Cornell High-Q update

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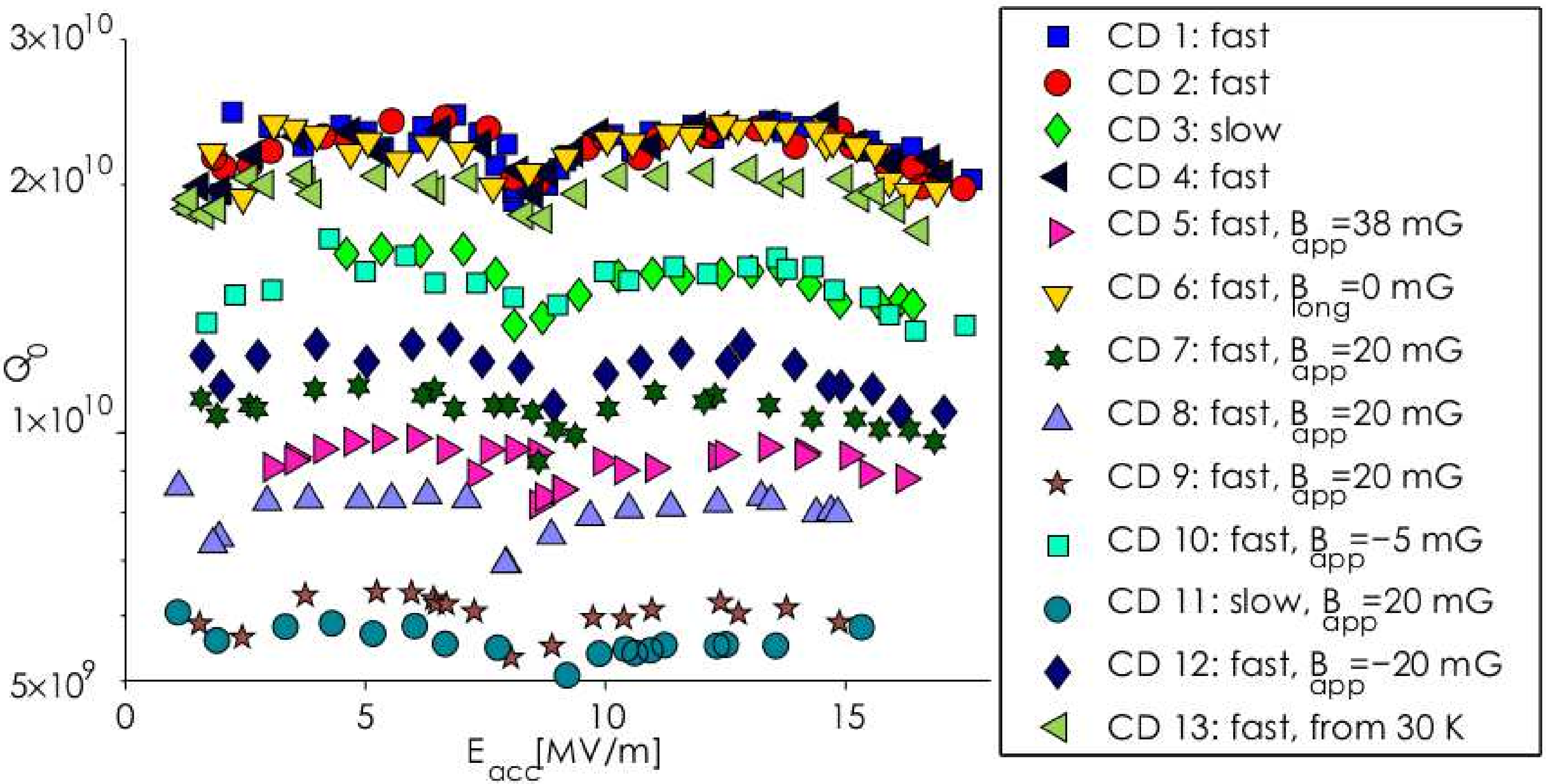
HTC9-3 results at Cornell AES018

Short history

- ❑ Processed and VT at Cornell.
- ❑ Sent to FNAL, helium jacket weld.
- ❑ HTS test at FNAL.
- ❑ Sent to Cornell, re-HPR and reassembled.
- ❑ Installed 50 turns of wire for solenoid on helium jacket.
- ❑ HTC test at Cornell.

