NNN13: International Workshop on Next generation Nucleon Decay and Neutrino Detectors

Monday 11 November 2013 - Wednesday 13 November 2013

Kavli IPMU

Book of abstracts

3 - Nucleon decay in anomalous U(1)_A symmetry models and E_6 × SU(2)_F model

Presenter: Mr. MURAMATSU, Yu (Nagoya university theoretical particle physics group)

We calculate nucleon lifetimes for various decay modes via dimension 6 operators in the anomalous U(1)_A GUT scenario, in which the unification scale \Lambda_u becames smaller than the usual supersymmetric unification scale \Lambda_G = 2 \times 10^{16} GeV in general. Since the predicted lifetime \tau(p -> \pi^0 + e^c) becomes around the experimental lower bound, the discovery of the nucleon decay in near future can be expected. The two ratios R_1 = \Gamma_{n -> \pi^0 + \nu^c}/\Gamma_{p -> \pi^0 + e^c} and R_2 = \Gamma_{p -> K^0 + \mu^c}/\Gamma_{p -> \pi^0 + e^c} are important in identifying grand unification group and we show that three anomalous U(1)_A SUSY GUT models with SU(5), SO(10) and E_6 grand unification group can be identified by measuring the two ratios. In these calculation we consider uncertainties of the unitary matrices that make Yukawa matrices diagonal.
In addition, we calculate nucleon lifetimes in E_6 \times SU(2)_F model. In this model, SU(2)_F symmetry restrict the unitary matrices that make Yukawa matrices diagonal. Our calculation shows that R_2 in this model tends to be smaller than that in E_6 model which does not have flavor symmetry.

5 - Search for non-standard interactions by atmospheric neutrino

Presenter: Mr. FUKASAWA, Shinya (Tokyo Metropolitan University)

It is known that neutral current Non-Standard Interactions (NSI) in propagation cause additional matter effect for neutrinos and that large NSI, which is comparable in strength to those in the Standard Model, can be consistent with the existing data. We investigate the effects of NSI in propagation to atmospheric neutrino experiments such as Super-Kamiokande and Hyper-Kamiokande. With the ansatz where the parameters which have strong constraints from other experiments are neglected, we show how these experiments put constraints on the remaining parameters of the Non-Standard Interactions.

6 - Sanford Underground Research Facility

Presenter: Dr. LESKO, Kevin (LBNL)

The concepts for SURF were developed with the support of the US National Science Foundation as the site for the Deep Underground Science and Engineering Laboratory (DUSEL). The US Department of Energy Office of High Energy Physics now supports the facility operation through Lawrence Berkeley National Laboratory that in turn support very important efforts in direct detection of dark matter and neutrinoless double beta decay.
SURF is being developed in the former Homestake Gold Mine, in South Dakota. Barrick donated the site to the State of South Dakota in 2003, following over 125 years of mining, which created over 600 km of tunnels and shafts in the facility, extending from the surface to over 8000 feet below ground.
The philanthropist, T. Denny Sanford, gifted US$70M, to convert the former mine into a laboratory and develop an education facility. The access to the underground has been rehabilitated and improved. The facility has been stabilized and the accumulated underground water has been pumped below the 6000L. The Davis Cavity at the 4850L has been enlarged and adapted primarily for dark matter experiments. A new laboratory has been excavated and outfitted adjacent to the Davis Cavity to host a neutrinoless double beta decay experiment. Additional science efforts are hosted throughout the facility, including an ultrapure detector development laboratory, multiple geoscience efforts, and a public outreach program.
The science program for the coming ~ five years consists of the MAJORANA DEMONSTRATOR, the LUX dark matter search, the Center for Ultralow Background Experiments, and geoscience installations. Plans are advancing to host the Department of Energy’s Long-Baseline Neutrino Experiment located at the 4850L, a nuclear astrophysics program, and subsequent 2nd and 3rd generation dark matter experiments.

The SURF facility and its science programs will be presented.

