T 32: Neutrinophysik II

Zeit: Dienstag 16:00–18:35 Raum: S06

Gruppenbericht T 32.1 Di 16:00 S06

Status and Physics of the SNO+ Experiment — •Mikko Meyer for the SNOplus-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Dresden, Deutschland

SNO+ is a large liquid scintillator based experiment located in the SNOLAB underground laboratory in Sudbury, Canada. The SNO+ experiment reuses the 12 m diameter acrylic vessel as well as the PMT array of the SNO detector. The main physics goal of SNO+ is the search for the neutrinoless double-beta decay with 130Te. During the initial double-beta phase, the liquid scintillator will be loaded with 0.5% natural tellurium, corresponding to 1330 kg of 130Te. SNO+ sensitivity to the effective Majorana neutrino mass will begin to explore the parameter space in the inverted hierarchy region. Higher Te loading are being developed and a SNO+ Phase II would extend sensitivity to the entire inverted hierarchy region. Designed as a general purpose neutrino experiment, the low background levels and the low thresholds will allow to additionally measure the reactor neutrino oscillations, geo-neutrinos in a geologically-interesting location, watch for supernova neutrinos, and measure the low energy solar neutrinos, like low energy 8B and possibly pep and CNO. This talk will focus on the current status of the SNO+ experiment and recent results.

Gruppenbericht T 32.2 Di 16:20 S06

The COBRA Double Beta Decay Experiment — •Robert Temminghoff for the COBRA-Collaboration — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4, 44227 Dortmund

The aim of the COBRA collaboration is to search for neutrinoless double beta-decay ($0\nu\beta\beta$-decay) with CdZnTe semiconductor detectors. This long-sought lepton number violating process is predicted by many Beyond-Standard-Model theories. Advantages of CdZnTe detectors are their commercial availability and ability to work at room-temperature, allowing for easy instrumentation and operation.

COBRA is currently operating two different sets of detectors in a low-background setup at the LNGS in Italy, placed in two distinct arrays, but sharing the same shielding and infrastructure. The *demonstrator* array consists of 64 $1\,\mathrm{cm}^3$ detectors and has now been in operation for several years. It has been used not only to search for various $0\nu\beta\beta$-decays, but also to perform an analysis of the spectral shape of the fourfold-forbidden β^--decay of ^{113}Cd in a low-threshold run.

In 2018, nine additional detectors with a size of $6\,\mathrm{cm}^3$ were installed forming the *extended demonstrator (XDEM)*. Besides being much larger, thus having a higher detection efficiency, these detectors were designed with a novel electrode structure, which helps to suppress the dominating surface related backgrounds found in the *demonstrator*.

In this talk, the current status of the experiment will be presented, including recent results from the spectral shape-investigation and first operational experiences of the *XDEM*.

Gruppenbericht T 32.3 Di 16:40 S06

Exploring CEνNS with nuCLEUS at the Chooz Nuclear Power Plant — •Victoria Wagner for the NU-CLEUS-Collaboration — IRFU, CEA, Université Paris Saclay, F-91191 Gif-sur-Yvette, France

Coherent elastic neutrino-nucleus scattering (CEνNS) offers a unique way to study neutrino properties and to search for new physics beyond the Standard Model. The nuCLEUS experiment offers a new approach to explore this process at unprecedented low energies.
nuCLEUS will be located at the Very-Near-Site (VNS), a new experimental hall at the Chooz nuclear power plant in France. The novel gram-scale fiducial-volume cryogenic detectors feature an ultra-low energy threshold of $\leq 20\,\mathrm{eV}$ in nuclear recoil, and a fast rise time of about $100\,\mu$s which allows the operation above ground. The fiducialization of the detector provides an effective discrimination of γ-, neutron and surface backgrounds. Furthermore, the use of multiple target nuclei allows to extract the CEνNS signature against possibly challenging backgrounds.

Gruppenbericht T 32.4 Di 17:00 S06

Search for neutrinoless double beta decay with GERDA: status and results — •Anna Julia Zsigmond for the GERDA-Collaboration — Max-Planck-Institut für Physik

The observation of neutrinoless double beta ($0\nu\beta\beta$) decay would establish both the violation of lepton number conservation and the Majorana nature of the neutrino, as well as constrain the neutrino mass hierarchy and scale. In 2018, the Gerda experiment reached an important milestone in the search for $0\nu\beta\beta$ decay with ^{76}Ge by achieving a half-life sensitivity of 10^{26} years. This is made possible by the background-free conditions in Gerda and by a factor of two increase in exposure since the data release in 2017. The details of the background reduction techniques and the latest results will be presented. In 2018, the Gerda setup has been upgraded with germanium detectors of a new design and improved instrumentation of the liquid argon to veto background events. The first results on the performance of the upgraded experimental setup will be also discussed.

