



PHYSICS IN NEW DIMENSIONS

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PHYSICS OF NEUTRINOS: THE ELUSIVE PARTICLES

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“A billion neutrinos go swimming in heavy water: one gets wet.”

— Michael Kamakana

Introduction

Neutrinos are tiny, neutral, spin half elementary particles and the most abundant of known particles in the universe, after photons. It is amazing to know that billions of the neutrinos pass through our body in one second but they do not interact with any single atom of our body. They are elusive and that is why sometimes they are called as ghost particles. This is due to the fact that the cross-section of interaction of neutrinos with matter at all present energies is many order of the magnitude smaller than the cross-section of the electromagnetic interaction of leptons with matter via the exchange of virtual photon. This is well established fact that the neutrinos interact with matter only via weak interactions i.e. by the exchange of the heavy particles and bosons; however, they might have gravitation interactions but immeasurably small because of negligible mass.

The idea of neutrino was coined by Wolfgang Pauli for the first time in 1930. Pauli found that the sacred laws of Physics such as conservation of energy, linear momentum and angular momentum were being violated in β -decay. Thus to save the conservation laws he postulated a neutral particle with half integer spin and almost zero mass. Initially Pauli called it as a *neutron* but later when neutron was discovered by Chadwick, it was named by Enrico Fermi as *Neutrino*. After the observation of discrete lines in the α - and γ - decay of atomic nuclei, it came as a surprise when J. Chadwick [1] discovered a continuous energy spectrum of electrons emitted in β -decay instead of discrete spectra as given in the figure below: