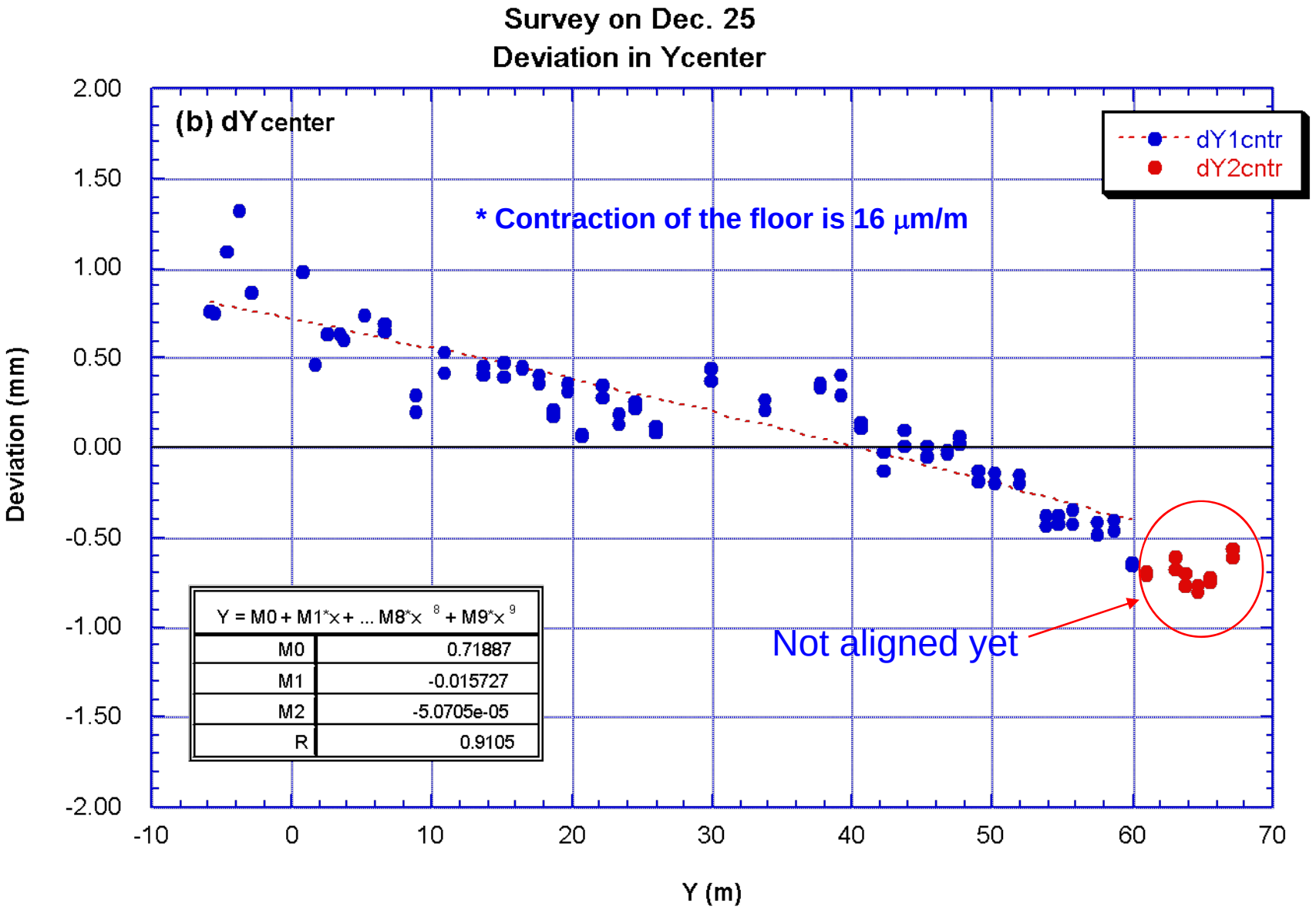

Survey on Dec. 22
Difference between Go and Back Measurement
(a) Go - Back in X
dX2-dX1
Y = M0 + M1*X
M0 0.056818
M1 -0.0038118
R 0.85744
• Error = ~40μm/10m
Deviation (mm)
Y (m)
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-10
0
10
20
30
40
50
60
70


Survey on Dec. 22
Difference between Go and Back Measurement
(a) Go - Back in Y
dY2-dY1
Deviation (mm)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-10
0
10
20
30
40
50
60
70
Y (m)

