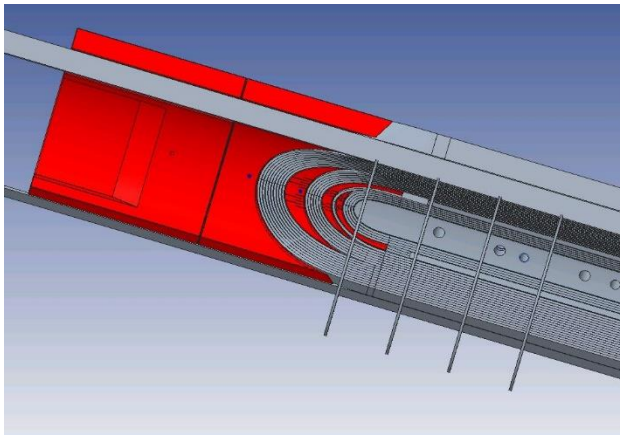
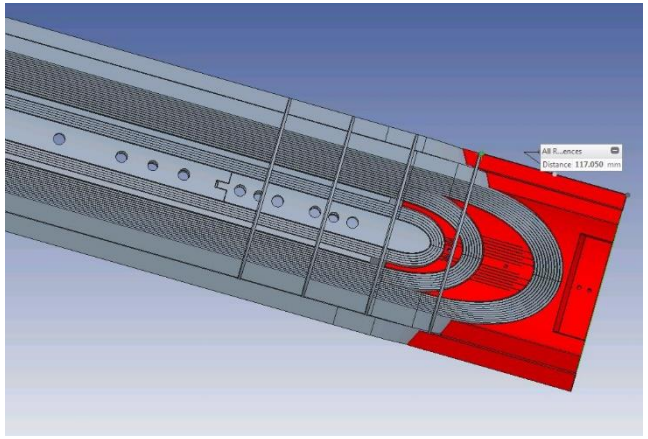
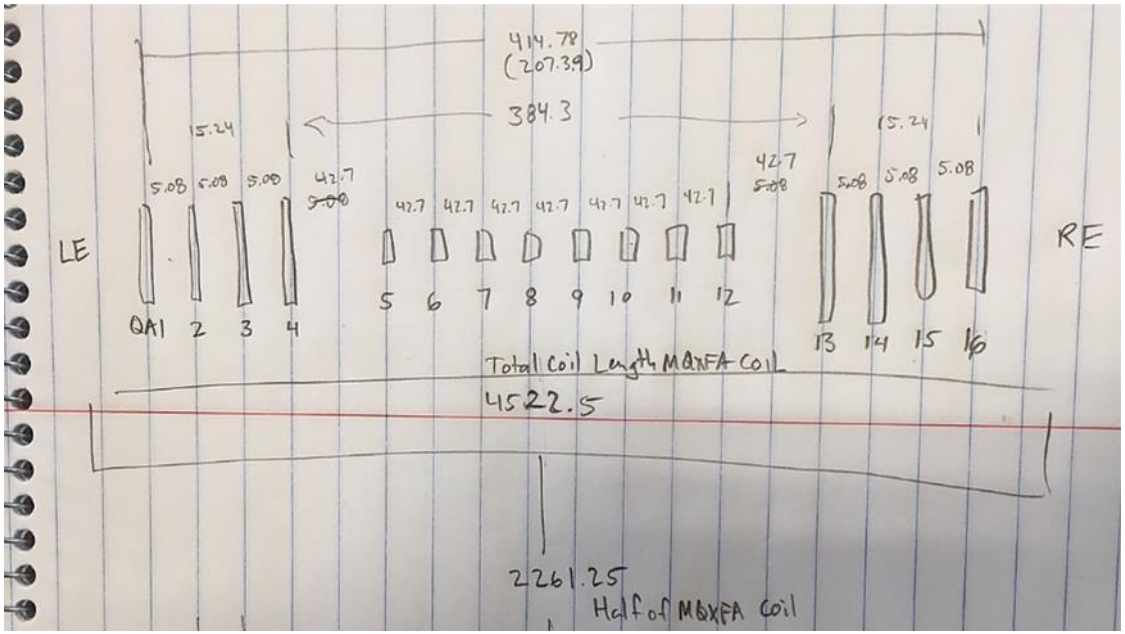
Quench antenna signal analysis for MQXFAP1b

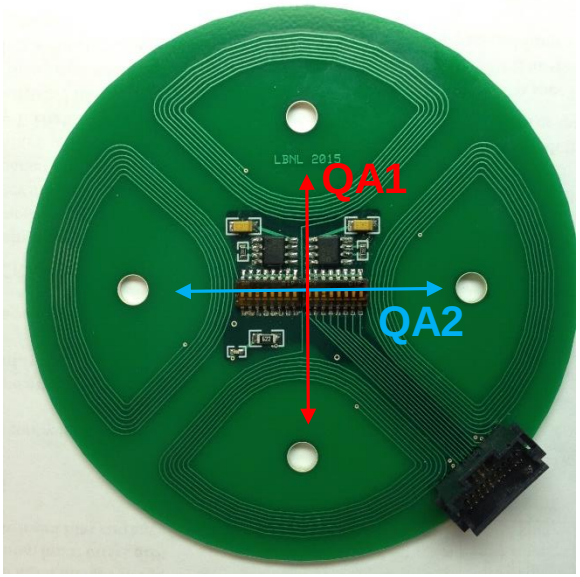
M. Marchevsky (LBNL)

Antenna configuration and positioning



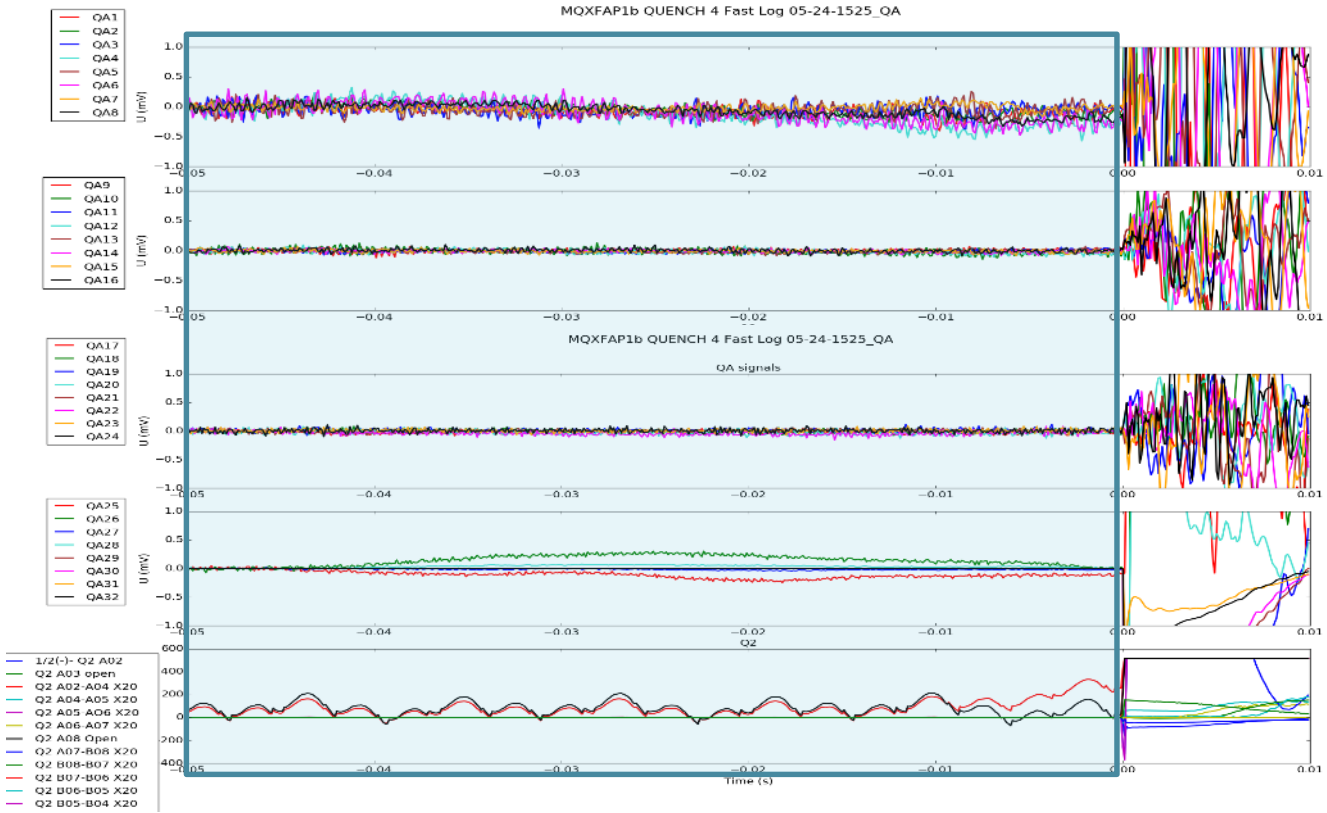






Raw signals and processing

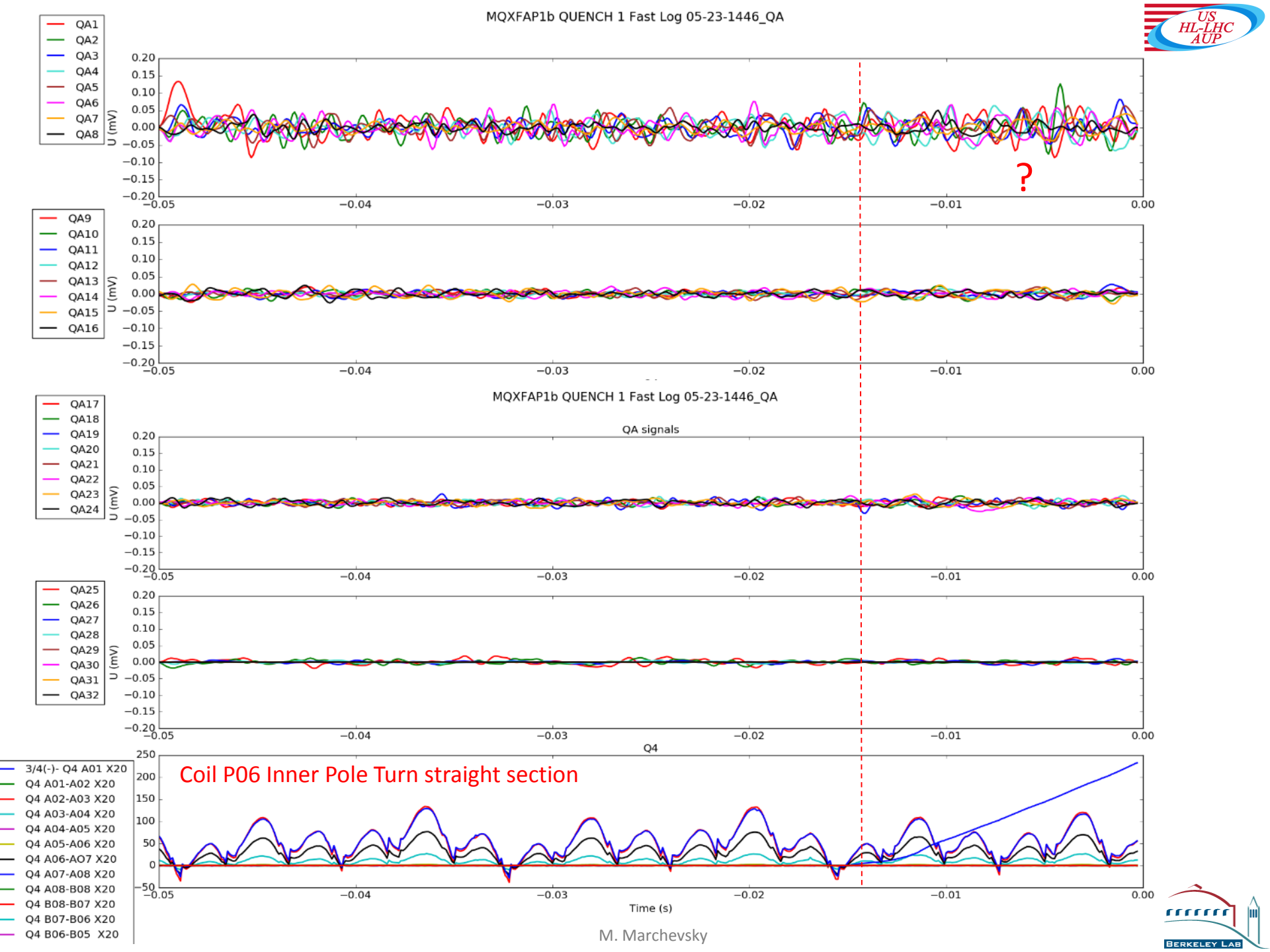
- Signal amplitudes are very low (bore tube shielding?)
- Background is noise looks different for different sections (shielding? gain? LP filtering?)
- Only for few quenches locations can be determined after filtering of the raw signals

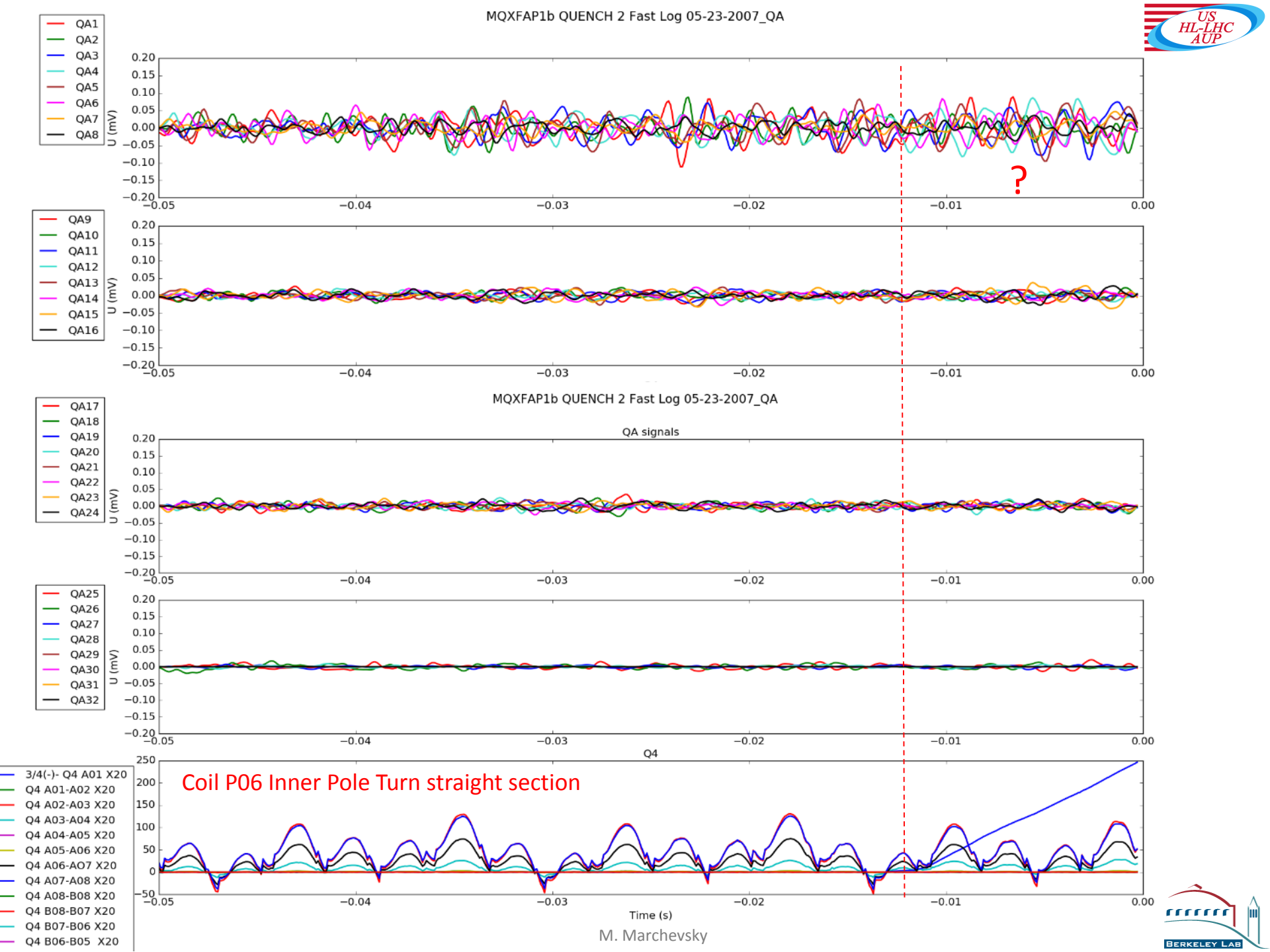


- 50 ms window taken, excluding the extraction portion
- Band-pass filtering of raw QA signals for the 70-700 Hz band

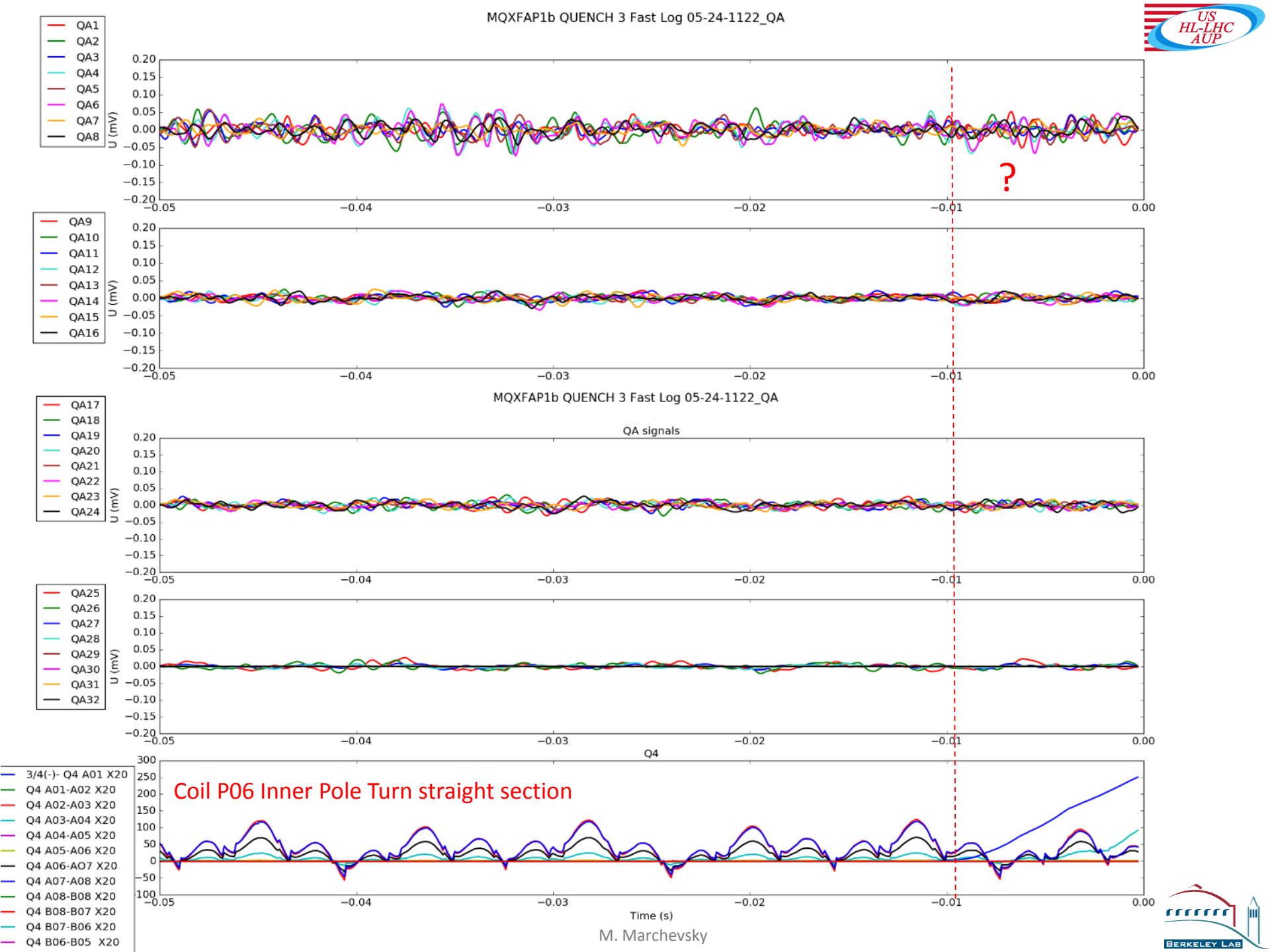
Q1= Coil 02
Q2= Coil 03
Q3= Coil 04
Q4= Coil 06

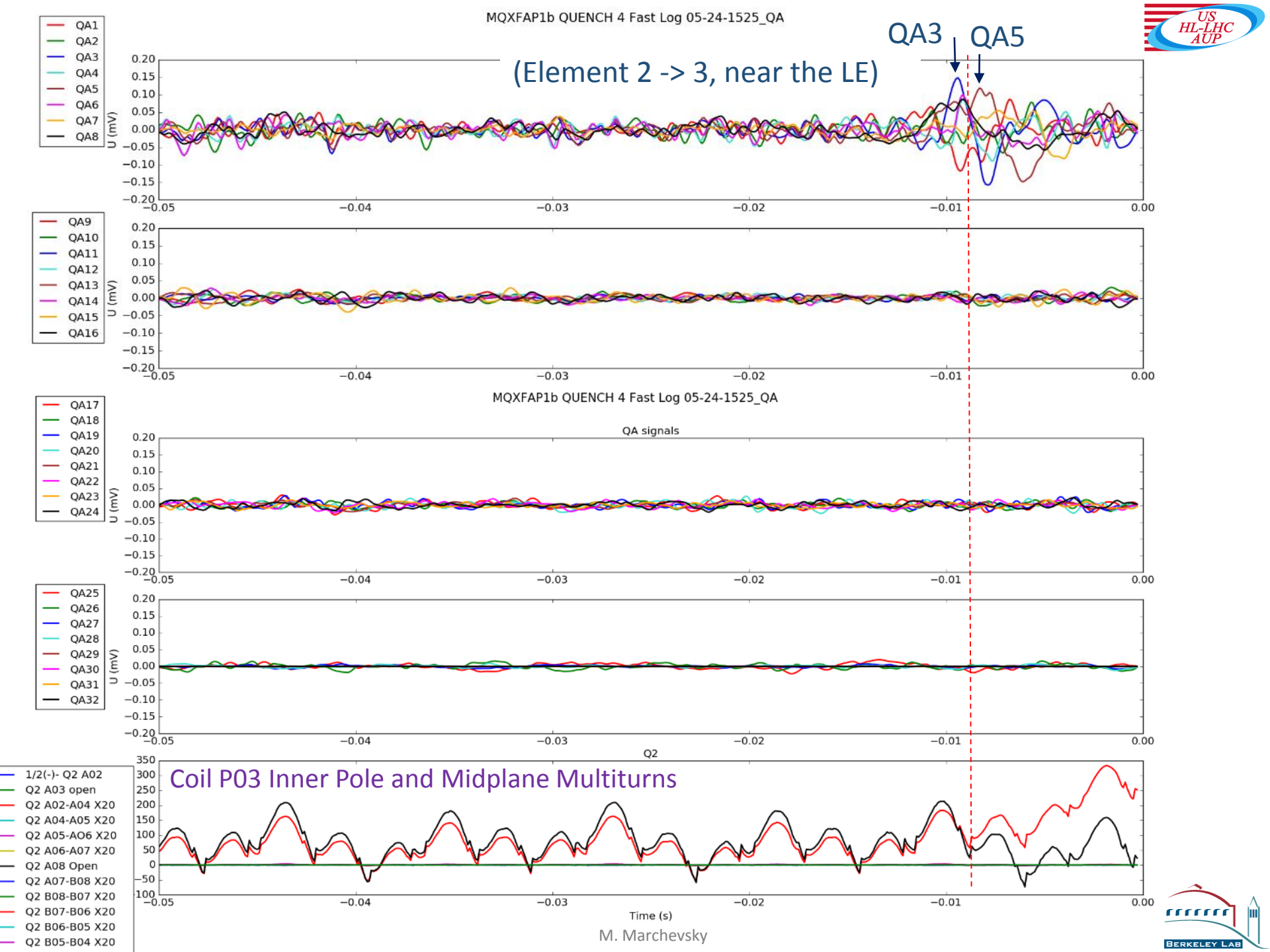
Example: raw quench antenna voltages in Quench #4

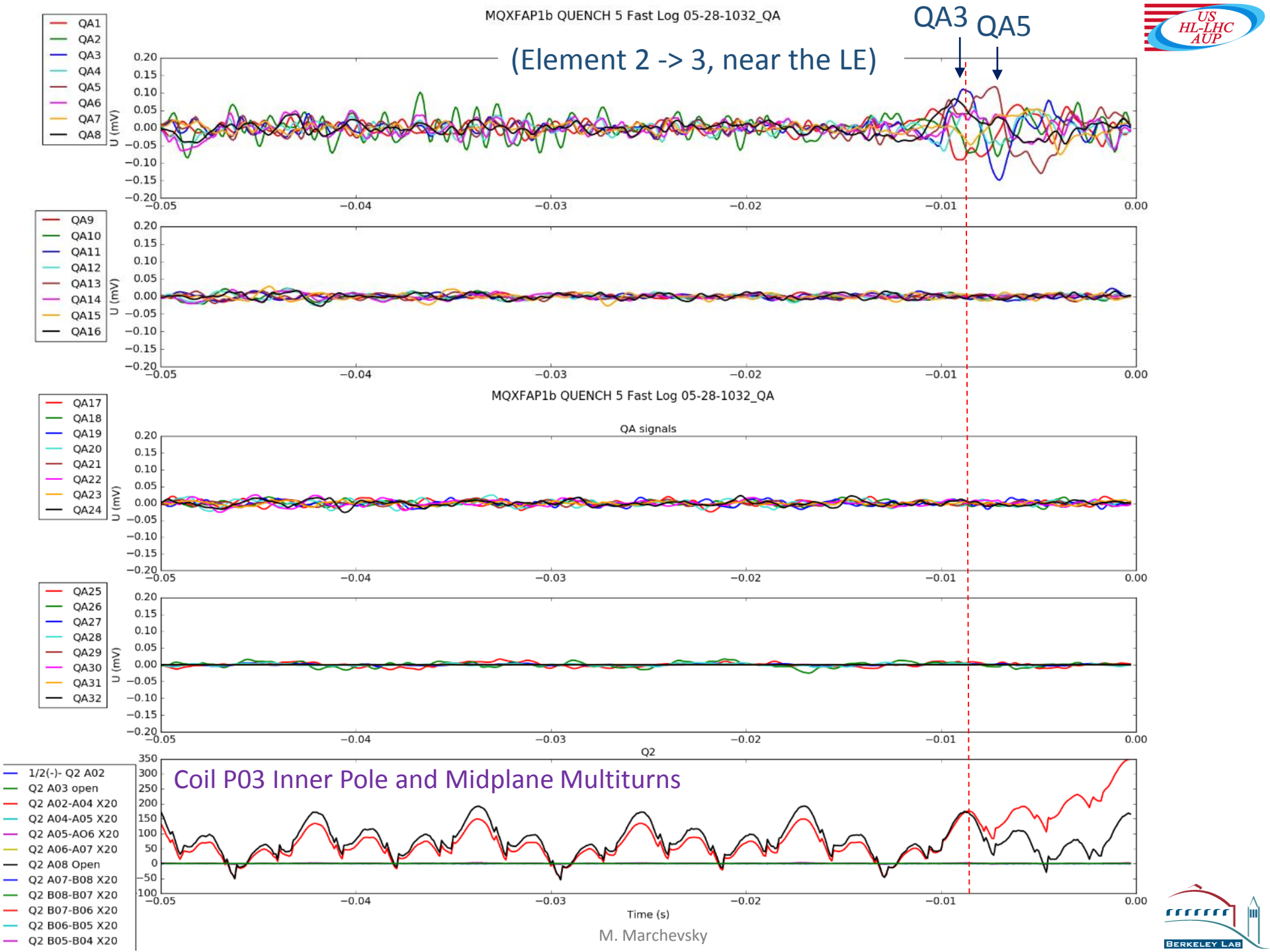

MQXFAP1b QUENCH 1 Fast Log 05-23-1446_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 1 Fast Log 05-23-1446_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q4
Coil P06 Inner Pole Turn straight section
3/4(-)- Q4 A01 X20
Q4 A01-A02 X20
Q4 A02-A03 X20
Q4 A03-A04 X20
Q4 A04-A05 X20
Q4 A05-A06 X20
Q4 A06-AO7 X20
Q4 A07-A08 X20
Q4 A08-B08 X20
Q4 B08-B07 X20
Q4 B07-B06 X20
Q4 B06-B05 X20
Time (s)

