

LOFAR - THE LOW-FREQUENCY ARRAY

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LOFAR is an innovative radio telescope in the frequency range of 10-240 MHz, realized as a phased array. It will become the largest radio telescope in the world in the time frame 2006-2010, located in Northern Europe. LOFAR is being implemented as a Wide Area Sensor Network which connects thousands of cheap sensors spread throughout the country to a central super computer using an ultra-broadband, synchronized data network. As the central processor IBM will provide its Blue Gene/L machine – the current number one of the top 500 supercomputers. It will process streaming data with more than 0.2 Terabit per second. Many simple radio antennas connected to the network turn it into a huge radio telescope for cosmological studies. In addition, geophones will turn LOFAR into an earthquake monitoring system and infrasound and meteorology sensors will turn LOFAR into a real-time weather monitoring array for agricultural applications. While the combination of these diverse applications in a single infrastructure is unique, just LOFAR's radio capabilities are already breathtaking. It is the first radio telescopes that can listen to radio signals from the entire sky overhead, on all time scales, at a large range of frequencies, and even look back in time for a couple of seconds. The main task of LOFAR as a radio telescope will be to survey and monitor the entire sky. One goal is to detect the first generation of black holes and galaxies in the universe during the epoch of reionization and study hydrogen formed after the big bang. LOFAR is also an ideal system to discover transient and sporadic radio signals. Likely transient sources to be discovered with LOFAR are bursting stars and Jupiter-like planets, gamma-ray bursts, radio outbursts from black holes, but also lightning on Earth and even radio flashes from ultra-high energy cosmic particles hitting the Earth atmosphere. Some LOFAR prototypes have recently been built. They have produced the first instantaneous all-sky maps and just discovered the radio emission from cosmic particle air showers.