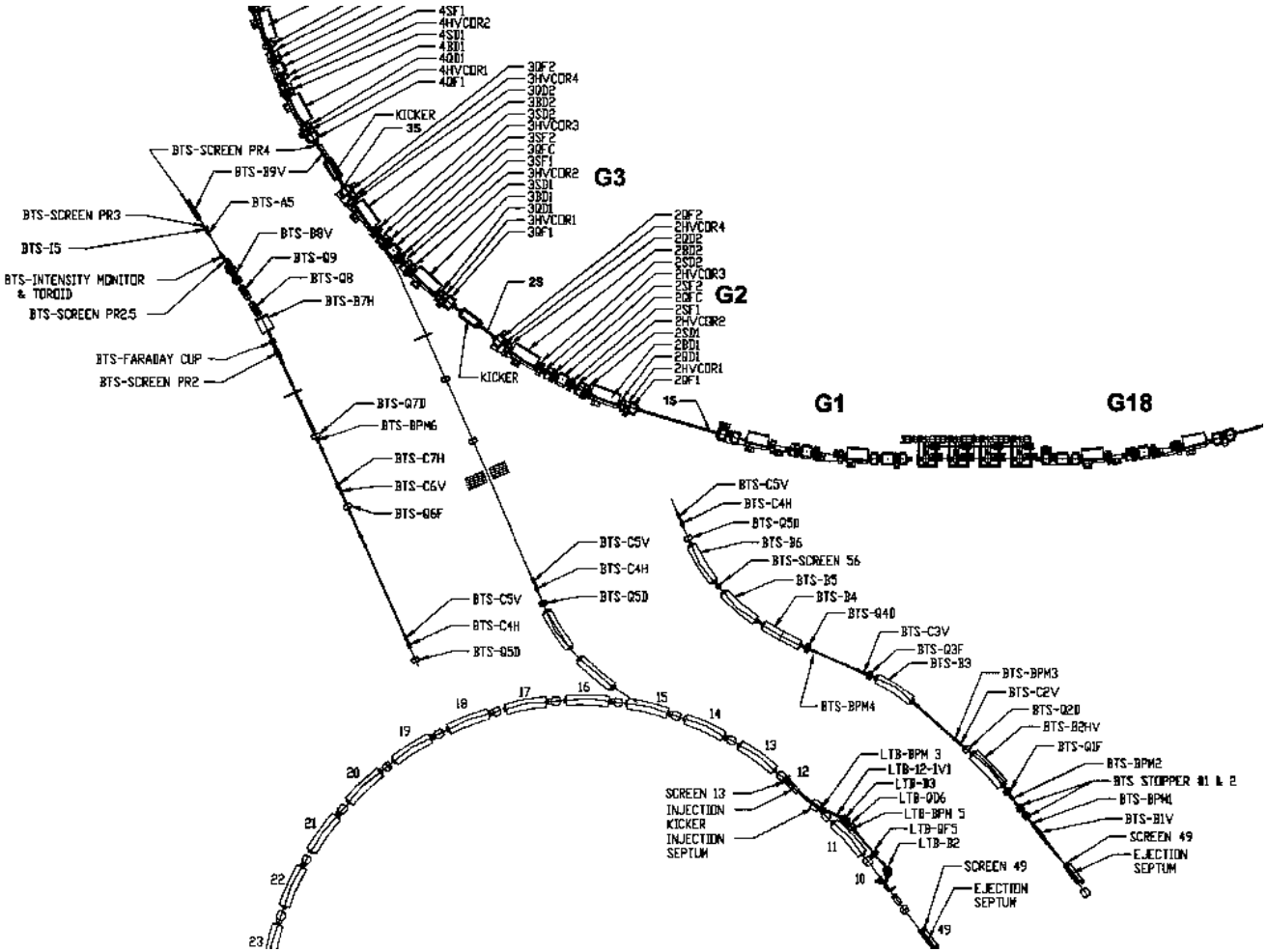
03/12/02 BTS Magnet Positions

			Spear BTS Line					Meeting Date : 03/12/02	
Magnet	Z (meters)	X (meters)	Y (meters)	Roll (deg)	Pitch (deg)	Yaw (deg)		TB's	Lab data
B1	-4.3712	-56.4709	0.2579	-0.30	3.98	-128.16		0	No
Q1	-6.1716	-54.1976	0.5019	0.04	4.74	-128.29		0	No
B2	-7.2231	-53.0429	0.5923	23.22	2.29	-134.46		4	Yes
Q2	-8.3666	-51.9364	0.6416	0.07	0.28	-139.89		0	No
B3	-12.4684	-48.6709	0.6384	-0.19	-0.10	-148.45		4	Yes
Q3	-13.8667	-47.9172	0.6404	0.02	-0.17	-157.34		0	No
Q4	-17.3114	-46.4451	0.6402	-0.03	-0.05	-157.10		0	No
B4	-18.7450	-45.7417	0.6418	0.00	0.08	-152.37		4	Yes
B5	-21.0662	-44.2106	0.6430	-0.03	-0.01	-139.32		4	Yes
B6	-23.0554	-41.8274	0.6424	0.02	0.00	-124.76		4	Yes 3/4
Q5	-23.8587	-40.4882	0.6415	-0.03	0.14	-113.93		0	No
Block Wall									
Q6	Inconsistant data in elevation							0	No
Q7	-29.2342	-28.3612	0.6340	-0.01	0.06	-118.35		0	No
B7	-31.9254	-22.3398	0.5561	-0.04	-0.10	-117.80		4	No
Q8	-32.4364	-21.4820	0.6293	-0.10	-0.56	-121.67		4	No
Q9	-33.0516	-20.4900	0.6290	-0.01	0.39	-121.73		4	No
B8	-33.3550	-19.3432	0.6052	0.00	-4.31	-121.79		4	Yes
