HZB Helmholtz Zentrum Berlin

QPR results: Nb_3Sn and Nb/Cu

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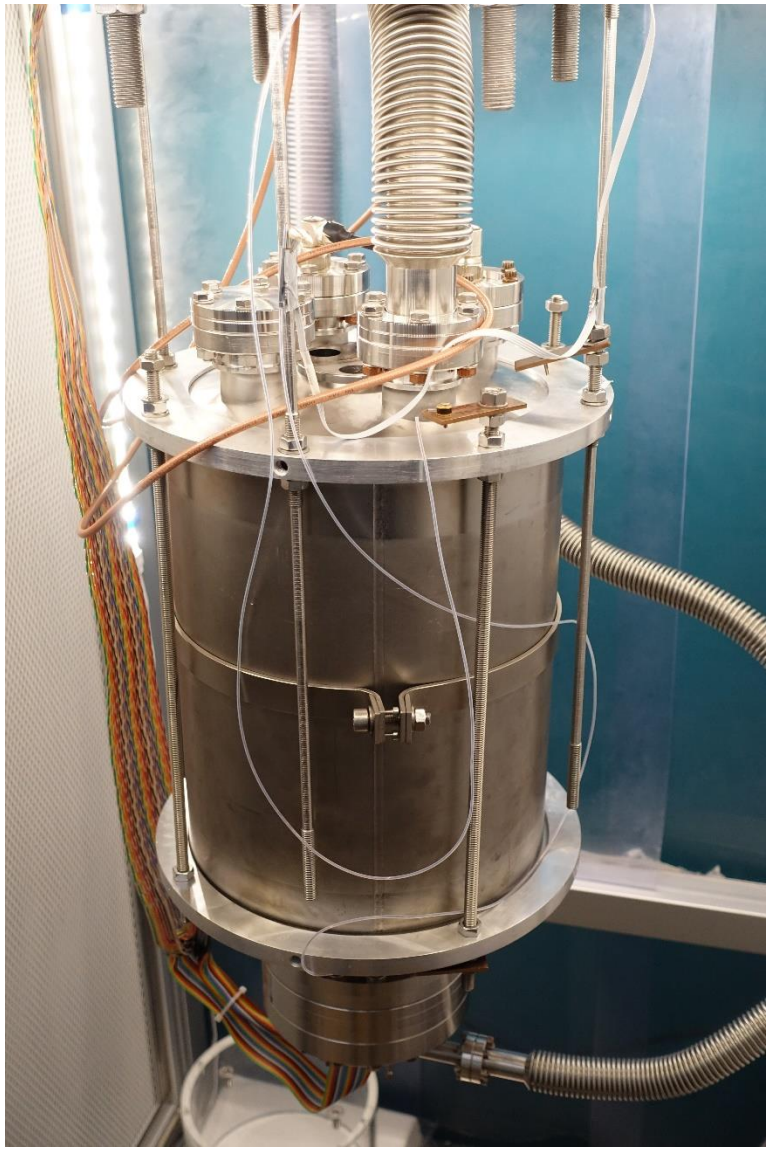
QPR runs
#39, #40, #41

Sample overview

- **Run #39: Nb_3Sn @ INFN LNL**
  - Bulk Nb substrate A5
  - No Nb baseline after chemical etching @ INFN

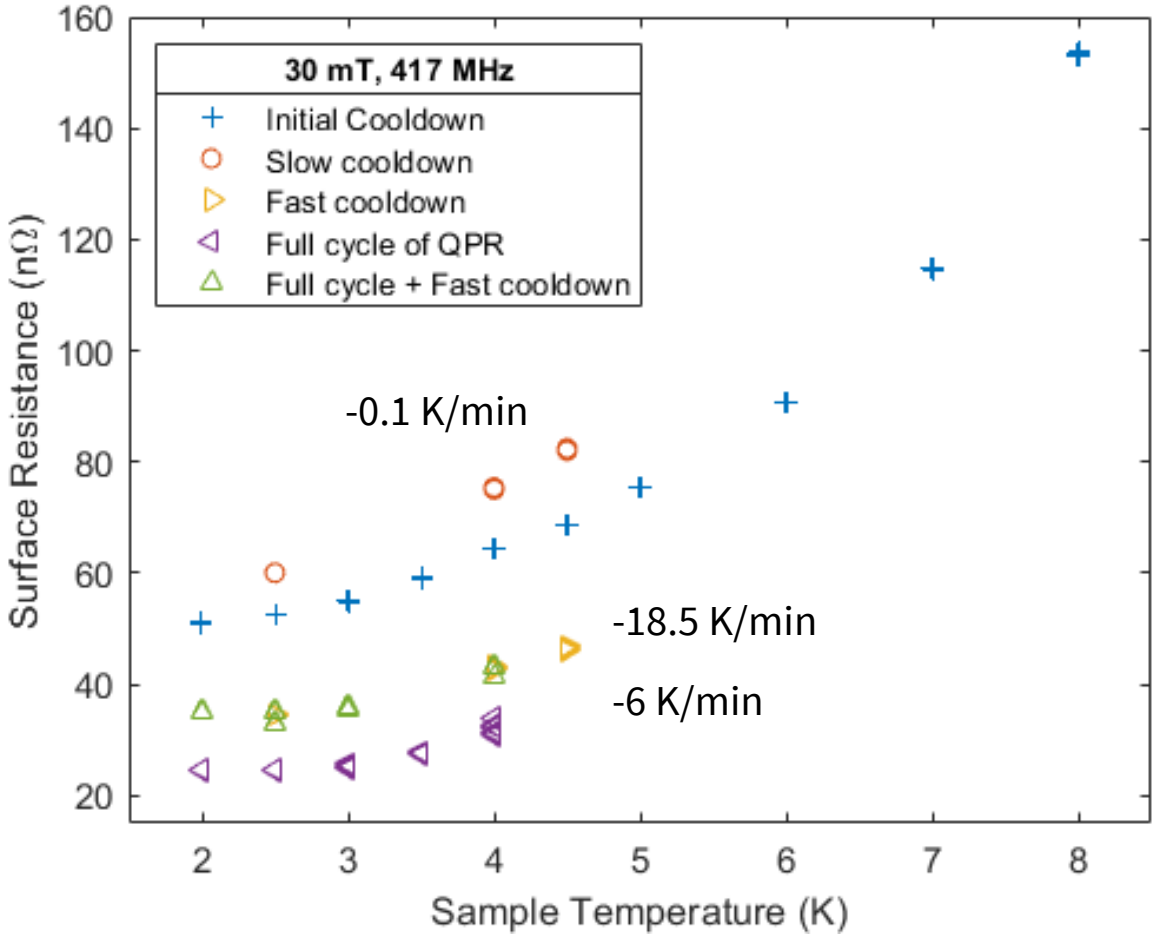
- **Run #40: Nb_3Sn @ STFC**
  - Bulk Nb substrate “1.2“
  - Metallograhic polishing @ IJCLab
  - Baseline $R_{res} < 2$ nΩ

