HK 51: Instrumentation 16

Time: Thursday 14:30–16:30 Location: M/HS2

Group Report HK 51.1 Thu 14:30 M/HS2

Status of the neutron detector NeuLAND in 2014 — •Kenjiro Miki[1], Thomas Aumann[1,2], Konstanze Boretzky[2], Christoph Caesar[1], Igor Gasparic[3], Michael Heil[2], Heiko Scheit[1], and Haik Simon[2] for the R3B-Collaboration — [1]IKP, TU-Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]RBI, Zagreb, Croatia

We report on the present status of the new neutron detector NeuLAND designed for the R3B facility at FAIR. The NeuLAND is a segmented large-volume plastic scintillation detector with a designed volume of 2.5 (width) × 2.5 (height) × 3.0 (depth) m^3, which will provide high efficiency, good timing resolution and high multi-neutron resolving power. Ten planes of scintillator walls, corresponding to the depth of 0.5 m, have been constructed and tested so far. The performance of this NeuLAND demonstrator was studied with fast neutrons from heavy-ion beams in GSI. The ^{48}Ca, ^{58}Ni and ^{236,238}U beams with incident energies from 400 to 800 MeV/u were impinged on C, Pb, or U target, and neutrons produced around 0 degrees were detected by the NeuLAND. Neutron hit distributions were obtained for one and multiple neutron events, allowing us for detailed response studies. An excellent timing resolution of typically 150 psec (σ) was determined online. The presentation will include the detailed explanation of the experimental setups and obtained results. The outlook comprises further NeuLAND construction and data taking during the next year.

This work is supported by HIC for FAIR, GSI–TU Darmstadt cooperation, ENSAR, and the BMBF project 05P12RDFN8.

HK 51.2 Thu 15:00 M/HS2

Chemical shifts of manganese K X-rays — •Malkhaz Jabua — Forschungszentrum Juelich, Juelich, Germany — Georgian Technical University, Tbilisi, Georgia

High resolution X-ray spectroscopy offers a powerful tool to study the complex electron-electron interaction in the atomic shells. Experimentally, this requires an energy resolution below one electron volt, which is achievable only with crystal spectrometers in the few keV range. Crystal spectrometry in this energy range exploits the so called Bragg's law, which measures a wavelength precisely via the diffraction angle. The goal of the experiment held at the institute of nuclear physics at Forschungszentrum Juelich is the measurement of K X-ray energies for various chemical compounds at ultimate precision. The measurements were performed with a Bragg spectrometer set up in Johann geometry. It allows to record simultaneously an energy interval according to the width of the X-ray source when using a correspondingly extended X-ray detector. A series of measurements for various manganese compounds has been completed. X-ray energies were determined to an accuracy of 10-20 meV confirming the known overall behavior of decreasing line energy with increasing ionization state of Mn atom. The talk is focused to describe the setup of the Bragg spectrometer and to present recent results of the comprehensive data analysis.

HK 51.3 Thu 15:15 M/HS2

A new digital pulse generator for the CALIFA detector — Michael Bendel, Roman Gernhaeuser, Benjamin Heiss, Philipp Klenze, •Patrick Remmels, and Max Winkel for the R3B-Collaboration — Physik Department E12, Technische Universität München

The 4π-calorimeter CALIFA ist one of the major detectors of the R3B-experiment at the upcoming Facility for Antiproton and Ion Research in Darmstadt. The monitoring of stability, single channel properties, temperature effects and rate dependency in a high resolution, high granularity calorimeter is essential for the success of the whole experiment. A new digital pulse generator will emulate the complex signal of the CsI(Tl) crystals in order to fine tune the online pulse shape analysis for particle identification, background suppression, energy calibration and for deadtime and pileup studies. The total pulse generator firmware is implemented into the digital readout platform FEBEX used in CALIFA. The FPGA and a small analog add on board allow for highly flexible parameter adjustment. New applications are easy to implement and even very complex shapes are produced by simple lookup tables. The concept, features and implementation of a prototype and a first application in the CALIFA Demonstrator Experiment in October 2014 at GSI in Darmstadt will be presented.

Supported by BMBF under contract 05P12WOFNF, and by GSI Darmstadt.

HK 51.4 Thu 15:30 M/HS2

The Photon Tagger NEPTUN at S-DALINAC: Current Status and Research Program — •Diego Semmler, Michaela Arnold, Thomas Aumann, Martin Baumann, Michael Beckstein, Alexander Blecher, Nebojsa Cvejin, Florian Hug, Christopher Lehr, Norbert Pietralla, Heiko Scheit, Dmytro Symochko, Christopher Walz, and Tim Wessels — Institut für Kernphysik, Darmstadt, Germany

The low energy photon tagger NEPTUN at the S-DALINAC delivers a quasi-monoenergetic photon beam between about 1 MeV and 20 MeV with a resolution of approximately 25 keV. Tagged photons provide the possibility to measure the full dipole strength of nuclei in the energy range below and above the neutron threshold. The highly efficient $LaBr_3$:Ce based spectrometer GALATEA will be used to detect not only the direct decays to the ground state, but also cascading decays can be measured with suitable efficiency. To measure (γ, n)- and $(\gamma, n\gamma)$-reactions the setup will be extended by neutron detectors based on liquid scintillators.

