

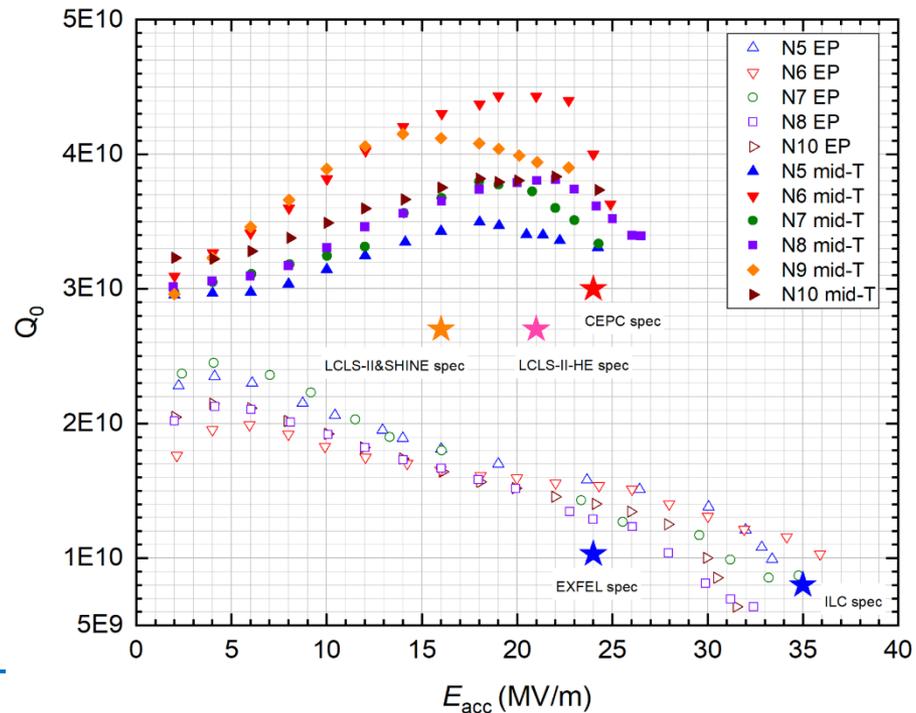
Experimental study of simplified mid-T furnace baking at IHEP

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IHEP 1.3 GHz 9-cell Cavities Vertical Test at 2 K





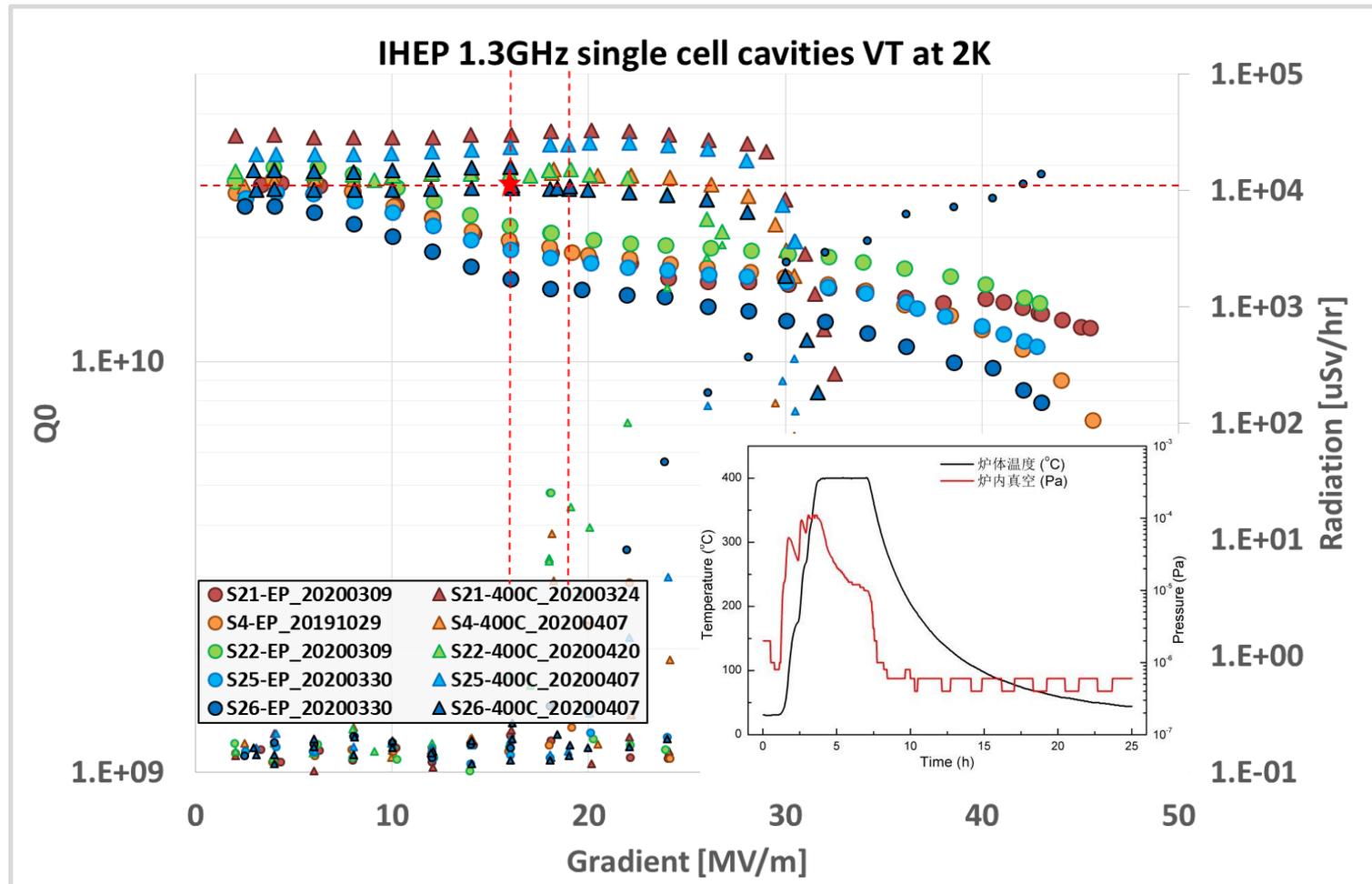
Outline

- Mid-T furnace baking experiments at IHEP
 - Various baking temperature
 - Features of mid-T furnace baked cavities
- Simplified mid-T furnace baking
 - Eliminating EP between high and mid-T baking
- Simplified mid-T furnace baking applied to 9cell cavities
 - A single EP before high baking
- Future plan
 - Horizontal test of jacketed cavity
 - Analysis of Nb samples



