T 37: Neutrino physics without accelerators IV

Time: Tuesday 17:00–18:30 Location: L-2.017

T 37.1 Tue 17:00 L-2.017

^{210}Bi - ^{210}Po studies for the measurement of CNO solar neutrinos with Borexino — •Sindhujha Kumaran[1,2], Zara Bagdasarian[1], Alexandre Göttel[1,2], Livia Ludhova[1,2], Ömer Penek[1,2], Mariia Redchuk[1,2], Giulio Settanta[1], and Apeksha Singhal[1,2] for the Borexino-Collaboration — [1]IKP-2, Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University

Borexino is a liquid scintillator detector located at the Laboratori Nazionale del Gran Sasso, Italy with the main goal to measure solar neutrinos. After the successful measurement of all the components of the pp fusion chain, the current focus of the detector is the discovery of neutrinos from the CNO-cycle. In addition to their very low expected rate, a major challenge is posed by the prerequisite to know the rate of internal ^{210}Bi background. This is due to the degeneracy of its spectral shape with that of CNO neutrinos. ^{210}Bi β- decays to ^{210}Po, which then α decays to stable ^{206}Pb. ^{210}Po can be distinguished on an event-by-event basis through pulse shape discrimination techniques. Ideally, ^{210}Bi should be in secular equilibrium with ^{210}Po. Unfortunately, additional ^{210}Po was brought from peripheral sources to the fiducial volume by the convective motions of the scintillator, triggered by seasonal temperature changes. The insulation performed in 2015 has helped to thermally stabilize the detector. This talk will present the strategies to extract the ^{210}Bi rate in Phase 3 through the analysis of ^{210}Po in the cleanest region of the detector.

T 37.2 Tue 17:15 L-2.017

New Analyses of Atmospheric Neutrino Oscillations with IceCube DeepCore — •Alexander Trettin for the IceCube-Collaboration — DESY Zeuthen

The low energy extension to the IceCube Neutrino Observatory, DeepCore, has now been taking data for more than eight years. Analyses previously published have used three years of its data to make competitive measurements of the atmospheric neutrino oscillation parameters. This talk presents a new analysis being developed using eight years of detector live time. An overview is given of the improvements to the event selection that yield a data sample of highly pure atmospheric neutrino events, as well as new reconstruction methods that achieve better resolutions and neutrino flavor separation. Together, these improvements lead to an atmospheric neutrino oscillation analysis with unprecedented sensitivity.

T 37.3 Tue 17:30 L-2.017

Latest advances in the development of a likelihood fit for the Double Chooz experiment — •Philipp Soldin, Christopher Wiebusch, and Achim Stahl — III. Physikalisches Institut B, RWTH Aachen University

Double Chooz is a reactor neutrino disappearance experiment that was operating between 2011 and the end of 2017. Its main purpose has been a precise measurement of the neutrino mixing angle θ_{13}. The experimental setup consisted of two identical liquid scintillator detectors at average baselines of about 400 m and 1 km to two reactor cores at the nuclear power plant in Chooz, France. The neutrinos were detected by the measurement of the inverse beta decay (IBD) signature, which consists of a prompt positron annihilation and a delayed neutron capture signal. The neutrino mixing angle θ_{13} can be obtained by utilising the rate and spectral energy shape of IBD events and all relevant backgrounds in a multivariate likelihood fit. This fit can also be used to observe deviations from the nuclear reactor spectral shape predictions. The latest advancements and applications of such a fit and the development of a new unbinned likelihood fit method are discussed in this talk.

T 37.4 Tue 17:45 L-2.017

Progress in solar neutrino analysis of the Borexino experiment — •Apeksha Singhal[1,2], Zara Bagdasarian[1], Alexandre Göttel[1,2], Sindhujha Kumaran[1,2], Livia Ludhova[1,2], Ömer Penek[1,2], Mariia Redchuk[1,2], and Giulio Settanta[1] for the Borexino-Collaboration — [1]Forschungszentrum Juelich, IKP-2, Juelich, Germany — [2]III B Physikalisches Institut, RWTH Aachen, Aachen, Germany

The Borexino experiment has the most radio-pure scintillator neutrino detector of the world. It is located at the Laboratori Nazionali del Gran Sasso in Italy and has been running since 2007. It has provided important measurements in the MeV scale neutrino physics, including spectroscopy of solar neutrinos from the pp fusion cycle (pp, pep, 7Be, and 8B neutrinos). The next Borexino goal is to observe solar neutrinos from the CNO cycle which has not yet been confirmed experimentally. The talk will discuss important aspects of the current Borexino solar neutrino analysis.

T 37.5 Tue 18:00 L-2.017

Accidental background reduction using artificial neural networks in the Double Chooz experiment — •Markus Bachlechner, Christopher Wiebusch, Achim Stahl, and Philipp Soldin — III. Physikalisches Institut B, RWTH Aachen University

Double Chooz is a reactor anti-neutrino disappearance experiment, which took data from 2011 until the end of 2017. The main purpose is a precise measurement of the neutrino mixing angle θ_{13} with two identical liquid scintillator detectors. Neutrinos are detected via the signature of the inverse beta decay (IBD), which is characterized by a prompt signal from a positron and a delayed signal from neutron capture. A major background is the random association of uncorrelated events that pass the selection criteria individually. The current separation is done in a multivariate analysis, performed by a multi-layer perceptron. In this talk a method to improve the current reduction by deep learning techniques is presented.

T 37.6 Tue 18:15 L-2.017

Evaluation of the Neutron Detection Efficiency in the STEREO Reactor Neutrino Experiment — •Helena Almazan, Aurelie Bonhomme, Christian Buck, Manfred Lindner, Christian Roca, and Stefan Schoppmann — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The STEREO detector is measuring electron antineutrinos from the research reactor at the Institut Laue-Langevin (Grenoble, France). Located at 10 m from its core and with a segmented neutrino target, STEREO is searching for light sterile neutrino oscillations as a possible explanation for the Reactor Antineutrino Anomaly observed in 2011. An accurate determination of the detection efficiency of the correlated signal created by the electron antineutrino interaction, $\bar{\nu}_e + p \rightarrow e^+ + n$, called inverse beta decay (IBD) is needed to reach that goal. More concretely, a good understanding of the detection efficiency for the IBD neutrons is required, in both data and simulation, since it is one of the dominant systematic uncertainties of the STEREO analysis. An AmBe neutron source has been deployed throughout the different sub-volumes of the detector target, and has been used to study the properties of the neutron detection with high accuracy. This talk is focused on presenting the most relevant properties of the neutron efficiency, and to test the modelisation of the gamma cascade emitted after a neutron capture on gadolinium (nuclei present in the liquid scintillator), providing thus a crucial input in the analysis of the STEREO experiment.