EASITrain

HZB Helmholtz Zentrum Berlin

Radiofrequency properties of superconducting Nb_3Sn and NbN thin films

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ESR8

EASITrain – European Advanced Superconductivity Innovation and Training. This Marie Sklodowska-Curie Action (MSCA) Innovative Training Networks (ITN) has received funding from the European Union's H2020 Framework Programme under Grant Agreement no. 764879

Project Objectives

- Determine the radiofrequency properties of A15 and B1 compounds low-temperature superconductor thin films by measuring the temperature-dependent surface resistance of samples using the HZB quadrupole resonator (QPR).

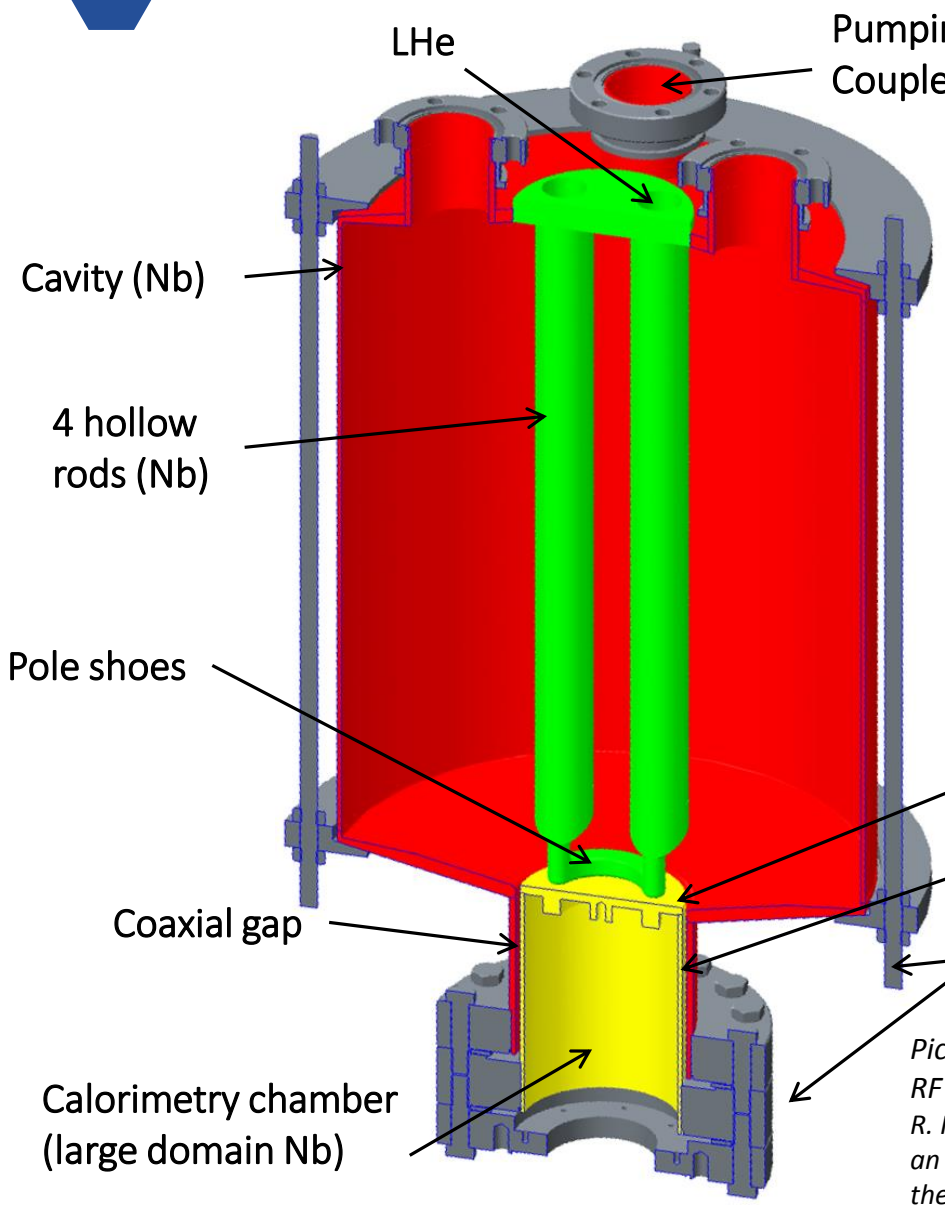
- Consequently, analyze the production recipes (ESR14 USIEGEN, ESR1 CERN) and manufacturing methods (ESR9 I-CUBE, ESR10 INFN-LNL) and examine impacts on the measured radiofrequency property results. Identify the coating parameters impacting the RF properties.

- Ultimately, the QPR is to be used to identify the most suitable material and production method of post-Niobium SRF cavities.

