BE 4: Diagnostics and Instrumentation II

Time: Tuesday 9:30–12:30 Location: ZEU 255

Group Report BE 4.1 Tue 9:30 ZEU 255

Development and Status Quo of the Optical Beam Diagnostics System at ELSA* — •Michael Switka, Sven Zander, Manuel Schedler, Philipp Hänisch, Tobias Schiffer, Dennis Proft, Frank Frommberger, and Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut der Universität Bonn

The pulse stretcher ring ELSA delivers polarized and non-polarized electrons with an adjustable beam energy of 0.5 - 3.5 GeV to external experimental stations. Extraction currents available are up to 1 nA with a maximum duty factor of 80%. To meet the growing demands of the user community regarding beam intensity and quality, the upgrade of vital accelerator components is an ongoing process. This includes the improvement of the beam diagnostics in order to resolve and monitor intensity and quality limiting effects. An optical diagnosis system utilizes the available synchrotron radiation at strategic locations. The system includes a streak camera, a fast photo diode and multiple CCD cameras in order to obtain transverse and longitudinal beam images. The streak camera's maximum resolution of 1 ps provides an equivalent observation bandwidth of up to 1 THz, thus being able to capture fast longitudinal and transverse beam dynamics. Its operation has recently started. The fiber coupled fast photo diode is set-up to provide an on-line filling pattern information. The overall performance of the optical diagnostics and machine relevant measurements are presented.
* Work funded by the DFG within SFB/TRR16.

BE 4.2 Tue 10:00 ZEU 255

Using a non-relational database for long term data storage in an accelerator control system — •Dennis Proft, Frank Frommberger, and Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

The electron stretcher facility ELSA serves external hadron physics experiments with a beam of unpolarized and polarized electrons of up to 3.2 GeV energy. Its in house developed control system is able to provide real time beam diagnostics as well as steering tasks in one homogeneous environment.

To surveil the long term evolution of beam properties and machine states access to all parameters values at any given time is needed. This yields a huge amount of data the storage system has to cope with. In order to read back the data to user applications with low latency fast random access to the data in specific time ranges is required. *Hypertable*, a non-relational database system, meets these requirements and is used as the storage engine.

This talk will give details on the setup of the history storage engine on top of hypertable together with a presentation of a newly developed, powerful and easy to use graphical data browser.

BE 4.3 Tue 10:15 ZEU 255

Beam Heat Load Measurements with COLDDIAG at the Diamond Light Source — •Robert Voutta[1], Sara Casalbuoni[1], Stefan Gerstl[1], Andreas Wolfgang Grau[1], David Saez de Jauregui[1], Tomas Holubek[1], Riccardo Bartolini[2], Matthew Peter Cox[2], Emily Carya Longhi[2], Günther Rehm[2], Jos Chris Schouten[2], Richard Walker[2], Mauro Migliorati[3], and Bruno Spataro[3] — [1]Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]Diamond Light Source, Oxfordshire, England — [3]INFN/LNF, Frascati, Italy

Understanding the heat load from an electron beam to the cold beam tube (liner) is an open issue of great interest for the cryogenic layout of superconducting insertion devices. COLDDIAG, a cold vacuum chamber for diagnostics was designed and built especially for this purpose. The instrumentation comprises temperature sensors, pressure gauges, mass spectrometers as well as retarding field analyzers with which it is possible to measure the beam heat load, total pressure, and gas content as well as the flux of particles hitting the chamber walls. COLDDIAG was installed in November 2011 in the Diamond light source (DLS). Due to a mechanical failure at one thermal transition, it was removed after only one week of operation. A redesign of the faulty transition in COLDDIAG allowed reinstallation in August 2012. In this presentation, we report on the measurements and results obtained during the first months since reinstallation in the DLS.

