HK 4: Instrumentation III

Time: Monday 16:30–18:00 Location: SCH/A117

Group Report HK 4.1 Mon 16:30 SCH/A117

Measurements with fast neutrons nELBE — •Roland Beyer[1], Roberto Capote[2], and Arnd R. Junghans[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Dresden, Germany — [2]International Atomic Energy Agency, Vienna, Austria

The neutron time-of-flight facility nELBE at Helmholtz-Zentrum Dresden-Rossendorf features the first photo-neutron source at a superconducting electron accelerator, which provides a very precise time structure, high repetition rate and favorable background conditions due to the low instantaneous flux and the absence of any moderating materials. The neutron energy spectrum ranges from about 100 keV up to 10 MeV. The resulting very flexible beam properties at nELBE enable a broad range of nuclear physics experiments, e.g. determination of the reaction cross section of elastic and inelastic neutron scattering or neutron induced fission or the determination of the response of detectors for in-situ particle range verification during cancer treatment with proton or ion beams.

As an examples the neutron transmission measurement of thick iron samples will be described in detail. The results of this measurement help to eliminate significant shortcomings in the resolved resonance region of all existing evaluations of iron isotopes that have been identified in leakage neutron measurements to be related to inaccurate elastic cross sections minima between 50 and 700 keV.

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847594 (ARIEL).

HK 4.2 Mon 17:00 SCH/A117

Towards a low-background X-ray setup at Felsenkeller Dresden — •Christoph Seibt, Hans Fritz Rudolf Hoffmann, Marie Pichotta, Steffen Turkat, and Kai Zuber — Institute of nuclear and particle physics, TU Dresden, Germany

Gamma Spectrometry is one of the most commonly used tools in nuclear physics, and it has advanced over the last decades considering efficiency, resolution and background reduction. X-ray spectrometry on the other hand is barely used in the field of nuclear physics despite a wide range of applications in the field of rare nuclear decays. Low-background X-ray spectrometry may enable the investigation of decays with no gamma ray emission and decays with a low Q-value. Therefore, a low-background X-ray spectrometry setup is designed and installed in the Felsenkeller shallow-underground laboratory in Dresden, Germany. The setup consists of a Silicon Drift Detector, encapsulated by a multi-layer passive shielding. This presentation reports on the current status of the setup design, installation and background measurements.

HK 4.3 Mon 17:15 SCH/A117

HPGe-BGO Pair Spectrometer for ELI-NP — •Ilja Homm for the ELI-NP Pair Spectrometer-Collaboration — Technische Universität Darmstadt, Germany

The new European research facility called ELI-NP (The **E**xtreme **L**ight **I**nfrastructure - **N**uclear **P**hysics) is being built in Bucharest-Magurele, Romania. ELI-NP will offer unprecedented opportunities for photonuclear reactions with high intensity, brilliant and fully polarized photon beams at energies up to 19.5 MeV.

The 8 HPGe CLOVER detectors of ELIADE are important instruments for the γ-spectroscopic study of photonuclear reactions. We investigate the possibility to operate an advanced version of an anti-Compton shield (AC shield) as escape γ-rays pair spectrometer for one of the ELIADE CLOVERS. This should improve the performance at high energies where the pair production process dominates. The BGO shield operated as a stand-alone device can also be used as γ-beam intensity monitor and to investigate the cross section for pair production near the threshold. A prototype pair spectrometer, consisting of 64 BGO crystals with SiPM (silicon photomultiplier) readout, has been designed and built. Two test measurements with high energy photons have been performed at the University of Cologne and at the ILL in Grenoble. Results are going to be presented.

This work is supported by the German BMBF (05P15RDENA, 05P21RDFN2) and the LOEWE-Forschungsschwerpunkt “Nukleare Photonik”.

HK 4.4 Mon 17:30 SCH/A117

Improved Pulse Shape Simulations for Highly Segmented HPGe Detectors — •Rouven Hirsch, Rainer Abels, Jürgen Eberth, Kai Henseler, Herbert Hess, Darius Luyken, and Peter Reiter — Institut für Kernphysik, Universität zu Köln

The Advanced GAmma Tracking Array (AGATA) utilizes the γ-ray tracking method to reconstruct the path of the γ rays through the detector array. Essential for the tracking is the determination of the γ-ray interaction positions with high spatial resolution. This is obtained via pulse-shape analysis (PSA) of the 37 preamplifier signals of the 36-fold segmented high purity germanium detectors. Simulated signal shapes are compared to measured signals to match the interaction positions. Simulated data bases of position dependent signals were generated for a cylindrical 36-fold segmented single ended coaxial HPGe detector employing the AGATA Detector Library [1] and SolidStateDetectors.jl [2]. Systematic deviations at the crystal borders and segmentation lines were identified and investigated by comparing simulated pulse shapes and measured signals for both approaches. The impact of individual parameters on the simulated pulse shapes were identified to improve the overall PSA performance. Supported by BMBF Project 05P18PKFN9 and 05P21PKFN9

[1] B. Bruyneel et al. Eur. Phys. J. A (2016) **52**: 70
[2] I. Abt et al. 2021 JINST **16** P08007

HK 4.5 Mon 17:45 SCH/A117

Revision of the AGATA Triple Cluster detectors — •Rainer Abels, Jürgen Eberth, Kai Henseler, Herbert Hess, Rouven Hirsch, Darius Luyken, Peter Reiter, and Jasper Wehlitz — IKP Universität zu Köln, Cologne, Germany

The Advanced GAmma Tracking Array (AGATA) is a 4π position sensitive γ-ray spectrometer based on the principle of γ-ray tracking. It provides high energy resolution, high efficiency and position resolution for in beam γ-ray spectroscopy. A high reliability of the AGATA Triple Cluster (ATC) detectors is mandatory for continues long term operation without maintenance of ATC detectors. For this purpose the following modifications were implemented. The HPGe crystals are encapsulated in a new reusable aluminum housing using a temperature resistant full-metal elastic seal. To recover the energy resolution of detectors suffering from neutron damage, a reliable annealing procedure was developed. New vacuum feedthroughs are implemented in order to increase the longevity of the ATCs. To improve the vacuum properties the position of getter materials inside the cold part was put close to the capsules. Novel test procedures for cold j-FETs were developed and new cold core preamplifiers replace obsolete electronic components. After the physics campaign at GANIL, France, AGATA was erected with the revised ATCs at LN Legnaro, Italy. Successful commissioning and first experiments were performed with improved performance values. Supported by BMBF Projects 05P18PKFN9, 05P21PKFN9.