- **Run #41: Nb/Cu @ Uni Siegen**
  - Bulk Cu substrate
  - Nb layer as base layer for bronze route

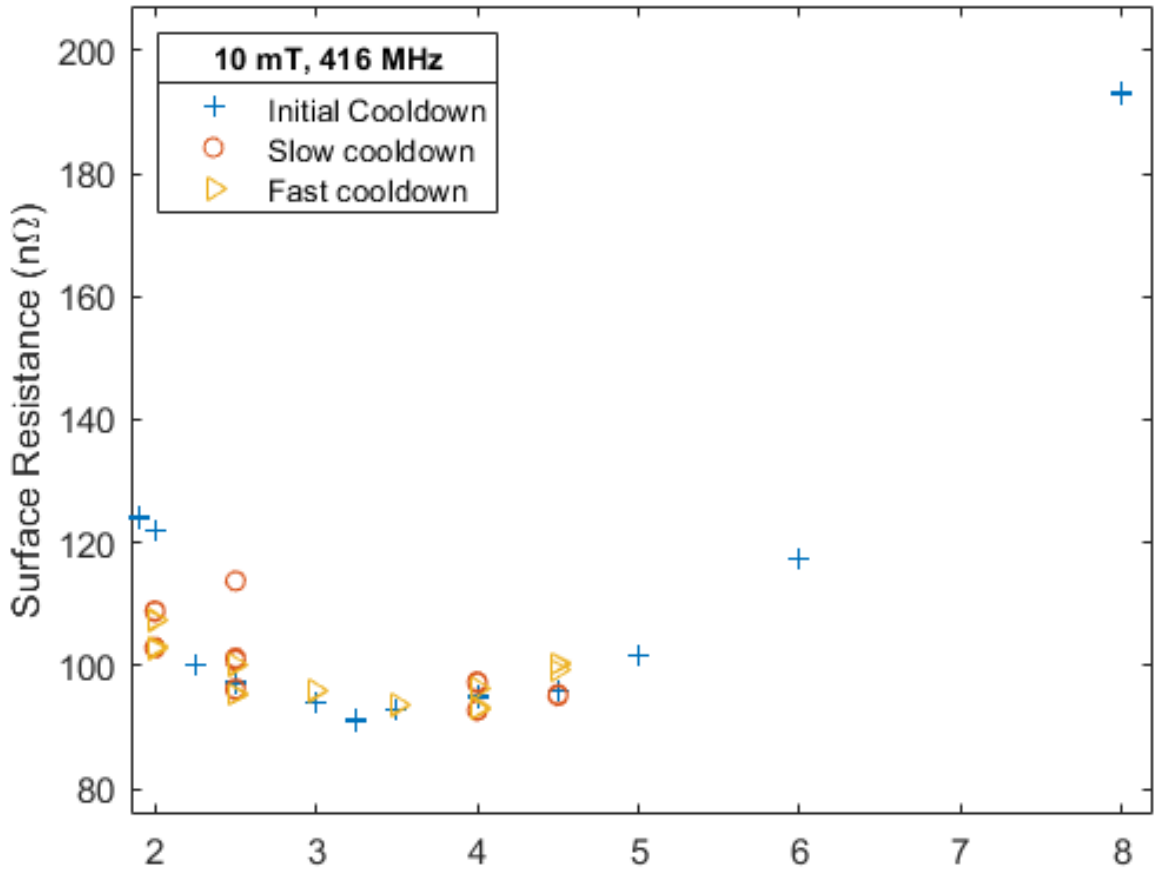


Nb_3Sn: Surface resistance vs. temperature

INFN sample, run #39

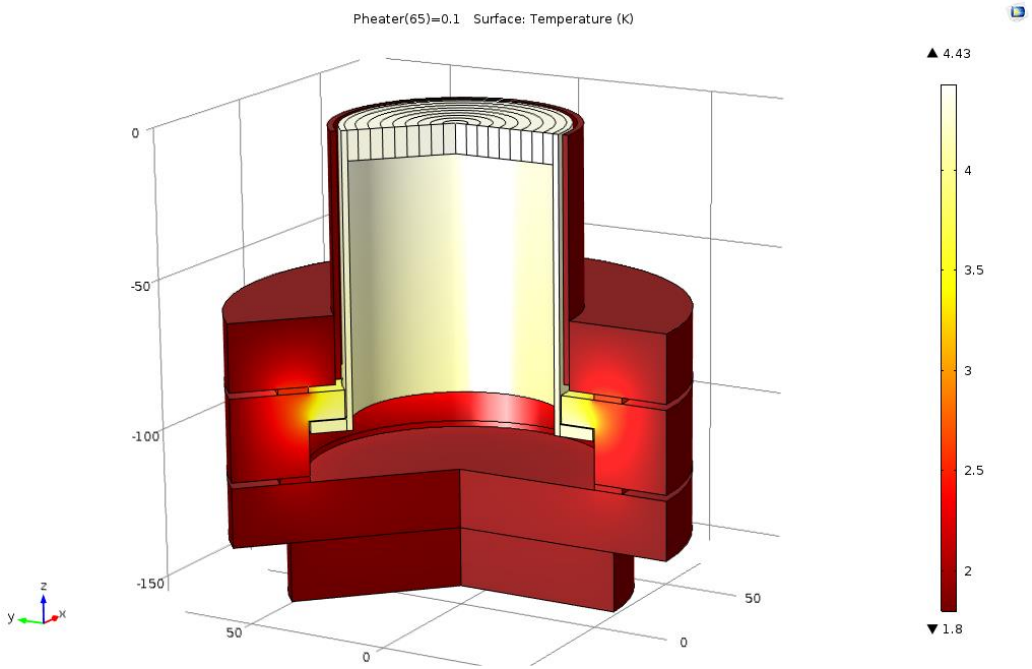


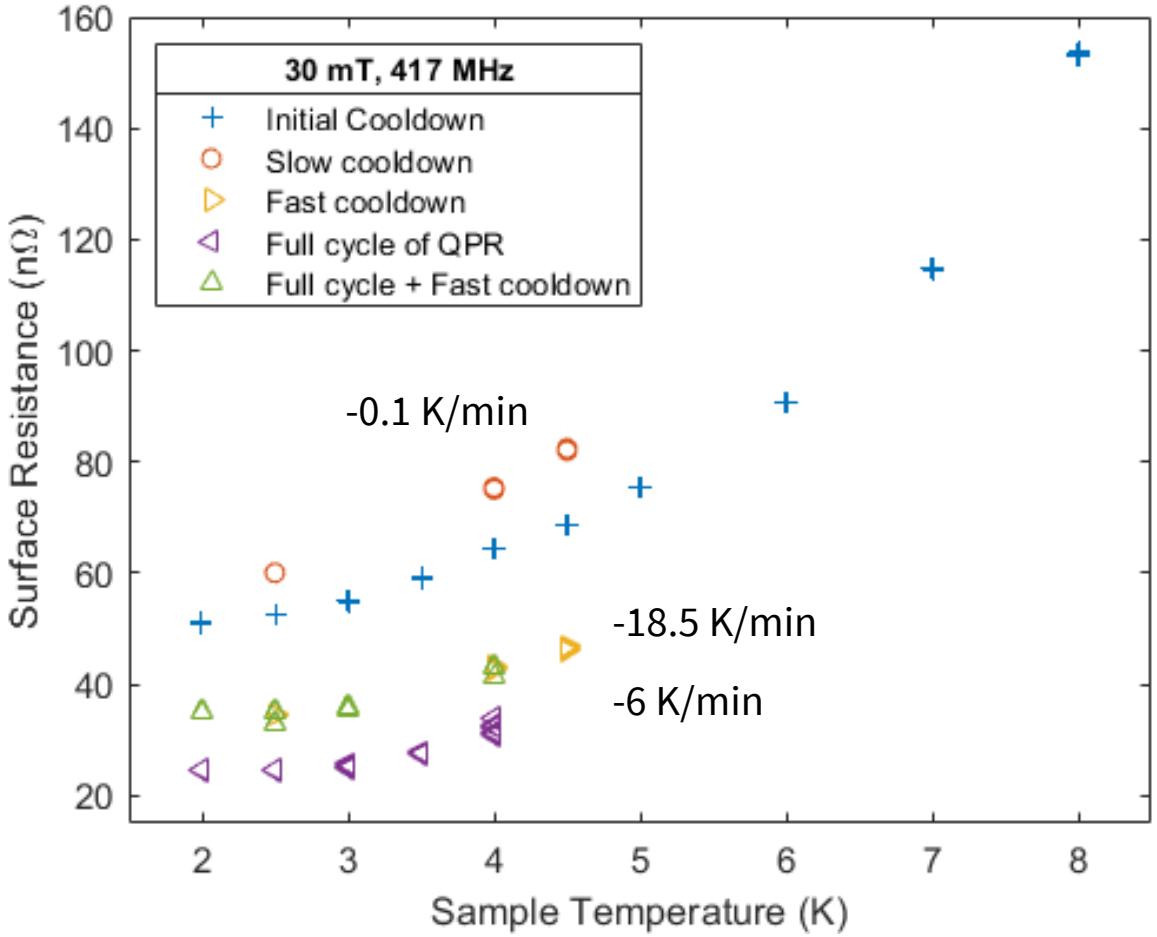
