HK 51: Instrumentation XIII

Time: Wednesday 17:30–19:15 Location: HBR 19: C 2

HK 51.1 Wed 17:30 HBR 19: C 2

Developing temperature simulations to optimize cluster-jet and droplet target designs — •Jost Froning, Elena Lammert, Christian Mannweiler, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

Internal hydrogen cluster-jet and droplet targets are widely applied in accelerator experiments in nuclear and particle physics. For example, both target types are to be used in the future PANDA experiment at FAIR.

Hydrogen at cryogenic temperatures is a mandatory requirement for the operation of cluster-jet and droplet targets in order to enable hydrogen liquefaction. The temperature demands on the target designs are therefore very high, so that proven design concepts have been relied on up to now. By simulating the temperature distributions of different target geometries, their performance can be predicted cost-effectively instead of constructing a new geometry without knowing its temperature behavior in advance.

This talk shows developed temperature simulations of current target designs using Autodesk CFD, comparisons between simulated and measured temperatures and optimization possibilities for future constructions.

The research project was supported by BMBF (05P21PMFP1) and the EU's Horizon 2020 programme (824093).

HK 51.2 Wed 17:45 HBR 19: C 2

Simulations of adiabatic fast passage spin flippers for the neutron lifetime experiment τSPECT — •Niklas Pfeifer[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

The τSPECT experiment aims to measure the free neutron lifetime with an uncertainity goal of sub second by storing ultra-cold neutrons in a fully magnetic bottle. A key element of the experiment is the adiabatic fast passage spin flipper. It is used to convert the neutrons into the storable, low-field-seeking spin state by applying a radiofrequency field in a magnetic field gradient region. To study and understand systematic effects and reduce uncertainties of the current design, simulations of neutron dynamics during the spin flip process are needed. Based on the PENTrack software we developed a simulation framework to accurately simulate the trajectories as well as the spin dynamics of ultra-cold neutrons in complex electromagnetic fields.

This talk will present the underlying theory, latest results and challenges of neutrons spin-flipping simulations for τSPECT as well as possible future optimizations and performance improvements.

HK 51.3 Wed 18:00 HBR 19: C 2

Evaluation of the precision of the NeuLAND positional calibration using different methods — •Yanzhao Wang[1], Igor Gasparic[2], Håkan Johansson[3], Konstanze Boretzky[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Germany — [3]Chalmers University of Technology, Sweden

The New Large-Area Neutron Detector NeuLAND, as part of the R^3B experiment at FAIR, aims at providing a high detection efficiency and spatial-temporal resolution of neutrons generated from the high-intensity radioactive beam[1]. Multiple calibration processes of NeuLAND, such as energy calibration and positional calibration, rely heavily on the reconstruction of local muon tracks from cosmic radiation. In this talk, we introduce two major methods for positional calibrations: the first method reconstructs local muon tracks using only the geometrical information of the NeuLAND scintillator array while the second method utilizes the Millipede algorithm in the reconstruction, irrespective of the large number of local parameters of muon tracks. The precisions from both methods will be compared based on the same experimental data from a R^3B experiment.

Supported by the BMBF (05P21PKFN1).

[1] K. Boretzky *et al.*, Nucl. Instrum. Methods Phys. Res. A1014 (2021) 165701

HK 51.4 Wed 18:15 HBR 19: C 2

Vacuum studies on the $\overline{\text{P}}$ANDA cluster-jet target considering flash evaporation and cluster bursting — •Michael Weide, Philipp Brand, Sophia Vestrick, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

In antiproton-proton annihilation experiments such as the upcoming $\overline{\text{P}}$ANDA experiment at FAIR, internal targets have a key role as they allow the accelerator beam to be utilized for multiple interactions with the target. Initially, this target will be realized by a cluster-jet target (CJT) operated with H_2, that produces clusters of sizes ≤ 10 microns in diameter.

A challenge of such an experiment is minimizing background reactions due to the costly production of antiprotons, thus good vacuum conditions are mandatory. Residual gas sources in a CJT include flash evaporation, i.e., the evaporation of H_2 due to thermal radiation and the pressure difference between the cluster and its surroundings, and cluster bursting, i.e., the burst of H_2 during the interaction between the accelerator beam and a cluster.

To analyze the gas load caused by flash evaporation, a simulation software was developed that computes the outgassing rate per cluster size along the entire cluster-jet. Additionally, measurements at the Cooler Synchrotron (COSY) at FZ Jülich were performed, to study the accelerator beam induced pressure increase in the interaction chamber.

