

# A First Look at Quench Antenna Data on MQXFA04

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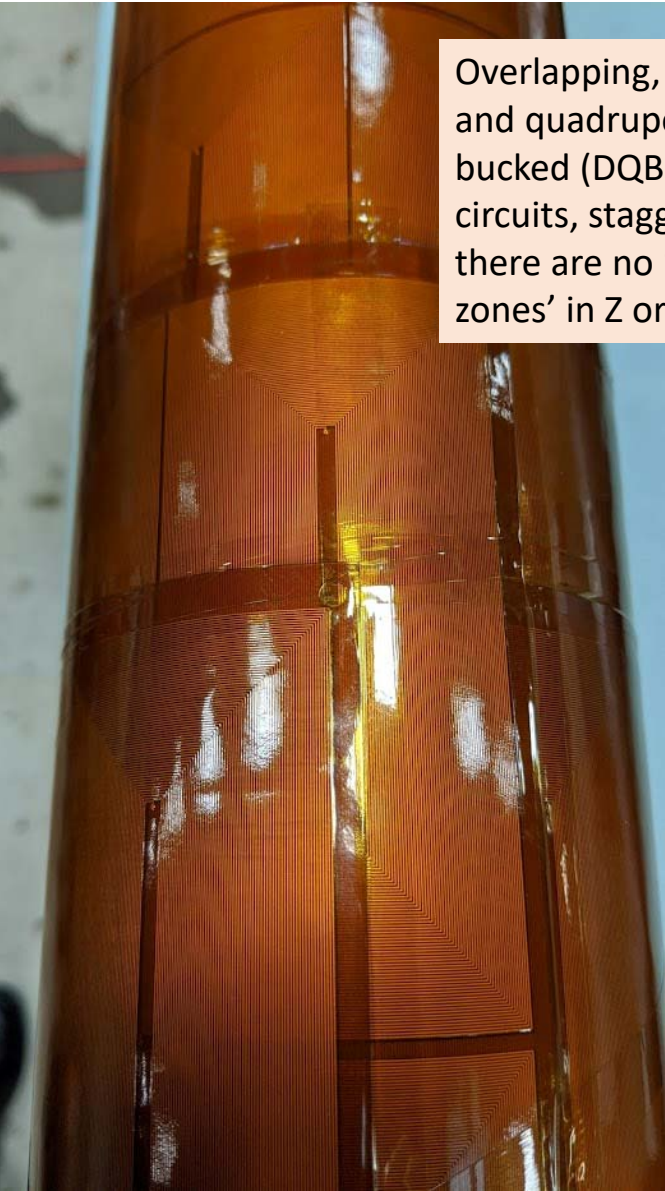
## Introduction:

In Fall of 2019, a Quench Antenna for MQXF production measurements with the following capabilities was proposed to be built at Fermilab with the following design criteria:

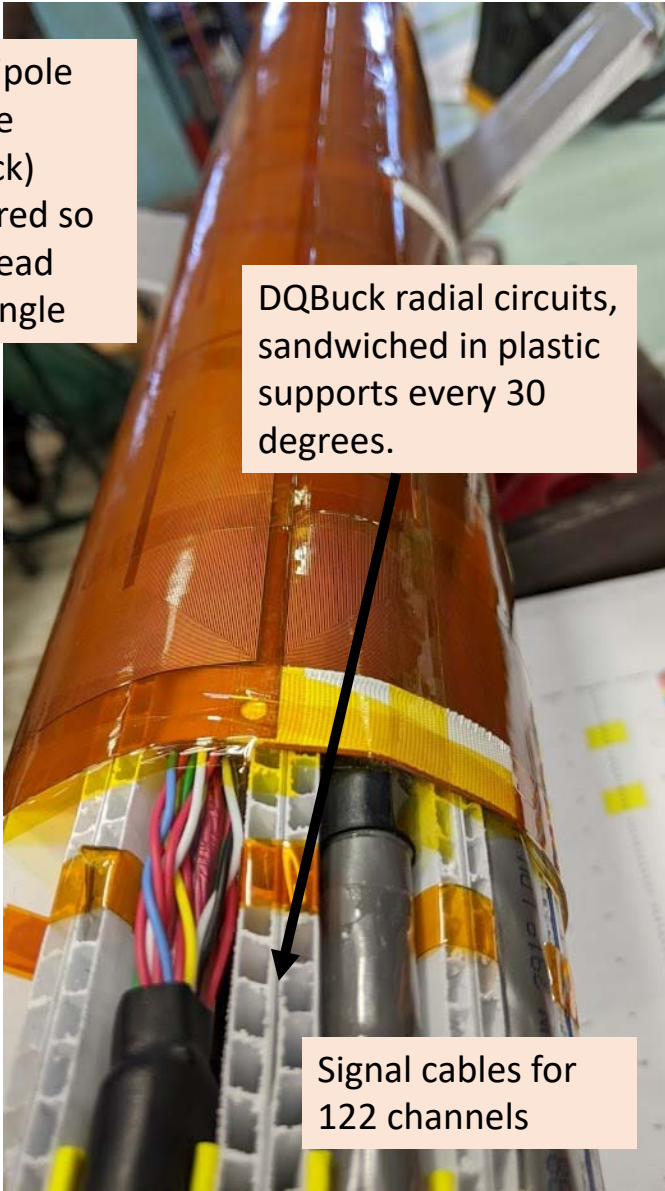
- Full coverage of magnet, including ends
- No 'dead zones'
- 2" nominal axial resolution (finer in some limited areas)
- Ability to determine azimuthal location of quenches

The completed QA was delivered to BNL in early August in time for the MQXFA04 testing

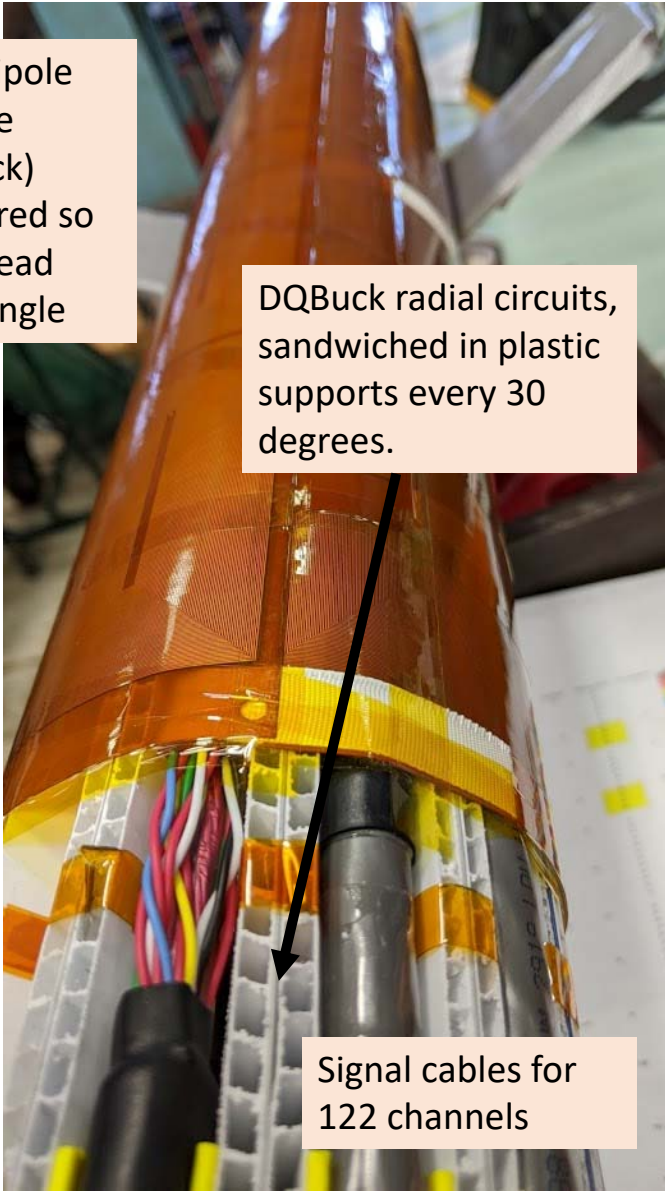
Note: no data available for quenches 5 and 7