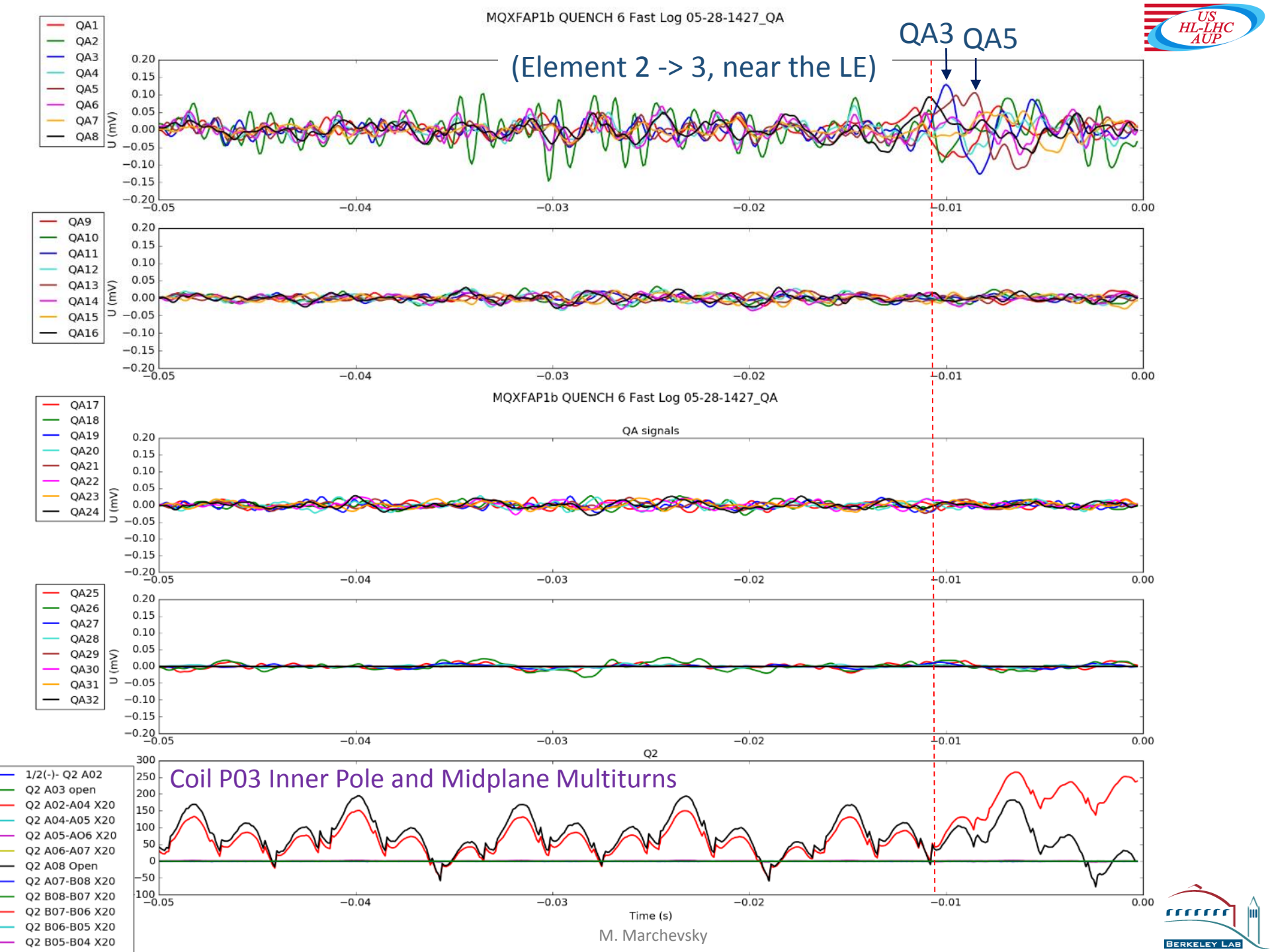


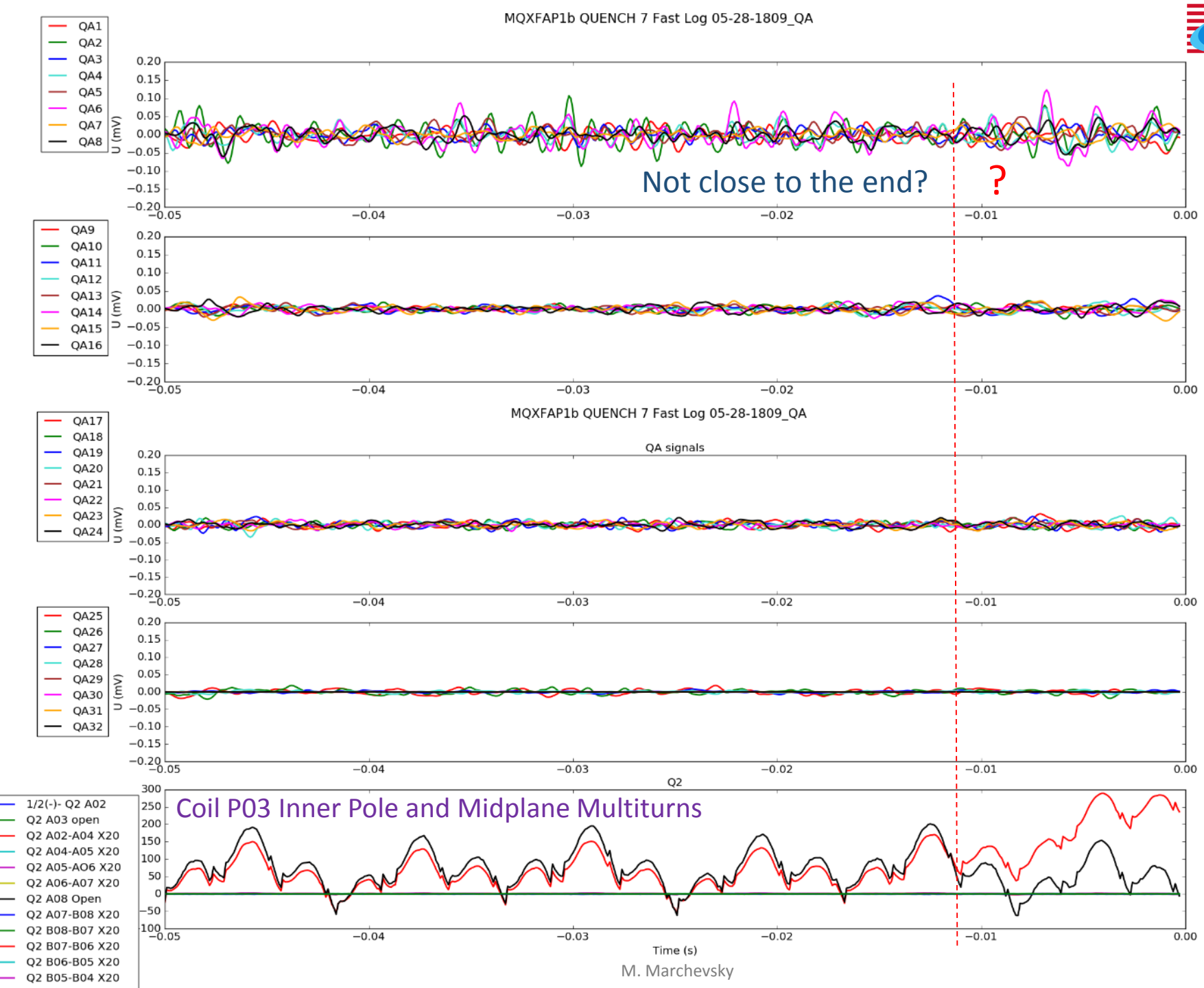
M. Marchevsky

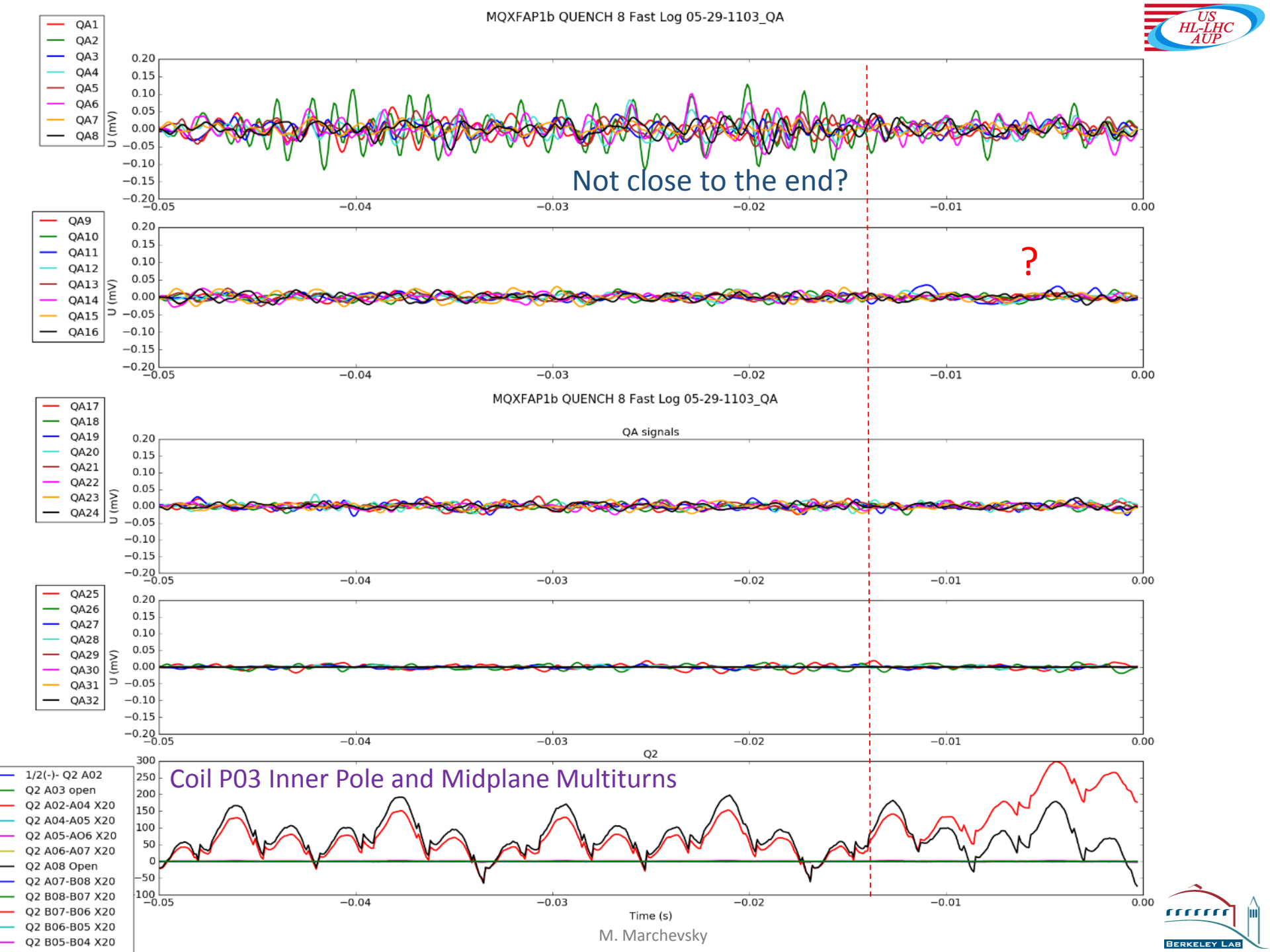

MQXFAP1b QUENCH 3 Fast Log 05-24-1122_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 3 Fast Log 05-24-1122_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q4
3/4(-)- Q4 A01 X20
Q4 A01-A02 X20
Q4 A02-A03 X20
Q4 A03-A04 X20
Q4 A04-A05 X20
Q4 A05-A06 X20
Q4 A06-A07 X20
Q4 A07-A08 X20
Q4 A08-B08 X20
Q4 B08-B07 X20
Q4 B07-B06 X20
Q4 B06-B05 X20
Coil P06 Inner Pole Turn straight section
Time (s)

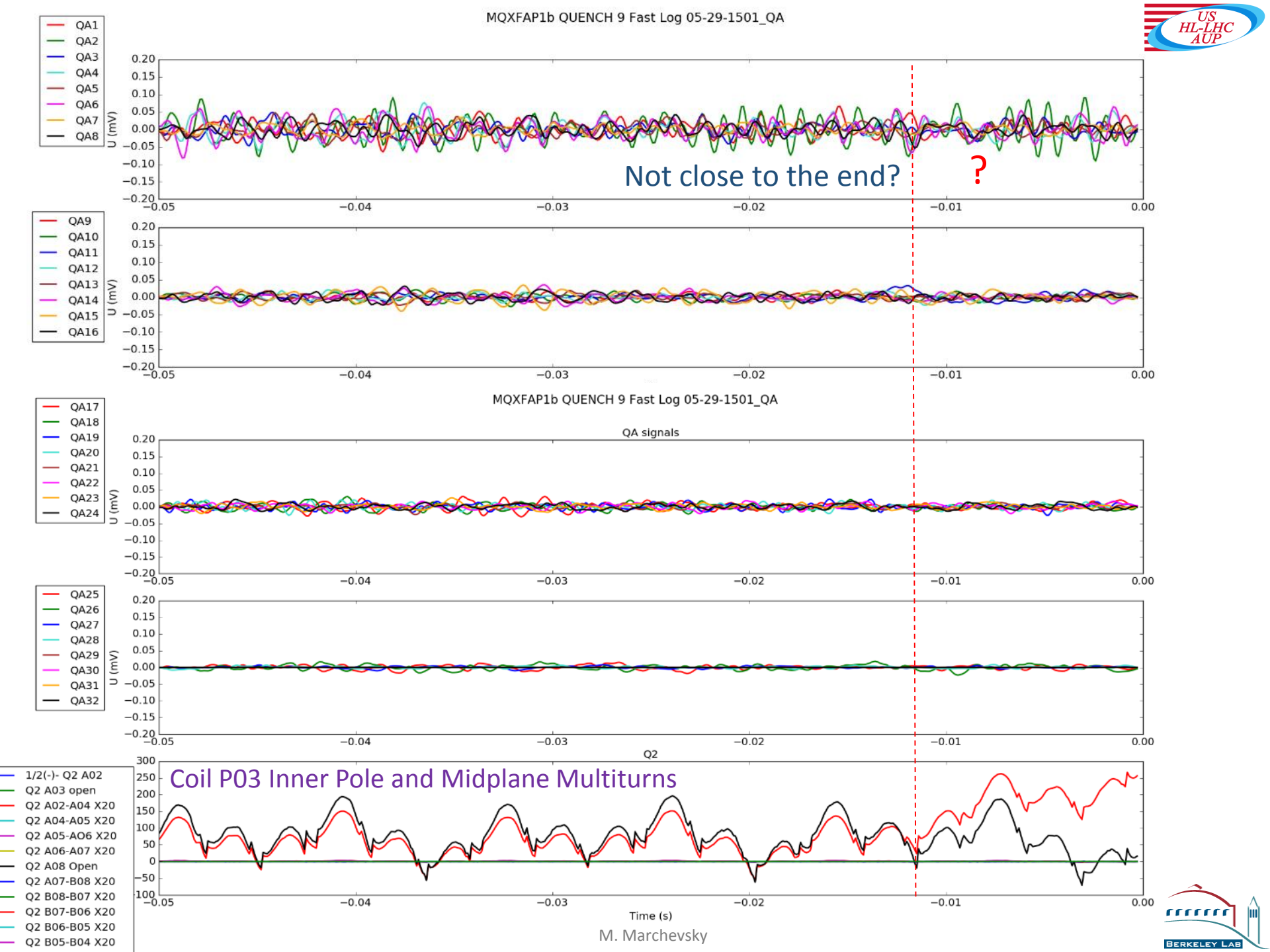

MQXFAP1b QUENCH 4 Fast Log 05-24-1525_QA
QA3
QA5
(Element 2 -> 3, near the LE)
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
U (mV)
QA signals
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