Repeat the KEK mid-T furnace baking

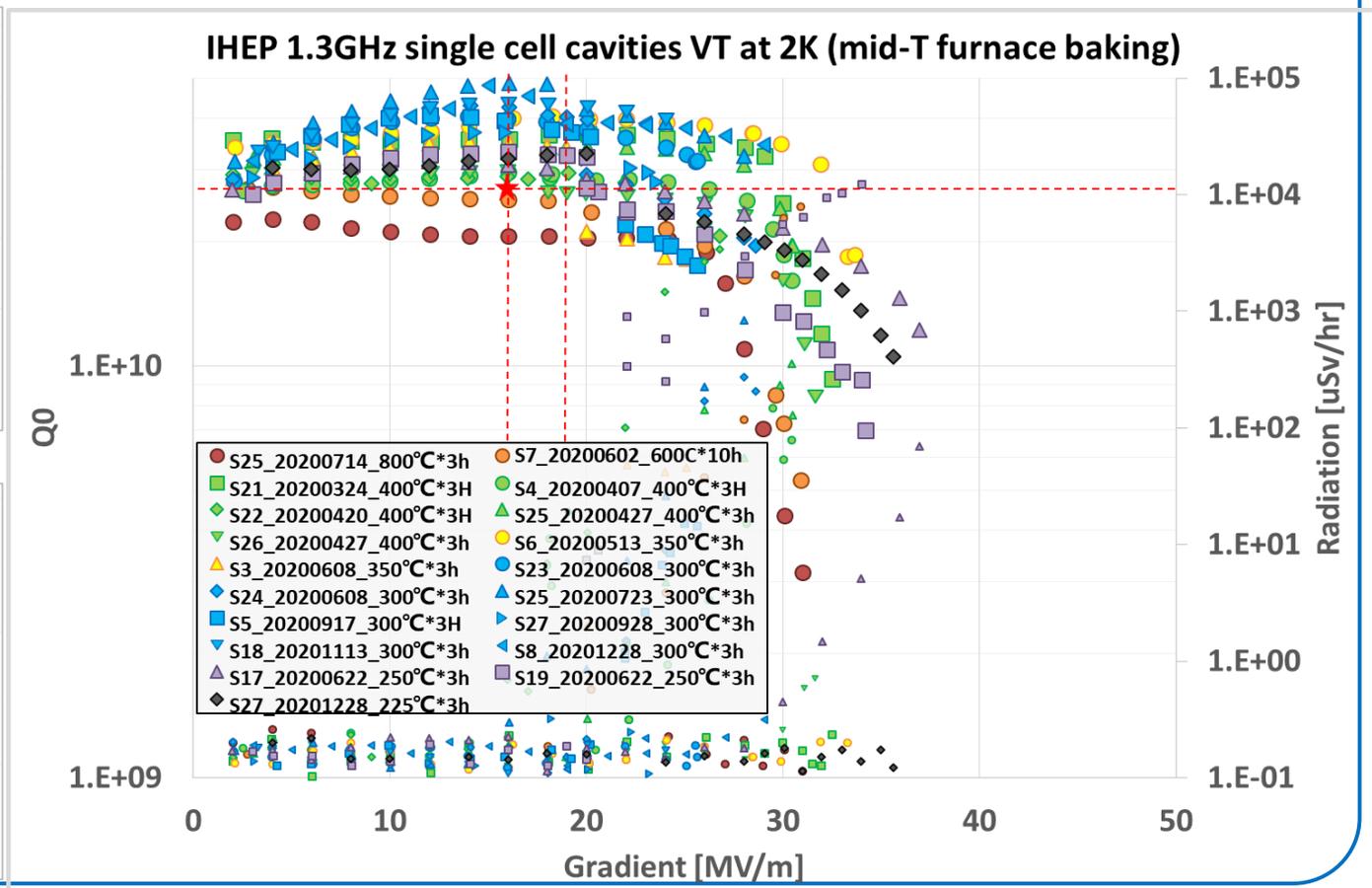
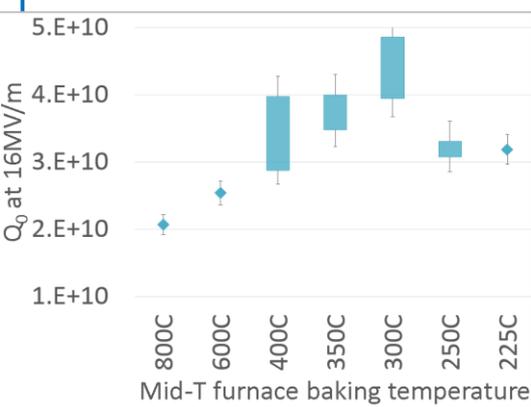
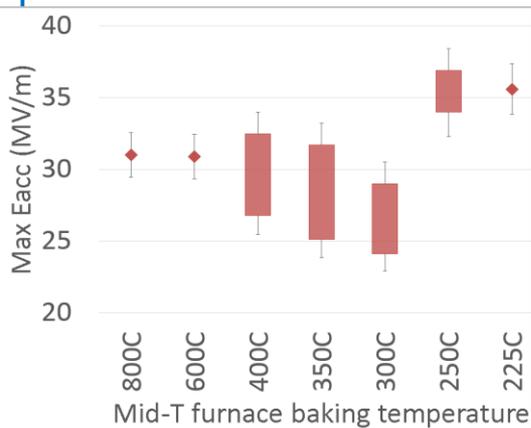
- Repeatable high-Q; sometimes Q-drop after quench





Mid-T furnace baking at various Temp.

- $Q_0 > 2.7e10 @ 16MV/m$ with $225 \sim 400^\circ C$ baking ($300^\circ C$ best)
- $T > 350^\circ C$ seems to induce HFQS





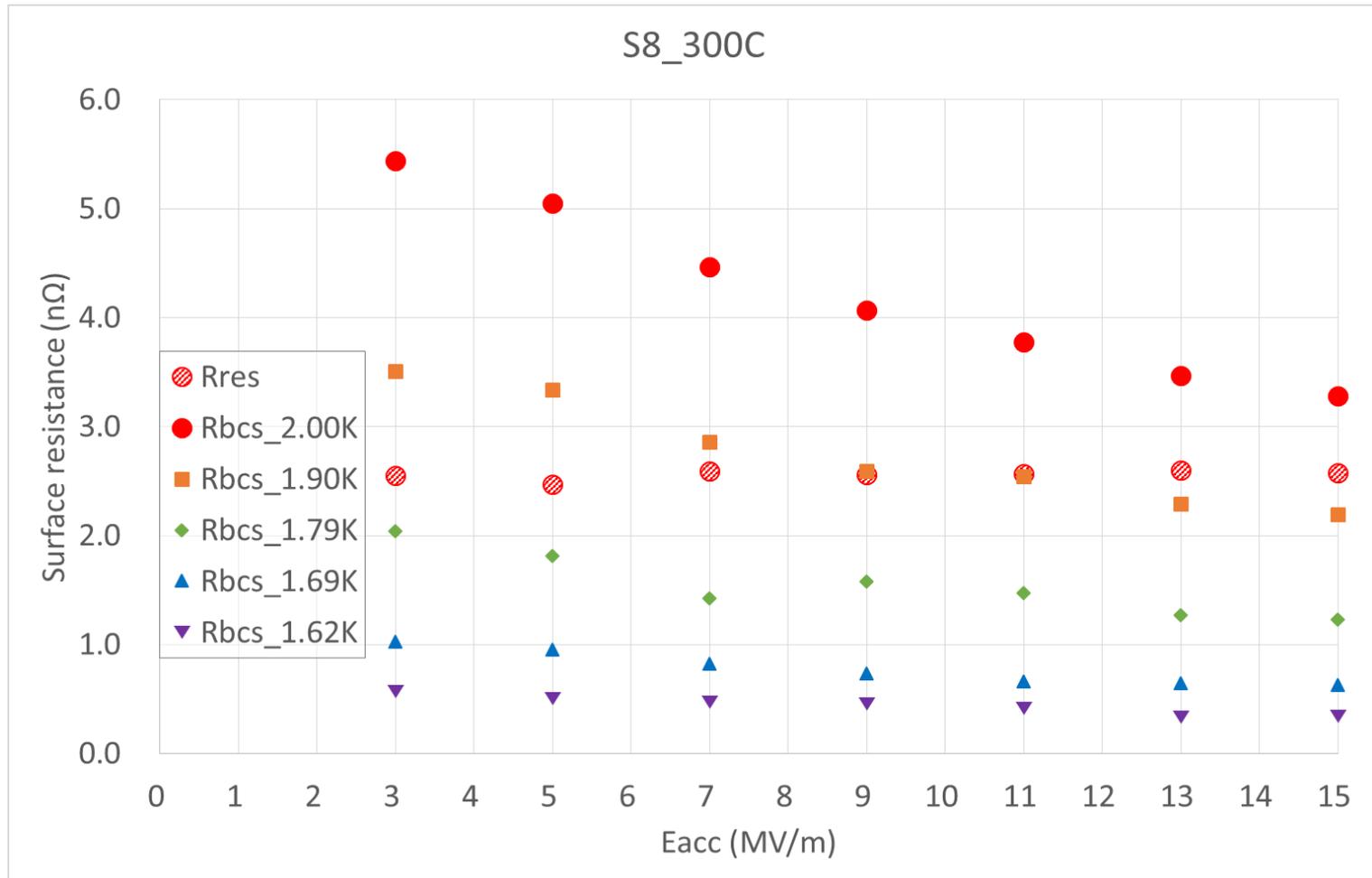
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Surface resistance

