

AKBP 9: Electron Accelerators and Particle Sources

Time: Wednesday 16:30–18:30

Location: AKBPb

AKBP 9.1 Wed 16:30 AKBPb

Towards control of a photoinjector by using spatial light modulators at FLUTE — ●CARL SAX², MICHAEL NASSE¹, CHENRAN XU¹, ANDREA SANTAMARIA GARCIA¹, ERIK BRÜNDERMANN¹, and ANKE-SUSANNE MÜLLER¹ for the FLUTE-Collaboration — ¹IBPT, KIT, Karlsruhe — ²LAS, KIT, Karlsruhe

The characteristics of an electron bunch created with a photoinjector are strongly influenced by the properties of the driving laser. Therefore, we plan to install spatial light modulators (SLMs) in the laser beam path to shape and manipulate the infrared laser pulses, which are converted to the ultraviolet spectrum, and eventually also the generated electron bunch in the transverse as well as the longitudinal plane. SLMs should also allow the flexible mitigation of aberrations in the beam profile. The SLMs are planned to be installed in FLUTE (FemtoFratot Linac- und Test-Experiment) at KIT, a compact linac-based test facility for accelerator R&D and source of intense THz radiation. In this presentation, the first test-setup is shown.

AKBP 9.2 Wed 16:45 AKBPb

Status of the MESA ERL project* — ●FLORIAN HUG — Johannes Gutenberg-Universität Mainz

MESA is a recirculating superconducting accelerator under construction at Johannes Gutenberg-Universität Mainz, which will be operated in either external beam or ERL mode. After completion, it is planned to be used for high precision particle physics experiments. The operating cw beam current and energy in EB mode is 0.15 mA with polarized electrons at 155 MeV. In ERL mode a polarized beam of 1 mA at 105 MeV will be available. In a later construction stage of MESA the beam current in ERL-mode may be upgraded to 10 mA (unpolarized). Civil construction and commissioning of components like electron gun, LEBT and SRF modules have been progressed already. In this contribution we give a project overview including the accelerator layout, the current status and an outlook to the upcoming construction and commissioning steps.

* This work has been supported by DFG through the PRISMA+ cluster of excellence EXC 2118/2019

AKBP 9.3 Wed 17:00 AKBPb

Development of a GaAs-based photo-electron source with cryogenic components — ●TOBIAS EGGERT, JOACHIM ENDERS, and YULIYA FRITSCHE — Institut für Kernphysik, TU Darmstadt, Germany

Polarized electron beams can be generated using the internal photoeffect with GaAs as a photocathode. However, a negative-electron-affinity (NEA) coating consisting of a CsO layer, is necessary when using GaAs. This layer limits the operational lifetime as it gets corroded by oxygen and destroyed by ionized residual gas molecules hitting the surface. The latter is called ion back-bombardment (IBB) and one of the main lifetime limiting factors. Improving the vacuum conditions near the cathode surface is expected to reduce IBB and increase the lifetime. At the Photo-CATCH test facility in Darmstadt, an electron source is developed which uses cryocooling of a sub-volume around the cathode. In addition to the sub-volume, the cathode itself gets cooled.

This project is supported by DFG (GRK 2128) and BMBF (05H18RDRB1).

AKBP 9.4 Wed 17:15 AKBPb

QE and life time of Cs2Te photocathodes on copper for SRF gun-II at HZDR — ●RONG XIANG¹, ANDRE ARNOLD¹, SHUAI MA^{1,2}, PETR MURCEK¹, ANTON RYZHOV¹, JANA SCHABER^{1,3}, and JOCHEN TEICHERT¹ — ¹Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — ²Universität Rostock, 18051 Rostock, Germany — ³Technische Universität Dresden, 01069 Dresden, Germany

The SRF gun-II at HZDR has been stably applied as the electron source for high power THz radiation since 2018, generating CW beams with bunch charges up to 300 pC at 100 kHz. It is an excellent demonstration that SRF guns can work reliably in a high power user facility. In order to generate higher current beam with MHz repetition rate, Cs2Te photocathodes are required. However, in last two experiments with Cs2Te, the Mo substrate plugs were overheated in superconducting rf cavity. The reason is that different thermal expansion coefficient

of Mo and Cu led to a bad thermal contact between the Mo plug and Cu holder. Thus we decided to use Cu as new substratum of Cs2Te cathodes. In last year we prepared several Cs2Te photocathodes on Cu plugs and improved the vacuum of cathode transfer system in order to achieve satisfied lifetime. In this contribution, we will present the study result of QE and life time of Cs2Te photocathodes with different thickness.