B9 (Sep)	-35.9233	-16.0757	0.0021	-0.35	0.00	-121.94		4	Yes
Coordinates in Spear datum.									

Critical Analysis

- Lack of Connection between Ring and Booster.
- Bad Geometry.
- No Consistent Lab Data.

BTS Layout


G3
G2
G1
G18
KICKER
BTS-SCREEN PR4
BTS-B9V
BTS-A5
BTS-SCREEN PR3
BTS-I5
BTS-B8V
BTS-INTENSITY MONITOR & TOROID
BTS-Q9
BTS-Q8
BTS-SCREEN PR25
BTS-B7H
BTS-FARADAY CUP
BTS-SCREEN PR2
BTS-Q7D
BTS-BPM6
BTS-C7H
BTS-C6V
BTS-Q6F
BTS-C5V
BTS-C4H
BTS-Q5D
BTS-B6
BTS-SCREEN 56
BTS-B5
BTS-B4
BTS-Q4D
BTS-C3V
BTS-Q3F
BTS-B3
BTS-BPM4
BTS-BPM3
BTS-C2V
BTS-Q2D
BTS-B2HV
BTS-Q1F
BTS-BPM2
BTS STOPPER #1 & 2
BTS-BPM1
BTS-B1V
SCREEN 49
EJECTION SEPTUM
LTB-BPM 3
LTB-12-1V1
LTB-B3
LTB-QD6
LTB-BPM 5
LTB-QF5
LTB-B2
SCREEN 13
INJECTION KICKER
INJECTION SEPTUM

Datum Analysis

- Booster TC2002 Survey: 9/2001
- BTS TC2002 Survey: 3/2002
- Building 130 Tracker Survey: 7/2002
- SSRL Tracker Survey: 9/2002
- SPEAR Ring Tracker Survey: 11/2002

Quadrupole Analysis Steps

- Make your Lab Data => System UVW.
- Gather all the observations on these features in one System XYZ (the SPEAR system).
- Find the best rigid Transformation between these 2 sets.