STFC sample, run #40



Nb_3Sn

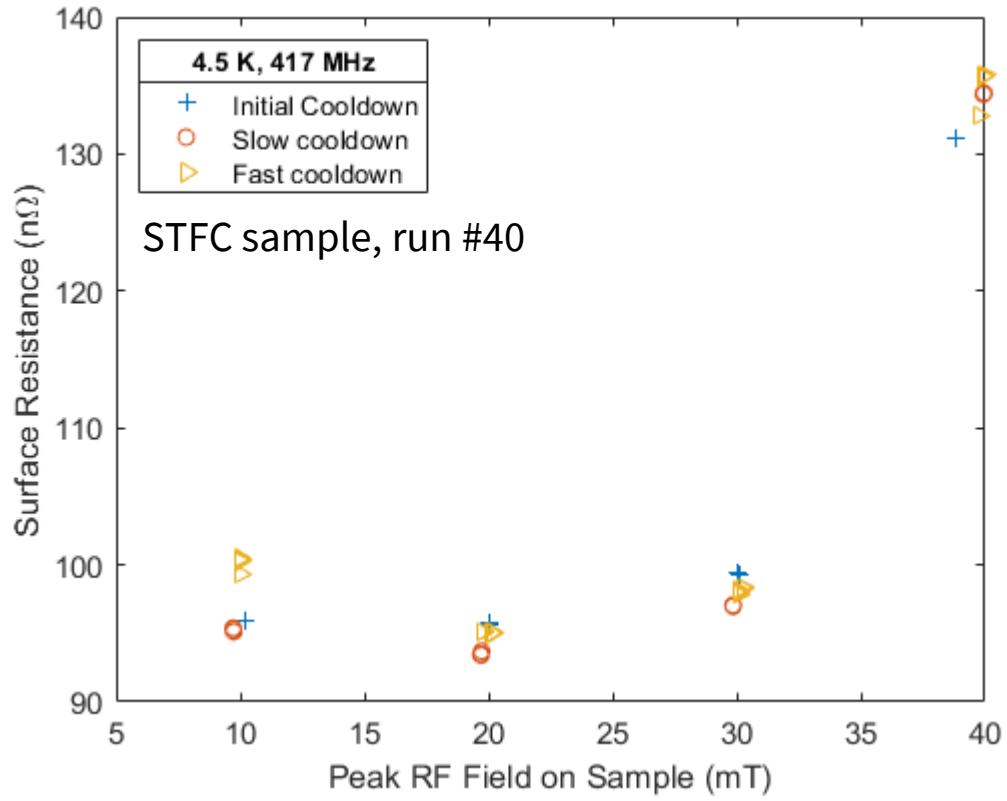
- **Nb_3Sn sputtered on bulk Nb at INFN LNL**
- **Cooling of sample very different from cavity VTS**
  - Slow coodown → increased radial T gradient
  - Fast cooldown → less T gradient
  - Full cycling → homogeneous T distribution

