# BE 2: Diagnostics and Instrumentation I

Time: Monday 15:00–17:45 Location: ZEU 255

**Group Report** BE 2.1 Mon 15:00 ZEU 255

**Status of Single-Shot EOSD Measurements at ANKA** — •Nicole Hiller[1], Andrii Borysenko[1], Edmund Hertle[1], Anke-Susanne Müller[1], Michael J. Nasse[1], Patrik Schönfeldt[1], Marcel Schuh[1], Nigel Smale[1], Peter Peier[2], Bernd Steffen[2], Volker Schlott[3], Benjamin Kehrer[1], and Vitali Judin[1] — [1]LAS/IPS/ANKA Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Deutsches Elektronen Synchrotron (DESY), Hamburg, Germany — [3]Paul-Scherrer Institut (PSI), Villigen, Switzerland

ANKA is the first storage ring in the world with a near-field single-shot electro-optical (EO) bunch profile monitor. The method of electro-optical spectral decoding (EOSD) uses the Pockels effect to modulate the longitudinal electron bunch profile onto a long, chirped laser pulse passing through an EO crystal. The laser pulse is then analyzed with a single-shot spectrometer and from the spectral modulation, the temporal modulation can be extracted. The setup has a sub-ps resolution (granularity) and can measure down to bunch lengths of 1.5 ps RMS for bunch charges as low as 30 pC. With this setup it is possible to study longitudinal beam dynamics (e. g. microbunching) occurring during ANKA's low-alpha-operation, an operation mode with compressed bunches to generate coherent synchrotron radiation in the THz range. In addition to measuring the longitudinal bunch profile, long-ranging wake-fields trailing the electron bunch can also be studied, revealing bunch-bunch interactions. The talk will give an overview over beam dynamics studies performed with the system. This work is funded by the BMBF contract numbers: 05K10VKC, 05K13VKA.

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**Emulated balanced detection of fast pulses by using a single detector** — •Johannes Steinmann[1], Erik Bründermann[2], and Anke-Susanne Müller[1] — [1]Karlsruhe Institute of Technology (KIT), Laboratory for Applications of Synchrotron radiation (LAS), Karlsruhe, Germany — [2]Ruhr-Universität Bochum, Physikalische Chemie II, Bochum, Germany

Shot to shot signal variations in intensity and spectral properties as they occur during bursts in the THz emission of storage ring light sources like ANKA at KIT operated in low alpha mode have to be compensated for time resolved measruements. A solution can be provided by balanced detection where the incoming radiation is split into a reference beam, providing calibration, and a beam passing through the experiment. If only the intensity varied, any two detectors could be used for the detection of the reference and sample beam. Since our THz source also varies in spectral properties, two detectors with the exact same spectral response would be needed. Ultra fast THz-Detectors are in their characteristics so far not sufficiently reproducible, hard to manufacture, and very expensive. This study demonstrates that near-simultaneous recording of signal and reference pulse via time-shifted detection can emulate the advantages of balanced detection exploited by using only a single detector, thus having exactly the same detector behavior.

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**Online Burst Analysis of Coherent THz Radiation at ANKA** — •Miriam Brosi[1], Michele Caselle[4], Edmund Hertle[3], Vitali Judin[2], Anke-Susanne Müller[1,2,3], Nigel Smale[2], and Johannes Steinmann[1] — [1]LAS, KIT, Karlsruhe — [2]ANKA, KIT, Karlsruhe — [3]IPS, KIT, Karlsruhe — [4]IPE, KIT, Karlsruhe

ANKA, the synchrotron light source in Karlsruhe, provides a low-alpha operation mode for users. In this mode, coherent synchrotron radiation (CSR), which is emitted by short bunches, can be provided up to a frequency of several THz. Bursts in the CSR intensity, driven by instabilities in the longitudinal phase space and bunch length fluctuations, have been measured for single and, recently, multi bunch operation. Providing coherent THz radiation for users on a reliable and controlled basis requires better understanding of these time dependent fluctuations. Therefore, ultra fast THz detectors together with an FPGA-based DAQ system are developed in collaboration with IPE and IMS at KIT.