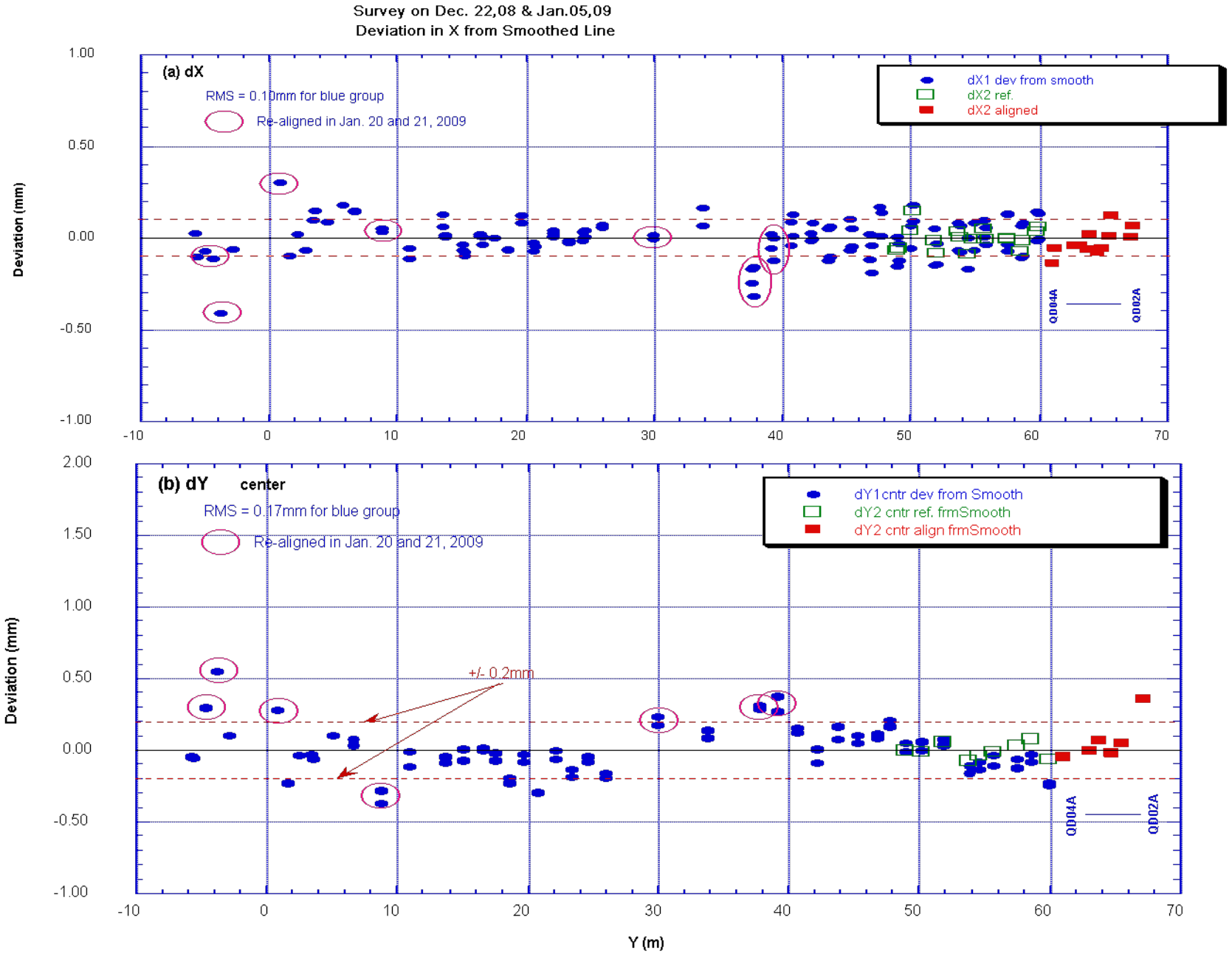
Surveyed after the second alignment (smoothing)