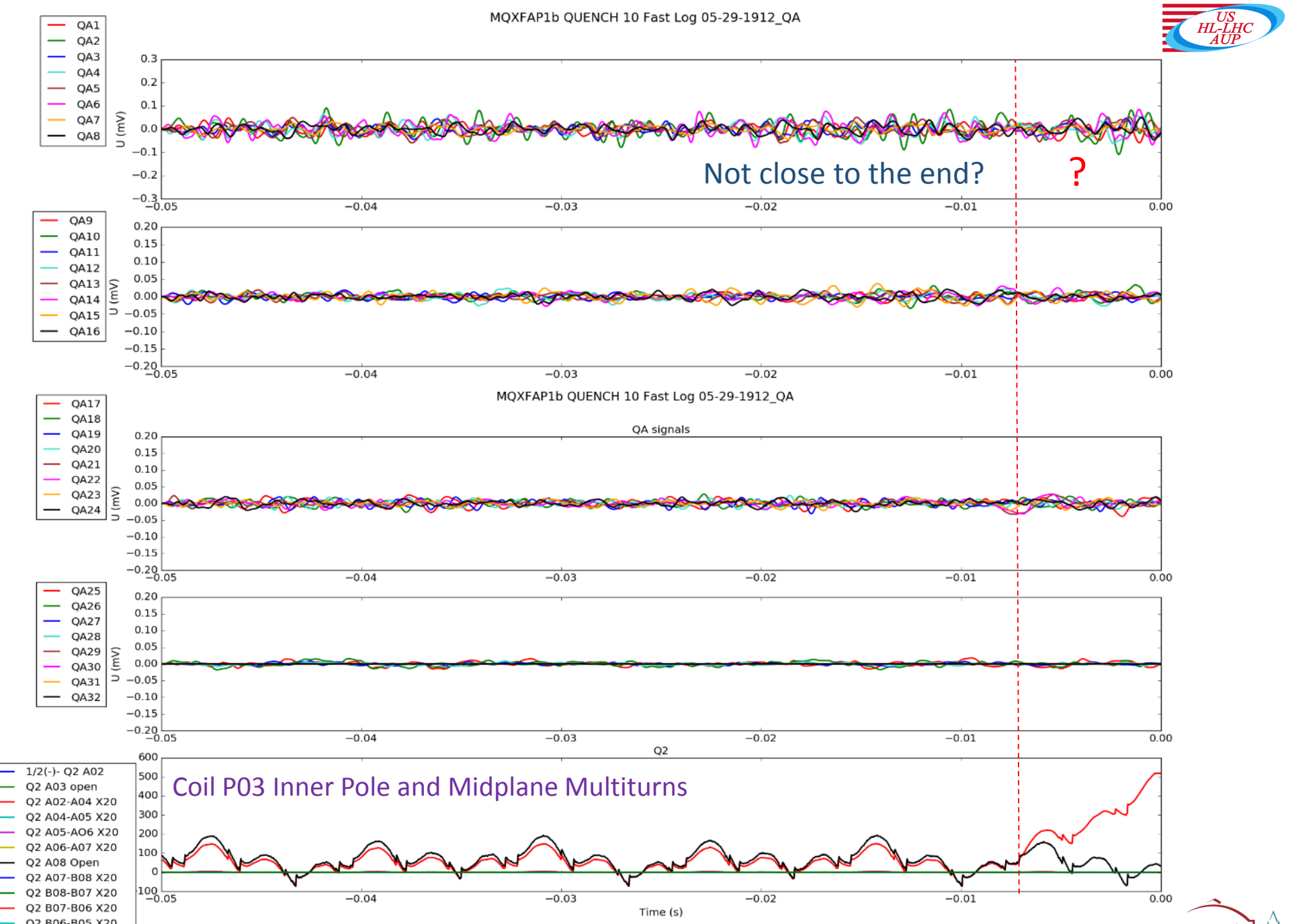

MQXFAP1b QUENCH 5 Fast Log 05-28-1032_QA
QA3
QA5
(Element 2 -> 3, near the LE)
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 5 Fast Log 05-28-1032_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
U (mV)
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

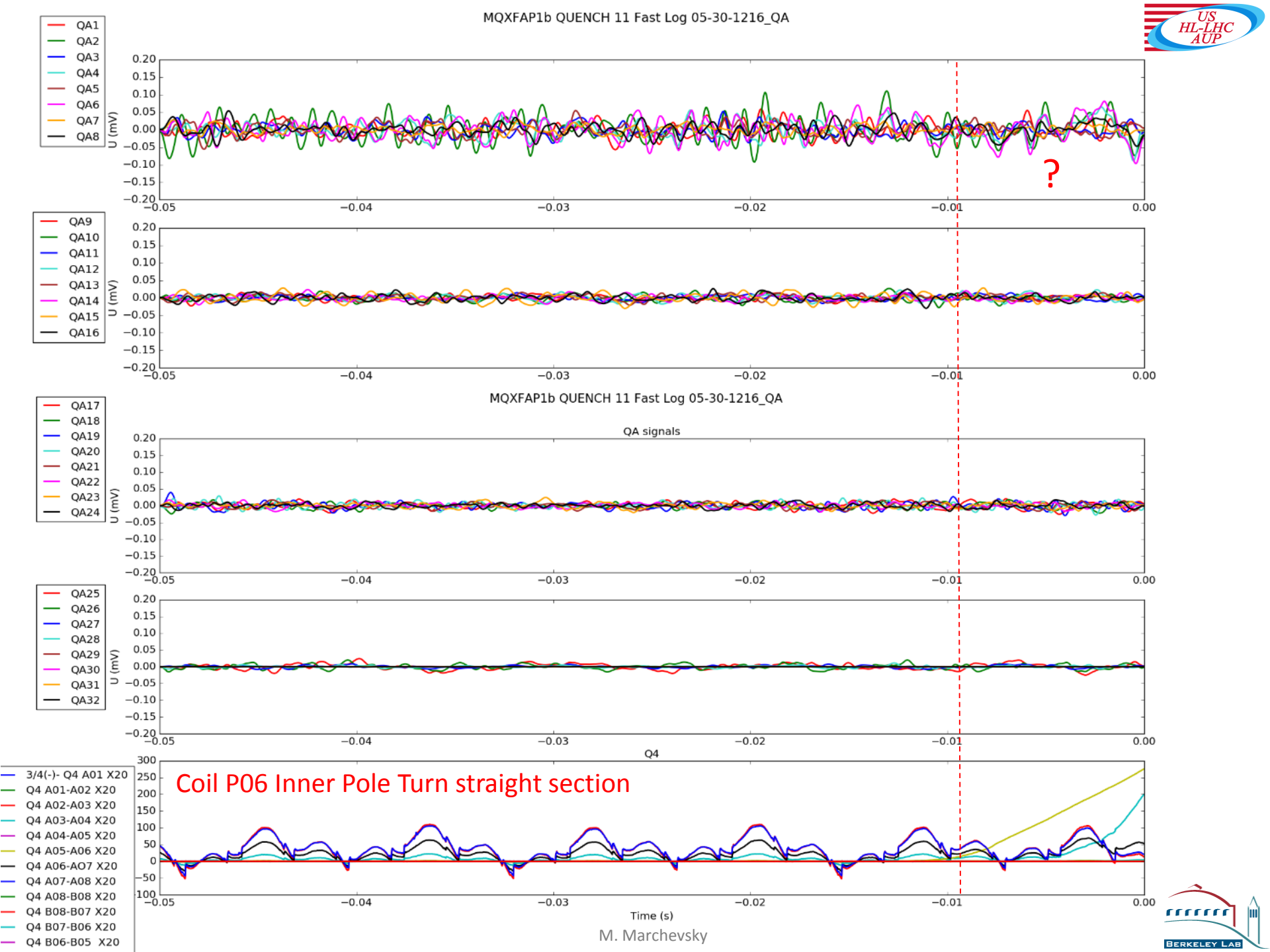

MQXFAP1b QUENCH 6 Fast Log 05-28-1427_QA
(Element 2 -> 3, near the LE)
QA3
QA5
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 6 Fast Log 05-28-1427_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

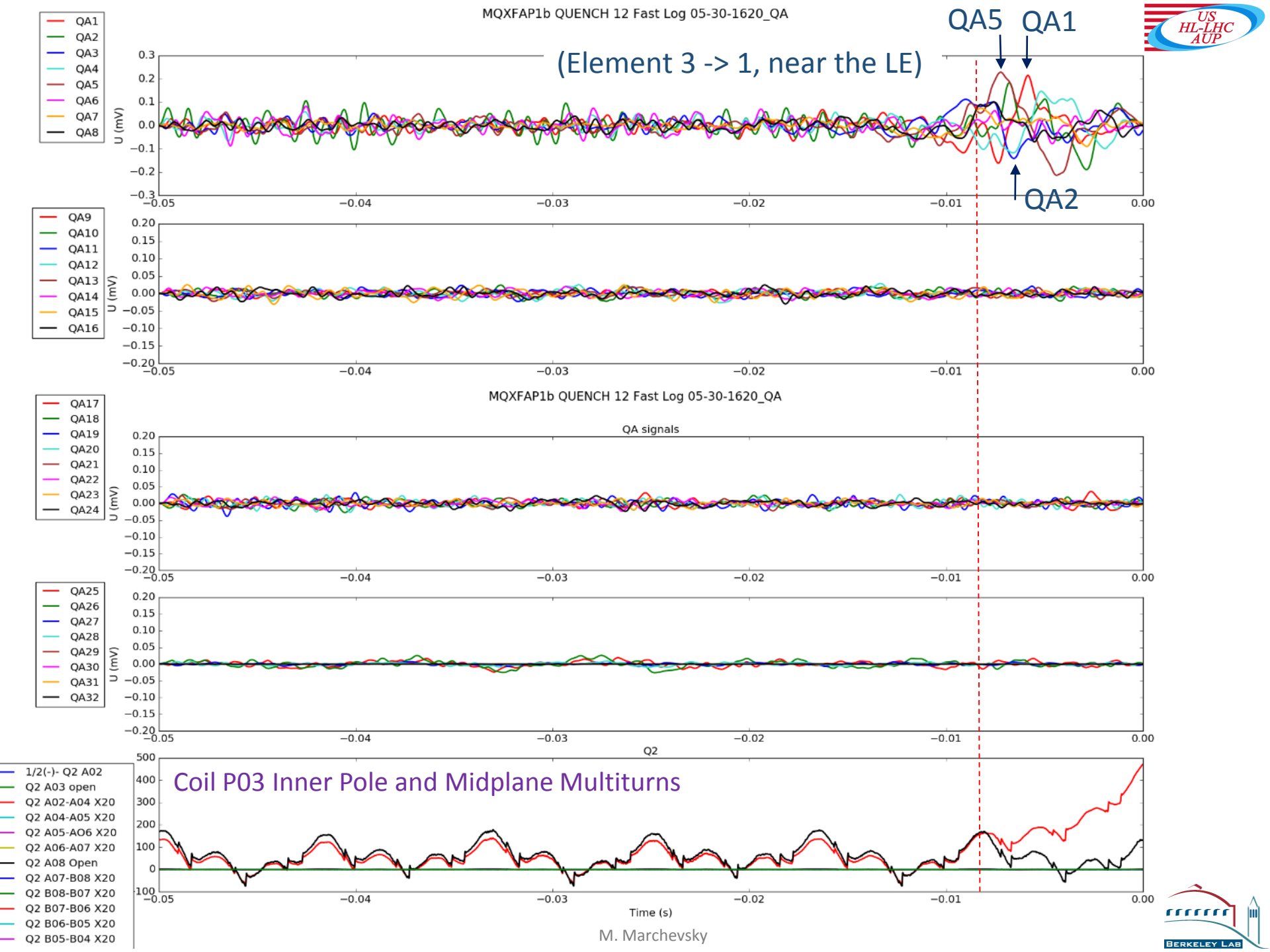

MQXFAP1b QUENCH 7 Fast Log 05-28-1809_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
Not close to the end?
?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 7 Fast Log 05-28-1809_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

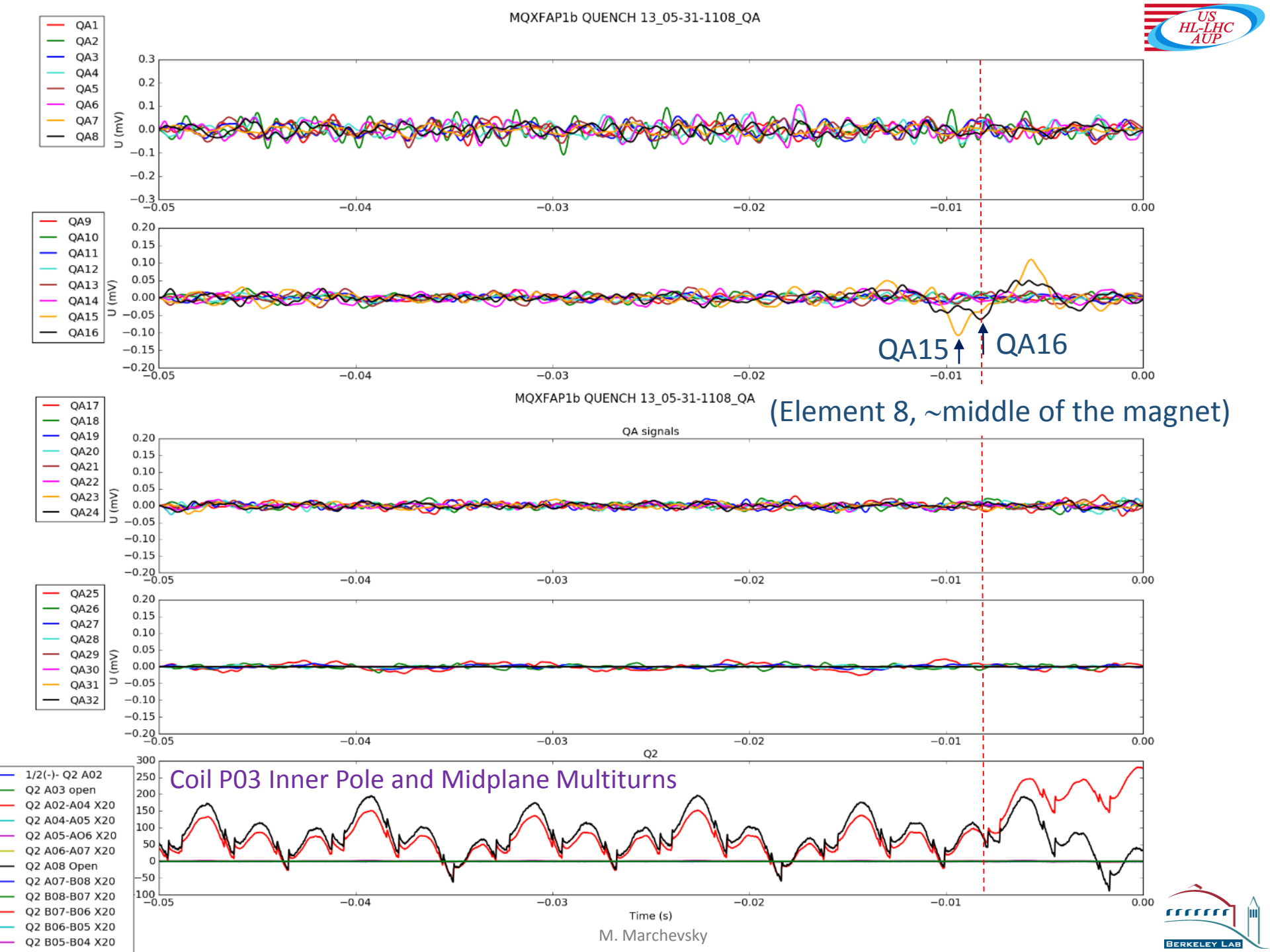

MQXFAP1b QUENCH 8 Fast Log 05-29-1103_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
Not close to the end?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
?
MQXFAP1b QUENCH 8 Fast Log 05-29-1103_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)


MQXFAP1b QUENCH 9 Fast Log 05-29-1501_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
Not close to the end?
?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 9 Fast Log 05-29-1501_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

