T 107: Neutrinophysik 8

Zeit: Donnerstag 16:45–18:45 Raum: H 2

T 107.1 Do 16:45 H 2

Testing the Neutrino Mass Ordering Using 4 Years of IceCube/DeepCore Data — •Martin Leuermann, Marius Wallraff, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University, Germany

The measurement of the Neutrino Mass Ordering (NMO), i.e. the ordering of the three neutrino mass eigenstates, is one of the major goals of many future neutrino experiments. One strategy is to measure matter effects in the oscillation pattern of atmospheric neutrinos as e.g. proposed for the PINGU extension of the IceCube Neutrino Observatory. Already, the currently running IceCube/Deepcore detector can explore this type of measurement – however, with lower significance.

We present a three dimensional likelihood analysis based on 4 years of IceCube data searching for indications of the NMO with a data sample reaching to energies below 10GeV and improved reconstruction techniques.

T 107.2 Do 17:00 H 2

Computational and statistical aspects of neutrino mass ordering studies with very-large-volume neutrino telescopes — •Thomas Ehrhardt and Sebastian Böser for the IceCube-Collaboration — Institut für Physik, Universität Mainz

Very-large-volume neutrino telescopes (VLVnTs) have the potential to determine the neutrino mass ordering (NMO) via a measurement of the flux of atmospheric neutrinos in the GeV energy range. Their sensitivity is brought about by an asymmetry in the oscillation pattern of Earth-crossing neutrinos. In combination with flux and cross-section differences between neutrinos and anti-neutrinos, this results in a few-percent net imprint of the NMO on the measured spectra, which can only be resolved unambiguously with megaton-scale detectors. In this talk, we highlight some computational and statistical challenges emerging from the high-statistics nature of the experiment, and introduce a fast detector simulation framework in which they are addressed.

T 107.3 Do 17:15 H 2

A muon veto for the measurement of the downgoing neutrino flux with KM3NeT/ORCA — •Marco Volkert, Jannik Hofestädt, and Thomas Eberl — ECAP, Universität Erlangen-Nürnberg, 91058 Erlangen

By measuring the energy- and zenith-dependent oscillation probabilities of atmospheric neutrinos passing through Earth, it is possible to determine the hitherto unknown neutrino mass hierarchy. With this aim, the underwater Cherenkov detector ORCA is being built by the KM3NeT Collaboration in the Mediterranean deep sea.

The atmospheric muon flux entering the detector from the direction of the water surface is the main background for the detection of neutrinos. On the one hand, incorrectly reconstructed tracks of atmospheric muons distort the measurement of the upgoing atmospheric neutrino flux passing through Earth. On the other hand, this background crucially complicates the measurement of the downgoing atmospheric neutrino flux from above, which could be used for reducing the systematic uncertainties of the mass hierarchy measurement.

This talk presents a veto strategy for atmospheric muons developed for the determination of the downgoing atmospheric neutrino flux. A atmospheric muon contamination of about 1 % remains, while an effective mass for neutrinos of roughly 1.75 Mton for neutrino energies above 10 GeV is achieved. Furthermore, an investigation to which precision the atmospheric neutrino flux parameters can be determined is presented.

T 107.4 Do 17:30 H 2

Measurement of neutrino interactions in gaseous argon with T2K — •Lukas Koch and Stefan Roth — RWTH Aachen University

The T2K near-detector, ND280, employs three large argon gas TPCs (Time Projection Chambers) for particle tracking and identification. The gas inside the TPCs can be used as an active target to study the neutrino interactions in great detail. The low density of the gas leads to very low track energy thresholds, allowing the reconstruction of very low momentum tracks, e.g. protons with kinetic energies down to $\mathcal{O}(1\,\mathrm{MeV})$. Since different nuclear interaction models vary considerably in their predictions of those low momentum track multiplicities, this makes neutrino interactions on gases a powerful probe to test those models.

The TPCs operate with an argon-based gas mixture (95% by volume) and have been exposed to the T2K neutrino beam since the beginning of the experiment in 2010. Due to the low total mass of the gas, neutrino argon interactions happen only rarely, compared to the surrounding scintillator-based detectors. We expect about 600 such events in the recorded data so far (about 300 in the fiducial volume). We are able to separate those events from the background and thus demonstrate the viability of using gaseous argon as a target for a neutrino beam. This enables us to do a cross-section measurement on gaseous argon, the first measurement of this kind. All previous neutrino cross-section measurements on argon were performed in liquid argon TPCs.

