# Tests of The Balloon Single Spoke Resonator

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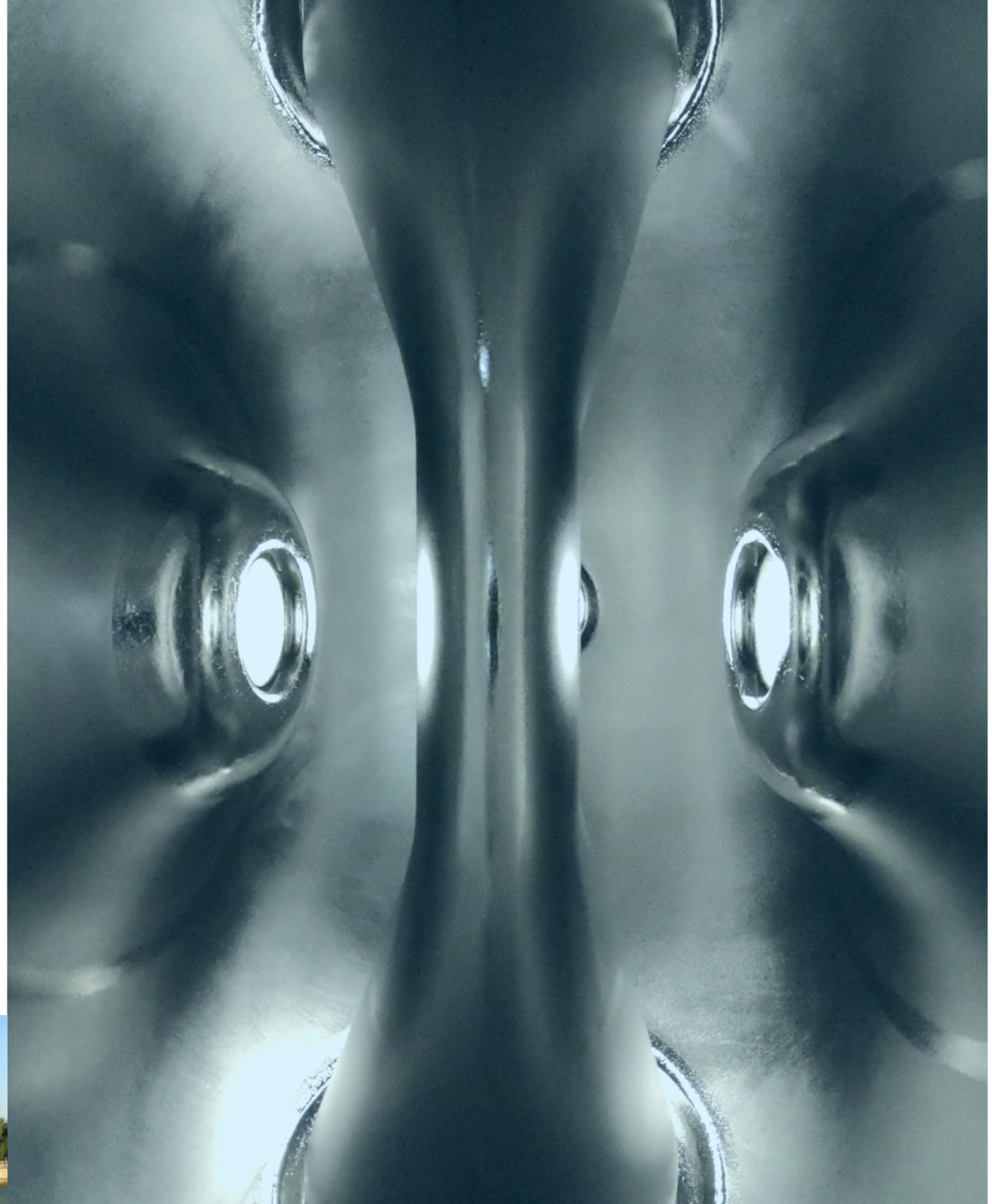
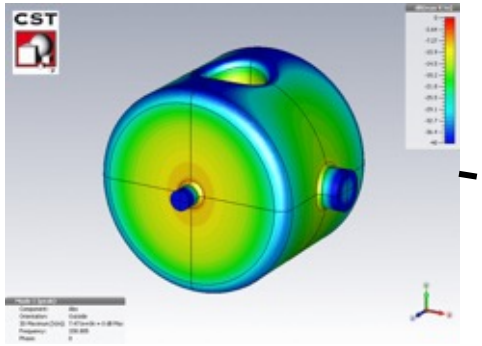


