T 38: Methods in Astroparticle Physics II

Time: Tuesday 16:15–18:30 Location: KS 00.004

T 38.1 Tue 16:15 KS 00.004

The Super-SANDI nylon vessel: Compatibility with Water-based Liquid Scintillator — •Noah Goehlke, Amala Augusthy, Johann Martyn, Philipp Kern, Michael Wurm, David Maksimovic, and Oliver Pilarczyk — Johannes Gutenberg-Universität Mainz

The Accelerator Neutrino Neutron Interaction Experiment (ANNIE) is a neutrino detector at the Booster Neutrino Beam at Fermilab, designed for measuring the neutron multiplicity in neutrino-nucleus interactions. ANNIE has a strong focus on testing new detector technologies, among which is Water-based Liquid Scintillator (WbLS). WbLS is a novel detection medium, consisting of liquid scintillator dissolved in water with the help of a surfactant. It allows for the simultaneous observation of Cherenkov and scintillation light. To test the reconstruction of extended event topologies in WbLS, ANNIE is going to deploy a nylon vessel containing 8 m^3 of WbLS (dubbed Super-SANDI) this summer. In preparation for Super-SANDI, the chemical compatibility between WbLS and different types of Nylon was investigated. UVvis spectroscopy was used to study the effects on the transparency and on the organic components of the WbLS after exposure to Nylon for an extended period of time. While the transparency is unaffected, an adsorption of PPO into nylon was found, creating slightly scintillating nylon.

T 38.2 Tue 16:30 KS 00.004

Developing a Cryogenic SiPM Characterization Setup — •Nicolas Krieger, Andreas Leonhardt, Stefan Schönert, and Mario Schwarz — Department of Physics, TUM School of Natural Sciences, Technical University of Munich, 85748 Garching b. München, Germany

Silicon photomultipliers (SiPMs) are promising photodetectors for liquid noble gas detectors, which impose challenging cryogenic and vacuum-ultraviolet conditions. Understanding SiPM behavior in this environment is crucial, given the strong temperature dependence of key performance parameters, such as the dark count rate (DCR), breakdown voltage (V_{bd}), gain, photon detection efficiency (PDE), crosstalk, and afterpulsing. We developed a dedicated SiPM characterization setup inside a temperature-controlled vacuum chamber (300-40K) and present the main challenges in achieving stable SiPM operation and readout. The vacuum environment enables systematic measurements over a wide temperature range and rapid sample turnaround, both of which are not accessible in liquid noble gas setups. Finally, we present temperature-dependent SiPM performance measurements, which will support ongoing studies of SiPM behavior for the LEGEND experiment. We acknowledge support from the Deutsche Forschungsgemeinschaft and through the Sonderforschungsbereich SFB 1258.

T 38.3 Tue 16:45 KS 00.004

Innovative Production Approach to Vacuum Beam Pipes of the Einstein Telescope — •Charlotte Benning, Robert Joppe, Oliver Pooth, and Achim Stahl — RWTH Aachen University, Physics Institute 3B

The Einstein Telescope (ET), Europe's next-generation gravitational-wave detector, requires 120 km of underground vacuum tubes with a diameter of 1 m to achieve the design sensitivity. The current design foresees the production of the beam pipes in sections of 15 m, which results in high efforts for transportation, welding, and cleaning. BeamPipes4ET proposes an innovative production approach in which the vacuum pipes are manufactured directly on-site inside the tunnels through a continuous forming process using sheet-metal coils. It offers potential reductions in time, cost, installation effort, and environmental impact. In this talk, the current project status, key technological developments, and a comparison between the current ET design and the BeamPipes4ET approach are discussed.

T 38.4 Tue 17:00 KS 00.004

Commissioning of a vacuum-insulated liquid argon purifier for removing trace amounts N2 featuring a novel Li-FAU molecular sieve for LEGEND — •Georgia Pavlidaki[1], Christoph Vogl[1], Laszlo Papp[1], Mario Schwarz[1], Grzegorz Zuzel[2], and Stefan Schönert[1] — [1]Department of Physics, TUM School of Natural Sciences, Technical University of Munich, 85748 Garching b. München, Germany — [2]M. Smoluchowski Institute of Physics, Jagiellonian University, Cracow, 30-348, Poland

LEGEND-1000 will search for neutrinoless double-beta decay of ^{76}Ge with up to 1000 kg of enriched high-purity germanium detectors. The detectors are operated bare in liquid argon (LAr) which acts as a coolant, shield, and particle detector. To effectively detect background radiation, LAr has to be kept clean. Impurities such as oxygen, nitrogen or water deteriorate its scintillation properties. A recently identified Li-FAU molecular sieve effectively removes nitrogen from LAr. We construct a LAr purification system featuring Li-FAU and a copper catalyst and report on the current status. The system is able to purify in batch and loop mode, and is vacuum insulated, minimizing LAr losses. The purifier will provide high-purity LAr for a future investigation of the scintillation properties of xenon-doped liquid argon, and offers excellent windows of opportunity to gain operational experience with Li-FAU for LEGEND-1000. We acknowledge support from the DFG under Germany's Excellence Strategy – EXC 2094 (ORIGINS) and through the Sonderforschungsbereich SFB 1258. We acknowledge support by the BMFTR Verbundprojekt 05A2023 (LEGEND).