BE 4.4 Tue 10:30 ZEU 255

Laser-induced fluorescence as neutral gas density diagnostic for an hybrid plasma accelerator — •Johannes Wein[1], Constantin Aniculaesei[1], Gregor Fuhs[1], Oliver Karger[1], and Bernhard Hidding[1,2] — [1]Universität Hamburg, Germany — [2]University of Strathclyde, Glasgow, United Kingdom

Relativistic electron beams with small emittance and size are needed for advanced applications such as free electron lasers (FEL) and other coherent light sources in the x-ray regime. The concept of underdense plasma photocathode acceleration uses a beam-driven plasma wave in a two component gas mixture consisting of a low ionisation threshold medium (LIT) a high ionisation threshold medium (HIT) and a low-energy laser pulse. Electron bunches with sub-fs-length and unprecedented normalized emittance down to 10^{-9} m rad can be produced. To achieve a controlled injection a homogenous plasma density is very important. Therefore a plasma oven for rubidium as both HIT and LIT medium is developed. The presentation discusses laser-induced fluorescence (LIF) as a method to measure the neutral gas density profile in this oven. LIF is a widely used technique for the detection of atomic species in gaseous environments. It excites present atoms with a laser and measures the intensity of transversally emitted relaxation photons. This method is capable to measure the gas density with high accuracy over a wide range of values.

BE 4.5 Tue 10:45 ZEU 255

Emittance Measurement of the Laser-Accelerated REGAE Beam — •Max Hachmann — DESY, Hamburg, Germany

The linear accelerator REGAE at DESY produces short and low charged electron bunches in order to investigate principal mechanisms of external injection inside a laser-plasma wakefield. This is only feasible with a high quality electron beam with a small beam emittance. The conservation of the beam quality while the acceleration is crucial for every further experiment. Results and simulations of the characterization of the injected as well as the accelerated electron beam will be presented and discussed.

15 min. break

BE 4.6 Tue 11:15 ZEU 255

Electro-Optical bunch length monitor for FLUTE: layout and simulations — •Andrii Borysenko[1], Edmund Hertle[1], Nicole Hiller[1], Vitali Judin[1], Sebastian Marsching[1], Anke-Susanne Müller[1], Michael Johannes Nasse[1], Markus Schwarz[1], and Bernd Steffen[2] — [1]KIT, Karlsruhe, Germany — [2]DESY, Hamburg, Germany

A new compact linear accelerator FLUTE is currently under construction at Karlsruhe Institute of Technology (KIT) in collaboration with DESY and PSI. It aims at obtaining femtosecond electron bunches (˜1fs - 300 fs) with a wide charge range (1 pC - 3 nC) and requires a precise bunch length diagnostic system. Here we present the layout of a bunch length monitor based on the electro-optic technique of spectral decoding using an Yb-doped fiber laser system (central wavelength 1030 nm) and a GaP crystal. Simulations of the electro-optic signal for different operation modes of FLUTE were performed and main challenges are discussed in this talk. This work is funded by the European Union under contract PITN-GA-2011-289191

BE 4.7 Tue 11:30 ZEU 255

Closed Orbit Control for Acceleration of Polarized Electrons in a Fast Ramping Accelerator — •Jens-Peter Thiry, Frank Frommberger, Andreas Dieckmann, and Wolfgang Hillert — Elektronen-Stretcher-Accelerator ELSA, Physics Institute, University Bonn

ELSA is a fast ramping stretcher ring supplying polarized electrons with energies up to 3.2 GeV. The acceleration is performed within 300 ms, with a fast energy ramp of 6 GeV/s. In order to preserve the initial degree of polarization during the ramping phase, various procedures are applied. These call for a high bandwidth of the orbit corrector system.

A fast energy ramp and a precise and stable control of the vertical orbit are crucial for polarization conservation. Additional harmonic field distributions have to be applied at certain energies, leading to

extra requirements of the system.

Recently the vertical corrector system was upgraded to fulfill the required maximum field strength and high bandwidth. In this talk an overview of the performance of our closed orbit control system and an outlook of possible future plans will be given.

BE 4.8 Tue 11:45 ZEU 255

Aufbau eines Synchrotronlichtmonitors am 2,5 GeV Booster-Synchrotron von ELSA — •Tobias Schiffer, Philipp Hänisch, Michael Switka und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut der Universität Bonn

Das 2,5 GeV Synchrotron ist seit 1967 an der Universität Bonn in Betrieb und wird zur Zeit als Vorbeschleuniger des ELSA-Stretcherrings genutzt. Es handelt sich um ein schnell rampendes combined function Synchrotron mit einer Zyklusdauer von 20 ms. Typischerweise werden Strahlströme von 10 mA auf eine Extraktionsenergie von 1,2 GeV beschleunigt.