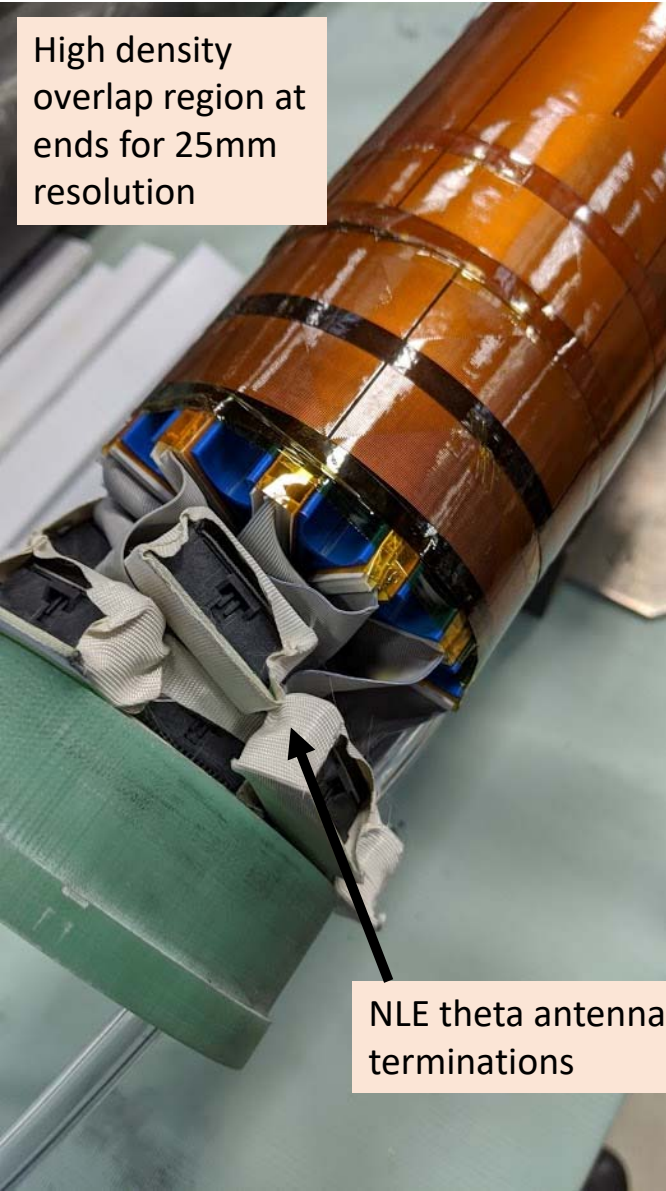
Overlapping, dipole and quadrupole bucked (DQBuck) circuits, staggered so there are no 'dead zones' in Z or angle



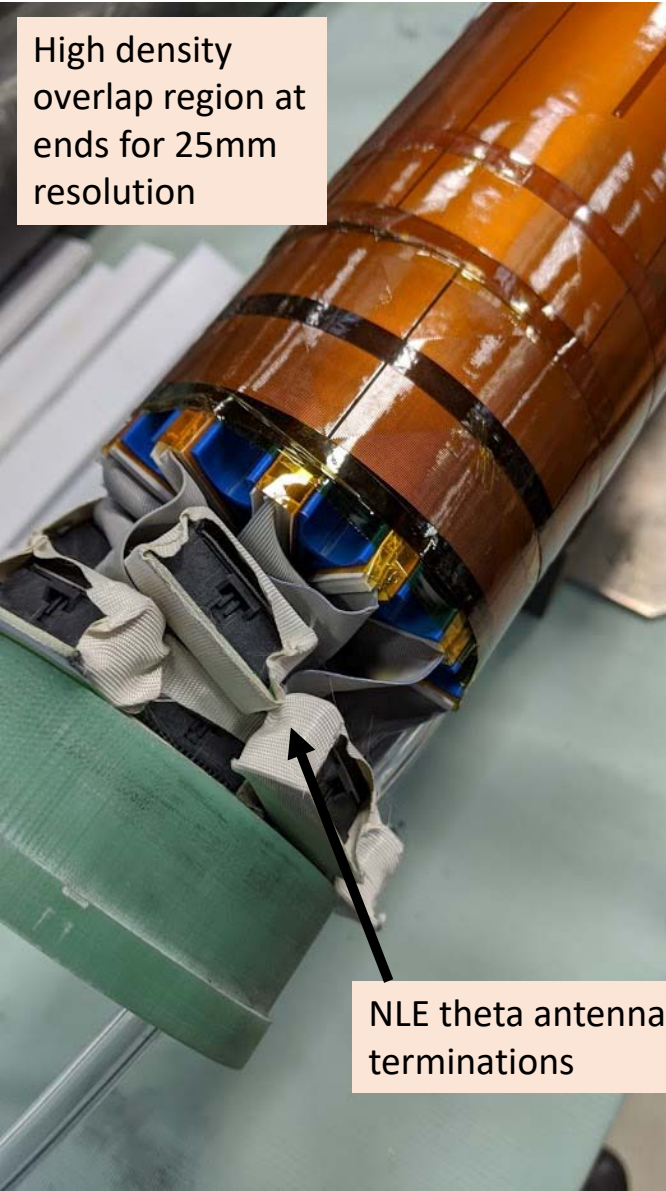
DQBuck radial circuits, sandwiched in plastic supports every 30 degrees.



Signal cables for 122 channels



High density overlap region at ends for 25mm resolution



NLE theta antenna terminations



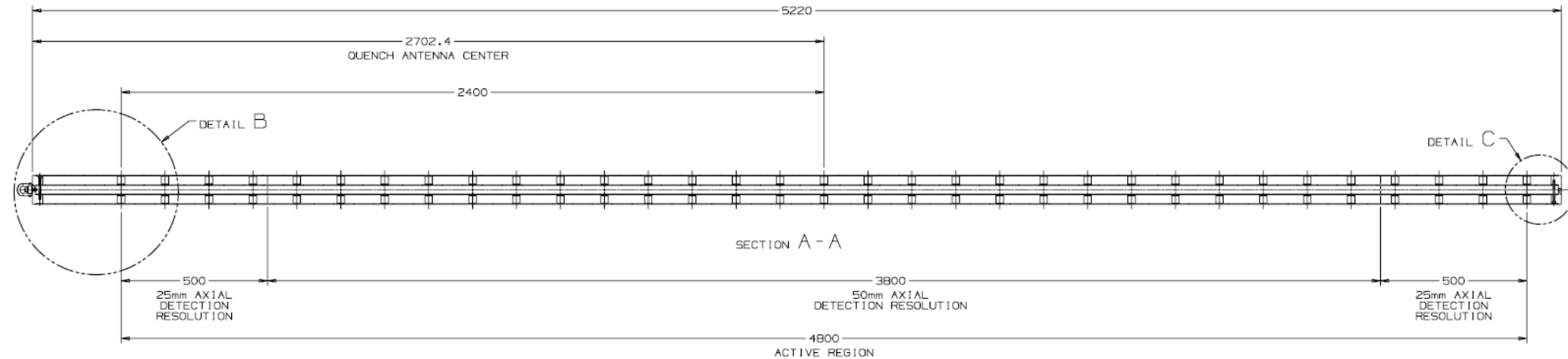
Nitrogen purge tube

LE interconnect with 1000x gain amplifiers for theta antennas

Final QA assembly ready to be shipped to BNL



QA active length 4800mm (+/- 2400 mm from QA center)



Center of QA about 96mm above magnet center when suspended.

