AKBP 3: Radiofrequency

Time: Tuesday 14:00–16:00 Location: AKBPb

AKBP 3.1 Tue 14:00 AKBPb

Investigation of RF-dependent charge production and electron energy at the FLUTE injector — •Tonia Windbichler for the FLUTE-Collaboration — KIT, Karlsruhe, Germany

FLUTE (Ferninfrarot Linac- und Test- Experiment) is a versatile and compact, linac-based test facility for accelerator R&D at the Karlsruhe Institute of Technology (KIT). The electron bunch is produced by a photoinjector in the injector section. The beam parameters, such as energy, energy spread and charge are highly dependent on the RF settings of the 3 GHz electron gun. Two adjustable RF parameters are the RF forward power and the accelerating phase at the time of electron production with the photoinjector laser system. In this study, the beam parameters' dependencies on the RF parameters have been scanned. Two examples are the points of highest energy transfer and highest charge production. In this contribution measurements of the influence of the RF phase and forward power on the beam parameters will be discussed.

AKBP 3.2 Tue 14:15 AKBPb

ALD-Based NbTiN studies for SIS R&D — •Isabel González Díaz-Palacio[1], Marc Wenskat[2], Wolfgang Hillert[2], Robert Zierold[1], and Robert Blick[1] — [1]Center for Hybrid Nanostructures, Hamburg — [2]Institute for Experimental Physics, Hamburg

Superconductor-Insulator-Superconductor multilayers (SIS structures) improve the performance of SRF cavities providing magnetic screening of the bulk cavity and lower surface resistance. In this framework NbTiN mixtures stand as a potential material of interest. One method which enables fine tuning of the stoichiometry and precise thickness control in sub-nm range is atomic layer deposition (ALD). ALD bases on a sequence of self-limiting gas-solid surface reactions and allows for uniform coating of complex geometries. In this talk, we report about NbTiN thin films deposited by plasma-enhanced ALD on insulating AlN buffer layer, which has been previously deposited in situ without vacuum break with the same technique. The deposition process has been optimized by studying the superconducting electrical properties of the films. Post-deposition thermal annealing studies with varying temperatures, annealing times, and gas atmospheres have been performed to further improve the thin film quality and the superconducting properties. Our experimental studies show an increase in Tc by 87.5% after thermal annealing and a maximum Tc of 13.9 K has been achieved for NbTiN of 23 nm thickness. Future steps include lattice characterization, using XRR/XRD/EBSD/PALS, and SRF measurements to obtain Hc1 and the superconducting gap Δ.

AKBP 3.3 Tue 14:30 AKBPb

Nb3Sn thin film synthesis for SRF application by co-sputtering — •Nils Schäfer, Nail Karabas, Márton Major, and Lambert Alff — Institute of Material Science, Technische Universität Darmstadt (Germany)

Nowadays Nb is commonly used for superconducting radio frequency (SRF) cavities. Nb3Sn is a promising thin film material for SRF cavities as it can empower the cavity to operate at higher acceleration fields and higher temperatures. This is also achievable by a higher quality factor since the surface resistivity is lower with respect to Nb-only cavities at radiofrequency. Several approaches could be used for deposition of Nb3Sn thin films (e.g. sputtering, evaporation, and CVD). The applicability to successfully coat cavities was demonstrated for several processes with their respective disadvantages. Nb3Sn is either synthesized by a deposition of Sn on the Nb cavity or a stoichiometric deposition of Nb and Sn. Film Thickness, and especially stoichiometry are essential for the high potential of the Nb3Sn material properties. A new Co-Sputtering process is used in the Advanced Thin Film Technology group to form high performance layers at unprecedented process temperatures. This process is able to overcome the detrimental diffusion of Sn at elevated temperatures.

AKBP 3.4 Tue 14:45 AKBPb

Nitrogen-doping of niobium for SRF cavities — •Márton Major, Stefan Flege, Lambert Alff, Jens Conrad, Ruben Grewe, Michaela Arnold, and Norbert Pietralla — Technische Universität Darmstadt, Darmstadt, Germany

Niobium is the standard material for superconducting RF (SRF) cavities. Superconducting materials with higher critical temperature and higher critical magnetic field allow cavities to work at higher operating temperatures and higher accelerating fields. One direction of search for new materials with better properties is the modification of bulk niobium by nitrogen doping. In the Nb-N phase diagram the cubic δ-phase of NbN has the highest critical temperature (16 K).

For the investigation of the NbN phases niobium samples were doped at the refurbished UHV furnace at IKP Darmstadt. In this contribution we focus on the structural investigations (x-ray diffraction and pole figure, secondary ion mass spectroscopy, scanning electron microscopy) of the doped samples. We show results of the first samples with NbN surface phase.

Work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H18RDRB2 and the German Research Foundation (DFG) via the AccelencE Research Training Group (GRK 2128).

