BE 11: Accelerator Physics Poster Session

Time: Wednesday 17:00–19:30 Location: P4

BE 11.1 Wed 17:00 P4

Corrugated and Dielectrically Lined Tubes as Dechirpers for ELBE — •Franziska Reimann[1], Ursula van Rienen[1], Peter Michel[2], and Ulf Lehnert[2] — [1]Universität Rostock, Institut für Allgemeine Elektrotechnik — [2]Helmholtz-Zentrum Dresden-Rossendorf

The generation of pulses in the range of sub-picoseconds at radiation sources, like the ELBE free electron laser in Dresden-Rossendorf, requires an efficient reduction of the electron beam's pulse length and energy width.

We show that both corrugated and dielectrically lined cylindrical tubes are suited to serve a passive beam dechirper, using the wakefields generated in these structures when they are passed by an electron beam ([1],[2]). The generated wakefields are dependent on the structural parameters of the dechirper, and we provide optimisations of these parameters for the dechirping requirements of the ELBE beam and demonstrate their dechirping effects on the beam using numerical simulations.

[1] Bane, Stupakov, SLAC-PUB-14925 (2012)

[2] Mosnier, Novokhatski, in: Proceedings of PAC97, Vancouver, Canada, 1997

BE 11.2 Wed 17:00 P4

Towards a high-field THz source operating at few 100 kHz repetition rates — •Michael Gensch[1], Sergey Kovalev[1], Bert Green[1], Christian Bauer[2], Michael Kuntzsch[1], Torsten Golz[3], Ala Al-Shemmary[3], Jens Hauser[1], Joerg Voigtlaender[1], Bernd Wustmann[1], Isabel Koesterke[1], Vivek Asgekar[1,3], Michael Freitag[1], Ulf Lehnert[1], Jochen Teichert[1], Matthias Justus[1], Wolfgang Seidel[1], Christoph Ilgner[1], Stephan Winnerl[1], Harald Schneider[1], Gianluca Geloni[4], Ilie Radu[5], Tobias Kampfrath[6], Simon Wall[7], Andrea Cavalleri[8], Joachim Heberle[2], Peter Michel[1], Alan Fisher[9], Anke-Susanne Mueller[10], Nikola Stojanovic[3], Manfred Helm[1], Ulrich Schramm[1], and Tom Cowan[1] — [1]HZDR, Bautzner Landstr. 400, 01328 Dresden — [2]FUB, Arnimallee 14, 14195, Berlin — [3]DESY, Notkestr. 85, 22607 Hamburg — [4]XFEL GmbH, Albert-Einstein Ring 19, ,22761 Hamburg — [5]HZB, Albert Einstein Str.15, 12489 Berlin — [6]FHI, Faradayweg 4-6, 14195 Berlin — [7]ICFO, Av. Carl Friedrich Gauss 3, 08860 Castelldefels (Barcelona), Spain — [8]MPSD-CFEL, Notkestr. 85, 22607 Hamburg — [9]SLAC, 2575 Sand Hill Rd, Menlo Park, CA 94025, USA — [10]KIT, Kaiserstr. 12, 76131 Karlsruhe

At the ELBE accelerator a unique super-radiant THz source is currently under developement. It aims at delivering fourier-limited THz pulses with pulse energies of up to 100 microJ at reprates of up to 500 kHz (cw). This corresponds to transient electric fields in the GV/m regime or transient magnetic fields in the few T regime. First results from the commissioning are discussed.

BE 11.3 Wed 17:00 P4

THz-based femtosecond-level arrival time monitor for quasi-cw electron accelerators — •Sergey Kovalev, Bert Green, and Michael Gensch — HZDR, Bautzner Landstr. 400, 01328 Dresden

In this contribution we present an electro-optic arrival time monitor for coherent THz pulses. The monitor operates robustly at high repetitionrates and extremely low THz pulse energies. It thereby has the potential to provide few femtosecond-level synchronization on next generation large scale X-ray photon sources based on high repetition rate electron accelerators such as X-ray FELs or energy recovery linacs.