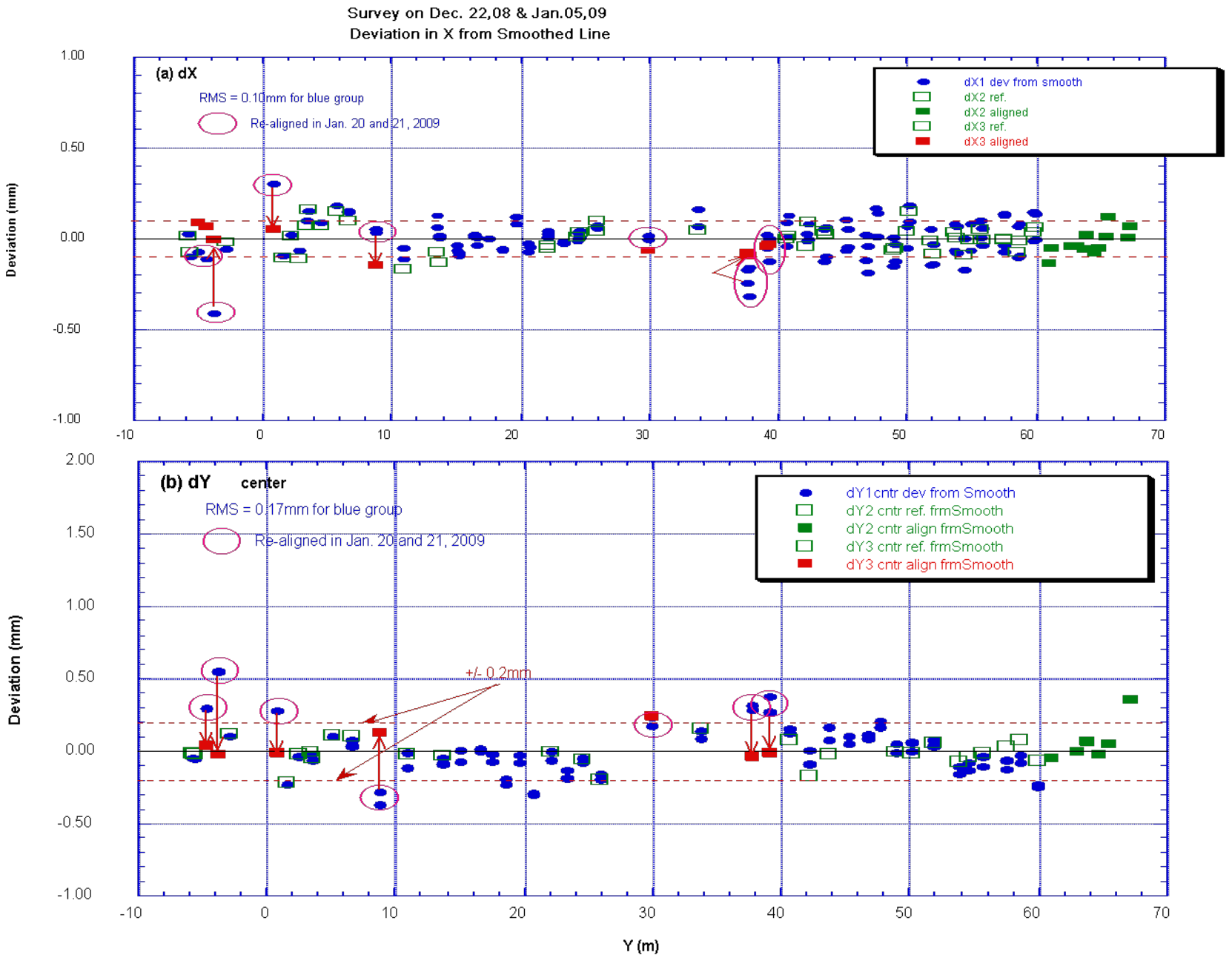


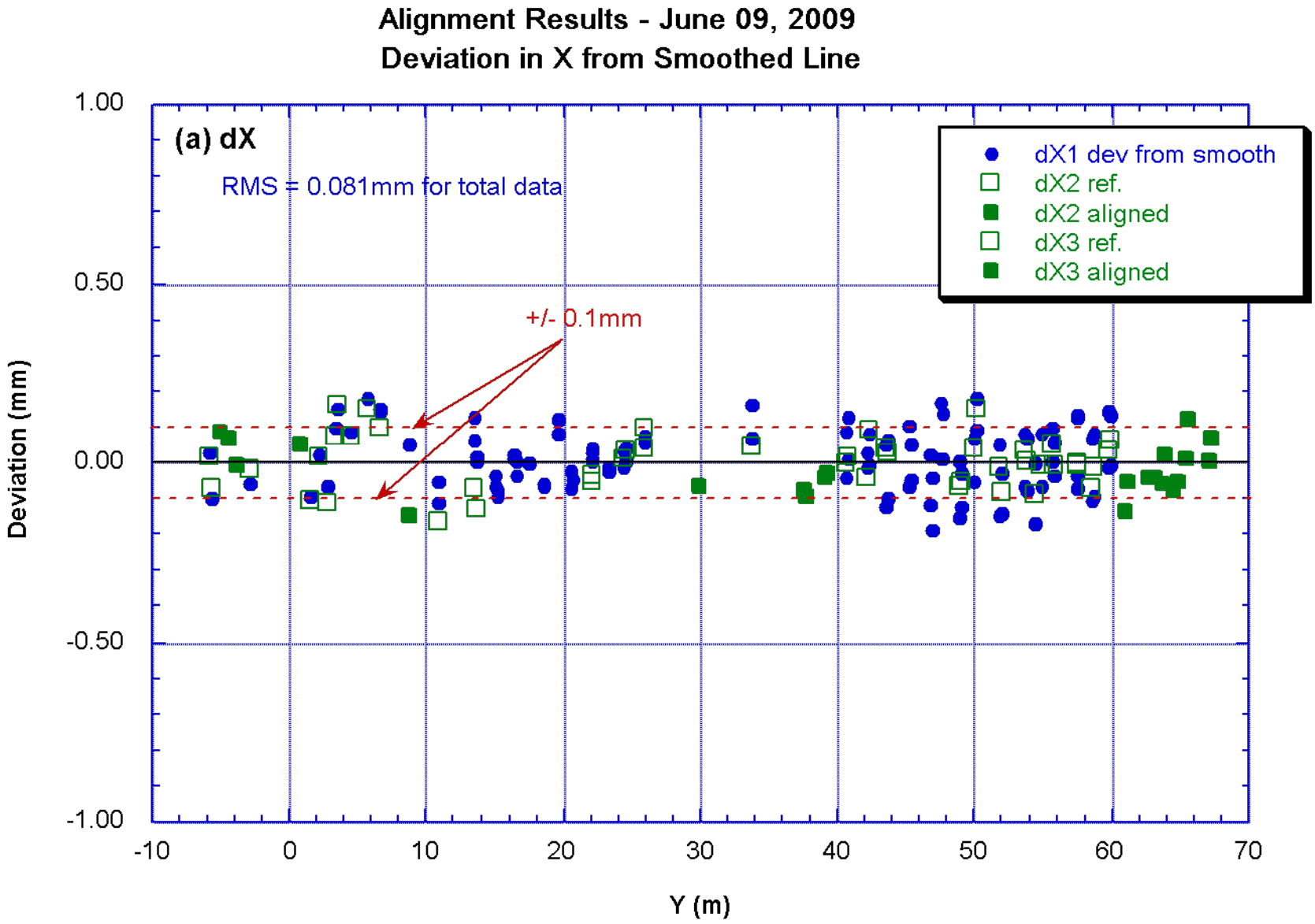
Surveyed after the second alignment (smoothing)