7 - Finite-size corrections to Fermi's golden rule

Presenter: Prof. ISHIKAWA, Kenzo (Hokkaido University)

Fermi's golden rule is the rule for computing the decay rates and cross sections in quantum mechanical processes and has been used in many area
as a standard method. The correction to the formula have been believed to be negligibly small, but it is found by the present authors recently that they are not in various processes of light particles. Particuraly, in the processes of neutrino or light, the selection rules which hold for the asymptotic values, such as helicity suppression in the pion decay and others, are modified due to the finite-size corrections. Clear observable effects, which have not been anticipated before, are predicted, and a new method for measuring the absolute neutrino mass is proposed.
Reference:
K.Ishikawa and Y.Tobita,Prog.Theo.Exp.Physics,2013,073B02,
K.Ishikawa and Y.Tobita,Proceeding in APPC 12,
K.Ishikawa and Y.Tobita, arXiv:1209.5585,1209,5586

10 - Limit on Neutrinoless ββ Decay of 136Xe from the First Phase of KamLAND-Zen

Presenter: Mr. XU, Benda (RCNS, Tohoku Univ., Japan)

We present results from the first phase of the KamLAND-Zen double-beta decay experiment, corresponding to an exposure of 89.5 kg yr of 136Xe. We obtain a lower limit for the neutrinoless double-beta decay half-life of T_{1/2}^{0ν}>1.9×1025 yr at 90% C.L. The combined results from KamLAND-Zen and EXO-200 give T1/20ν>3.4×1025 yr at 90% C.L., which corresponds to a Majorana neutrino mass limit of ■mββ■<(120–250) meV based on a representative range of available matrix element calculations. Using those calculations, this result excludes the Majorana neutrino mass range expected from the neutrinoless double-beta decay detection claim in 76Ge, reported by a part of the Heidelberg-Moscow Collaboration, at more than 97.5% C.L.

Reference: Phys. Rev. Lett. 110, 062502 (2013)

12 - Detector R & D of the Emulsion Neutrino Spectrometer for future neutrino experiment

Presenter: Dr. FUKUDA, Tsutomu (Toho University)

In future neutrino oscillation experiments, it is essential to identify the incident neutrino flavor and also to distinguish neutrino from anti-neutrino interactions. Nuclear emulsion detectors can identify νe/νμ/ντ interactions as clearly demonstrated in the DONuT and OPERA experiments. The Emulsion Neutrino Spectrometer will add a new capability to distinguish neutrino/anti- neutrino interactions. It is accomplished by measuring the deflection of the produced lepton in a magnetic field and determining the sign of its electric charge. Results of recent test experiments for the detector R & D will be reported here.

13 - Decoupling can revive minimal supersymmetric SU(5)

Presenter: TAKUMI, Kuwahara (Nagoya university)

We revisited proton decay via the colored Higgs bosons in the minimal supersymmetric SU(5) grand unified model with High-scale supersymmetry breaking. Since this model has predicted too short lifetime of the proton if the supersymmetry is broken near the electroweak scale, it has been believed to be excluded. However, we have found that it is possible to evade the constraints on the proton lifetime if the supersymmetric particles have much heavier than the standard model particles. Since the proton lifetime lies in the region which may be reached in the future experiment, we may verify this scenario by the proton decay experiments.

14 - Development of Liquid Scintillator containing a Zirconium Complex for Neutrinoless Double Beta Decay Experiment

Presenter: Prof. FUKUDA, Yoshiyuki (MIyagi University of Education)