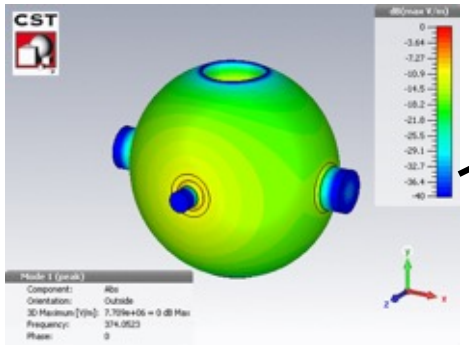
# Balloon Single Spoke Resonator

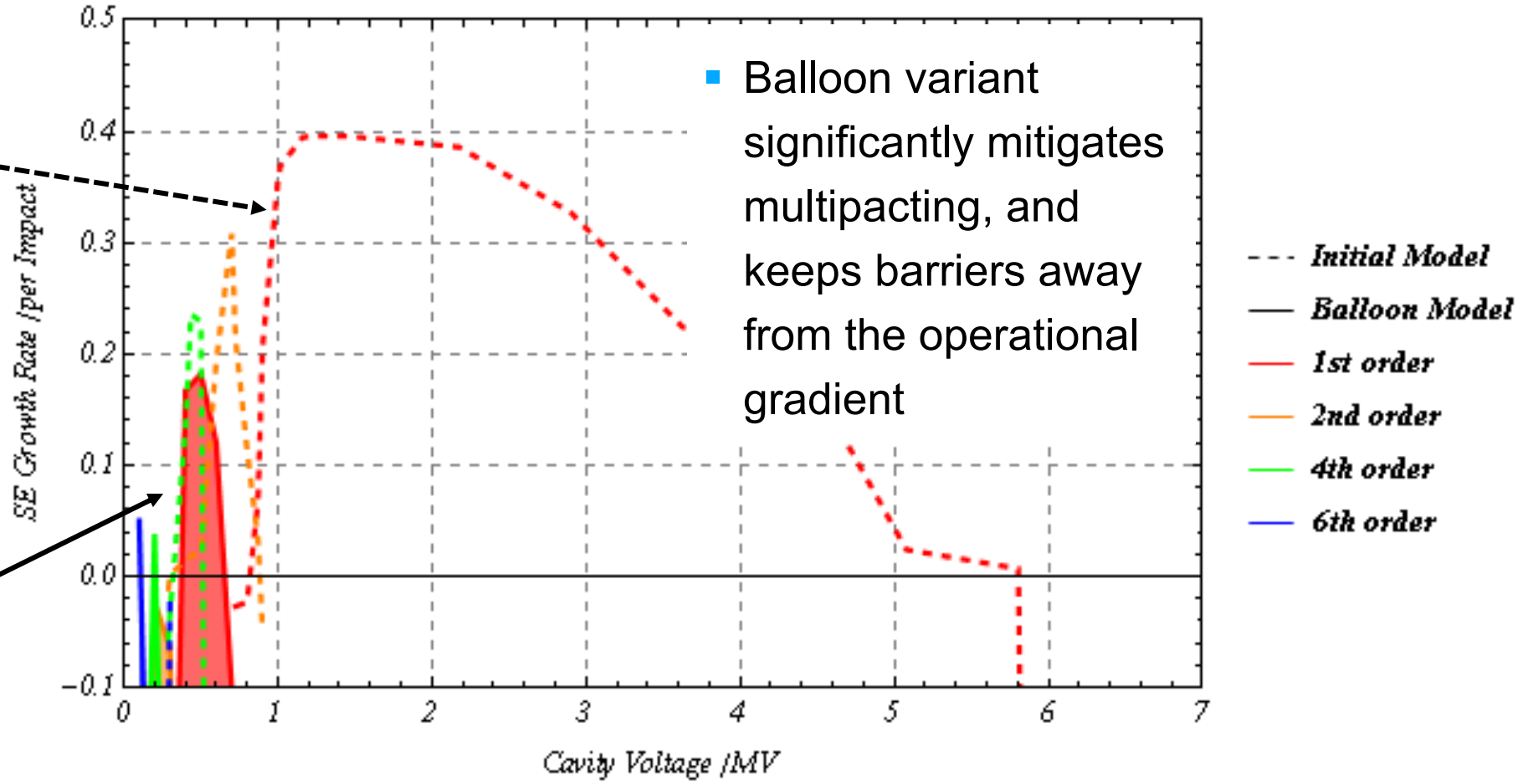


*Traditional SSR*



*Balloon SSR*





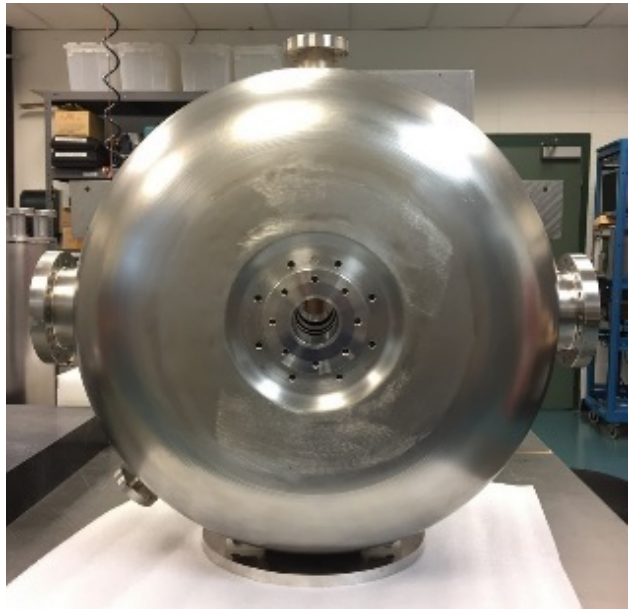

- Balloon variant significantly mitigates multipacting, and keeps barriers away from the operational gradient

*Z. Yao, Design and Fabrication of Balloon Single Spoke Resonator, SRF2017*

# Prototype of Balloon SSR



- The first balloon SSR was designed, fabricated, processed and tested at TRIUMF.