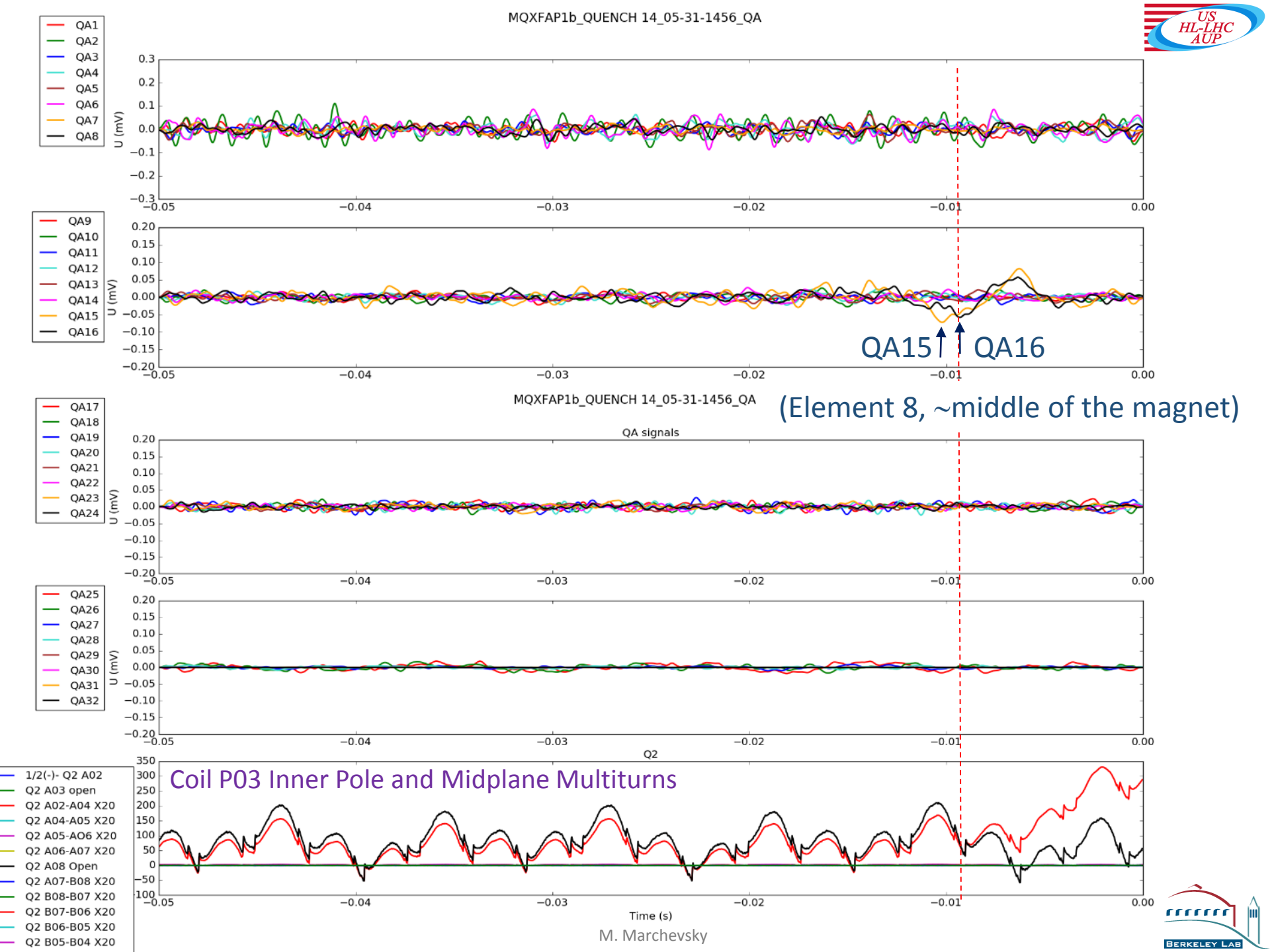

MQXFAP1b QUENCH 10 Fast Log 05-29-1912_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
Not close to the end?
?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 10 Fast Log 05-29-1912_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)


MQXFAP1b QUENCH 11 Fast Log 05-30-1216_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
?
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 11 Fast Log 05-30-1216_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q4
Coil P06 Inner Pole Turn straight section
3/4(-)- Q4 A01 X20
Q4 A01-A02 X20
Q4 A02-A03 X20
Q4 A03-A04 X20
Q4 A04-A05 X20
Q4 A05-A06 X20
Q4 A06-AO7 X20
Q4 A07-A08 X20
Q4 A08-B08 X20
Q4 B08-B07 X20
Q4 B07-B06 X20
Q4 B06-B05 X20
Time (s)


MQXFAP1b QUENCH 12 Fast Log 05-30-1620_QA
QA5
QA1
(Element 3 -> 1, near the LE)
QA2
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
U (mV)
QA signals
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

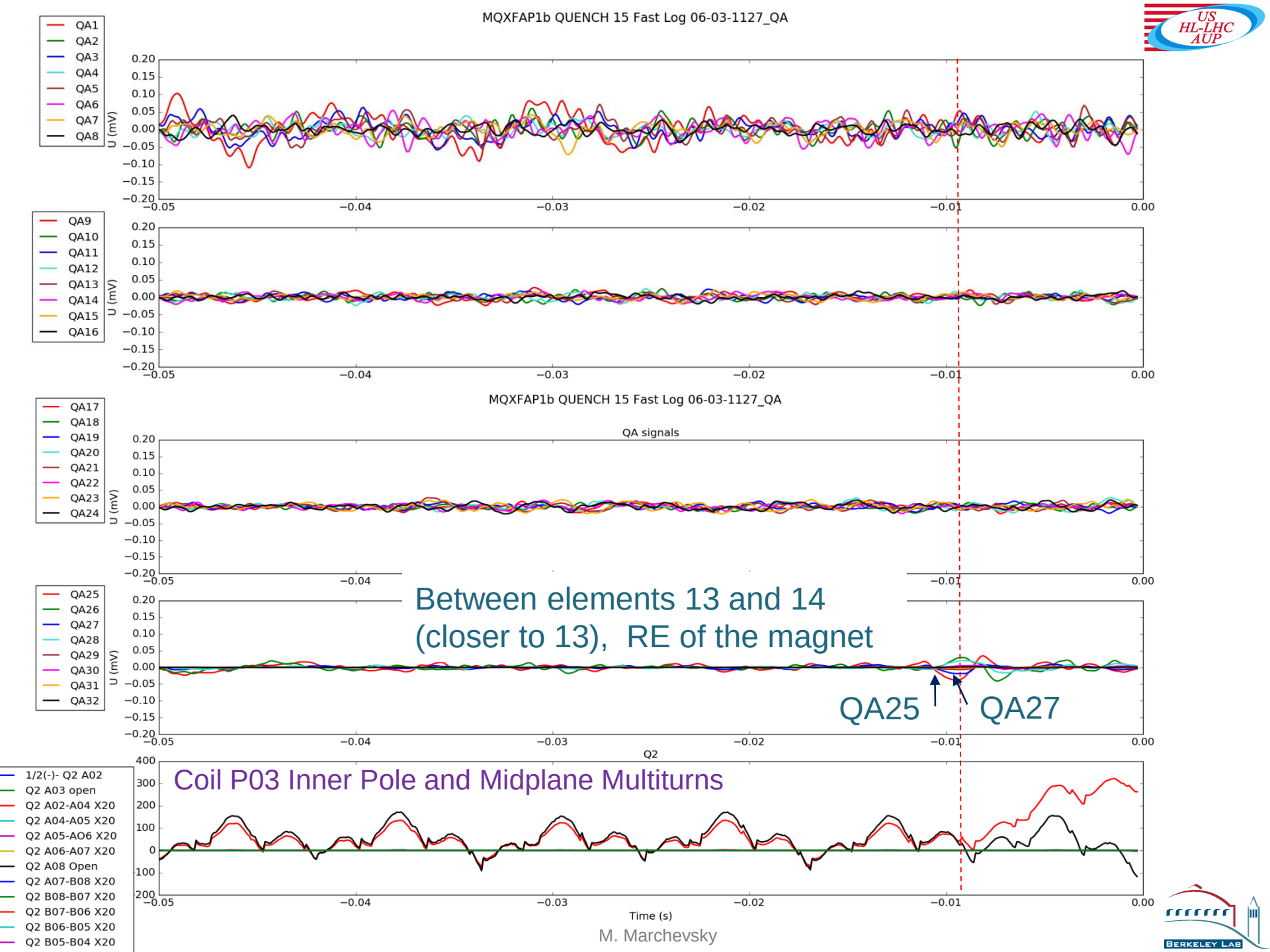


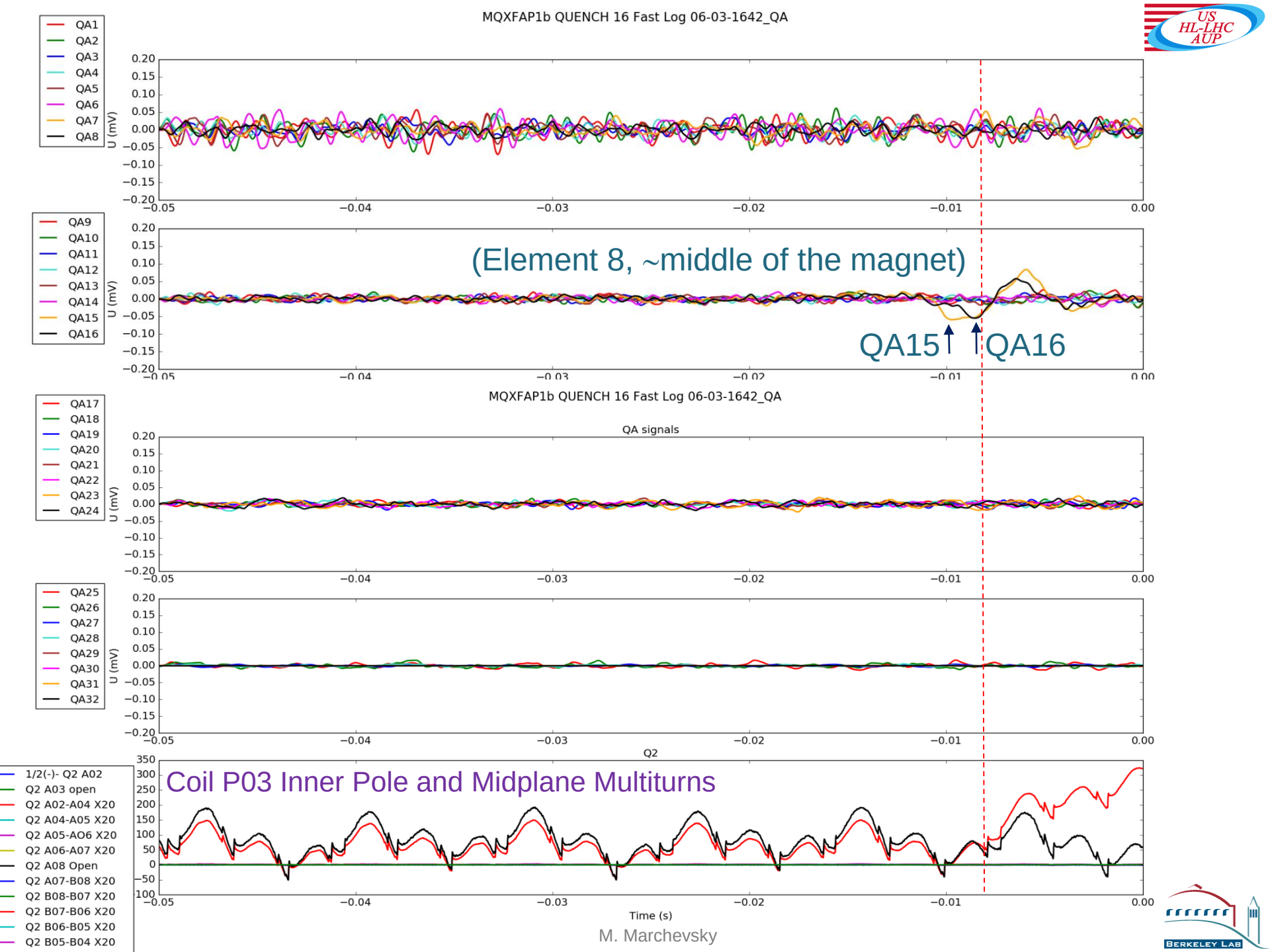
(Element 8, ~middle of the magnet)

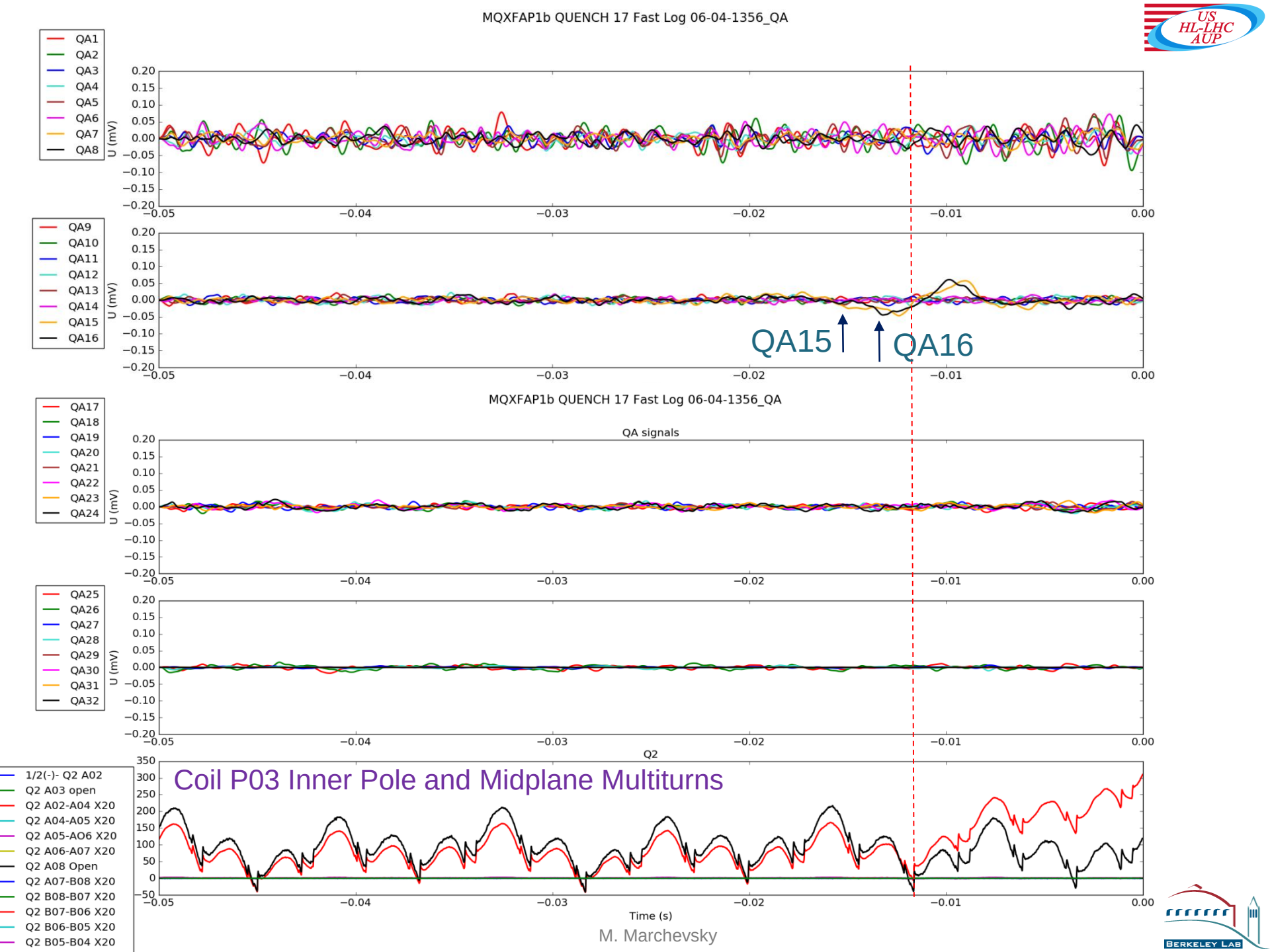


(Element 8, ~middle of the magnet)