Q1 Data

- Lab Data:
  - A -0.09004 0.21387 -0.26543
  - B 0.09004 0.21387 -0.26543
  - C -0.09004 -0.21387 -0.21463
  - D 0.09004 -0.21387 -0.21463
- Observation Source:
  - Corners A & B are part of the booster map.
  - The 4 corners have elevation.

Q1 Analysis

Residuals	W	U	V	Z	X	Y
• A	0.00017	0.00082	-0.00037	0.00000	0.00000	0.00000
• B	-0.00017	-0.00082	0.00037	0.00000	0.00000	0.00000
• C	0.00002	-0.00002	0.00035	0.00881	0.00295	0.00000
• D	-0.00002	0.00002	-0.00035	0.00886	0.00299	0.00000

A posteriori standard deviation : 0.000563498

Q2 Data

- Lab Data:
  - A -0.09004 0.21387 -0.26543
  - B 0.09004 0.21387 -0.26543
  - C -0.09004 -0.21387 -0.26543
  - D 0.09004 -0.21387 -0.26543
- Observation Source:
  - 4 Corners are part of the booster map.

Q2 Analysis

Residuals	W	U	V	Z	X	Y
• A	0.00050	0.00137	0.00013	0.00000	0.00000	0.00000
• B	0.00064	-0.00095	-0.00013	0.00000	0.00000	0.00000
• C	-0.00023	0.00024	-0.00013	0.00000	0.00000	0.00000
• D	-0.00091	-0.00067	0.00013	0.00000	0.00000	0.00000

A posteriori standard deviation : 0.000903874

Q3 Data

- Lab Data:
  - A -0.09004 0.21387 -0.26543
  - B 0.09004 0.21387 -0.26543
  - C -0.09004 -0.21387 -0.26543
  - D 0.09004 -0.21387 -0.26543
- Observation Source:
  - 3 Corners are part of the booster map.

Q3 Analysis

Residuals	W	U	V	Z	X	Y
• A	-0.00008	0.00075	0.00000	0.00000	0.00000	0.00000
• B	0.00038	-0.00017	0.00000	0.00000	0.00000	0.00000
• D	-0.00030	-0.00058	0.00000	0.00000	0.00000	0.00000

A posteriori standard deviation : 0.000628191

Q4 Data

- Lab Data:
  - A -0.09004 0.21387 -0.26543
  - B 0.09004 0.21387 -0.26543
  - C -0.09004 -0.21387 -0.26543
  - D 0.09004 -0.21387 -0.26543
- Observation Source:
  - 4 Corners are part of the booster map.

Q4 Analysis

Residuals	W	U	V	Z	X	Y
• A	-0.00008	0.00121	-0.00006	0.00000	0.00000	0.00000
• B	0.00095	-0.00036	0.00007	0.00000	0.00000	0.00000
• C	-0.00114	0.00002	0.00006	0.00000	0.00000	0.00000
• D	0.00026	-0.00087	-0.00007	0.00000	0.00000	0.00000

A posteriori standard deviation : 0.000878653

Q5 Data

- Lab Data:
  - 1 0.09004 0.21387 0.21463
  - 2 -0.09004 0.21387 0.21463
  - 3 0.09004 -0.21387 0.21463
  - 4 -0.09004 -0.21387 0.21463
  - U -0.09004 0.84252 0.21463
  - D 0.09004 0.84252 0.21463
- Observation Source: 1 TC set-up with long extension arm
  - 4 Y shots
  - 2 side (Z and X) shots.

