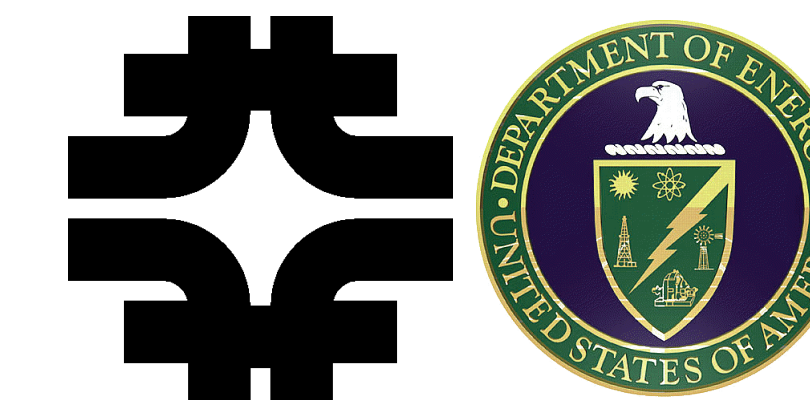


# TEST STAND FOR ROUTINE THERMAL CONDUCTIVITY MEASUREMENTS OF SRF CAVITY

## MATERIAL

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## Motivation

Cavity manufacturing is a long and labor-intensive process that involves multiple steps. Current specifications for the SRF cavity material require a number of quality control operations, including measurements of RRR, grain size and tensile properties. Unfortunately, these measurements are not sufficient to insure quality of the cavity. Thermal conductivity has great influence on Q-factor of the cavity. We argue that thermal conductivity cannot be accurately estimated with current approach and additional control of thermal conductivity of Nb sheets is required to minimize rejected percentage.

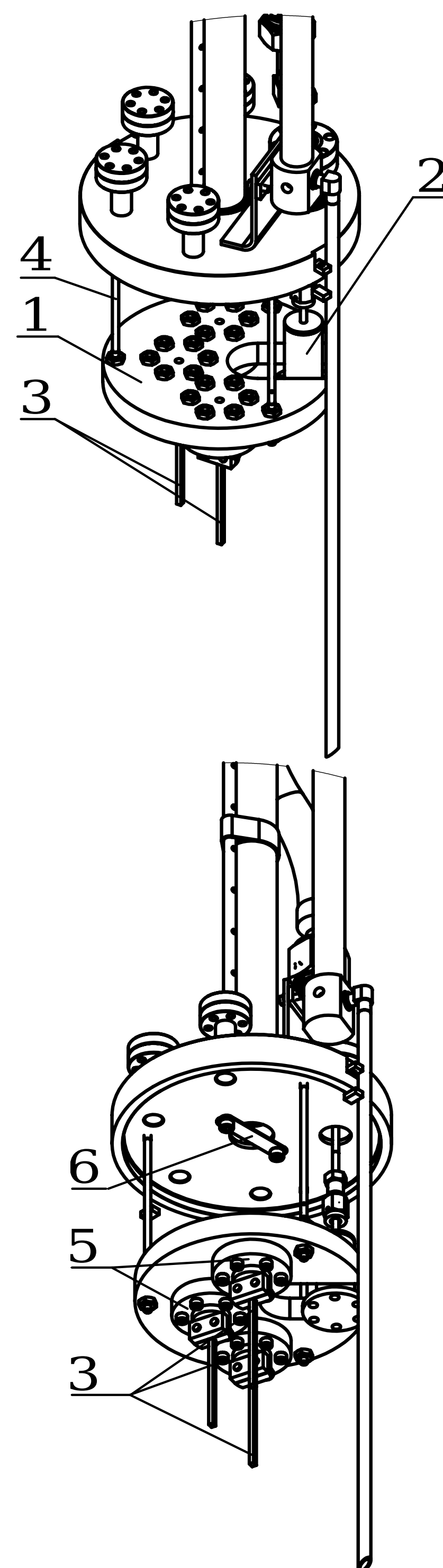
## Design

The design of the test stand should satisfy several requirements based on proposed application and location of the apparatus. The test stand should also provide capabilities to measure thermal conductivity and heat capacity for research purposes.