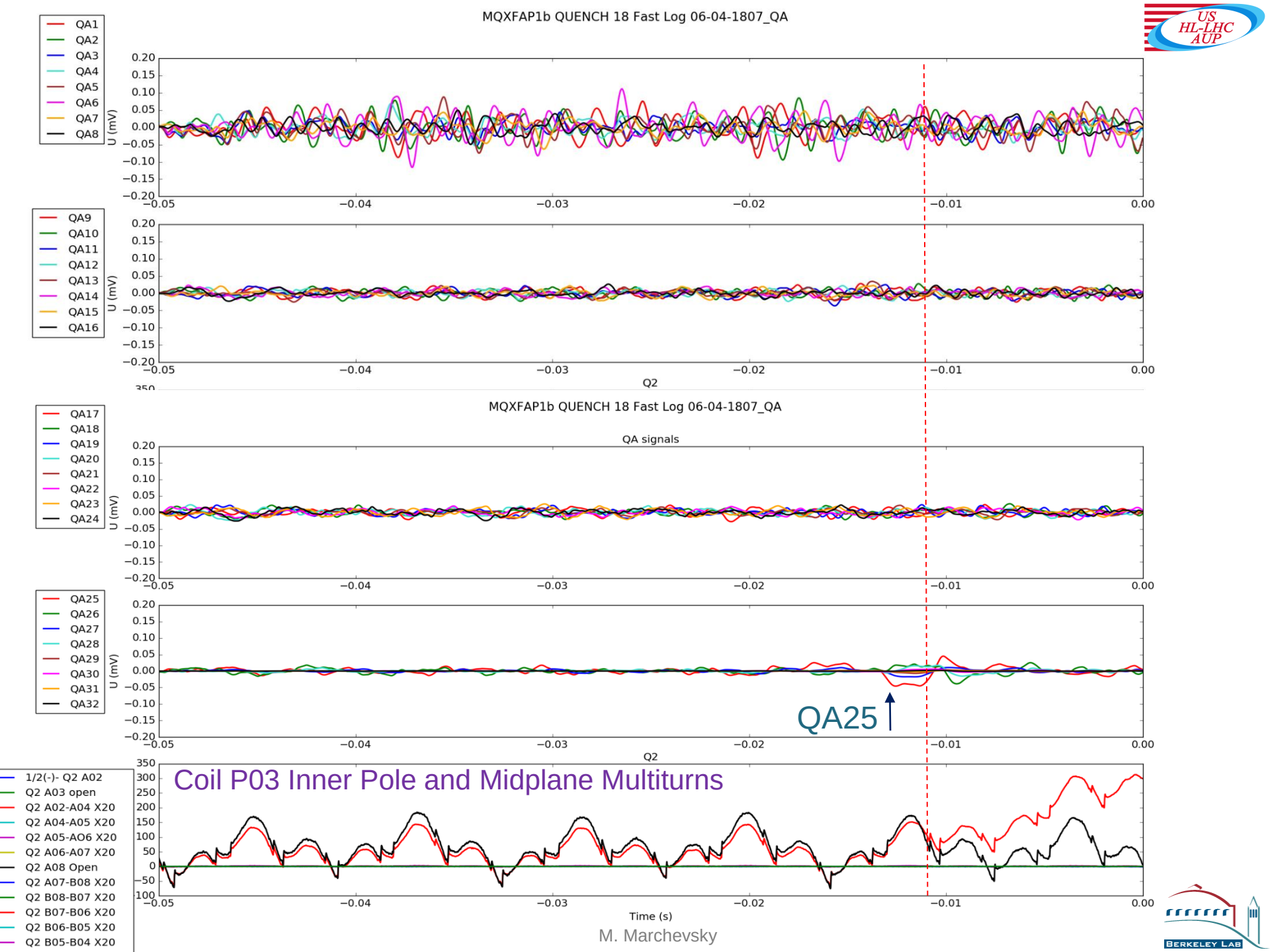
Coil P03 Inner Pole and Midplane Multiturns


MQXFAP1b QUENCH 15 Fast Log 06-03-1127_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 15 Fast Log 06-03-1127_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Between elements 13 and 14
(closer to 13), RE of the magnet
QA25
QA27
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)

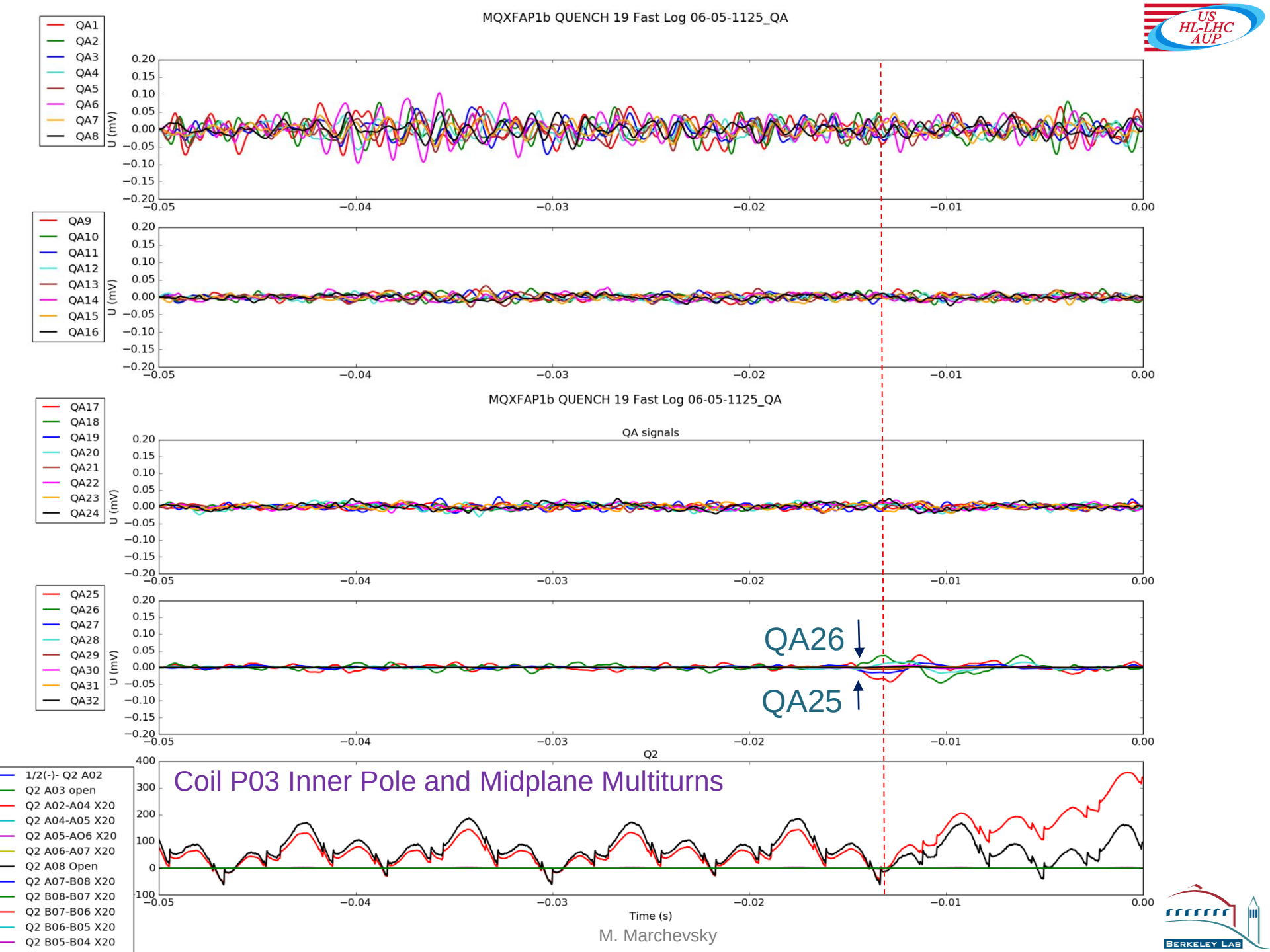

MQXFAP1b QUENCH 16 Fast Log 06-03-1642_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
U (mV)
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
(Element 8, ~middle of the magnet)
QA15
QA16
MQXFAP1b QUENCH 16 Fast Log 06-03-1642_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
Coil P03 Inner Pole and Midplane Multiturns
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)