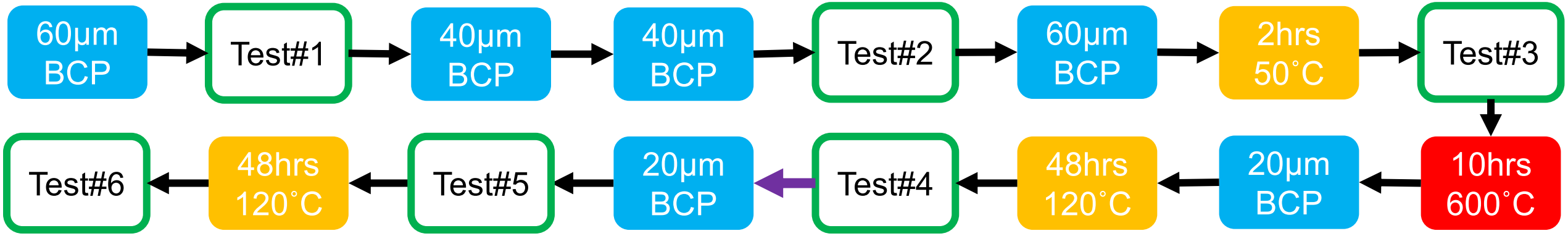


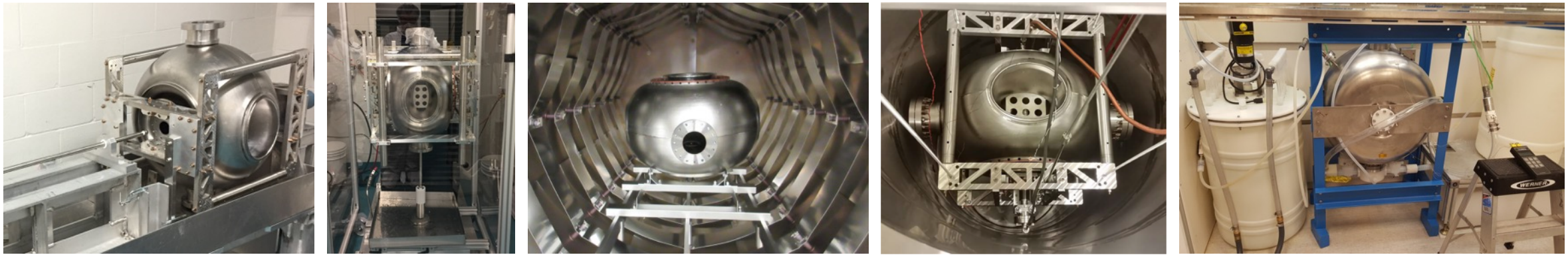
*Design Parameters of the Balloon SSR.*

| | |
|---|---|
| **Frequency** | 325 MHz |
| **Geometry β** | 0.30 |
| **Geometry factor** | 93 Ω |
| **R/Q** | 233 Ω |
| **$E_{peak}/E_{acc}$** | 3.84 |
| **$B_{peak}/E_{acc}$** | 6.07 mT/(Mv/m) |
| **df/dp** | -1.6 / +1.5 Hz/mbar |
| **Lorentz force detuning** | -8.7 / -1.4 Hz/(MV/m)$^2$ |
| **Tuning sensitivity** | 467 kHz/mm |
| **Spring constant** | 14 kN/mm |