HTC9-3, 2.0 K Q vs E



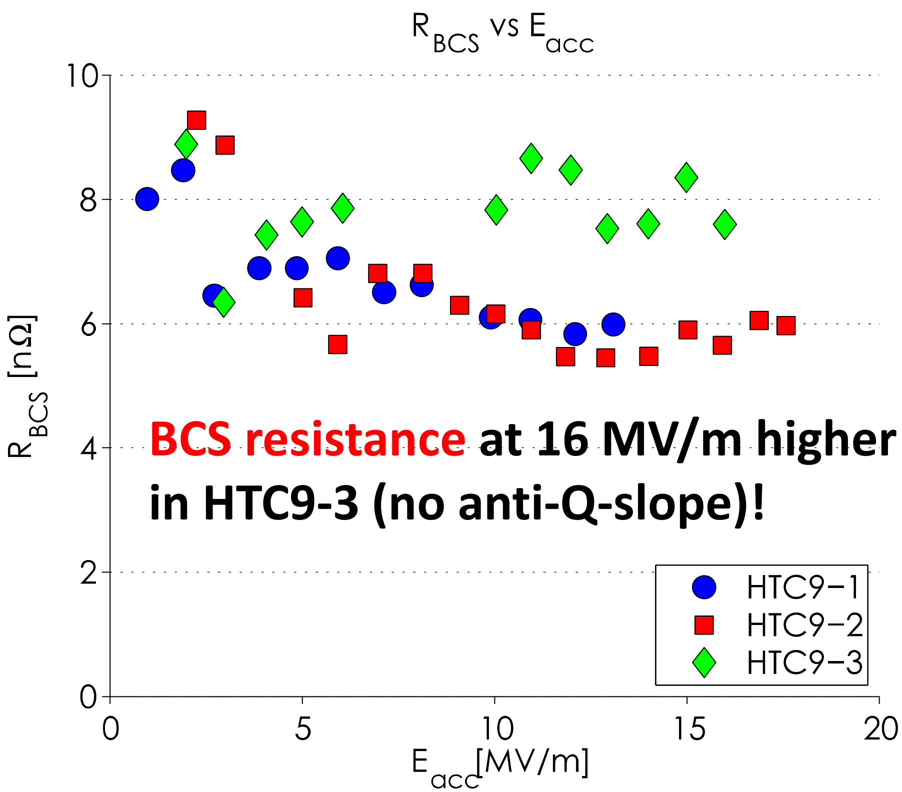
HTC9-3, Testing Overview

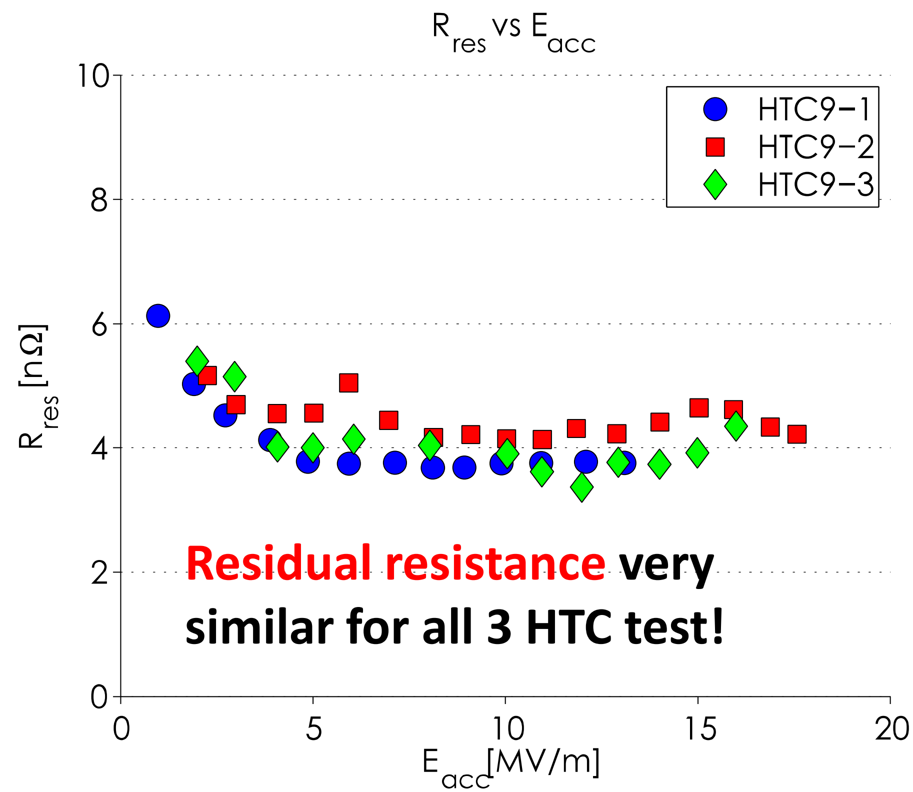
Cool Down	Solenoid On	Max ΔT_{horiz} [K]	Max ΔT_{vert} [K]	B_{long} (10 K) [mG]	B_{perp} (10 K) [mG]	Q_0 (2 K, 16 MV/m)	R_{res} (16 MV/m) [nΩ]
1	No	N/A	N/A	6.2	-0.7	2.2×10^{10}	3.7
2	No	19.1	76.9	7.1	3.4	2.1×10^{10}	4.4
3	No	0.3	2.7	-2.5	3.1	1.5×10^{10}	9.9
4	No	4.4	40.1	5.7	1.8	2.1×10^{10}	3.9
5	Yes	32.9	44.0	38.2	3.0	8.8×10^{9}	22.7
6	No	6.7	69.6	0.03	2.5	2.0×10^{10}	4.4
7	Yes	9.9	61.8	20.0	4.5	1.0×10^{10}	18.9
8	Yes	3.9	38.2	20.0	0.5	8.0×10^{9}	26.4
9	Yes	1.9	16.3	20.0	-0.5	5.9×10^{9}	36.5
10	Yes	4.6	57.1	Approx. -5.0	2.5	1.4×10^{10}	9.8
11	Yes	0.9	7.0	20.0	2.2	5.8×10^{9}	42.6
12	Yes	9.3	71.3	-20.0	5.2	1.1×10^{10}	15.6
13	No	4.9	18.8	-0.02	3.1	1.9×10^{10}	5.7