The data will be combined with experiments at Duke University, GSI and RIKEN to obtain a complete picture of dipole strength function evolution in Sn isotopes.

This talk will cover the link between the different experiments and focus on the setup and status of the NEPTUN commissioning program. If available, data from the first runs with Sn will be shown.

Supported by DFG (SFB 634)

HK 51.5 Thu 15:45 M/HS2

Ergebnisse der iPhos-Energierekonstruktion hochenergetischer Protonen — •Michael Bendel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze und Max Winkel für die R3B-Kollaboration — Physik-Department E12, Technische Universität München

Im R^3B-Experiment, das an der neuen Experimentiereinrichtung FAIR (Darmstadt) aufgebaut wird, soll die gesamte Targetregion von dem grossvolumigen Kalorimeter CALIFA eingeschlossen werden.
Dieses Kalorimeter bestehend aus 2500 CsI(Tl)-Kristallen mit einer Auslese durch Avalanche-Photodioden, ist ein sehr vielseitiges Instrument, das eine Schlüsselrolle in der Realisation von kinematisch vollständigen Messungen spielt. Die wesentlichen Anforderungen sind eine hohe Effizienz, eine gute Energieauflösung im Bereich von 5% bei 662keV γ-Strahlung und ein riesiger dynamischer Bereich, der es erlaubt gleichzeitig γ-Quanten mit wenigen 100keV, aber auch gestreute Teilchen mit mehreren 100MeV nachzuweisen. In Kernreaktionen bei relativistischen Strahlenergien erhalten leichte geladene Teilchen vorallem in Vorwärtsrichtung sehr hohe Energien bis zu 700MeV. Im Rahmen dieses Vortrags stellen wir experimentelle Ergebnisse der neuen iPhos-Rekonstruktionsmethode vor, die mit Protonen bei kinetischen Energien bis zu 480MeV am TRIUMF in Vancouver, Kanada erfolgreich getestet wurde. Gefördert durch BMBF (05P12WOFNF, 05P12WONUE), GSI Darmstadt und TRIUMF Vancouver.

HK 51.6 Thu 16:00 M/HS2

Monte-Carlo studies of BGO Compton-suppression shields for the MINIBALL spectrometer — •Dawid Rosiak, Peter Reiter, and Michael Seidlitz — Institut für Kernphysik, Universität zu Köln

An enhanced detection sensitivity of the high-resolution MINIBALL spectrometer is required for future experiments at the HIE-ISOLDE accelerator at CERN. Beam energies up to 10 MeV/u will allow for direct reactions and fusion-evaporation reactions, populating excited nuclei at higher excitation energy than the existing REX-ISOLDE facility. Moreover, high angular-momentum transfer will cause events with higher γ-ray multiplicities. The existing MINIBALL spectrometer with its closely packed eight triple cluster detectors was designed for highest solid-angle coverage, causing best γ-ray efficiency for low-multiplicity events. In future the triple-cluster detectors will be optionally surrounded by BGO Compton-suppression shields in order to cope with the scattering between detectors from high energetic γ-rays and with double hits from high multiplicity. A detailed Monte-Carlo study, based on the GEANT4 simulation toolkit [1], was performed for the full spectrometer by varying the geometry of the BGO detectors. The final result is a detector configuration with improved peak-to-total ratio of up to 55% and a reduced efficiency, which will be the basis of a first prototype detector.

[1] S. Agostinelli *et. al.*, Nucl. Instrum. Methods A 506, 250 (2003).

HK 51.7 Thu 16:15 M/HS2

Energie- und Effizienzeichung eines $LaBr_3$-Szintillations-Detektors mittels $^{27}Al(p,\gamma)^{28}Si$ — •Enno Hrivula[1], Meiko Voknandt[1], Klaus Eberhardt[2], Anne Endres[1], Matthias Fix[1], Tanja Heftrich[1], Arnd Junghans[3], Franz Käppeler[4], Alberto Mengoni[5], Rene Reifarth[1], Stefan Schmidt[1], Dorothea Schumann[6], Kurt Stiebing[1], Mario Weigand[1] und Norbert Wiehl[2] — [1]Goethe University Frankfurt, Germany — [2]Gutenberg University of Mainz, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [4]KIT, Germany — [5]Cern, Switzerland — [6]Paul-Scherrer-Institute Villingen, Switzerland

Die Messung des Neutroneneinfangquerschnittes des radioaktiven ^{10}Be ist derzeit nur mit Hilfe der Aktivierungsmethode möglich. Dies erfordert die Detektion des Zerfalls des kurzlebigen ^{11}Be, welches am besten anhand der hochenergetischen Gammalinie bei 6.79 MeV möglich ist. Das übliche verfahren zur Effizienzkalibration mit Standardquellen ist für diese Energien nicht ausreichend. Daher wurde die Kalibration auf Basis der $^{27}Al(p,\gamma)$-Reaktion durchgeführt. Für Protonenenergien um 1 MeV läßt sich so anhand der Resonanzen dieser Reaktion die Detektoreffizienz für Gammaenergien von 2 MeV bis oberhalb von 10 MeV durchführen. Im Rahmen des Vortrages wird die Methode am Beispiel eines zylindrischen $LaBr_3$Detektors von 7.5 cm Durchmesser und 7.5 cm Dicke vorgestellt.