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Status of the Orbiting Low Frequency Antennas for Radio Astronomy (OLFAR) project

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OLFAR, the Orbiting Low Frequency Antennas for Radio astronomy project, is targeting a radio telescope for observing the Universe at frequencies below 30 MHz. For frequencies above 30 MHz several instruments have been implemented in the last two centuries, like LOFAR (LOw Frequency ARray) in the Netherlands and its European extension ILT, the International LOFAR Telescope. However, at frequencies below 30 MHz, Earth-based observations are limited due to a combination of severe ionospheric distortions, almost full reflection of radio waves below 10 MHz, solar eruptions and the radio frequency interference (RFI) of human-made signals. Scientifically this frequency band is extremely interesting, for instance giving information from the early universe as well as cyclotron radiations originating from the magnetic fields of (exo)planets. The aim of OLFAR is to open up this last, virtually unexplored frequency domain in the electromagnetic spectrum.

In this paper we will discuss the current status of the project. New antenna structures have been designed, using inflatable structures, to improve the observations antennas which are mostly simple wire antennas (monopoles/dipoles). Inflatable structures have been used in the past in Space, but only as reflectors in antenna structures. Our approach is to make the (large) observational antennas directly using the inflatable structure. A miniaturized integrated LNA has been designed that offers increased performance at lower mass and volume compared to earlier designs. The design will be available soon for testing. In addition, new architectures for the required intra-satellite communication between the satellite swarm are currently being designed. To retrieve the processed astronomical data back on Earth, integrated solar-antenna panels for Earth-downlink are developed. The satellites in the OLFAR swarm also need to be localized and synchronized in a reference-free (GPS-denied) environment, to ensure coherence for space-based interferometry. To ensure this functionality, distributed algorithms for localization, synchronization, navigation, correlation and imaging are currently being developed.

To test our new solutions, we identified three experimental platforms. The first, already existing platform, is the Netherlands China Low Frequency Explorer. The instrument is placed on the Chang'e 4 satellite, orbiting in the Earth-Moon-L2 point. The instrument is operational and demonstrated the antenna concept, and the scientific data is expected soon. The second experimental platform is LOBE, our high-altitude balloon platform (estimated altitude is 40 to 50 km), to test several antenna concepts as well as communication (inter-satellite and up/downlink), synchronization and localization algorithms, and distributed processing algorithms. Third platform is an experiment on the REXUS rocket platform, allowing us to test equipment (like the inflatable structure) at an altitude of 100 km. A prototype comprising of various subsystems is currently being developed for all these platforms.

In this talk, we will present the status of the OLFAR project, the on-going research on the various subsystems, and the progress of the prototypes for the three experimental platforms; where the OLFAR subsystems will be validated.