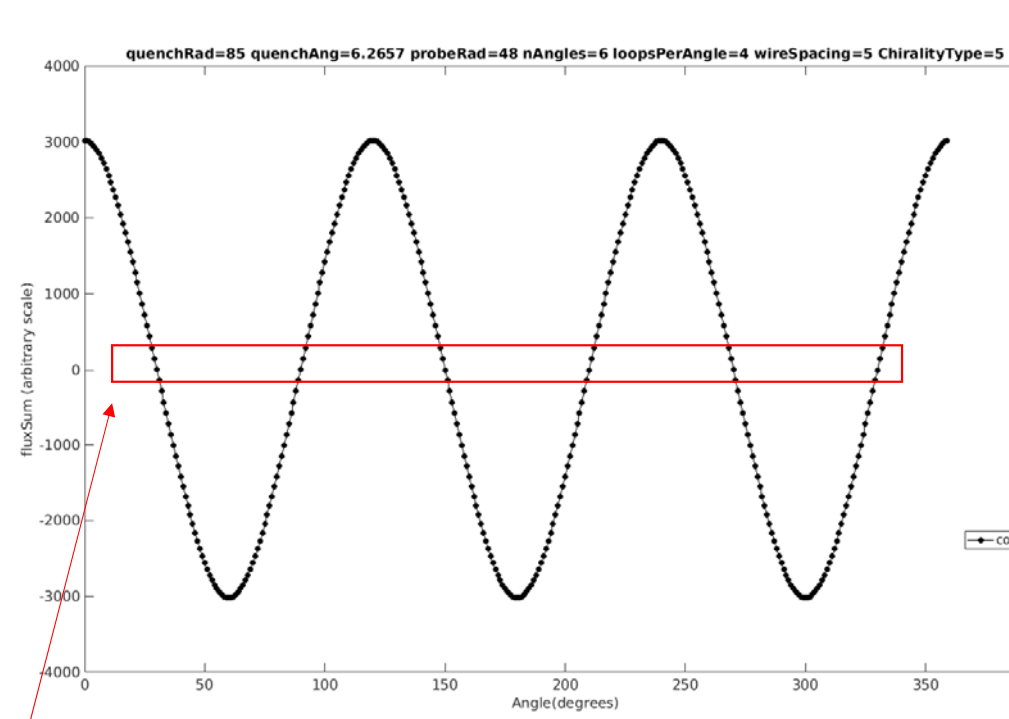
Length of magnet coils at 1.9K = ~4530 mm

(4200 SS + 155 NLE + 175 LE) magnet center around 2250 from NLE

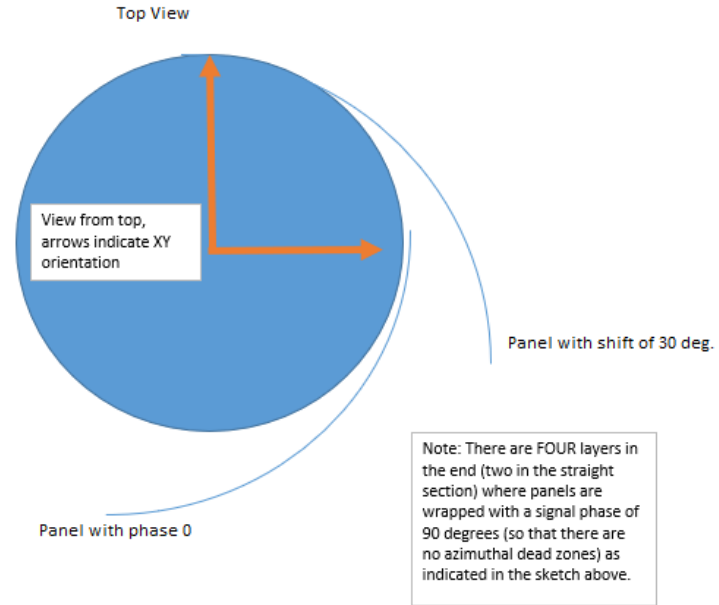
→ Start of NLE of coil is  $2100 + 155 + 96 = 2351$  mm below quench antenna center or ~50 mm above QA  $z=0$  (i.e. subtract 50mm from QA segment name to get quench  $z$ -position wrt NLE coil)

# Z - Antennas

Overlapping panels are mechanically shifted by 30 deg. to preclude angular dead zones

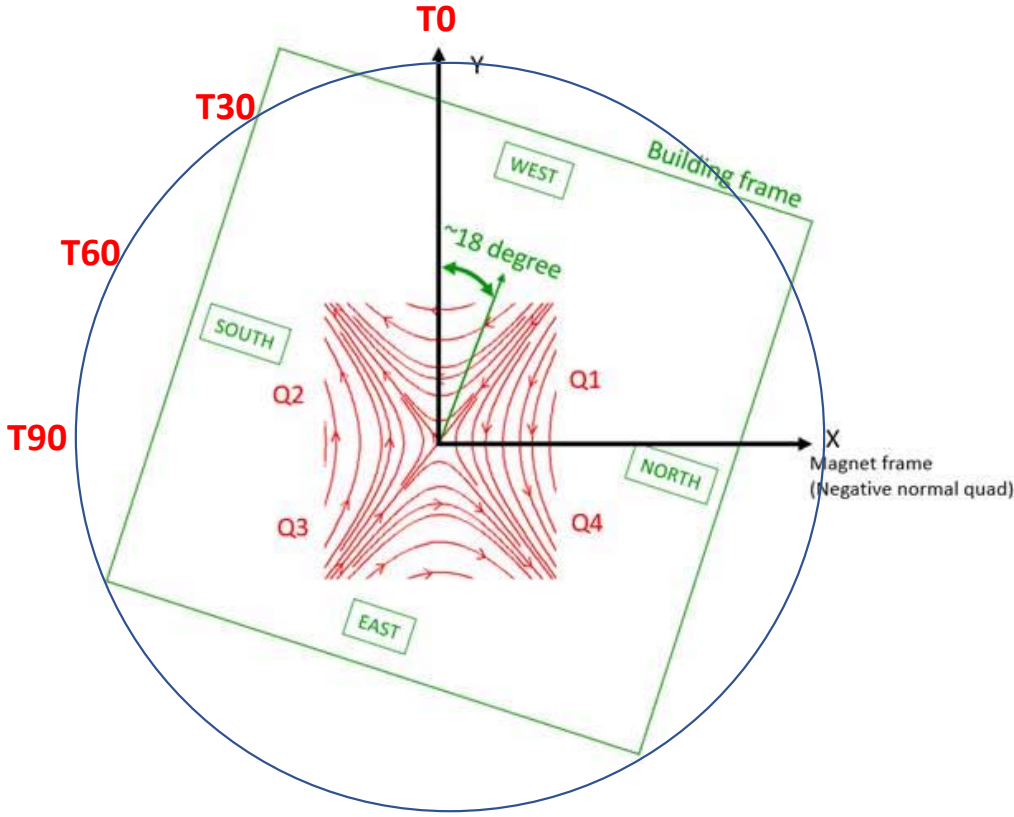
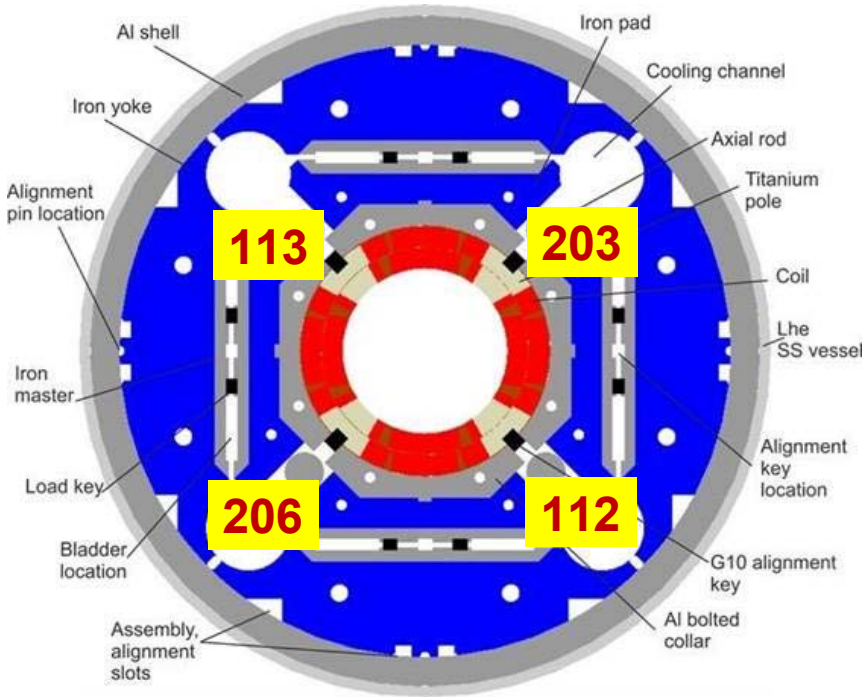