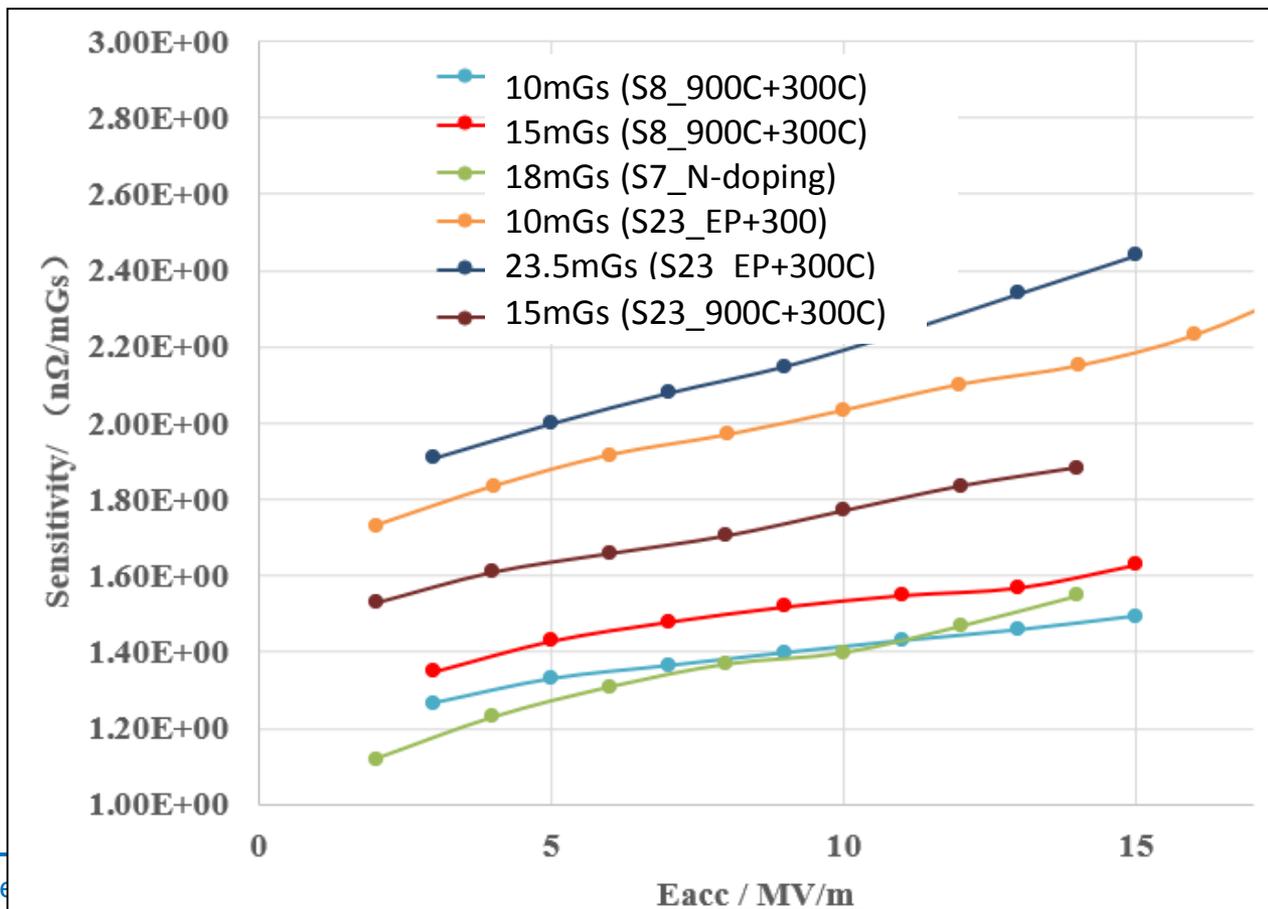
- The anti-Q-slope comes from the decrease of Rbcs





Magnetic field sensitivity

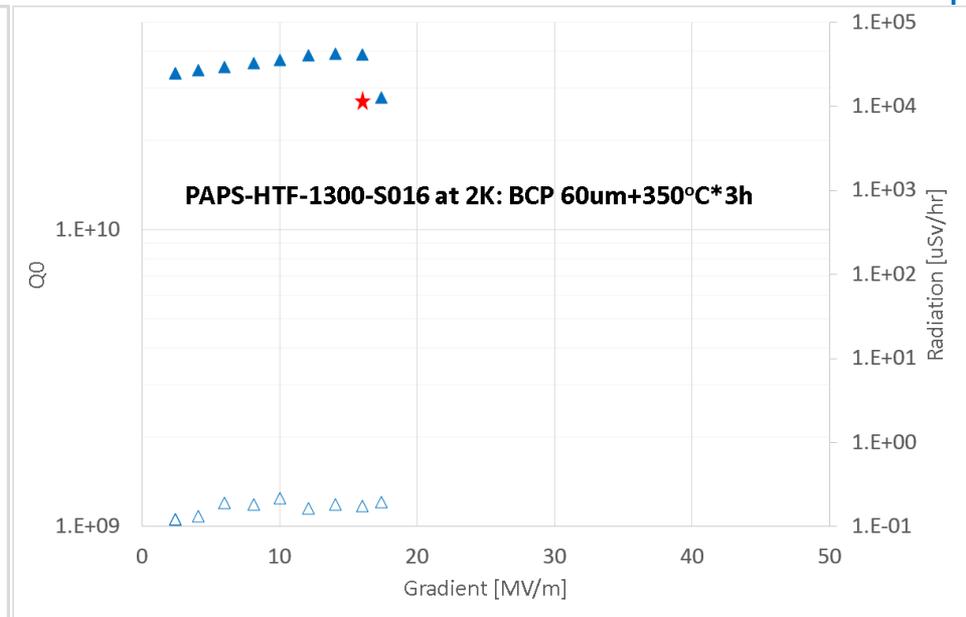
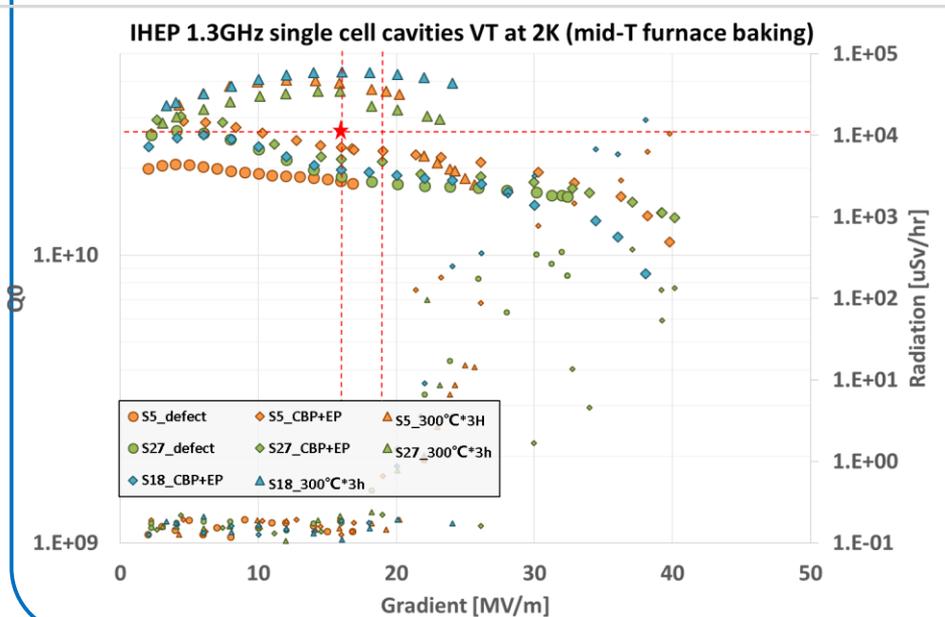
- The magnetic field sensitivity of 300C baked cavities seems lower if EP between high and mid-T baking is removed.
- More data is needed to give a conclusion.