# Cavity Processing and Cold Tests



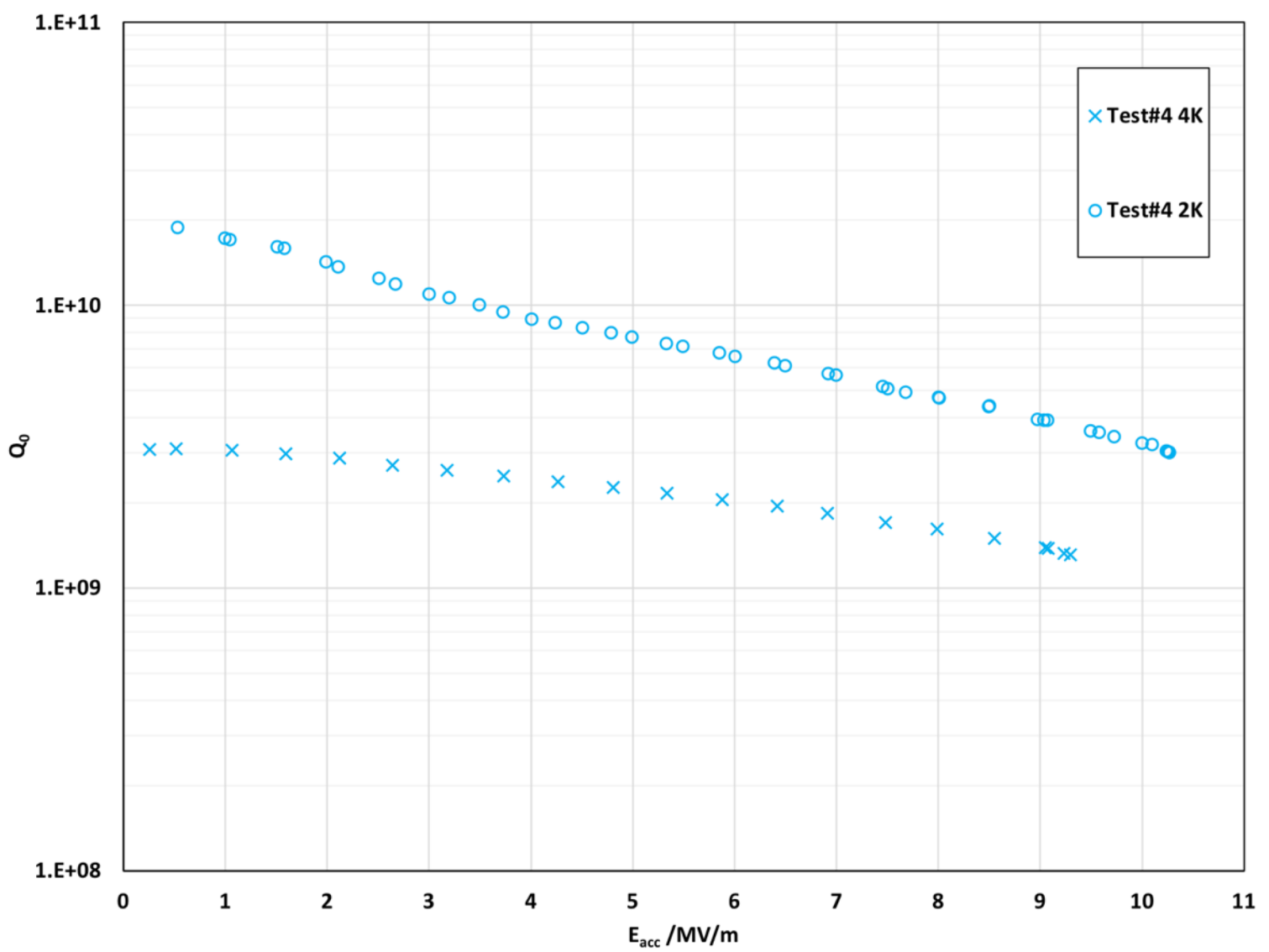


# Bare Cavity



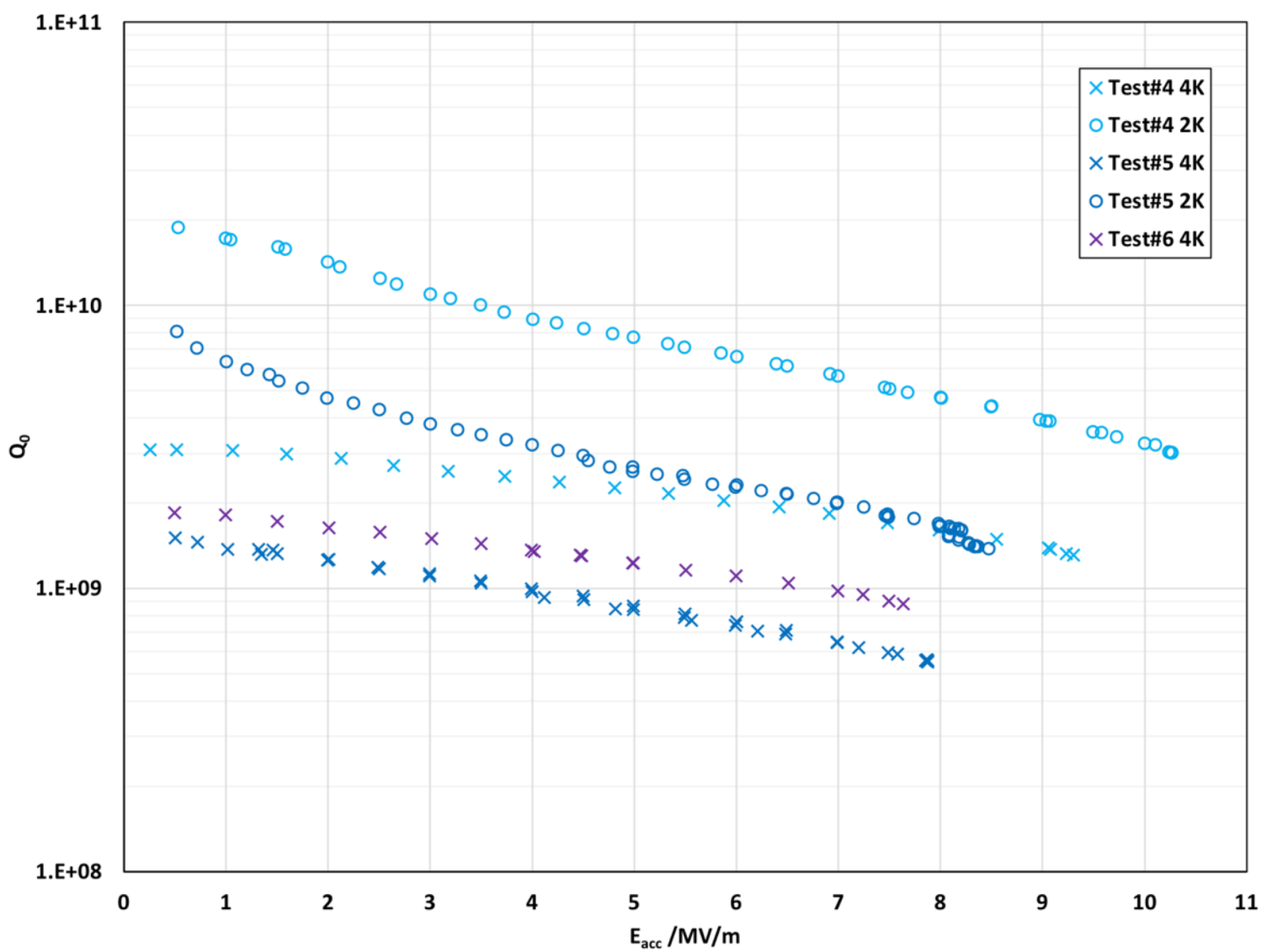
- Test with total etching depth of 220 μm and degassing.
- Degassing records indicated high hydrogen levels.
- The base residual resistance is 4.9nΩ with an ambient magnetic field of 35mG.
