# Why mid-T baked cavities are (probably) not limited by thermal quench

based on results from

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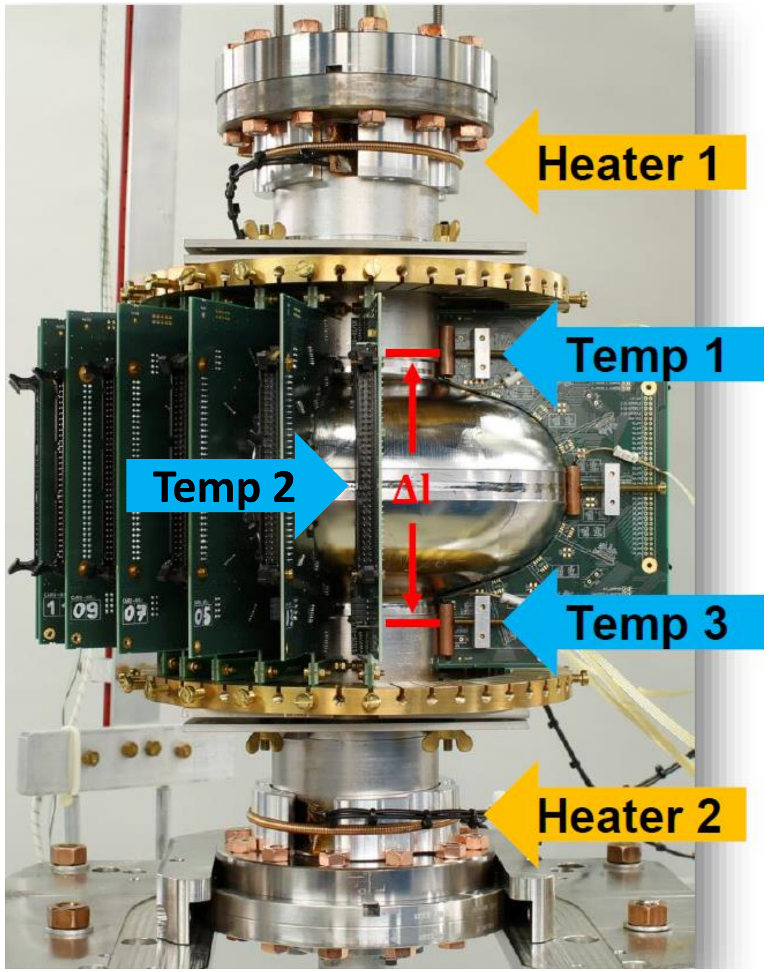
by M. Wenskat – 4.9.2024

# Do you plan to measure mid-T baked samples with this?

J. Wolff after Leon‘s Introduction Talk

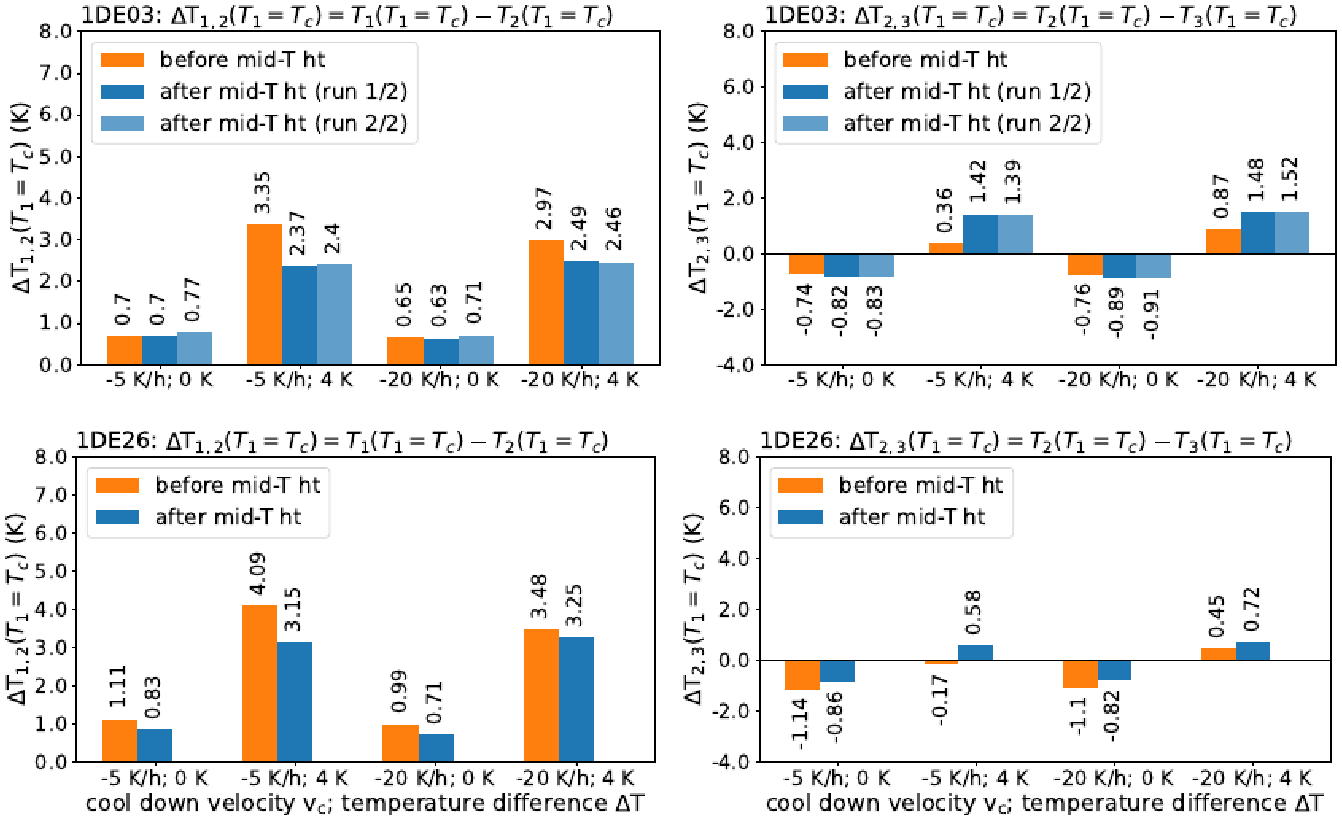
- Why did he asked that question?
- Because he saw something unusual in his measurements!

# What did he saw?




- Establish a temperature gradient ΔT and measure flux expulsion
- 2 gradients ΔT: 4K or 0K over Δl.
  - For 0K: heat at the **bottom**, as $T_3 < T_1$
  - For 4K: heat at the **top**, as $T_3 < T_1$ & ΔT is lower as 4K
- What is the difference
  - $T_3 - T_1 \longrightarrow$ over whole cavity
  - $T_{1,2} = T_1 - T_2 \longrightarrow$ top half of cavity
  - $T_{2,3} = T_2 - T_3 \longrightarrow$ bottom half of cavity

