In the recent years a new method of Earth exploration was developed. It is based on detection of extremely low frequency (ELF) electromagnetic waves (frequency of 3 to 3,000 Hz) generated by thunderstorms. These waves propagate in the space between the Earth's surface and lower layers of the ionosphere, situated at an altitude of about 75 km. A natural waveguide created in this way has such a small attenuation, that in some particular cases we can observe ELF pulses that propagate around Earth several times. Because of a very small attenuation, a single ELF observatory can study strong discharges of various types on the entire Earth's surface. In addition to strong positive cloud-to-ground discharges, the most interesting atmospheric discharges include several kilometer long discharges between cloud tops and the lower ionosphere, which are accompanied by transient luminous events such as SPRITE and Gigantic Jets (GJ). Energy of the latter is comparable to that of a small nuclear weapon (5 kt TNT). Small attenuation in the ELF range leads to interference of the waves propagating around the Earth in the opposite direction. This creates resonance of the waves in the Earth-ionosphere cavity. This phenomenon, known as the Schumann resonance (from the name of the discoverer, W.O. Schumann, 1952), is clearly visible all the time in form of resonance maxima of the background noise at frequencies of about 8, 14, 20, 26,...Hz. The resonance field in the cavity is created because of constant activity of the storm centers on Earth, in which there are about 50 "typical" negative cloud-to-ground discharges per second. Schumann resonance observation is currently one of the most important methods for studying electrical activity of the atmosphere and lower layers of the Earth's ionosphere. It enables monitoring the movement of thunderstorms and their intensity globally.

Methods used on Earth can be successfully adapted to study Mars. Even a single ELF station on its surface will enable the detection of individual atmospheric discharges anywhere in the planet's atmosphere and the studies of electrical activity of the Martian dust storms. Due to a considerable depth of penetration of the dry Martian ground by ELF waves (much greater than on Earth), the propagation of ELF waves strongly depends on the ground composition. The main goal of this project is to carry out modeling of the ground-ionosphere waveguide for various assumptions about the composition of the Martian subsurface. These solutions will be used in the future not only to study discharges, but also to perform tomography of the Martian crust up to the depth of a few tens of kilometers.

The project involves the construction of new generation ELF measuring equipment, which could become the base model for designing equipment for future Mars missions. We will profit from many years of experience of the team in building ELF equipment for their automatic Hylaty observatory in the Bieszczady Mountains. The project requires a deep optimization of the equipment in terms of dimensions, weight and power consumption. Particular emphasis will be placed on designing a new generation of low noise light active antennas for the magnetic field component. The new equipment will be fully autonomous and remotely control via radio waves. Using this equipment we will measure electric activity of dust storms on Earth.

The project will help to determine the limits for planetary studies performed by natural ELF waves generated on their surfaces. This will allow us to specify the limit of this method in future Martian missions, e.g., for detection and distribution of water content under the surface. This will help planning future experiments in the incoming ESA/NASA missions and potential participation of Poland in them. In this field, thanks to our experience, Poland could play an important role.