HK 52: Instrumentation XI, Accelerators and Applications

Zeit: Donnerstag 14:00–16:00 Raum: HS 11

Gruppenbericht HK 52.1 Do 14:00 HS 11

The strangeness S=-2 nuclear physics setup at PANDA: status and prospects — Patrick Achenbach, Sebastian Bleser, Michael Bölting, Josef Pochodzalla, Birte Sauer, Falk Schupp, and •Marcell Steinen for the PANDA-Collaboration — Helmholtz Institute Mainz, Johannes Gutenberg University, 55099 Mainz

PANDA at FAIR will address the physics of strange baryons with S=-2 in nuclei by several novel and unique measurements. In particular, PANDA will extend the studies on double hypernuclei by performing high resolution γ-spectroscopy of these nuclei for the first. Furthermore, PANDA offers the unique possibility to search for X-rays from very heavy hyperatoms as e.g. Ξ^{-}-^{208}Pb. This will complement experiments at J-PARC which attempt to measure X-rays in medium-heavy nuclei. Finally, the exclusive production of hyperon-antihyperon pairs close to their production threshold in $\overline{p}$ - nucleus collisions offers a unique and hitherto unexplored opportunity to elucidate the behaviour of antihyperons in nuclei.

In this contribution we will review the strangness $S = -2$ nuclear physics program at PANDA with emphasis on the hyperatom part. We will also present the design of the detection system and the current status of the prototype. Test results of the various detector components will be discussed.

HK 52.2 Do 14:30 HS 11

A feedback system to minimize the electron bunch arrival-time jitter between femtosecond laser pulses and electron bunches for Laser-Driven Plasma Wakefield Accelerators — •Stefano Mattiello[1], Holger Schlarb[2], and Andreas Penirschke[1] — [1]Technische Hochschule Mittelhessen, Friedberg, Deutschland — [2]DESY, Hamburg, Deutschland

In a laser driven plasma based particle accelerator a stable synchronization of the electron bunch and of the plasma wake field in the range of less than 2 fs is necessary in order to optimize the acceleration. For this purpose we are developing a new shot to shot feedback system with a time resolution of less than 1 fs. We plane to generate stable THz pulses by optical rectification of a fraction of the plasma generating high energy laser pulses in a nonlinear lithium niobate crystal. With these pulses we will energy modulate the electron bunches shot to shot before the plasma to achieve the time resolution. In this contribution we will focus on realization aspects of the shot to shot feedback system and the lithium niobate crystal itself. Here we compare different approximations for the modeling of the generation dynamics (second order or first order calculation) and of the dielectric function (influence of the dispersion relation, of the free carries generated by the pump adsorption and their saturation, depletion of the pump) in order to investigate the importance of a detailed description of the optical properties for the THz generation.

HK 52.3 Do 14:45 HS 11

Upgrade of the FRS Ion Catcher RFQ beamline — •Lizzy Gröf[1], Daler Amanbayev[1], Samuel Ayet[1,2], Sönke Beck[2], Julian Bergmann[1], Timo Dickel[1,2], Hans Geissel[1,2], Florian Greiner[1], Christine Hornung[1], Jennifer Koch[2,3], Israel Mardor[4,5], Ivan Miskun[1], Wolfgang Plass[1,2], and Christoph Scheidenberger[1,2] — [1]Justus-Liebig Universität Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Beuth Hochschule für Technik, Berlin, Germnay — [4]Soreq NRC, Yavne, Israel — [5]Tel Aviv University, Israel

At the FRS Ion Catcher at GSI high precision mass measurements of thermalized exotic nuclei can be performed. Projectile and fission fragments are produced at the FRS at relativistic energies, seperated in-flight and slowed-down and thermalized in a cryogenic stopping cell (CSC). The FRS Ion Catcher consists of three main parts, the CSC, an RFQ beamline and a multiple-reflection time-of-flight mass-spectrometer (MR-TOF-MS). The RFQ beamline connects the CSC and the MR-TOF-MS. Its upgrade includes new features, for example a Laser Ablation Carbon Cluster Ion Source (LACCI). It can provide ions for calibration over a broad mass range with masses close to the ions of interest and is ideally suited for the requirements of MR-TOF-MS. Another part of the upgrade is an RFQ mass filter, which allows an additional stage of mass selection before the ions reach the MR-TOF-MS. Futhermore the upgrade improves the differential pumping of the system, which leads to a higher stopping efficiency. The RFQ beamline and its upgrade will be presented.

HK 52.4 Do 15:00 HS 11

Material studies for the DarkMESA calorimeter — •Mirco Christmann[1], Patrick Achenbach[1], Sebastian Baunack[1], Paul Felix Burger[1], Achim Denig[1], Luca Doria[1], and Frank Maas[2] for the MAGIX-Collaboration — [1]Institut für Kernphysik Mainz — [2]Helmholtz-Institut Mainz

At the Institute for Nuclear Physics in Mainz the new electron accelerator MESA will go into operation within the next years. In the extracted beam operation (155 MeV, 150 μA) the P2 experiment will operate 10,000 hours. Therefore, the high-power beam dump of this experiment is ideally suited for a parasitic dark sector experiment.