# How even is the heat distributed?



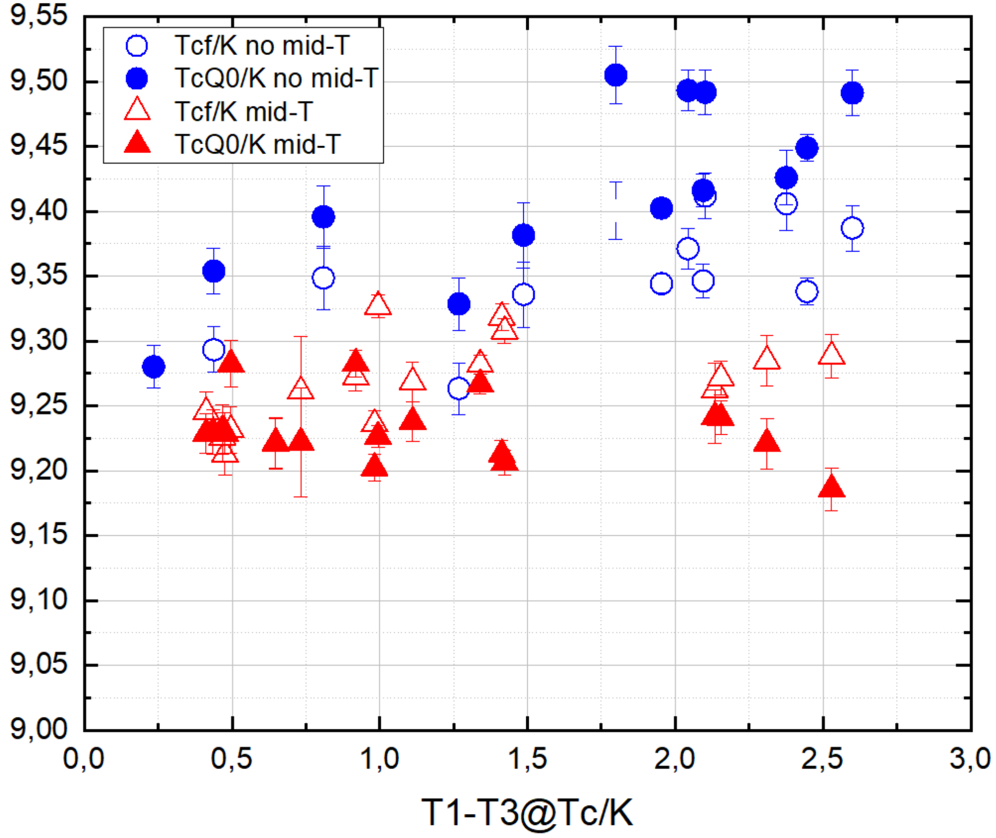

- For ΔT = 0K/Δl
  - Before/after mid-T „linear“

    $T_{1,2} \approx - T_{2,3}$
- For ΔT = 4K/ Δl
  - Before mid-T uneven top/bottom

    $T_{1,2} \gg - T_{2,3}$
  - After mid-T

    $T_{1,2} > - T_{2,3}$ ⟶ difference shrunk
- Does this mean that heat is better transported?

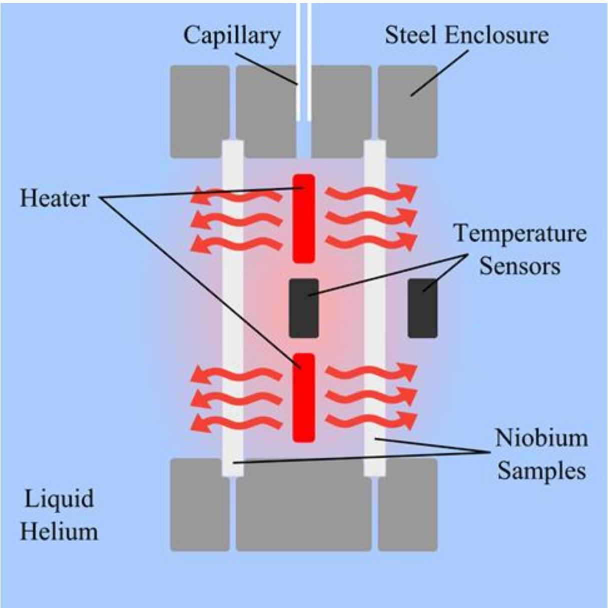
# Measured $T_c$ of fvT

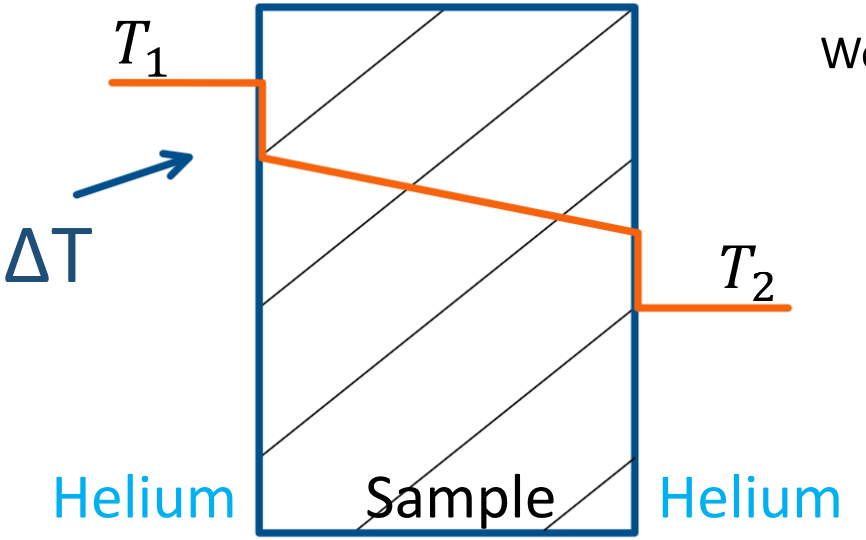



- No mid-T cavities seem to have a temperature gradient dependent $T_c$
- For mid-T cavities, no such temperature gradient dependency is observed

- Ways to explain this:
    1. T-sensor is better coupled to real cavity temperature and therefore less deviation from real transition of 9.27K
    2. Temperature distribution is more “linear” like in Jonas measurement
- Both seem to indicate a thermal conductance effect