Tools are being developed and optimized to characterize and further understand the bursting behavior for different storage ring parameters and to investigate phase, correlations and interaction between the bursting of different bunches. In this contribution the first results are presented and an outlook towards an online data analysis system is given.

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**First Results of the new bunch-by-bunch feedback system at ANKA** — •Edmund Hertle[1], Markus Höner[4], Erhard Huttel[2], Anke-Susanne Müller[1,2], Nigel Smale[2], and Dmitry Teytelman[3] — [1]Karlsruhe Institute of Technology (KIT) Institute for Photon Science and Synchrotron Radiation (IPS/ANKA) — [2]Karlsruhe Institute of Technology (KIT) ANKA Synchrotron Radiation Facility — [3]Dimtel, Inc. (Dimtel) — [4]Dortmund University (DELTA) Center for Synchrotron Radiation

A new digital three dimensional fast bunch by bunch feedback system has been installed and commissioned at ANKA. Immediate improvements to stored current and lifetime were achieved for normal user operation. For this, the feedback has to be running during the injection and the energy ramp to 2.5 GeV. Additionally, the feedback system was also incorporated into the diagnostic tool-set at ANKA and opened up new possibilities of automated and continuous measurements of certain beam parameters. The system can operate in different modes such as the low alpha operation mode, which has different requirements on the feedback system compared to normal user operation. Results on the various aspects will be presented as well as future improvements.

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**Design of a compact setup to determine beam energy by detection of Compton backscattered photons at ANKA** — •Cheng Chang[1], David Batchelor[2], Edmund Hertle[1], Erhard Huttel[2], Vitali Judin[2], Anke-Susanne Müller[1,2,3], Michael Nasse[3], Marcel Schuh[3], and Johannes Steinmann[3] — [1]IPS, KIT, Karlsruhe — [2]ANKA, KIT, Karlsruhe — [3]LAS, KIT, Karlsruhe

One of most important parameters of accelerators is their electron beam energy. So far, the method of resonant depolarization was used to accurately determine the energy at ˜2.5GeV of the ANKA storage ring, which, however, becomes cumbersome for lower energies. A good alternative is the detection of Compton backscattered photons, generated by laser light scattered off the relativistic electron beam. To achieve compactness and integration into the storage ring, the setup of transverse scattering is proposed instead of conventional head-on collision. The feasibility has been studied by comparison between simulations of Compton backscattered photons by AT and CAIN 2.35 and actual measurement of background radiation with an HPGe (High Purity Germanium) spectrometer. The configuration of the setup is also presented.

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**15 min. break**

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**Status of bunch-by-bunch feedback systems at the DELTA storage ring used for electron beam diagnostics*** — •Markus Höner, Svenja Hilbrich, Holger Huck, Maryam Huck, Shaukat Khan, Arne Meyer auf der Heide, Carsten Mai, Robert Molo, Helge Rast, Andreas Schick, Malte Sommer, and Peter Ungelenk — Center for Synchrotron Radiation (DELTA), TU Dortmund University, 44227 Dortmund, Germany

At the 1.5-GeV electron storage ring DELTA (TU Dortmund), bunch-by-bunch feedback systems are in use to analyze and counteract transverse and longitudinal multi-bunch instabilities. An automatic readout of bunch position data allows a real-time mode analysis during machine operation, which is available in the control room. In dedicated machine shifts an excitation of particular multi-bunch modes allows further investigation of beam stability and determination of natural damping times of all modes even below the instability threshold.

Besides that, a chromaticity-dependent single-bunch instability will be discussed and first bunch-by-bunch data taken from the synchrotron (BoDo) will be shown.

* Work supported by the BMBF.