AKBP 9.5 Wed 17:30 AKBPb

Preparation of photocathodes with nitrogen trifluoride — ●JENNIFER GROTH — Johannes Gutenberg-Universität Mainz, Institut für Kernphysik, Mainz, Deutschland

In the new, energy-recovering superconducting accelerator MESA in Mainz, spin-polarized electrons are required in the P2 experiment. Here the requirements increase considerably compared to the photocathode for the spin-polarized electrons for the microtron in Mainz.

A very sensitive part of the photocathodes concerns the specially prepared surface. The surface, which has a negative electron affinity, is particularly sensitive to residual gases in vacuum and suffers from ion back bombardment due to the radiation generated. The negative electron affinity of the surface is achieved through a preparation with alkali metals and an oxidizing agent, in the most common case with cesium and oxygen. One aspect of surface preparation that is being pursued takes up the idea of working oxygen-free with nitrogen trifluoride and cesium. It has already been shown in other studies that this method delivers results that are as good as a preparation with oxygen and cesium with regard to the quantum yield.

The aim is to examine the advantages of an oxygen-free preparation, especially with regard to the influence on the evolution of spin polarization during the experiment.

AKBP 9.6 Wed 17:45 AKBPb

Design of Photon Masks for the ILC Positron Helical Undulator — ●KHALED ALHARBI^{1,2,4}, SABINE RIEMANN², GUDRID MOORTGAT-PICK^{1,3}, ANDRIY USHAKOV¹, and PETER SIEVERS⁵ — ¹University of Hamburg — ²Desy, Zeuthen — ³Desy, Hamburg — ⁴KACST, Saudi Arabia — ⁵CERN

The positron source of the International Linear Collider (ILC) is based on a superconducting helical undulator passed by the high-energy electron beam to generate photons which hit a conversion target. Since the photons are circularly polarized the resulting positron beam is longitudinally polarized.

At a center-of-mass energy of 250 GeV (ILC-250), the undulator with 231 m magnet length is needed to produce the required number of positrons. The power deposition in the undulator walls should be below the acceptable limit of 1W/m since it is a superconducting undulator and also to fulfill the vacuum requirements. The power deposition of the photon beam in undulator walls was studied and shown that the peak power deposition in the undulator walls is above 20 W/m.

To keep the power deposition below the acceptable limit, 22 photon masks must be inserted in the undulator line.

In this paper the design of photon masks for an ideal and realistic helical undulator is presented.

AKBP 9.7 Wed 18:00 AKBPb

Automated activation procedures for GaAs-photocathodes — ●MARKUS ENGART, JOACHIM ENDERS, YULIYA FRITSCHE, MAXIMILIAN HERBERT, MANUEL STEINHORST, and VINCENT WENDE — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt

Gallium-arsenide-based photocathodes are used for a variety of applications. In particular, they serve in sources of polarized electrons. The source performance depends on the quantum efficiency and lifetimes of the photocathodes, usually activated to negative electron affinity using an alkali metal and an oxidant. Good reproducibility of the activation is desired in order to ensure stable and simple operation of such sources. Hence, an automation of this process is envisaged.

The Photo-CATCH (Photo-Cathode Activation, Test and Cleaning using Atomic Hydrogen) test stand at TU Darmstadt is used for experiments with un-/spinpolarized electrons with energies up to 60 keV. This contribution presents the results of experiments with automated activations following the co-deposition of caesium and oxygen using

empirically determined values for the the different activation stages. Results show typical variations in the achieved quantum efficiency of about 20%.

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AKBP 9.8 Wed 18:15 AKBPb

Corrections of high-order nonlinearities in the LHC and HL-LHC (An introduction to my PhD Thesis) — ●JOSCHUA DILLY — CERN and Humboldt Universität zu Berlin

Optics Measurements and Corrections have been of utmost importance for successful operation of the LHC and will continue to be so for the

upcoming High-Luminosity upgrade HL-LHC. The optics in the insertion regions in particular are very sensitive to errors in their elements, due to the extremely high beta-functions present.

In this talk basic concepts of local and global corrections are presented and arguments made for the importance of extending these corrections to high-order magnetic field errors to improve beam stability and lifetime.

These procedures are presented in the framework of my PhD-Thesis, in which I am concerned with the mitigation of these errors by utilizing resonance driving terms and investigating the effects from feed-down emerging from the non-zero closed orbit in the insertion regions. Results of my studies of the first half of my PhD are shown and discussed here together with an outlook on the upcoming second half.