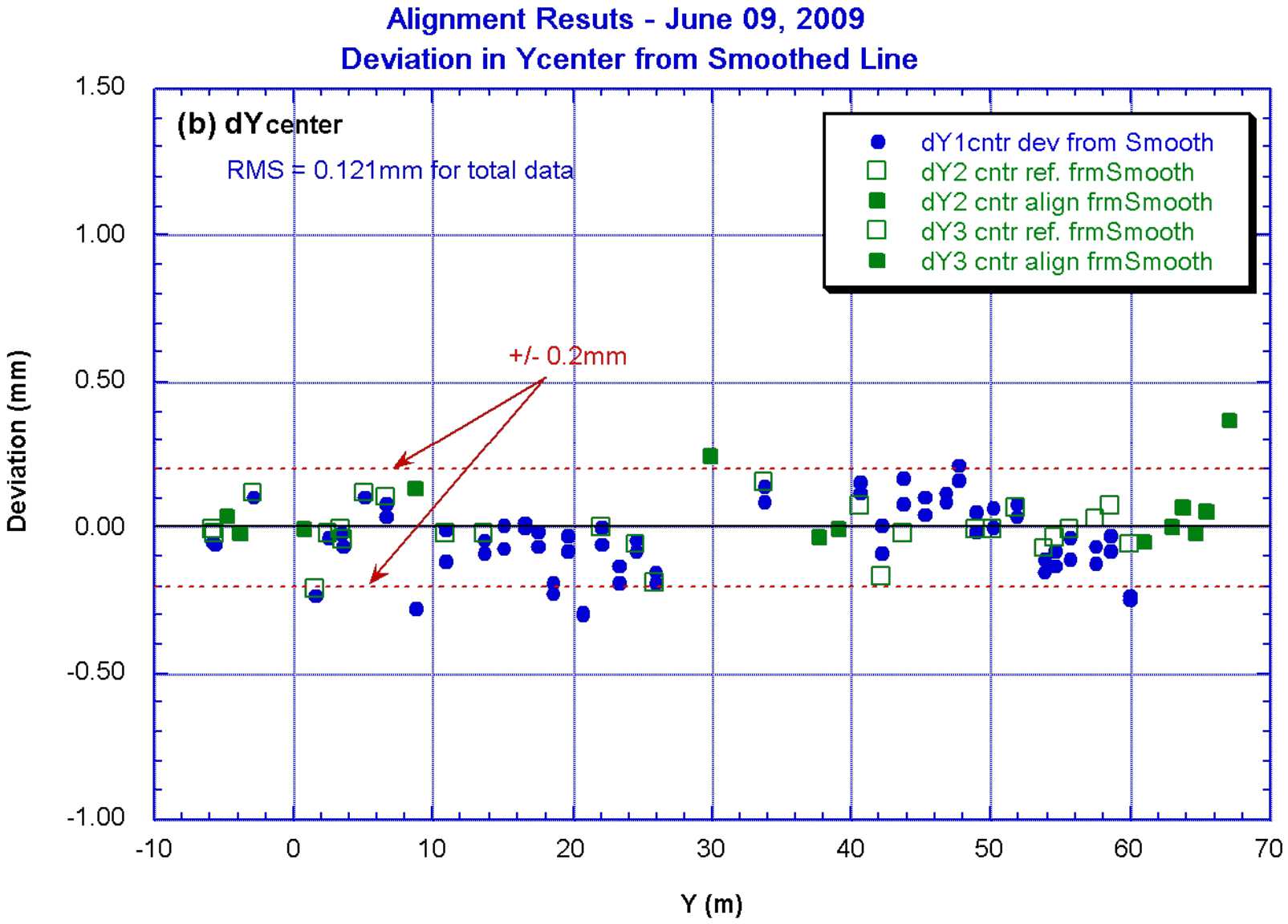


Magnets, QD04A - QD02A, in the edge part of BL have been aligned

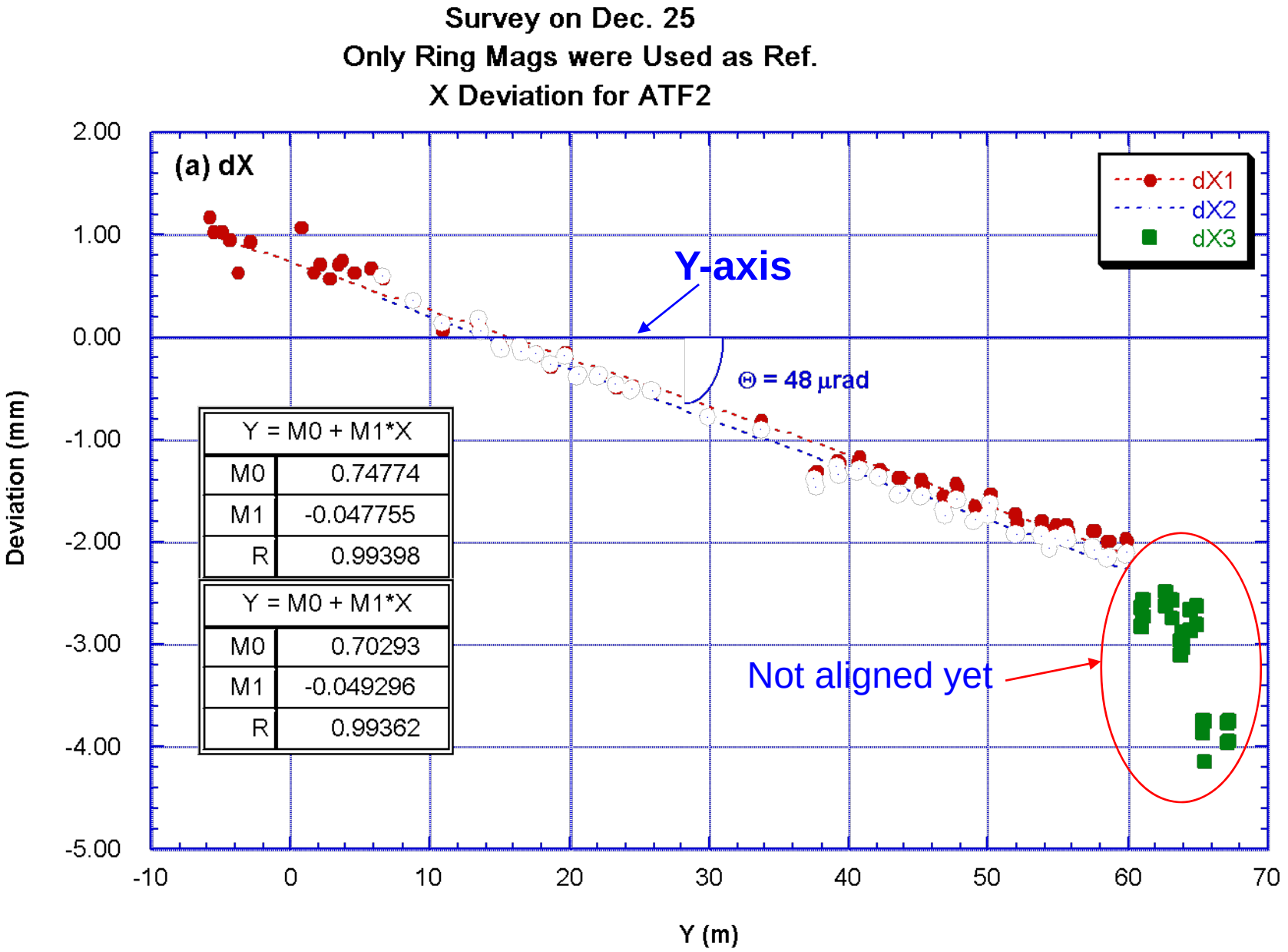


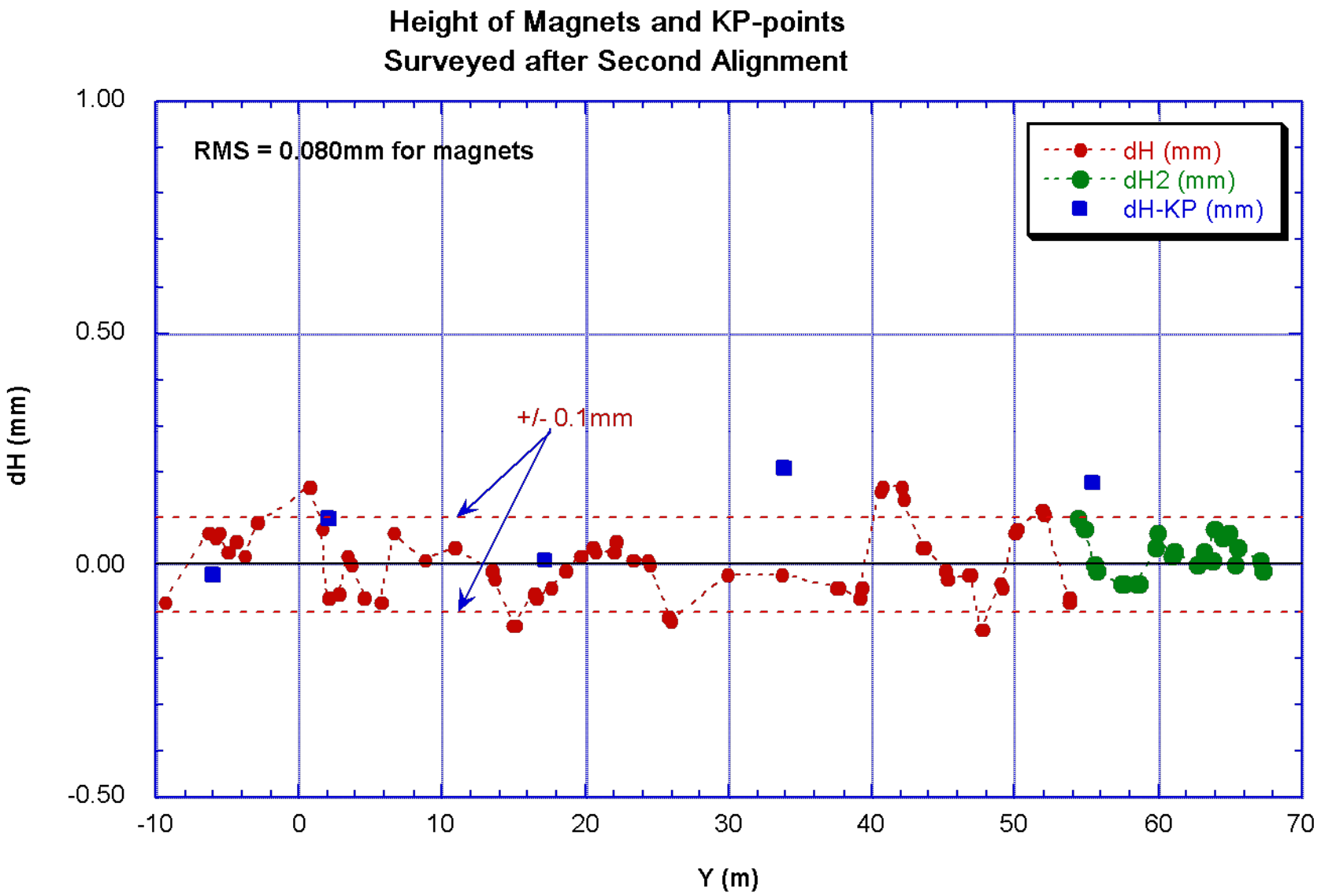

Survey on Dec. 22,08 & Jan.05,09
Deviation in X from Smoothed Line
(a) dX
RMS = 0.10mm for blue group
Re-aligned in Jan. 20 and 21, 2009
dX1 dev from smooth
dX2 ref.
dX2 aligned
dX3 ref.
dX3 aligned
Deviation (mm)
1.00
0.50
0.00
-0.50
-1.00
-10
0
10
20
30
40
50
60
70
(b) dY center
RMS = 0.17mm for blue group
Re-aligned in Jan. 20 and 21, 2009
dY1cntr dev from Smooth
dY2 cntr ref. frmSmooth
dY2 cntr align frmSmooth
dY3 cntr ref. frmSmooth
dY3 cntr align frmSmooth
+/- 0.2mm
Deviation (mm)