An organic liquid scintillator containing a zirconium complex has been developed for a new neutrinoless double beta decay (ZICOS) experiment. In order to produce a detector that has good energy resolution (4% at 2.5 MeV) and low background (0.1 counts/(t■year) and that can monitor tonnes of target isotope, we chose a zirconium beta-diketone complex having high solubility(over 10 wt.%) in anisole. However, the absorption peak of the diketone ligand overlaps with the luminescence of anisole. Therefore, the light yield of the liquid scintillator decreases in proportion to the concentration of the complex. To avoid this problem, we synthesized a beta-keto ester complex introducing -OC3H7 or -OC2H5 substituent groups in the beta-diketone ligand, and a diethyl malonate complex. Those shifted the absorption peak to around 245 nm and 210nm, respectively, which are shorter than the emission peak of anisole (275 nm). However, the shift of the absorption peak depends on the the scintillation solvent. Therefore we have to choose an adequate solvent for the liquid scintillator. The best performance will be obtained by pure anisole scintillator containing a tetrakis diethyl malonate zirconium. We also synthesized a Zr-ODZ complex, which has a high quantum yield (30%) and good emission wavelength (425 nm)
with a solubility 5 wt.% in benzonitrile. However, the absorption peak of the Zr-ODZ complex was around 240 nm. Therefore, it is better to use the scintillation solvent which has shorter luminescence wavelength than that of benzonitrile.

15 - Neutron detection and distinguishing high energy Anti-neutrinos in Super-Kamiokande

Presenter: Mr. IRVINE, Tristan (ICRR)

When a neutrino undergoes a quasi-elastic charged current interaction, it will produce a neutron or a proton, depending on whether or not the neutrino was an antiparticle. These neutrons can be identified by the distinctive 2.2MeV γ-ray signal produced after neutron capture on hydrogen. I will discuss new techniques to detect these 2.2MeV γ-rays in Super Kamiokande, and application of these techniques to improve sensitivity to atmospheric anti-neutrinos.

16 - Neutrino masses and mixings with one hundred thousand reactor events

Presenter: Dr. MARRONE, Antonio (University of Bari & INFN Bari)

This work is is based on an article written in collaboration with E. Lisi (INFN, Bari, Italy) and F. Capozzi (U. of Bari, Italy), recently appeared on the archives (arXiv:1309.1638).
We investigated the requirement of future medium-baseline reactor experiments such as Daya Bay II, that will probe the neutrino mass hierarchy and significantly reduce the uncertainties on oscillation parameters related to electron neutrino disappearance. To achieve these goals, control of the energy spectrum with sub-percent accuracy is needed. We investigate several ingredients of prospective data analyses: nucleon recoil in inverse beta decay cross section calculation and its impact on energy reconstruction and resolution, hierarchy and matter effects in the oscillation probability, spread of reactor distances, irreducible backgrounds from geoneutrinos and from far reactors, and degeneracies between energy scale and spectrum shape uncertainties. We quantitatively discuss the sensitivity to the mass-mixing parameters and to the hierarchy. To this end, we introduce a continuous parameter \alpha, which interpolates between normal hierarchy (\alpha=+1) and inverted hierarchy (\alpha=-1), allowing intermediate cases (\alpha ~ 0) where the hierarchy may be "undecidable".

17 - Searches for Processes Violating Baryon Number by Two Units at Super-Kamiokande

Presenter: Mr. GUSTAFSON, Jeffrey (Boston University)

It is important to study possible baryon number violating processes from a variety of contexts. In this poster I will discuss processes that violate baryon number by two units, starting with two bound nucleons and ending with multiple pions. These will be discussed in the context of the Super-Kamiokande water Cherenkov detector, which has typically focused on single-nucleon decays. In particular, reconstruction of simulated events and separation from the dominant atmospheric neutrino background will be discussed.

18 - Dark Matter Search with MiniCLEAN

Presenter: KACHULIS, Christopher (Boston University)

MiniCLEAN is a 100-kg single-phase cryogenic liquid dark matter detector capable of switching between a LAr or LNe target. I will describe the methodology for a dark matter search and background rejection including pulse shape discrimination, and neutron tagging. I will give the current status of the project, which is under construction at SNOLAB at this time. I will also describe the motivation of this technology as a candidate for scaling to much larger multi-ton detectors.

