

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Sudan University of Science and Technology

College of Science- Physics Department

A Review of Solar Neutrino Problem

A Graduation project submitted as partial fulfillment for the requirements of B.Sc. (Honor)
degree in physics Science

Submitted by:

Awatif Ahmed Yousif Salih

Thurya Abdelaziz Abdelgadir

Zeinab Suliman Ismail Mohammed

Supervised By:

Dr. Magdi Elfadil Yousif Suliman

June 2014

الآية

قال تعالى:

(وَيَسْأَلُونَكَ عَنِ الرُّوحِ قُلِ الرُّوحُ مِنْ أَمْرِ رَبِّي وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيلًا)

صدق الله العظيم

سورة الاسراء (آية 85)

Dedication

This work is dedicated to:

Our small families including: parents, sisters and brothers

&

All members of our great families.

Authors

Acknowledgement

First and foremost our thanks are to Allah our Almighty God. Moreover, our thanks are extended to our Supervisor/ Dr. **Magdi Elfadil** who helped us during completion of this work, for his patient, support and guidance. Our thanks are also extended to the Staff of Sudan University of Science and Technology, College of Science- Physics Department for their support, instruction and guides during the course of our studies and being affiliated to this outstanding Physics Department as undergraduate students.

Finally, our big applause is for everyone who helped us during the completion of this work.

It is worth noting the acknowledgement of the authority of the Super Kamiokande for the provision of the neutrino data, we thank everyone who look after this neutrino detector which is located in Japan.

Abstract

The neutrino is an elementary particle that product from different types of nuclear reactions such as the nuclear reactions that took place in core of the Sun , it is one of the components of the atom, it has not got an electric charge, it has not got a weight, for its weight is almost equal to zero, and moreover, the neutrino has the largest abundance in the universe; and because the neutrino does not interact directly with matter this made the detection of the neutrino is something so difficult; in addition monitoring of the neutrino needs large and sensitive devices and apparatuses .

The studies that focus on the neutrino are of a wide abundance in the history, in this project we will discuss one of the topics on the neutrino, that is the so-called solar neutrino problem, this problem demonstrated as follows: for all the experiments conducted during the last three decades scientists discovered a diminish in the number of neutrinos emitted from the sun compared to the number of neutrinos that are been calculated a accordingly the model; one of the possible explanation is that the neutrino would be converted in to another type of neutrino such as neutrino muon or neutrino tau that is during its travel on its way from the Sun to the Earth.

المستخلص

النيوترينو هو عبارة عن جسيم أولي ينتج عن أنواع معينة من التفاعلات النووية مثل التي تحدث في الشمس. والنيوترينو هو جزء من مكونات الذرة ، لا يمتلك شحنة كهربائية، ووزنه تقريباً يساوي الصفر. والنيوترينو من أكثر الجزيئات تواجداً في الكون ، ولأنها لا تتفاعل مع المادة يعتبر من الأمر العسير جداً اكتشافها . ومراقبة النيوترينوات تحتاج إلى أجهزة كبيرة جداً وحساسة جداً .

والدراسات العلمية المتعلقة بالنيوترينوات ليس لديها حصر ، وفي هذا البحث سنتناول أحد الموضوعات عن النيوترينو هو ما يسمى بمشكلة النيوترينو الشمسي ، وتشير تلك المشكلة إلى أن التجارب الأرضية التي أجريت خلال الثلاثة عقود الماضية لرصد النيوترينو قد اكتشف فيها تضاعل عدد النيوترينوات المنبعثة من الشمس بالمقارنة بعدد النيوترينوات المحسوبة المتوقعة من النموذج ، وأحد التفسيرات المحتملة هو أن النيوترينو يتحول إلى نوع آخر من نيوترينو آخر مثل نيوترينو ميون أو نيوترينو تاو وذلك أثناء خروجه من الشمس ووصوله إلى الأرض .

Contents

Holly Quran verse	I
Acknowledgement	II
Dedication	III
Abstract (English)	IV
Abstract (Arabic)	V
Contents	VI
Chapter One	
Introduction & Historical Background	
1-1 Introduction	1
1-2 The importance of the project	1
1-3 The problem of the project	1
1-4 Objectives of the project	2
Chapter Two	
Neutrino Physics	
2-1 Introduction	3
2-2 Definition of Neutrino	3
2-3 Historical Background of the solar neutrino	3
2-4 The Astrophysics of the sun	4
2- 5Standard solar model	6
2-6 Solar neutrinos	7
2 – 7 Neutrino Flavor Change in Matter	8
2 – 8 Neutrino oscillation	9
2 – 9 Neutrino mass	10
Chapter Three	
Solar Neutrino Problems	

3-1 Introduction	11
3-2 Solar neutrino problem	11
3-3 Neutrino detectors	11
3- 4 Solutions to the solar neutrino problem	13
3-4-1 Astrophysical Solutions	13
3-4-2 A Physical Solutions	13
Chapter four	
Experiment super kamiokande	
4-1 Introduction	14
4-2 Outline of super kamiokande	14
4-3 Details of the detector	15
4-4 Event Display	19
4-5 Muon Events	20
4-6 Neutrino Events	21
Chapter five	
Result and Discussion	
5-1 Result	23
5-2 Discussion	24
Chapter six	
Conclusion	
6-1 Conclusion	25
6-2 References	26
6-3 Appendix	27

