T 139: Neutrinos VI

Time: Thursday 17:30–19:00 Location: POT/0051

T 139.1 Thu 17:30 POT/0051

Status of the NUCLEUS experiment — •Sebastian Dorer — Technische Universität Wien, Vienna, Austria

Coherent elastic neutrino nucleus scattering (CEvNS) is a well-predicted Standard Model process only recently observed for the first time. Its precise study could reveal non-standard neutrino properties and open a window to search for physics beyond the Standard Model.

NUCLEUS is a CEvNS experiment conceived for the detection of neutrinos from nuclear reactors with unprecedented precision at recoil energies below 100 eV. Thanks to the large cross-section of CEvNS, an extremely sensitive cryogenic target of 10g of CaWO4 and Al2O3 crystals is sufficient to provide a detectable neutrino interaction rate.

NUCLEUS will be installed between the two 4.25 GW reactor cores of the Chooz-B nuclear power plant in the French Ardennes, which provide an anti-neutrino flux of 1.7×10^{12} $\nu/(\mathrm{s\ cm}^2)$. At present, the experiment is under construction. The commissioning of the full apparatus is scheduled for 2023, in preparation for the move to the reactor site. In this talk we will discuss the NUCLEUS goals and sensitivity, as well as present the recent activities and progresses of the experiment.

T 139.2 Thu 17:45 POT/0051

Design and fabrication of MMC-based P2 detectors to be coupled to scintillating crystals at mK temperatures — •Ashish Jadhav, Christian Enss, Andreas Fleischmann, Daniel Hengstler, Daniel Unger, and Loredana Gastaldo — Kirchhoff Institute for Physics, Heidelberg University, Im Neuenheimer Feld 227, 69120 Heidelberg, Germany.

We present the development of high-energy resolution integrated photon and phonon detectors (P2), based on low-temperature Metallic Magnetic Calorimeters (MMC) to be coupled to a scintillating crystal operated at 20 mK. The present design of P2 is based on a 3 inch wafer. The central part, of area 15 cm^2 is connected to the rest of the wafer through 7 legs fabricated using deep silicon etching and is used for the detection of visible photons emitted after the interaction of a particle in the crystal. On the outer part of the wafer, three double meander MMC detectors are fabricated as phonon detectors. They will be connected to the crystal for monitoring the increase in temperature upon the interaction of a particle. We aim at demonstrating an energy resolution better than 1 keV for the phonon detectors and a time resolution better than 1 μs for the photon detector. This detector development is part of the R&D for the AMoRE experiment searching for $0\nu\beta\beta$ decay in ^{100}Mo. Demonstrating the expected performance for P2 will have a substantial impact on background reduction and influence the design of detector modules for the next stage of the AMoRE experiment.

T 139.3 Thu 18:00 POT/0051

CEvNS and searches for new physics with the CONUS experiment — •Sophie Armbruster for the CONUS-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg

The CONUS experiment (COherent elastic NeUtrino nucleus Scattering) aims to detect coherent elastic neutrino-nucleus scattering (CEvNS) of reactor antineutrinos on germanium nuclei in the fully coherent regime. The CONUS experiment - operated in the Brokdorf nuclear power plant (Germany) between April 2018 and December 2022- was located at 17m from the 3.9 GWth core. The possible CEvNS signature was studied with four 1 kg point-contact high-purity germanium (HPGe) detectors, which provided a sub keV energy threshold with background rates in the order of 10 events per kg, day and keV. The analysis of the final CONUS data set allows us to establish competitive limits on CEvNS from a nuclear reactor with a germanium target. The most recent results including constraints on beyond the Standard Model parameters will be presented together with future plans of the project.

T 139.4 Thu 18:15 POT/0051

CNO solar neutrinos measurement with Borexino detector: updated combined analysis with directionality constraint — •Luca Pelicci — Forschungszentrum Jülich GmbH, Institut für Kernphysik IKP-2, Jülich, Germany — Johanniterstrasse 22

Borexino was a large liquid scintillator experiment with an unprecedented level of radiopurity, designed for real-time detection of low-energy solar neutrinos. It was located at the underground INFN Laboratori Nazionali del Gran Sasso, in Italy. During more than ten years of data taking, it has measured the neutrino flux from each individual within the proton-proton-chain, i.e. the main fusion process accounting for 99 % of the energy production of the Sun, and in the CNO cycle, responsible for the remaining 1%. To disentangle neutrino-induced signals from residual background, a multivariate analysis was adopted, based on the fitting of the spectrum of Borexino events with Monte-Carlo simulated reference shapes. In recent years, through the method called "Correlated and Integrated Directionality" (CID) Borexino has also provided a proof of principle for the exploitation of the sub-dominant Cherenkov information produced by sub-MeV solar neutrinos in a liquid scintillator detector. In this talk, the improvements and upgrades performed in recent years will be discussed. Furthermore, the combination of the two analysis approaches was recently exploited for a measurement of the CNO solar neutrinos with improved precision. The most recent results will be presented.

T 139.5 Thu 18:30 POT/0051

Looking for sterile neutrinos using the solar ^{8}B neutrino spectrum — •Simon Appel and Lothar Oberauer — Technische Universität München, München, Germany

Solar ^{8}B neutrinos are detected via elastic scattering on electrons in large radiopure detectors. The expected upturn in the survival probability of solar ^{8}B neutrinos is still not detected. Current generation detectors struggle with several challenges. Cosmic muons produce radiogenic isotopes that mimic the ^{8}B neutrino shape. Especially the long lived ^{10}C and ^{11}Be isotopes are problematic. External gamma background limits the fiducial volume.The expected upturn in the survival probability of solar ^{8}B neutrinos is still not detected. Current Besides the MSW effect there is more physics beyond the standard model that could affect the neutrino survival probability. Light sterile neutrinos $\Delta m^2_{01} \simeq (0.7-2) \cdot 10^{-7}\mathrm{eV}^2$ and flavor changing ν_e-ν_τ interactions affect the survival probability in the same energy region as the MSW effect. This talks focuses on the ability of future detector generations exploring this parameter space. This work is supported by the DFG collaborative research centre 1258 "NDM", and the DFG Cluster of Excellence "Origins".

T 139.6 Thu 18:45 POT/0051

Directionality measurement of CNO neutrinos in the Borexino detector — •Johann Martyn[1] and Apeksha Singhal[2,3] — [1]Johannes Gutenberg - Universtät Mainz — [2]Forschungszentrum Jülich GmbH, Nuclear Physics Institute IKP-2 — [3]III. Physikalisches Institut B, RWTH Aachen

Borexino has been a 280 t liquid scintillator detector situated at the INFN Laboratori Nazionali del Gran Sasso in Italy. With an unprecedetened level of radiopurity and a 3800 m.w.e. of rock shielding its main goal is the measurement of solar neutrinos. Previously the Borexino collaboration has provided the first directional measurment of sub-MeV ^{7}Be neutrinos using the so called "Correlated and Integrated Directionality" (CID). Here the known position of the Sun is correlated to the reconstructed photon direction, given by the hit PMT position and the reconstructed event position. Cherenkov hits from the neutrino recoil electrons show a correlation to the position of the Sun, while the isotropic scintillation and background events are not. The integrated angular distribution of the hits for a large number of events then allows for the statistical inference on the number of neutrino events. This talk presents the CID measurement of CNO neutrinos, using the full Borexino detector live time from May 2007 to October 2021.