HK 70: Instrumentation 20

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

Group Report HK 70.1 Fri 14:30 M/HS2

Detection of Low-Energy Antinuclei in Space Using an Active-Target Particle Detector — •Thomas Pöschl[1], Daniel Greenwald[1], Igor Konorov[1], Martin Losekamm[1,2], and Stephan Paul[1] — [1]Physics Department E18, Technische Universität München — [2]Institute of Astronautics, Technische Universität München

Measuring antimatter in space excellently probes various astrophysical processes. The abundancies and energy spectra of antiparticles reveal a lot about the creation and propagation of cosmic-ray particles in the universe. Abnormalities in their spectra can reveal exotic sources or inaccuracies in our understanding of the involved processes. The measurement of antiprotons and the search for antideuterons and antihelium are optimal at low kinetic energies since background from high-energy cosmic-ray collisions is low. For this reason, we are developing an active-target particle detector capable of detecting ions and anti-ions in the energy range of 30 - 100 MeV per nucleon. The detector consists of 900 scintillating fibers coupled to silicon photomultipliers and is designed to operate on nanosatellites. The primary application of the detector will be the *Antiproton Flux in Space* (AFIS) mission, whose goal is the measurement of geomagnetically trapped antiprotons inside Earth's inner radiation belt. In this talk, we will explain our particle identification technique and present results from first in-beam measurements with a prototype. This work is supported by the Excellence Cluster 'Origin and Structure of the Universe'.

HK 70.2 Fri 15:00 M/HS2

A highly-segmented neutron detector for the A1 experiment at MAMI — •Matthias Schoth for the A1-Collaboration — Institut für Kernphysik, Mainz

Electric and magnetic form factors of the neutron, are one of the defining properties to characterize its structure quantitatively. A planned physics program to improve the data base significantly requires high performance detection of relativistic neutrons. Exploiting the full potential of the high luminosity supplied by the MAMI accelerator, a novel neutron detector is being developed in the scope of the A1 collaboration.

A large active detector volume of 0.96 m^3 is required to achieve a high raw detection efficiency. The detector is subdivided into 2048 plastic scintillators to be able to cope with high background rates. The light is extracted via wavelength shifting fibres and then guided to multi anode photomultiplier. The signal is read out with FPGA based TDCs (TRBv3 developed at GSI). The energy of the signal is obtained via time over threshold information in combination with a suitable shaping and discriminating circuit.

Prototype tests have been performed to optimize the choice of materials and geometry. The capability to detect neutrons in the relevant momentum range has been demonstrated using pion production.

A Geant4 simulation using tracking algorithms evaluating the deposited energy is able to optimize key detector properties like particle id efficiency, multiplicity or the effective analyzing power for double polarized scattering experiments.

HK 70.3 Fri 15:15 M/HS2

Performance of BEGe detectors for GERDA Phase II — •Andrea Lazzaro for the GERDA-Collaboration — Physik-Department E15, Technische Universität München, Germany

After the end of the data–taking for GERDA Phase I, the apparatus has been upgraded to fulfill the requirements of the second phase. Phase II sensitivity will be driven by 30 custom made BEGe detectors. This detectors are now available and can be operated in phaseII configuration in the GERDA cryostat together with the liquid argon scintillation veto.

The performances of BEGe detectors in liquid argon will be presented in this talk. Besides the spectroscopy capability, the focus will be placed on the expectations in terms of background rejection via pulse shape discrimination (PSD). In particular the main goal the BEGe's pulse shape analysis is to discriminate surface events produced by beta emitters (e.g. ^{42}K) present in the liquid Ar.

This work was supported in part by BMBF (05A14W03).

