U.S. NAVAL RESEARCH LABORATORY

DLITE

Deployable Low-band Ionosphere and Transient Experiment

AT A GLANCE

What is it?

A small radio telescope array (four antennas) that uses cosmic sources of low-frequency (35 MHz) radio emission to study irregularities within Earth's ionosphere.

How does it work?

The array uses specially designed techniques and a relatively large bandwidth to monitor a handful of exceptionally bright cosmic radio sources without a large dish and/or phased array. This dramatically decreases the cost and increases the portability of the system. Ionospheric irregularities on km scales cause these objects to appear to vary in brightness while larger structures (~10-100 km) make them seem to move around on the sky relative to their expected positions.

What will it accomplish?

DLITE measurements of the level of ionospheric irregularity activity can be used to estimate the negative impact these structures have on high frequency (HF; 3-30 MHz) systems within the same region (for example, radars and radio telescopes). Additionally, the low cost of the array enables it to be used as an educational tool for students from high school to graduate school.

R&D Sponsors

DARPA NRL

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One of four DLITE antennas deployed at Malabar Annex Space Force Base near Palm Bay, Fla. Image credit: Nikolay Zabotin.

The Deployable Low-band Ionosphere and Transient Experiment (DLITE) is a unique combination of technologies and methodologies developed by the U.S. Naval Research Laboratory (NRL) for astrophysics and ionospheric remote sensing. DLITE uses antennas (see image above) specially designed by NRL for astronomical observations of radio-emitting objects in the 20-80 MHz range combined with commercial off-the-shelf parts to form a small telescope array. With only four of these antennas, DLITE is sensitive to a handful of exceptionally bright cosmic radio sources (supernova remnants and radio galaxies). However, this is more than sufficient to probe irregularities within the ionized portion of Earth's upper atmosphere called the ionosphere (~90-1,000 km altitude).

By monitoring apparent changes in intensity and sky position of a handful of bright cosmic radio sources at 35 MHz caused by ionospheric irregularities, a DLITE array can passively specify the irregularity environment. These cosmic emitters are entirely resilient against space weather events that can physically damage satellite-based beacons. They also emit over an extremely wide bandwidth, enabling frequency agility.

A Growing Program

Working with DoD and university partners, NRL has established three DLITE arrays in New Mexico, Maryland, and Florida with a fourth planned in Texas (see map to the right). These support both basic and applied research.

Current/planned locations of DLITE arrays

The relatively low materials cost (currently ~$45k) and simple design make DLITE an excellent platform for student engagement and education in fields such as signal processing and interferometry. Researchers from institutions in multiple countries are pursuing funding for their own arrays, which would expand the nascent DLITE network globally, enabling irregularity monitoring in a wider variety of regions/environments.