DESCRIPTION FOR THE GENERAL PUBLIC

Accreting black holes, which are present in both the active galactic nuclei and in some stellar binary systems, are unique laboratories for the study of physical processes in the extremely relativistic regime of the event horizon vicinity. This region is a source of strong X-ray radiation as well as energetic particles which escape (forming so called jets) with velocities close to the speed of light. Despite several decades of theoretical and observational investigations, details of these observed phenomena are not fully understood. Results of our project will allow to better understand involved physical processes. Our primary aim is to verify if the black hole vicinity can be the source of very high energy particles (here the energies are much larger than energies of the escaping particles forming jets), which are detected thanks to spectacular development of several ground-based experiments.
In particular, first cosmic neutrinos have been registered by the huge IceCube detector in Antarctica. The sources of these neutrinos are unclear. Our investigation should answer if the neutrinos may be produced close to black holes. Similarly, we intend to explain whether the highest-energy cosmic rays may come from the same sites. Observations of one of the best studied active galaxies, M87, provide a strong motivation to consider the production of very high energy particles in the vicinity of black-hole event horizons. In this galaxy, Cherenkov telescopes (MAGIC and H.E.S.S.) registered very high energy gamma-ray photons which undoubtedly come from the immediate surrounding of the supermassive black hole. Energies of these gamma-ray photons are smaller than those of neutrinos or cosmic rays, but still very high (comparable to energies achieved in LHC in CERN).