### Requirements:

- Integration into existing cryogenic system
- Independent work mode without connection to cryogenic system
- Temperature range:  $\approx 1.6 - 10\text{ K}$
- Temperature stability  $\leq 50\text{ mK}$  at low end of temperature range
- Adequate accuracy of measurement of thermal conductivity
- Different sample shapes
- Multiple samples per operating cycle
- Automated measurements

The main part of the test stand is Thermal Properties Research Insert for the existing Cryofab wide neck dewar. Vacuum chamber is submerged into liquid He inside the dewar and contains samples (3), sensors and other instrumentation. Continuous flow He evaporation refrigerator (2) provides cooling to Copper platform (1). Thermal bridge with low thermal resistance connects the platform to the refrigerator for increased thermal stability. Replaceable sample holders (5) provide good thermal contact to the Copper platform. Hollow supports (4) and baffles inside the pump-out line (6) reduce heat leak to the low temperature part of the test stand.



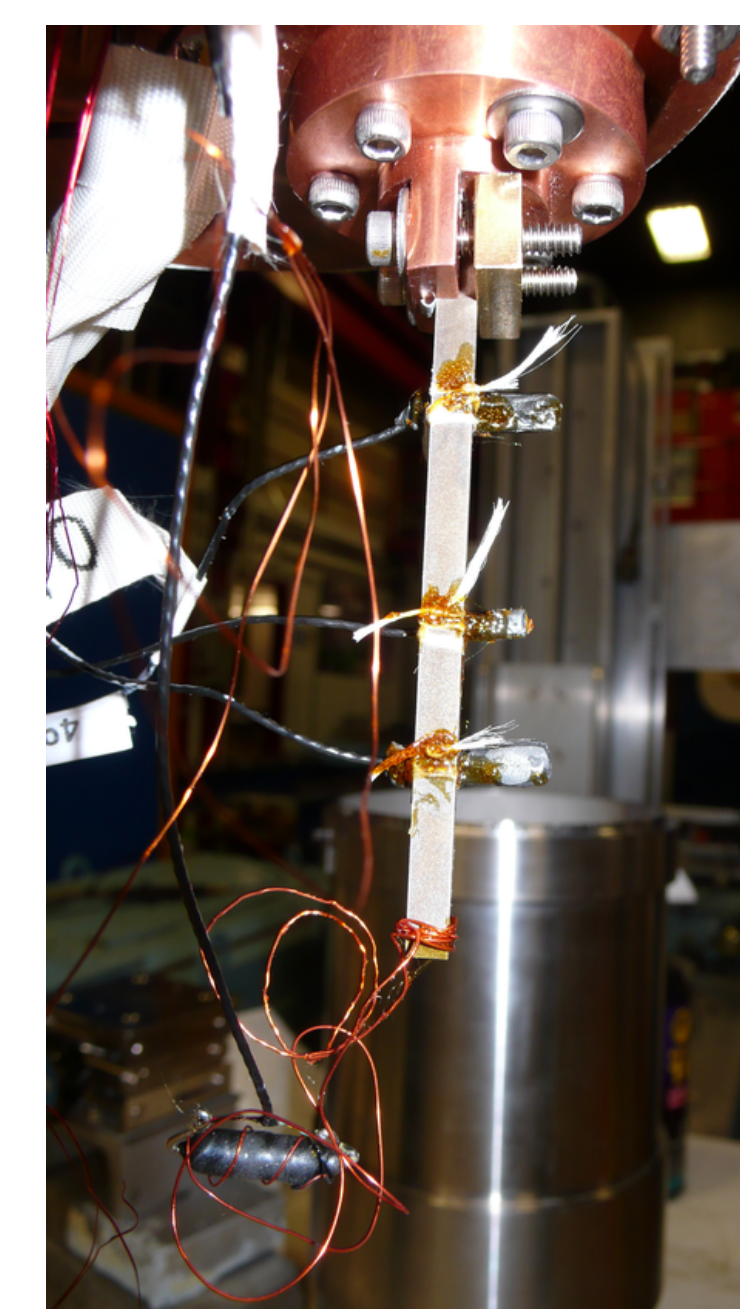
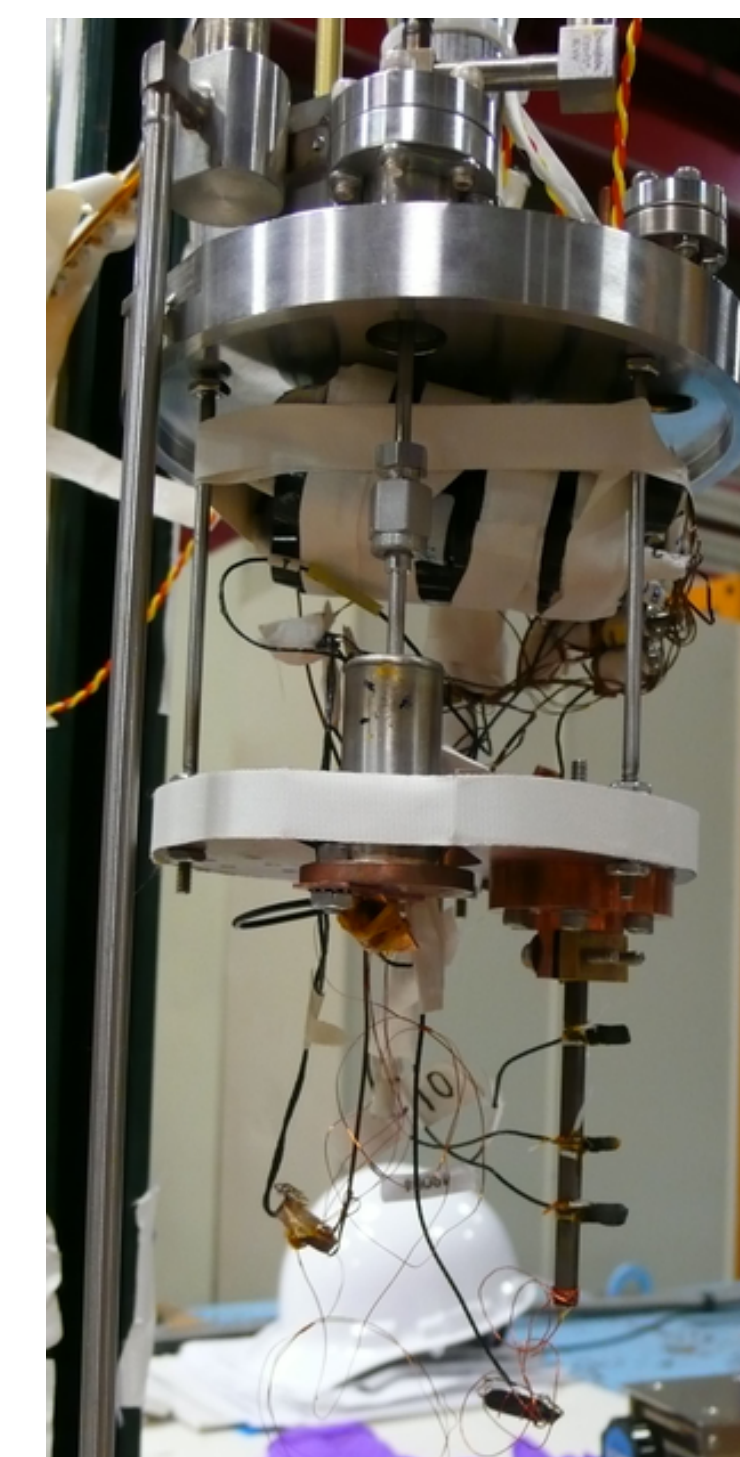
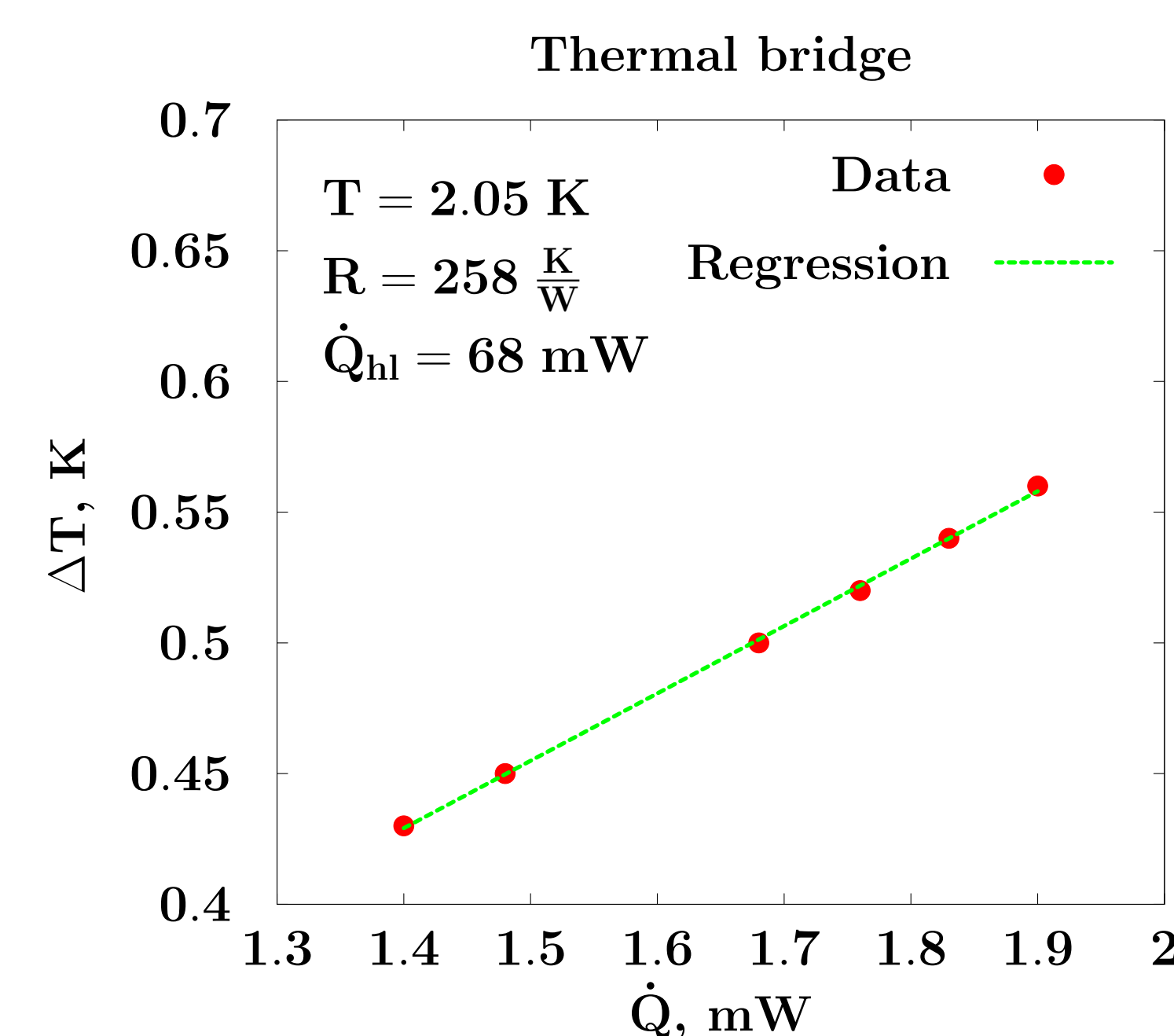
## Thermal Properties Research Insert