The pre-baking surface

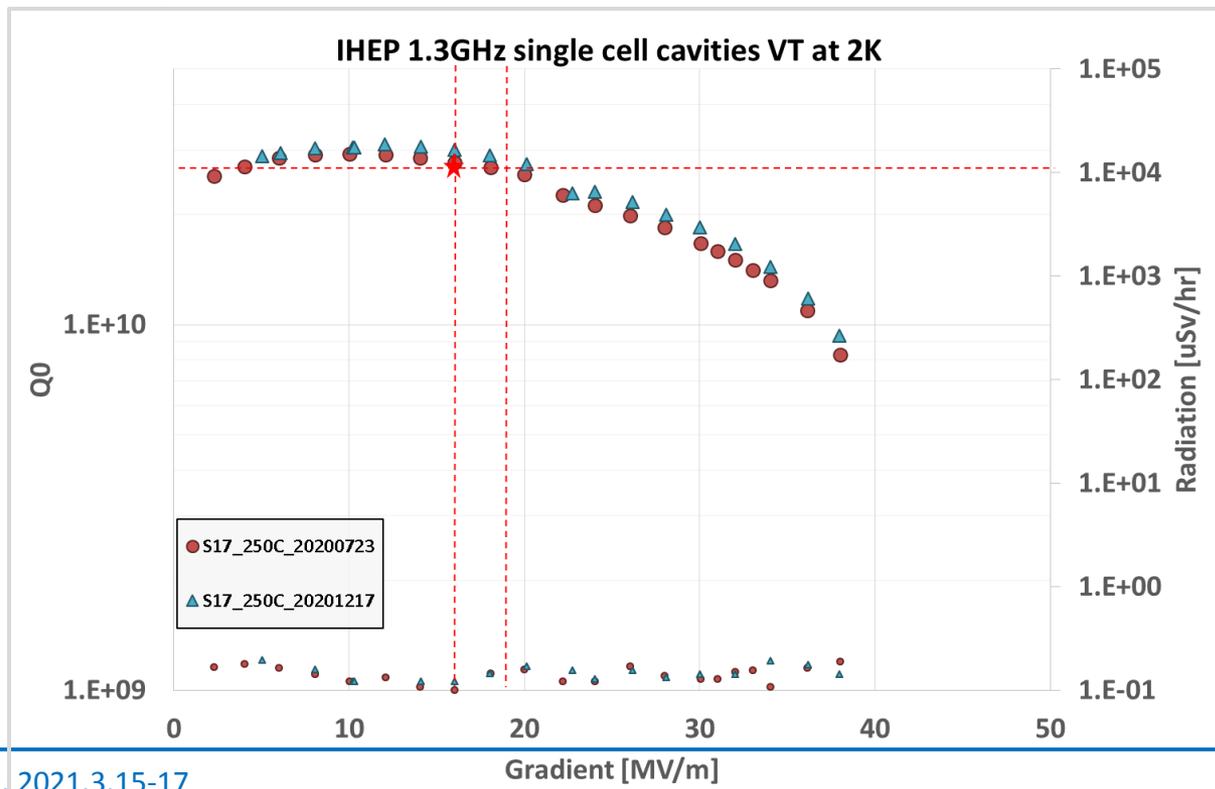
- How sensitive is Q_0 to quality of the surface?
 - Light EP at 16~18°C for 20-30 μ m is adequate.
 - CBP repaired cavity is OK
 - What if cavity is BCPed? Q_0 is high (3.9e10@16MV/m), but it may quench early





The post-baking surface

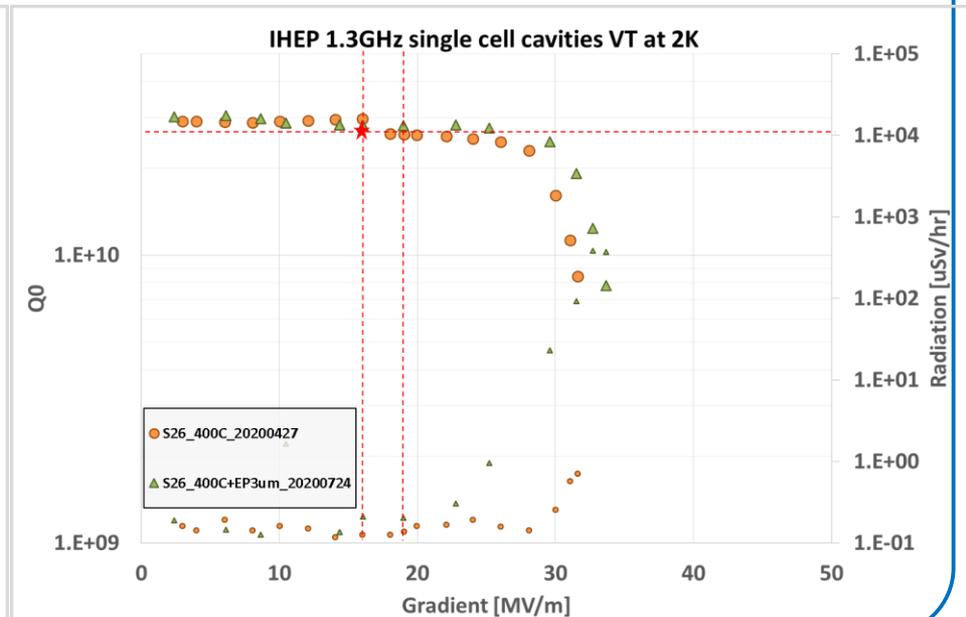
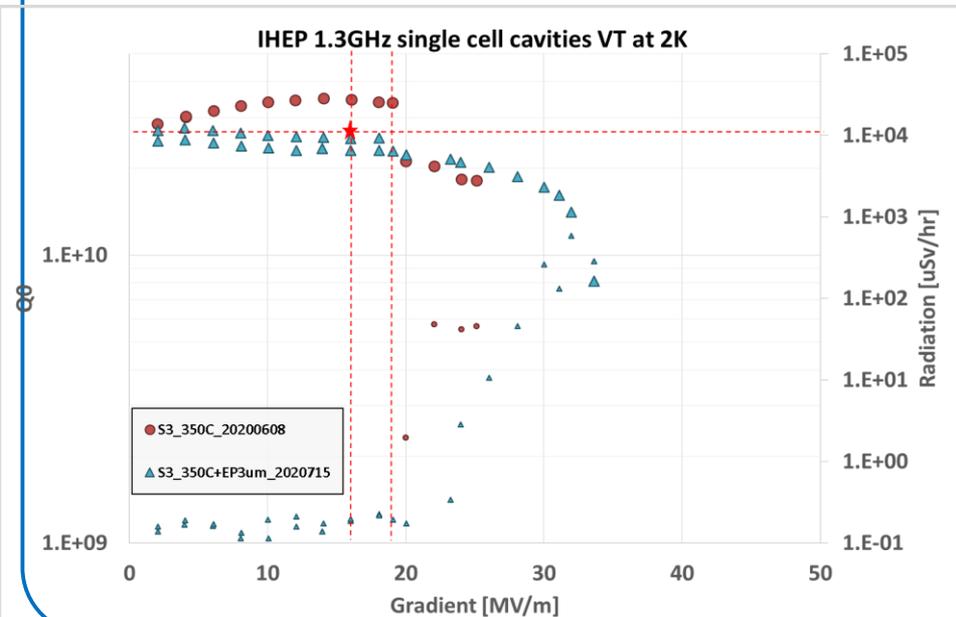
- Degradation is not observed after air exposure
 - After mid-T furnace baking, cavities are exposed in air for 6 hours to 16 days before HPR
 - S17 were open outside cleanroom for 4 months before re-HPR