BE 11.4 Wed 17:00 P4

THz-based electron bunch length monitoring at the quasi-cw SRF accelerator ELBE — •Bertram Green[1], Sergey Kovalev[1], Alan Fisher[2], Christian Bauer[1], Michael Kuntzsch[1], Ulf Lehnert[1], Rico Schurig[1], Torsten Golz[3], Peter Michel[1], Nikola Stojanovic[3], and Michael Gensch[1] — [1]HZDR, Bautzener Landstrasse 400, 01328 Dresden — [2]SLAC, 2575 Sand Hill Rd, Menlo Park, CA 94025, USA — [3]DESY, Notkestrasse 85, 22607 Hamburg

In the past few years the quasi-cw SRF electron accelerator ELBE has been upgraded so that it now allows compression of electron bunches to the sub-picosecond regime. The actual optimization and control of the electron bunch form represents one of the largest challenges of the coming years, in particular with respect to the midterm goal to utilize the ultra-short electron bunches for Laser-Thomson scattering experiments or high field THz experiments. Current developments of THz based longitudinal electron bunch diagnostic are discussed and an outlook into future developments is given.

BE 11.5 Wed 17:00 P4

Development of a compact, integrated on-chip THz spectrometer for the use in electron bunch compression monitors at SRF accelerators — Bert Green[1], Niels Neumann[2], Martin Laabs[2], Michael Schiselski[2], Sergey Kovalev[1], Dirk Plettemeier[2], and •Michael Gensch[1] — [1]HZDR, Bautzner Landstr. 400, 01328 Dresden — [2]Chair for RF engineering, TU Dresden, Georg-Schumann Str.9, 01062 Dresden

In a collaborative effort between the TU Dresden and the HZDR within the frame of the BMBF Project InSEl, a compact on-chip THz spectrometer shall be developed which allows detecting the intensity distribution at up to 20 different THz frequencies between 0.1 and 1.5 THz simultaneously. The intended use of the spectrometer which shall not exceed 5 mm diameter in size is to replace current single element THz detectors in the bunch compression monitors in the ELBE accelerator at the HZDR. If successful the device could also be of interest for the longitudinal electron bunch diagnostic at other electron linacs such as FLUTE, BERlinPro, FLASH or the European X-FEL.

BE 11.6 Wed 17:00 P4

Transverse Emittance Compensation for a Superconducting Photo Injector – One Year later — •H. Vennekate[1,3], A. Arnold[1], T. Kamps[2], P. Kneisel[4], P. Lu[1,3], P. Mucek[1], J. Teichert[1], and R. Xiang[1] — [1]HZDR — [2]HZB — [3]TU Dresden — [4]JLab

The Helmholtz-Zentrum Dresden Rossendorf is one of the leading institutes in the development of superconducting electron photo injectors for particle accelerators of all kind. The local facility provides its own 40 MeV linear accelerator which can operate various beamlines such as a free electron laser. Recently, a new gun cavity has been prepared at JLab and transferred to Dresden to be put in use in the coming summer. This project includes an updated cryostat design, introducing a superconducting solenoid to enhance the emittance compensation of the final injector. The poster is going to present the commissioning of these systems, the results of several tests of subsystems, and the current status of the new injector.

BE 11.7 Wed 17:00 P4

Simulation of the Rossendorf SRF photo injector with a new cavity — •Pengnan Lu[1,2], Andre Arnold[1], Ulf Lehnert[1], Petr Murcek[1], Jochen Teichert[1], Hannes Vennekate[1,2], and Rong Xiang[1] — [1]HZDR, Dresden, Germany — [2]TUD, Dresden, Germany

In Rossendorf, a new 3*-cell cavity is under preparation and will be installed to the SRF photo injector in April 2014. This cavity is constructed and tested in Jefferson Lab, with the designed final energy up to 7.5 MeV.

The simulation presented in this contribution includes the particle tracking in the new cavity itself with ASTRA, and also the bunch transport in ELBE with elegant. On the cathode, the profile and time structure of the UV laser are utilized to specify the electron bunch parameters. Then a single bunch of electrons are tracked in the cavity field that calculated by Superfish. From the exit of the cavity, we apply the elegant matrix calculations for magnet elements and accelerator modules.

The main purpose of this simulation is to find the optimized parameters of different beam transport tasks. For a more convenient operation among different codes, a Labview program is introduced which executives all codes automatically from settings of parameters to the final results.