z(mm)	shift 30°	shift 0
0		z0
25		z0 z25
50	z50	z0 z25
75	z50 z75	z0 z25
100	z50 z75 z100	z25
125	z50 z75 z100 z125	
150	z150 z75 z100 z125	
175	z150 z175 z100 z125	
200	z150 z175 z200 z125	
225	z150 z175 z200 z225	
250	z250 z175 z200 z225	
275	z250 z275 z200 z225	
300	z250 z275 z300 z225	
325	z250 z275 z300 z325	
350	z350 z275 z300 z325	
375	z350 z375 z300 z325	
400	z350 z375 z400 z325	
425	z350 z375 z400 p2	
450	z450 z375 z400	
475	z450 p4 z400	
500	z450 z500	
525	z450 z500	
550	z550 z500	
575	z550 z500 p1	
600	z550 z600 p3	
625	z550 z600	
650	z650 z600	
675	z650 z600	



# Theta Antennas

Quench Antenna T0 placed along Y-axis, s.t. Coil 113 lies between antenna signals T0 and T90



MQXFA04 08-29-1102\_Fast Logger Quench 1

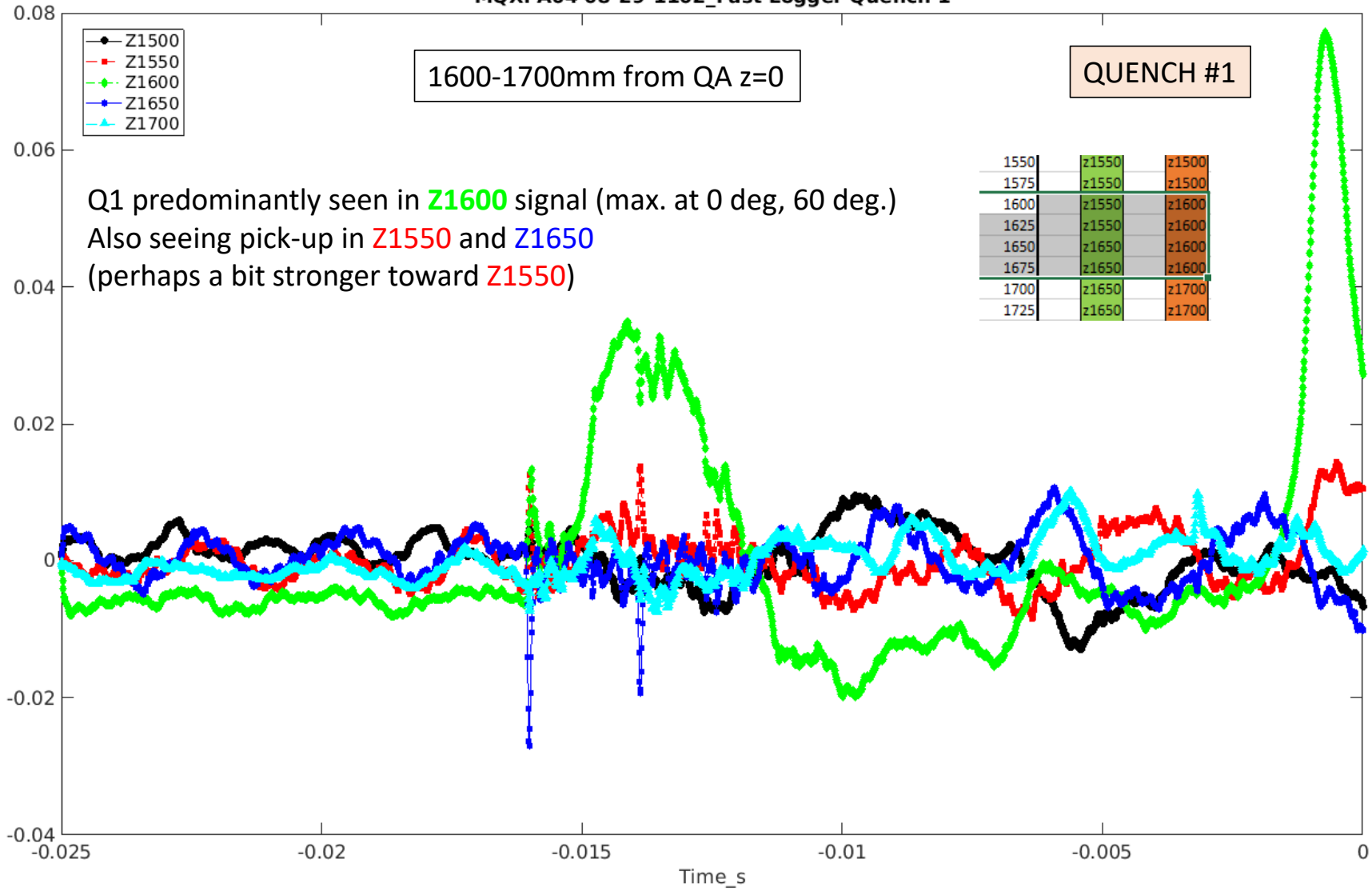
1600-1700mm from QA z=0

QUENCH #1

- Z1500
- Z1550
- Z1600
- Z1650
- Z1700

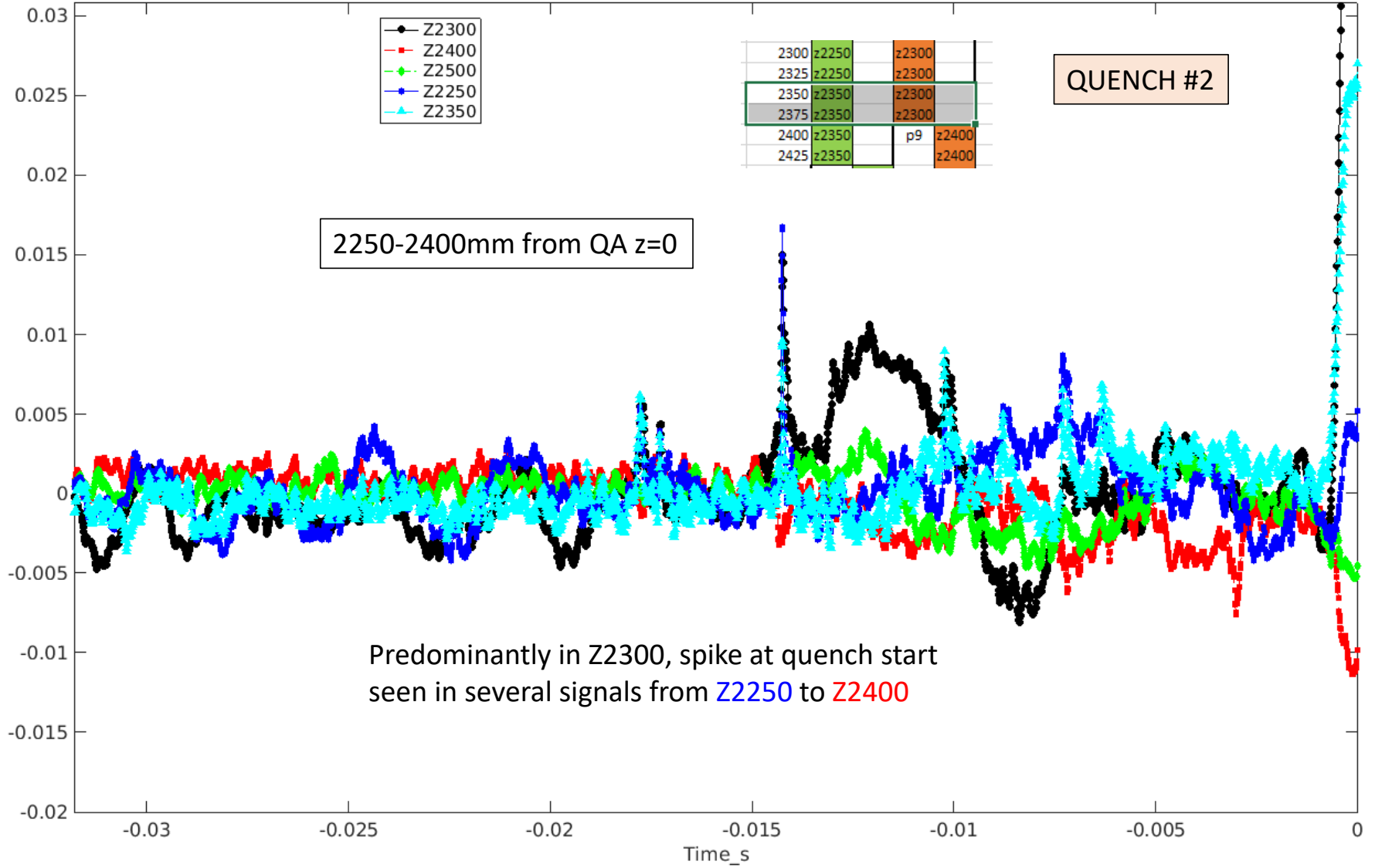
Q1 predominantly seen in Z1600 signal (max. at 0 deg, 60 deg.)  
Also seeing pick-up in Z1550 and Z1650  
(perhaps a bit stronger toward Z1550)