Note: Temperature gradients are measured by sensors near the top and and bottom of the LHe vessel end walls, and not directly on the cavity.

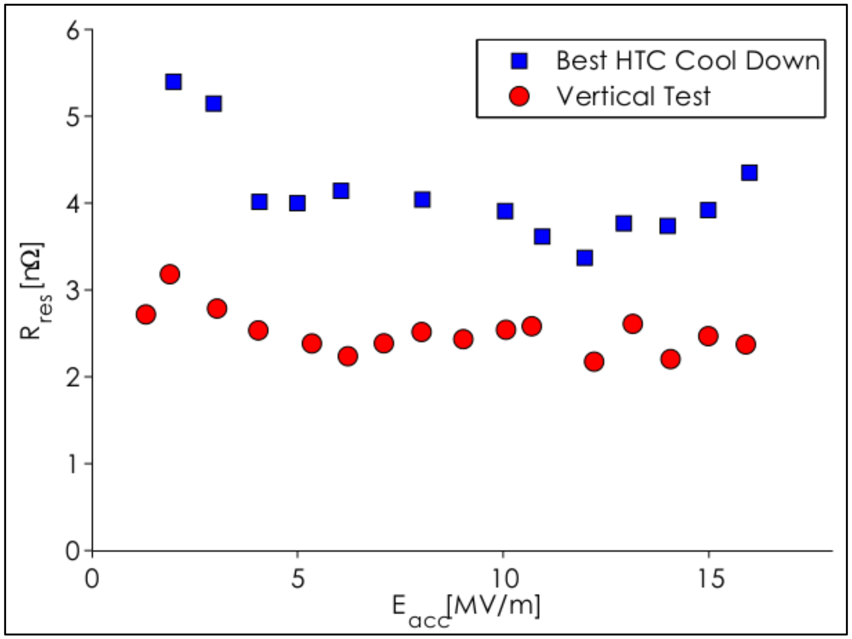
Changes from VT to HTC

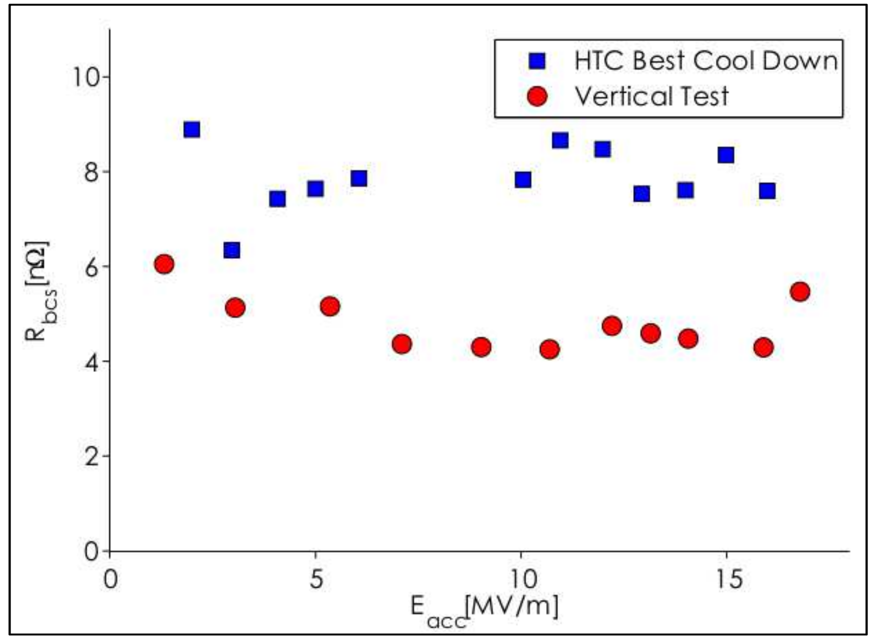
Cavity	Lhe Tank	HTC Test	VT Result	HT Result (cool down from 80K)	$\Delta R_{VT\text{->}HT}$ [nΩ]
TB9ACC012	ILC	HTC9-1	$(3.5\pm0.4)\times10^{10}$	$(2.8\pm0.3)\times10^{10}$	2 ± 2
TB9AES011	ILC	HTC9-2	$(3.4\pm0.3)\times10^{10}$	$(2.7\pm0.3)\times10^{10}$	2 ± 2
TB9AES018	LCLS-II	HTC9-3	$(3.1\pm0.3)\times10^{10}$	$(2.2\pm0.2)\times10^{10}$	4 ± 2





Why Lower Q?

