Abstract

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Preparatory studies to search for the production of new heavy particles with unusual properties in protonproton collisions at 7 TeV with the CMS experiment at the Large Hadron Collider LHC

Preparatory studies to search for the production of new heavy particles with unusual properties in proton-proton collisions at 7 TeV with the CMS experiment at the Large Hadron Collider LHC. The fundamental structure of the universe has always captured the human curiosity. The concept of atomism can be tracked back to Democritus, in the ancient Greece. Atoms were considered the indivisible constituents of matter until early 20th century. Modern particle physics has appeared with the discovery of the electron by J. J. Thomson, and the substructure of the atom emerged as a result of the famous Rutherford scattering experiments, that pictures that electrons are in orbits around a positively charged nucleus that is in the center of the atom. During this interval many experiments were performed to reveal many mysteries of nature, where putting detectors for studying cosmic rays, on ground and at high altitudes, led to important discoveries. Ground level detectors discovered a particle with a mass of ~ 100 MeV now known as the muon (and is family of the electron). Higher altitude detectors discovered a particle with a higher mass of ~ 150 MeV that decayed in a muon, this was a family of the proton namely a meson, “called pion now”, triggering the age of particle physics to be truly starting. The transformation of particle physics into high energy physics, through the invention of the particle accelerators, which accelerate protons electrons to very high energies and smash them into nuclei each other, revealed a whole zoo of new particles. Accelerators were reaching higher energies more and more particles were discovered. By the early 1960s, physicists once again faced the problem of classification of over one hundred new particles, and the question whether these are the true elementary constituents of matter. Continued efforts of theorists and experimentalists were rewarded by the very elegant solution. The fundamental particles could be reduced to the quarks and leptons, and to the carriers of their interactions. All other particles (e.g. protons neutrons) consist of these elementary quarks. The most robust and widely accepted description of these fundamental particles and their interactions is given by the so called Standard Model (SM). High energy physics experiments are now designed to test this model and to seek for new phenomena that lay beyond the Standard Model. Here we studied a minimal extension of the Standard Model assuming an additional unbroken SU (N) gauge group is added to the fundamental representation. (The qualitative features some fermions ?, ? of the model are unchanged if the particles are scalars rather than fermions). The model is parametrized by the mass of the new particles m? in the interesting range (very roughly 100 GeV < ? mQ < ? 1000 TeV) and the SU (N) gauge coupling, which can be parametrized by the scale ? where it gets strong. In addition, there is a discrete choice of the Standard Model gauge quantum numbers of these new fermions.