Popular description

Highest energy electromagnetic waves (gamma ray photons) arriving from space do not penetrate as far down as the Earth's surface. They interact with atoms in the upper atmosphere, at heights above 10 km, initiating cascades of large quantities of electron-positron pairs that propagate down through the atmosphere with nearly the speed of light. The cascades emit so called ***Cherenkov radiation*** – an optical blue and ultraviolet light emission. Large optical "Cherenkov telescopes" situated on earth and operating as multi-telescope arrays allow for a simultaneous registration of very short (several nanoseconds) flashes of individual cascade emissions by a few telescopes, which enables one to make a precise reconstruction of the original gamma ray direction and energy. As each of the telescopes can register signals from photons hitting nearly one square kilometre of the atmosphere, in the considered energy range the sensitivity of such observatories on the ground is much higher than that of satellite observatories operating in space.

The **Cherenkov Telescope Array (CTA)** Project is a world-wide ground based gamma ray observatory currently under construction. It will enable one to perform a detailed exploration of the Universe in the highest energy gamma rays currently studied, involving energies that are many times higher than, e.g., the highest particle energies achievable in the Large Hadron Collider at CERN. Efforts for designing and the construction of the new large scientific infrastructure was initiated in 2006 by scientists involved in the currently running H.E.S.S. and MAGIC gamma ray observatories, after these projects demonstrated large observational and discovery potential in the field. Following a joint proposal by Germany, France and **Poland,** the CTA Project was introduced to the European ESFRI roadmap in 2008, as well as to several other main international roadmaps. It is also listed on the Polish national roadmap of large scientific infrastructures of the Ministry of Science and Higher Education. The CTA Project is a truly global effort. It involves more than 1400 scientists and engineers from 33 countries at 5 continents. The observatory, with two sites, one in the southern and one in the northern hemisphere, will consist of several arrays of Cherenkov telescopes, including in total 8 large telescopes with mirrors of 23 m in diameter, 40 medium ones with 12 m mirrors and 70 smaller ones with 4 m mirrors. For comparison, the largest currently operating observatory involves a single large telescope and 4 medium size ones. As a result, the sensitivity of CTA will be an order of magnitude higher. In addition it will allow for gamma ray studies in a significantly wider energy range. It will make it possible to discover and study thousands of new gamma ray sources (various kinds of "cosmic particle accelerators") and perform a number of unique measurements of high importance to particle physics and cosmology. A few examples of the expected CTA research potential include studies of high energy processes near black holes, in pulsars and pulsar wind nebulae, in supernova remnants, or in relativistic jets. Scientific research program will further include cosmological studies of the cosmic background radiation in the optical and ultraviolet energy range and of primordial magnetic fields in the intergalactic space, search for gamma ray emission generated by dark matter particles, and an attempt at their identification, or efforts to reveal quantum gravity effects in the propagation of highest energy photons over cosmological distances. This wide array of seminal research topics will give an exceptional opportunity to researchers of the **Polish Consortium of the Cherenkov Telescope Array Project** – which is one of main partners of the project, including 13 Polish scientific institutions and about 70 people – to perform (or contribute to) discoveries of potentially fundamental importance to astronomy and particle physics. In addition, as a significant part of the project observational time will be available to all researchers from the countries that are involved in the project, a wide community of astronomers and physicists working in Poland will get an opportunity to perform their own unique research projects with CTA. The CTA Project will enable a continuation of the currently performed studies and will strengthen the international position of Poland in the field of high energy astrophysics. It will also allow for an optimal use of some leading astronomical facilities in the world that involve Polish contribution, and that will collaborate with CTA, for instance the European Southern Observatory or the radioastronomical observatory LOFAR.