CASE STUDIES & RECOMMENDATIONS OF EXPERIMENTAL WORKING GROUPS OF NEUTRINO MASS

SANGEETA SHARMA
Research Scholar, Dept. of Philosophy, Singhania University, India
sangeeta5april@gmail.com

Dr. ANIL SHROTRIA
Professor, Dept. of Physics, Singhania University, India
anilshrotriya@rediffmail.com

Abstract –*In this research, a critical study of neutrinos and their oscillations were conducted. In addition to the neutron vibrations and their effects, case studies were conducted on numerous neutrino probes around the world. From the discussion in the previous section, it is clear that neutrinos do not have a mass in the standard model (SM). Groundless gives them a different position than other fermions like charged lupine and quarks. SM is very successful in explaining the many processes of the charged and neutral current involving neutrinos. Therefore, it is believed for a long time that neutrinos are a mass. This scenario has changed completely since many experiments have been conducted in the last two decades with convincing evidence of the neutrino mass. At the moment, suppose that the neutrinos are huge (experimental evidence will be discussed later). Therefore, the preferences of Eigenstates for neutrinos differ from those of Eigen to the masses,and we can treat the Eigenstate of benevolence as a linear combination of Eigen mass states.*

Keywords: *Neutrino Mass, Lupine, Quarks, Solar & Atmospheric Experiments, SuperBeam.*

1. INTRODUCTION

Current research will describe the recommendations of the following cases of experimental working groups:

1. Solar and Atmospheric Experiments Working Group
2. Reactor Working Group
3. Super beams Working Group
4. Neutrino Factory and Beta Beams Experiments and Development Working Group
5. Neutrinoless Double Beta Decay and Direct Searches for Neutrino Mass Working Group
6. Neutrino Astrophysics and Cosmology Working Group
7. Theory Discussion Group
8. APS Study Origins.

From the experimental working groups above the recommendation will be developed in the current thesis and they will conclude for the finding the neutrinos. All the results will be processed in the followingthe order.

Stage 1: Conducting studies about Neutrinos and their flavors.

Stage 2: Studying the Oscillations of Neutrinos and their properties.

Stage 3: Conducting Case Studies in two categories such Experimental working groups and developing the recommendations to identify the observations of Neutrinos in the world scenario.

Stage 4: From the recommendations of case studies a brief study is conducted to list out the cases to develop the antibodies for neutrinos and the control measures for the world scenario.

2. Solar and Atmospheric Experiments Working Group

Executive Summary

Both the first evidence and the first discoveries of the neutrino flavor come from experiments using natural neutrinos. These results were fascinating not only because they were unexpected discoveries in the purest sense, but because they were initially made through different experiments designed to do physics. Ray Davis solar neutrino experiment was created to study solar astrophysics, not neutrino particle physics. The International Maritime Bureau, Kamiokande,and the Super-Camiocande Experiment Experiment expected to observe proton decay, instead of studying (apparently relatively uninteresting) the flow of neutrons into the atmosphere. These experiments and their successors were extensive in our view of the neutron effect and the standard model highlights the two most important to continue current and create future experiments of solar neutrons and naturally-motivated atmosphere naturally into a wide range of physics (after even neutron physics) and thus have great potential to discover what It is new and really unexpected.

The fact that experiments using solar neutrons and naturally occurring atmospheric neutrino rays brings the third main impulse beams themselves interesting in their own right. The study of neutrons in the atmosphere can tell us about the flow of primary cosmic rays, and high energy can lead to Castro-astronomical sources (see the report of the Working Group on Astrophysics) or perhaps about particle interactions in systems that are still inaccessible to accelerators. For solar neutron, the interest of lightning is more considerable. The only particles that can travel unobstructed from the heart of the sun to us, neutrons tell us details about the inner workings of the sun The latest surprising confirmation of the solar model standard predictions (SSM) is practically the tip of the iceberg: we have not exclusively examined more than 99% of the solar flow neutrino. Discovering and understanding the neutrino flavor shift now allows us to return to the original project of the solar neutron, using neutron to understand the sun.

The fourth and perhaps strongest motivation for solar and neutron experiments in the atmosphere is that they still have a vital role in exploring new neutron physics paper. The beams used in these experiments give him a unique sensitivity to some of the most interesting new phenomena. Large-scale solar beam, free of flavor money, passes through amounts of material it is not available for terrestrial experiments. The air beam is wide-ranging, but unlike the sun's beam, it has an additional advantage that mainly ranges from tens of thousands of kilometers.

Recommendations

The highest priority of the working group neutrino experiments in the field of solar and atmospheric research is the development of a real-time precision experiment, which analyzes the solar neutrino flux pp. A solar pp-neutrino flux measurement, compared to the existing high-energy neutron flux 8B precision measurements, will demonstrate the transition between vacuum- and material-dominated oscillations and thus quantitatively test a fundamental prediction of the standard transformation scenario. Of neutrino flavor. The initial solar neutrino beam is clean, which also allows sensitive testing for sterile neutrinos. The pp experiment will also allow a much-improved determination of θ12 and, together with other solar neutrino measurements, either be a measure of θ13 or a double constraint below the existing limits.