T 107.5 Do 17:45 H 2

Current studies on solar neutrinos with Borexino — •Zara Bagdasarian for the Borexino-Collaboration — Forschungszentrum Jülich, Jülich, Germany

Borexino is located at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy with the primary goal of detecting solar neutrinos, particularly those below 2 MeV with unprecedentedly high sensitivity. Its technical distinctive feature is the ultra low radioactive background of the inner scintillating core, which is the basis of the outstanding achievements obtained by the experiment. During the Phase I (2007-2010), Borexino precisely measured the flux of ^7Be solar neutrinos, ruled out any significant day-night asymmetry of their interaction rate, made the first direct observation of the pep neutrinos, and set the best available upper limit on the flux of solar neutrinos produced in the CNO cycle (carbon, nitrogen, oxygen). The data gathered starting from 2011 (Phase II), characterized by even lower background than Phase I, is currently under detailed investigation. In order to update the previously published results, the fit on the whole energy spectrum of the Phase II data is performed, obtaining simultaneously all solar neutrino components.

T 107.6 Do 18:00 H 2

Cosmic Muon Modulation Analyses with Borexino — •Dominik Jeschke — 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 cosmic muon flux 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 $(3.41 \pm 0.01) \cdot 10^{-4}\mathrm{m}^{-2}\mathrm{s}^{-1}$ with a mean energy of 270 GeV is still present. These muons are detected by a highly efficient muon veto.

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 that decay in flight without undergoing any interactions before produce muons with enough 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 pions.

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.

T 107.7 Do 18:15 H 2

A new approach to identify cosmogenic ^{11}C burst in Borexino — •Alessio Porcelli for the Borexino-Collaboration — Johannes Gutenberg Universität, Mainz

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, in particular from the Beryllium, pp, pep and CNO fusion reactions. With the start of the phase II, the aim is to improve the pep and CNO results. The background sources are mainly radioisotopes induced by muons in the detector, in particular ^{11}C cosmogenics produced in muon spallation from ^{12}C nuclei with emission of neutrons. The physics of this process is not very well understood, therefore carbon isotopes are not easy to predict. The Borexino analysis approach to deal with them, called Three Fold Coincidence (TFC), relies on time and space coincidence of muons, neutrons and ^{11}C, vetoing volumes where those associated signatures occurred.

The work presented is a new approach to identify ^{11}C events produced in “bursts”, i.e. by the same muon, entirely based on their correlations in time and space, without using μ and n signals. This cannot fully substitute the TFC technique, but in combination is expected to reduce the vetoed volumes, increasing the data statistics of the neutrino measurements. Moreover, it might be used to better identify ^{11}C samples to improve the study of the physics of their production.

T 107.8 Do 18:30 H 2

Update on the 8B analysis with the Borexino detector — •Simon Appel for the Borexino-Collaboration — simon.appel@ph.tum.de

Borexino is a liquid scintillator based real-time neutrino detector with a target mass of 278t, located at the Laboratori Nationali del Gran Sasso. Due to its low energy threshold of 100*keV, Borexino was able to perform the first real-time measurement of 7Be and pp neutrinos. Furthermore it is also sensitive to 8B neutrinos, which is main topic of this talk. The 8B analysis is limited to a lower energy threshold of 3*MeV by external gamma background. As the expected event rate is in the order of only 0.2-0.3 counts per day, it is crucial to have a profound knowledge of the different background sources. Especially radio-isotopes produced by muons are a major source of background for this analysis. To veto these events one has to identify cosmic muons crossing Borexino, which is realized with a water cherenkov veto in the outer detector and a pulse shape analysis in the inner detector. A time cut after each muon reduces background induced by comsogenically produced radio-isotopes. In the presented analysis it was possible to suppress all the backgrounds to a negligible value. This allows to detect solar 8B neutrinos in Borexino and thus makes it possible to confirm the MSW-LMA solution. This talk will give an update on this analysis within the Borexino detector framework. This work is funded by the DFG and the Exzellenzcluster Universe Munich.