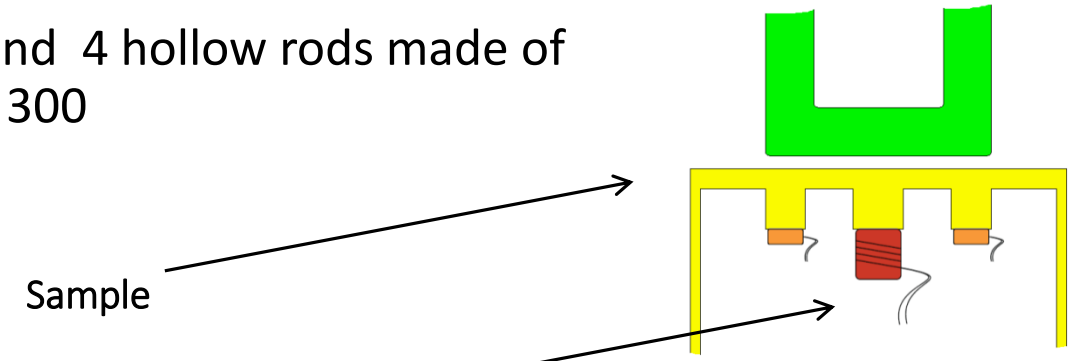
The Quadrupole Resonator (QPR)

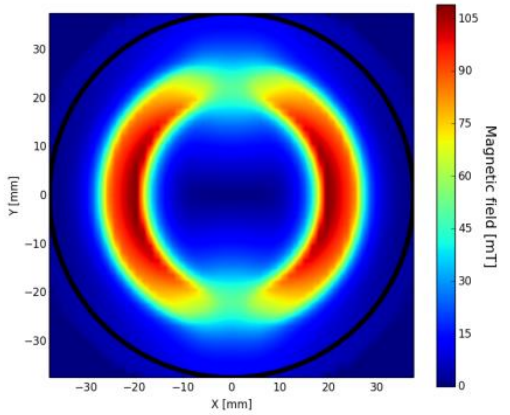
- For the purpose of investigation of surface treatment technics and research on new materials The Quadrupole Resonator (QPR) at HZB was developed, built and commissioned over the past few years.
- The RF properties are determined by measuring the temperature-dependent surface resistance of material samples. Also penetration depth and critical magnetic field are measured in QPR.
- Temperatures can vary from 1.8 K up to several 10s of Kelvin. Measurements can be done at 430 MHz, 850 MHz, and 1270 MHz.
- Magnetic field on the sample can be up to 120 mT (which corresponds to 30 MV/m gradient in TESLA cavity)

The Quadrupole Resonator (QPR)



- System based on CERN design
  EPAC ´98, Rev. Sci. Instrum. 74, 3390-3393 (2003)
- Optimized RF parameters
- Cavity and 4 hollow rods made of Nb RRR 300

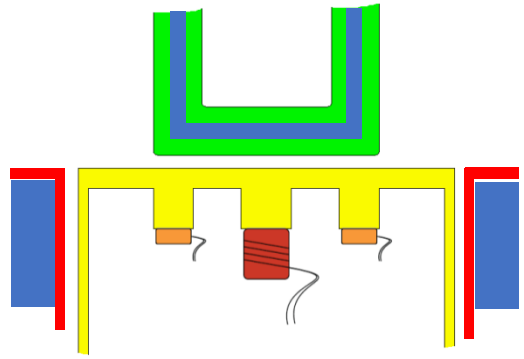




Pictures: Sebastian Keckert, HZB
RF design by Raphael Kleindienst (HZB),
R. Kleindienst, O. Kugeler and J. Knobloch. Development of an Optimized Quadrupole Resonator at HZB. Proceedings of the SRF2013 Paris, France.

Challenges

- Investigate and develop detachable samples design
- Identify and remove systematic errors, especially at 1.27 GHz, expand accessible parameter space
- Resolve microphonics issues
- Problems with power deposition in caoxial gap



Coaxial gap

Work Plan

Introductory

- CERN 'summer school'
- Knowledge transfer from preceding PhD student (MS1)

Secondments and schools

- EASIschool in Vienna
- Industry second. to accompany production of Nb and Nb/Cu composite samples.
- And other..

experimental setup

- Make samples more compatible to thin film preparation facilities (MS2)
- Identify sources of systematic errors that still remain within the parameter space covered by the QPR
- Remove those sources or solve the problem otherwise (MS3)

Measurements and data analyses

- Measure Nb on Cu (collaboration with ESR14 and ESR10 and Daresbury Labs within ARIES project)
- Measure Nb3Sn sample provided by ESR14, and/or Cornell university, possibly collaborate with ESR1 (CERN)
- Measure N-doped Nb in collaboration with DESY and Jefferson Laboratories
- Identify additional collaboration partners that provide SC films of interest
- Evaluate data from measured systems (MS5)

Publications and thesis defense

- Multiple publications of measurements results and modernization of the resonator.
- Writing and thesis and defense

Approaching work

- Perform measurements of the J-lab sample (~ beginning of May)
- Resolve problems with power deposition in caoxial gap
- Investigate and develop detachable samples design

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THANK YOU

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