20 - A Near Detector Proposal for High Precision Neutrino Oscillation Experiments

Presenter: Dr. WILKING, Michael (TRIUMF)

The next generation of long-baseline neutrino oscillation experiments will require an even more precise understanding of neutrino cross section uncertainties. In particular, the relationship between the measured outgoing lepton kinematics and the incident neutrino energy is highly model dependent due to nuclear effects. This is particularly problematic for neutrino oscillation measurements, where a bias in the reconstructed neutrino energy will result in a bias in the measured oscillation parameters. Standard detector technologies are not capable of detecting such a bias, since both near a far detectors are subject to the same effect. By sampling a large range of angles off-axis from the primary neutrino beam, it is possible to constrain the relationship between the neutrino energy and lepton kinematics independent of neutrino interaction modeling. This concept will be presented in the context of Tokai to Hyper-KamiokaNDE beam, and the robustness of this type of measurement against beam flux uncertainties will be discussed.

21 - Proton Decay into Purely Leptonic Three-Body Final States

Presenter: Mr. TAKHISTOV, Volodymyr (University of California, Irvine)

A unique test of GUT scale physics unreachable by accelerators, nucleon decay is a vital component of BSM searches. Given
exclusion of minimal SU(5) unification by current proton lifetime limits, it is of high significance to test other unification scenarios. Progress on first 3 body decay search at SuperK of p -> enunu and p -> mununu will be presented. Such tri-lepton modes could arise from a Pati-Salam partial unification model, potentially originating from SO(10) breaking chain. Additionally, an argument will be provided for employing positron spectrum from electroweak formalism of muon decay as a decent approximation to the spectrum of 3 body nucleon decay. The interest lies in nucleon decay experimental searches utilizing only phase space but not the dynamics of decay, both being of relevance for 3 body case and implemented in muon decay theory.

22 - T2K electron neutrino appearance analysis using Markov chain Monte Carlo

Presenter: Dr. BRONNER, Christophe (Kyoto University)

The Tokai to Kamioka (T2K) experiment studies neutrino oscillations using a beam of muon neutrinos produced by an accelerator in the J-PARC center on the east coast of Japan and detected after 295km of propagation in the far detector Super-Kamiokande. In this poster we present an analysis of electron neutrino appearance from the oscillation numu → nue, using information from momentum and angle of the lepton reconstructed in the far detector. This analysis uses a technique called Markov Chain Monte Carlo to compute the distribution of the likelihood, which allows to study the contribution of several oscillation parameters at the same time. We will present some interesting features of this technique, as well as results obtained with the data corresponding to the first three (four for some results) years of data taking of the experiment.

23 - fiTQun: A New Event Reconstruction Algorithm for Large Water Cherenkov Detectors

Presenter: Mr. TOBAYAMA, Shimpei (University of British Columbia)

fiTQun is a new event reconstruction algorithm which has been developed for the Super-Kamiokande water Cherenkov detector. Using the charge and time information from the photomultiplier tubes in the detector, a likelihood function is constructed, which is then maximized to extract the kinematics of the particles in the detector. The new algorithm has a potential to substantially improve particle identification performance as well as vertex and momentum resolutions compared to the existing Super-K event reconstruction framework. Furthermore, the new algorithm can be naturally adopted to proposed future large water Cherenkov detectors such as Hyper-K. The recent development status and the performance of the new software, as well as its implications for neutrino oscillation and nucleon decay analyses will be presented.

25 - Solar neutrino results of Super-Kamikande IV

Presenter: Mr. NAKANO, Yuuki (ICRR of the univ of Tokyo)

Super-Kamiokande (SK), a 50 kton water Cherenkov detector in Japan, observes ^{8}B solar neutrinos with neutrino-electron elastic scattering.
The fourth phase of SK (SK-IV) began data taking in September 2008, with upgraded electronics and various improvements to water circulation system, calibration methods and analysis techniques.
Due to these improvements, the solar neutrino energy threshold could be set as 3.5MeV (recoil electron kinetic energy).