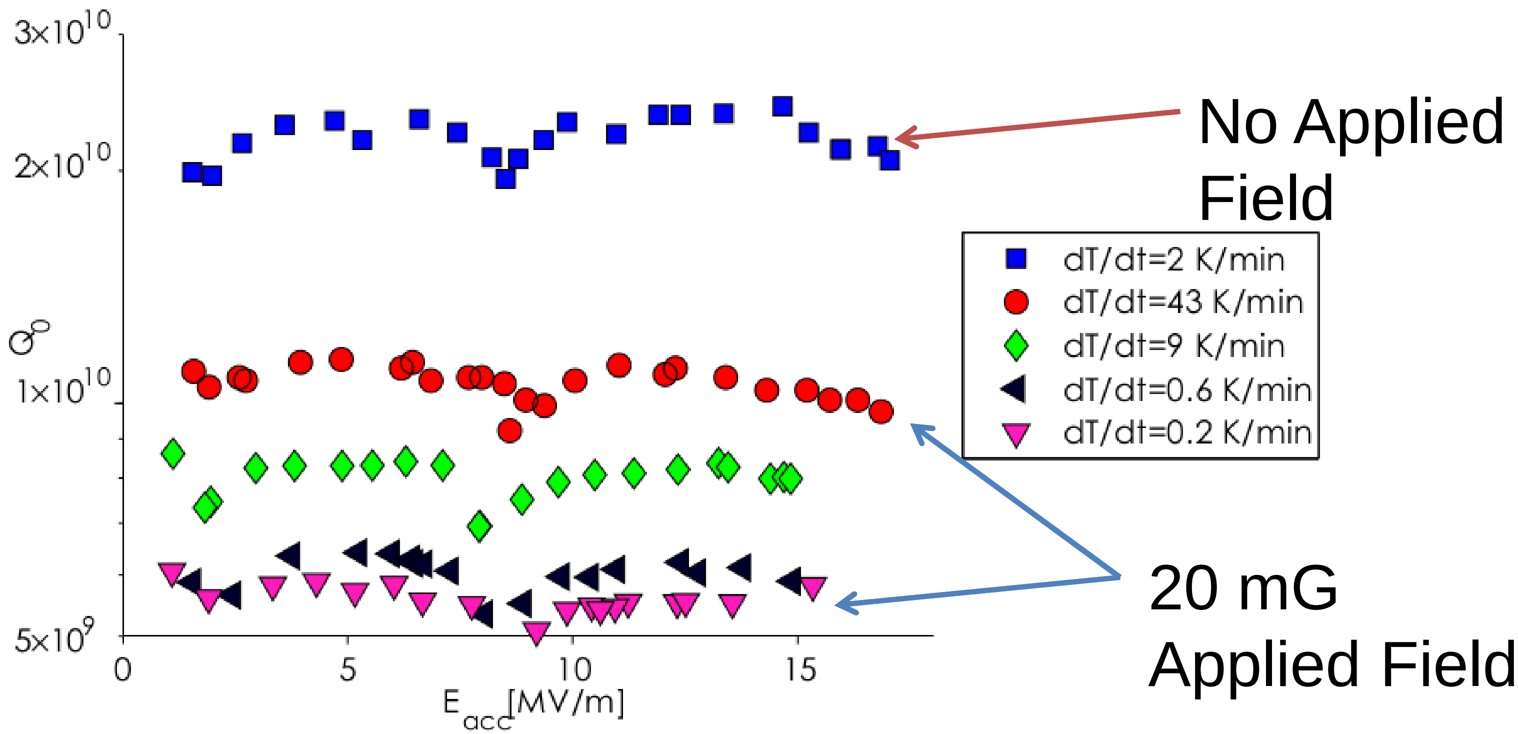




- Uncertainty on values: 1 to 2 nOhm.
- Increase in residual resistance from VT->HTC: 1 to 2 nOhm.
- Increase in BCS resistance at 16 MV/m from VT->HTC: 2 to 3 nOhm.

