AKBP 7: Ion and Medical Accelerators

Time: Tuesday 14:00–15:30 Location: SCH/A117

AKBP 7.1 Tue 14:00 SCH/A117

Theoretical and Numerical Studies of the Effects of Ultra-High Dose Rate Pulses — •Athanasios Koutsostathis, Miriam Brosi, and Anke-Susanne Müller — Karlsruhe Institute of Technology, Karlsruhe, Germany

The understanding of the interaction of high-intensity particle beams with matter is an important aspect for the development of novel accelerator instrumentation. Recently, methods for delivery of ultra-high dose rate radiation have become an increasingly important area of accelerator technology, for example, in the context of FLASH radiotherapy, dosimetry, and particle detector development. In this paper, theoretical models and numerical simulations have been implemented to determine the thermal and subsequent mechanical response of materials subjected to sub-millisecond irradiation with high-intensity particle beams. Emphasis is placed on the identification of phenomena with the potential to drive the development of next-generation accelerator technologies.

AKBP 7.2 Tue 14:15 SCH/A117

Dosimetry for FLASH Radiotherapy with High-Energy Electrons at ELSA — •Anne Stähler, Klaus Desch, Dennis Proft, Michael Switka, and Leonardo Thome — Physikalisches Institut der Universität Bonn

At the electron accelerator facility ELSA, FLASH radiotherapy is being studied. This treatment concept utilises high dose rates in nanosecond to microsecond pulses, which may reduce damage to healthy tissue and improve treatment for deep-seated tumours. Experiments are performed with high-energy electrons between 1.2 GeV and 3.2 GeV, to investigate the underlying beam properties. By applying a newly implemented extraction mode, spill durations of around 330 ns can be achieved. The electromagnetic shower and beam profile throughout water are characterised with Gafchromic films and Cherenkov-light measurements. These results provide, for the first time at energies up to 3.2 GeV, an understanding of the beam properties under FLASH conditions for future radiation studies.

AKBP 7.3 Tue 14:30 SCH/A117

Laser cooling of bunched relativistic ion beams at the FAIR SIS100 — •Danyal Winters[1], Michael Bussmann[2,3], Tamina Grunwitz[4], Jens Gumm[4], Volker Hannen[5], Thomas Kühl[1,6], Sebastian Klammes[1], Benedikt Langfeld[4], Ulrich Schramm[2,7], Denise Schwarz[4], Mathias Siebold[2], Peter Spiller[1], Thomas Stöhlker[1,6,8], Ken Ueberholz[5], and Thomas Walther[4,9] — [1]GSI Darmstadt — [2]HZDR Dresden — [3]CASUS Görlitz — [4]TU-Darmstadt — [5]Uni Münster — [6]HI-Jena — [7]TU-Dresden — [8]Uni-Jena — [9]HFHF Campus Darmstadt

The heavy-ion synchrotron SIS100 is (at) the heart of the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. It is designed to accelerate intense beams of heavy highly charged ions up to relativistic velocities and to deliver them to unique physics experiments, such as those planned by the APPA/SPARC collaboration. In order to cool these extreme ion beams, bunched beam laser cooling will be applied using a dedicated facility at the SIS100. We will use a novel 3-beam concept, where laser beams from three complementary laser systems (cw and pulsed) will be overlapped in space, time and energy to interact simultaneously with a very broad ion velocity range in order to maximize the cooling efficiency. We will present this project and give an update of its current status. We will also give an overview of the laser and detector systems that will be used.

AKBP 7.4 Tue 14:45 SCH/A117

Acceletor Physics at ESR — •Areso Sherjan[1], Aaron Heinz[2], Giuliano Franchetti[1,2,3], Bernd Lorentz[1], Sergey Litvinov[1], Regina Hess[1], Claude Krantz[1], Jon Rossbach[1], Claudius Peschke[1], Ronald Joseph[1], and Ulrich Popp[1] — [1]GSI Darmstadt — [2]Goethe Universität Frankfurt — [3]HFHF

The ESR (experimental storage ring) at GSI can store and decelerate heavy ion beams with different charge states covering a wide range of energy. Hence, the ESR facility provides suitable conditions for various atomic physics experiments, which requires a very precise control on the machine optics during operation. It is therefore of paramount importance the excellent optics control on the machine and the assessment of all the parameters to prevent beam degradation during the deceleration ramp. This talk reviews the accelerator physics activity of the ESR group for delivering high brightness beam to the low energy experiments.

AKBP 7.5 Tue 15:00 SCH/A117

Dosimetry and beam monitoring for laser-accelerated protons — •Joshua Schilz, Florian Kroll, Karl Zeil, Ulrich Schramm, and Josefine Metzkes-Ng — Helmholtz-Zentrum Dresden-Rossendorf, Germany

Laser-driven plasma accelerators (LPAs) provide multi-10 MeV proton bunches at extremely high instantaneous dose rates, offering unique opportunities for application-oriented studies such as radiobiology. To use these beams effectively, a dedicated experimental environment is required. The ALBUS-2S beamline at the Helmholtz-Zentrum Dresden–Rossendorf delivers such proton beams and is already qualified for irradiating millimeter-scale *in vivo* samples. Building on initial pilot work, we investigate improved methods for beam monitoring and dosimetry of single, ultra-short proton bunches delivering multi-Gy doses.

Two detector concepts were tested at ALBUS-2S. The miniSCIDOM scintillator tomograph enables online 3D dose reconstruction in volumes of about 1 cm^3 with sub-500 μm resolution and 100 mGy sensitivity, including characterization of scintillator quenching at LPA dose rates. A complementary time-of-flight detector records transmitted proton spectra, allowing Monte Carlo-based depth–dose predictions; recent studies have established an optimized detector configuration for routine use.

Together, these diagnostics enable precise characterization of laser-accelerated proton beams, supporting reliable radiobiological experiments under the extreme conditions produced by LPAs.

AKBP 7.6 Tue 15:15 SCH/A117

Advancements in Fast Extraction Methods of Short High Ity Pulses at ELSA for FLASH-RT Researchntensi — •Leonardo Thome, Klaus Desch, Dennis Proft, and Michael Switka — Physikalisches Institut der Universität Bonn

Studies investigating the FLASH effect for radiotherapy (FLASH-RT) are currently being carried out at the electron accelerator facility ELSA. In an initial operation mode, the booster synchrotron provides 1.2 GeV electron pulses of 250 ns duration for the irradiation of cell samples. To access higher beam energies up to 3.2 GeV and pulse lengths spanning from the nanosecond to the millisecond regime, this is complemented with a new developed fast extraction scheme from the stretcher ring. Current work focuses on repurposing the existing injection kickers to achieve single-turn or few-turn extraction. The extracted beam is characterized with charge and profile monitors. In parallel, the feasibility of faster resonant extraction techniques to provide spill durations up to several milliseconds is being investigated.