AKBP 3.5 Tue 15:00 AKBPb

beam coupling impedance minimization of the SPS cavities using the generalized coupled S-parameter method — •Shahnam Gorgi Zadeh[1], Erion Gjonaj[2], and Ursula van Rienen[1] — [1]Universität Rostock, Rostock, Germany — [2]Technische Universität Darmstadt, Darmstadt, Germany

The High Luminosity LHC (HL-LHC) project aims at increasing the luminosity in the LHC by up to a factor of ten. The longitudinal impedance of the Super Proton Synchrotron (SPS) poses a limitation on increasing the beam intensity in the injector chain. Beam dynamical studies have shown a large longitudinal impedance in the SPS cavities. Different types of higher order mode (HOM) couplers are used in the SPS cavities for the damping of different HOM passbands. The location of the HOM couplers in the cavities affects the damping of HOMs. Finding an efficient configuration requires solving a discrete optimization problem in which the cells that require a HOM coupler have to be identified to minimize the longitudinal impedance at the desired frequencies. The large size of the cavities, with a diameter of 0.75 m and a length which reaches up to 17 m, hinders the calculation of the beam coupling impedance by the conventional time-domain wakefield analysis methods. In this presentation, the Generalized Coupled S-parameter Calculation method, which is a domain decomposition scheme for the impedance calculation of large structures, is used to find an optimum HOM coupler configuration for the SPS cavities.

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AKBP 3.6 Tue 15:15 AKBPb

Status of the vertical bath cryostat at the S-DALINAC — •R. Grewe, M. Arnold, J. Conrad, S. Weih, and N. Pietralla — Institut für Kernphysik, TU Darmstadt

For sophisticated measurements of the intrinsic quality factor Q_0 of superconducting radio frequency (srf) cavities the vertical bath cryostat (vtc) of the S-DALINAC[1] is used. To reduce uncertainties of the measurements, the vtc was subject to detailed upgrades. Particular attention was given to the the radio frequency (rf) input and output couplers. To match the input coupler to the cavity it is now possible to change the input coupling strength, which leads to reduced uncertainties of the measured Q_0. The upgrade will be explained along with first measurement results of different srf cavities.

[1] N. Pietralla, Nuclear Physics News, Vol. 28, No. 2, 4 (2018).

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AKBP 3.7 Tue 15:30 AKBPb

Design and fabrication of a new quadrupole resonator for SRF R&D — •Ricardo Monroy-Villa[1,2], Wolfgang Hillert[1], Detlef Reschke[2], Jan-Hendrik Thie[2], Marc Wenskat[1], Piotr Putek[3], and Shahnam Zadeh[3] — [1]Universität Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Hamburg, Germany — [3]Universität Rostock, Rostock, Germany

Radio frequency cavities made from superconducting niobium have the advantage to achieve high accelerating gradients while operating at low losses. As superconducting RF (SRF) cavities are now approach-

ing the theoretical limits of the material, a variety of different surface treatments have been developed to further improve their performance; although no fully understood theory is yet available. Small superconducting samples are studied to characterize their material properties and their evolution under different surface treatments. To study the RF properties of such samples under realistic SRF conditions at low temperatures, a test cavity called quadrupole resonator (QPR) is currently being fabricated. In this work we report the status of the QPR at Universität Hamburg in collaboration with DESY. Our device is based on the QPRs operated at CERN and at HZB and its design allows for testing samples under cavity-like conditions, *i.e.*, at temperatures between 2 K and 8 K, under magnetic fields up to 120 mT and with operating frequencies of 433 MHz, 866 MHz and 1300 MHz. Fabrication tolerance studies on the electromagnetic field distributions and simulations of the static detuning of the device, together with a status report on the current manufacturing process, will be presented.

AKBP 3.8 Tue 15:45 AKBPb

Refurbishment of a spare cryomodule for MESA* — •Paul Plattner, Florian Hug, and Timo Stengler — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The Mainz Energy-Recovering Superconducting Accelerator (MESA) will be a new recirculating accelerator, which can operate in an external beam mode and an energy recovering mode. In the ERL-mode the electrons cross an internal gas-target at MAGIX and give their kinetic energy into the Superconducting Radio Frequency (SRF) system back after experimental use. The MESA cryomodules are based on ELBE-type cryomodules, which contain two 9-call TESLA/XFEL-type cavities. In the cryomodule the superconducting cavities are cooled down to 2 Kelvin with liquid helium. For any maintenance work at the cavities, it is necessary to disassemble the cryomodule. This includes to remove the cavities from the cold string. Smallest impurities can lead to big dercrease of the quality factor of the cavity, which reduces the achievable beam energy of the accelerator. That is why the disassembling and the later reassembling of the cryomodule must be done under very clean conditions which is provided in clean rooms. The plans of disassembling one cryomodule and cleaning the cavities are presented. For that project a spare module of the disassembled ALICE ERL at Daresbury, UK will be used.

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