Optical light of astronomical sources is being studied for centuries now using ground based telescopes. Nevertheless, shorter wavelengths, corresponding to photons (which are the particles of light) of higher energies do not reach the ground instruments. X-rays and gamma rays with energies MeV to GeV (milions to billions times more energetic than visible light) are absorbed in the Earth's atmosphere. These photons can be studied using satellite experiments. On the other hand, we can use the absorption in the atmosphere to study the highest energy gamma rays (with energies exceeding 30 GeV, i.e. above 30 billion times more energetic than visible light). A gamma-ray photon entering the atmosphere interacts with the atmospheric nuclei producing thousands of secondary electrons and positrons in the so-called extensive air shower (EAS). Those of the particles propagating faster than light in the atmosphere cause emission of faint, nanosecond-long flashes of bluish Cherenkov light. Ground-based telescopes can detect this light and obtain images of individual EAS on their cameras. This technique is relatively new. The first very high energy gamma-ray source, Crab Nebula, was discovered in 1989 by the Whipple telescope. The breakthrough occurred around 2004 when the current generation of Cherenkov telescopes started its operations. Since that time, the number of sources known in this energy range increased from about a dozen to over 200. The three main instruments in this field are: MAGIC, located in La Palma, Spain, H.E.S.S., located in Namibia and VERITAS located in Arizona, USA. Polish groups of scientists participate currently in studies performed with H.E.S.S. and MAGIC telescopes. The next generation of Cherenkov telescopes is the large, international project CTA (Cherenkov Telescope Array). CTA will consist of about 100 telescopes in three different sizes, spread over two locations: Northern in La Palma, Spain, just next to the MAGIC telescopes, and Southern in Paranal, Chile. The construction of the prototype of the largest type of CTA telescopes – LST1 in La Palma has been completed recently.

Within this project the planned group of young scientists will participate in building and commissioning of an array of next-generation telescopes, LST. We will use the LST to observe gamma rays from the so-called active galaxies. A galaxy is called active if its central part emits radiation with properties that cannot be explained by the emission of typical stars in galaxies. Moreover, active galaxies are often highly variable. The luminosity of such objects has been observed to change on time scales as short as minutes. The observational properties of active galaxies allow us to suspect that they are powered by infall of matter onto a central black hole with mass of billions of masses of Sun and radius of the order of the Earth-Sun distance. From the central region of active galaxy two jets are ejected with the velocity approaching the speed of light. The jets are filled with both magnetic field and matter. By studying the varying in time emission of active galaxies with Cherenkov telescopes we can reveal the nature of the most energetic processes occurring in those sources. In particular, we still do not know what kind of processes are responsible for the acceleration of charged particles to velocities close to the speed of light, or where inside the jet the emission of gamma rays occurs. Observations of active galaxies with Cherenkov telescopes give scientists also unique chance to study models of physics at scales of elementary particles and cosmology. Violently variable emission is used in the search of quantum gravity effects, i.e. the dependence of the speed of light on the energy. The radiation reaching us from far active galaxies allows us to study the extragalactic background light (the total light of all the galaxies and intergalactic dust spread in the Universe) and extremely faint and enigmatic intergalactic magnetic fields. Therefore, the studies proposed in this project will allow us to find some answers on the nature of the most extreme objects in the universe, such as active galaxies and gamma-ray bursts, and of the whole Universe.