T 110: Niederenergie-Neutrinophysik/Suche nach Dunkler Materie 5

Zeit: Mittwoch 16:45–19:20 Raum: ZHG 102

Gruppenbericht T 110.1 Mi 16:45 ZHG 102

Das Neutrinoobservatorium LENA — •Daniel Bick, Caren Hagner, Markus Kaiser, Sebastian Lorenz und Michael Wurm — für die LENA Working Group — Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

LENA (Low Energy Neutrino Astronomy) ist ein zukünftiger Detektor zur Untersuchung astrophysikalischer Neutrinos. Das Projekt befindet sich zur Zeit in der Entwurfsphase und ist Teil der europäischen LAGUNA-LBNO Designstudie. Die Neutrinos sollen in 50 kt Flüssigszintillator nachgewiesen werden. Eine wesentliche Stärke liegt hierbei in der niedrigen Energieschwelle und der guten Untergrunddiskrimination.

Ziel des Experiments ist die Untersuchung von Neutrinos im Niederenergiebereich aus einer Fülle von astrophysikalischen und terrestrischen Quellen, vor allem Geoneutrinos, solaren Neutrinos und Neutrinos aus Supernova Explosionen.

Darüber hinaus wird LENA auch in der Lage sein, Messungen im GeV Bereich durchzuführen. Im Rahmen von LAGUNA-LBNO wird gegenwärtig das Potential LENAs als Detektor für einen Long-Baseline Neutrinostrahl evaluiert. Weiterhin kann nach dem Protonenzerfall im Kanal $p \to K^+ + \bar{\nu}$ gesucht werden.

T 110.2 Mi 17:05 ZHG 102

Supernova-Neutrinos in LENA: Diskrimination der Detektionskanäle — •Markus Kaiser, Caren Hagner, Michael Wurm, Daniel Bick und Sebastian Lorenz — Für die LENA Arbeitsgruppe - Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Das zukünftige Neutrinoobservatorium LENA wird mit einer Targetmasse von 50 kt Flüssigszintillator ein breites Spektrum von niederenergetischen Neutrinos nachweisen können. Für eine Supernova im Zentrum unserer Milchstraße werden etwa 10^4 Ereignisse erwartet. Neben der niedrigen Energieschwelle bietet LENA dabei die Möglichkeit, über verschiedene Detektionskanäle die Spektren der einzelnen Neutrinoflavor getrennt zu bestimmen: Der goldene Kanal für $\bar{\nu}_e$, der inverse Beta-Zerfall, bietet dabei die größte Statistik. Die elastische Streuung am Proton ist primär sensitiv auf ν_μ und ν_τ, während NC und CC-Reaktionen am ^{12}C sowie elastische Streuung an Elektronen auch Informationen zu den ν_e liefern. Es werden Studien zur Effizienz vorgestellt, mit der Ereignisse aus den verschiedenen Kanäle diskriminiert werden können. Diese Analyse ist eine wichtige Grundlage für das Verständnis des SN-Neutrinosignals in LENA.

T 110.3 Mi 17:20 ZHG 102

Alpha-Beta Discrimination in LENA — •Randolph Möllenberg — for the LENA working group - Technische Universität München, Physik Department E15, James Franck Straße 1, 85748 Garching

Alpha emitting isotopes, mainly ^{210}Po, provide a background for the detection of ^{7}Be neutrinos in LENA (Low Energy Neutrino Astronomy). This background can be reduced by a pulse shape analysis, as alpha particles and electrons have a different typical pulse shape, caused by the different energy deposition per unit path length ($\frac{\mathrm{dE}}{\mathrm{dx}}$). Thus, the efficiency of this method was analyzed by a detailed Monte Carlo study. Several scintillators as well as the influence of the photomultiplier performance on the discrimination efficiency were investigated.

This work was supported by the Maier-Leibniz-Laboratorium and the cluster of excellence 'Origin and Structure of the Universe'.