1550	z1550	z1500
1575	z1550	z1500
1600	z1550	z1600
1625	z1550	z1600
1650	z1650	z1600
1675	z1650	z1600
1700	z1650	z1700
1725	z1650	z1700

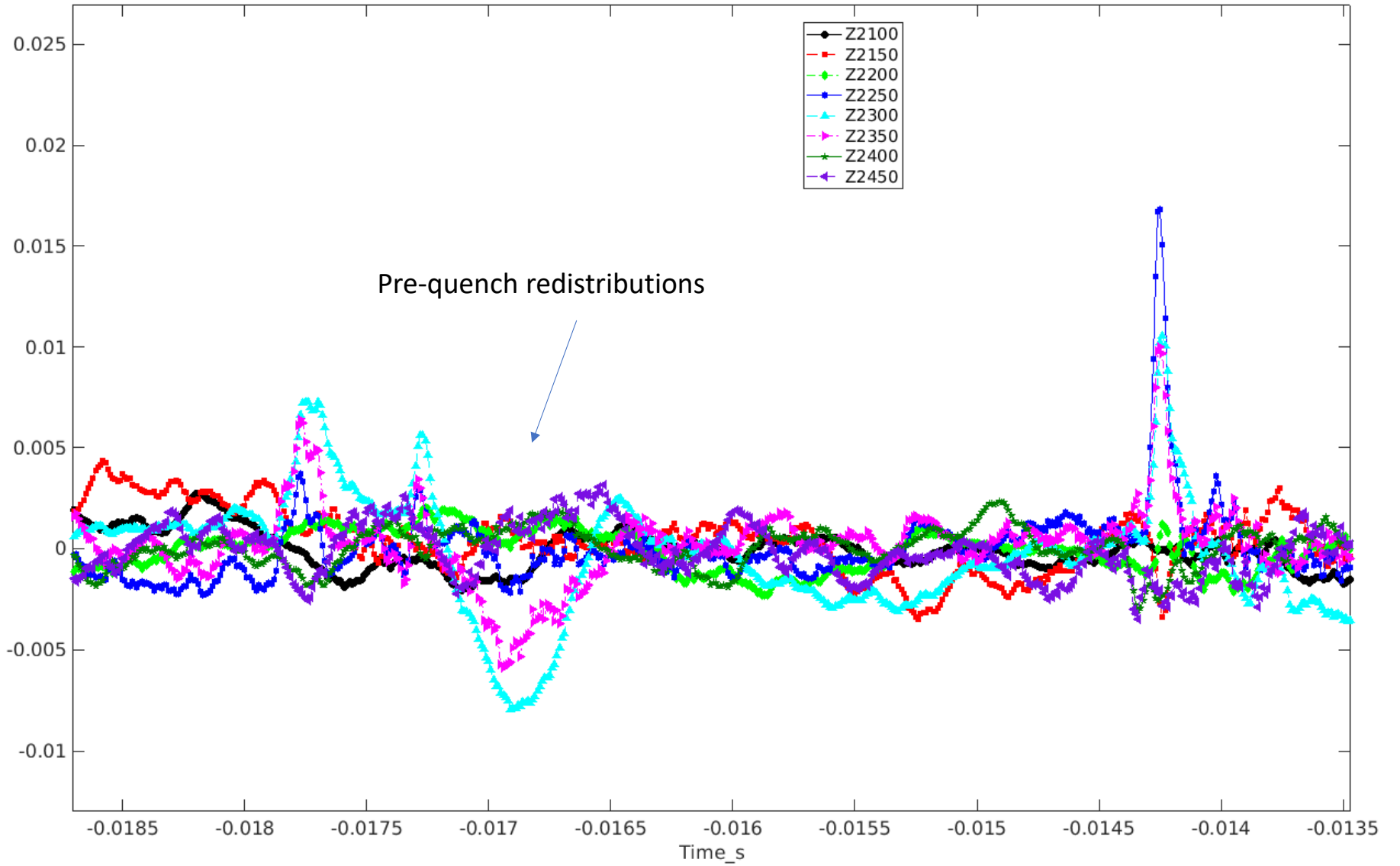




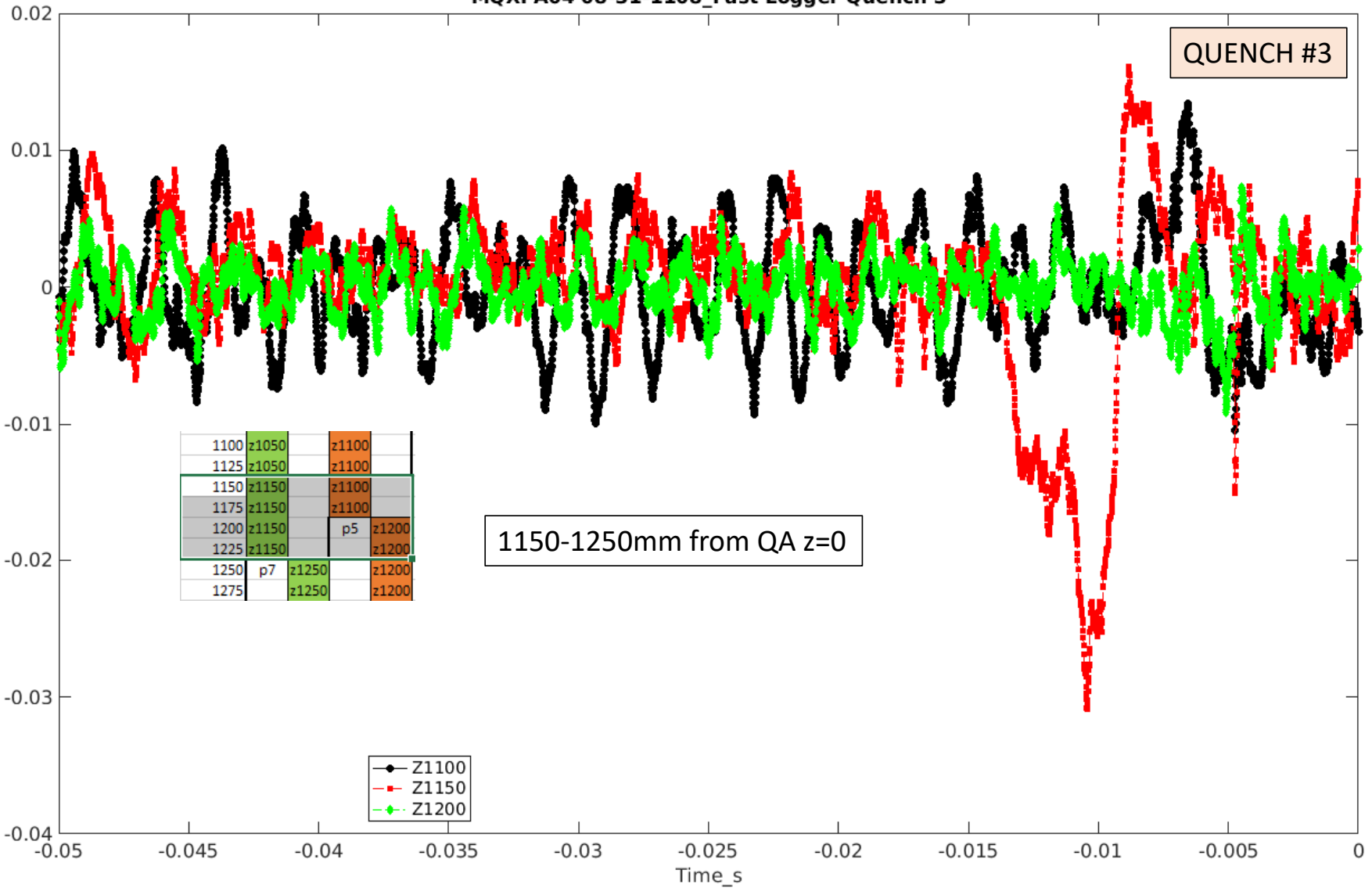
### MQXFA04 08-29-1629\_Fast Logger Quench 2



