moduleqnc
quantum & neuromorphic computing

Examining cryo-compatible devices and superconducting materials

Cryogenic characterization capacities

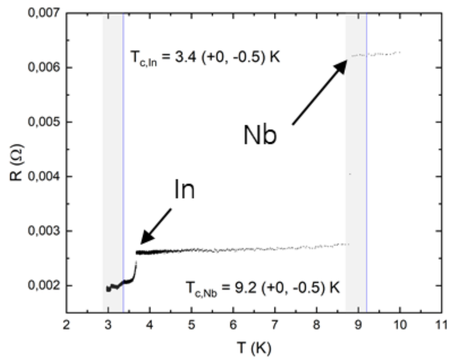
1 Motivation

Superconducting and spin quantum computers:

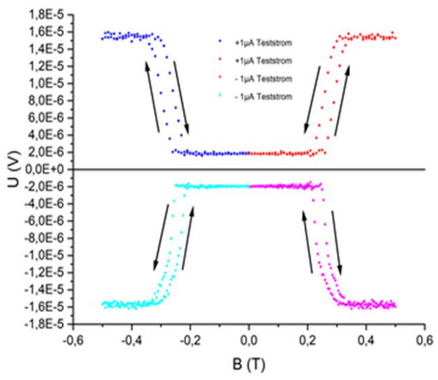
- Operate at **extremely low temperatures**
- Have very **low noise tolerance**

→ Develop **materials and devices** with perfect adaption for cryogenic environment
→ Demand for new **test setups** and **characterization methods**

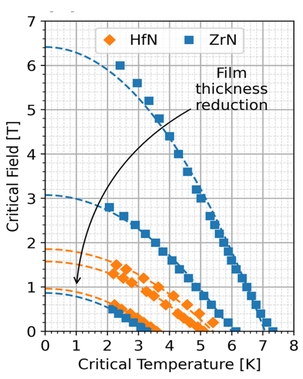
2 Electrical DC characterization of superconductors



Measurement of the transition temperature for chip stacks with Nb wiring and indium bumps



Measurement of critical magnetic field strength of Nb



Critical temperature of HfN and ZrN as a function of magnetic field and layer thickness

3 Specialized analyses

QuBit readout and control setup from Zurich instruments

T2r (Ramsey) measurement of a transmon qubit

Power-dependent Q-factor of a super-conducting resonator

Characterization of superconducting resonators

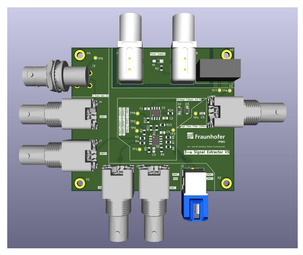
- Q-factors down to single photon limit
- Temp.-dependence of Q-factors

Qubit characterization

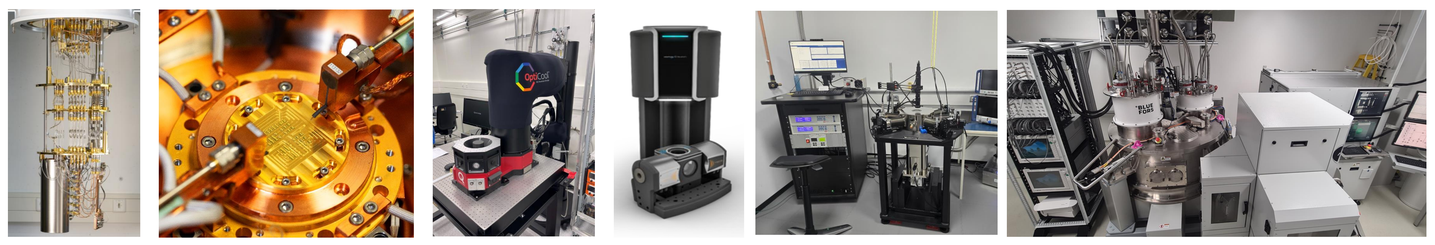
- T1, T2r, T2e, randomized benchmarking
- TLS spectroscopy

Measure thermal transport

- PCB to determine heat transport by 3-ω method between oszillating heat source and thermometer

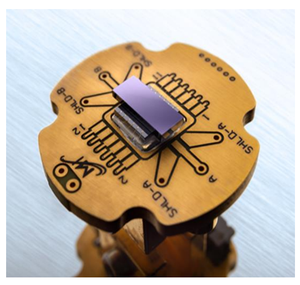


4 Cryogenic testing capacities

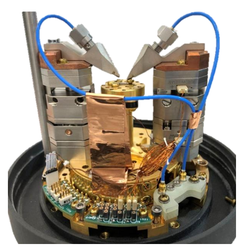


	Prober CRX-4K	Prober CRX-4K	Prober CPX-2K	QD Opticool	Coax. Module setup	Coax. Module setup	Kiutra L type rapid	Bluefors SD	Bluefors LD 400	Cryo station s50	Bluefors Cryogenic Wafer Prober
Temper. range (K)	4.5-300	4.5-350	2-300	2-300	1.5-300	4.5-300	0.1-300	0.03-40	0.01-300	3.1-300	1K
Max. magn. field (T)	-	-	±2.5	±7	-	-	5	-	-	±0.7	-
DUT size/kind	chip	chip	chip	chip	chip	chip	chip	chip	chip	chip	200mm or 300mm wafer
Max. frequ. (GHz)	67	67	67	40	67	26	18	18	18	20	40
RF lines	4	2	2	4	6	6	4	4	69	2	4
DC lines	24	>24	24	16	>24	24	40	48	96	12	192
Needles	yes	2x12	2x12	25 or 2x7 or 2xGSG	-	-	-	-	-	-	DCx13 or DCx96

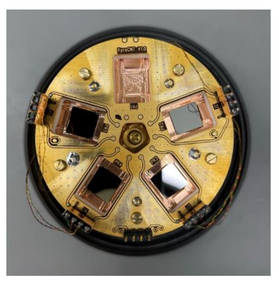
5 Setups for cryogenic tests



Flip-chip structure of a niobium circuit with indium bumps



RF setup with two GSG-probes on micropositioners



Measurement setup for superconductor thin-film samples

6 Summary

- Vast capacities for cryo measurement with diverse temperatures, magnetic fields, sample sizes and frequencies
- Specialized setups for qubit, superconductor, package and thermal transport testing

For inquiries, email us at experts@module-qnc.de

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