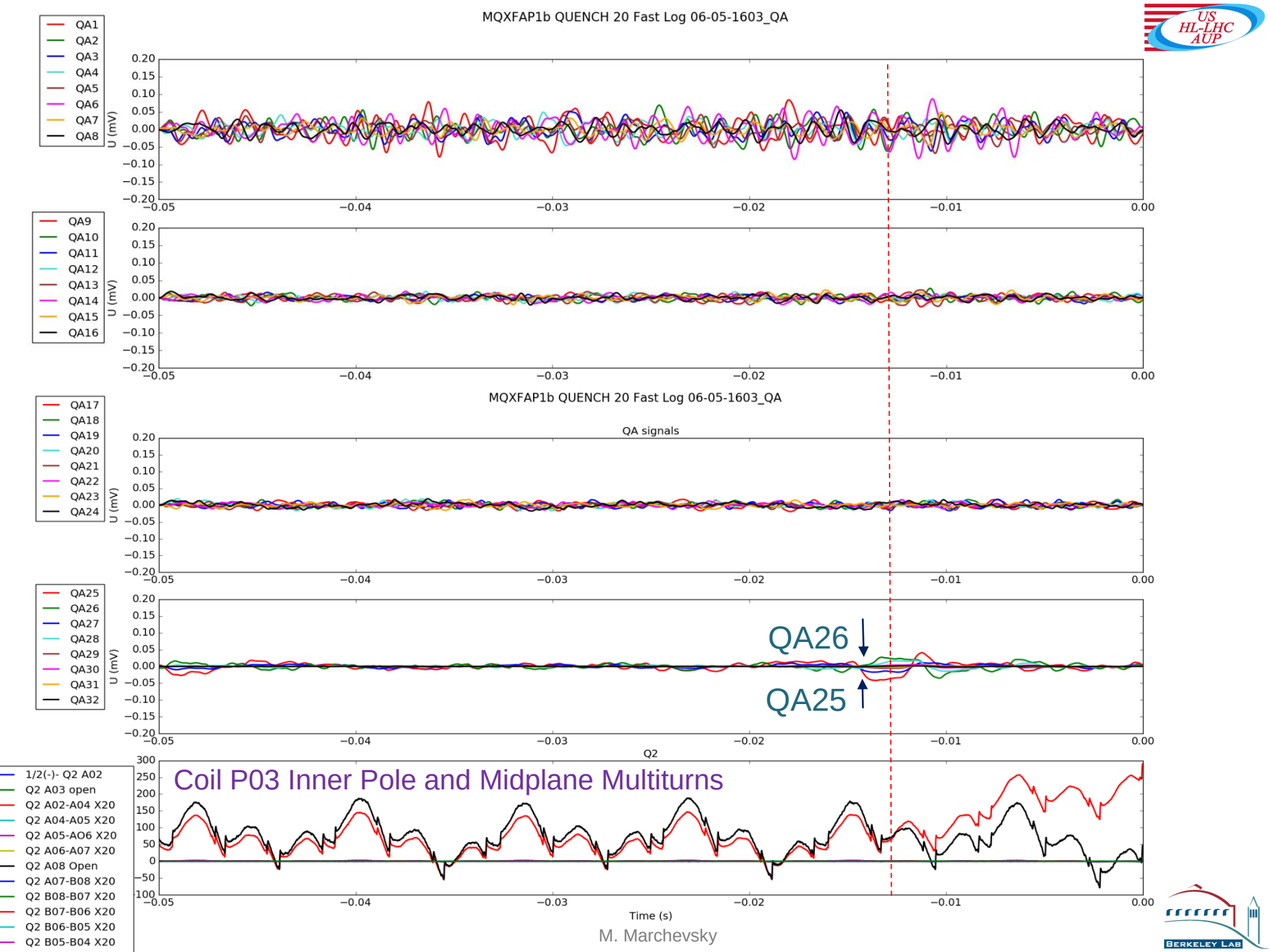
M. Marchevsky



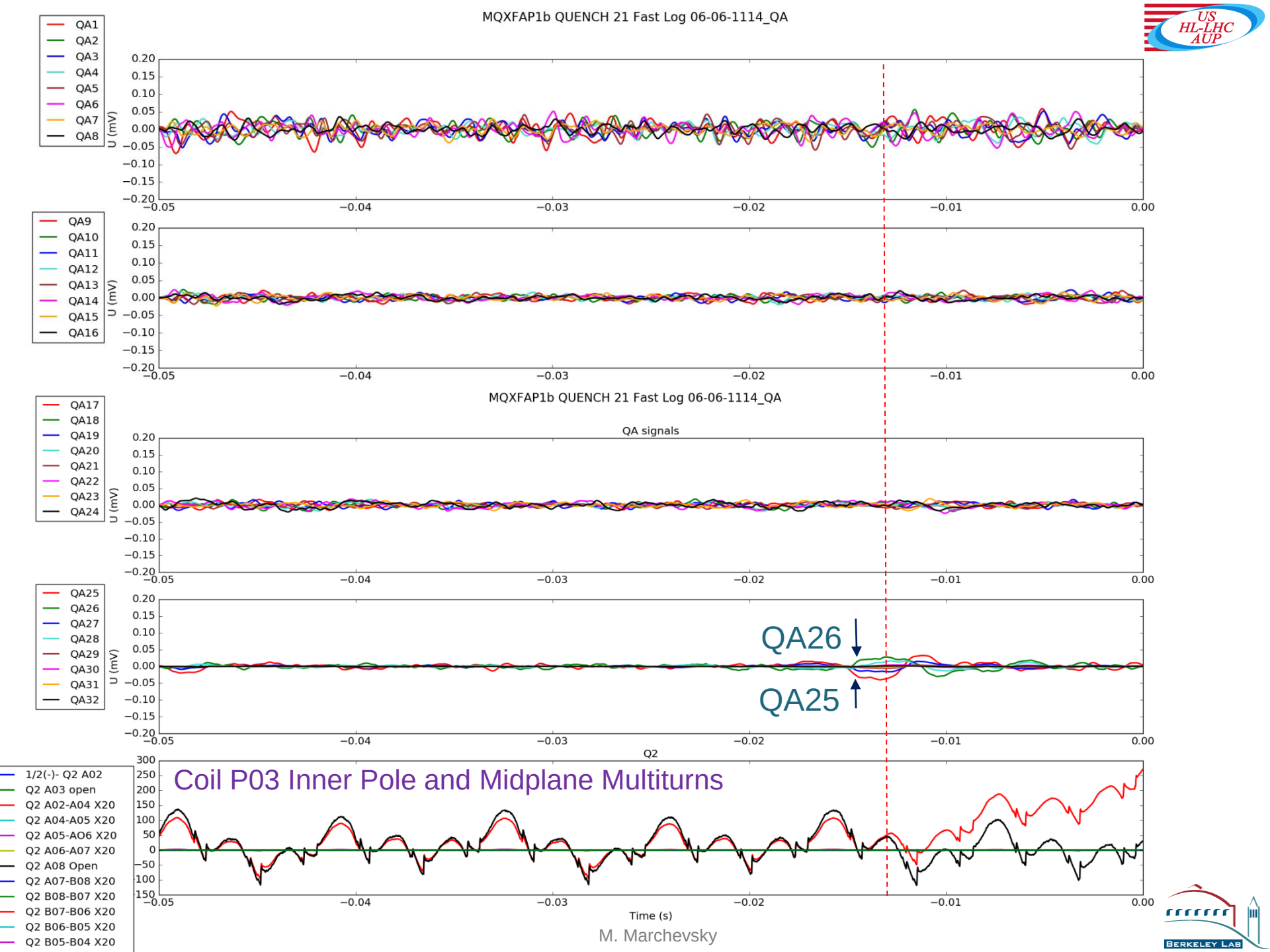
M. Marchevsky



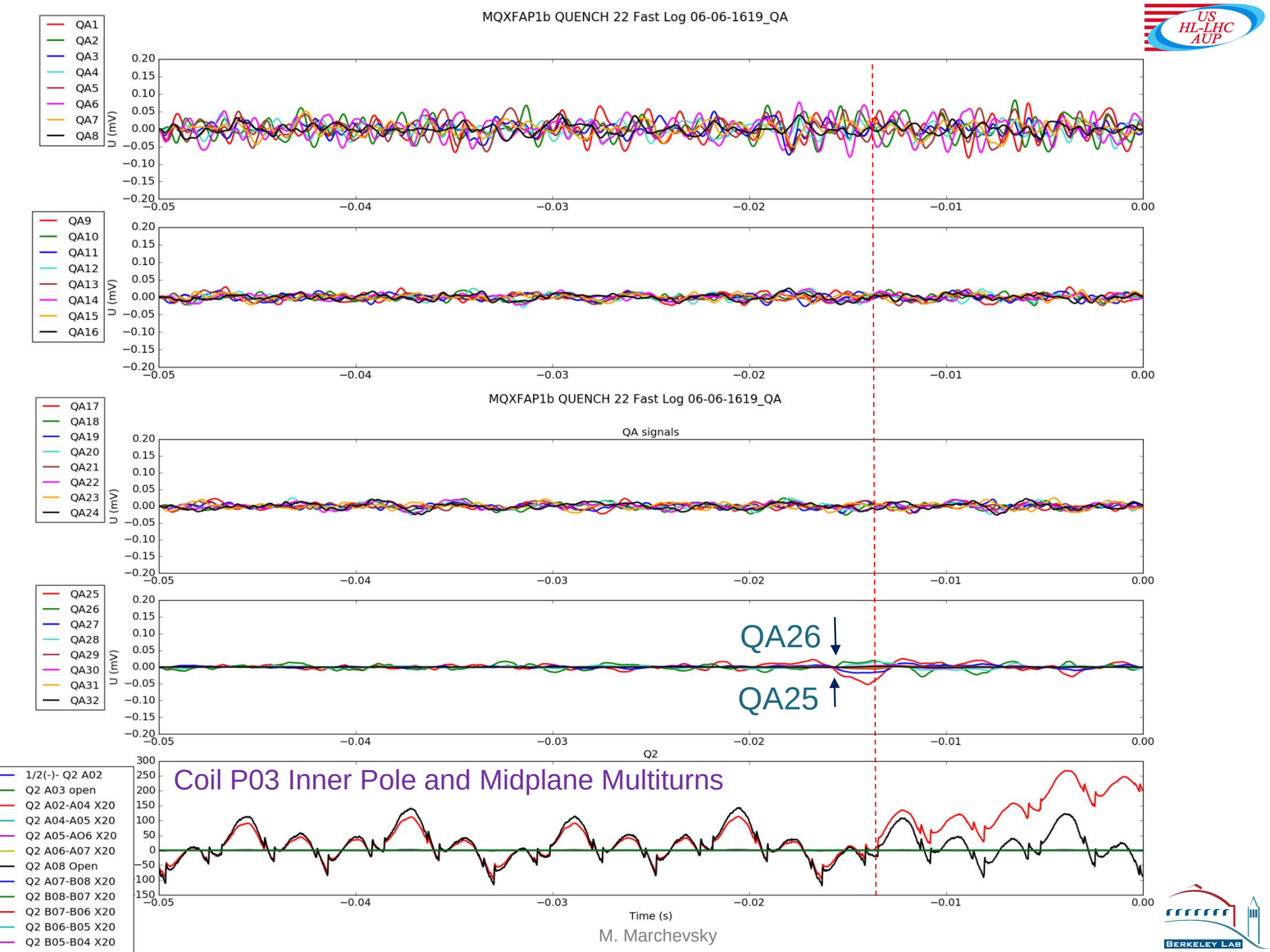
M. Marchevsky



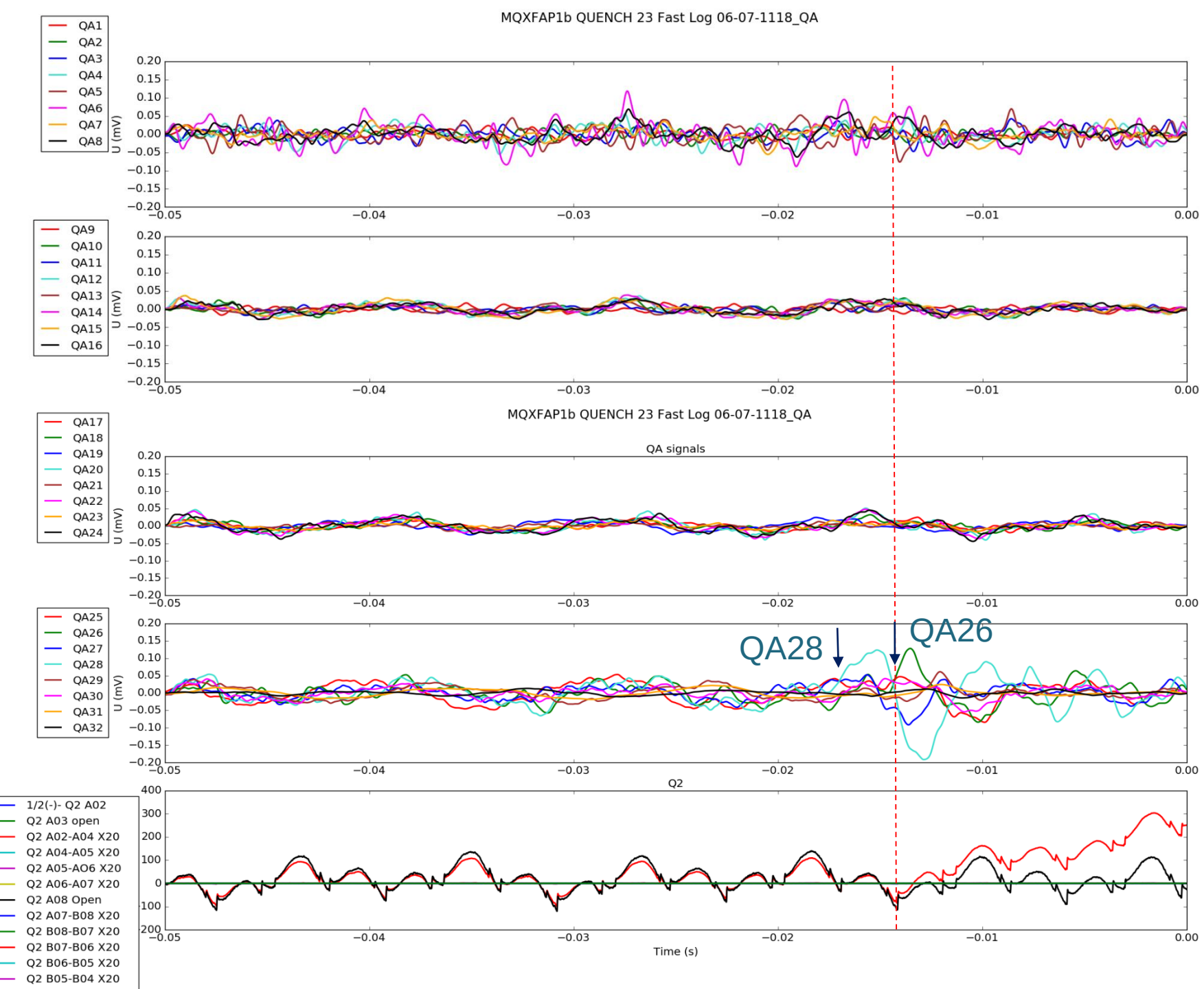
M. Marchevsky

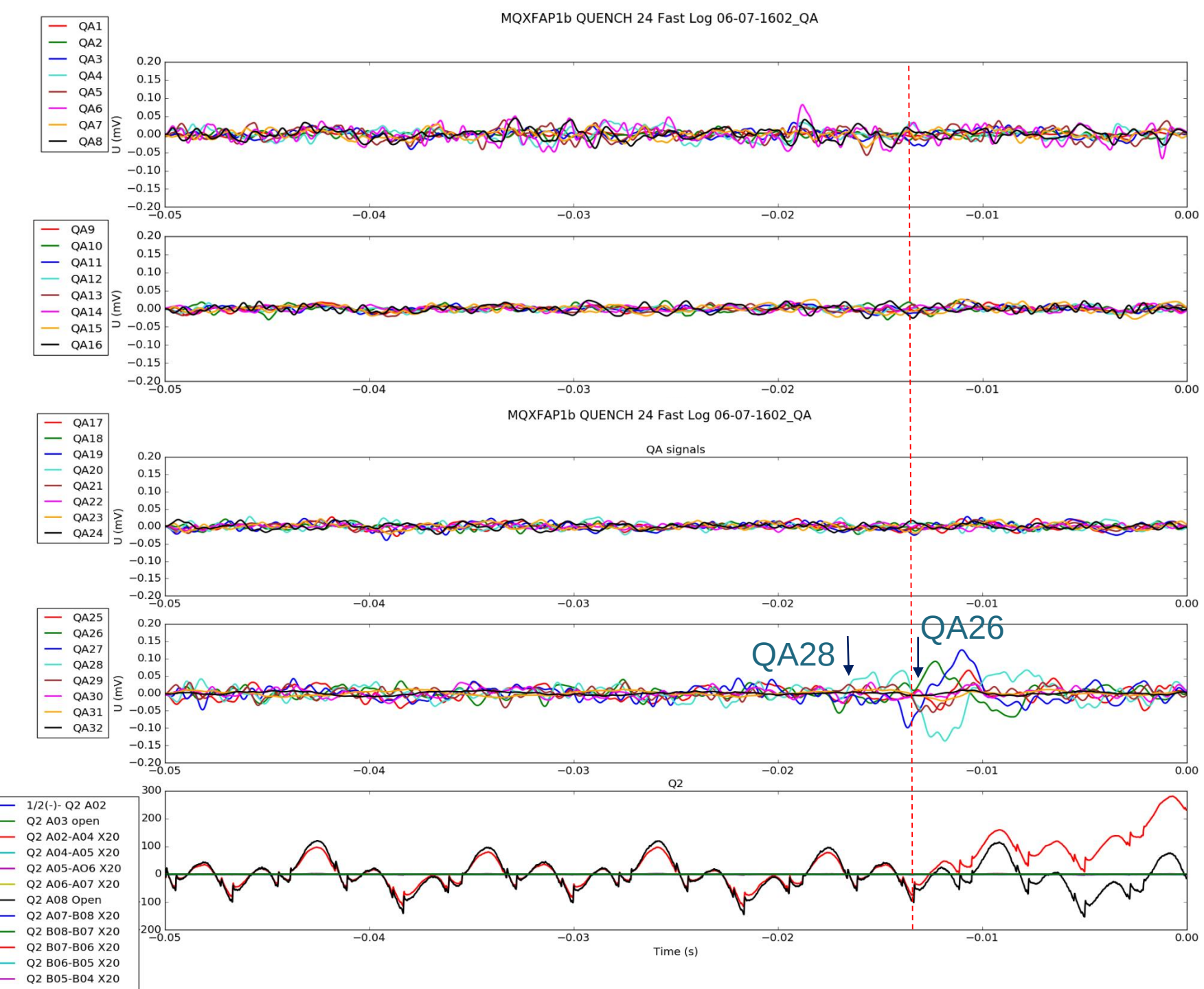


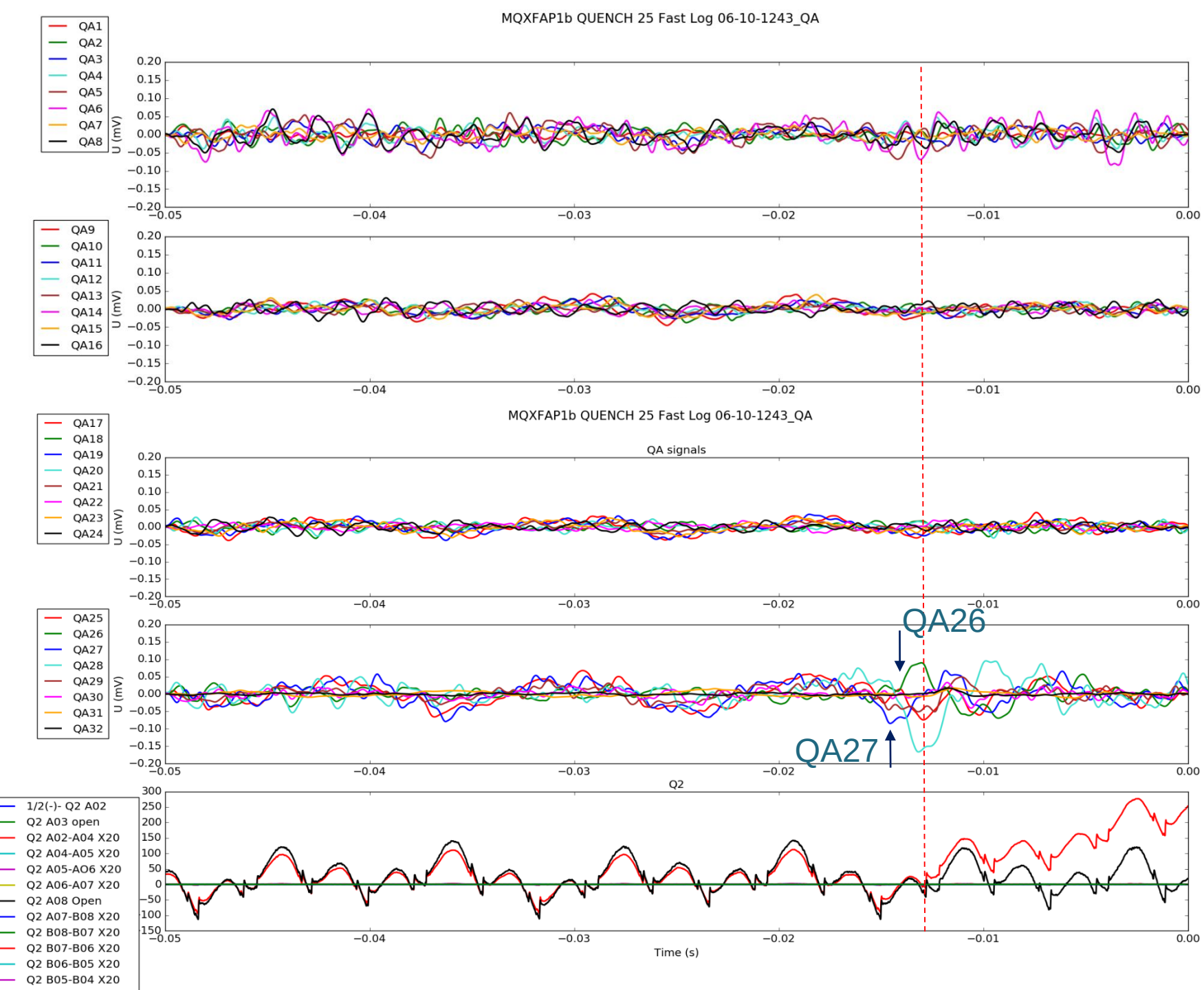
M. Marchevsky

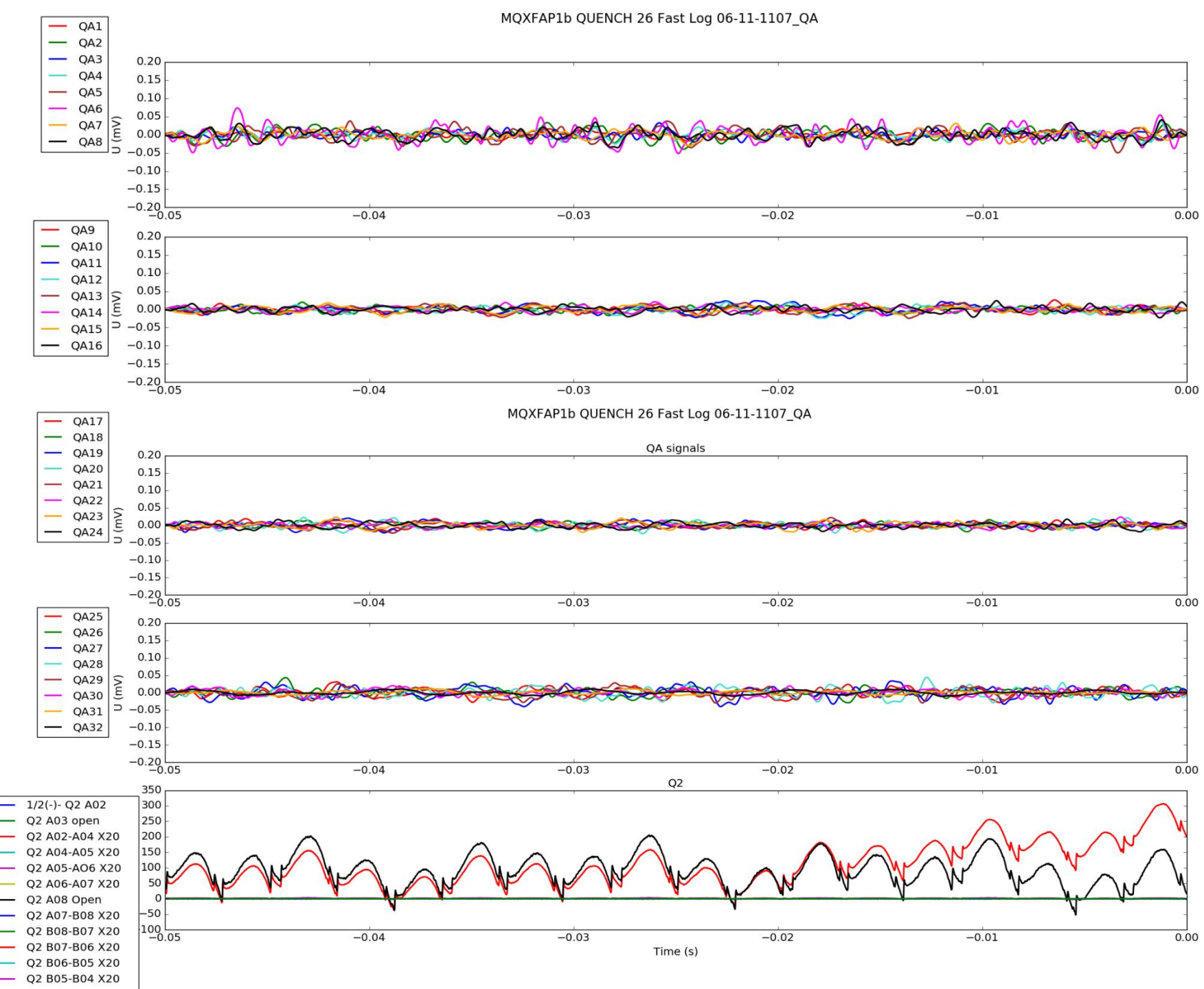


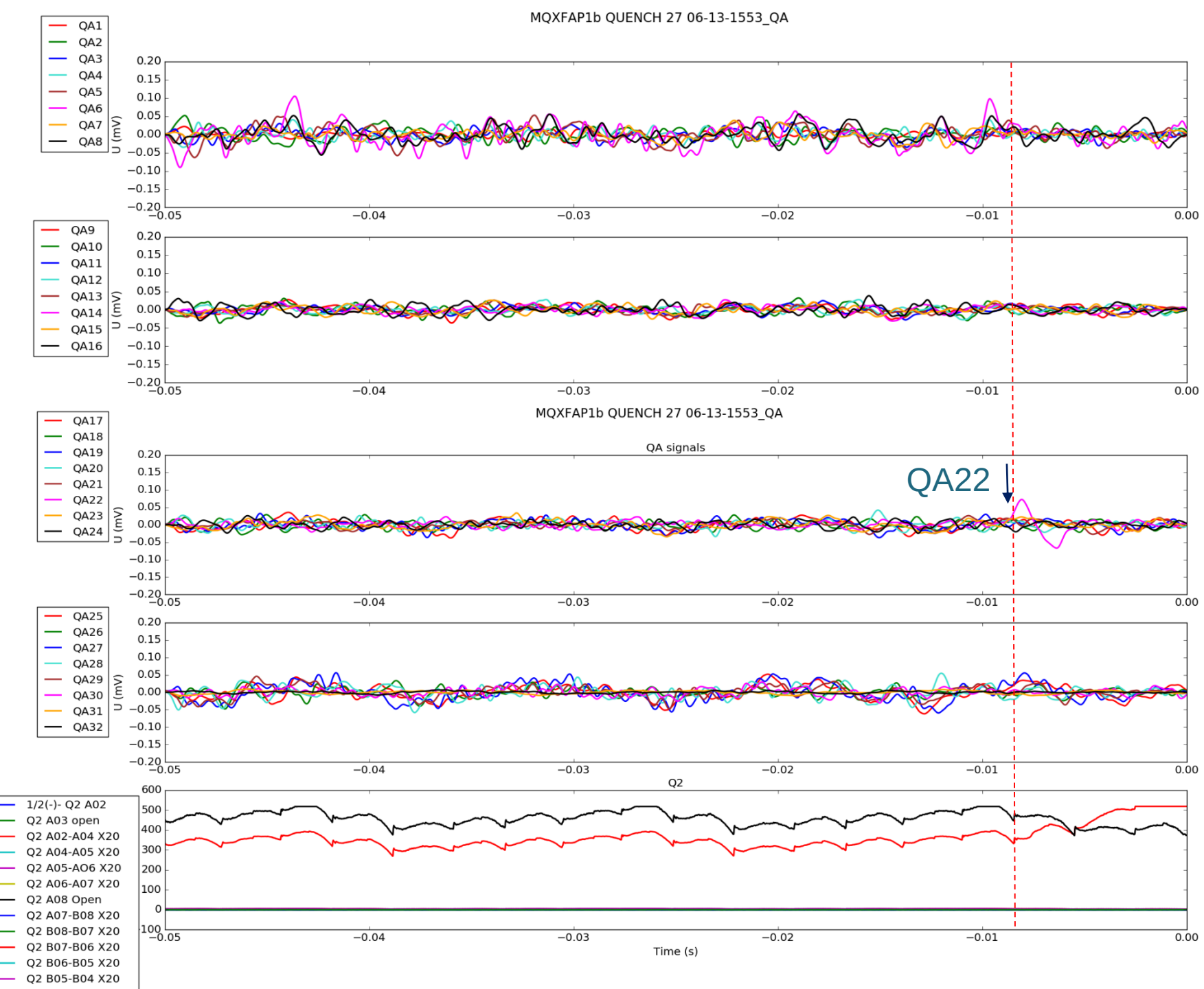
M. Marchevsky

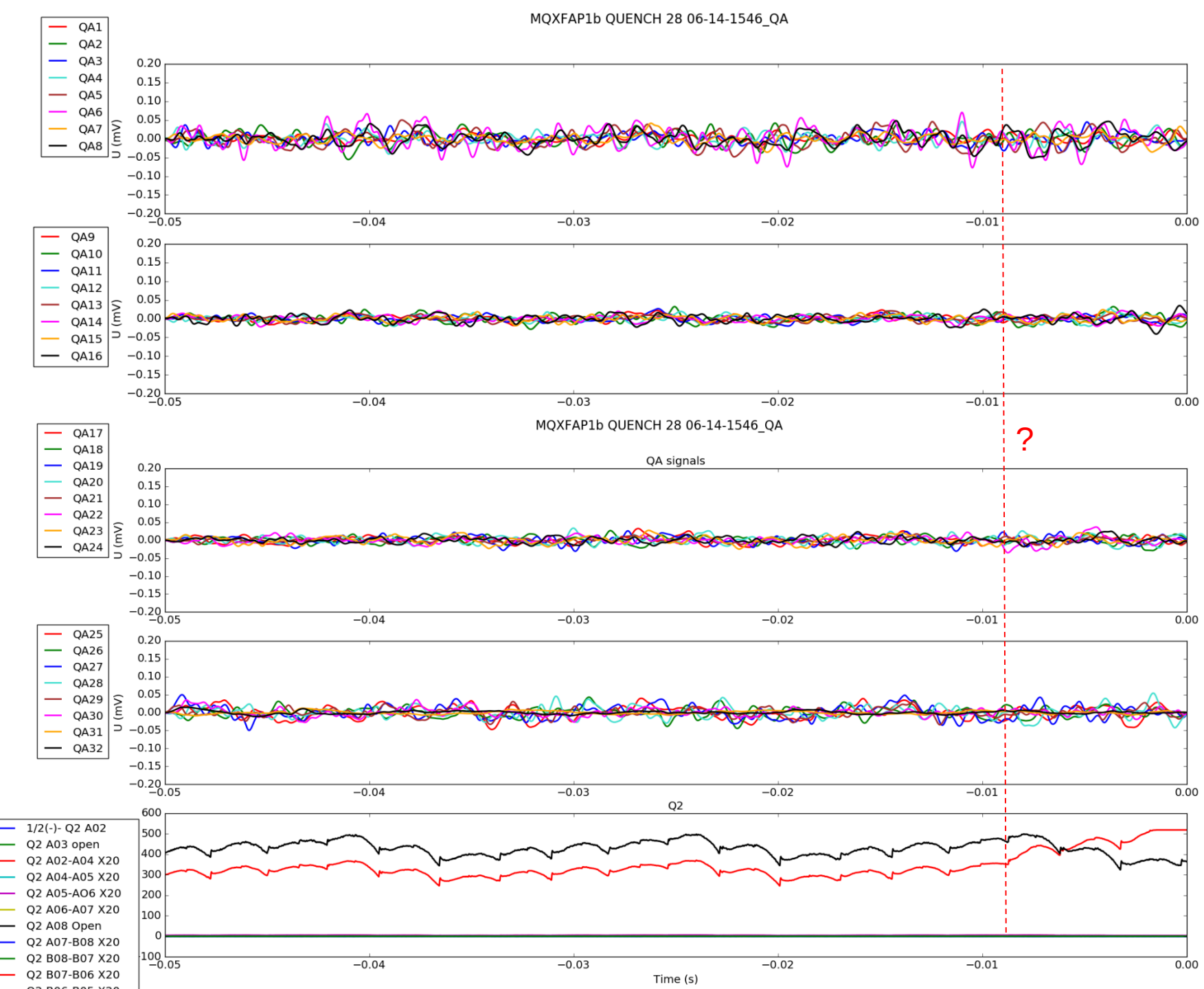

MQXFAP1b QUENCH 23 Fast Log 06-07-1118_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
MQXFAP1b QUENCH 23 Fast Log 06-07-1118_QA
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA signals
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
QA28
QA26
Q2
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
U (mV)
Time (s)


MQXFAP1b QUENCH 24 Fast Log 06-07-1602_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 24 Fast Log 06-07-1602_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
QA28
QA26
Q2
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)


MQXFAP1b QUENCH 25 Fast Log 06-10-1243_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 25 Fast Log 06-10-1243_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
QA26
QA27
Q2
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)


MQXFAP1b QUENCH 26 Fast Log 06-11-1107_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 26 Fast Log 06-11-1107_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)


MQXFAP1b QUENCH 27 06-13-1553_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 27 06-13-1553_QA
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA22
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Q2 B06-B05 X20
Q2 B05-B04 X20
Time (s)


MQXFAP1b QUENCH 28 06-14-1546_QA
QA1
QA2
QA3
QA4
QA5
QA6
QA7
QA8
QA9
QA10
QA11
QA12
QA13
QA14
QA15
QA16
U (mV)
MQXFAP1b QUENCH 28 06-14-1546_QA
?
QA signals
QA17
QA18
QA19
QA20
QA21
QA22
QA23
QA24
QA25
QA26
QA27
QA28
QA29
QA30
QA31
QA32
Q2
1/2(-)- Q2 A02
Q2 A03 open
Q2 A02-A04 X20
Q2 A04-A05 X20
Q2 A05-AO6 X20
Q2 A06-A07 X20
Q2 A08 Open
Q2 A07-B08 X20
Q2 B08-B07 X20
Q2 B07-B06 X20