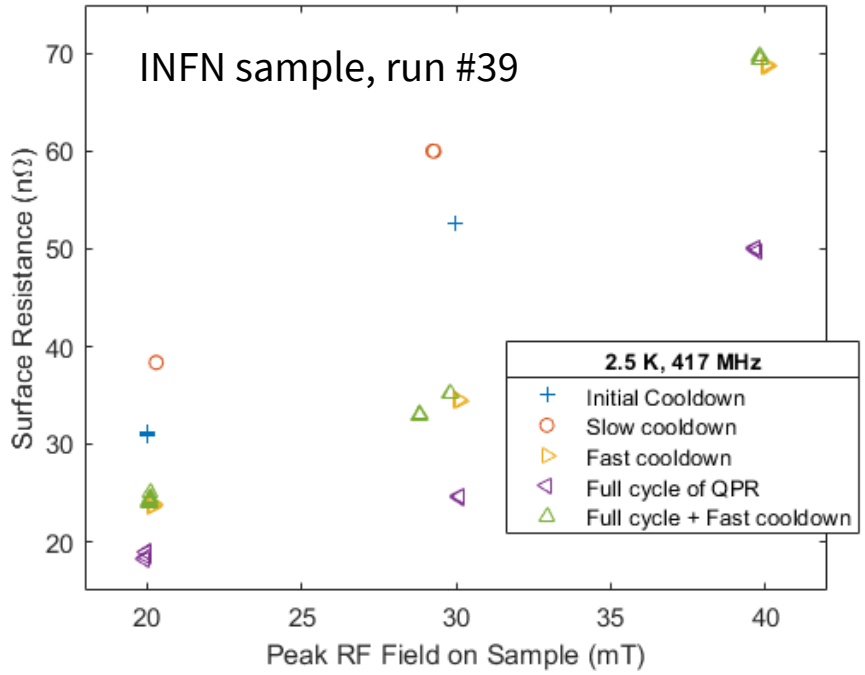


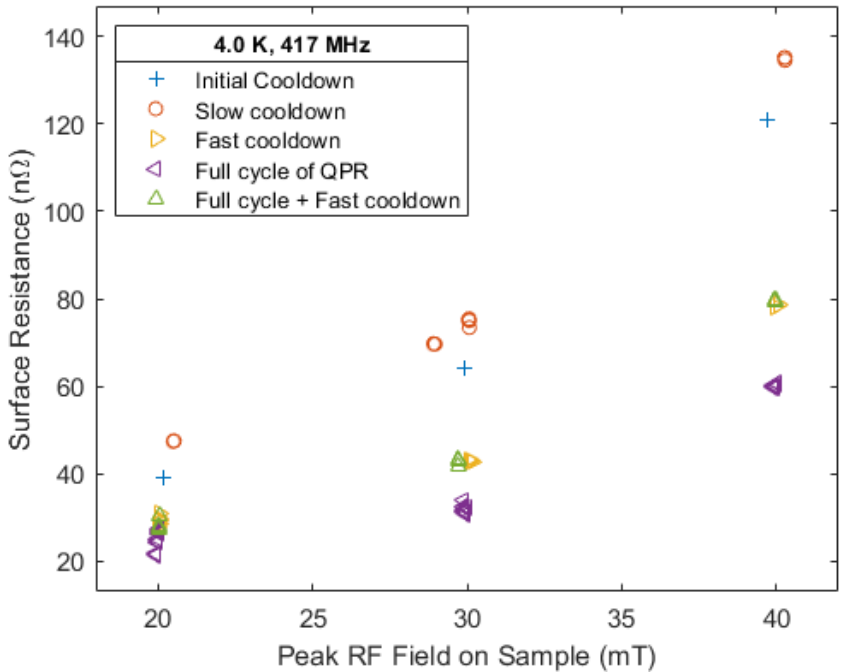


Nb_3Sn: Surface resistance vs. RF field

- **STFC sample: high R_{res} but low sensitivity to cooldown and less Q-slope**

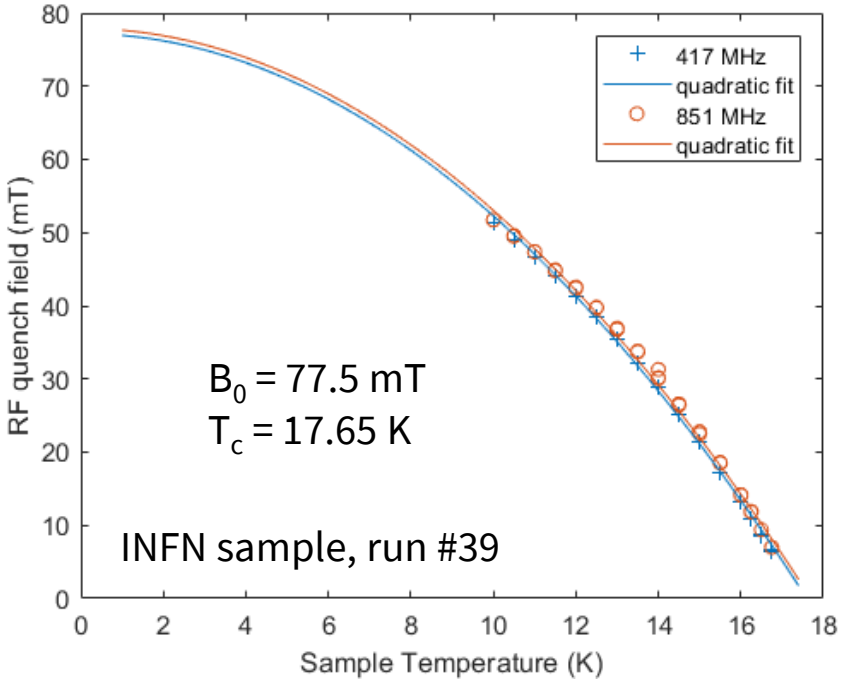