Q5 Analysis

Residuals	W	U	V	Z	X	Y
• 1	0.00000	0.00000	0.00003	0.01269	0.00758	0.00000
• 2	0.00000	0.00000	-0.00003	0.01265	0.00757	0.00000
• 3	0.00000	0.00000	-0.00004	0.01274	0.00748	0.00000
• 4	0.00000	0.00000	0.00004	0.01270	0.00747	0.00000
• U	-0.00085	-0.00094	0.00000	0.00000	0.00000	-0.03572
• D	0.00085	0.00094	0.00000	0.00000	0.00000	-0.03374

A posteriori standard deviation : 0.000519304

Q6 Data

- Lab Data:
  - Y1 -0.09000 -0.21389 0.23368
  - Y2 0.09007 -0.21379 0.23360
  - Y3 0.08984 0.21396 0.23360
  - XUS -0.08307 -0.23292 0.21459
  - XDS 0.07712 -0.23292 0.21459
  - ZDS 0.10909 -0.16076 0.21459
- Observation Source: 1 TC set-up
  - 3 Y, 2 X and 1 Z shots

Q6 Analysis

- Original observation set:
  - Inconsistent Ys => no Y, roll or pitch.
  - Solve only for Z, X and yaw.
- 03/03/03 level data:
  - 1 level set-up based on: BTS143 & BTS145.
  - Shot the base plate near 3 corners of the quad.

Q7 Data

- Lab Data:
  - DSX 0.09004 -0.23292 0.21463
  - USX -0.09004 -0.23292 0.21463
  - Y1 -0.09004 -0.21387 0.23368
  - Y2 0.09004 -0.21387 0.23368
  - Y3 0.09004 0.21387 0.23368
  - Z1 0.10909 -0.21387 0.21463
- Observation Source: 1 TC set-up
  - 3 Y, 2 X and 1 Z shots

Q7 Analysis

Residuals	W	U	V	Z	X	Y
• DSX	0.03961	0.00000	-0.01400	-0.00004	-0.00003	-0.00001
• USX	-0.00699	0.00000	-0.00614	-0.00001	0.00001	-0.00001
• Y1	-0.05005	-0.07018	0.00000	-0.00004	0.00007	-0.00001
• Y2	0.01472	-0.00310	0.00000	-0.00001	-0.00001	0.00008
• Y3	-0.05871	0.06163	0.00000	0.00008	0.00003	0.00000
• Z1	0.00000	0.04985	-0.05102	0.00002	-0.00008	-0.00005

A posteriori standard deviation : 0.001350076

Q6 and Q7

Q7 Additional Data

- 03/03/03 level set up:
  - Same level set-up as Q6.
  - 3 shots on the baseplate.
- Comparison:
  - Average Y moves down 1.3mm.
  - The base plate shows a significant roll (~40mil). The top of the magnet had less 10 mil roll!

Q8 Data

- Lab Data:
  - A -0.25273 0.00000 -0.19774
  - B 0.06422 0.00000 -0.19774
  - C 0.00000 -0.08572 -0.26352
  - D 0.00000 0.08572 -0.18732
- Observation Source:
  - 1 TC set-up for the 4 TBs (C & D used extensions for elevation only).

Q8 Analysis

Residuals	W	U	V	Z	X	Y
• A	0.00000	0.00000	-0.00004	0.00000	0.00000	0.00000
• B	0.00000	0.00000	-0.00017	0.00000	0.00000	0.00000
• C	0.00000	0.00000	0.00011	-0.14176	-0.23773	0.00000
• D	0.00000	0.00000	0.00011	0.28197	0.01763	0.00000

A posteriori standard deviation : 0.000095957

Q9 Data

- Lab Data:
  - A 0.24447 0.00000 -0.19774
  - B -0.09349 0.00000 -0.19774
  - C 0.00000 -0.08572 -0.18612
  - D 0.00000 0.08572 -0.18612
- Observation Source:
  - 1 TC set-up for the 4 TBs (C & D used extensions for elevation only).

