DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

The main goals of the **VErTIGO** project are related to the biggest open questions in the contemporary science. These unprecedentedly difficult problems call for implementation and developing of the most advance and novel techniques of computer simulation and data analysis.

In the past two decades cosmology has become one of the most important and most successful branch of physical sciences. The clear testimony for this are three Nobel prizes awarded in this field in recent years. All these amazing discoveries and theoretical breakthroughs lead to the constitution of the Standard Cosmological Model (SCM).

The standard model consists of a set of theories and established parameters which gives us the most adequate description of the Universe and its evolution on the largest scales. The SCM successfully predicts and explain a wealth of astronomical observations. In particular it describes how tiny primordial density fluctuations present in young and hot Cosmos had evolved in over 13 billions years of cosmic evolution to from the observed magnificent large-scale structure of the cosmic web in which galaxies and their clusters are arranged.

Despite these all unquestioned great successes, the advancement of the modern cosmology and extragalactic astronomy had brought also the biggest unsolved puzzles of the modern science. One of those is to find and explain the physical mechanism responsible for accelerated expansion of the Universe. The standard model employs General Relativity (GR) for describing the gravitational interactions on all scales. Within the framework of the Einstein's theory the accelerated expansion is driven by the so-called Cosmological Constant (CC), which would have to be very small. On the other hand the quantum physics predicts that if the speeding up of the expansions is caused by the CC it vale would be 50 orders of magnitude greater than the observed one. It is the biggest discrepancy between the theory prediction and a measurement in the history of the natural sciences.
The search for accelerated expansion explanation and the CC problem have become topics of the whole new area of research in modern theoretical cosmology. There have been many interesting ideas put forward to modify GR in a way that would allow for accelerated expansion of space-time without the CC. On the other hand we also know that the Einstein's theory has been rigorously tested only on the interplanetary distance scales. Yet we apply GR to describe the whole Universe. This is an extrapolation of the theory over 15 orders of magnitude in scale!

It is not surprising then that the construction and conduction of novel gravity tests on cosmological scales had become one of the most important and pressing challenges of the contemporary cosmology. The **VErTIGO** project will contribute significantly towards solutions of these problems. The development of a novel method of using observed galaxy peculiar velocities to test GR and rivalling theories will amount to new stringent tests of gravity on intergalactic scales. The planned research will capitalize on the fact that velocities with which galaxies travel through the Cosmos are very sensitive to even smallest departures from Einstein's theory of gravity. The **VErTIGO** method will allow for testing the theory of gravity on cosmological scales with unprecedented accuracies of 10% and 5%!

For such gravity tests to become reality a novel software for simulation of the formation of galaxies and large-scale structure of the Cosmos in different gravity theories will be required. This will be accompanied be another software packages dedicated to analysis of might large new data sets, which will flood us from the current and incoming space missions and observing campaigns such as Euclid and Gaia satellites or Large Synoptic Sky Telescope and Dark Energy Spectroscopic Instrument. All of this will be among goals and deliverables of the VErTIGO project.