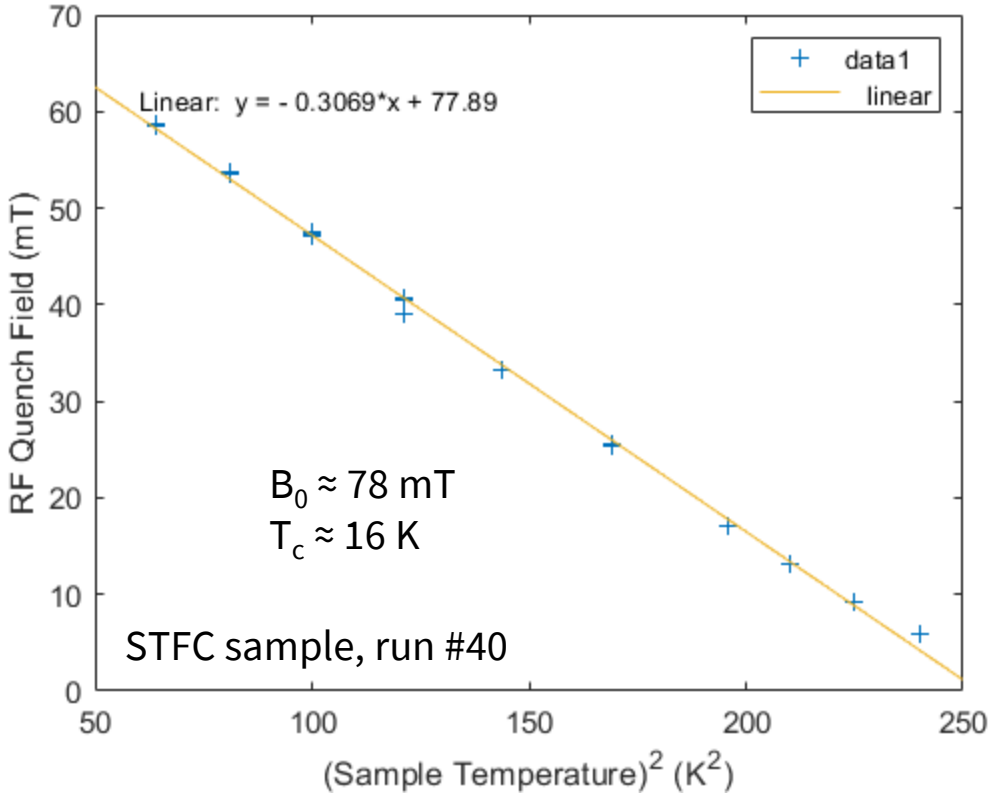




Nb_3Sn: critical field

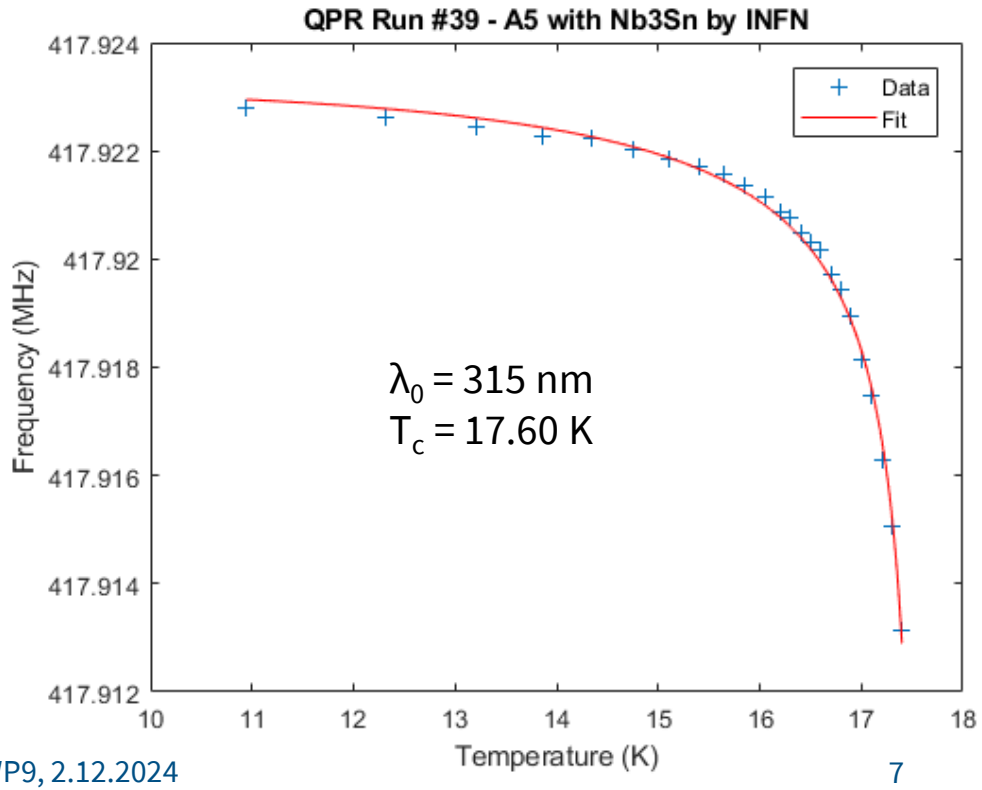
- **Quench field vs T "nicely" quadratic, but rather low B_0**
  TESLA: 4.26 mT/(MV/m) -> E_{max} = 18.2 MV/m
- **Surprisingly similar quench limits !**