Q9 Analysis

Residuals	W	U	V	Z	X	Y
• A	0.00000	0.00000	-0.00021	0.00000	0.00000	0.00000
• B	0.00000	0.00000	-0.00054	0.00000	0.00000	0.00000
• C	0.00000	0.00000	0.00037	0.09162	-0.00322	0.00000
• D	0.00000	0.00000	0.00037	-0.03952	-0.08292	0.00000

A posteriori standard deviation : 0.000319665

New BTS Quadrupole Position

			Spear BTS Line				Meeting Date : 02/20/03		
Magnet	Z (meters)	X (meters)	Y (meters)	Roll (deg)	Pitch (deg)	Yaw (deg)		TB's	Lab data
B1								0	No
Q1	-6.1803	-54.2006	0.4995	0.02	4.74	-128.31		0	No
B2								4	Yes
Q2	-8.3760	-51.9400	0.6393	0.07	0.28	-139.91		0	No
B3								4	Yes
Q3	-13.8773	-47.9220	0.6380	0.02	-0.17	-157.36		0	No
Q4	-17.3225	-46.4508	0.6379	-0.03	-0.05	-157.12		0	No
B4								4	Yes
B5								4	Yes
B6								4	Yes 3/4
Q5	-23.8714	-40.4957	0.6391	-0.03	0.14	-113.94		0	No
