



Science and
Technology
Facilities Council



Progress with RF Characterisation facility at STFC

*3rd IFAST WP9 Meeting
17th November 2021*

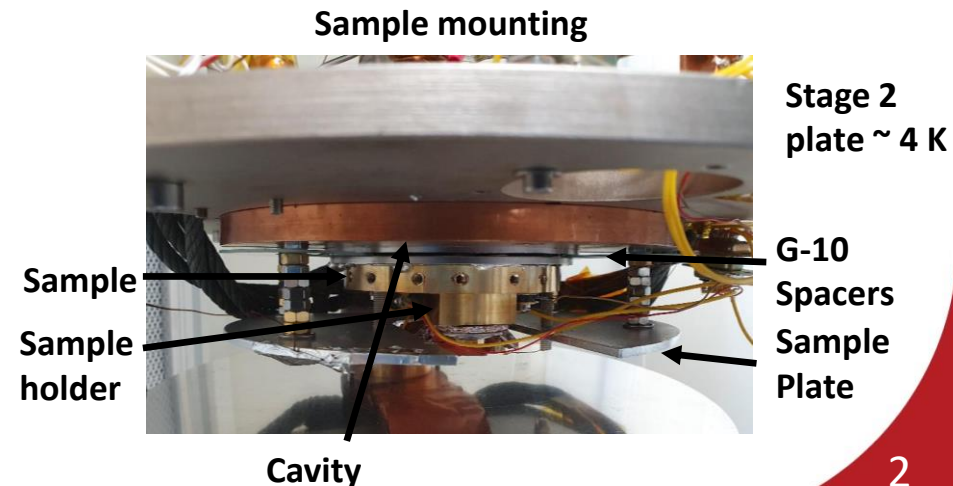
Daniel Seal

*Lancaster University/Cockcroft Institute
daniel.seal@cockcroft.ac.uk*



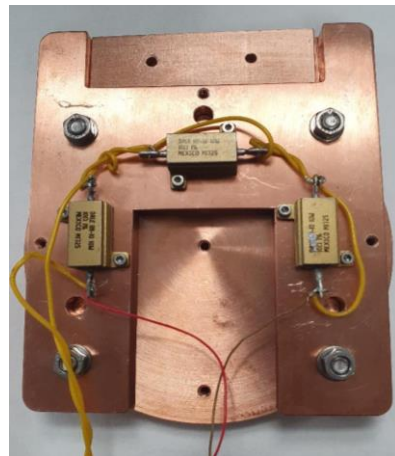
The Facility

- Measurements of R_s with RF-DC compensation using Nb choke cavity (3 choke or 2 choke)
- Test planar samples **90 - 110 mm** diameter with **2 to 3 day turnaround** between tests
- So far allows measurements of:
 - R_s under RF at **7.8 GHz**
 - $T_s = 4$ to **10 K**
 - **RF Power up to 1 W**
 - $B_{s,pk} \leq 0.8$ mT
- Commissioned with bulk Nb discs
- Two Nb on Cu samples tested
- Addition of pickup antenna in progress



