T 68: Neutrinophysik III

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 2.012

T 68.1 Mi 16:30 Z6 - SR 2.012

The calibration campaign of the Borexino experiment — •Michael Nieslony for the Borexino-Collaboration — Institute of Physics, JGU Mainz, Germany

The Borexino experiment is a liquid scintillator detector located at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy which was originally aimed at detecting solar neutrinos. The experiment's exceptional radiopurity levels enabled the spectral measurement of almost the whole pp-fusion-cycle of the sun, including ^{7}Be-, *pp*-, and *pep*-neutrinos. Besides the solar program, a multitude of analyses ranging from the detection of geoneutrinos up to setting the most stringest limit on the lifetime of the electron were performed.

To ensure the ongoing high-accuracy analysis of the experiment, an extensive calibration campaign is planned for the near future. The basic features and some preliminary studies are presented in this talk.

T 68.2 Mi 16:45 Z6 - SR 2.012

Optimisation of selection cuts for updated geoneutrino analysis with Borexino — •Sindhujha Kumaran, Dong Han, and Livia Ludhova for the Borexino-Collaboration — IKP-2 Forschungszentrum Jülich

The Borexino detector is a liquid scintillator detector located at the Laboratori Nazionali del Gran Sasso at a depth of 3800 meters water equivalent. Far distance from nuclear reactors and the high level of radiopurity of the liquid scintillator make Borexino ideal for geoneutrino analysis.

Geoneutrinos are electron flavoured antineutrinos produced from natural radioactive decays within the Earth, and can provide direct information from the inside of our planet. Detailed study of geoneutrinos will help us to set further constraints to the current Earth models. Borexino has observed geoneutrino signal with more than 5 sigma confidence level in 2015. Thanks to improved selection criteria of inverse beta decay events in the whole data set from 2007, we expect an important increase in the total statistics.

Due to a very low interaction rate of geoneutrinos, it is important to maximise the used exposure. This contribution will present the optimisation of the selection cuts crucial for the updated analysis.

T 68.3 Mi 17:00 Z6 - SR 2.012

Background study for an updated geoneutrino analysis with Borexino — •Dong Han, Sindhujha Kumaran, and Livia Ludhova for the Borexino-Collaboration — IKP-2 Forschungszentrum Jülich

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Borexino detector is located in Laboratori Nazionali del Gran Sasso underground laboratory in Italy, at a depth of 3800 meters water equivalent. Far distance from nuclear reactors, as well as a high level of radiopurity of liquid scintillator, makes Borexino an excellent geoneutrino observatory. Borexino has observed geoneutrino signal with more than 5 sigma confidence level in 2015. Thanks to improved selection criteria of inverse beta decay events in the whole data set from 2007, we expect an important increase in the total statistics.

This talk will concentrate on the investigation of backgrounds, which needs to be reevaluated after the changes in the analysis approach.

T 68.4 Mi 17:15 Z6 - SR 2.012

Solar neutrino analysis with the Borexino detector — •Mariia Redchuk and Livia Ludhova for the Borexino-Collaboration — IKP-2 Forschungszentrum Jülich, Jüilch, Germany

Borexino is a liquid scintillator detector the primary goal of which is measuring the flux of neutrinos coming from the un. It is located in the Laboratori Nazionali del Gran Sasso (LNGS) in the mountains of Italy at 3800 m water-equivalent depth. In 2012 Borexino started Phase-II of data taking which is characterized by its higher sensitivity. This was made possible due to extensive purification campaigns in 2010 and 2011 after which the already unprecedentedly low radioactive background of the detector was improved even more.

In the recent analysis of Phase-II data, for the first time the energy range of the fit was extended in order to obtain information about the pp, 7Be, and pep solar neutrinos simultaneously. To determine the rates of the background and the solar species, multivariate fits have been performed on the Borexino energy spectra, the radial and pulse-shape distributions of the events. Monte Carlo as well as analytical approaches were used in the analysis.

The highlights of the Phase-II data analysis and updated results on the measurement of the solar neutrino fluxes will be summarized in this talk.

T 68.5 Mi 17:30 Z6 - SR 2.012

Rejection of the cosmogenic ^{11}C background in the Borexino detector for the observation of the neutrino flux from CNO chain in the sun — •Alessio Porcelli for the Borexino-Collaboration — Johannes Gutenberg Universität, Mainz, Deutschland

Borexino is a liquid scintillator detector sited underground in the Laboratori Nazionali del Gran Sasso. Its physics program is centred in the study of solar neutrinos. Recently, a simultaneous spectroscopy was performed for the neutrinos from the *pp*, *pep* and ^{7}Be fusion reactions, together with a new analysis of the νs from the ^{8}B chain. The next goal of the Borexino solar program is to improve the current lower limit of the neutrino flux from the CNO cycle, or possibly measure it for the first time. This result will greatly improve the understanding of the Solar Standard Model. The main limitation of this measurement is the ^{11}C cosmogenic background produced from ^{12}C nuclei by muon induced spallations with emission of neutrons: the physics of this process is not very well understood and ^{11}C has a long average decay time (half hour), therefore its direct identification and prediction is not possible. The Borexino analysis approach to deal with this background is called Three Fold Coincidence (TFC) and relies on time and space coincidence of muons and neutrons, vetoing volumes where those associated signatures occurred and might contain ^{11}C. In this work it is presented an overview of the TFC and studies performed to improve its efficiency, including a complementary method that take advantage of possible productions of multiple ^{11}C by the same muon.