The post-baking surface

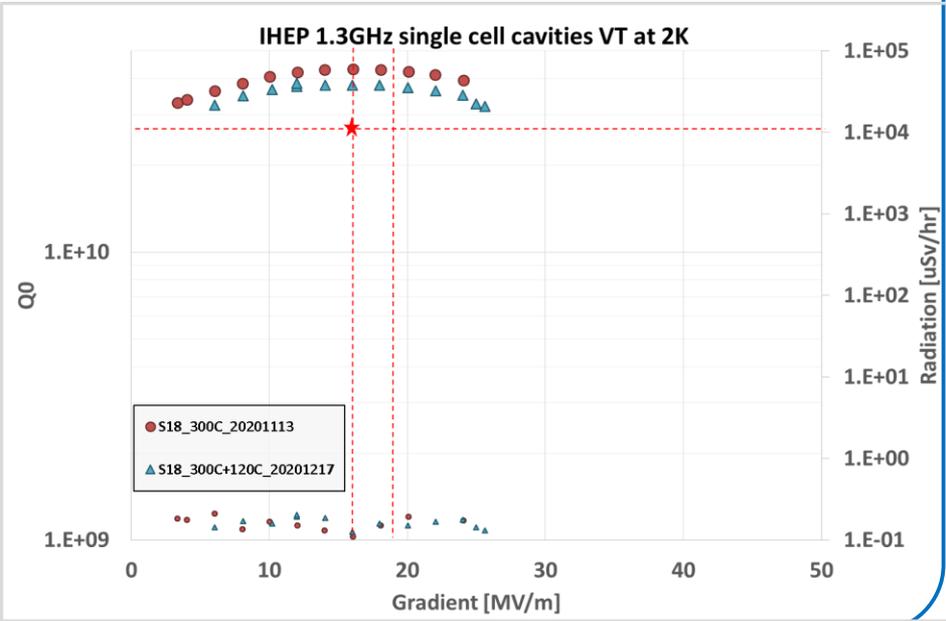
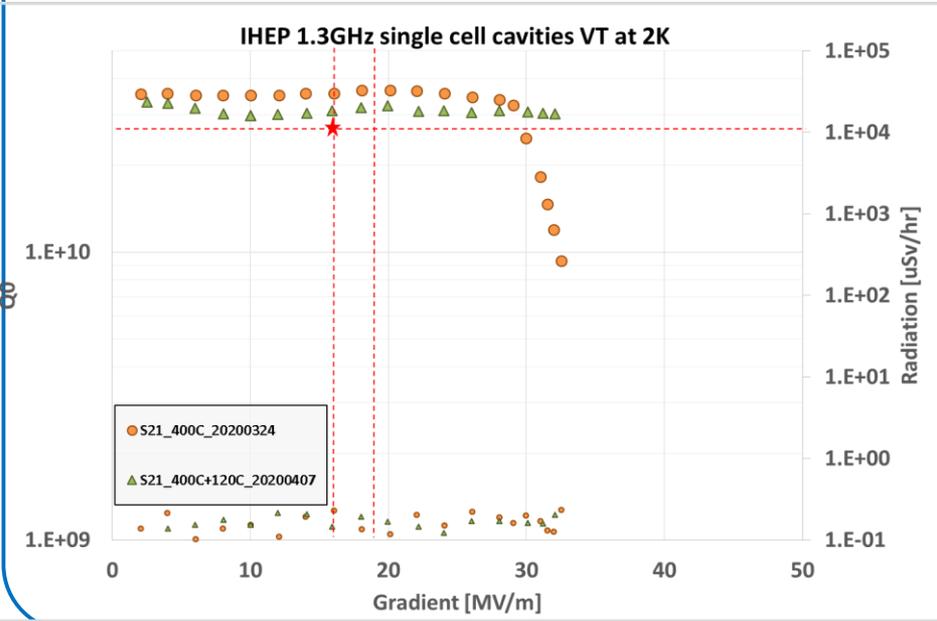
- What if cavity is EPed after baking?
 - 1300-S3 and S26 received 3um EP (~16-18C)
 - Gradient of both cavities were increased (more or less)
 - No benefit on Q_0 was observed.
 - S3 seems less sensitive to flux trapping after EP (?)





The post-baking surface

- What if cavity is 120C*48h baked after mid-T baking?
- Low baking cures the HFQS of 400C baked cavity
- Low baking decreases Q_0 slightly
- 120C baking is not recommended for mid-T.