The main motivation of solar neutrino measurements with SK-IV is to obsreve the MSW effect through a solar neutrino energy spectrum distortion induced by the matter in the Sun, and through a day/night solar neutrino flux asymmetry induced by the matter in the Earth.

SK is scanning the transition region between vaccum dominanted oscillations (lower energy solar neutrino) and matter dominanted oscillations (higher energy solar neutrino) leading to the distortion.

Due to the MSW effect, electron type solar neutrino re-generated while they travel through the Earth's matter. SK comfirms (at a 2.7 sigma level) a higher solar neutrino flux at night than during the day.

The combined energy spectrum and the day/night solar neutrino flux asymmetry from SK-I to SK-IV will be presented. A global oscillation analysis using SK-I,II,III, and SK-IV data and combined with the results of other solar neutrino experiments as well as KamLAND reactor experiment hs been carried out. The results of this global analysis will also be presented as well.

26 - Development of Detector Simulation for New Water Cherenkov Detector

Presenter: Mr. OKAJIMA, Yuji (Tokyo Institute of Technology)

Hyper-Kamiokande is a proposed future neutrino experiment with physics goals such as search for leptonic CP violation, nucleon decay, supernova neutrino and so on, using a 1Mton water Cherenkov detector.
The baseline design of detector exists, but the detailed design is still to be studied.
For that study, evaluation of the detector's performance with a suitable detector simulation is necessary.

SKDetSim, which is the detector simulation used for Super-Kamiokande, uses Geant3 and Fortran.
WCSim, a new detector simulation package based on Geant4 has been developed.
WCSim is a flexible toolkit allowing the simulation of many different water Cherenkov detectors.
WCSim has now been extended to simulate the Hyper-Kamiokande Geometry and can also simulate Super-Kamiokande.

SKDetSim has been extensively validated with Super-Kamiokande data.
Therefore, the outputs of SKDetSim and WCSim in Super-Kamiokande geometry have been compared, and a good agreement has been achieved.
Furthermore, fiTQun,which is a new event reconstruction software for Super-Kamiokande and used by T2K, is adopted to be used with WCSim output.

27 - Three flavor oscillation analysis with atmospheric neutrino observed in Super-Kamiokande

Presenter: Mr. IYOGI, Kazuki (ICRR of Tokyo university)

It is described about study of the neutrino mass hierarchy, CP-violating-phase, and, θ_23 octant with Super-Kamiokande atmospheric neutrino data in this poster session. Three flavor neutrino oscillation probability is depend on two mass differences |Δm^2_21| and |Δm^2_32|, three mixing angles θ_12, θ_23, θ_13, and the CP phase. It is possible to study of the mass hierarchy, CP-phase and θ_23 octant because the atmospheric neutrino oscillation probability has dependency on mass hierarchy by matter effect. It is important to detect pure electron in study of the mass hierarchy, CP-phase and θ_23 octant
This poster presents the latest result of the oscillation analysis which is included new enriched electron neutrino sample.

28 - The new wide-band solar neutrino trigger for Super-Kamiokande

Presenter: Dr. CARMINATI, Giada (University of California, Irvine)

Super-Kamiokande (SK) observes low-energy electrons induced by the elastic scattering of ^{8}B solar neutrinos. The current 3.5 MeV kinetic energy threshold of the recoil electrons in SK leaves the transition region between vacuum and matter oscillations (with neutrino energy near 3 MeV) still partially unexplored. To study this intermediate regime, a new software trigger, the Wide-band Intelligent Trigger (WIT), has been developed to simultaneously trigger and reconstruct very low-energy electrons (above 2.5 MeV) with an efficiency close to 100\%.
In case of a neutron capture tag, such as the GADZOOKS! experiment that proposes an upgrade of the SK detector by doping the water with Gadolinium, the WIT system will be crucial. The neutron capture gamma cascade emitted by Gd must be identified with high efficiency over the copious backgrounds. Those 8 MeV gamma rays can Compton scatter and produce recoil electrons above the Cherenkov threshold with an average energy of about 4.5 MeV, observable by SK. Thus, this neutron identification technique's maximum power is realized if the effective energy threshold in SK is well below 4.5 MeV; hence the importance of WIT.

