AKBP 10: New Accelerator Concepts and Radiofrequency

Zeit: Donnerstag 16:30–18:30 Raum: NW-Bau - HS2

AKBP 10.1 Do 16:30 NW-Bau - HS2

Plasma acceleration experiments at DESY Zeuthen — •G. Loisch[1], R. Brinkmann[2], Y. Chen[1], J. Chun-Sung[1], J. Engel[1], M. Gross[1], F. Grüner[3,4], G. Koss[1], M. Krasilnikov[1], O. Lishilin[1], A. Martinez de la Ossa[2,4], T. Mehrling[2], J. Niemiec[1], A. Oppelt[1], J. Osterhoff[1], S. Philipp[1], M. Pohl[1], D. Richter[5], F. Stephan[1], and S. Vafin[1] — [1]Deutsches Elektronen-Synchrotron, 15738 Zeuthen — [2]Deutsches Elektronen-Synchrotron, 22607 Hamburg — [3]Center for Free Electron Laser Science, 22607 Hamburg — [4]Universität Hamburg, 20148 Hamburg — [5]Helmholtzzentrum Berlin für Materialien und Energie, 14109 Berlin

Plasma acceleration has attracted a lot of attention in the past decade due to successful acceleration of electrons with gradients exceeding those of conventional accelerator technology by orders of magnitude. An experimental programme was started at the Photoinjector Test Facility, DESY Zeuthen (PITZ), to study aspects of the acceleration mechanisms in beam-driven plasma wakes. Original goals were the investigation of the self-modulation instability and the acceleration of particles with high ratios between energy gain of accelerated and energy loss of wake-driving particles. The goals were later on extended by studies on other wakefield acceleration mechanisms and laboratory studies of acceleration mechanisms in space plasmas as a source of PeV-scale cosmic ray particles. A brief overview of the experiments including experimental results, simulations and plans for future studies is presented.

AKBP 10.2 Do 16:45 NW-Bau - HS2

Start-to-end simulations of the self-modulation experiment at PITZ — •Osip Lishilin, Matthias Gross, Gregor Loisch, and Frank Stephan — DESY, Zeuthen, Germany

The PWFA experiment at the Photo Injector Test facility at DESY, Zeuthen site (PITZ), was launched to experimentally demonstrate and study a promising phenomenon for future plasma-based accelerators and one of the major aspects of the AWAKE experiment – the self-modulation of long particle beams in plasma. First time-resolved measurements of the self-modulation instability (SMI) of a long electron beam in plasma took place at PITZ in 2016; however the due to technical shortcomings the plasma density during the experiment was about an order of magnitude lower than expected.

This contribution describes start-to-end beam dynamics simulations performed for the electron beam and plasma parameters corresponding to that of the experiment conducted in 2016; the beam-plasma interaction is studied for several possible cases of initial beam charge density distributions in plasma, then the measurement of the longitudinal phase space is simulated. The performed simulations show complete saturation of the SMI over the length of the PITZ plasma source and good agreement with the experimental data.

In addition, a variable plasma channel length setup for upcoming in-depth experimental studies of the SMI is presented.

AKBP 10.3 Do 17:00 NW-Bau - HS2

RF Control Stability Investigations during the first Energy Recovery Operation at the S-DALINAC* — •Manuel Steinhorst, Michaela Arnold, Christoph Burandt, and Norbert Pietralla — Institut für Kernphysik - TU Darmstadt, Darmstadt, Deutschland

The recirculating superconducting Darmstadt linear accelerator S-DALINAC is one of the main research instruments at the institute for nuclear physics at the TU Darmstadt. Since the first recirculated beam in 1991 many improvements on the S-DALINAC were implemented. In 2015/2016 the S-DALINAC was upgraded from a twice recirculating to a thrice recirculating scheme. With the new beam line the S-DALINAC is able to provide a beam with the same design energy of up to 130 MeV in cw operation at reduced accelerating gradients by using the main accelerator an additional time. Furthermore a phase-shift of up to 360° due to a path length variation of the arcs in the second recirculation can be done. Therefore the S-DALINAC can be operated in energy recovery mode after this upgrade shifting the phase by 180°. In August 2017 a first once recirculating energy recovery operation was achieved using the second recirculation. During this energy recovery beamtime measurements regarding the rf control stability and rf power were done. This talk is discussing this measurements and possible improvements for future energy recovery beam times.

Supported by the DFG through GRK 2128.

AKBP 10.4 Do 17:15 NW-Bau - HS2

Developing an Improved Capture Section and Longitudinal Beam Diagnostics for the S-DALINAC* — •Simon Weih[1], Michaela Arnold[1], Dmitry Bazyl[2], Herbert De Gersem[2], Joachim Enders[1], and Norbert Pietralla[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]Institut für Theorie Elektromagnetischer Felder, Technische Universität Darmstadt, Darmstadt, Germany

For an optimized capture of electron bunches in the radio-frequency (RF) field of the injector of the superconducting Darmstadt electron linear accelerator S-DALINAC, a new capture cavity is currently being developed. For installing this cavity, the cryomodule has to be modified. These modifications include adaptions of the tuner frame as well as changes in the position of the RF output coupler. Furthermore, simulations of the longitudinal beam dynamics of the injector were carried out in order to gain a first estimate of the expected beam quality improvements using the new capture structure. Due to the absence of longitudinal diagnostics in the low-energy section so far, an energy-spread measurement setup is currently also under development. This setup is planned to be used for a characterization of the thermionic gun beam, which then will contribute to more accurate simulations for the commissioning phase of the upgraded injector. This contribution will present the cryomodule modifications, some simulation results, and the conception of the energy-spread measurement setup.