The research project was supported by BMBF (05P21PMFP1) and the EU's Horizon 2020 program (824093).

HK 51.5 Wed 18:30 HBR 19: C 2

Beam and Target Optimization for the KOALA Experiment — •Ruijia Yang[1,2], Frank Goldenbaum[1,2], and Huagen Xu[2] for the PANDA-Collaboration — [1]Bergische Universität Wuppertal — [2]Forschungszentrum Jülich GmbH

The KOALA experiment is aimed to measure (anti)proton-proton elastic scattering over a wide range of four momentum transfer squared $0.0008 < |t| < 0.1(GeV/c)^2$ in order to precisely determine the differential cross section. The wide range of |t| is achieved by measuring the total kinetic energy as well as the recoil angle $\alpha(=90°-\theta)$ from -1.8° to 15° of the recoil protons with a recoil detector consisting of silicon and germanium single-sided strip sensors. The large background at small |t| can be suppressed by measuring the elastically scattered beam particles in the forward direction close to the beam axis with a forward detector, which contains two layers of plastic scintillators. It is noted that the finite thickness of the target profile and the residual gas in the scattering chamber play critical roles at such small recoil angles (α<1.2°), while attempting to achieve the expected smallest |t|. Meanwhile it is also observed that the beam imperfection such as large profile and offset to beam axis introduces a non-negligible impact on the measurement precision. As a compensation for the missing acceptance at the forward region, a larger scintillator detector has been implemented. The simulation study based upon KoalaSoft for the influence of the realistic target profile, residual gas in the scattering chamber as well as the beam imperfection is ongoing. The latest results of the study will be presented.

HK 51.6 Wed 18:45 HBR 19: C 2

Characterisation and optimisation of the MDT-H droplet target — •Christian Mannweiler, Daniel Bonaventura, Jost Froning, Anna Luna Hannen, and Alfons Khoukaz for the PANDA-Collaboration — Universität Münster

Internal target systems enjoy widespread use in various different fields of physics, such as plasma or particle physics. A prominent example will be the $\overline{\text{P}}$ANDA experiment at FAIR which will make use of both hydrogen cluster-jet and droplet/pellet target systems.

The operating principle of a hydrogen droplet target is to force cryogenic liquid hydrogen through a nozzle with an aperture size of around 10 microns. By inducing vibrations in the nozzle through a piezoelectric element the resultant liquid hydrogen beam is then broken up into droplets which can then propagate over ranges of several meters through vacuum.

The MDT-H is a newly constructed droplet target prototype currently set up in Münster. Through a novel, modular gas system design which allows for a higher standard of purity this target is considerably more reliable than previous designs and allows for quick progress in the characterisation and optimisation of its properties.

In our contribution we will present the MDT-H in detail and show some first results of our characterisation and optimisation endeavours.

This project has received funding from the EU Horizon 2020 programme (824093).

HK 51.7 Wed 19:00 HBR 19: C 2

Advancing Nuclear Technology: Applications and Studies of High Entropy Alloys — •Gizem Öztürk[1], Hüseyin Ozan Tekin[2], Bakı Akkuş[3], and Ömer Güler[4] — [1]Department of Physics, Faculty of Science, Istanbul University, 34134, Istanbul, Turkey — [2]Department of Medical Diagnostic Imaging, College of Health Sciences, University of Sharjah, 27272, Sharjah, United Arab Emirates — [3]Department of Physics, Faculty of Science, Istanbul University, 34134, Istanbul, Turkey — [4]Rare Earth Elements Application and Research Center, Munzur University, 62000 Tunceli, Turkey

High Entropy Alloys (HEAs) have emerged as a frontier for innovative advancements, particularly in nuclear applications. This presentation commences with a foundational overview of HEAs, elucidating their unique compositional and structural attributes. These alloys offering remarkable attributes such as high strength, corrosion resistance, and thermal stability. Our research group members have employed cutting-edge techniques such as additive manufacturing and advanced characterization methods to understand the microstructural and mechanical properties of these alloys. Our findings reveal that specific HEA compositions exhibit enhanced radiation tolerance and mechanical robustness, making them suitable for nuclear applications. In conclusion, our research underscores the transformative potential of High Entropy Alloys in nuclear applications. By offering novel insights into their properties and applications, this presentation aims to pave the way for safer, more efficient, and sustainable nuclear technologies.