Combined with the essential preliminary experiments that measure the flux of 7Be solar neutrinos with 5% accuracy, a measurement of the solar neutrino pp flux will be a sensitive test for the non-standard solar energy generation mechanisms. The standard solar model predicts that pp and 7Be neutrinos together make up more than 98% of the solar neutrino flux. The comparison of neutrino-measured solar luminosity with that measured by photons will test all unknown energy-producing mechanisms within the next star. Accurate measurement of the neutrino pp flux (estimated at 92% of the total flux) will also make it possible to rigorously test the theory of stellar evolution since the standard solar model predicts the flow of pp with a theoretical uncertainty of 1%.

3. Reactor Working Group

Executive Summary

The worldwide program to understand neutrino oscillations and determine the mixing parameters, CP violating effects and mass hierarchy will require a large combination of measurements. Our group believes that a key element of this future neutrino program is a multi-detector neutrino experiment (with baselines of ~ 200 m and ~ 1.5 km) with a sensitivity of sin2 $2\theta^{13}$ = 0.01. In addition to oscillation physics, the reactor experiment may provide interesting measurements of sin2 θ_W at Q2 = 0, neutrino couplings, magnetic moments, and mixing with sterile neutrino states.

θ13 is one of the twenty-six parameters of the standard model, the best model of electroweak interactions for energies below 100 GeV and, as such, is worthy of a precision measurement independent of other considerations. A reactor experiment of the proposed sensitivity will allow a measurement of θ13 with no ambiguities and significantly better precision than any other proposed experiment or will set limits indicating the scale of future experiments required to make progress. Figure 10 shows a comparison of the sensitivity of reactor experiments of different scales with accelerator experiments for setting limits on sin2 2θ13 if the mixing angle is very small, or for measuring sin2 2θ13 if the angle is observable. A reactor experiment with a 1% precision may also resolve the degeneracy in the θ23 parameter when combined with long-baseline accelerator experiments.

Recommendations

This group has one highest priority recommendation:

• We recommend the rapid construction of a multi-detector reactor experiment with a sensitivity of 0.01 for $\sin^2 2\theta^{13}$.

Our other recommendations are the following:

• To help accomplish our highest priority recommendation, we recommend R&D support necessary to prepare a full proposal.

• We recommend continued support for the KamLAND experiment. KamLAND has made the best determination of Δm212 to date and will provide the best measurement for the foreseeable future. As the most in-depth running reactor experiment, it also provides critical information about cosmic-ray detailed backgrounds for future experiments.

• We recommend the exploration of potential sites for a next-generation experiment at a distance of 70 km from an isolated reactor complex to make high precision measurements of θ12 and Δm^{212}.

• We recommend support for the development of future large-scale reactor θ13 experiments that fully exploit energy spectrum information.

4. Super beams Working Group

Executive Summary

As we seek the answers to the central questions in neutrino physics, accelerator-based experiments will be crucial for providing the necessary precision and sensitivity. There are several physics questions which accelerator super beam experiments will address:

• What is the mixing pattern among the neutrinos? Do the mixings suggest some new fundamental mechanism which causes them to have exceptional values?

• What is the mass hierarchy for the three known neutrinos?

• Do neutrinos violate the symmetry CP?

• Are there additional light neutrinos and do they participate in oscillations with the three known neutrinos?

• Do we understand the underlying mechanism of neutrino oscillations?

• Do neutrinos have measurable magnetic moments or other exotic properties?

Shorter experiments will depend on existing accelerator capabilities. However, in the long run, it is clear that we need new or improved proton accelerators capable of delivering more than one megawatt of proton energy to a neutrino superjet. With such a pilot, a new program rich in neutrino oscillations and other physical measurements will be possible.

Recommendations

These are the necessary components for a complete set of precision measurements on the vibration parameters of interest. The main characteristic of these experiments is that they give 1% of the measurement of $\sin^2 2\theta_{23}$ and Δm^2_{23} and that the sensitivity of $\sin^2 2\theta_{13}$ is less than 0.01 (depends on the other parameters). If $\sin^2$ 2θ13 weremore magnificent than about 0.01, these experiments would also provide a detection and measurement capability for CP violation and, because of long baselines, would provide a unique mass hierarchy function. A very large multipurpose detector in an underground location allows not only measurements of long-wave vibrations, but also measurements on solar and atmospheric neutrinos, a search for supernova neutrinos and a search for the disintegration of protons. The new proton driver allows long and short experiments with basic vibrations, as well as various other experiments on neutrinos. It will also provide new accurate experiments on muons and hadrons and serve as a critical first step in a possible future neutrino plant.

