

TEST note of 1.3GHz single-cell cavity 10th VT in A0

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The brief history of this cavity:

1.3GHz single-cell Cavity TE1AES004 was manufactured by AES Corporation, and BCP'd 107.m; EP'd 65.m; and baked 120C 48 hrs. A huge pit was found by Kyoto inspection machine. The 5th, 6th, 7th and 8th tests in IB1 and A0 showed the cavity quenched at $E_{acc}=37\sim39\text{MV/m}$ and non-FE. The 9th VT showed the cavity had FE and the gradient decreased to 32.5MV/m , the main purpose of 10th VT is to test the brand new second sound system in A0, and also to confirm the quenching location traveling when the LHe bath temp is above the λ point. The cavity was kept under vacuum since last vertical test.

The process and test results:

During the E_{acc} vs. Q_0 measurement (Fig1), the X-ray started at $19\sim20\text{ MV/m}$, and first quench happened, after that processing started and several quenches happened. The cavity finally quenched at 33.8 MV/m , and $Q_0=5.72\text{E}9$, this is the FE induced the quench, X-ray radiation level was more than 30000 cpm.

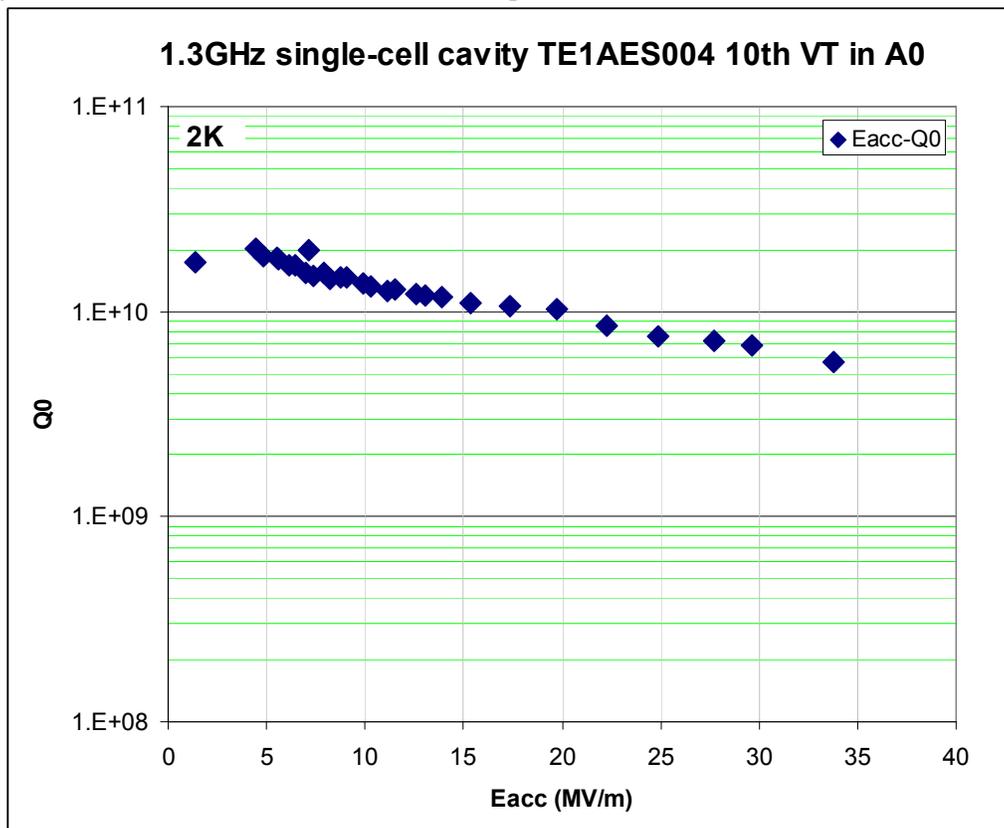


Fig1

Heating of quench location

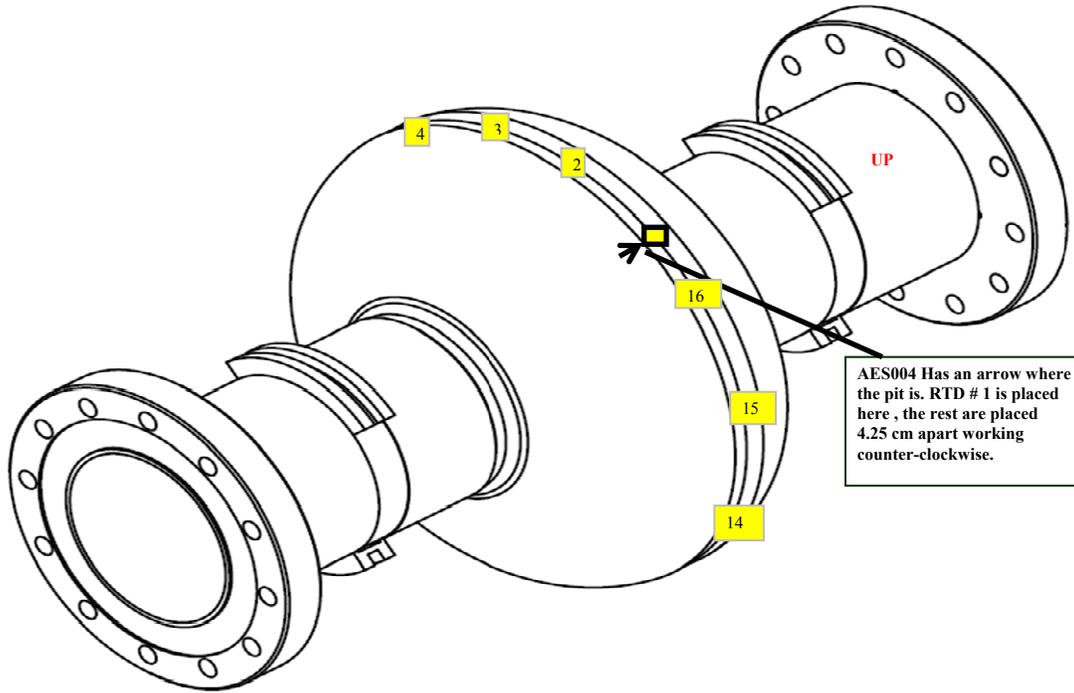


Fig2

We prepared 16 fast thermometers and attached them evenly on the cavity equator where showed as Fig2. We placed RTD#1 right on the pit location. The color code showed in Table1.

Table1: Color codes

Cable1 and Cable2			Cable3 and Cable4		
Ch 1 (FIR)		RTD#1	Ch 1 (FIR)		RTD#9
Ch 2 (FIR)		RTD#2	Ch 2 (FIR)		RTD#10
Ch 3 (FIR)		RTD#3	Ch 3 (FIR)		RTD#11
Ch 4 (FIR)		RTD#4	Ch 4 (FIR)		RTD#12
Ch 5 (FIR)		RTD#5	Ch 5 (FIR)		RTD#13
Ch 6 (FIR)		RTD#6	Ch 6 (FIR)		RTD#14
Ch 7 (FIR)		RTD#7	Ch 7 (FIR)		RTD#15
Ch 8 (FIR)		RTD#8	Ch 8 (FIR)		RTD#16

As showed in Fig3, we first put the cavity at 2K, and it quenched at RTD#13, and RTD#5 detected pre-heating. At 2.2K where is above the λ point, the quench location changed to RTD#12, and RTD#2 showed pre-heating, then we went back to 2K, the cavity quenched at RTD#5, where was pre-heating.