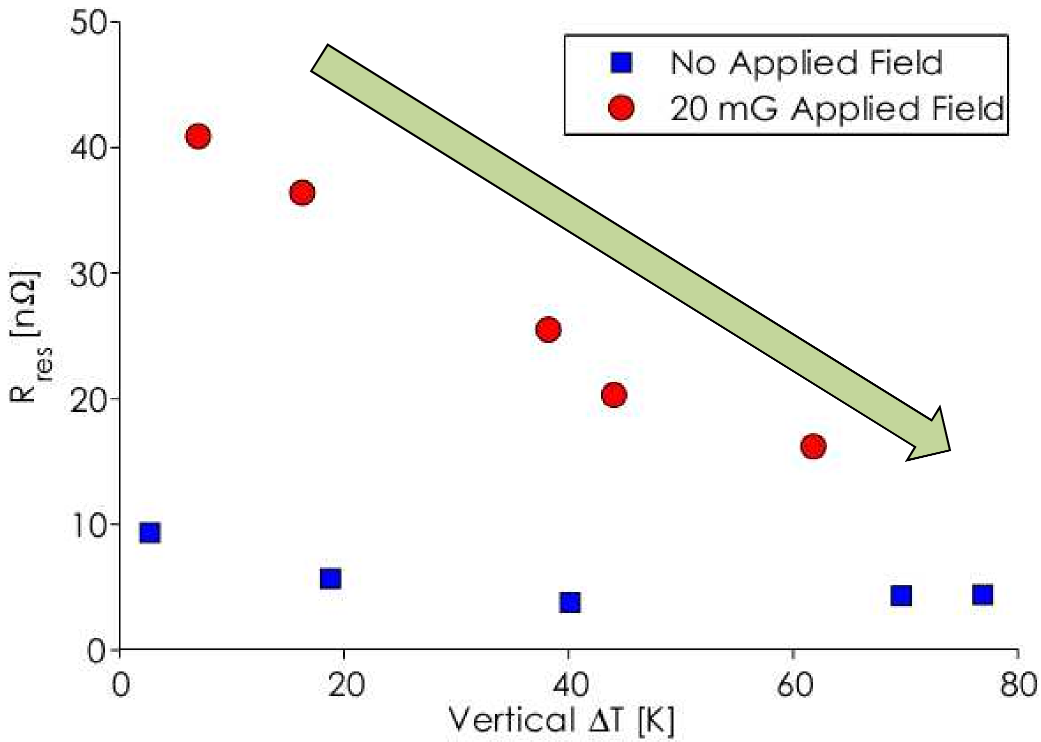
- Residual resistance is higher in HTC.
- BCS resistance has also increased
  - Degradation somehow due to tank welding?
  - Local heating at high fields (e.g. due to trapped flux, as suggested by FNAL)?

Magnetic Field Study



- Slow cool down (100% flux trapping) gives an additional ~2 nΩ/mG.
- Fast cool down gives an additional ~0.7 nΩ/mG.