### Specification

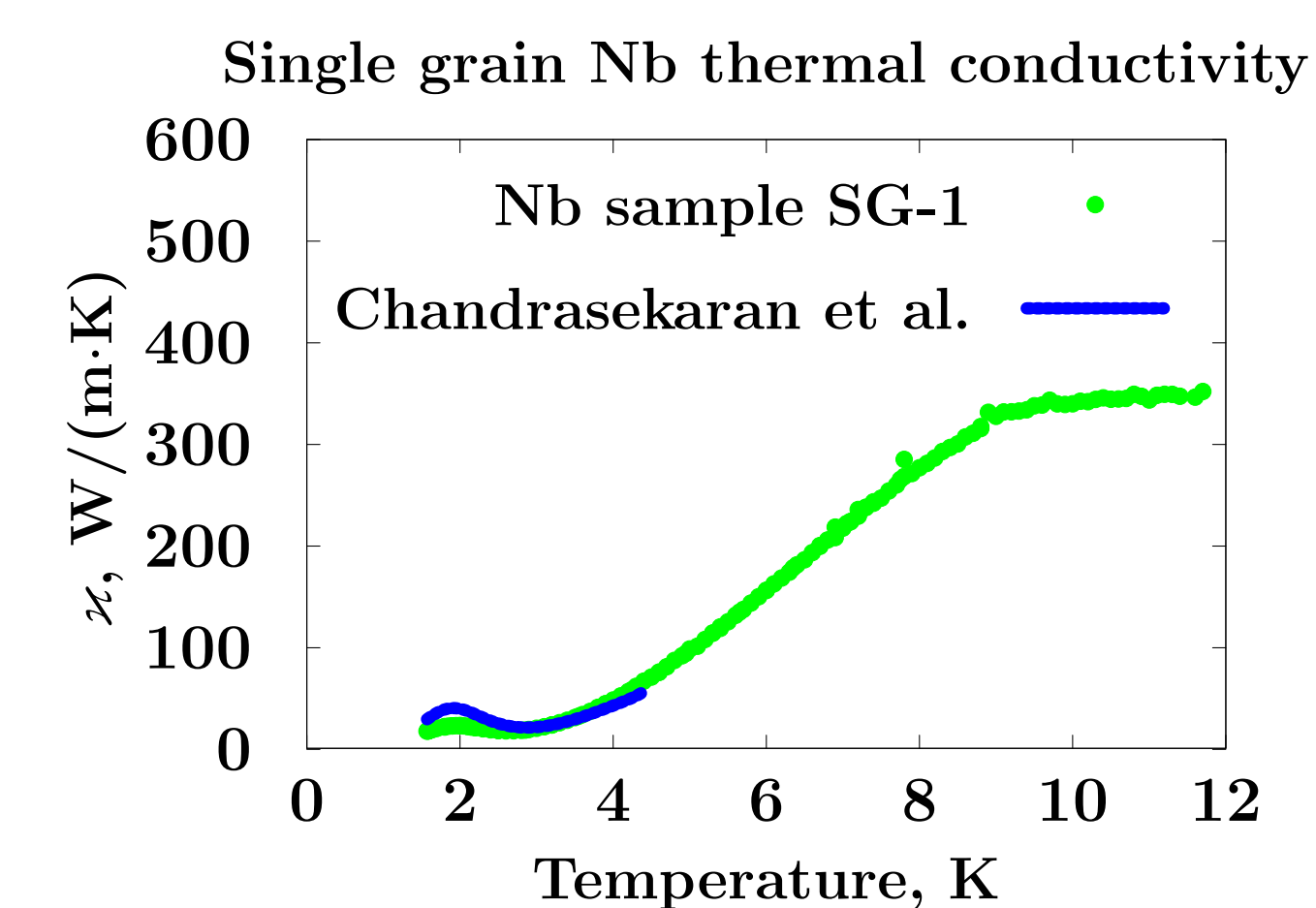
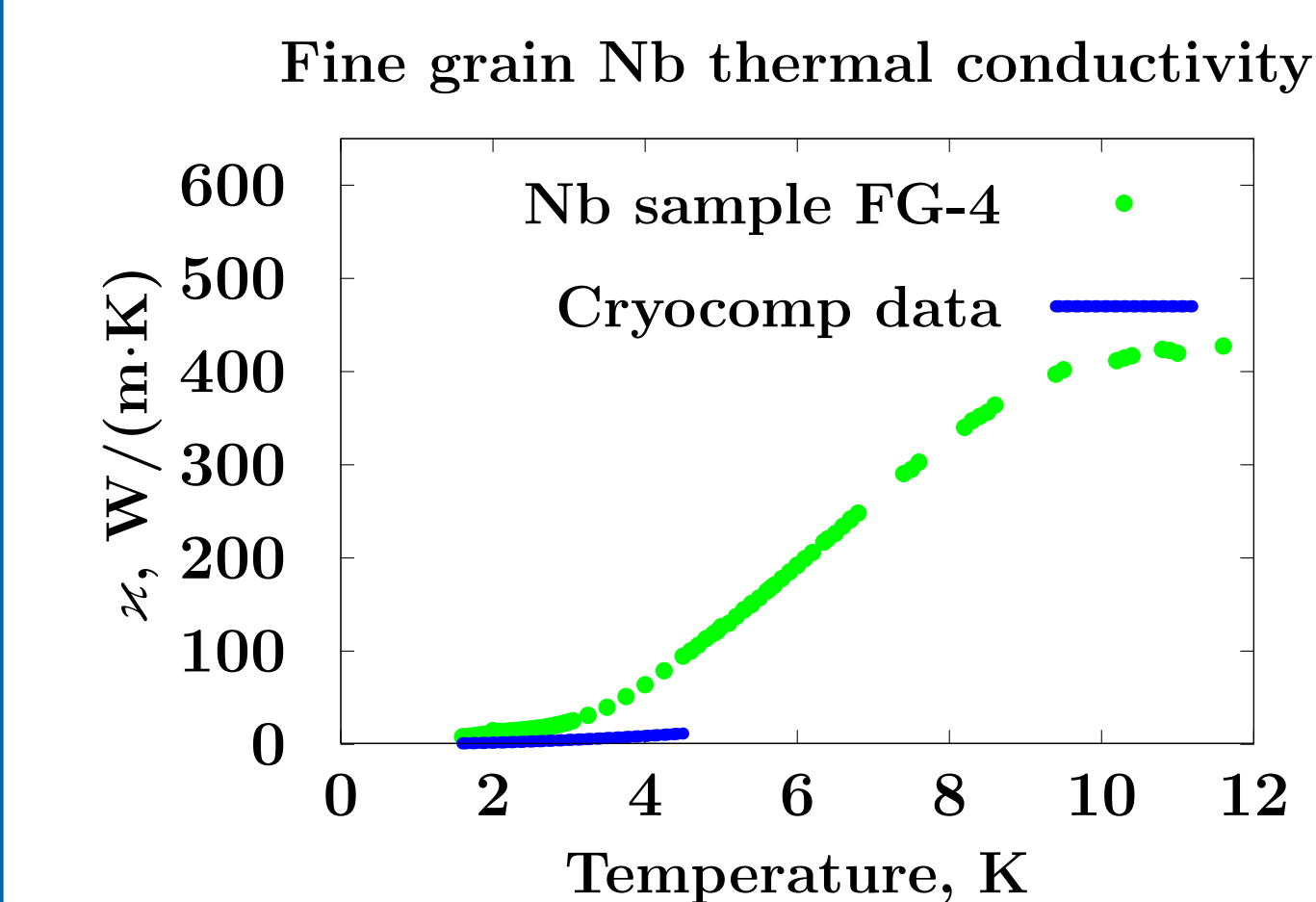
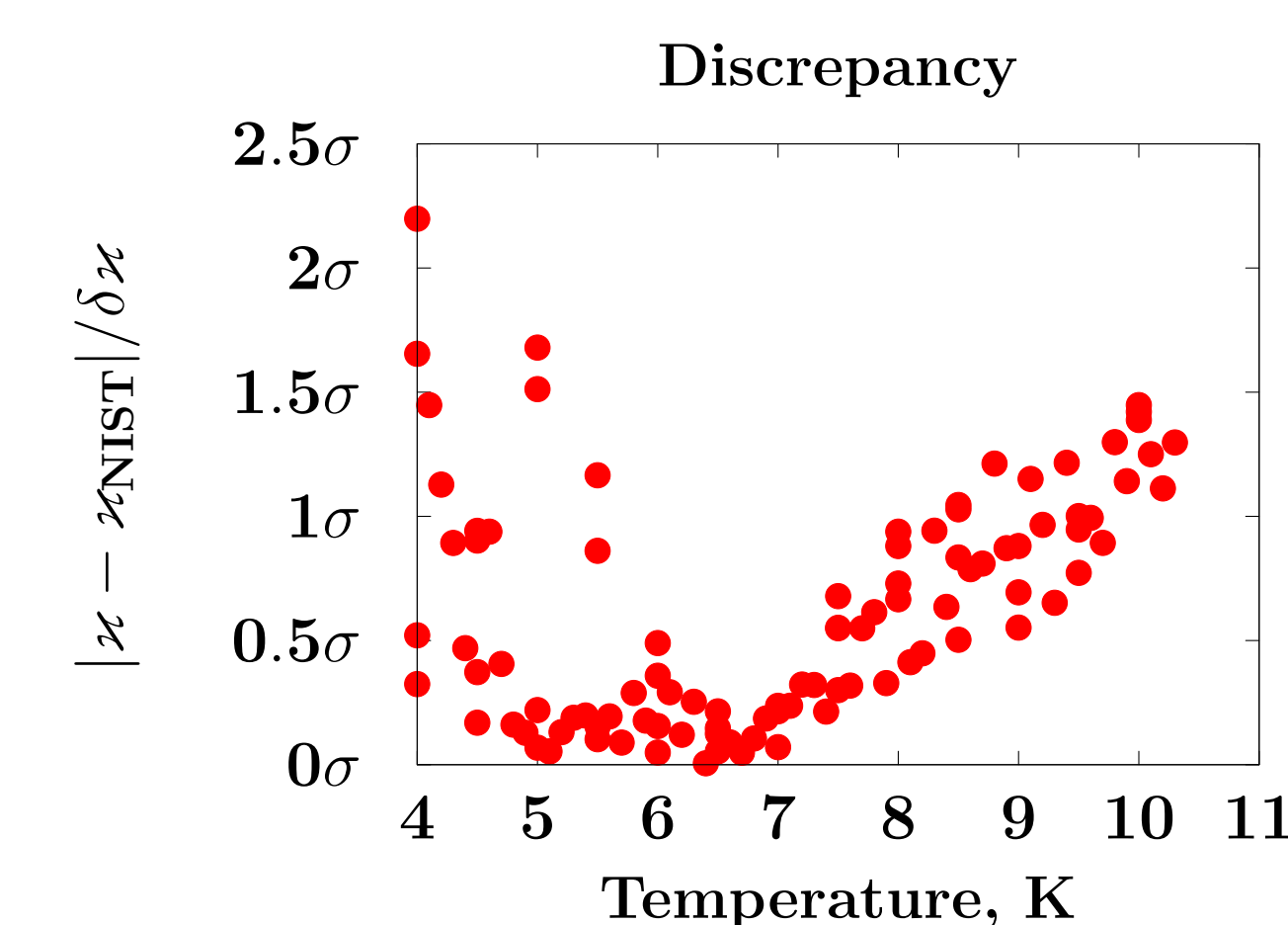
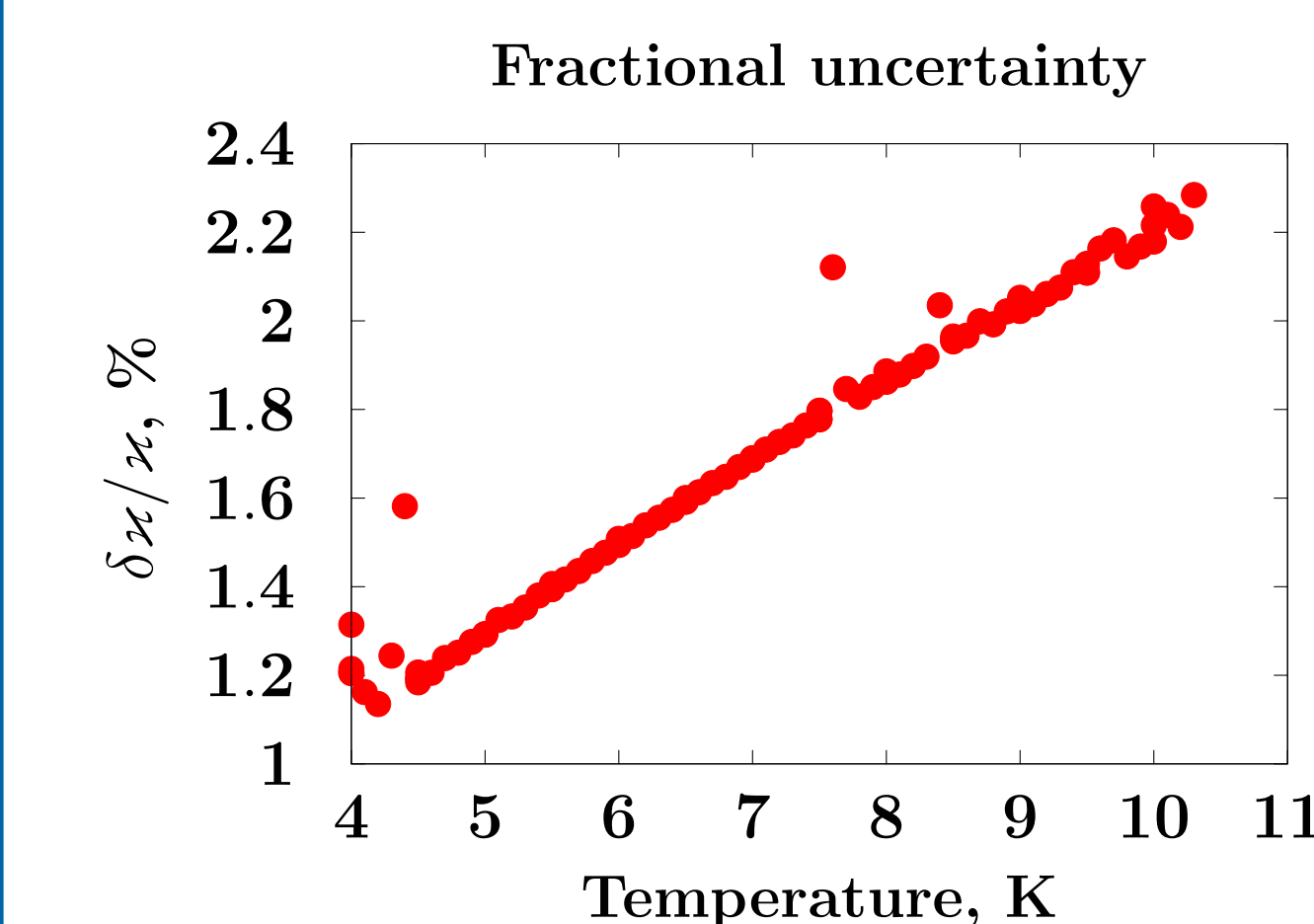
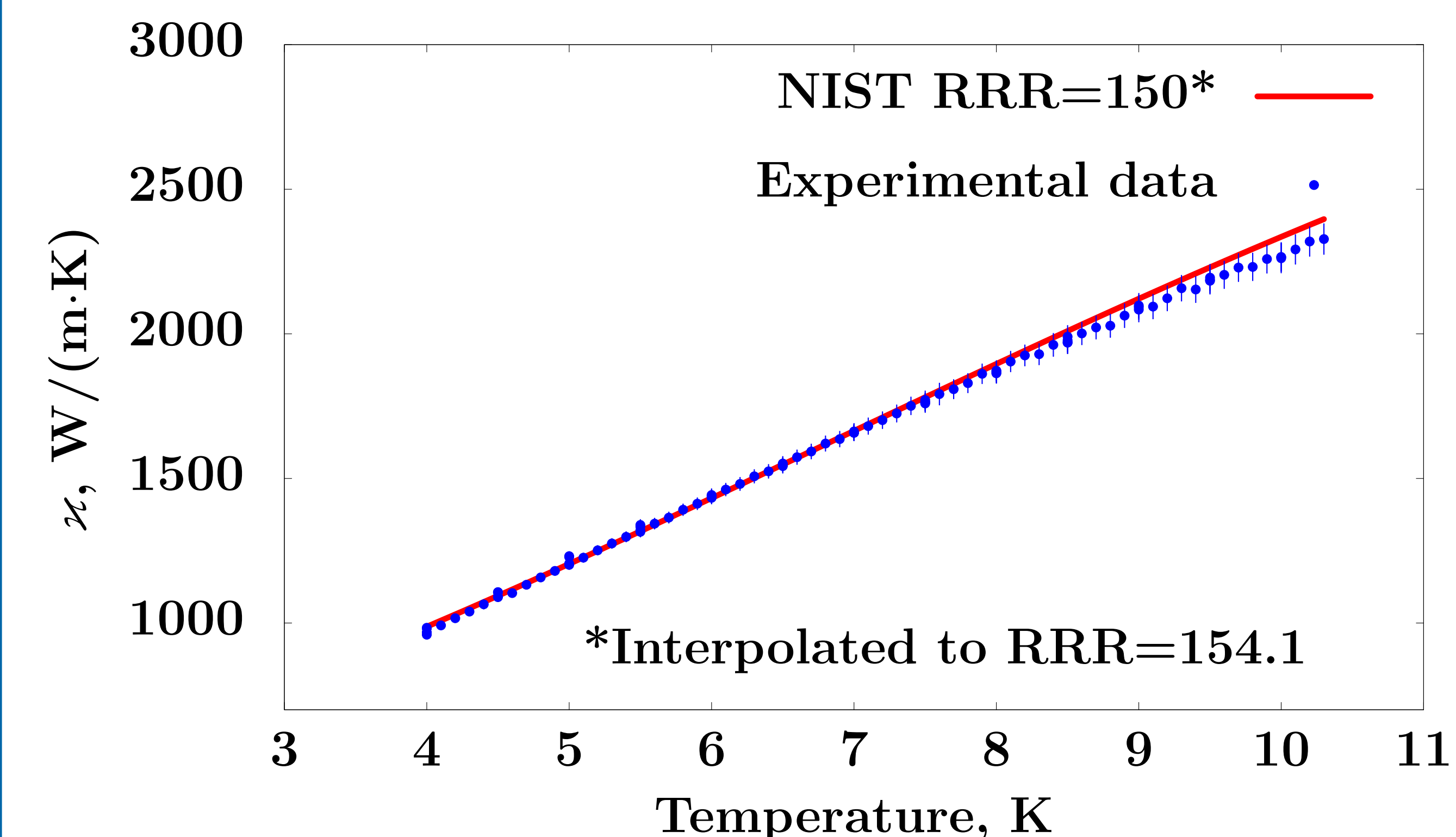
- Cooling capacity:  $\approx 70\text{ mW}$
- $4.5\text{ K}$  He bath
- Vacuum chamber pressure:  $\leq 10^{-5}\text{ torr}$
- Heat leak:  $68\text{ mW}$  at  $2\text{ K}$
- Temperature stability  $\leq 30\text{ mK}$  below  $4\text{ K}$
- Cryogen consumption:  $0.07\text{ L/hr}$
- 5 mil capillary tube with 4 mil Ni wire
- Holder for heat capacity measurements

Linear regression analysis of heater power vs temperature difference between the platform and the refrigerator is used to estimate cooling capacity and the heat leak values.



## Results

### Copper thermal conductivity



## Conclusions

The test stand provides capabilities of routine measurements of thermal conductivity of SRF Nb samples with low operating and maintenance requirements. High accuracy and flexibility allows to use the test stand for research purposes.