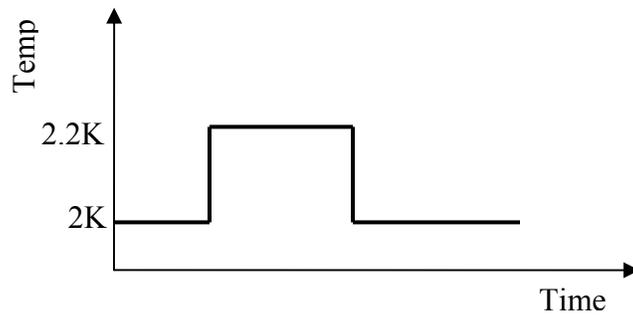
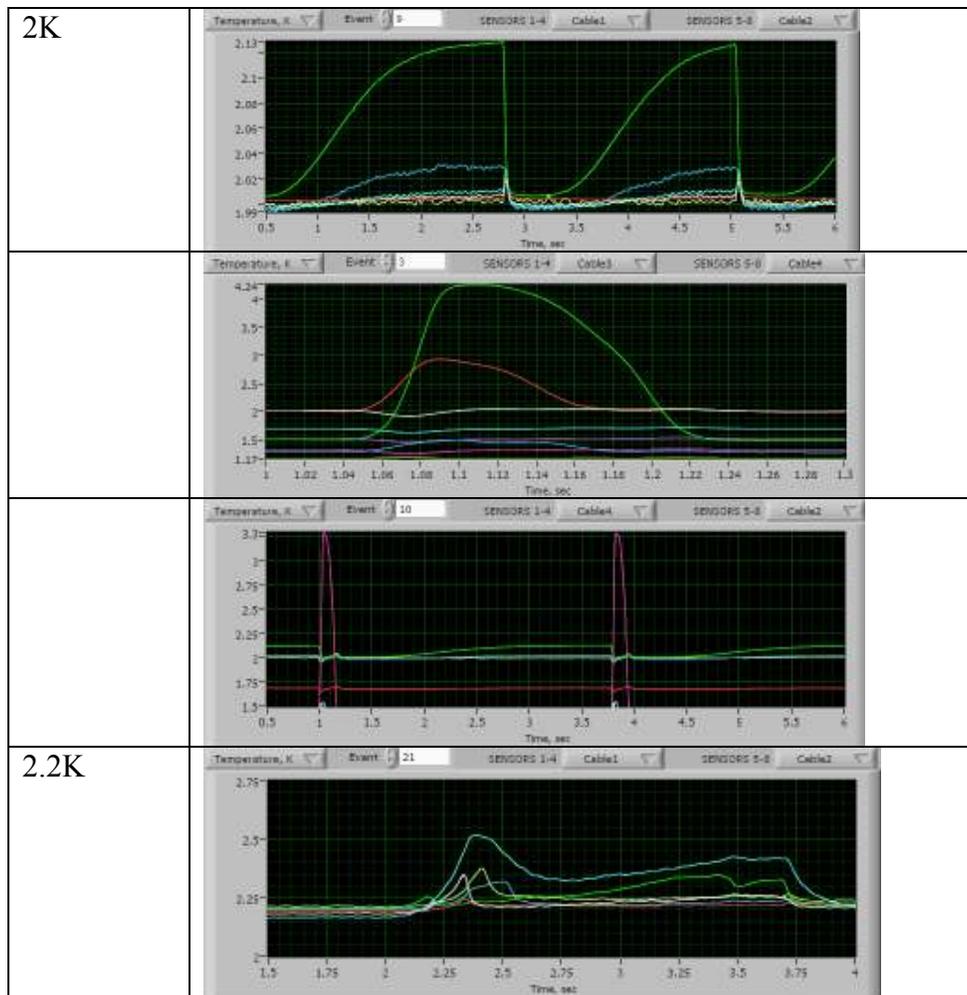
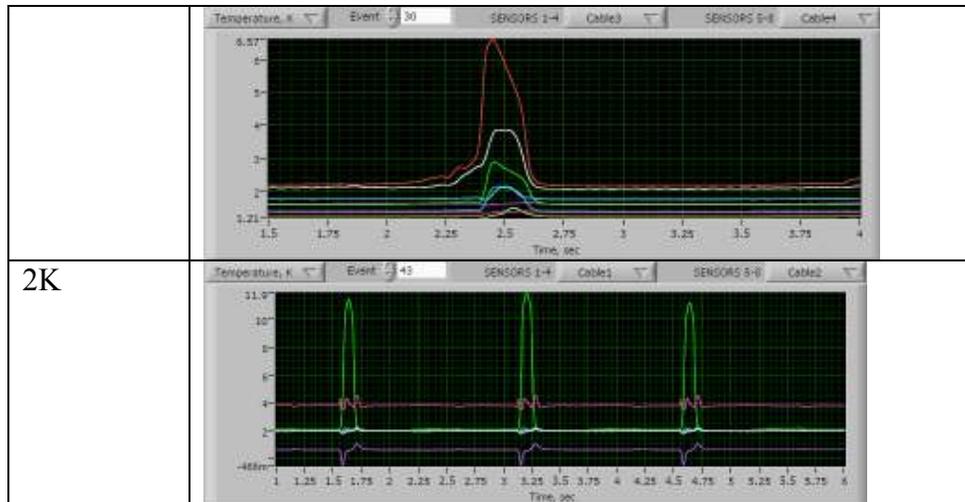


Fig3





Second Sound system

We totally set up 4 Second sound sensors (Fig4), and two of them (#6 and #7) showed quench signals, these two sensors indicated the consistent quench location with thermometers. In Fig 5, the red line was the store energy of cavity, and the dark blue and light blue line were sensor #6 and #7 quench signal. And they are about 4.3 and 10.4 ms delay from the quench moment, the distance from the calculation is supposed to be about 8.77cm and 21.22cm. (Second Sound Wave Velocity = 20.4 m/s @ 1.7K He-II), When the Helium bath temperature went above λ point, the quenching signal was not accompanied.