T 110.4 Mi 17:35 ZHG 102

Development of an Optical Module for LENA — •Marc Tippmann — for the LENA working group - Technische Universität München, Physik-Department E15, James-Franck-Straße, D-85748 Garching

LENA (Low Energy Neutrino Astronomy) is a next-generation liquid-scintillator neutrino detector with 50kt target mass. The broad spectrum of physics goals ranging from the sub-MeV to the GeV regime sets high demands on the photosensors.

In order to select the optimum sensor, first simulations regarding the influence of sensor properties on detector behavior have been performed. In addition, a photosensor testing facility has been constructed. Potential sensor types for LENA are discussed.

As PMTs are currently the most promising option, the status of the development of an optical module for PMTs is presented. This consists of PMT, voltage divider, Mu-metal, a pressure withstanding encapsulation and a light concentrator.

This work has been supported by the Maier-Leibnitz-Laboratorium, the TR 27 "Neutrinos and Beyond" and the cluster of excellence "Origin and Structure of the Universe".

T 110.5 Mi 17:50 ZHG 102

Proton Recoils in Organic Liquid Scintillator — •Jürgen Winter — for the LENA working group - Technische Universität München, Physik Department E15, James Franck Straße, 85748 Garching

In liquid-scintillator detectors like the LENA (Low Energy Neutrino Astronomy) project, understanding the nature of proton recoils is vital. First of all concerning the observation of the diffuse Supernova $\bar{\nu}_e$ background with the inverse beta decay (IBD). This signature can be mimicked by the thermalization and capture of a knockout neutron originating from inelastic NC interactions of atmospheric neutrinos on ^{12}C. However, with the help of pulse shape discrimination between the neutron-induced proton recoils and the prompt positron signal from the IBD, this background might be reduced effectively. Furthermore, elastic ν-p scattering is an important channel for neutrinos from a galactic core-collapse SN. In order to reconstruct the initial neutrino energy, the energy-dependent quenching factor of proton recoils has to be known. Therefore, a neutron scattering experiment at the Maier-Leibnitz-Laboratorium in Garching has been set up in order to understand the response of proton recoils in organic liquid scintillator.

This work has been supported by the Maier-Leibnitz-Laboratorium and the cluster of excellence 'Origin and Structure of the Universe'.

T 110.6 Mi 18:05 ZHG 102

Borexino: Update on the 7Be-neutrino measurement and results of the first pep-neutrino analysis — •Timo Lewke — Borexino Collaboration — Technische Universität München, Physik Department E15, James Franck Straße, 85748 Garching

Borexino is a 300t liquid-scintillator detector designed for the realtime detection of solar neutrinos in the sub-MeV energy range. Based on the statistics of 4 years, Borexino has recently published a new high precision measurement of the 7Be-neutrinos. In addition first results of the pep- and CNO-neutrino analysis will be presented in this talk.

This work is supported by funds of the Maier-Leibnitz-Laboratorium (Munich), the DFG, and the Excellence Cluster "Universe".

T 110.7 Mi 18:20 ZHG 102

Eigenschaften der Double Chooz Szintillatoren — •Christoph Aberle, Christian Buck, Benjamin Gramlich, Francis X. Hartmann, Manfred Lindner, Bernd Reinhold, Stefan Schönert, Ute Schwan, Stefan Wagner und Hideki Watanabe — Max-Planck-Institut für Kernphysik Heidelberg

Für das Reaktorneutrinoexperiment Double Chooz wird ein Gadolinium-beladener organischer Flüssigszintillator als Neutrino-Target verwendet. Der Gadolinium-freie Gamma Catcher Szintillator umgibt das Neutrino-Target. Die Herstellung von über 40 Tonnen der beiden Szintillatoren wurde am Max-Planck-Institut für Kernphysik durchgeführt.