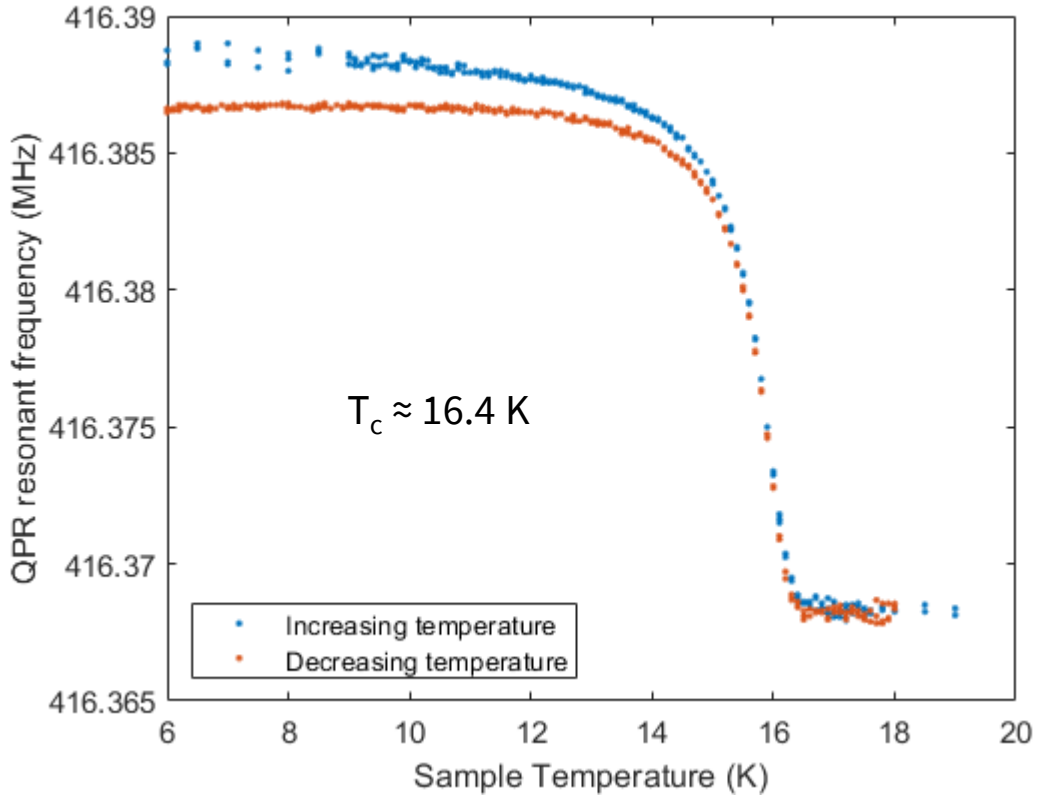




Nb_3Sn: frequency shift measurement

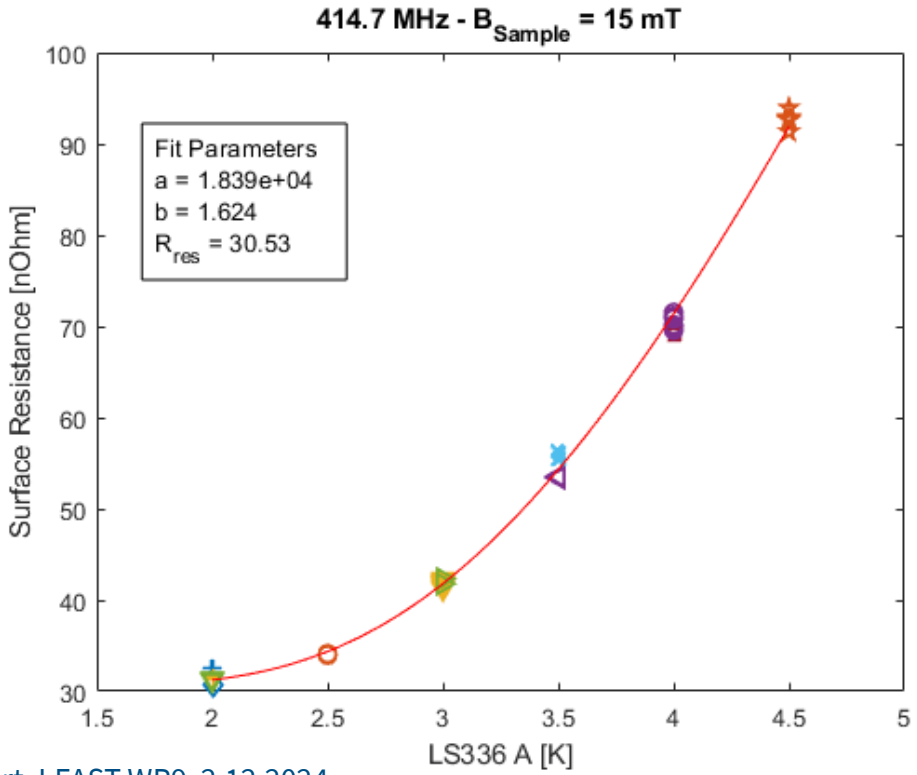
- Penetration depth and quench field data yield consistence T_c for both samples
- No penetration depth fit possible for STFC data
  → very inhomogeneous film?

