The main aim of the research project will be to elaborate a survey of promising prospects for finding characteristic features of *dark matter sector*. We use black objects, i.e., black hole and their higher-dimensional generalisation like black branes, as well as, wormholes for constraining the features of *dark sector*. The connection between black object physics and *dark matter* remains largely unexplored and many problems remain to be solved in order to improve existing constraints and obtain more complete and robust perspectives for searching *dark matter sector* features in future or ongoing experiments, in various branches of physics where the black objects play the significant role.

We shall consider the following three models of *dark sector*, i.e., axion-like *dark matter* model, where the coupling between Maxwell field strength and its dual is important, *dark photon model*, where the gravity theory with ordinary Maxwell field is supplemented by the additional U(1)-gauge field (the so-called dark photon) interacting with the Maxwell one and responsible for the existence of *dark sector* and dark axion model, where axion can couple to two *dark photon* and to photon and *dark photon*.

In our research we shall consider environmental effects of *dark sector* in the vicinity of black objects. The distribution of *dark sector* around black objects will be the key point of this researches. On the other hand, phase transitions with the influence of *hidden sector* will constitute the second objective. Formation of cosmic web from the *dark matter* on which ordinary matter condensate giving rise to formation of large-scale structures (confirmed by Hubble space-telescope observations), is one of the important subject of the current theoretical physics and astrophysics researches.

Having in mind the future observations of Event Horizon Telescope we pay attention to the problem of the additional magnetic field stemming from *dark sector* and its influence of supermassive black hole physics.

The research project authorises the inventory way of looking at the properties *dark matter*, by methods devised in the mathematical theories of gravity. The possible results can be of great importance due to the planned and ongoing experiments of detection of this elusive ingredient of our Universe constituting over 23 percent of its mass.