# How do we measure the thermal transmittance



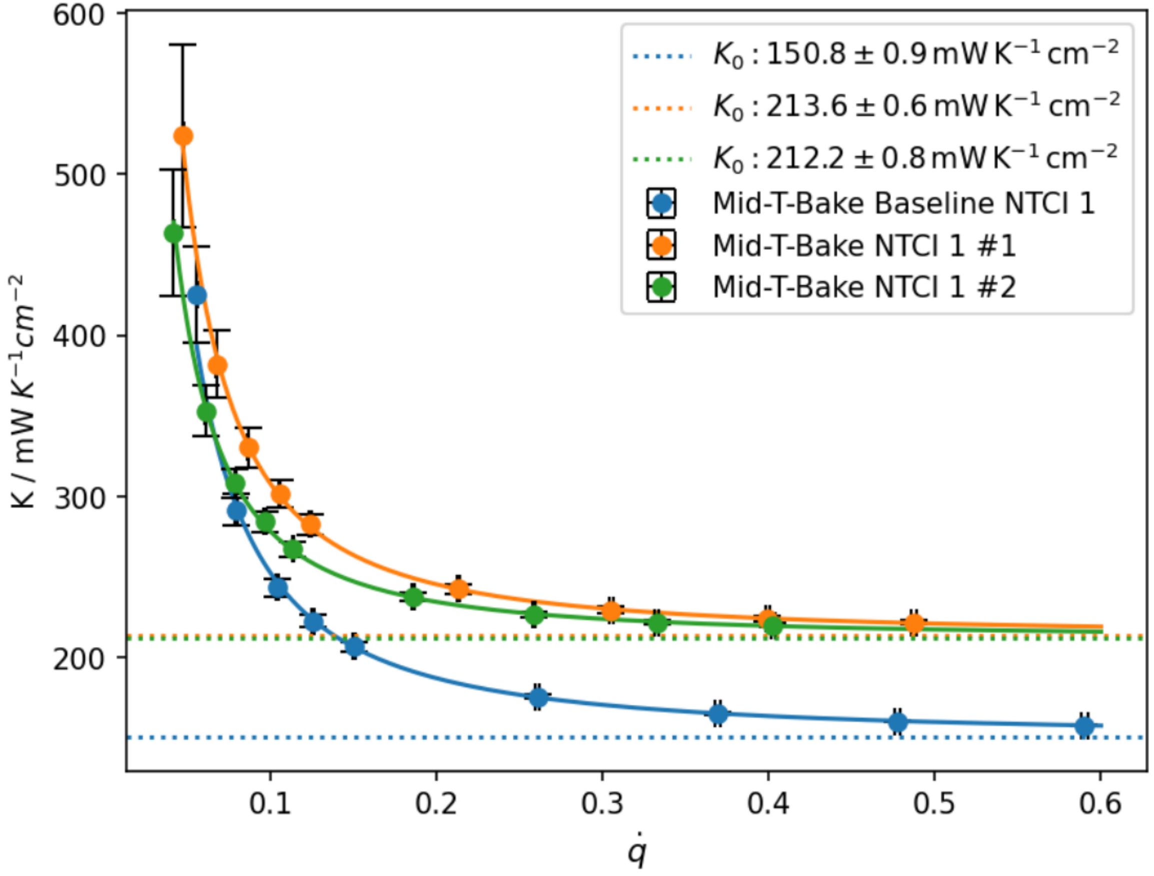




We know $A$, control $\dot{Q}$ and measure $\Delta T$

$$\underbrace{\left(\frac{d}{k} + R_k\right)}_{1/K}\dot{Q} = A \cdot \Delta T$$

*1/K* ⟶ This is what we obtain

# Mid-T treatment improves thermal transmittance




- $K_0$ of the baseline is in agreement with literature and other samples
- $K_0$ of mid-T sample (3h@300°C) is **higher**!
- All three observation are unexpected as thermal conductivity goes linear with RRR

$$k = \frac{RRR}{4}|_{4.2K}$$

- IF layer thickness *d* is meaningful (?), a negative effect of mid-T is expected

$$\frac{1}{K} = \left(\frac{d}{k} + R_k\right)$$

- $R_k$ better?

# Summary

- Three different measurements indicate an improved thermal transmittance $K \longrightarrow$ unexpected
- Thermal conductance should decrease, but might be negligible if layer is not thick
- Interface resistance could be the reason for improvement (tbd)

- Those results indicate that a *magnetic quench* and **not** a *thermal quench* is the cause for BD in mid-T baked cavities