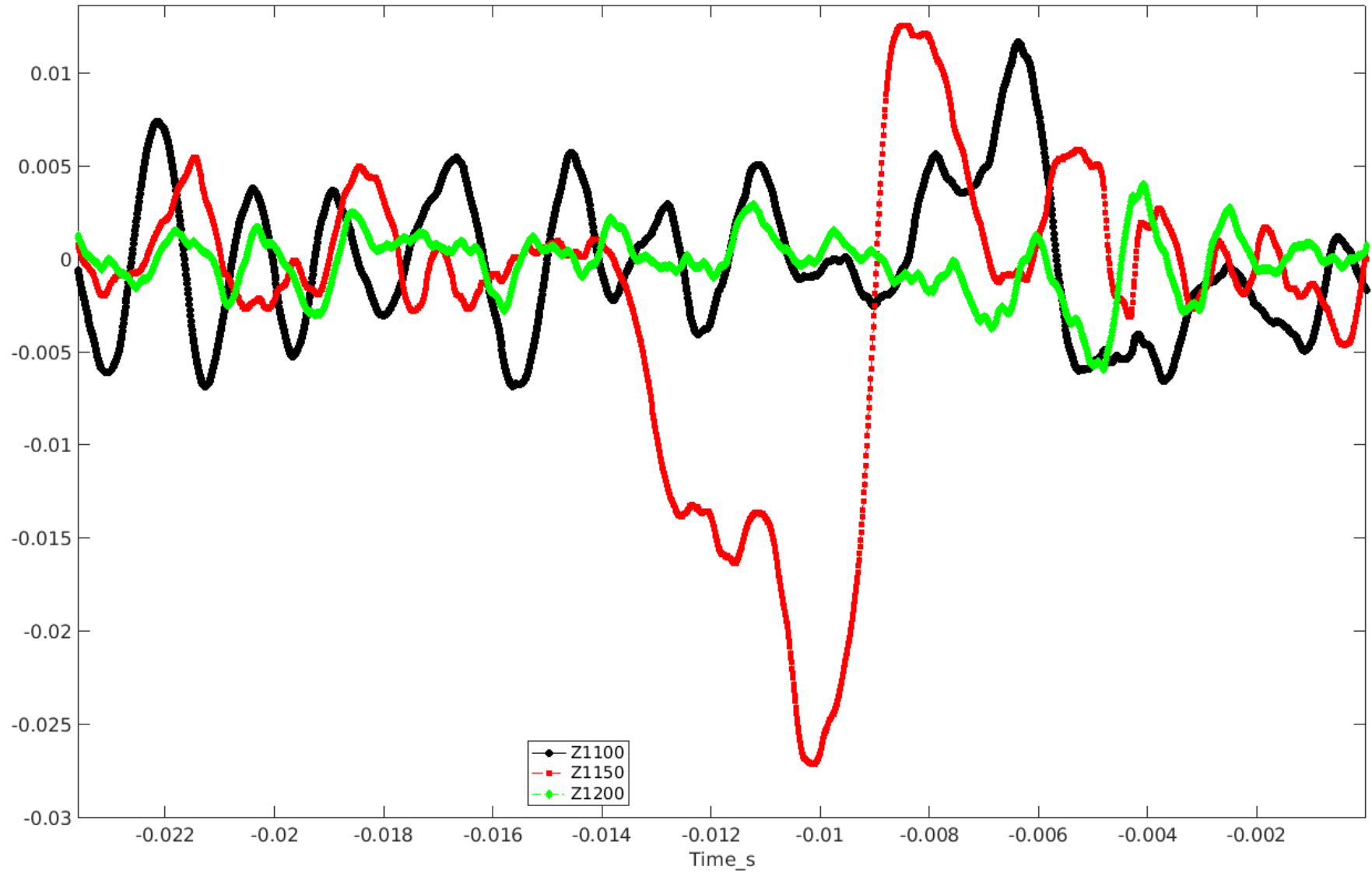
MQXFA04 08-29-1629\_Fast Logger Quench 2