The WIT system, comprising one 10 GbE network switch and eleven computers for a total of 280 (Hyper-threaded) cores, has been recently installed and integrated in the online DAQ system of SK and the complete system has just begun online data testing. Prospects and validation of the WIT system are presented.

29 - Neutron Tagging in an Advanced Water Cherenkov Detector

Presenter: Dr. WETSTEIN, Matthew (University of Chicago)

Neutron tagging in Gadolinium-doped water may play a significant role in reducing backgrounds from atmospheric neutrinos in next generation proton-decay searches using Megaton-scale Water Cherenkov detectors. Similar techniques might also be useful in the detection of Supernova neutrinos. Accurate determination of neutron tagging efficiencies will require a detailed understanding of the number of neutrons produced by neutrino interactions in water, as a function of momentum transferred. In this talk we present the proposed Atmospheric Neutrino Neutron Interaction Experiment (ANNIE), designed to measure the neutron yield of atmospheric neutrino interactions in gadolinium-doped water. We will introduce some of the physics motivations for this measurement as well as the novel technological aspects. One important component of the ANNIE design is the use of precision timing to localize interaction vertices in the small fiducial volume of the detector. To achieve this, we propose to use early prototypes of LAPPDs (Large Area Picosecond Photodetectors), now in the commercialization phase. These photosensors and their status will also be discussed.

30 - Sterile Neutrino Decay in Super-Kamiokande

Presenter: Mr. RICHARD, Euan (ICRR)

Theoretical right-handed heavy neutrinos may take part in neutrino mixing, thus may appear to take part in weak interactions, despite being themselves "sterile". If they are heavy enough, they may produce detectable decay products. Preliminary study indicated that the SK atmospheric data may search beyond current limits in part of the MeV mass range.

31 - Performance Evaluation of the 8-inch Hybrid Photo-Detector

Presenter: Mr. SUDA, Yusuke (Department of Physics, University of Tokyo)

We have been developing the large-aperture Hybrid Photo-Detectors (HPDs) for a next generation underground water Cherenkov detector, Hyper-Kamiokande. Our goal is to develop a high quantum efficiency HPD which has about 30% quantum efficiency.

An HPD consists of a photo-tube and an avalanche diode (AD). An amplification of the HPD consists of two steps; bombardment of photoelectrons to the AD with a high electric field between photocathode and the AD, and avalanche multiplication inside the AD. Compared to a conventional PMT such as Super-Kamiokande PMT, an HPD has simpler structure, better collection efficiency (CE), timing resolution, and capability of single photon detection.

We present the basic performance of 8-inch HPDs under development. The calculated CE is about 97%. The timing resolution for a single photoelectron signal is measured to be about 1 nsec and the resolution of output charge for a single photoelectron signal is about 14% in sigma. Other performance such as the dark rate, stability and temperature dependence of gain and noise are also presented.

32 - Supernova Neutrino Database

Presenter: Dr. NAKAZATO, Ken'ichiro (Tokyo University of Science)

We present a new series of supernova neutrino light curves and spectra calculated by numerical simulations for a variety of progenitor stellar masses (13–50 M■solar) and metallicities (Z = 0.02 and 0.004), which would be useful for a broad range of supernova neutrino studies, e.g., simulations of future neutrino burst detection by underground detectors or theoretical predictions for the relic supernova neutrino background. To follow the evolution from the onset of collapse to 20 s after the core bounce, we combine the results of neutrino-radiation hydrodynamic simulations for the early phase and quasi-static evolutionary calculations of neutrino diffusion for the late phase, with different values of shock revival time as a parameter that should depend on the still unknown explosion mechanism.We describe the calculation methods and basic results, including the dependence on progenitor models and the shock revival time. The neutrino data are publicly available electronically.

