We are in a turning point of particle physics. The Standard Model (SM) was confirmed in 2012 by the discovery at LHC of the last predicted by it particle: the Higgs particle. However, the SM is only an effective theory at the electroweak scale and does not solve some fundamental problems. These are for example the following questions:

- dynamical origin and stability of the scale of weak interactions
- nature and origin of Dark Matter
- nature and origin of Dark Energy
- origin of the flavor structure and CP violation
- origin of the baryon-antibaryon asymmetry present in the Universe
- unification of elementary interactions, including gravity

SM is not the final theory of elementary interactions. There must exist a deeper theory, an extension of the SM, which solves the above mentioned problems leading to deeper understanding of the structure of matter and the history of the Universe. Finding such theory is the main challenge and the main goal of particle physics. Paving the way towards this goal is the main objective of this project.

In the last several decades, particle physics has been progressing "according to the plan". Discoveries of successive new particles were possible due to tremendous progress of experimental techniques but were not very surprising for physicists. Examples are discoveries of $W$ and $Z$ bosons, $t$ quark and finally the Higgs scalar. After this last discovery, we know all particles predicted by the SM. Now we do not know which new discoveries one should expect. The reason is that there is neither a unique extension of the SM nor clear indication at what energy scale new effects should appear. We are facing the situation that is not unusual in basic science whose purpose is the exploration of unknown territories, with high risk but also with possibilities of important discoveries.

So far, searches at LHC for phenomena indicating physics beyond the SM gave no convincing positive results. Such searches are performed paying attention to several concrete models proposed as extensions of the SM. Negative results impose restrictions or even exclude some versions of those models and give valuable hints for construction of other possible extensions of the SM. Of course, when investigating such models one should not be guided only by the results from LHC. Obviously, any such model must agree with all existing experimental data and must be mathematically consistent. Very important is also to try to solve the above listed problems of the SM.

The main goal of the scientific program proposed in this project is to search for possible extensions of the SM according to the above mentioned principles. The central issue of our investigations will be Dark Matter. We plan also to relate it to the origin of the electroweak scale and to possible extensions of the theory of gravitational interactions. The obtained results will allow for better understanding of perspectives for possible new discoveries in particle physics and for better understanding of the structure of the Universe