In diesem Vortrag werden die Auswirkungen der optimierten optischen Eigenschaften der Szintillatoren auf zentrale Merkmale des Detektors gezeigt. Wichtige optische Eigenschaften sind unter anderem die Lichtausbeuten von Target und Gamma Catcher, die Absorptionslängen und die zeitliche Stabilität dieser Größen. Sie bestimmen die Homogenität des Detektorsignals und sind damit entscheidend für die Energieauflösung. Die Bestimmung dieser Ortsabhängigkeit der sichtbaren Energie führt zu einer Methode zur Korrektur von Detektorinhomogenitäten.

T 110.8 Mi 18:35 ZHG 102

The $\bar{\nu}_e$ spectrum of the fission products of ^{238}U — •Nils Haag, Lothar Oberauer, Stefan Schönert, and Klaus Schreckenbach — Technische Universität München

The $\bar{\nu}_e$'s emitted by a reactor core are produced in the subsequent beta decays of all fission products of the four main fuel isotopes ^{235}U, ^{238}U, ^{239}Pu and ^{241}Pu. Since until now only three of these spectra are directly measured, one has to rely on calculations and simulations to predict reactor antineutrino spectra. A measurement of the last missing spectrum of ^{238}U was performed with a γ-suppressing electron-telescope at the neutron source FRMII in Garching. As in the first phase the Double Chooz experiment is taking data with a single detector, this measurement on ^{238}U lowers the systematical error significantly. In addition this spectrum is an important input to the discussion of the reactor antineutrino anomaly and sterile neutrinos. A reevaluation of the data now delivers the betaspectrum of ^{238}U with an absolute calibration. In this talk, the accuracy as well as a conversion method into the $\bar{\nu}_e$ spectrum will be discussed. This work is funded by the Excellence Cluster "Universe", the DFG Transregio 27: Neutrinos and beyond and the Maier-Leibnitz-Laboratorium Garching.

T 110.9 Mi 18:50 ZHG 102

Atmospheric neutrino oscillations with IceCube — •Andreas Gross for the IceCube-Collaboration — TU München

IceCube is a cubic kilometer scale neutrino telescope completed in December 2010 optimized for neutrino energies on the TeV to PeV scale. With its more densely instrumented DeepCore subarray in the center, the performance in the 10 GeV to 1 TeV energy range has been improved significantly. We present the status of an analysis using IceCube and DeepCore in the 79-string configuration which operated from May 2010 until May 2011. In this configuration it is expected to be sensitive to standard neutrino oscillations by atmospheric muon neutrino disappearance with a maximum effect around 30 GeV and for vertically upgoing events. An atmospheric neutrino event sample is extracted from DeepCore data in the energy range 15 GeV - 150 GeV. Higher energetic atmospheric neutrinos detected by IceCube serve as a control sample for which no oscillation effects are expected.

T 110.10 Mi 19:05 ZHG 102

Atmospheric ν_μ disappearance in the IceCube+DeepCore detector — •Juan Pablo Yanez and Rolf Nahnhauer for the IceCube-Collaboration — DESY, 15738 Zeuthen

Neutrino oscillations, a theoretical prediction outside the Standard Model, is now an accepted fact supported by a large amount of experimental data. However, because of the difficulties associated with the production and detection of neutrinos, even new precision experiments are restricted to limited statistics and to operate at a fixed baseline and/or energy. The DeepCore sub-array, enclosed in the IceCube Neutrino Observatory, is an optical water Cherenkov neutrino detector sensitive to neutrinos down to energies of $\mathcal{O}$(10 GeV). It has a fiducial volume of 107 m^3, in which $\sim 100,000$ atmospheric neutrino events will be registered every year, with a baseline varying between $0 - 12,700$ km. These unique characteristics make it suitable for oscillations measurements.

The work presented here attempts to observe the gradual disappearance of muon neutrinos as a function of the baseline, which is maximal for those crossing the whole Earth at $E = 25$ GeV. The results shown are obtained using simulation. The analysis will be applied to the data acquired by the full detector, which started operations in 2011.