Since the dawn of our spice, people were interested in exploring world around them. The impulse was coming from practical reasons as well as hunger for knowledge. The one of the fundamental questions was about the composition and properties of matter. The resolution of the human eye (a~measure of the distance at which two items blur into one) was a natural barrier from investigating small objects for a long time. After the invention of instruments such as magnifying glass or microscope the objects with a sizes of microns become open for investigation.

The current optical microscopes allow one to get a magnification of order of several thousand times. This is due to the fact that in order to observe the structure of an object, the light wavelength must be smaller than its size. Scientists were able to overcome these limitations by e.g. building the so-called "scanning microscopes" which, thanks to the precise electronic measurements, can study objects of a size of single atoms.

In order to have a deeper look at the structure of matter, e.g. to study the composition of a~single atom, it is necessary to apply another solution -- instead of light (photons) particles, such as electrons or protons have to be used. It is known from the quantum mechanics that the wavelength of the particle depends on its energy -- the greater is the energy, the shorter is the wavelength. Therefore, a "particle microscope" is the solution! Such devices are called "accelerators" and are being constructed for more than 100 years. Moreover, the technological progress makes such microscopes better and better, with more energy available to investigate structures of matter. The largest accelerator built so far is called Large Hadron Collider (LHC). It located at the European Organization for Nuclear Research (CERN) and has a circumference of 27 km!

What are the scientists searching for using the so monstrous devices? Studies are focused on the two main points:
- finding new aspects of matter (such as the recently discovered Higgs boson),
- checking if our current understanding of the behaviour of our World is consistent with the new data.

My work, entitled "Exclusive Light Meson Production: Theory vs Experiment" address both points.

It should be noted that the exact description of our world is not known -- in order to explain the principles the theoretical models are constructed and the laws are formulated. Therefore it could happen that the existing theories are modified in a light of new data. For example this was a case for the Newtonian mechanics which fails to predict motion at very high velocities and should be replaced by Special Theory of Relativity.

The same situation applies also for the case of modelling the behaviour of matter -- one need to check whether their predictions are or are not in conflict with the new measurements. But how one can connect equations derived by theorists on a piece of paper with the measurements? In high energy physics physics scientist use dedicated computer programs -- so-called Monte Carlo generators. The engine of such program is a theoretical formula. On these basis the computer can generate the given process. For example, one of the processes that are to be tested by our generator is the exclusive pion production:
- take two protons with a given energy,
- collide them,
- as a result of this collision protons lose some of their energy which is used for a production of two charged pi mesons.

This process is called an exclusive one, because all produced particles can be measured. It is a unique phenomenon -- usually interacting protons are destroyed and their remnants can not be measured in particle detectors.

Properties of produced particles, such as their energy or momentum are one of the possible solutions of used theoretical model. The possibility to generate such processes enables further studies using computer simulations. Using the well-known laws of interactions between particles and detectors' matter, scientists created precise computer models of particle detectors. As a result, the theory predictions programmed into Monte Carlo generators can be accurately compared to the reality. This in turn allows for the efficient verification of the theoretical predictions and systematic expansion of our knowledge about the world.

In my Monte Carlo generator a series of processes of light meson production will be implemented. Predictions given by this tool can be then verified in the light of data from the largest and most powerful particle accelerator the Large Hadron Collider. This generator will be the most modern tool of this type -- its engine will contain the most recent and advanced theoretical models. In a wider perspective this project will:
- confirm if our understanding of the world is correct or not,
- encourage scientists interested in theory for further work in this direction,
- motivate scientists working with the LHC data for delivering further, more detailed tests in this field.