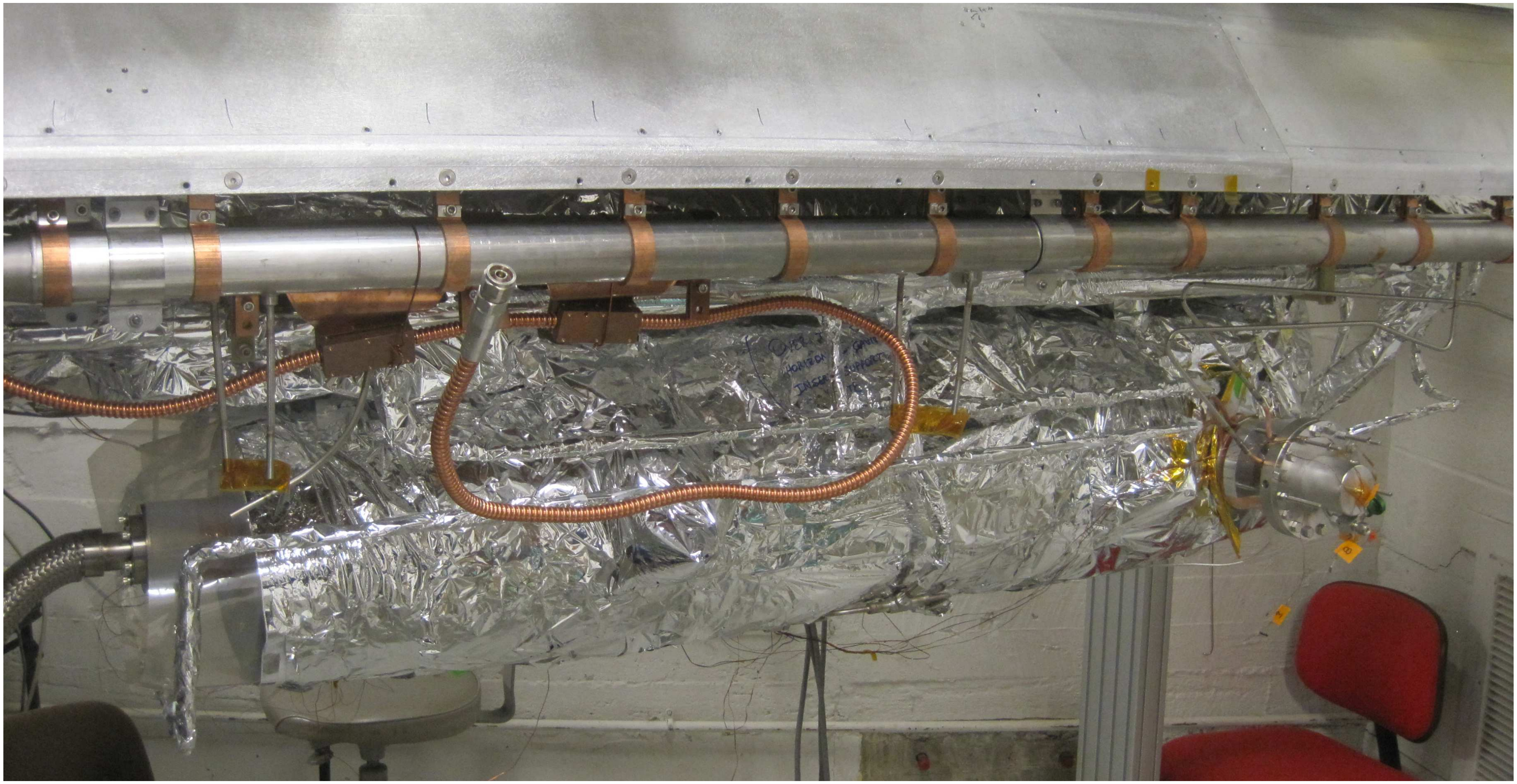
Effects of Cool Down on R_{res}



- As shown in previous HTC tests, **large vertical temperature gradients** give more flux expulsion and **lower residual resistance**.

- Fast cool downs without applied field show now further reduction in R_{res} for $\Delta T > 40$ K.
- Remaining residual resistance not from trapped flux or from flux that does not get pushed out, even with very fast cool down (see FNAL suggestion)?