MQXFA04 08-31-1108\_Fast Logger Quench 3



MQXFA04 08-31-1108\_Fast Logger Quench 3



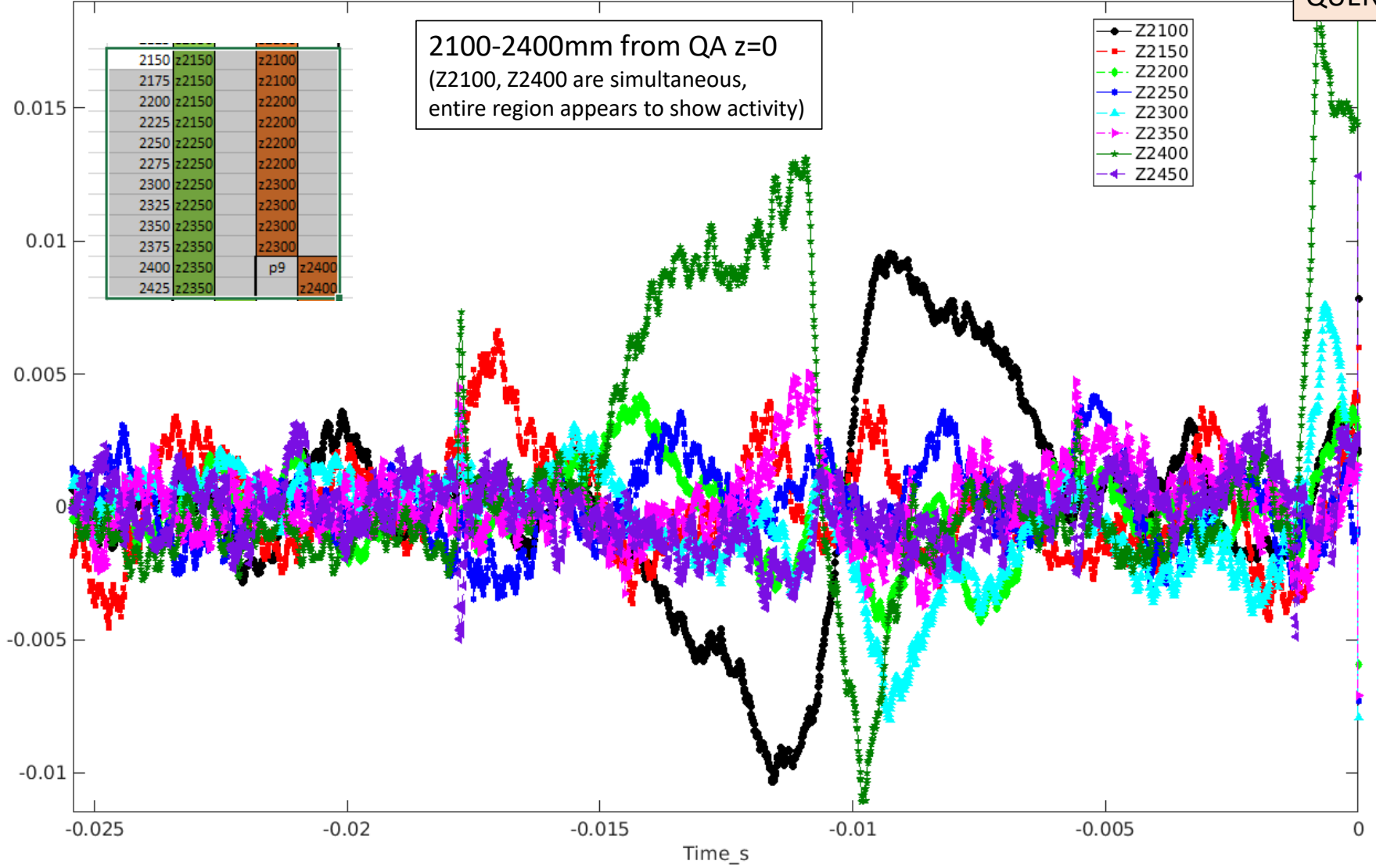
MQXFA04 09-01-1517\_Fast Logger Quench 4

QUENCH #4

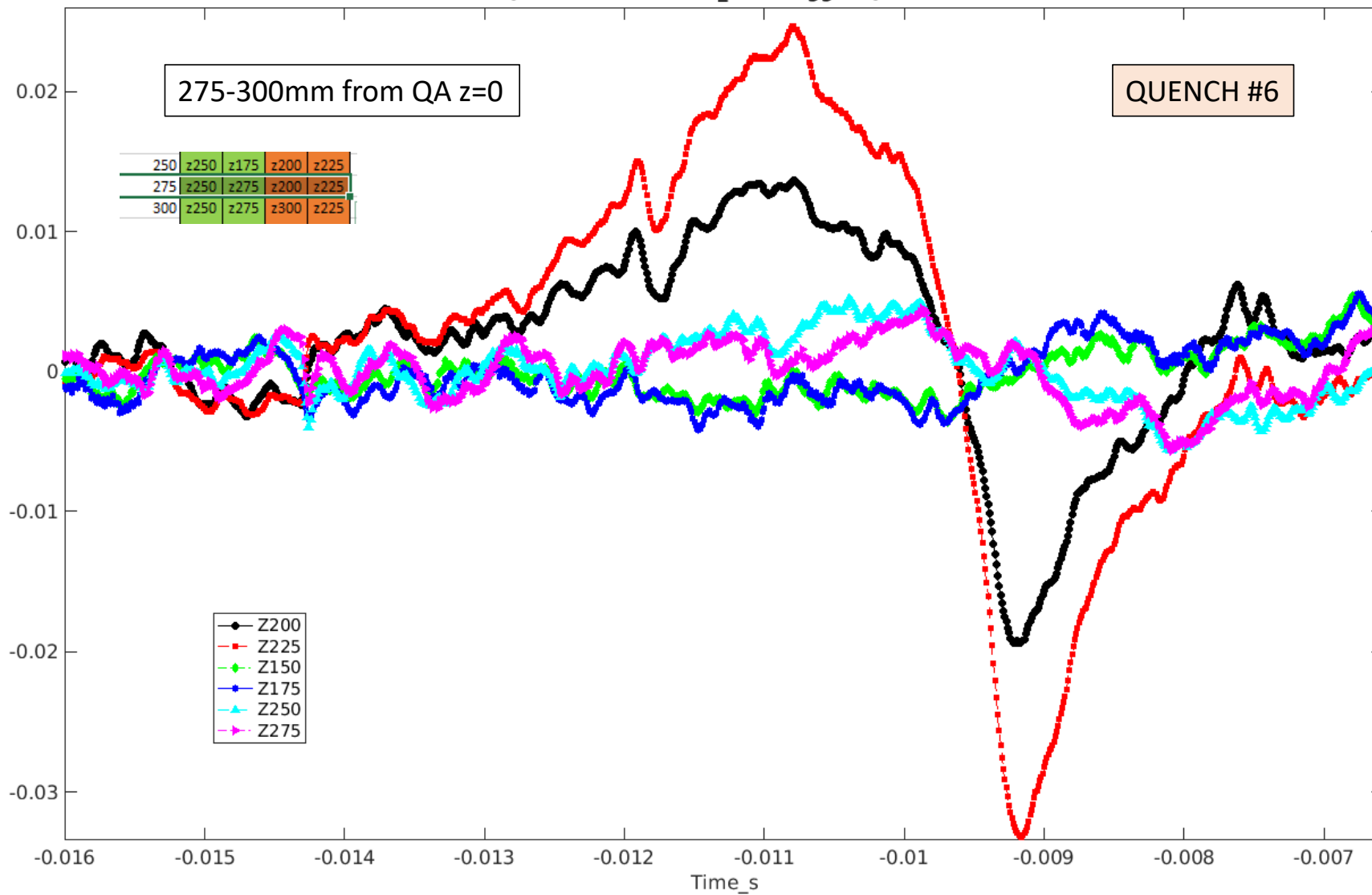
2100-2400mm from QA z=0  
(Z2100, Z2400 are simultaneous,  
entire region appears to show activity)

2150	z2150	z2100
2175	z2150	z2100
2200	z2150	z2200
2225	z2150	z2200
2250	z2250	z2200
2275	z2250	z2200
2300	z2250	z2300
2325	z2250	z2300
2350	z2350	z2300
2375	z2350	z2300
2400	z2350	p9 z2400
2425	z2350	z2400

