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Fourteen billio n years ago, the universe arose from the Big Bang, a state of infinite density and temperature. Today, elementary particles are produced with difficulty as the products of collisions in gigantic accelerator rings and they are detected with complex equipment. In the early universe, these particles were plentiful and existed naturally. The Big Bang and its aftermath is therefore an ideal situation to study the infinitesimal.

It is possible to restrict a theory by imposing the fact that its particles and interactions do not disturb the essential features of the universe. For this, one has to know those features very well. This is exactly is the aim of cosmology and of its study of the anisotropies of the diffuse cosmic background radiation and of far-away supernovae.

The most recent measurements confirm the flatness of the universe and that it contains one mysterious major component, Dark Matter, whose existence was suspected by the Swiss astronomer Fritz Zwicky in 1933. Being of a non-baryonic origin, dark matter could consist of massive particles with weak interactions of a type called neutralinos. Their residual mutual annihilation within the Milky Way and the associated production of various radiation, such as high energy photons or antiparticles,have stimulated many important experiments. Therefore, we are particularly attentive to it. Indeed, our group is involved in studying the propagation of cosmic rays with energies ranging from a few GeV to the extremely high values where the production mechanism is still a mystery and may result from Gamma-Ray Bursters.

In addition to dark matter, a large component of the Universe is an enigmatic fluid exerting a negative pressure, i.e., one tending to make the universe expand! The origin of this component, called Dark Energy, is very difficult to understand. It suggests that the conventional Friedmann-Lemaitre model of the universe is unsatisfactory, and that we should explore new approaches, such as cosmological models with extra dimensions of space and time.

The main themes studied are:

Dark matter

Anisotropies of diffuse cosmic background radiation

Type-la supernovae and cosmological parameters

Cosmology with extra dimensions

Gamma ray bursts

Cosmic rays of extreme energy