HTC9-4, AES018 w/ coupler

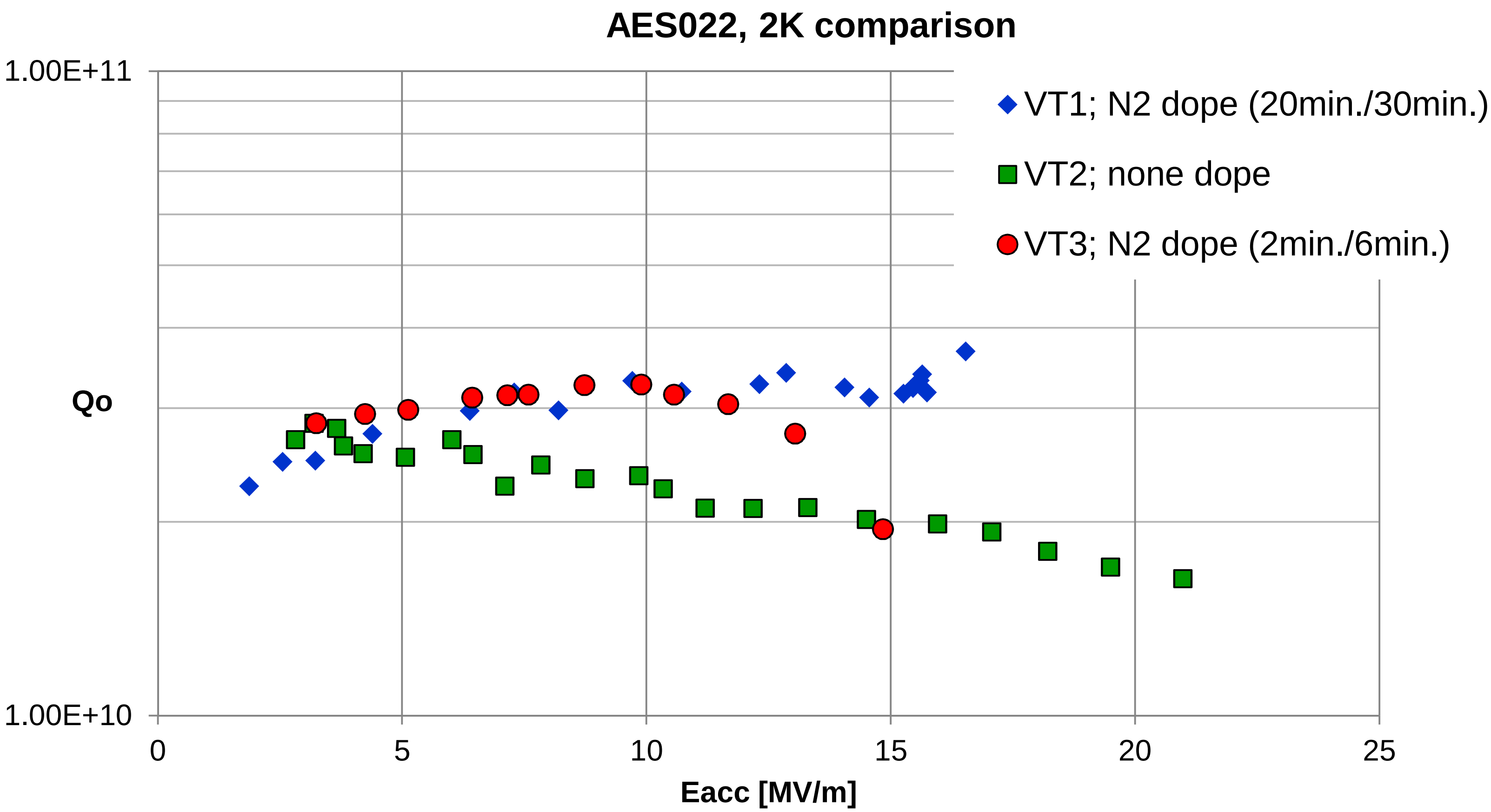


Preparation is on going….

Recent 9-cell VT results
AES022

Quench localization w/ T-map before/after N2 doping

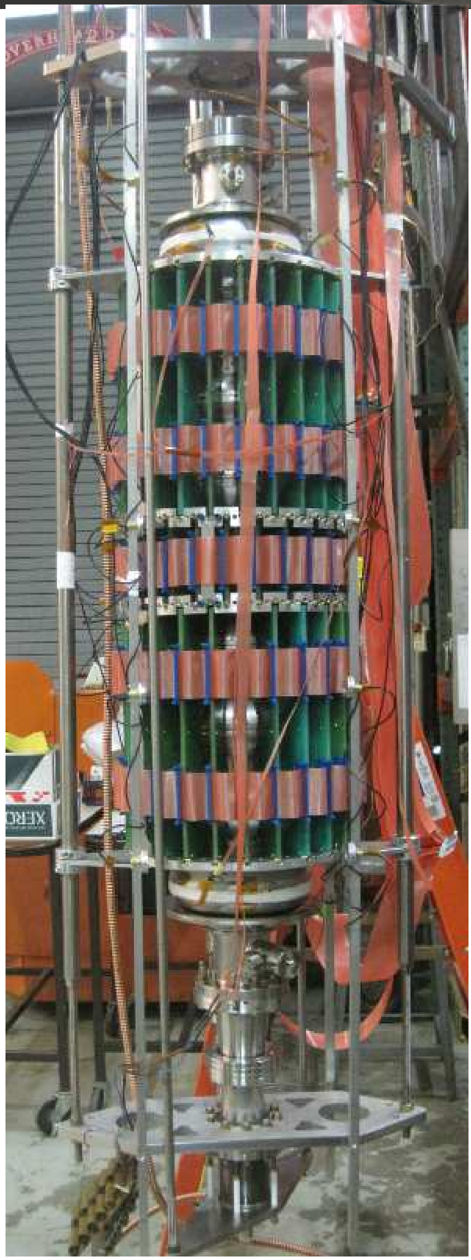
VT, 2K results,



	Process
VT1	Bulk VEP(120um) + 800C bake + N2 dope (20min./30min.)+ light VEP (14um)
VT2	Re-VEP(50um) + 800C bake + light VEP (5um) + 120C bake
VT3	Re-VEP(10um) + 800C bake + N2 dope (2min./6min.) + light VEP (5um)

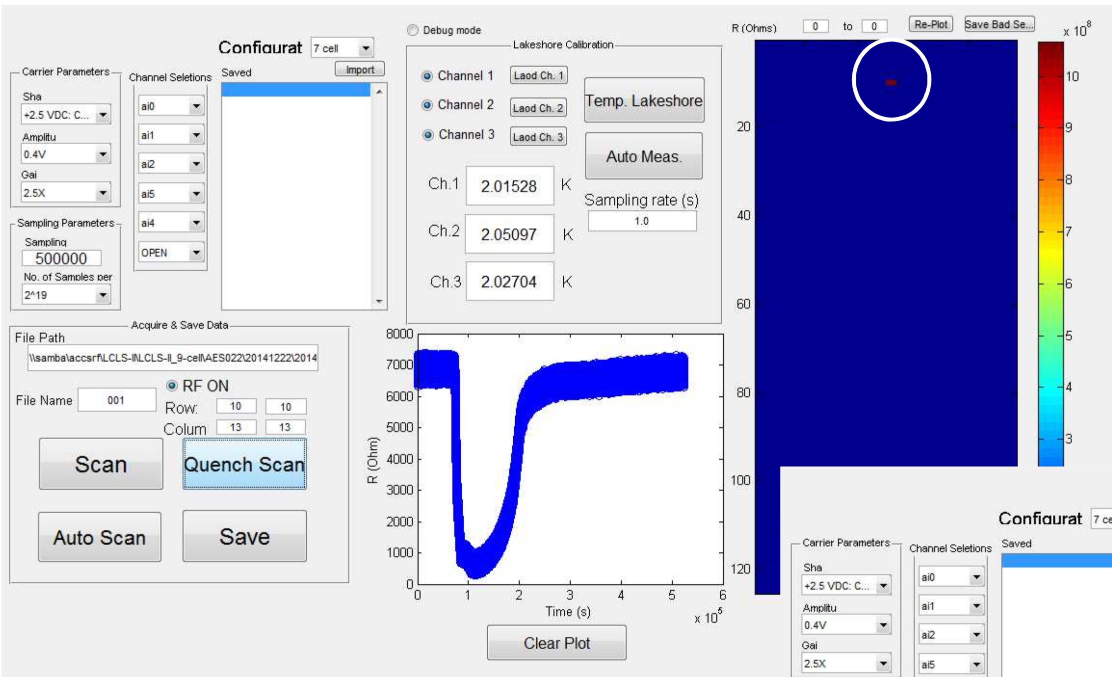
Quench localization by T-map (1)