Time (s)

Quench summary (to date)

#	Quench description	QA-based location
1	IQ = 15111.67 A Coil P06 Inner Pole Turn straight section	?
2	IQ = 16003.10 A Coil P06 Inner Pole Turn straight section	?
3	IQ = 16500.14 A Coil P06 Inner Pole Turn straight section	?
4	IQ= 16308.37 A Coil P03 Inner Pole and Midplane Multiturns	Element 2 -> 3 (LE)
5	IQ = 16182.85 A Coil P03 Inner Pole and Midplane Multiturns	Element 2 -> 3 (LE)
6	IQ = 16133.03 A Coil P03 Inner Pole and Midplane Multiturns	Element 2 -> 3 (LE)
7	IQ = 16223.59 A Coil P03 Inner Pole and Midplane Multiturns	? Not LE
8	IQ = 16336.46 A Coil P03 Inner Pole and Midplane Multiturns	? Not LE
9	IQ = 16021.07 A Coil P03 Inner Pole and Midplane Multiturns	? Not LE
10	IQ = 16698.21 A Coil P03 Inner Pole and Midplane Multiturns	? Not LE
11	IQ = 17163.87 A Coil P06 Inner Pole Turn straight section	?
12	IQ = 17251.35 A Coil P03 Inner Pole and Midplane Multiturns	Element 3 -> 1 (LE)
13	IQ = 16304.67 A Coil P03 Inner Pole and Midplane Multiturns	Element 8
14	IQ = 15960.27 A Coil P03 Inner Pole and Midplane Multiturns	Element 8
15	IQ = 17672.52 A Coil P03 Inner Pole and Midplane Multiturns	Elements 13 and 14 (RE)
16	IQ = 16234.71 A Coil P03 Inner Pole and Midplane Multiturns	Element 8
17	IQ = 15110.15 A Coil P03 Inner Pole and Midplane Multiturns	Element 8
18	IQ = 17156.90 A Coil P03 Inner Pole and Midplane Multiturns	Element 13

#	Quench description		QA-based location
19	IQ = 16674.41 A	Coil P03 Inner Pole and Midplane Multiturns	Element 13
20	IQ = 16610.33 A	Coil P03 Inner Pole and Midplane Multiturns	Element 13
21	IQ = 16353.06 A	Coil P03 Inner Pole and Midplane Multiturns	Element 13
22	IQ = 16326.96 A	Coil P03 Inner Pole and Midplane Multiturns	Element 13
23	IQ = 16402.49 A	Coil P03 Inner Pole and Midplane Multiturns	Element 14
24	IQ = 16551.63 A	Coil P03 Inner Pole and Midplane Multiturns	Element 14
25	IQ = 16311.32 A	Coil P03 Inner Pole and Midplane Multiturns	Element 13
26	IQ = 13357.22 A	Coil P03 Inner Pole and Midplane Multiturns	?
27	IQ = 16761.93 A	Coil P03	Element 11 (?)
28	IQ= 16245 A	Coil P03	?