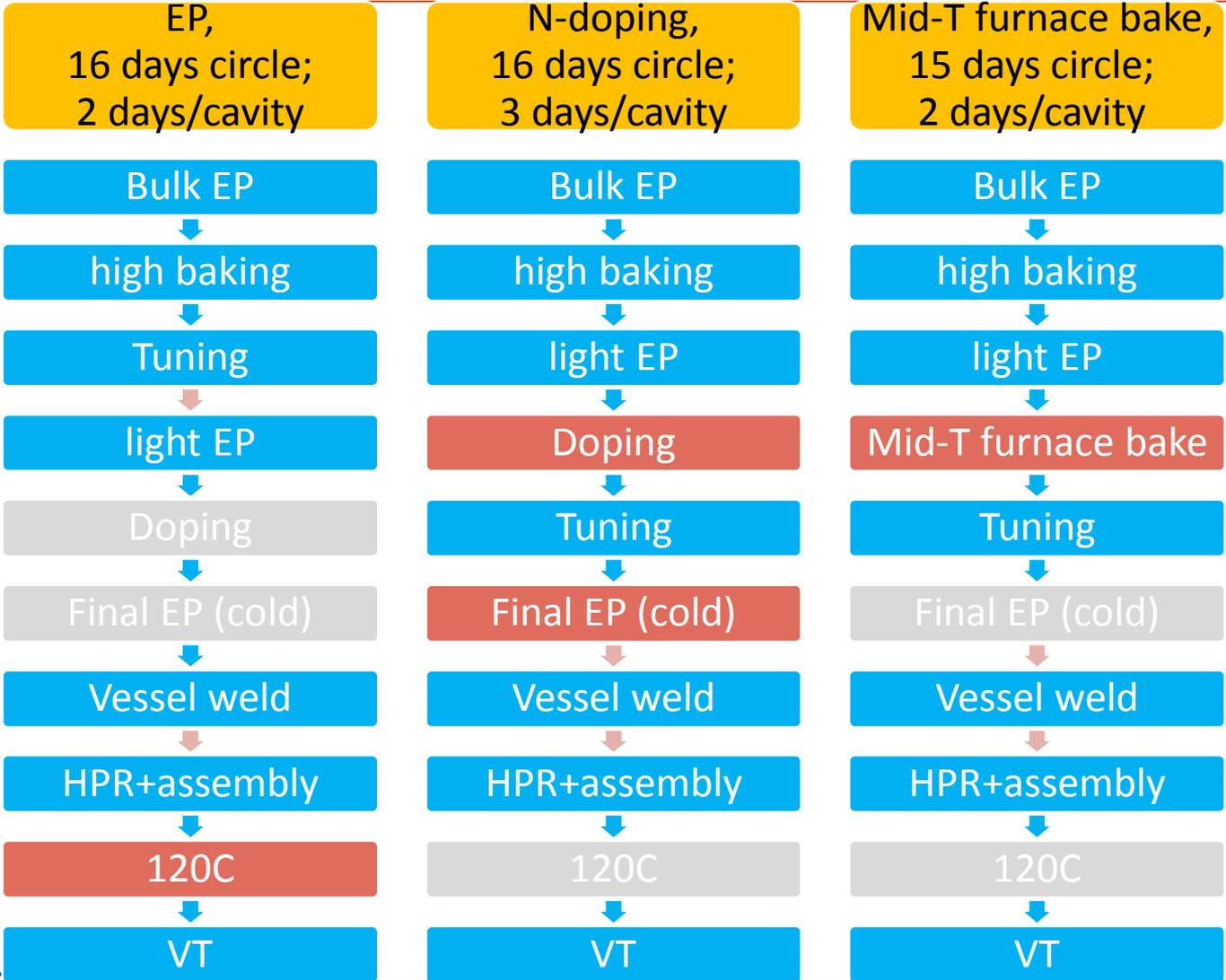


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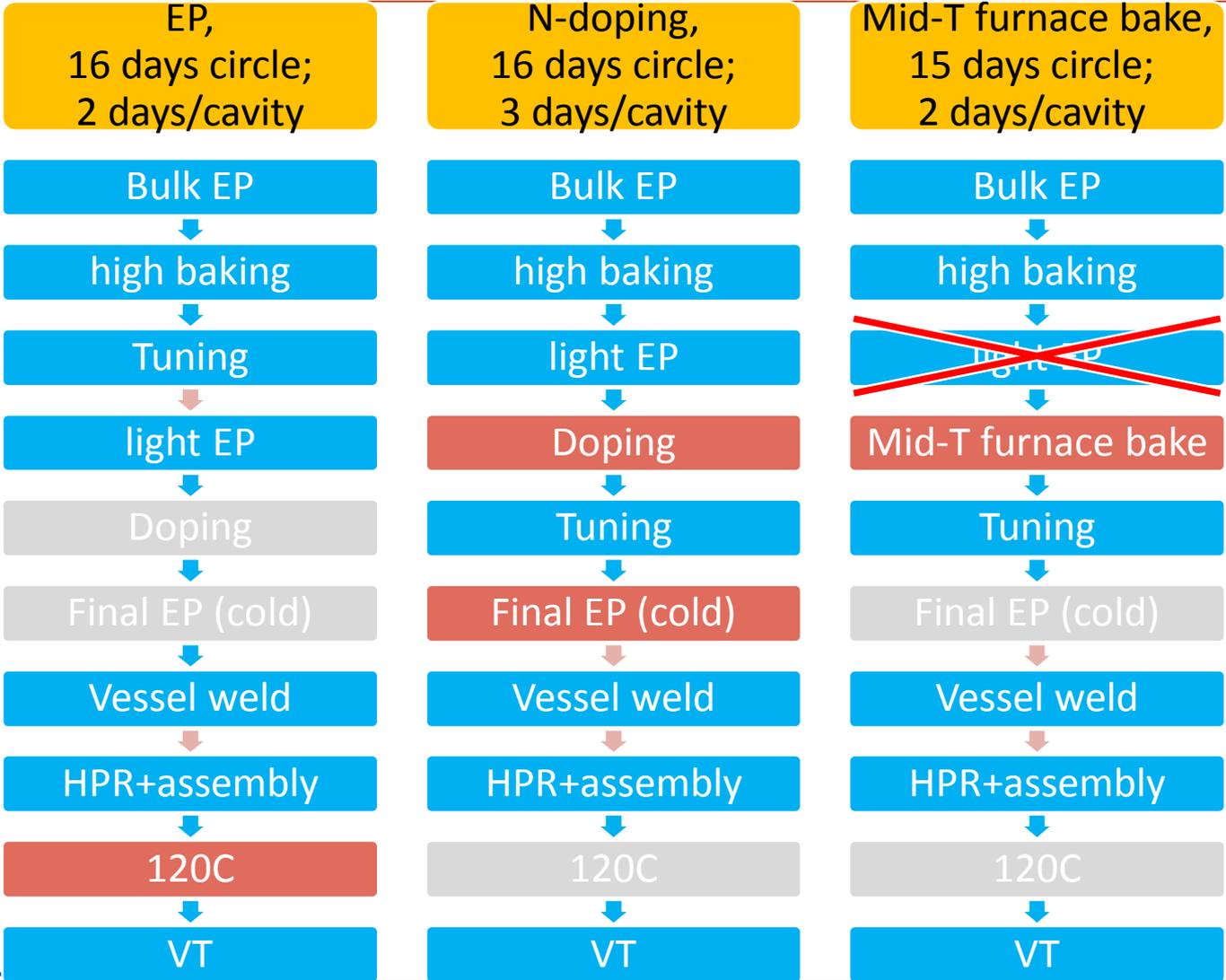


Simplified mid-T furnace baking





Simplified mid-T furnace baking



Idea of simplified mid-T furnace baking:

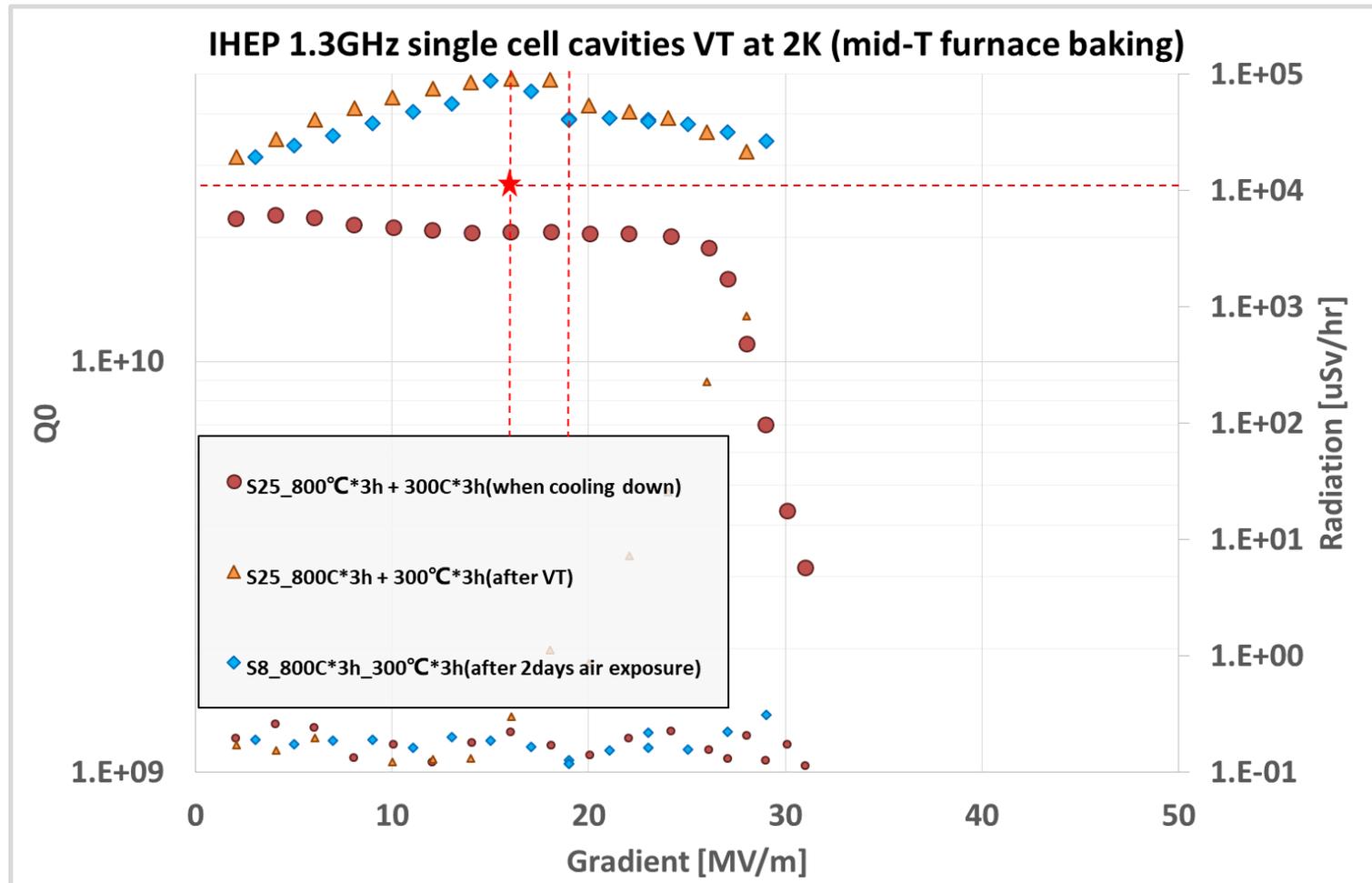
1. Contamination induced by high baking is avoidable
2. Mid-T furnace baking is not sensitive to the quality of EP

So, is light EP after high Baking really necessary?



Simplified mid-T furnace baking

- Try to omit light EP between high&mid-T baking:

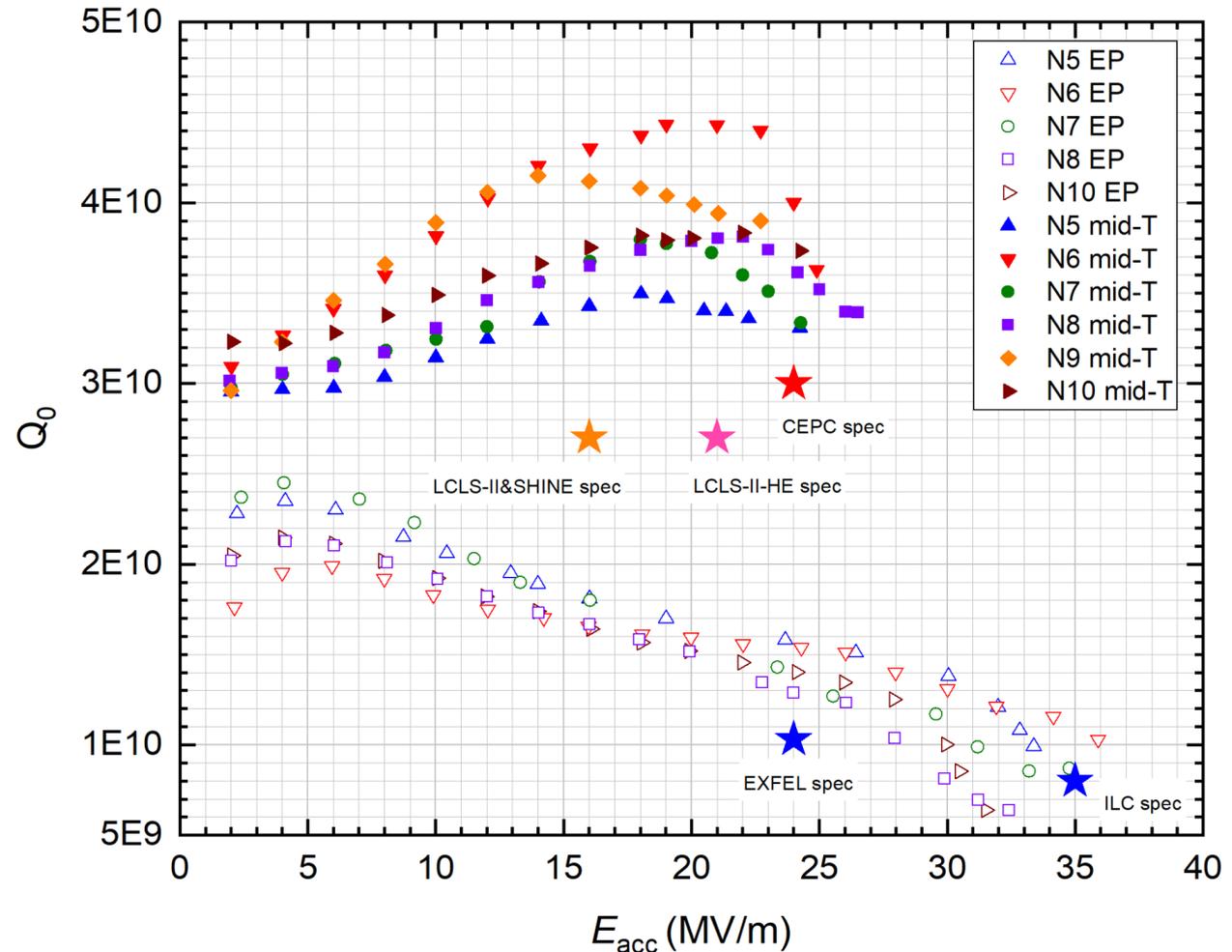




9-cell cavity simplified mid-T furnace baking

- 1300-N6/N7/N8/N10: EP baseline + 900C + air exposure + 300C
- 1300-N5: EP baseline + bulk EP + 900C + air exposure + 300C
- 1300-N9: a single bulk EP + 900C + air exposure + 300C