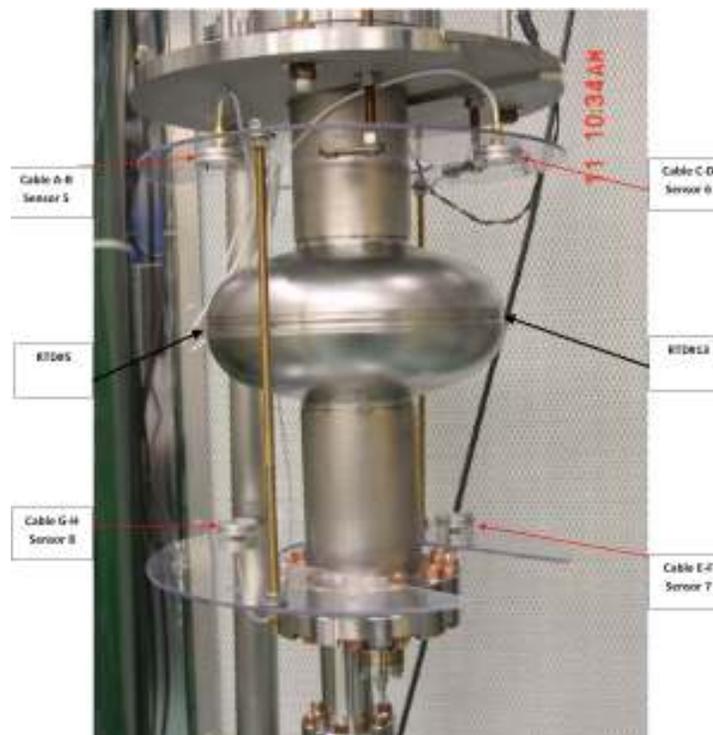


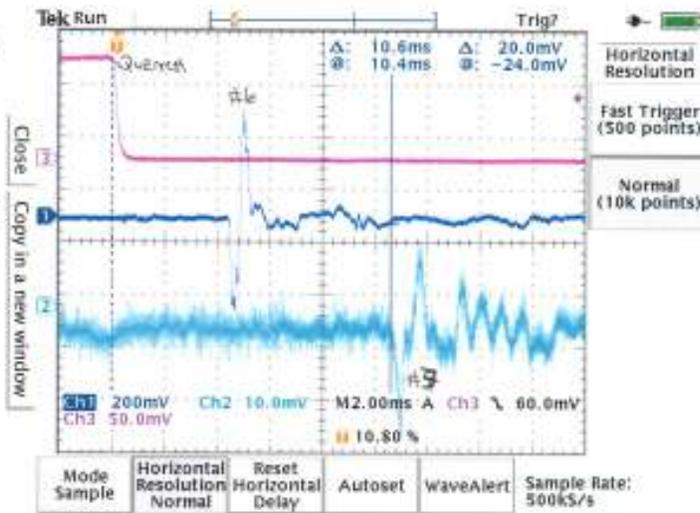
Fig 4

Second Sound Velocity = 20.4 m/s

#6
 $\Delta t = 4.3 \text{ ms}$
 $\Delta l = \Delta t (20.4 \text{ m/s}) = 8.77 \text{ cm}$

#7
 $\Delta t = 10.4 \text{ ms}$
 $\Delta l = \Delta t (20.4 \text{ m/s}) = 21.22 \text{ cm}$

Quench Occurred
 8.77 cm from
 sensor #6,
 21.22 cm from #7



Full size image from Test 12306

http://www.fredalab.gov/Files/0001240002360711666000...

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Fig 5

Conclusion

1. The cavity performance limited by FE induced quench, the quench location was not on huge pit this time, the pre-heating was detected on about 180 deg away from the quench location.
2. The quenching location changed when the helium bath temperature went above λ point.
3. The second sound system detected the quenching signal at 2K and is consistent with thermometer's results. When the helium bath went above λ point, the quenching signal was not accompanied by a response from the Second Sound Detectors as would be expected.