Block Wall									
Q6	-27.5587	-32.1524				-113.77		0	No
Q7	-29.2397	-28.3477	0.6339	-0.03	0.05	-113.86		0	No
B7								4	No
Q8	-32.4352	-21.4835	0.6329	-0.10	0.02	-121.67		4	No
Q9	-33.0522	-20.4889	0.6318	-0.01	0.03	-121.73		4	No
B8								4	Yes
B9 (Sep)								4	Yes
Coordinates in Spear datum									

Changes

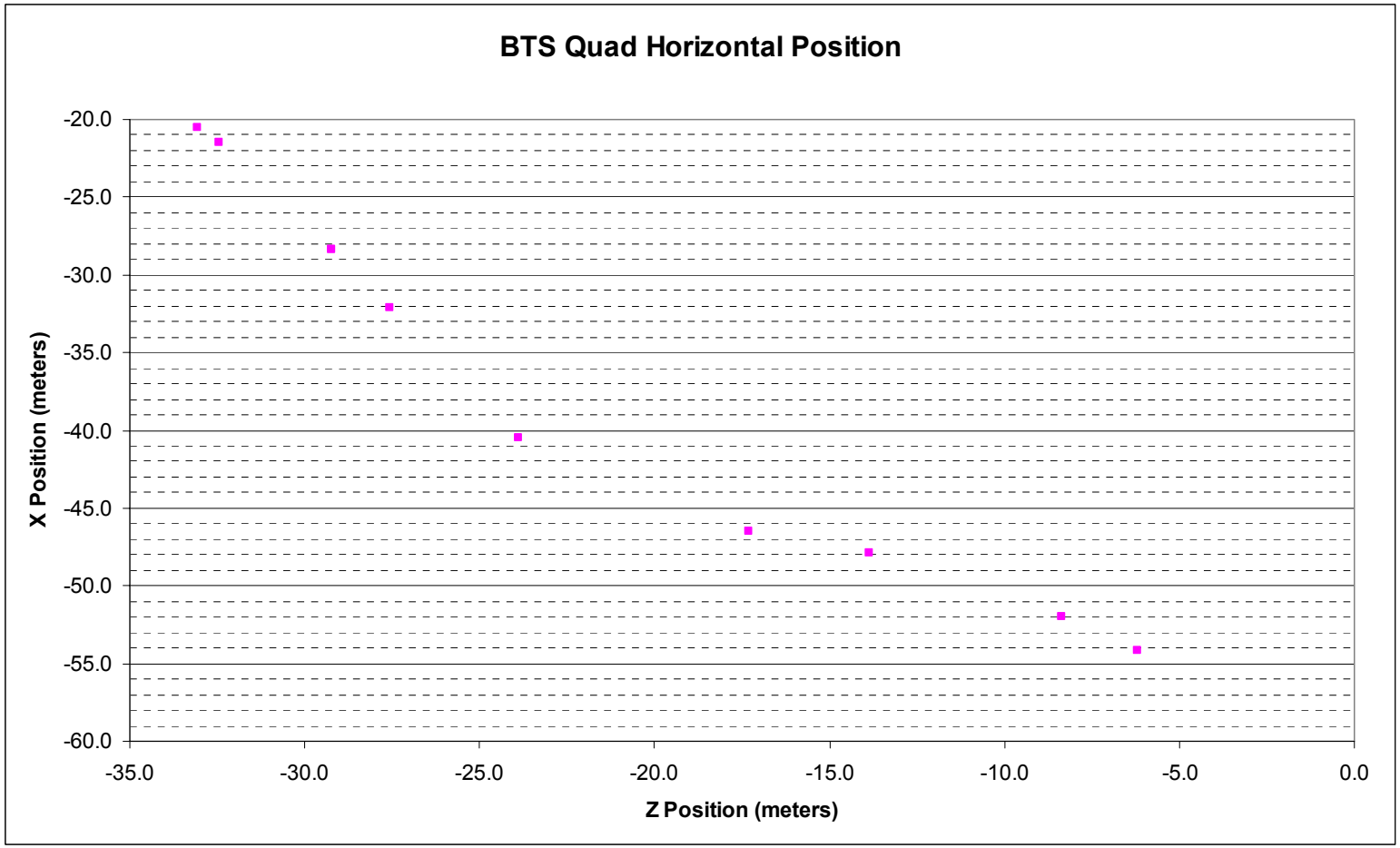
Magnet	DZ (mm)	DX (mm)	DY (mm)		DRoll (deg)	DPitch (deg	DYaw (deg)
B1							
Q1	-8.7	-3.0	-2.4		-0.02	0.00	-0.02
B2							
Q2	-9.4	-3.6	-2.4		0.00	0.00	-0.01
B3							
Q3	-10.6	-4.9	-2.4		0.00	0.00	-0.01
Q4	-11.1	-5.7	-2.3		0.00	0.00	-0.02
B4							
B5							
B6							
Q5	-12.7	-7.5	-2.3		0.00	0.00	-0.01
Block Wall							
Q6							
Q7	-5.4	13.6	-0.1		-0.02	-0.01	4.49
B7							
Q8	1.2	-1.5	3.6		0.00	0.58	0.00
Q9	-0.6	1.0	2.8		0.00	-0.36	0.00
B8							
B9 (Sep)							

