T 85: Astroteilchenphysik: Methoden IV

Zeit: Donnerstag 16:00–17:45 Raum: S12

T 85.1 Do 16:00 S12

Performance increase due to new optical modules for IceCube Upgrade — •Wing Yan Ma for the IceCube-Collaboration — DESY, Zeuthen, Germany

The IceCube Neutrino Observatory is a cubic-kilometer Cherenkov detector at the South Pole. The planned upgrade to IceCube's neutrino detection capability relies on the deployment of a denser array of Digital Optical Modules (DOMs) inside the current DeepCore volume. The addition instrumentation will rely on a new generation of DOMs with improve detection efficiency as well as directional resolution for Cherenkov photons. In this talk, the IceCube Upgrade project is outlined and the expected performance increase due to the new generation of DOMs are presented.

T 85.2 Do 16:15 S12

Simulation studies on the thermal properties of the mDOM for the IceCube Upgrade — •Judith Schneider, Gisela Anton, Jonas Reubelt, and Gerrit Wrede for the IceCube-Collaboration — Erlangen Centre for Astroparticle Physics, 91058 Erlangen, Germany

In the framework of a planned upgrade of the IceCube Neutrino Observatory and a next-generation neutrino telescope at the South Pole, new optical modules are being developed, which are expected to significantly increase the detector sensitivity. One of such concepts is the multi-PMT Digital Optical Module (mDOM) which features 24 three-inch PMTs inside a pressure vessel resulting in a homogeneous directional sensitivity. We have implemented the construction of a mDOM with its substantial components and their thermal properties in a COMSOL simulation as well as a heat source reproducing the expected heat input of the mDOM electronics. With the assumption that all heat is conducted away via the pressure vessel, the thermal flux is determined. The results are compared to measurements of the thermal behavior of a mDOM in the climate chamber.

T 85.3 Do 16:30 S12

Event selection studies for the IceCube-Upgrade — •Cristian Jesús Lozano Mariscal and Alexander Kappes for the IceCube-Collaboration — Institüt für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

For the planned upgrade of the IceCube neutrino telescope, seven additional strings equipped with new optical modules will be installed in the center of DeepCore, the current low energy IceCube extension. The upgrade will significantly enhance IceCube's low-energy neutrino detection capabilities with the goal of performing precision measurements in atmospheric neutrino oscillation, and improve the calibration of the existing IceCube detector in particular also for the reconstruction of astrophysical high-energy neutrinos. In order to achieve these goals, a crucial pre-requisite is to accurately distinguish between neutrinos and atmospheric muons. This study presents initial studies on event selection algorithms and their performance.

T 85.4 Do 16:45 S12

In-situ measurement of the luminescence of IceCube ice* — •Anna Pollmann for the IceCube-Collaboration — Bergische Universität Wuppertal

The IceCube neutrino observatory uses $1\,\mathrm{km}^3$ of the clear, natural ice near the geographic South Pole as an optical detection medium. When charged particles, such as neutrino secondaries, pass through the ice, Cherenkov light is emitted. The light is then recorded by embedded optical modules.

However new kind of signatures, produced by exotic particles, could be detected by using light emission from luminescence. It is induced by highly ionizing particles passing through matter causing the excitation of surrounding atoms and molecules which then emit photons as they return to ground state. This process is highly dependent on the ice structure, impurities, pressure and temperature. Therefore a logging devices was build in order to measure these ice properties in-situ.

For the measurements in the recent Antarctic summer season, a 1.7 km deep and 12.5 cm wide hole is used which was recently drilled near the IceCube site. The small diameter of the hole presents a challenge for the construction of the experiment and the design of the read-out electronics inside the pressure vessels. The details of the experiment as well as available measurement results will be presented.

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T 85.5 Do 17:00 S12

Ultra-low energy calibration of the XENON1T detector with an internal ^{37}Ar source — •Christopher Hils for the XENON-Collaboration — Institut für Physik & Exzellenzcluster PRISMA, J. Gutenberg-Universität Mainz, 55099 Mainz, Germany

XENON1T is the first ton-scale dual phase xenon Time Projection Chamber aiming at the direct detection of Dark Matter, which in 2018 set the most stringent constraints on the interaction cross-section between nucleons and Dark Matter in the form of Weakly Interacting Massive Particles. Due to the size of the active volume and the excellent self shielding properties of xenon, the understanding of the detector response relies to a large extent on internal calibrations, based on ^{83m}Kr and ^{220}Rn gaseous isotopes diluted into the liquid xenon and distributed over the whole active volume. In this talk we report on the novel internal calibration isotope ^{37}Ar, produced with high purity by neutron capture in the TRIGA research reactor in Mainz, and introduced in XENON1T in October 2018: this isotope provides two (X-rays and Auger electrons) calibration lines at 2.8 keV and 270 eV that allowed an unprecedented study of the ultra-low energy response of the detector and its detection thresholds. After the calibration, the isotope has been efficiently removed by the XENON1T distillation column originally designed for krypton removal, opening the way for the adoption of this calibration technique in the upcoming XENONnT experiment.

T 85.6 Do 17:15 S12

Radar measurements in glacial ice — •Pia Friend, Alexander Kyriacou, Klaus Helbing, and Uwe Naumann — Bergische Universität Wuppertal, Fachbereich Physik

Some of the icy moons in the outer solar system are most promising potential hosts of extraterrestrial life. To access their water reservoirs, and test it for possible signs of life, a melting probe must navigate through their icy crusts. Therefore, as a part of the DLR funded Enceladus Explorer initiative (EnEx), we aim to develop a radar based positioning system working in ice. Essential for this is the knowledge of the permittivity and the attenuation of radio waves in ice. To evaluate these principles, measurements of radio wave propagation will be performed on an alpine glacier in february 2019. We will melt several boreholes up to 15 m in the glacier and will take radar measurements at different depths, at different distances and at frequencies between 500 MHz and 2 GHz. In this way, we can study dependences of the permitivity on the density of the ice and air mixture at different depths within the glacier. Additionally, from the attenuation, we will further evaluate the frequency range to provide optimal range and distance resolution for in-ice radar sounding. First results will be provided.

T 85.7 Do 17:30 S12

Alexander Kyriacou — •Alexander Kyriacou, Pia Friend, Klaus Helbing, and Uwe Naumann — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

The sub-surface ocean of Saturn's ice-moon Enceladus is considered one of the most promising and accessible environments in the solar system to search for extra-terrestrial life. Enceladus Explorer (EnEx) is a DLR initiative to test the feasibility of sending a lander to Enceladus' south pole, which would deploy an autonomous melting probe or 'IceMole' that travels through the ice to a near-surface aquifer and perform in-situ tests for microbial life. The success of such a mission depends on accurate radar mapping of the ice interior from orbit, the surface and from within the ice.

The feasibility of using frequency modulated radar at ultra-high frequencies, deployed from the lander and IceMole is under investigation. The visibility range of radar in Enceladus' surface ice is uncertain, requiring better knowledge of the local permittivity. The effects of attenuation, refraction, internal reflections, dispersion, refraction and dust scattering are investigated using ray-tracing based simulations. The results of these simulations are to be compared against measurements of radar transmission through an alpine glacier, conducted in February of 2019. The resulting radar modulations, and the measured local permittivity will be used to train the simulations to predict radar propagation on Enceladus for given permittivity and attenuation profiles. These insights on radio propogation in ice will also assist in the development of neutrino detection using radio waves.