Radio Astronomy at Very Low Frequencies

The following scientific areas are among those identified as potentially benefitting from very low frequency radio observations of the universe.[1]

The unexpected unknown. First and foremost: *things we don't know and can't foresee!* Every time we open up a new window on the universe, we find things we didn't expect. This is perhaps the most important potential of the entire effort.

Magnetic fields. Magnetic fields can be hard to detect and measure from afar, but because they are often associated with plasma structures, and because plasma structures radiate at very low frequencies, some new investigations of magnetic fields on various scales may become possible.

Large-scale plasma structures. On planetary, stellar, interstellar, and galactic scales, there are large, coherent plasma structures that can be investigated because they radiate in very low frequencies.

Solar activity. We may obtain a new picture of solar activity, potentially shedding light on the nature of the energetic, explosive events underlying solar flares and coronal mass ejections—processes that are not currently fully understood.

Planetary imaging. Images of the radio activity (including that resulting from lightning) of the outer planets—Jupiter, Saturn, Uranus, and Neptune. Some very limited, low-frequency radio measurements were done by the Voyager spacecraft decades ago, but there is much to learn.

Asteroid and comet detection. Observations at very low frequencies may provide a new way to detect asteroids and comets. As they travel through the interplanetary medium, asteroids and comets excite the solar wind (a plasma), causing it to radiate in these very low frequencies.[2]

Low-energy cosmic rays. Cosmic rays below a certain energy cannot penetrate the Sun's heliosphere, so we currently know nothing about them, but they can radiate in very low frequencies.

Supernovae remnants. Certain parts of supernovae remnants are expected to radiate in the very low frequencies.

Structure of the Milky Way Galaxy. Certain features of the Galaxy's magnetic fields and the interstellar medium can be investigated.

Radio galaxies and other active galaxies. The mysterious phenomena of active galactic nuclei can be illuminated in a completely new way, which may shed some light on one of the most interesting mysteries of galactic astronomy.

1. Unless otherwise noted, these are some scientific potentials summarized in the 1997 ESA report, "Very Low Frequency Array On The Lunar Far Side."

2. Proposed at the 1992 Los Alamos National Laboratory planetary defense conference. See "Space Optical and Low-Frequency Radio Searches for Earth-Crossing Asteroids and Comets" by J. G. Hills in *Proceedings of the Near-Earth Object Interception Workshop*, LANL, Los Alamos, New Mexico, Jan. 14-16, 1992.