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MISSION CONCEPT FOR LUNAR LOW FREQUENCY ANTENNAS FOR RADIO ASTRONOMY (LUFAR)

Abstract

Since the 1930s, radio astronomers have been studying celestial structures and phenomenon of the universe with the help of ground-based radio telescopes. Unlike the large networks of telescopes around the world, like the VLA (Very Large Array) and LOFAR (Low Frequency Array), a network of radio telescope based in space will give radio astronomers a number of significant advantages over their ground-based counterpart and open a whole new region of unexplored cosmic science. The far-side of the Moon provides natural shielding against man made radio signals and with no atmosphere to block very low frequencies (below 30 MHz) as it is a problem on Earth. This makes the Moon an ideal location for low frequency radio astronomy. Creating such an infrastructure at once on the Moon would be very challenging, which will be addressed by LUFAR, the Lunar Low Frequency Antennas for Radio Astronomy.

LUFAR would make use of several individual nodes, like LOFAR does on Earth, to make a large array of antennas. While current concepts, deploy large static stretched out antennas from a central node, in LUFAR a group of state-of-the-art nanorovers carrying one antenna each, to form a pattern best suited to make observations. As the array is made up of mobile platforms, the array formation is dynamic in nature and can adjust in shape and size to test a number of configurations. The rovers will be deployed on the far side of the moon onboard a lander which will land on the edge of the far side. Doing so, the lander can be in the field of view of the swarm on the far side and at the same time to ground stations on Earth. This will allow the lander to act as a communication hub and relay data between the Earth, if an in-orbit relay spacecraft is not available. The rovers will take measurements and transfer raw data within the swarm for correlation via fiber optic cables. The processed data can be sent to the relay system to be communicated to Earth.

A first model of the LUFAR nanorover is ready to test the concept on the Moon, which is expected to be placed on the Moon in the coming two years. In this paper we will discuss the LUFAR concept in detail, and will present the model and subsystems of the LUFAR nanorover.