Chapter 1

Introduction

The Standard Model is a Quantum Field Theory, which has achieved to concieve the interaction of three of the fundamental forces of nature and its interaction with fundamental particles. However, different experiments show data that the Standard Model must be extended. An example is the discovery of neutrino oscillation. [1]

The mechanics of Newton describes with great accuracy the dynamic of bodies with at velocities in comparison with the speed of light. When the velocities of the bodies are close to the speed of light, their kinematics are described by Special Relativity. At the same time, Newtons Mechanics is able to predict the phenomena in scales much larger than 1 Angstrom(much smaller than cosmological scales), however in small scales like 1 Angstrom, particles do not behave classically. It is necessary a quantum theory in order to modelate the phenomena in these scales. Since elemental particles are bodies traveling with speeds close to the speed of light, it is necessary to use the laws of Special Relativity. Also, elementary particles are bodies much smaller than 1 Angstrom size, therefore it is necesary to apply the laws of Quatum Mechanics. A new theory rises called *Quantum Field Theory* that considers both quantum and relativistic physics.

During the years 1960-1970 a theory arose, describing all the interactions between the elemental particles with the exception of gravitational force. This Theory that incluided *Quantum Electrodynamics*, *Glashow-Weinberg-Salam Theory of weak force* and *Quantum Cromodynamics* is the Standard Model.
The Standard Model describes the Electromagnetic, Weak and Strong interactions under symmetry properties.

In Physics exist laws as the conservation of Energy. In particle physics is added the conservation of charge and flavor and some other quantities related with discrete symmetries. However in recent experimental data, it has been found violations to the conservation of flavor. [10] LHC Experimental data has shown that exists a decay of a Higgs boson into a τ particle and a μ particle. With a supersymmetric correction, it could be possible to explain this no conservation of flavor.
Physics demands in special relativity symmetry with Lorentz Transformations,

where the Maxwell equations can be written in covariant form. In Quantum Mechanics exists symmetry when the Lagrangian is invariant when it has a change $\delta\psi$ for any state ψ. In Supersymmetry Theory includes a new symmetry that tranforms fermionic fields to bosonic fields. From the transformations is deduced that all fermion has a *bosonic super-partner* as the selectron, slepton,etc and all boson has a fermionic partner as the higgsino, neutrino). We make a so called one loop correction in the Feynman Diagrams for the decay $h^0 \to \tau\mu$. We use three of the superparticles. The bino $\tilde{B}$ and the sleptons $\tilde{\mu}$ and $\tilde{\tau}$.

The first goal of this thesis is to calculate the branching ratio of the decay of the Higgs boson to two leptons tau and muon with an Ansatz whitin the MSSM(Minimal Super Symemetric Model). As the masses of the superparticles of the MSSM have not been discovered, it will be calculated the decay with different masses of the super-particles. A similar method that was used to calculate the Higgs boson mass before it were discovered, will be used to calculate the masses of the super-particles. After we obtain the decay rate, we will compare the decay with the data given by the experiment CMS.

The Large Hadron Collider (LHC) that is located Switzerland and France is the biggest particle accelerator of the world. High energy physics is studied in this accelator collisioning ions and protons to study the properties of matter in scales much smaller than an atom. The biggest experiments at the LHC are the ATLAS,CMS LHCB and ALICE experiment. Each of these experiments have a certain purpouse.The ALICE experiment studies the matter under extreme conditions of temperature and high energy density. However, we are interested in the photoproduction of the J/Ψ.

The collisions that take place at ALICE can be central, peripheral and ultraperipheral. In the latter collisions the ions only interact electromagnetically and no hadron interaction exist. The production of particles by this mechanism has the advantage that background is much smaller in comparison with other collisions. In this thesis we study the ultraperipheral collisions that take place in the ALICE experiment at the LHC and the decay to μ^+, μ^- of the particles that are produced with low p_T.