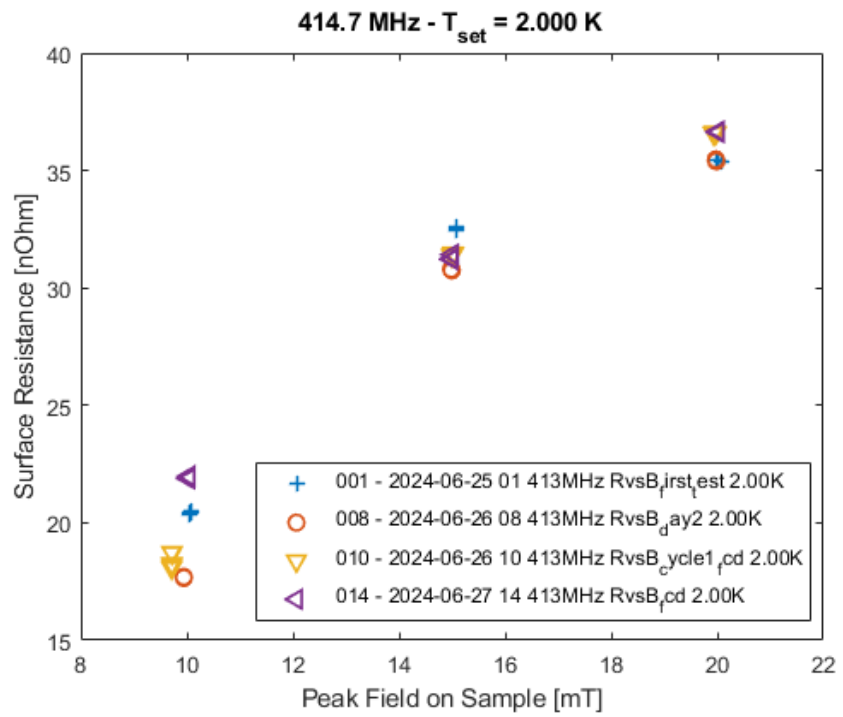


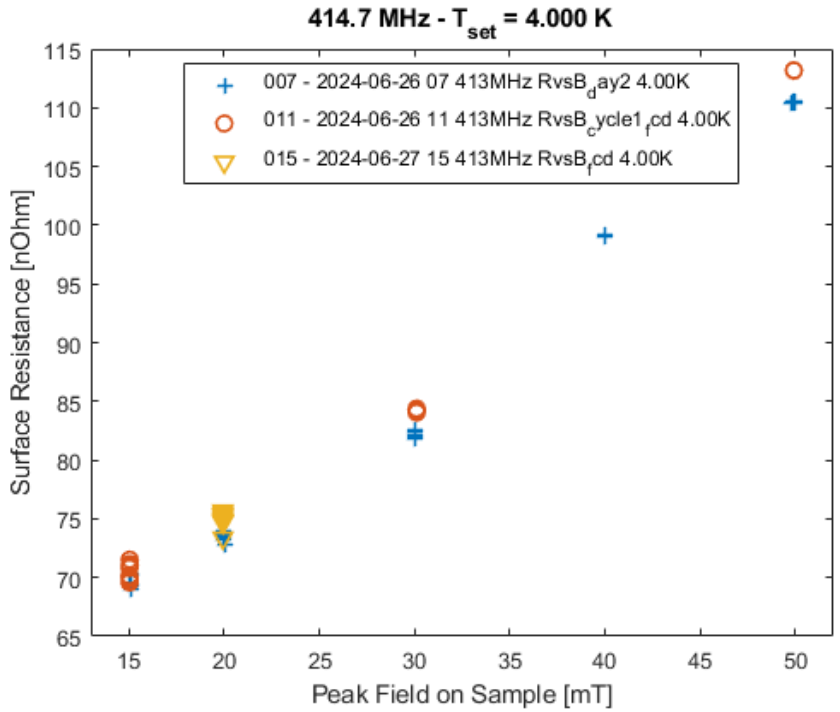


Nb on Cu: Surface resistance

- Coating at University of Siegen
- Later: Bronze route to Nb_3Sn @ HZB
- Initial cooldown and fast cooldowns show very similar R_S