- 2 K curve has a pronounced Q-slope in the medium field range due to the significant field dependence on residual.
- Cavity quench limits the cavity gradient at 10.3 MV/m, corresponding to a nominal peak magnetic field of 63 mT.
- Surface defects in the form of either geometry or foreign material are suspected.



# Jacketed Cavity

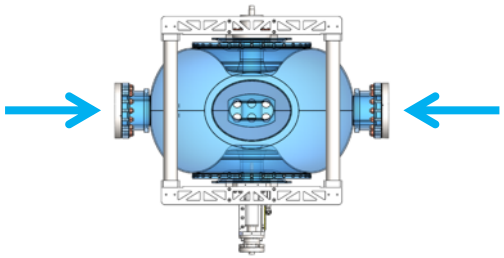


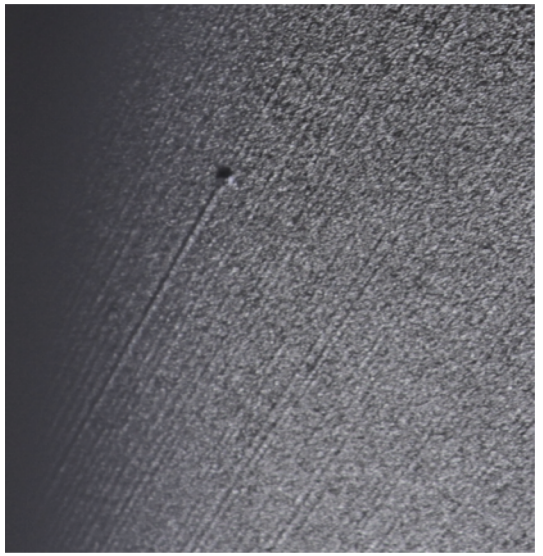
- Resonant frequency at 2 K is 324.995MHz without tuning.
- Cavity performance declined after jacketing.
- The etch after jacketing opened up one or more inclusions is suspected.
- Signs of defects and uneven surface finish were seen.
- 120 ºC bake improves 4 K $Q_0$.