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-10
0
10
20
30
40
50
60
70
Y (m)


Alignment Results - June 09, 2009
Deviation in X from Smoothed Line
(a) dX
RMS = 0.081mm for total data
+/- 0.1mm
dX1 dev from smooth
dX2 ref.
dX2 aligned
dX3 ref.
dX3 aligned
Deviation (mm)
1.00
0.50
0.00
-0.50
-1.00
-10
0
10
20
30
40
50
60
70
Y (m)


Alignment Resuts - June 09, 2009
Deviation in Ycenter from Smoothed Line
(b) dYcenter
RMS = 0.121mm for total data
dY1cntr dev from Smooth
dY2 cntr ref. frmSmooth
dY2 cntr align frmSmooth
dY3 cntr ref. frmSmooth
dY3 cntr align frmSmooth
+/- 0.2mm
Deviation (mm)
1.50
1.00
0.50
0.00
-0.50
-1.00
-10
0
10
20
30
40
50
60
70
Y (m)

Angles of ATF2 beam line from Y-axis is 48 μrad




Height of Magnets and KP-points
Surveyed after Second Alignment
RMS = 0.080mm for magnets
dH (mm)
dH2 (mm)
dH-KP (mm)
+/- 0.1mm
1.00
0.50
0.00
-0.50
dH (mm)
-10
0
10
20
30
40
50
60
70
Y (m)

Summary of alignment for magnets in the ATF2 beam line

- Alignment for ATF2 magnets have been carried out, and have resulted alignment errors of 0.081mm for X, 0.121mm for Y and 0.080mm for Height in RMS
- Current ATF2 beam line has an angle of 48 μrad to the Y-axis
- Only the last magnet, QD02A, needs to be improved in Y position
- As I am not touching three sextupole magnets and the final doublet, I am expecting someon to report on the current alignment errors for these magnets and how to achieve the aiming precisions