T 32.5 Di 17:20 S06

Investigation of EC/β^+-decays with the COBRA experiment — •Juliane Volkmer for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

Besides the very commonly investigated $\beta^-\beta^-$-decay also $\beta^+\beta^+$-decay modes can be of great interest. However, they are more difficult to observe than their $\beta^-\beta^-$-counterpart – only the EC/EC of ^{78}Kr has been managed to be observed, yet. Of the three $\beta^+\beta^+$-decay modes also the EC/β^+-decay is promising to be detected, though. It has a lower half-life than the $\beta^+\beta^+$-decay and creates a more characteristic signature in the detector array than the EC/EC. Measuring the half-life of 2νEC/β^+-events would help to probe models used to calculate nuclear matrix elements, while 0νEC/β^+-events are especially sensitive to the involvement of right-handed currents in the decay mechanism, thus, could help to gain a deeper understanding of the general physics involved.

The COBRA demonstrator, consisting of $4 \times 4 \times 4$ CdZnTe semiconductor detectors, provides three different isotopes capable of EC/β^+-decays. Additionally, the experiment's granularity greatly improves the probability to recognize the events' characteristic decay structures.

This talk's topic will be the investigation of double beta-decay modes with the COBRA experiment and focus on EC/β^+-decays. First investigations of the prospects and feasibility of the EC/β^+-decays' investigation in general as well as with the COBRA experiment in particular and the current status of the data analysis will be discussed.

T 32.6 Di 17:35 S06

Double beta decay of Ge-76 into excited states of Se-76 in Gerda — •Birgit Schneider and Thomas Wester for the GERDA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik

Gerda is an experiment searching for the neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. The observation of such a decay would prove the Majorana character of the neutrino, i.e. that it is its own antiparticle. This could shed light upon the neutrino mass ordering realized in nature as well as the effective Majorana neutrino mass.

The half life of the neutrino accompanied double beta ($2\nu\beta\beta$) decay from the 0^+ ground state of ^{76}Ge into the 0^+ ground state of ^{76}Se has been measured by Gerda with unprecedented precision. Furthermore, ^{76}Ge can decay into excited states of ^{76}Se, though these transitions are phase space suppressed. Theoretical calculations predict the half lives of these decays, but the results vary by several orders of magnitude due to different nuclear models and their internal parameters. The observation of the $2\nu\beta\beta$ decay of ^{76}Ge into excited states could constrain these models and decrease their uncertainties. Moreover, models of the $0\nu\beta\beta$ decay, that rely on similar assumptions, would be improved.

The excited states analysis of the Gerda data is performed by counting coincident events within the Germanium detector array and optimized with the help of Monte Carlo simulations. The talk will present the analysis technique and preliminary results of the current Gerda Phase II data.

This project is partially funded by BMBF.

T 32.7 Di 17:50 S06

Investigation of Detector Settings for JUNO wih respect to Supernova Neutrinos — •Sivaram Yogathasan, Thilo Birkenfeld, Shivani Ramachandran, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

The Jiangmen Underground Neutrino Observatory (JUNO), a 20 kt liquid scintillator reactor neutrino observatory, will be located near Kaiping in the province Guangdong, China. The main goal is the determination of the neutrino mass hierarchy. The large target mass with a low energy threshold and the energy resolution of $3\%/\sqrt{(E(MeV))}$ makes it possible to yield high statistics of measured neutrinos. Supernovae are powerful cosmic sources of neutrinos in the MeV range. They are rare in close proximity and current theories have yet a high uncertainty. The expected high number of detected neutrinos from a galactic supernova, yields the possibility to constrain various supernovae models. An investigation of detector settings for supernova events, based on the simulated detector response for different supernova models is presented in this talk.

T 32.8 Di 18:05 S06

Investigation of Supernova neutrinos in the JUNO detector — •Shivani Ramachandran, Thilo Birkenfeld, Achim Stahl, Christopher Wiebusch, and Sivaram Yogathasan — III. Physikalisches Institut B, RWTH Aachen University

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator reactor neutrino experiment, currently under construction in China. Its main physics goal is the determination of the neutrino mass hierarchy with a large fiducial volume and an energy resolution of $3\%/\sqrt{\mathrm{MeV}}$. Multiple channels, such as the inverse beta decay (IBD), neutrino-proton elastic scattering (pES), neutrino-electron elastic scattering (eES) as well as neutrino charged current (CC) and neutral current (NC) interactions on carbon will contribute to the measurement of neutrinos. The detector response to various supernova explosion models is studied via the JUNO detector simulation. Trigger settings are investigated for the future discovery of such supernova events.

T 32.9 Di 18:20 S06

Sensitivity of multi-PMT optical modules to the energy spectrum of MeV supernova neutrinos — •Lozano Mariscal Cristian Jesús, Sprenger Florian, and Kappes Alexander for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

Within the upgrade of the IceCube neutrino detector new optical modules like the multi-PMT optical module (mDOM) are being developed, which are expected to significantly boost IceCube's performance in its main energy range from GeV to PeV and above. On the other hand, Neutrinos from core-collapse supernovae with energies as low as few MeVs can reveal a detailed picture of the events that accompany the collapse of the core and verify and enhance our picture of these powerful explosions. With its unique features like local coincidences and information on the arrival direction of detected photons, the mDOM may enable the event-by-event detection of MeV neutrinos with a single module while at the same time keeping the background sufficiently low. The talk presents studies on the energy sensitivity for SNe neutrinos by using coincidences within and between mDOMs.