# Interior Surface

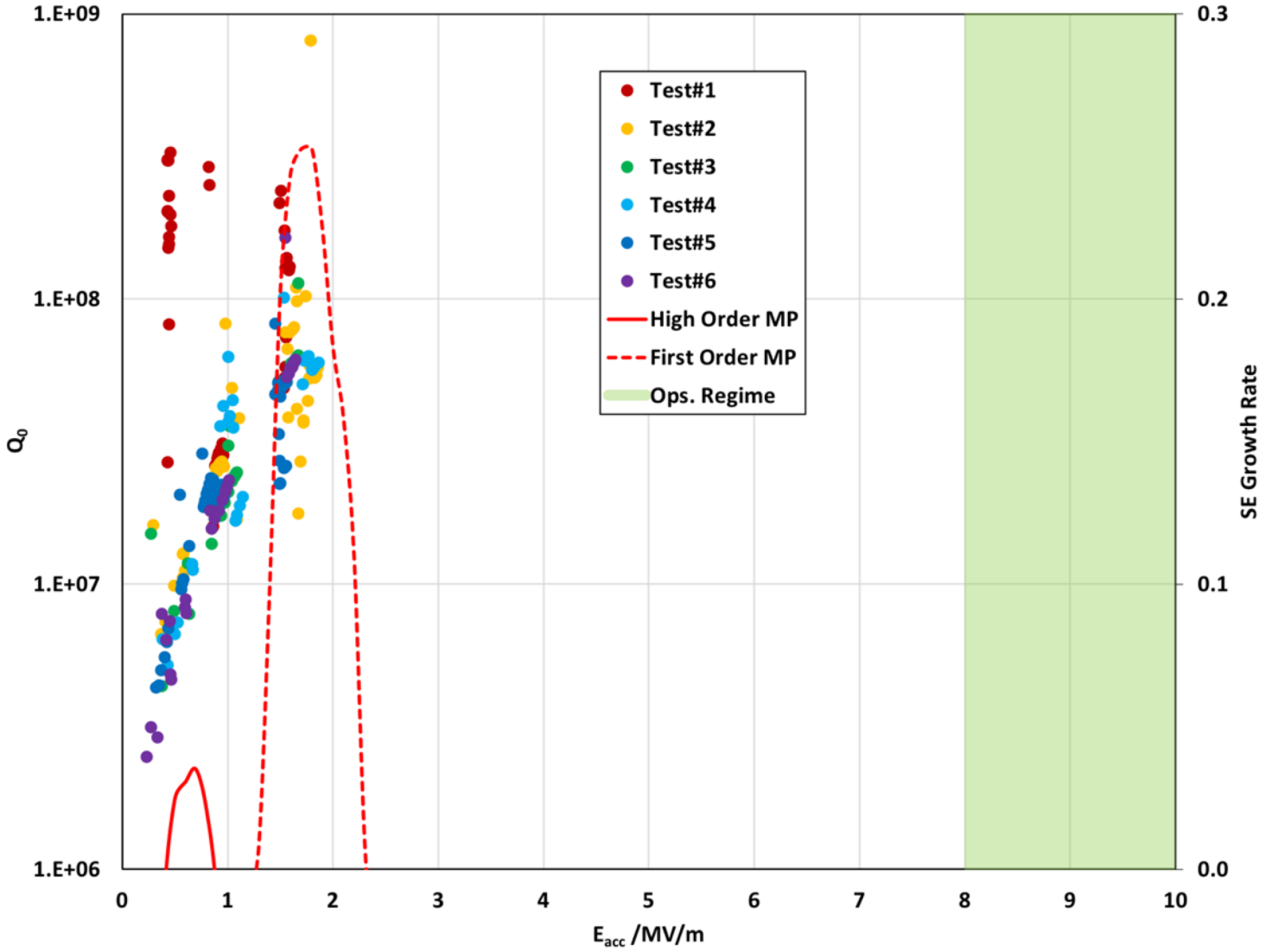
- Evidence of bubble trace on shell near RF ports
- Small geometry defects on shell
- Imperfect welds at the spoke collars





