Radiofrequency properties of superconducting Nb$_3$Sn and NbN thin films

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ESR8
• 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
- 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.
• 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
**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
• Perform measurements of the J-lab sample (~ beginning of May)
• Resolve problems with power deposition in coaxial gap
• Investigate and develop detachable samples design
THANK YOU

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