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DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

One of the most appealing questions in physics that has been studied for several decades is the fundamental structure of matter in Nature. The vast amount of effort devoted to understand the basic ingredients of matter and their interactions resulted as a quantum theory called as the Standard Model. The fundamental building blocks of the matter in the Standard Model are known as quarks and leptons and they have been discovered over the years in series of experiments. In this theory, the interactions between these fundamental building blocks of the matter is governed by force carriers. According to the Standard Model, there are three different types of forces: electromagnetic, weak and strong forces. Each of these three forces have their own quantum carriers. The force between the quarks is the strong force and its quantum carrier is called gluon. These elementary particles (quarks and gluons) combine together and form the composite particles called as hadrons but the dynamics of how hadrons are formed and held together are far from being straightforward. The theory that studies the interactions between the quarks and gluons is called Quantum Chromodynamics and it is contained in the Standard Model.

The theory of Quantum Chromodynamics is essential to understand the fundamental structure of the matter. After several decades of experimental and theoretical work, we now know some features of this theory. One of the most important feature is that the number of particles that are produced in a collision of two hadrons increases with the increasing energy. It is understood that this behavior is due to the fact that the number of gluons inside the colliding hadrons increases rapidly with increasing energy. This phenomenon is related with the fundamental property of gluons which tends to split into the daughter gluons. However, one question that should be asked is whether the increase in the number of gluons with in- creasing energy can continue without any limitation. There are strong indications both from theoretical works and from experimental results that there is mechanism that stops this rapid growth. At sufficiently high energies, the split gluons start recombining and this process slows down the increase of gluon density. This phenomenon is known as gluon saturation. This brings a nonlinear aspect to the dynamics of the interaction of the elementary particles. Thus, it is crucial to study and develop new methods to study such complicated systems and their non-linear dynamics at high energies.

Nowadays, one of the biggest collider that studies the fundamental structure of matter is the Large Hadron Collider at CERN in Switzerland. This joint European collider has provided and will continue providing a vast amount of data to unravel the mysteries of the structure of matter. Future collider projects are also under consideration both in Europe and in USA. The main goal of this project to improve and develop the necessary theoretical tools to study saturation phenomena for a better understanding of the currently available data and also to provide theoretical support for the future experimental programs in high-energy and nuclear physics.