HK 70.4 Fri 15:30 M/HS2

Performance of the LAr scintillation veto of GERDA Phase II — •Christoph Wiesinger for the GERDA-Collaboration — Technische Universität München, Physik Dep., E15, James-Franck-Straße, 85748 Garching

Gerda is an experiment to search for the neutrinoless double beta decay in ^{76}Ge. Results of Phase I have been published in summer 2013 and Gerda is upgraded to Phase II. To reach the aspired background index of $\leq 10^{-3}$ cts/(keV·kg·yr) for Phase II active background-suppression techniques are applied, including an active liquid argon (LAr) veto. It has been demonstrated with the LArGe test facility that the detection of argon scintillation light can be used to effectively suppress background events in the germanium, which simultaneously deposit energy in the LAr. The light instrumentation consisting of photomuliplier tubes (PMT) and wavelength-shifting fibers connected to silicon multipliers (SiPM) has been installed in Gerda. In this talk the low background design of the LAr veto and its performance during the comissioning runs will be reported.

This work was partly funded by BMBF 05A14W03.

HK 70.5 Fri 15:45 M/HS2

Measuring the attenuation length in liquid scintillators — •Dominikus Hellgartner[1], Lothar Oberauer[1], Sabrina Prummer[1], Julia Sawatzki[1], Andreas Ulrich[2], and Vincenz Zimmer[1] — [1]Technische Universität München, Physik Departement E15, James Franck Straße, 85748 Garching — [2]Technische Universität München, Physik Departement E12, James Franck Straße, 85748 Garching

The next generation of liquid scintillator detectors like the proposed LENA detector or the planned JUNO detector will feature diameters of order 30 m. Due to this vast size, the optical quality of the scintillator is of crucial importance.

To determine the attenuation length of liquid scintillators, an experiment with a 5 m long measurement section was set-up in the underground laboratory in Garching. The current set-up of the experiment will be presented along with a discussion of the results of the first measurements. Additionally, there will be an outlook towards possible upgrades of the experiment in the future.

HK 70.6 Fri 16:00 M/HS2

Measurement of proton-quenching and PSD performance of organic liquid scintillators — •Vincenz Zimmer, Dominikus Hellgartner, Julia Sawatzki, and Lothar Oberauer — Physik-Department, Technische Universität München

Understanding quenching effects in organic liquid scintillators is vital for various present and future neutrino experiments, like Double Chooz, Borexino, LENA and JUNO.

The understanding of proton-quenching is important for both signal and background detection in neutrino experiments. This effect defines the energy scale of ν-p-scattering, which is a major detection channel for supernova-νs. Furthermore, recoil protons from cosmogenic neutrons pose a severe background for the detection of the diffuse supernova neutrino background (DSNB) and reactor neutrinos. Pulse shape discrimination (PSD) is a powerful tool to identify the type of particle by its typical scintillation light emission and, therefore, to distinguish between background and signal events.

A time of flight based experiment has been established at the MLL (Garching). Using a pulsed ^{11}B-beam and a fixed H_2-target neutrons with about $6-11$ MeV are produced to investigate the quenching effect and γ-n-discrimination performance by the resulting proton recoils in different liquid scintillator samples.

This research was supported by the DFG cluster of excellence 'Origin and structure of the Universe' and the Maier-Leibnitz-Laboratorium (MLL), Garching.

HK 70.7 Fri 16:15 M/HS2

(Alpha-) Quenching temperature dependence in liquid scintillator — •Arnd Sörensen, Valentina Lozza, Belina von Krosigk, and Kai Zuber — Institut für Kern- und Teilchenphysik, TU Dresden

Liquid scintillator (LS) is an effective and promising detector material, which is and will be used by many small and large scale experiments. In order to perform correct signal identification and background suppression, a very good knowledge of LS properties is crucial.

One of those is the light yield from alpha particles in liquid scintillator. This light output strongly quenched, approx. 10 times compared to that of electrons, and has been precisely studied at room temperature for various LS. Big scintillator experiments, such as SNO+ and maybe future large scale detectors, will operate at different temperatures.

While a strong temperature dependence is well known for solid state scintillators, due to the different scintillation process, a quenching temperature dependence in LS is usually assumed negligible. On the other hand, inconsistencies in between measurements are often explained by potential temperature effects.

This study investigates LAB based liquid scintillator with an intrinsic, dissolved alpha emitter and its behaviour with temperature change. In a small, cooled and heated setup, a stabilized read-out with two PMTs is realised. First results will be presented. This work is supported by the German Research Foundation (DFG).