33 - Intra-bunch feedback system at J-PARC Main Ring for High Intensity neutrino beam

Presenter: NAKAMURA, Keigo (Kyoto University)

In T2K Experiment, the neutrino beam is produced,impinging the proton beam to the carbon target.
To increase the intensity of the neutrino beam,
it is essential to make the proton beam more intense.

One way for the higher intensity is to decrease the beam loss.
One of the causes of the loss is beam instability,
which increases the amplitude of betatron oscillation and leads to the loss.
In J-PARC, bunch by bunch feedback system is applied in 2011 to suppress the instability.

But the present system still cannot efficiently suppress the intra-bunch motions.

When the beam intensity becomes high, beam instability caused by the intra-bunch motions will increase beam loss.

In this paper, we will introduce intra-bunch feedback system to suppress this motion.

This system is still under R, we aim at 300kW beam operation next year.

34 - Development of New Data Acquisition System at Super-Kamiokande for Nearby Supernova Bursts

Presenter: ORII, Asato (ICRR, Univ. of Tokyo)

Super-Kamiokande(SK), a 50-kiloton water Cherenkov detector, is one of the most sensitive neutrino detectors and this detector is capable in detecting neutrinos generated at supernova with high efficiency.

According to the simulation study based on the Livermore model, the neutrino burst from a supernova farther than about 1300 light years can be recorded without loss of data by current DAQ system. However, the neutrino event rate is expected to exceed more than 30 MHz if the supernova happened in less than several hundreds of light years. In such a case, the system can record only about first 20% of the events. To overcome this inefficiency, we are developing a new DAQ system which records the total number of hit PMTs so that we can count the neutrinos and obtain a time profile of the number of neutrinos emitted at the supernova.

Also, some models predict the emission of low energy neutrinos before the supernova burst. Since supernova burst is a very rare phenomenon and details of the burst mechanism are not known yet, all possible data should be recorded without any bias. To accomplish these requirements, we designed the board to record the total number of hits at 60MHz for 30 seconds before and after the supernova burst.

We will present the detail of the new DAQ system and its test results.

35 - The light yield from water-soaked plastic scintillator with WLS fiber readout

Presenter: Mr. YOSHIDA, Kento (Kyoto University)

We propose a new neutrino scattering experiment in the T2K neutrino beam to measure the neutrino cross section on water. The understanding of the neutrino cross section on water is important for the T2K experiment because the uncertainty is one of the major systematic errors in neutrino oscillation analysis. In the proposing experiment, by using a new water target detector, we will measure the ratio of charged current neutrino cross sections between water and plastic with an accuracy of a few percent.
As an R of the water detector, we study the light yield from water-soaked plastic scintillator with WLS fiber readout using cosmic-ray muons. Current status of the study will be presented.

36 - Performance evaluation of new MPPC

Presenter: Mr. KOGA, Taichiro (Tokyo University)

I tested a new sample of MPPC developed by Hamamatsu Photonics. We quantitatively confirm that it has low darknoise, much less afterpulse, and wider operation voltage region compared to old version. We also tested an optional version of MPPC with crosstalk suppression and confirm it has low crosstalk rate. New MPPC will be useful for upgrade of near detector of T2K experiment and other future detectors as a device which has excellent photon counting capability.

37 - Development and proof-test of new large-aperture photo-detectors for a gigantic Cherenkov detector

Presenter: Dr. NISHIMURA, Yasuhiro (ICRR, University of Tokyo)

We are currently developing new photo detectors with a large aperture for a gigantic Cherenkov detector, such as Hyper-Kamiokande planned in Japan. Hybrid Photo-Detector (HPD) with an avalanche diode and Photomultiplier Tube (PMT) with a dynode upgrade (box-and-line type) are both considered, with possible diameters of 20 or 8 inches. Two particular examples of new photo-detectors, a 20-inch PMT with a higher QE (30%) than the 22% of a current 20-inch PMT used in Super-Kamiokande and 8-inch HPD, have already been manufactured and installed in a 200-ton water Cherenkov detector for a proof-test. Recent activity and progress is presented.