Currently, DarkMESA is studied with a simulation based on MadGraph and Geant4. Theoretically, dark photons γ' are generated in the beam dump by a process analog to electromagnetic bremsstrahlung and decay invisibly to pairs of dark matter particles. Behind the beam dump, electrons scattered off by dark matter particles can be detected in a calorimeter.

The simulation was extended by an optical photon study, where the response of possible calorimeter materials – PbF_2, BGO, the lead glasses SF5, SF6 and SF57HTultra – was examined. In this contribution the simulation outcomes are compared with the results of first prototypes tested at MAMI with 6 to 14 MeV electrons.

In the first stage of DarkMESA we will use more than 1,000 PbF_2 crystals from the previous A4 experiment. Exclusion limits for the different stages of DarkMESA will be discussed and the current status of a prototype detector array including a veto system will be presented.

HK 52.5 Do 15:15 HS 11

Characterization of organo-metallic liquids for a novel PET detector — •Simon Peters[1], Konstantin Bolwin[2], Björn Gerke[2], Volker Hannen[1], Christian Huhmann[1], Klaus Schäfers[2], and Christian Weinheimer[1] — [1]Institut für Kernphysik, WWU Münster — [2]European Institute for Molecular Imaging, WWU Münster

Recently, a new type of PET detector has been proposed using a heavy organo-metallic liquid - TriMethyl Bismuth (TMBi) - as target material. TMBi is a transparent liquid with 82% by weight of Bismuth as the heaviest non-radioactive element. 511 keV photons from annihilation processes are effectively converted to photo-electrons in the material due to the high Z bismuth component. These photo-electrons produce both Cherenkov light and charges in the liquid. While the optical component enables a fast timing, a charge readout using a segmented anode can provide an accurate position reconstruction.

The charge measurement requires a high level of purification of the liquid to remove any electro-negative contaminations. In addition, as charge multiplication in the liquid is not an option, the readout of the pulses requires extremely low noise electronics. To be able to compare to existing results from literature, first test measurements were performed using Tetra-Methyl-Si as detection medium. The talk will present the setup of a test bench for purification and current / pulse detection and thereby characterization of the organo-metallic liquid under study. This work is supported by DFG via the Cells-in-Motion Cluster of Excellence.

HK 52.6 Do 15:30 HS 11

Applications of Neutron Depth Profiling at the N4DP Instrument at the Heinz Maier-Leibnitz Zentrum — •Markus Trunk[1], Lukas Werner[1], Bastian Märkisch[1], Ralph Gilles[2], Zsolt Revay[2], Morten Wetjen[3], Fabian Linsenmann[3], Hubert Gasteiger[3], and Roman Gernhäuser[1] — [1]TUM, Physik Department, Garching b. München — [2]TUM, Heinz Maier-Leibnitz Zentrum, Garching b. München — [3]TUM, Lehrstuhl für Technische Elektrochemie, Garching b. München

Neutron Depth Profiling (NDP) is a non-destructive, isotope-specific, high-resolution nuclear analytical technique, which is often used to probe lithium or boron concentration profiles in different host materials. The presented N4DP experiment is carried out at the PGAA facility of Heinz Maier-Leibnitz Zentrum, which provides a cold neutron flux up to 5E10 s-1cm-2. When a neutron is captured the investigated Li-6 nuclei undergo nuclear reactions and emit charged particles with well-defined energies and the energy loss of the charged particles traveling through the host material is related to the depth of origin at a resolution level up to a few ten nanometers. We investigated NDP on several applications such as heat-treated superalloys with boron additives and OLED prototypes with lithium. In this contribution lithium concentration profile measurements in different lithium-ion battery components are presented. Here NDP reveals new insights into the evolution of immobilized lithium in battery electrodes, which is one of the main causes of battery lifetime limitation.

HK 52.7 Do 15:45 HS 11

Investigation of non-depolarizing neutron guide coatings for neutron beta decay studies with PERC — •Alexander Hollering[1], Thorsten Lauer[3], Bastian Märkisch[1], and Ulrich Schmidt[2] — [1]TUM — [2]Universität Heidelberg — [3]Movatec GmbH

Neutron beta decay is a sensitive tool to search for non-V-A couplings beyond the Standard model in the charged weak interaction. The PERC instrument, which is currently under construction at the MLZ, Garching, aims to measure correlation parameters in neutron beta decay with an accuracy improved by one order of magnitude to a level of 10^{-4}. This also requires control of the neutron polarization on the same level. Inside the PERC instrument an 8 m long neutron guide is used as decay volume in a magnetic field of 1.5 Tesla and is fed by a highly polarized cold neutron beam. Supermirror neutron guides are usually made of hundreds of nanometer thin layers from nickel and titanium on a glass substrate. But the nickel is magnetized by the magnetic field which leads to depolarization of the neutron beam even for layers made of nickel alloy with vanadium added. In order to ensure a depolarization of the neutron beam on the level of 10^{-4} per bounce, completely non-magnetic coatings preferably made of diamagnetic materials are required. We present results on mirrors made from copper and titanium layers with excellent reflectivity. Despite copper is well known for its high mobility, which lead to degradation of the reflectivity caused by interdiffusion, our supermirrors are highly resistant to baking-out. We present an element analysis of the supermirrors via elastic recoil detection and reflectivity measurements.