# Multipacting

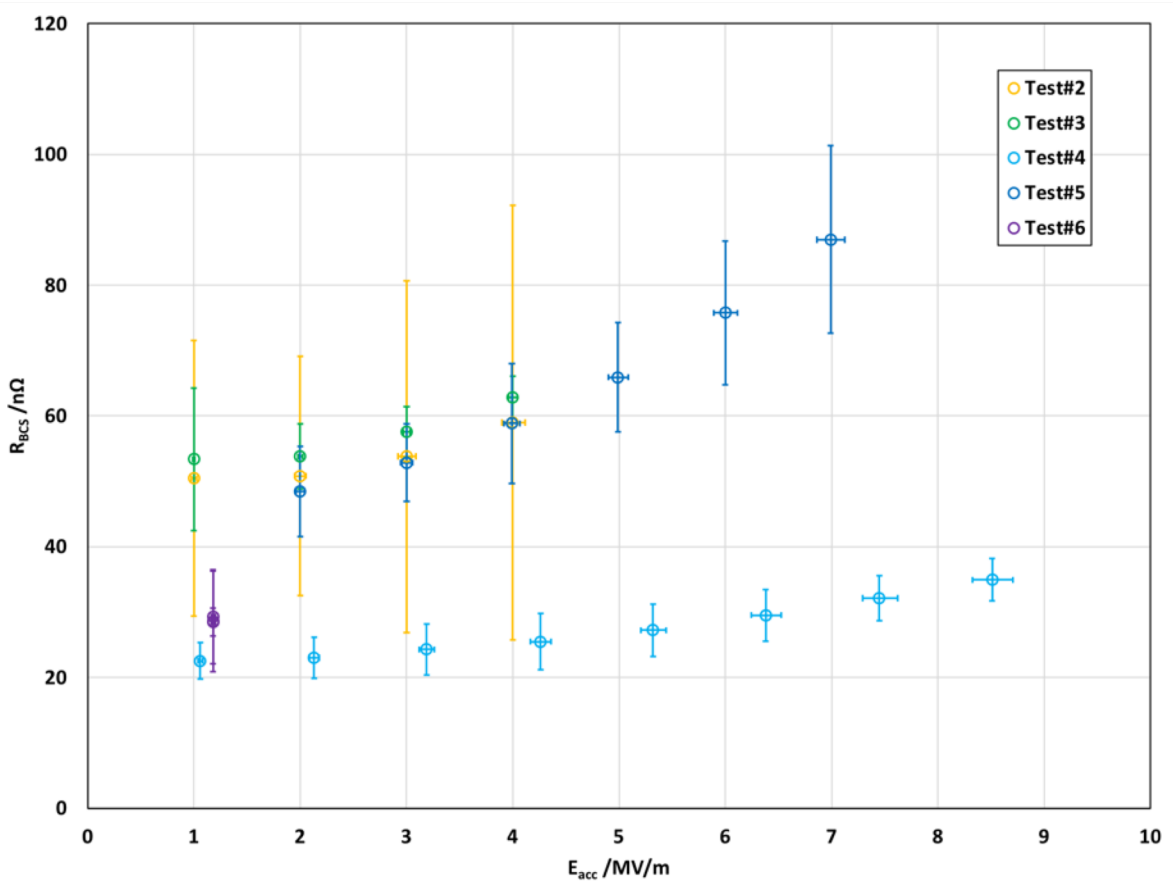
- There is excellent agreement between MP simulations and cold test data
- No multipacting barriers near the operational gradient or below 0.1 MV/m.
- The barriers only exist between 0.2 MV/m and 1.8 MV/m.



# Low Temperature Bake



- Two recipes
  - 50 ºC for 2 hours
  - 120 ºC for 48 hours
- Both recipes save time consumption of multipacing conditioning by ~50%
- 120 ºC bake reduces BCS resistance by ~50% at 325 MHz, and mitigates field dependence of BCS component.



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Thank you

Merci

谢谢

**Poster TUPO039 for more details**

Discovery, accelerated