T 68.6 Mi 17:45 Z6 - SR 2.012

Modulation of the cosmic muon flux measured at Borexino — •Dominik Jeschke for the Borexino-Collaboration — Technische Universität München

The Borexino Experiment is situated at the Laboratori Nazionali del Gran Sasso and aims for the measurement of low energetic solar neutrinos. Even though the flux of cosmic muon is reduced by a factor 10^6 due to the 3800 mwe. of rock overburden at the experimental side, a residual cosmic muon flux of $(3.432 \pm 0.001) \cdot 10^{-4}\mathrm{m}^{-2}\mathrm{s}^{-1}$ with a mean energy of 270 GeV is still present. These muons are detected by a highly efficient muon veto at Borexino.
Most of the cosmic muons reaching the detector are produced in the decay of pions that originate from collisions of the primary cosmic radiation with atoms of the atmosphere. Since only pions and kaons that decay in flight without undergoing any interactions before produce muons with sufficient energy to reach the detector, a seasonal modulation of the cosmic muon flux is expected due to density changes in the atmosphere that alter the mean free path of the parent mesons.
In this talk, an analysis of the cosmic muon flux based on almost 10 years of data from the Borexino experiment is presented. Besides the seasonal modulation, other periods are searched for and their significance is checked with the help of a Lomb-Scargle periodogram. This work is funded by the DFG (GZ:OB 168/2-1).

T 68.7 Mi 18:00 Z6 - SR 2.012

A thermal calorimeter for the activity measurement of the SOX antineutrino source — •Konrad Altenmüller for the Borexino-Collaboration — Technische Universität München

A thermal calorimeter was developed by TUM and INFN to measure the activity of a ^{144}Ce-^{144}Pr antineutrino source for the SOX experiment, which investigates short baseline neutrino oscillations with the Borexino detector to search for eV-scale sterile neutrinos. The source activity is estimated from the decay heat that is measured through the temperature increase of a well-defined water flow in a heat exchanger that surrounds the source. Adjustable measurement conditions and an elaborate thermal insulation allow an operation with negligible heat losses. In a blind measurement with an electrical source mockup it was shown that the heat of a decaying source can be measured with $< 0.2\%$ uncertainty. This talk presents a complete overview on this apparatus and the final results of the characterization.

T 68.8 Mi 18:15 Z6 - SR 2.012

Backgrounds in the SOX experiment — •Birgit Neumair for the Borexino-Collaboration — James-Franck-Straße 1, 85748 Garching bei München

In the last years, several neutrino oscillation experiments reported results not compatible within the 3-neutrino model, which hint at the existence of light sterile neutrinos. To test this hypothesis, the SOX (Short distance neutrino Oscillations in BoreXino) experiment will search for oscillations from active to sterile neutrinos by placing a (100-150) kCi $\bar{\nu}_e$ - source underneath the liquid scintillator detector Borexino. Oscillations will be observed via a reduction of the detected interaction rate of the $\bar{\nu}_e$ and an oscillatory pattern as a function of the neutrino energy and travelled distance. In the talk the individual background components are discussed.

The work is supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 68.9 Mi 18:30 Z6 - SR 2.012

Gamma biasing in the Borexino/SOX framework — •Michael Gschwender — University of Tübingen

The **S**hort distance neutrino **O**scillations with Bore**X**ino (SOX) experiment aims to search for sterile neutrinos in the eV-scale. SOX is searching for the disappearance of antineutrinos from a radioactive source (^{144}Ce - ^{144}Pr).
In order to achieve a higher sensitivity, SOX aims to use the whole Borexino inner vessel scintillator, in contrast to previous analysis of solar neutrinos where a smaller fiducial volume was used. This introduces in turn more background contributions to the sensitive volume. A source of background originates from gammas coming from outside the buffer liquid of Borexino. In order to simulate these gammas in a reasonable timeframe within the Borexino simulation framework, a biasing approach has been implemented. By dividing the Borexino detector geometry into multiple slices and making use of techniques such as geometrical importance sampling, and weight roulett this can be done in a feastable way. This talk presents the implemented techniques used by this approach as well as some simulation results.
This work is funded by the Deutsche Forschungsgemeinschaft.

T 68.10 Mi 18:45 Z6 - SR 2.012

Vessel shape reconstruction for the SOX experiment — •Sebastian Rottenanger for the Borexino-Collaboration — Eberhard Karls Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen

The SOX (**S**hort distance neutrino **O**scillations with Bore**X**ino) experiment will measure the energy spectrum and spatial distribution of anti-neutrino capture events from an artificial source, looking for a signature of sterile neutrinos in the eV-range. This ^{144}Ce-^{144}Pr source will be placed below the Borexino liquid-scintillator detector.
The thin inner nylon vessel containing the scintillator, changes its shape over time. To have the best possible sensitivity within the enlarged target volume this shape has to be well known. This can be achieved using an event data sample of background events, allowing a reconstruction of the vessel shape on a regular basis.
A method to perform a fit of the vessel shape is already in use and a new improved and more stable method is currently under development. Several background contributions are fitted simultaneously to the energy spectrum and spatial event distribution. The basic concept and first results will be presented in this talk.
This work is funded by the Deutsche Forschungsgemeinschaft.