BE 11.8 Wed 17:00 P4

Development status of Photo-CATCH facility at the S-DALINAC — •Neeraj Kurichiyanil, Christian Eckardt, Joachim Enders, Markus Wagner, Martin Espig, and Yuliya Fritzsche — Institut für Kernphysik, TU Darmstadt

We report on the development status of a photocathode activation, test and cleaning using atomic hydrogen (Photo-CATCH) facility for semiconductor photocathodes used at the polarized electron source at the Darmstadt superconducting accelerator S-DALINAC. Three ultra-high vacuum (UHV) chamber design has dedicated chambers for 1) atomic hydrogen cleaning 2) single- or multi-alkali negative electron affinity (NEA) activation and quantum efficiency (QE) as well as lifetime studies and 3) test of the activated cathodes at high-voltage. A polarized electron beam of up to 60 keV will be available for operational QE and charge lifetime measurements and other experiments. The research is aimed at improving vacuum conditions, cathode dark and charge lifetimes, and exploring superior activation procedures. Supported by DFG through SFB 634 and by the state of Hesse within the LOEWE centre HIC for FAIR.

BE 11.9 Wed 17:00 P4

A Method for Measuring the r.m.s Beam Dimension $\sigma_x^2 - \sigma_y^2$ — •Joel Alain Tsemo Kamga, Wolfgang F. O. Müller, and Thomas Weiland — Institut für Theorie Elektromagnetischer Felder, 64289 Darmstadt, Germany

Quadrupole pickups are of particular importance in the accelerator physics because they allow the measurement of some parameters like the beam emittance. However, the emittance can be obtained by measuring the quadrupole moment of the beam by means of a quadrupole pickup consisting of four electrodes placed at 0° (Right), 90° (Top), 180° (Left) and 270° (Bottom). Usually, the difference over sum method is used to pick up the quadrupole moment. However, we use another method starting from the log-ratio method. The analysis and comparing of all these methods will be presented in this work.

BE 11.10 Wed 17:00 P4

Numerical Calculation of Electromagnetic Fields in Acceleration Cavities Under Precise Consideration of Coupler Structures — •Cong Liu, Wolfgang Ackermann, Wolfgang F.O. Müller, and Thomas Weiland — Institut für Theorie Elektromagnetischer Felder, TU Darmstadt, Darmstadt, Germany

During the design phase of superconducting radio frequency (RF) accelerating cavities a challenging and difficult task is to determine the electromagnetic field distribution inside the structure with the help of proper computer simulations. In reality, because energy transfer occurs in the dissipative superconducting cavities, the numerical eigenmode analysis based on real-valued variables is no longer suitable to describe the dissipative acceleration structure. Dissipation can occur with the help of dedicated higher order mode (HOM) couplers, the power coupler as well as the beam tube once the resonance frequency is above the cutoff frequency of the corresponding waveguide. At the Computational Electromagnetics Laboratory (TEMF) a robust parallel eigenmode solver based on complex-valued finite element analysis is available. The eigenmode solver has been applied to the TESLA 1.3 GHz cavity and the third harmonic nine-cell cavity (3.9 GHz) to determine the resonance frequency, the quality factor and the corresponding field distribution of eigenmodes.

BE 11.11 Wed 17:00 P4

Bunch Emission Study of the PITZ Electron Gun by Use of the CST Particle Studio — •Ye Chen, Erion Gjonaj, Wolfgang Müller, and Thomas Weiland — Institut für Theorie Elektromagnetischer Felder,Technische Universität Darmstadt,Schloßgartenstr. 8, 64289 Darmstadt

The Photo Injector Test Facility at DESY Zeuthen (PITZ) is dedicated to test and to optimize sources of high brightness electron beams for future free electron lasers and linear colliders. The main task of PITZ is to produce an intense electron beam with very small transverse emittance. Bunch emission process contributes significantly to the emittance of a charged electron beam. In order to investigate the emittance manipulation, we have the possibility to perform Particle-in-Cell (PIC) simulations by use of the Computer Simulation Technology (CST) [1] code.

Depending on an extremely fine mesh resolution of 10 micrometers, CST simulations have shown convergent results on beam quality parameters for a bunch charge of 1nC. Cross-checking the results with A Space Charge Tracking Algorithm (ASTRA) [2] simulations showed good agreements on convergent trends of the beam parameters, while a discrepancy of 15% on transverse emittance can be found. Due to memory limitations and a long processing timescale, current simulation scheme give its way to further improvements.