5. Neutrino Factory and Beta Beam Experiments and Development Working Group

Executive Summary

Two new types of plants have been proposed, which could have a significant impact on future neutrino experiments - the neutrino plant and the beta beam plant. Unlike conventional muon neutrino beams, neutron beam and beta beam devices would provide a source of electron neutrinos (νe) and antineutrinos (-νe) with very little systematic uncertainty in beam fluxes and spectra associates. The experimental signature for νe → νμ transitions is extremely clean, with meager base rates. Neutrino plants and beta rays would therefore allow susceptible vibration measurements. This is particularly true for a neutrino plant that not only provides very high energy beams but also electron neutrinos (νe) and antineutrinos (- νe). This would allow a wide variety of complementary oscillations measurements in a single detector and our ability to test the three-flavor mixing structure, to measure CP violation in the lepton sector (and perhaps to determine the mass hierarchy of neutrinos) and to improve, if necessary, extremely low values of the mixing angle θ13.

At this time, we do not know the value of θ^{13}. If $\sin^2 2\theta^{13} < 0.01$, much of the physics program of neutrino oscillations will be out of reach of conventional neutrino beams. In this case, the neutrino plants and the beta beams are the only way to follow the desired physics program.

Recommendations

Accelerator R & D is an integral part of the ongoing global neutrino program. The limited beam intensity already limits the neutrino physics program and will continue to do so in the future. More tremendous and new types of neutrino radiation would have a significant impact on the future neutrino program. A neutrino plant would require an MW super-beam proton source. We, therefore, encourage the rapid development of a source of super-beam protons.

6. Conclusions & Discussions

Through the findings of the task force and the Snowmass discussion, a drafting committee prepared this final report of the study. This report, the neutrino matrix, aims to integrate the findings of the working group into a coherent plan for the future that reflects the consensus that emerged from Snowmass.

The low mass and neutral charge of neutrinos imply a very weak interaction with other particles and fields. This characteristic of weak interaction is of interest to scientists because it means that neutrinos can be used to study environments that other radiation (such as light or radio waves) can not penetrate.

References

[1] *Blennow, M Coloma, P Huber, P & Schwetz, T. (2014, 3 5). Quantifying the sensitivity of oscillation experiments to the neutrino mass ordering. Journal of High Energy Physics, 2014(3), 28.*

[2] Buchmann, E Böhm, K & Raabe, O. (2008). Privacy2.0: Towards collaborative data-privacy protection. IFIP International Federation for Information Processing.

[3] Capozzi, F Lisi, E & Marrone, A. (2014, 1 9). Neutrino mass hierarchy and electron neutrino oscillation parameters with one hundred thousand reactor events. Physical Review D, 89(1), 013001.

[4] Coloma, P D, T.-P & 2016, u. (n.d.). Generalized mass ordering degeneracy in neutrino oscillation experiments. APS.

[5] Duffy, K. (2017). First measurement of neutrino and antineutrino oscillation at T2K. Springer.

[6] Fisher, P Kayser, B & McFarland, K. (1999, 6 3). Neutrino Mass and Oscillation.

[7] Helveston, M. (2015). Consumer Protection in the Age of Big Data.Wash. UL Rev.

[8] Helveston, M. (2016). Consumer Protection in the Age of Big Data. Washington University Law Review.

[9] Kayser, B. (2001, 4 15). Neutrino Mass, Mixing, and Oscillation.

[10] Kudenko, Y. (2017, 6 5). Neutrino detectors for oscillation experiments. Journal of Instrumentation, 12(06), C06003-C06003.

[11] Mantelero, A & Vaciago, G. (2015). Data protection in a big data society. Ideas for a future regulation. Digital Investigation.

[12] Robinson, R. (2016). Data privacy vs. data protection. Ipswitch blog.

[13] Salas, P Forero, D Ternes, C ..., M.-a & 2017, u. (n.d.). Status of neutrino oscillations 2017. arxiv.org.

[14] Schünemann, W & Baumann, M. (2017). Privacy, data protection and cybersecurity in Europe.

[15] Seadrow, S Frohlich, C ..., H.-A & 2014, u. (n.d.). The Effects of Collective Neutrino Oscillations on Supernova Nucleosynthesis. adsabs.harvard.edu.

[16] Shimizu, Y & Tatsuta, Y. (2016, 7 31). Edge of a cliff.

[17] Timmons, A. (2017). Search for sterile neutrinos with the Minos long-baseline experiment. Springer.

[18] Yang, W & Huang, S. (2008). Data privacy protection in multi-party clustering. Data and Knowledge Engineering.

[19] Zalipska, J. (2016, 11). Latest (Anti) Neutrino Oscillation Results from T2K. Journal of Physics: Conference Series, 770, 012022.