*Work supported by DFG through GRK 2128 "Accelence"

AKBP 10.5 Do 17:30 NW-Bau - HS2

RF Design of an RFQ Linac for PIXE Analysis — •Hermann Pommerenke[1,2], Alexej Grudiev[1], and Ursula van Rienen[2] — [1]CERN, Geneva, Switzerland — [2]University of Rostock, Germany

MeV protons are commonly used for Ion Beam Analysis (IBA) of materials, in particular with the PIXE (Proton Induced X-ray Emission) technique, which is the most widely used in IBA. PIXE covers the quantitative analysis of elements with very good efficiency and minimum detection limits reaching ppm range. Because of its non-damaging character, it is widely used in different fields, in particular for the diagnosis of cultural heritage artwork.

Despite many benefits, moving masterpieces from museum to IBA laboratories can be expensive, unacceptable for curators or simply impossible due to the size or the conservation stage. A transportable accelerator is a unique tool capable of providing access to IBA analysis almost anywhere, in museums, restoration centers or even in the field. Additional applications include environmental and atmospheric sciences, material sciences, and quality control.

This PhD project covers the RF design of a compact transportable radio frequency quadrupole (RFQ) operating at 750 MHz, which will serve as a source of 2 MeV protons for PIXE analysis. The RFQ will be constructed at CERN in close collaboration with Le Louvre (AGLAE laboratory) and INFN-Firenze (LABEC laboratory).

Here, we present general project parameters and the current state of the RF design, which includes results regarding the RFQ geometry, required fabrication tolerances and thermal simulation.

AKBP 10.6 Do 17:45 NW-Bau - HS2

Structural investigations of nitrogen-doped niobium for superconducting RF-cavities — •Márton Major[1], Matthias Mahr[1], Stefan Flege[1], Lambert Alff[1], Jens Conrad[1], Ruben Grewe[1], Michaela Arnold[1], Norbert Pietralla[1], and Florian Hug[2] — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]Johannes Gutenberg Universität Mainz, Mainz, Germany

Niobium is the standard material for superconducting RF (SRF) cavities. Superconducting materials with higher critical temperature or higher critical magnetic field allow cavities to work at higher operating temperatures or higher accelerating fields, respectively. Enhancing the surface properties of the superconducting material in the range of the penetration depth is also beneficial. 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). Already slight nitrogen doping of the α-Nb phase results in higher quality factors [Grassellino *et al.*, Proc. SRF2015, MOBA06, 48].

Nb samples were N-doped at the refurbished UHV furnace at IKP Darmstadt. Reference samples were annealed in 1 bar nitrogen atmosphere at different temperatures. In this contribution the results on the structural investigations (x-ray diffraction and pole figure, secondary ion mass spectroscopy, scanning electron microscopy) at the Materials Research Department of TU Darmstadt will be presented.

Work supported by the German Federal Ministry for Education and Research (BMBF) through grant 05H15RDRBA.

AKBP 10.7 Do 18:00 NW-Bau - HS2

RF Control for SRF Cavity Tests * — •Sebastian Thomas — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The ERL type accelerator MESA, which is currently under construction at the Institut für Kernphysik at the Johannes Gutenberg-Universität Mainz, will utilize two modified ELBE type SRF cryomodules with field strengths of 25 MeV each, for achieving electron energies up to 155 MeV. To realize a stable operation of energy recovery, the cryomodules and, in particular, the two 9-cell TESLA type cavities per module need to meet high fabrication standards. They have to be tested and measured prior to installation. This will be done at the HIM facility on the University campus. One key component of the test setup is the RF control, which is realized by a Phase Locked Loop. The PLL compares the phase of two RF signals in order to maintain the driving signal at the resonance frequency of the SRF cavity. This talk will give an insight into the planning and implementation of a RF control that allows high performance operation in a testing environment for SRF structures.

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AKBP 10.8 Do 18:15 NW-Bau - HS2

Measurement of the Quality Factors at the S-DALINAC Accelerator Cavities. — •Simon Roeder, Michaela Arnold, Ruben Grewe, Christoph Burandt, and Norbert Pietralla — IKP, TU Darmstadt, Germany

The superconducting thrice recirculating linear electron accelerator at TU Darmstadt (S-DALINAC) is designed to reach a maximum beam energy of 130 MeV. The 20-cell superconducting radio frequency (srf) cavities have design values for an accelerating gradient of 5 MV/m with quality factors of $3 \cdot 10^9$. Due to a lower quality factor during operation of the srf cavities, high beam energies are limited by the cooling power of the helium liquifier. All accelerating gradients and quality factors of the S-DALINAC srf cavities have been measured in-situ, providing information on how to use a given amount of cooling power in the most efficient way. This contribution will present the results of these measurements and was funded by the DFG as part of the GRK 2128.