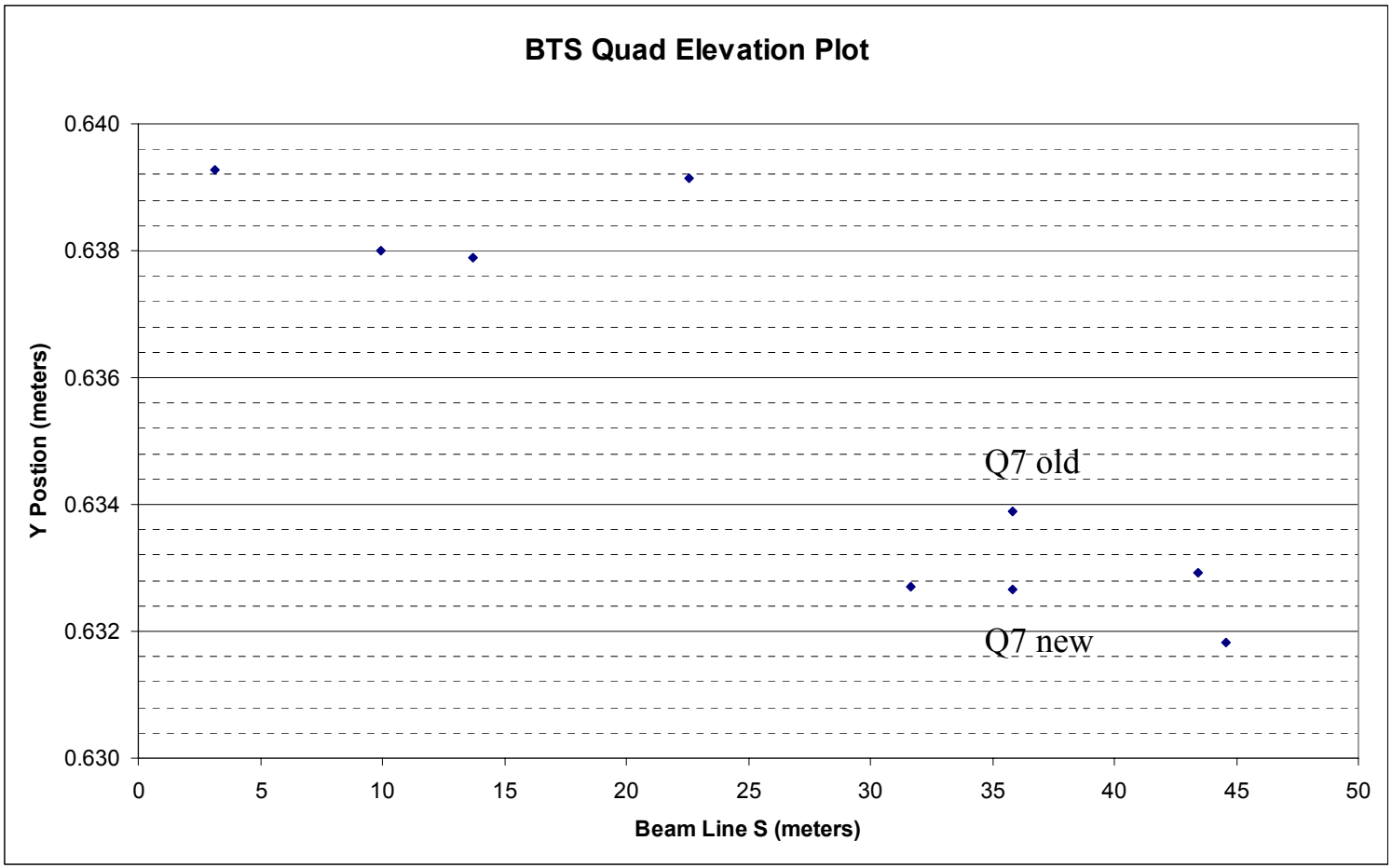
03/03/03 BTS Quadrupole Position

			Spear BTS Line						
Magnet	Z (meters)	X (meters)	Y (meters)		DZ (mm)	DX (mm)	DY (mm)		
B1									
Q1	-6.1803	-54.2006	0.4995		-8.70	-3.00	-2.4		
B2									
Q2	-8.3760	-51.9400	0.6393		-9.40	-3.60	-2.4		
B3									
Q3	-13.8773	-47.9220	0.6380		-10.60	-4.90	-2.4		
Q4	-17.3225	-46.4508	0.6379		-11.10	-5.70	-2.3		
B4									
B5									
B6									
Q5	-23.8714	-40.4957	0.6391		-12.70	-7.50	-2.3		
Block Wall									
Q6	-27.5587	-32.1524	0.6327						
Q7	-29.2397	-28.3477	0.6333		-5.40	13.60	-0.7		
B7									
Q8	-32.4352	-21.4835	0.6329		1.20	-1.50	3.6		
Q9	-33.0522	-20.4889	0.6318		-0.60	1.00	2.8		
B8									
B9 (Sep)									

Conclusion

- Unification of datum achieved.
- Overall quality of the results limited to mm level due to:
  - Lack of real fiducialization.
  - Poor geometry.
- BTS Profile Summary:
  - Average height before the wall (Q2, Q3, Q4, Q5): 0.6385m
  - Average height after the wall (Q6, Q7, Q8, Q9): 0.6325m


BTS Quad Horizontal Position
X Position (meters)
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
-55.0
-60.0
-35.0
-30.0
-25.0
-20.0
-15.0
-10.0
-5.0
0.0
Z Position (meters)


BTS Quad Elevation Plot
Y Postion (meters)
0.640
0.638
0.636
0.634
0.632
0.630
0
5
10
15
20
25
30
35
40
45
50
Beam Line S (meters)
Q7 old
Q7 new