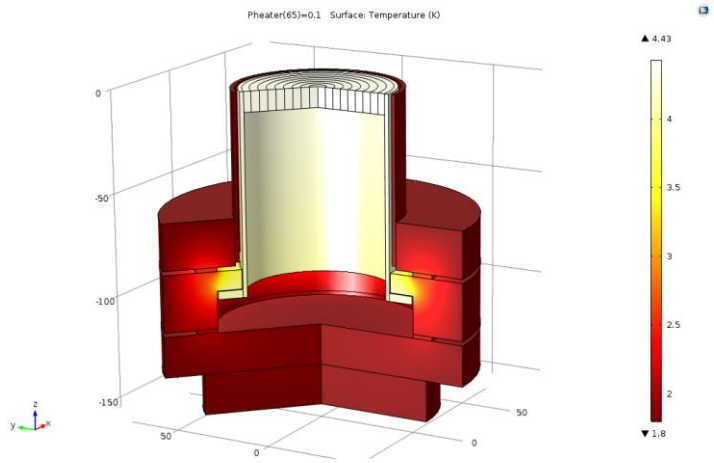


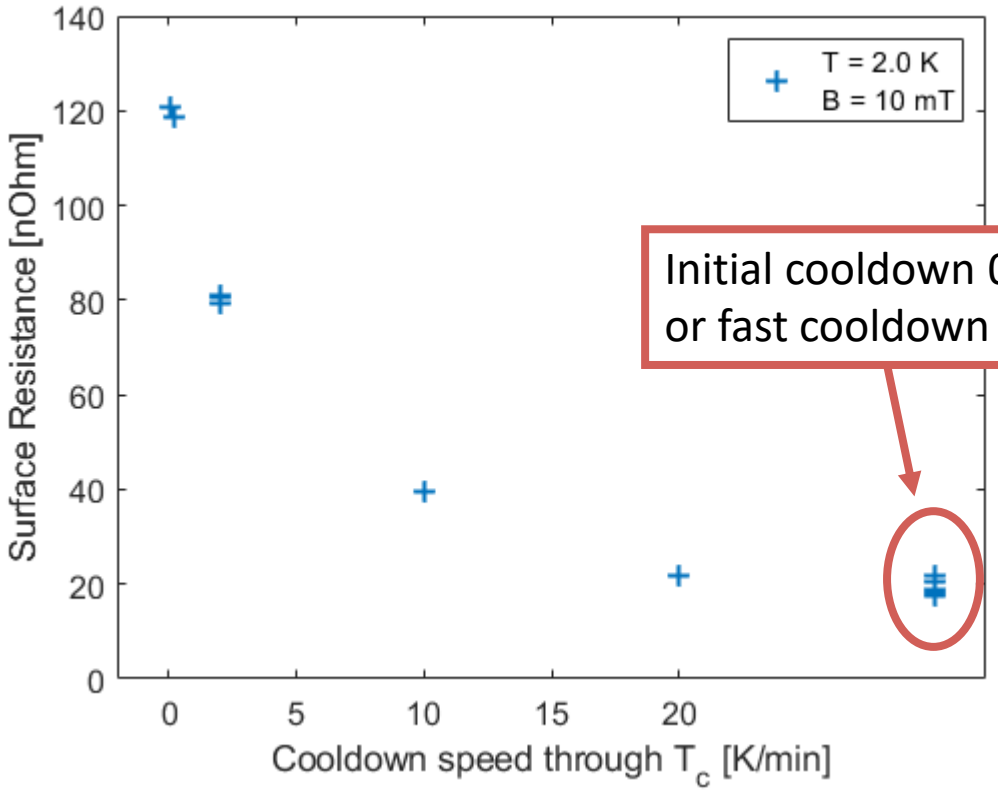




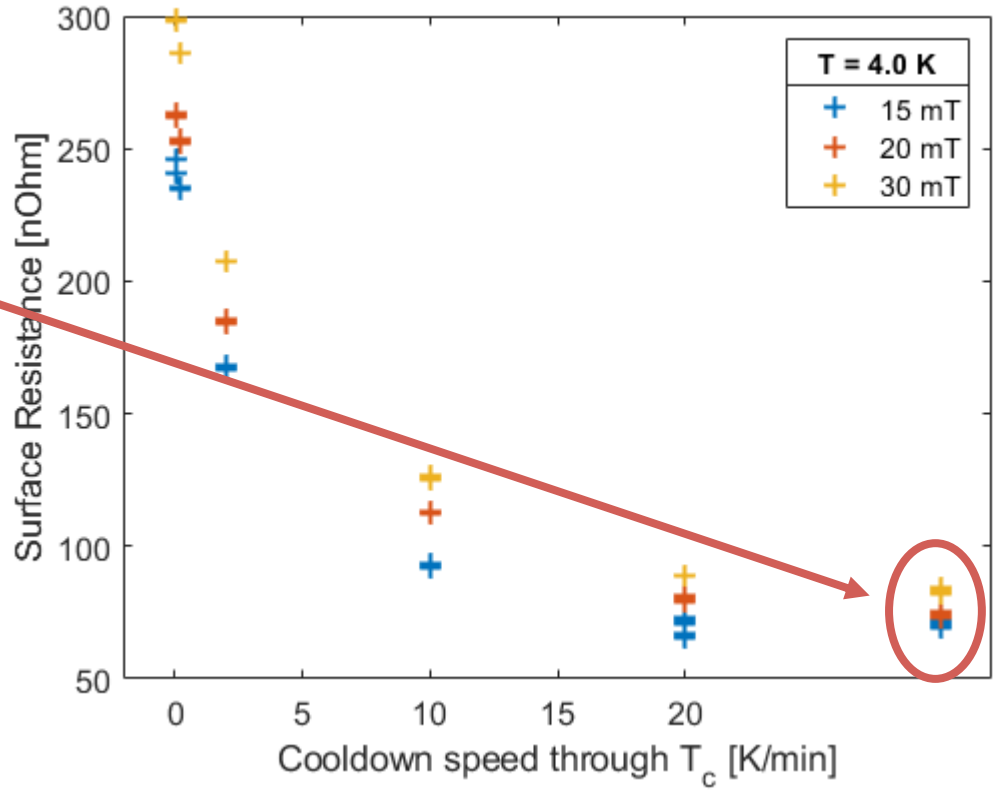
Nb on Cu: Study of cooldowns

- Similar behavior as with Nb_3Sn: slow cooling → high R_S
- QPR: slow cooling = heater ON → radial T gradient





Initial cooldown 0.4 K/min
or fast cooldown 23 K/min



Nb on Cu: RF quench field

- Good T_c and high B_0
  but as usual: high uncertainty when extrapolating to 0 K
- R_{res} = 30 nΩ is not correlated to a lower quench limit
- $T^{2.7}$ describes data best, but still gives B_0 = 190 mT