Samples

Sample Holder



Sample



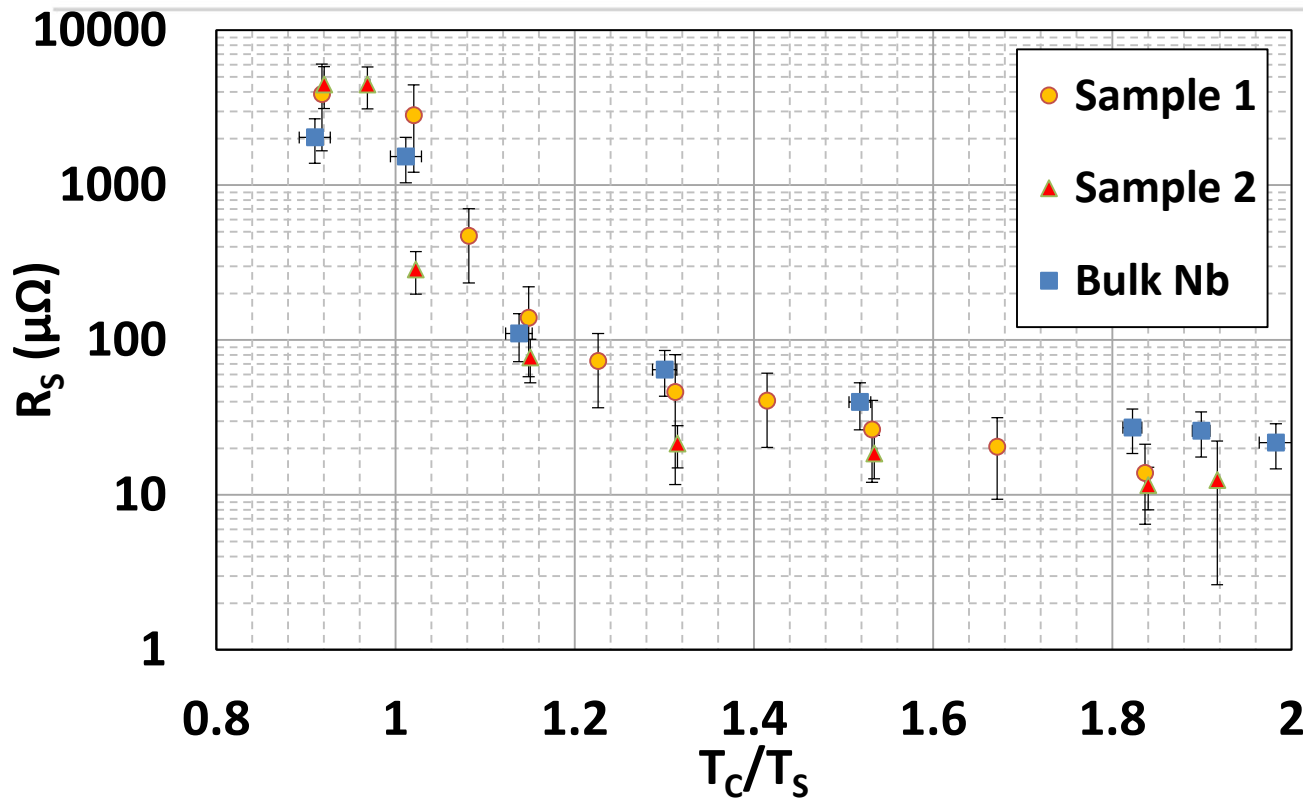
Design 1

- Sample heated to $\sim 160^{\circ}\text{C}$ and indium brazed to sample holder in separate facility
- Use with Nb and Cu discs 100 mm in diameter, few mm thick
- Thermometers only mounted to sample holder

Design 2

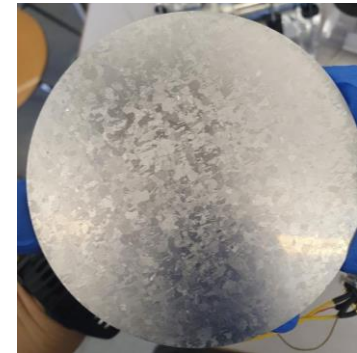
- Sample bolted to sample holder around edge for improved thermalisation
- Cu discs ~ 110 mm diameter with drilled holes to avoid indium brazing
- Thermometers can be mounted directly to sample
- Thermal gradient between centre and edge \sim few mK

Preliminary Results – Nb on Cu



- Cu mechanically polished with diamond abrasive
- Surface analysis yet to be made

Sample 1 - 600°C



Sample 2 – Room temperature



- Nb on Cu compared with best bulk Nb measurements (other measurements shown in previous meeting)
- Errors mainly due to uncertainties in stored energy measurements from using single coupler → will add a pickup (+SEL) to reduce this

Summary

- Facility for measuring R_s of planar samples is operational and is now being used to test thin film samples:
 - **Planar sample diameter: 90 – 110 mm**
 - **Frequency: 7.8 GHz**
 - **Temperature range: > 4 K**
 - **RF Power up to 1 W**
 - **$B_{s,pk} \leq 0.8$ mT (maximum for samples tested limited by microphonics)**
- No sample-cavity welding will allow for 2 sample tests per week
- System can be used in addition to QPR
- Higher resonant frequency (7.8 GHz) and lower power compared with QPR and limited to one frequency
- In the process of adding a pickup probe for more accurate stored energy measurements
- Send cavity + bulk Nb samples to INFN for BCP