T 38.5 Tue 17:15 KS 00.004

Low-Background Gamma Spectrometry for LEGEND — Hannes Bonet[1], •Patrick Bongratz[1], Benjamin Gramlich[1], Manuel Huber[2], Matthias Laubenstein[3], Susanne Mertens[1], Hardy Simgen[1], Herbert Strecker[1], and Edgar Sanchez Garcia[1] for the LEGEND-Collaboration — [1]Max Planck Institut für Kernphysik, Heidelberg — [2]Technische Universität München, Garching — [3]Laboratori Nazionali del Gran Sasso (LNGS)

Low-background experiments depend on minimizing radioactive contamination in detector materials. For example, in the Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay (LEGEND), all materials are screened for radioisotopes to achieve this high radiopurity. This is commonly done by gamma spectroscopy using low-background, high-purity Germanium (HPGe) spectrometers. Operating these spectrometers in an underground laboratory reduces the cosmic background for the measurement. In this talk, I present on HPGe-spectrometers operated at 15 m.w.e. in Heidelberg (Germany) and at 3800 m.w.e. at LNGS (Italy). I describe how measurements from these detectors are used to derive the total background budget for the LEGEND-1000 experiment and to fix radiopurity requirements for its components. Sample-specific detection efficiencies are determined using the Geant4-based simulation framework remage.

T 38.6 Tue 17:30 KS 00.004

Characterizing infrared scintillation light in xenon — •Robert Hammann, Kai Böse, Steffen Form, Luisa Hötzsch, and Teresa Marrodán Undagoitia — Max- Planck-Institut für Kernphysik

Xenon in gaseous and liquid form is a widely used target material for rare-event searches, including the direct detection of dark matter. Its scintillation properties in the ultraviolet (UV) spectrum are well-known and extensively used. However, the potential of infrared (IR) scintillation light remains largely unexplored. Characterizing this IR component is important for evaluating possible improvements in the physics output of future astroparticle detectors.

This contribution presents studies of xenon gas scintillation at room temperature using a dedicated setup equipped with an alpha particle source, as well as one IR- and two UV-sensitive photomultiplier tubes. This allowed the first time-resolved measurement of the IR scintillation response, revealing both a fast nanosecond-scale and a slow microsecond-scale decay component. Remarkably, our measurements showed that the IR light yield is comparable to the UV yield. We also investigated the effects of gas pressure and impurity levels on the IR signal.

Initial results with a dual-phase detector possessing broadband wavelength sensitivity are consistent with IR emission from the liquid xenon target and electroluminescence in the gas phase, indicating the potential of xenon-based detectors with multi-wavelength readout.

T 38.7 Tue 17:45 KS 00.004

Methods to measure the ice stratigraphy in the IceCube Upgrade — •Anna Eimer for the IceCube-Collaboration — Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-

Universität Erlangen-Nürnberg

A precise understanding of the optical properties of the instrumented Antarctic ice sheet is crucial to the performance of the IceCube Neutrino Observatory and its planned successors.

The ice optical properties are driven by impurities deposited with the snow that formed the ice and thus layers of constant optical properties form a stratigraphy. Due to the underlying bedrock, these layers undulate over the large lateral footprints of these detectors.

Within IceCube, the layer undulations have originally been mapped using stratigraphy measurements by a stand-alone laser dust logger. It required a dedicated deployment setup, as it was not located on the main sensor cables. This resulted in significantly increased costs.

New methods to replace the stand-alone dust logger as have been employed during the deployment of the IceCube Upgrade will be shown in this talk. One approach consists of a light source that was co-deployed with the photosensor modules and operated during the deployment of the detector. Another approach uses a camera to record the stratigraphy. Initial data from both approaches, in particular sampling 150m below the depth instrumented by IceCube, will be shown and discussed.

T 38.8 Tue 18:00 KS 00.004

Deployment of the Acoustic Module for the IceCube Upgrade — •Andreas Nöll, Jan Audehm, Jürgen Borowka, Mia Giang Do, Christoph Günther, Dirk Heinen, Christopher Wiebusch, and Simon Zierke — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory is a cubic kilometer-sized detector located at the geographic South Pole, consisting of 5160 Digital Optical Modules (DOMs). In the Antarctic summer 2025/26 more than 700 new modules will be installed as part of the IceCube Upgrade. These include ten Acoustic Modules (AMs), capable of transmitting and receiving acoustic signals between 5 and 30kHz. Additionally, up to 30 acoustic receivers will be located in new DOMs. The goal of these devices is to improve the geometry calibration based on multilateration of the measured acoustic propagation times, as well as enhance our understanding of the acoustic properties of the ice. This talk presents the current state of the project after the deployment of the IceCube Upgrade.

T 38.9 Tue 18:15 KS 00.004

Experimental progress of the Munich Electrostatic Storage Ring (ESR) — •Adil W. Muggo, Chiara Brandenstein, Nils Doll, Peter Fierlinger, Dario Rückwarth, Wolfgang Schott, Vitus Schuster, Hans Th. J. Steiger, Konstantin Walter, and Florian Zötl — School of Natural Sciences, Physics-Department, Technical University of Munich, 85748 Garching, Germany

Stored ions or ionic molecules in a non-relativistic electrostatic storage ring can serve as a versatile platform for various fundamental experiments. Through precise control of beam dynamics and polarization, searches for electric dipole moments (EDMs) or axion-like particles (ALPs) become feasible in a rather unique and novel setting. Recent progress on the implementation of such a device is being discussed. Our experimental demonstrator comprises three subsystems: a laser ablation source for ion generation and acceleration, an injection beamline for beam focusing and transport, and the storage ring itself, where electrostatic elements confine the ions on stable trajectories. The current commissioning status of the setup is presented, as well as experimental challenges and first performance benchmarks.