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**First Considerations on a Broadband TM11-RF-Kicker for Transverse Bunch-By-Bunch-Feedback in Comparison with a Standard Stripline Kicker*** — •Malte Sommer, Thomas Weis, Bernard Riemann, and Markus Höner — Center for Synchrotron Radiation (DELTA), TU Dortmund University, 44227 Dortmund, Germany

Longitudinal and transverse bunch-by-bunch-feedback-systems are well established in high intensity beam accelerators such as synchrotron light sources. Modern accelerator concepts like energy recovery linacs (ERL) and/or the use of high acceleration gradients in storage rings however require superconducting multicell resonators with a high probability of residual impedances and therefore fast feedback systems with increased strength and efficiency of the kicker structures. Based on the properties of a broadband longitudinal kicker we have investigated the possibility of operating a similar RF-structure in the TM11 dipole mode as a transverse kicker without any striplines. First attempts have been made to optimize the system concerning operation frequency, bandwidth and efficiency by numerical simulations with CST Microwave Studio. The layout of the transverse kicker structure is presented and compared with numerical studies of a transverse stripline-kicker operated at the DELTA storage ring.

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BE 2.8 Mon 17:15 ZEU 255

**Cone-shaped pickups upgrade for the 40 GHz Bunch Arrival-time Monitors at FLASH and European XFEL** — •Aleksandar Angelovski[1], Andreas Penirschke[1], Marie Kristin Czwalinna[2], Cezary Sydlo[2], Christopher Gerth[2], Holger Schlarb[2], Silke Vilcins-Czvitkovits[2], Thomas Weiland[3], and Rolf Jakoby[1] — [1]Institut für Mikrowellentechnik und Photonik, TU Darmstadt, Germany — [2]DESY, Hamburg, Germany — [3]Institut für Theorie Elektromagnetischer Felder, TU Darmstadt, Germany

For sub-10 fs measurement resolution of the arrival time for electron bunches higher than 200 pC, an electro-optical detection scheme was developed and implemented at FLASH. The Bunch Arrival-time Monitors (BAMs) comprise pickup electrodes, an RF and electro-optical frontend and read out electronics. In order to measure the arrival time for charges as low as 20 pC the bandwidth of the BAMs was increased up to 40 GHz. First measurements show reduced signal strength due to high losses in the RF signal path. An analysis towards increasing the pickup signal level through modifying the pickup design is presented. A non-hermetic demonstrator is build to compare RF measurements with CST STUDIO SUITE simulations.

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**Status des neuen Ankunftszeitmonitorsystem bei FLASH** — •Alexander Kuhl[1], Juliane Rönsch-Schulenburg[1], Jörg Rossbach[1], Michael Bousonville[2], Marie Kristin Czwalinna[2], Holger Schlarb[2], Cezary Sydlo[2], Sascha M. Schnepp[3] und Thomas Weiland[4] — [1]Universität Hamburg, Hamburg, Deutschland — [2]DESY, Hamburg, Deutschland — [3]Laboratory for Electromagnetic Fields and Microwave Electronics (IFH), Zürich, Schweiz — [4]TEMF, Technische Universität Darmstadt, Darmstadt, Deutschland

Im Freie-Elektronen-Laser Hamburg (FLASH) werden Ankunftszeitmonitore betrieben, die eine Zeitauflösung von etwa 10 fs bei Bunchladungen über 500 pC ermöglichen. Für den FEL Betrieb mit single-spike Pulsen werden niedrigere Bunchladungen von etwa 20 pC benötigt. Um die geforderte Zeitauflösung für solch kleine Ladungen zu ermöglichen, wurde ein neuer Pickup mit einer deutlich größeren Bandbreite von 40 GHz entwickelt und in FLASH eingebaut. Dazu passend wurde ein neues Frontend entwickelt. Hierbei stellte die höhe Bandbreite die größte Herausforderung dar. Im Vortrag werden der aktuelle Stand der Entwicklung und erste Testmessungen vorgestellt.