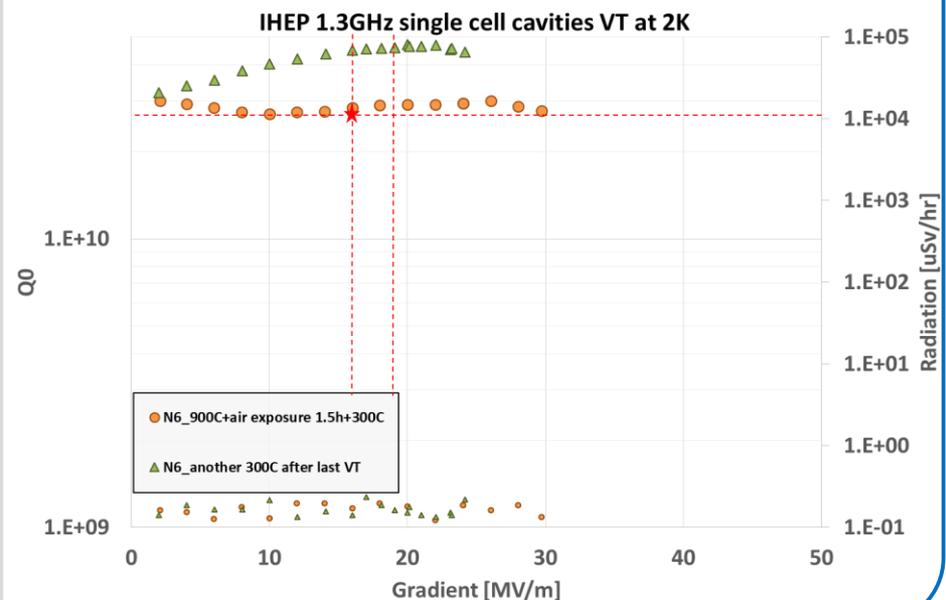
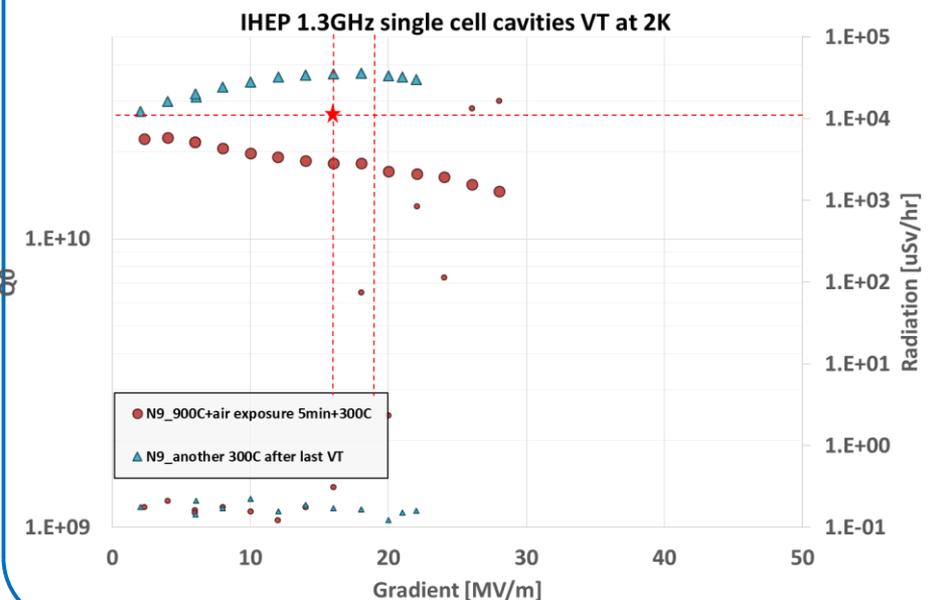
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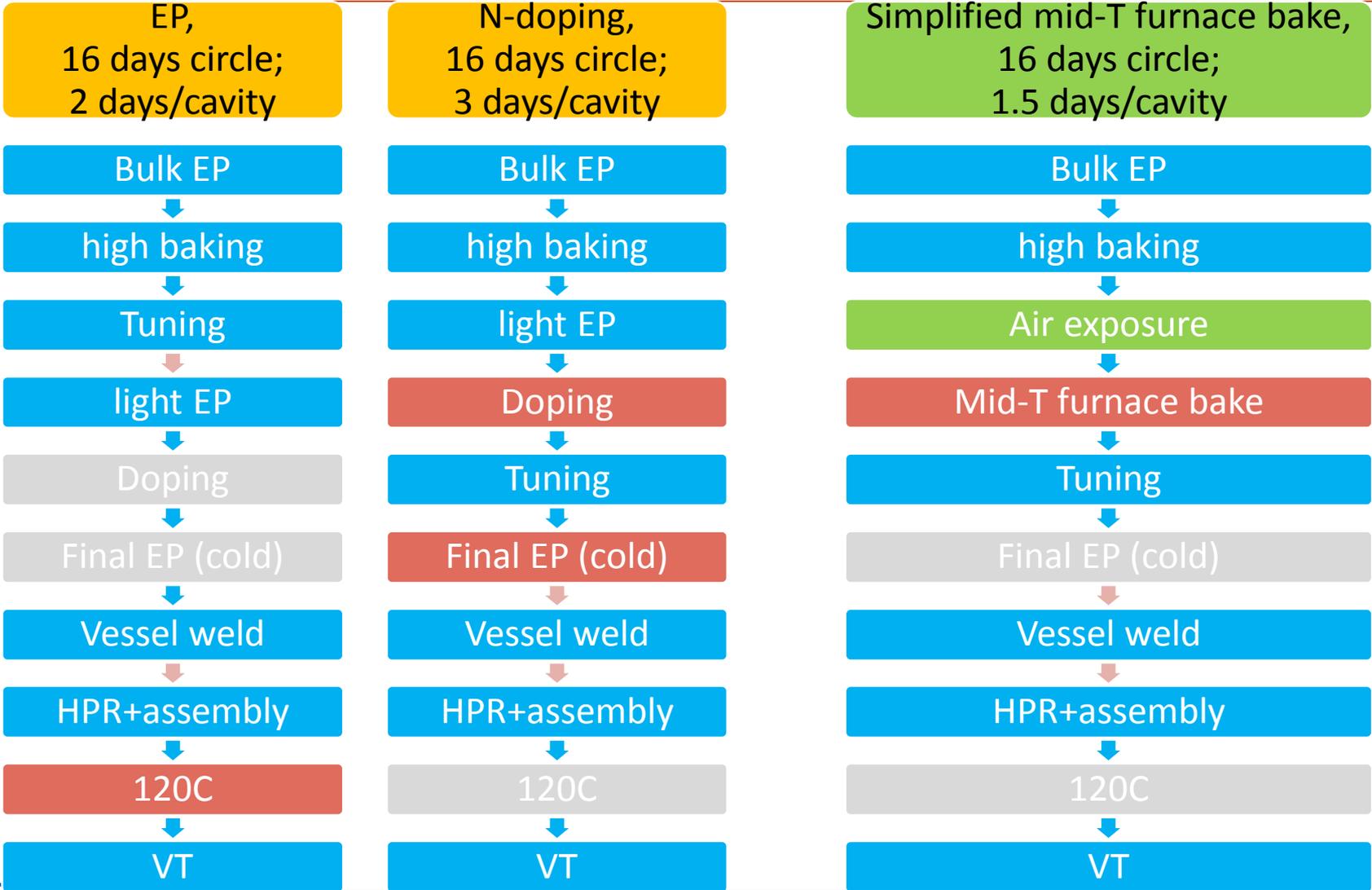
Effect of air exposure time

- The air exposure between high and mid-T furnace baking is essential for high Q
- 1.5 hours exposure is not enough
- 2 days exposure is adequate (probably not optimized)





Simplified mid-T furnace baking





Ongoing work

- Vertical test of jacketed cavity:
 - 1300-N6 has been vertical tested after helium vessel welding, with no degradation of Q_0 and Eacc
- Horizontal test of jacketed cavity (Q-matched):
 - An old cryomodule is modified to perform horizontal test of 1300-N6, and we are working on cooling down the cavity now





Summary

- Mid-T furnace baking at various temperature has been studied on 1.3GHz single-cell cavities.
- Some features of the baking, such as pre-surface quality, magnetic field sensitivity, post-baking degradation and post-processing, are studied.
- Simplified mid-T furnace baking has been applied to single cell and 9cell cavities, to save time for mass production
- High Q is achieved in vertical test with a high success rate.



Thanks for your attention!