38 - Detector Design for Water/CH Neutrino Cross Section Measurement

Presenter: Mr. HAYASHINO, Tatsuya (Kyoto University)

In the T2K experiment, neutrino oscillations are measured by using the J-PARC neutrino beam, the near detector in J-PARC and the far detector, Super-Kamiokande, at Kamioka. The near detector adopts plastic scintillators (CH) as a target material of neutrino interactions, and the far detector adopts water. The difference of the target materials causes a systematic uncertainty on neutrino cross section that is one of the major systematic errors in neutrino oscillation analysis. In order to reduce the systematic errors, we propose a new neutrino cross section experiment with a water target detector in J-PARC. We will measure the ratio of charged current neutrino cross sections between water and plastic with an accuracy of a few percent. We are designing the water target detector by using the Monte Carlo simulation. We present the design of the detector and the experimental sensitivity.

39 - Statistical analysis of expected supernova neutrino events in Super-KAMIOKANDE

Presenter: YAGAI, Masumi (Tokyo University of Science)

Nakazato et al. made a supernova neutrino database in which numerical simulation data concerning time evolution of supernova neutrino energy spectra for various models/progenitors are listed. Using it, we investigate the statistical fluctuation of supernova neutrino events in Super-KAMIOKANDE. We found that the shock revival time scale could be estimated for a galactic supernova by observing the time evolution of average event energy.

40 - Probing 2-3 Mixing Angle in Current and Future Superbeam Experiments

Presenter: Prof. AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar, Orissa, India)

Preliminary results of MINOS experiment indicate that 2-3 mixing angle is not maximal. Global fits to world neutrino data suggest two nearly degenerate solutions
for theta23: one in the lower octant (LO: theta23 < 45 degree) and the other in the higher octant (HO: theta23 > 45 degree). numu to nue oscillation channel in superbeam experiments are sensitive to the octant and are capable of resolving this ambiguity. First, I will discuss the prospects of this resolution by the current T2K and upcoming NOvA experiments. Then, I will present the octant discovery reach of the future high precision superbeam experiments, LBNE (baseline of 1300 km) and LBNO (baseline of 2300 km).

41 - Renormalization Factors of Dimension-six Proton Decay Operators in the Supersymmetric Standard Models

Presenter: KOBAYASHI, Daiki (Nagoya university)

The unified gauge coupling constant increases if there exist extra particles in the intermediate scale. We found that proton lifetime is significantly reduced in such cases. Moreover, the two-loop effects may be more significant in such cases. We evaluate the renormalization factors of the dimension-six effective operators for proton decay at two- loop level in the supersymmetric grand unified theories. These factors can be easily calculated using the effective Kahler potential. Numerical values for the factors are presented in the minimal supersymmetric SU(5) grand unified model and that with extra vector-like multiplets.

43 - Status of SNO+

Presenter: DI LODOVICO, Francesca

The SNO+ experiment is the successor to the Sudbury Neutrino Observatory (SNO), in which SNO's heavy water is replaced by approximately 780T of liquid scintillator (LAB). A low background level and a low energy threshold can be achieved through the combination of the 2km underground location, the use of ultra-clean materials and the high light-yield of the liquid scintillator. The main physics goal of SNO+ is the search for neutrinoless double beta decay. By loading the
liquid scintillator with 0.3% of natural Tellurium, resulting in about 800kg of 130Te (isotopic abundance is slightly over 34 %), a competitive sensitivity to the effective neutrino mass can be reached. Moreover, due to the multipurpose nature of its detector, SNO+ has the potential to address a diverse set of physics goals, including the detection of reactor, solar, geo- and supernova neutrinos. This talk will present the status of the SNO+ detector, and then discuss the plans and goals of the double beta decay phase.