T 23: Experimental Techniques in Astroparticle Physics 1

Time: Monday 16:15–17:45 Location: T-H36

T 23.1 Mon 16:15 T-H36

Monte Carlo simulation of background components in low level Germanium spectrometry — •Nicola Ackermann[1], Hannes Bonet[1], Christian Buck[1], Janina Hakenmüller[1], Gerd Heusser[1], Matthias Laubenstein[2], Manfred Lindner[1], Werner Maneschg[1], Jochen Schreiner[1], and Herbert Strecker[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Laboratori Nazionali del Gran Sasso, Via G. Acitelli 22, 67100 Assergi L'Aquila, Italy

This talk presents Monte Carlo simulations of the background spectra of the 4 screening detectors GeMPI 1 - 4 at the Gran Sasso Underground Laboratory (LNGS) using the Geant4 based framework MaGe. The GeMPI detectors are low background Ge spectrometers located at a depth of 3500 m.w.e. and achieve extremely high sensitivites in material screening at a level of μBq/kg. They are used to test material samples on their suitability to use in rare event experiments. In the simulations, muons, neutrons and tiny radioactive contaminations of the detector and shielding materials are investigated as possible sources of background radiation and it was found that the ^{210}Pb contaminations in the detector shield and the neutrons coming from radioactive decays in the surrounding rock are the biggest contributors. A detailed understanding of the composition of the background spectra was achieved, allowing for the suggestion of two new possible shield designs for future GeMPI-like detectors

T 23.2 Mon 16:30 T-H36

Biases in the ^{76}Ge $0\nu\beta\beta$ tagging from calibrations — •Tommaso Comellato[1], Matteo Agostini[1,2], and Stefan Schönert[1] — [1]Technical University of Munich, Garching bei München, Germany — [2]University College London, London, United Kingdom

The analysis of the time profile of electrical signals in germanium detectors provides a powerful tool for a high efficiency selection of neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. The standard discrimination techniques are calibrated using samples of $0\nu\beta\beta$-like events, which either occur at a different energy or contain a significant background contamination. With the help of a ^{56}Co source (which was custom produced by the Jagiellonian University in Krakow), we present a precision measurement of the biases of the standard event selection techniques in $0\nu\beta\beta$ experiments with ^{76}Ge, and propose an additional calibration method. This work has been supported in part by the ERC (Grant agr. No. 786430 - GemX) and by the SFB1258 funded by the DFG.

T 23.3 Mon 16:45 T-H36

Towards a low background SDD for IAXO — David Casado Moran[1,2], Frank Edzards[1,2], Thibaut Houdy[3], Susanne Mertens[1,2], Juan Pablo Ulloa Beteta[1,2], •Christoph Wiesinger[1,2], and Michael Willers[1,2] — [1]Max-Planck-Institut für Physik, München — [2]Physik-Department, Technische Universität München, Garching — [3]IJCLab, Université Paris-Saclay, Paris

The International Axion Observatory (IAXO) is aiming to detect solar axions, as they are converted into X-rays in a strong magnet pointing towards the sun. Excellent spectroscopic performance, high X-ray absorption efficiency at and below 10 keV and potential for ultra-low background operations are features of Silicon Drift Detectors (SSDs) that could facilitate this search. First measurements in the Munich shallow underground laboratory have shown promising background performance. Dedicated low-background designs, following a conventional passive shielding strategy and a novel all-semiconductor active shield approach, are under development. In this talk, we will report on the latest achievement towards a low background SDD for IAXO.

T 23.4 Mon 17:00 T-H36

The Pacific Ocean Neutrino Experiment: Results from three years of pathfinder data — Christopher Fink, Kilian Holzapfel, Stephan Meighen-Berger, Imma Rea, Li Ruohan, •Lisa Schumacher, Maria Sharshunova, and Laura Winter for the P-ONE-Collaboration — Experimental Physics with Cosmic Particles, TU Munich

The Pacific Ocean Neutrino Experiment (P-ONE) is a planned, cubic-kilometer-scale neutrino telescope at 2660 m depth in Cascadia Basin located off the coast of Vancouver, Canada. The telescope is planned by a growing collaboration of Ocean Networks Canada (ONC), and Universities from Germany, Canada and the USA. Two pathfinder experiments have been deployed in Cascadia Basin using the already available infrastructure of ONC: STRAW (STRings for Absorption length in Water) in 2018 and STRAW-b in 2020. Both pathfinder experiments - and P-ONE in the future - are based on vertical, deep-sea cable lines equipped with multiple photosensors and calibration light sources. The main goal of the pathfinder lines is to characterize the optical properties of the site, which proved suitable to host P-ONE. Another purpose of the pathfinder lines is the monitoring of background light caused by K40 decay and bioluminescence, by now over more than three years. We will present an overview over recent results obtained with the STRAW and STRAW-b lines.

T 23.5 Mon 17:15 T-H36

Performance evaluation of the Wavelength-shifting Optical Module for the IceCube Upgrade — •Yuriy Popovych[1], Sebastian Böser[1], Anna Pollmann[2], John Rack-Helleis[1], and Martin Rongen[1] for the IceCube-Collaboration — [1]JGU Mainz — [2]Bergische Universität Wuppertal

In the upcoming IceCube Upgrade several new types of sensors will be deployed so to increase the sensitivity and explore possibilities for the envisioned IceCube Gen2 detector.

One of the modules to be deployed in the Upgrade is the Wavelength-shifting Optical Module (WOM). It consists of a quartz tube coated with Wavelength-Shifting (WLS-) paint with two Photomultiplier Tubes (PMTs) attached to its ends located inside a quartz pressure vessel filled with PFPE. The paint absorbs UV-photons and reemits them as visible light which is then captured through total internal reflection and propagate to a PMT on each side. This design results in a large photosensitive area, UV-sensitivity and a high signal-to-noise ratio. Through various improvements, like the choice of the filling material or coating techniques the efficiency of the modules can be optimized.

This talk will present the optical design of the WOM and explain the contributions of the single WOM components to efficiency of the module. Further, several simulation tools will be presented used to study and optimize the overall performance.

T 23.6 Mon 17:30 T-H36

Timing characteristics of the Wavelength-shifting Optical Module — •John Rack-Helleis[1], Sebastian Böser[1], Martin Rongen[1], Klaus Helbing[2], Anna Pollmann[2], Nick Schmeisser[2], Yuriy Popovych[1], and Kyra Mossel[1] for the IceCube-Collaboration — [1]Johannes Gutenberg Universität Mainz — [2]Bergische Universität Wuppertal

The Wavelength-shifting Optical Module (WOM) uses the techniques of wavelength shifting and light guiding to achieve a large photosensitive area, UV-sensitivity and improved signal-to-noise ratio. The centerpiece of the sen- sor is a hollow quartz cylinder coated with wavelength-shifting paint with a PMT (Photomultiplier Tube) optically coupled to each of its ends. Incident photons are absorbed, wavelength shifted and re-emitted into the tube walls. From there, they are guided towards one of the read out PMTs via total inter- nal reflection. While effective area and signal-to-noise ratio scale approximately linearly with the cylinder length, the average time it takes photons to reach one of the readout PMTs also increases. The timing of the WOM can be described by a convolution of three main components: The time response of the attached read out PMT, the photoluminescence characteristics of the WLS paint, and the path length distribution of photons inside the WLS tube. In this presentation we elaborate on the understanding of the timing of the WOM from a theoretical and experimental stand point. We present the intricacies of a device where everything seemingly runs in circles.