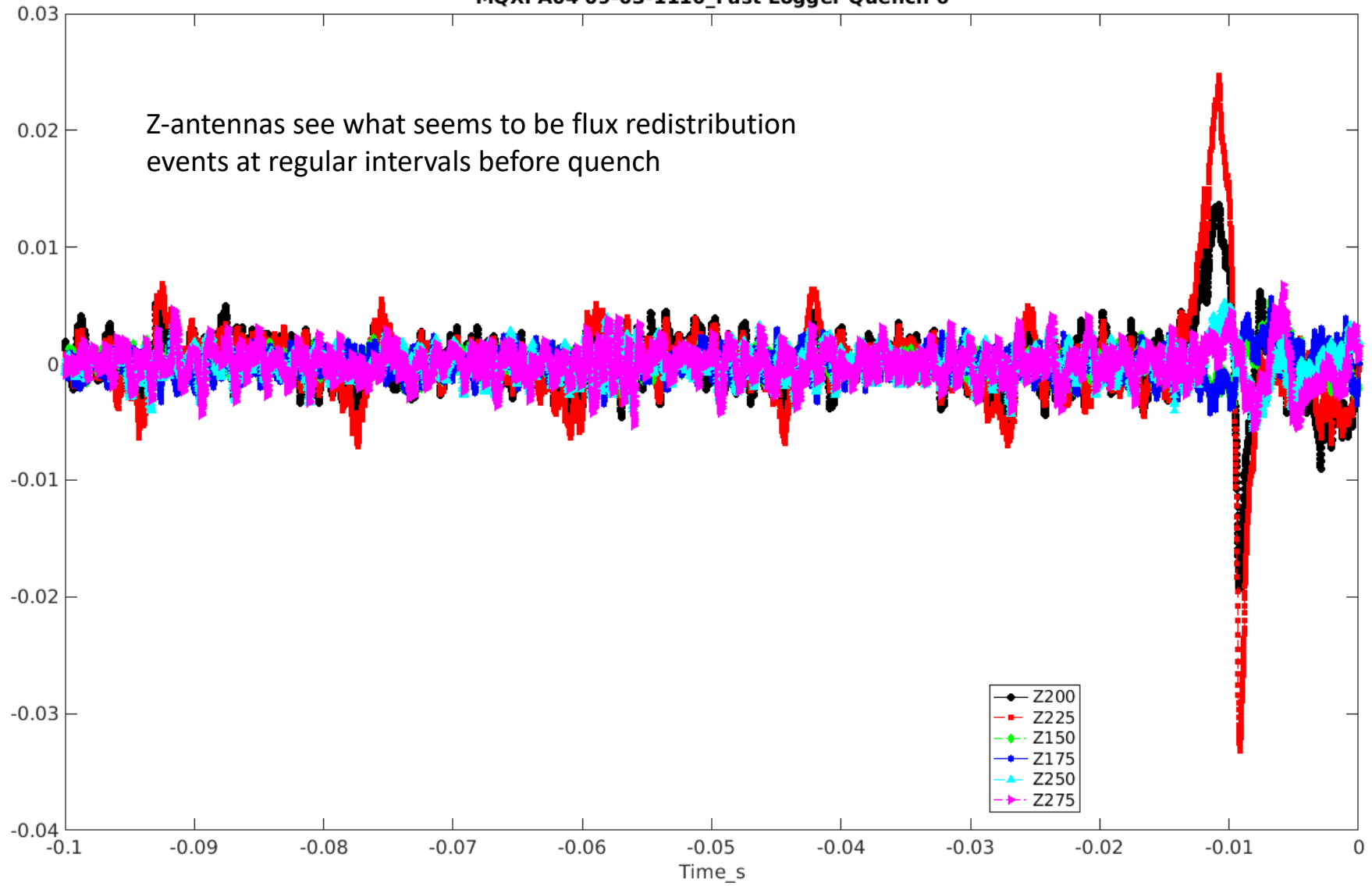
- Z2100
- Z2150
- ◆ Z2200
- ★ Z2250
- ▲ Z2300
- ▼ Z2350
- ✱ Z2400
- ◇ Z2450



MQXFA04 09-03-1110\_Fast Logger Quench 6

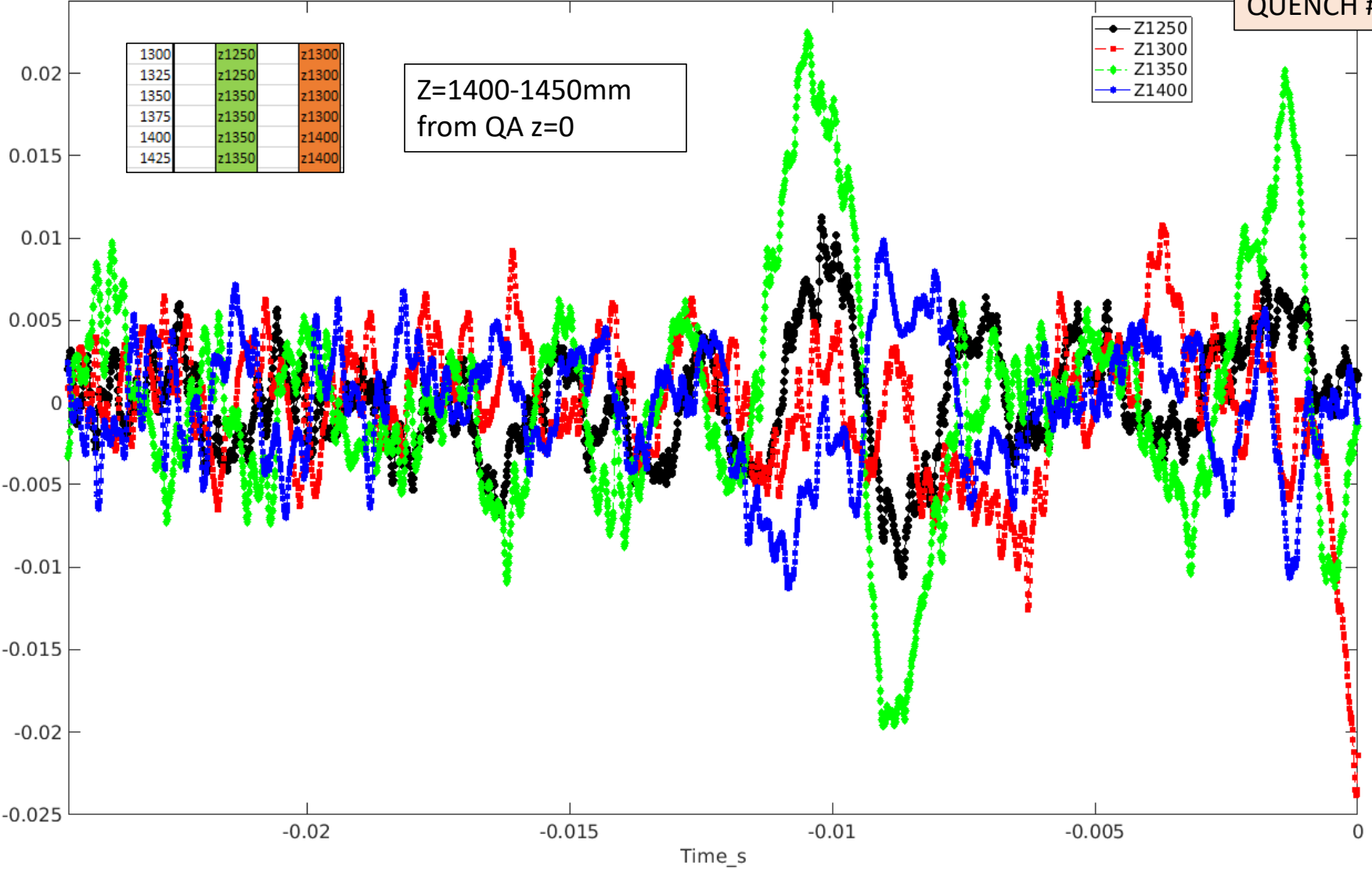


MQXFA04 09-03-1110\_Fast Logger Quench 6



MQXFA04 09-14-1036\_Fast Logger Quench 8

QUENCH #8 (4.5K)





## Quench Location Summary Table

1. 1550-1650mm from coil end
2. 2200-2350mm
3. 1100-1200mm
4. 2050-2350mm
- 5.
6. 225-250mm
- 7.
8. 1350-1400mm

## Vtap coil locations

1.  $I_Q = 15125.63 \text{ A}$  Coil 113 Inner Pole Turn SS
2.  $I_Q = 15649.56 \text{ A}$  Coil 113 Inner Pole Turn SS + RES
3.  $I_Q = 15944.96 \text{ A}$  Coil 113 Inner Pole Turn SS + multiturn
4.  $I_Q = 15608.21 \text{ A}$  Coil 113 Inner Pole Turn SS + multiturn
5.  $I_Q = 16162.04 \text{ A}$  Coil 203 Inner Pole Turn + multiturn
6.  $I_Q = 16343.87 \text{ A}$  Coil 113 Inner Pole Turn near RE
7. (4.5K)  $I_Q = 16372.39 \text{ A}$  Coil 112 (Q4) A2-A7 inner layer pole turn + multiturn (lost taps A3-A6)
8. (4.5K)  $I_Q = 16423.25 \text{ A}$  Coil 113 (Q2) A2-A6 inner layer pole turn + multiturn (lost taps A3-A5)

Theta antennas are also seeing the quenches (except quench #4 for some reason)

- Still trying to understand these
- One example will be shown for Quench 6

MQXFA04 09-03-1110\_Fast Logger Quench 6