[1] CST Computer Simulation Technology AG, CST Particle Studio, http://www.cst.de. [2] K. Flöttmann, ASTRA particle tracking code, http://www.desy.de/~mpyflo/.

BE 11.12 Wed 17:00 P4

A Poisson solver with various boundary conditions for simulation in particle accelerators — •Dawei Zheng, Gisela Pöplau, and Ursula van Rienen — Institut für Allgemeine Elektrotechnik, Fakultät für Informatik und Elektrotechnik, Universität Rostock, Rostock, Germany

Future technologies for particle acceleration need more precise numerical simulation tools to meet the tight requirements for beam quality. Therefore, beam dynamics studies play an important role in all phases of establishing new machines. The investigation of space charge fields of charged particle bunches and their interaction with electron or ions clouds poses an important task within these numerical simulations. Possible approaches to determine space charge fields are the particle-mesh method and the particle-particle method. Our software package MOEVE (MOEVE: Multigrid Poisson Solver for Non-Equidistant Tensor Product Meshes) uses multigrid algorithms for the computation of 3D space charge fields. Now, an additional fast 3D solver based on spectral decomposition of matrix will be integrated into MOEVE in order to meet recent facilities' demands. The solver is designed for various mixed boundary conditions, such as Dirichlet, Neumann, and Periodic. The implementation is based on fast Fourier transform and related fast trigonometric transforms, and it uses the state-of-the-art framework FFTW [*].

[*] M. Frigo and S.G. Johnson, FFTW, C program library, www.fftw.org

BE 11.13 Wed 17:00 P4

Suppression Methods of Multipacting in a Superconducting RF Gun — •Eden Tafa Tulu[1], Tomasz Galek[1], André Arnold[2], and Ursula van Rienen[1] — [1]Universität Rostock, Institut für Allgemeine Elektrotechnik, Albert-Einstein-Str. 2, 18051 Rostock, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany

Superconducting radio frequency (SRF) structures may be subjected to electron multipacting (MP). This phenomenon is a problem that limits the accelerating gradient in the cavity. Moreover, it might cause an impair of RF components and distortion of the RF signal. Therefore, there should be an efficient countermeasure to suppress multipacting in order to boost the performance of SRF gun. Three techniques of suppression of the electron cloud from the vicinity of the cathode, such as DC-bias, simple geometric modification of the cathode and microstructure of the cathode's surface, in the Rossendorf SRF gun are presented in this work.

BE 11.14 Wed 17:00 P4

Quantification of Geometric Uncertainties in Single-Cell Cavities for BESSY VSR using Monte-Carlo Simulation — •Johann Heller, Thomas Flisgen, Christian Schmidt, and Ursula van Rienen — Institute for General Electrical Engineering, University of Rostock, Germany

The electromagnetic properties of SRF cavities are mostly determined by their shape. Due to fabrication tolerances, tuning and limited resolution of measurement systems, the exact shape remains uncertain. In order to make assessments for the real life behaviour it is important to quantify how these geometrical uncertainties propagate through the mathematical system and influence certain electromagnetic properties, like the resonant frequencies of the structure's eigenmodes. Since the deterministic problem is relatively fast to compute, this can be done by using non-intrusive straightforward methods like Monte-Carlo (MC) simulations. Using this technique we investigate the propagation of geometric uncertainties on a single cell cavity from BESSY VSR regarding certain RF properties. In the future we plan on the application of the gained knowledge on a higher order mode beam position monitoring system as well as using different techniques for uncertainty quantification like polynomial chaos expansion in order to reduce the computational time.

BE 11.15 Wed 17:00 P4

HOM Couplers for CERN SPL Cavities — •Kai Papke[1,2], Frank Gerigk[1], and Ursula van Rienen[2] — [1]CERN — [2]University of Rostock

The CERN SPL (Superconducting Proton Linac) is a R&D project with the focus on neutrino or radioactive beam facilities. The linac is composed of two types of cavities operating at 704.4 MHz in pulsed mode and with geometrical beta of 0.65 and 1. In order to limit beam induced Higher-Order-Modes (HOM) effects, CERN considers the use of HOM couplers on the cut-off tubes of the 5-cell superconducting cavities. We present the design process taking into account the RF characteristics, mechanical aspects, heat loss as well as multipacting sensitivity. A comparison is made between various design options for the medium and high-beta SPL cavities. Two options are presented, tested as warm prototypes on 5-cell high-beta copper cavity models.