- T-map boards covered center 7-cell, no T-map on end cells.
- OSTs are installed to cover end cells.

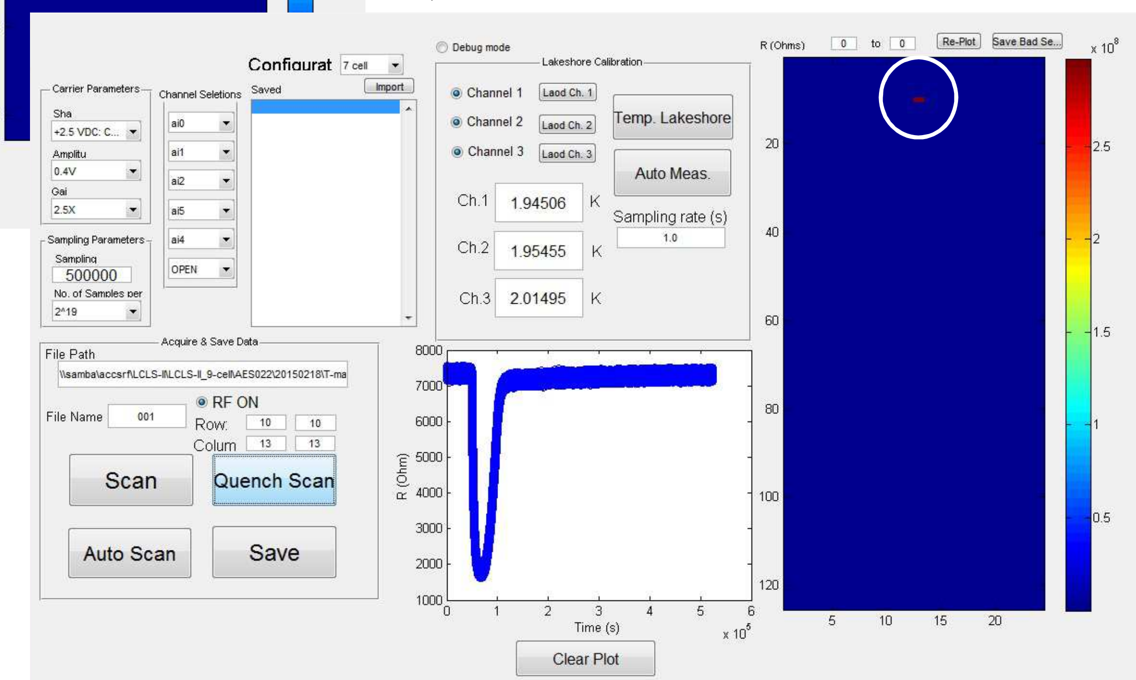


Quench localization by T-map (2)

VT2; Quench spot at 23MV/m



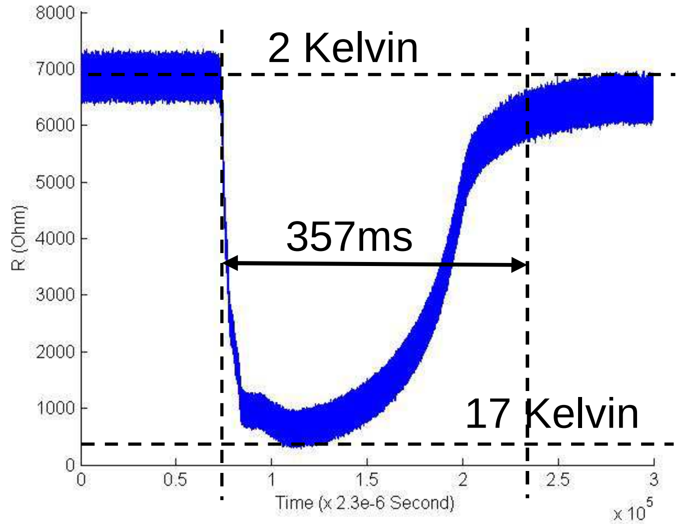
VT3;Quench spot at 15MV/m



Same quench spot before/after N2-dope.

Quench localization by T-map (3)

Signal profile (VT2)



Defect found at the location.

OST predicts same quench location with T-map