Im Zuge der Aufrüstung der Beschleunigeranlage zur Erhöhung des Strahlstroms soll am Booster-Synchrotron eine nicht-destruktive Strahldiagnose aufgebaut werden. Diese basiert auf der Detektion des vom Strahl emittierten Synchrotronlichts zur Bestimmung der transversalen Position und Intensitätsverteilung des umlaufenden Strahls. Im Vordergrund steht hier insbesondere ein Studium der dynamischen Effekte auf der schnellen Energierampe. Bei dieser wird die Strahlenergie innerhalb von 8,6 ms von 20 MeV auf 1,2 GeV erhöht, wobei das Magnetfeld mit maximal 85 T/s geändert wird. Der momentane Stand der Planung und Installation wird präsentiert.

BE 4.9 Tue 12:00 ZEU 255

GunLab - Eine kompakte Diagnoseeinrichtung zur Untersuchung von Elektronenstrahlen aus SHF-Photoelektronen-Injektoren — •Jens Völker[1], Roman Barday[1], Thorsten Kamps[1], Jeniffa Rudolph[1], Susanne Schubert[1], Stephan Wesch[1], Alessandro Ferrarotto[2], Thomas Weis[2], Vasiliy Ivanovich Shvedunov[3] und Ivan Yu Vladimirov[3] — [1]Helmholtz Zentrum Berlin — [2]DELTA, Dortmund — [3]MSU SINP, Moscow

Supraleitende Hochfrequenz (SHF)- Photoelektronen Injektoren sind für zukünftige ERLs und FELs mit kleinen Emittanzen, hohen mittleren Strahlströmen und kurzen Pulslängen die ideale Lösung. Im Rahmen von **B*ERL*inPro** werden verschiedenen SHF Injektorkonzepte und Photokathoden entworfen und sollen in **GunLab** getestet werden. Mit **GunLab** wird es möglich sein den kompletten 6d-Phasenraum der extrahierten Bunche zu charakterisieren. Des Weiteren sollen Halo- und Dunkelströme parallel zum Photoelektronenstrahl im Detail untersucht werden. In dieser Arbeit präsentieren wir Aufbau und erwartete Messgenauigkeiten von **GunLab**.

BE 4.10 Tue 12:15 ZEU 255

Strahlenschutzkonzepte für die Strahlführung für Detektortests an ELSA — •Nikolas Heurich, Philipp Hänisch, Frank Frommberger und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Gegenwärtig wird am Elektronenbeschleuniger ELSA eine neue externe Strahlführung aufgebaut, deren Aufgabe es ist, einen primären Elektronenstrahl für Detektortests zur Verfügung zu stellen. Damit soll die Beschleunigeranlage nicht nur für die momentan durchgeführten Photoproduktionsexperimente der Hadronenphysik zur Verfügung stehen, sondern auch eine Plattform für das „Forschungs- und Technologiezentrum Detektorphysik“ zur Entwicklung von Detektoren für die Teilchen- und Astroteilchenphysik bieten.

Zur Vernichtung und gleichzeitigen Strommessung des Elektronenstrahls hinter den Detektorkomponenten wird ein Faraday-Cup, bestehend aus abgereichertem Uran, eingesetzt. Die Reststrahlung, die den Cup verlässt, wird in einer Betonummantelung absorbiert. Das Strahlenschutzkonzept für den gesamten Bereich der neuen Strahlführung wurde mit Hilfe des Monte-Carlo-Simulationsprogramms *Fluka* entworfen. Dabei wurden neben der Dimensionierung der Betonummantelung auch Strahlenschutzmauern berücksichtigt, um ein gefahrloses Arbeiten im dadurch geschaffenen Nebenraum zu ermöglichen.

In diesem Vortrag werden verschiedene Konzepte für den Strahlenschutz vorgestellt. Außerdem wird über Fortschritte an der Strahlführung berichtet.