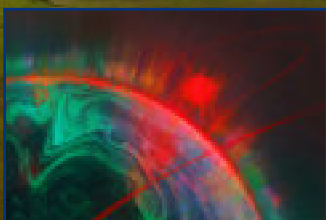
LOFAR2.0

LOFAR
ERIC

Hardware and software upgrade of the largest radio telescope on the planet



The LOw Frequency ARray (LOFAR), developed by ASTRON (Netherlands Institute for Radio Astronomy) together with national and international partners, is the world's largest radio telescope operating at low frequencies. It brings unrivaled image resolution and exquisite sensitivity to study the lowest radio frequencies observable from Earth. As of the mid-2020s, the upgraded network of LOFAR2.0 antenna stations, data processing, and storage facilities is jointly operated by the LOFAR ERIC. The telescope is open for science projects proposed by the full international community. LOFAR features 24 stations in a dense "core" near Exloo (NL); 14 stations distributed more broadly in the Netherlands; and 16 stations located in nine other European partner countries, stretching from Ireland to Bulgaria. Each station contains hundreds of dipole antennas, of two types: LBAs optimized for frequencies of 10-90 MHz and HBAs for frequencies of 110-250 MHz. The LOFAR2.0 upgrade leverages and substantially extends the initial hardware and software components, keeping LOFAR cutting-edge well into the 2030s. LOFAR2.0 will continue to be unique and world-leading, with an angular resolution > 10× higher than that of the planned Square Kilometre Array low-frequency component (SKA-Low), and also accessing the largely unexplored spectral window below 50 MHz.

What does the upgrade to LOFAR2.0 bring

- A factor of 10 increase in the computing power available at each LOFAR station, allowing more science to be done with the radio waves that arrive at the antennas.
- Access to all LOFAR antenna data, all the time; in comparison, previously only 1/3 of the antennas could be used at any given time. This boosts the sensitivity and spectral range.
- A doubling of the field-of-view for more efficient surveys of the radio sky.
- A single clock system to synchronize the antennas to within nanosecond precision. This sharpens the resolution of the radio images.
- A new filter to prevent artificial, human-made radio signals from corrupting the data.
- Improved ultra-high-resolution imaging through new antenna stations in Italy and Bulgaria and connection to a super-station (`NenuFAR') in France.
- A new monitoring and control system (TMSS) and central `brain' for the telescope, which enable dynamic scheduling and multiple types of observations simultaneously.
- An an overall improvement to the sensitivity and accuracy (image fidelity) of the data, along with open source software tools and analysis pipelines.

Some science cases LOFAR2.0 will be used for

- Stars with (potentially habitable) exoplanets
- Astrophysics of the Sun and surrounding heliosphere
- Gas and stars in our Milky Way galaxy
- Structure, magnetic fields, and evolution of nearby galaxies
- Super-massive black holes and star formation in galaxies
- Structure and evolution of the early Universe
- Variable and transient objects related to extreme astrophysical events
- High energy particles (cosmic rays) impacting the Earth
- Studies in Earth's atmosphere, including lighting, meteors, and the ionosphere
- Outbursts on the giant planets (Jupiter, Saturn)

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For more information visit www.lofar.eu.