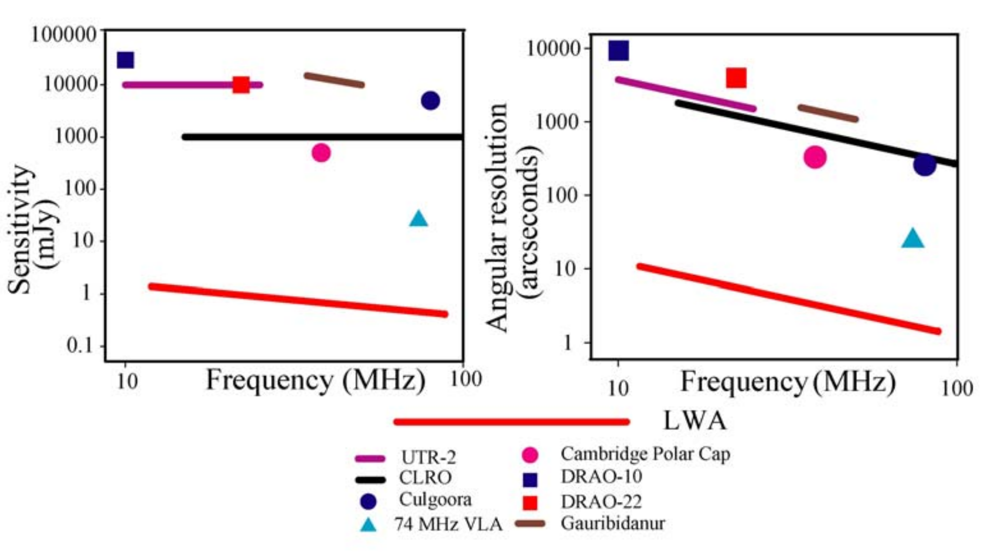
COMPARING THE LWA TO OTHER INSTRUMENTS



INSTITUTIONS OF THE LWA PROJECT

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LWA Long Wavelength Array

Catching Big Waves with Small Blades

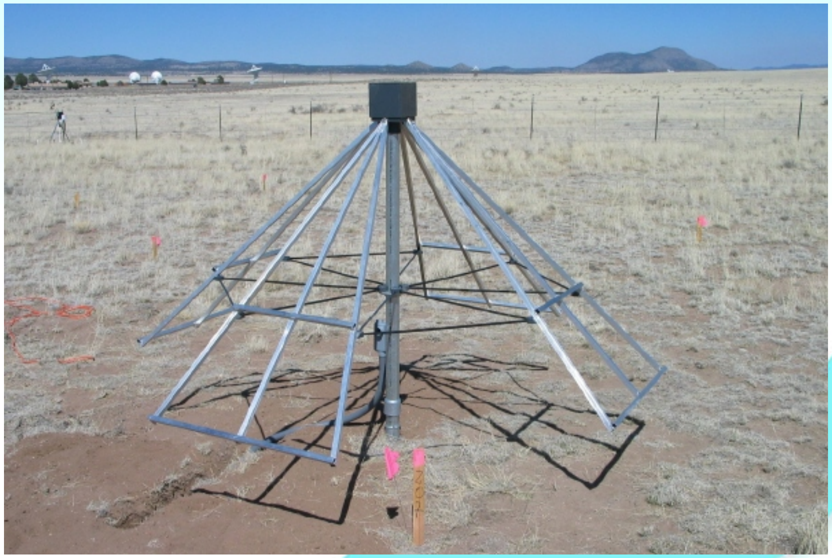
[Revised May 9, 2009]

LWA – The greatest discoveries in Space Physics & Astrophysics have accompanied technological innovations that opened new windows of the electromagnetic spectrum. One of the last poorly explored regions lies between 100 MHz and the ionospheric cutoff at 10 MHz. Ionospheric variations have limited ground-based observations in the past to small (<5 km) apertures with resultant relatively primitive angular resolution and sensitivity. Ever-increasing computing power combined with new wide field-of-view imaging algorithms and self-calibration techniques make it possible to overcome these restrictions. The 74 MHz observing system at the VLA has elegantly demonstrated that connected element interferometry at low frequencies can provide high-precision, synoptic views of the ionosphere and solar weather events, and of a panoply of astrophysical phenomena. The LWA will provide major advances in sensitivity and angular resolution, together with refinements in calibration and new strategies for mitigation of interference at radio frequencies.

The **LWA** will have a very large aperture (400 km) and operate between 10 and 88 MHz. The approximately 50 stations of dipoles will be located in New Mexico.

Spring Break 2009 at U. of New Mexico = Work Week at the LWA for several graduate students from the Department of Civil Engineering. They trenched, installed conduit and pulled electrical cables through it, surveyed, and tested the strength of the *Oz-Post* on which the antenna is mounted.

THE FIRST ANTENNA (one of 256) AT THE SITE OF LWA - 1



The final design for the LWA-1 antennas has been completed and prototyped. The prototypes were built by Burns Industries under the guidance of the Naval Research Laboratory and assembled at the LWA -1 site in April 2009 (see Figure). This design uses considerably less material than the initial blade design, while still meeting the electrical performance requirements. It furthermore meets the necessary criteria for stiffness and ease of installation (recall that there are 256 elements in each station). These antennas mount onto a post (the *Oz-Post*) that can be hammered into the ground in minutes. The black box on top of the antenna houses the front end electronics that match the impedance and amplify the incoming radio waves.

Land acquisition has been approved and construction on the first LWA station (LWA -1) begins in the summer 2009.

Long wavelength astronomy in the southwestern United States offers many collectively unmatched advantages:

- Co-location with a premier radio astronomy facility, the VLA, thus permitting cooperative and complementary radio observations from 10 MHz to 50 GHz,
- Access to the Galactic Center, and access to important northern regions of the sky such as Virgo, Coma, and Andromeda,
- Supporting university institutions interested in re-invigorating university based radio science in the US, and
- Superior existing infrastructure resources, particularly land, access, and fiber-optic cable.

Outstanding science - Superior location – Committed team

LWA KEY SCIENCE DRIVERS

Ionospheric, Solar, & Space Weather Science	High-precision measurements of ionospheric waves & turbulence
	Radioheliography of solar bursts & Coronal Mass Ejections
	Solar radar
Solar & Exosolar Planets	Bursts and nonthermal emission in the Solar system
	Searches of magnetized exosolar planets
Transient Phenomena	Pulsars and magnetars
	Prompt, coherent emission
	High energy cosmic ray air showers
Acceleration, Turbulence, & Propagation in the ISM	Origin, spectrum, & distribution of Galactic cosmic rays
	Scattering & thermal absorption in the ISM
	Supernova remnants & Galactic evolution
Cosmic Evolution	High redshift radio galaxies including the earliest black holes
	Large-scale structure including Dark Matter & Dark Energy
	Epochs of reionization and reheating
	Interstellar matter in nearby galaxies

LWA BASIC SPECIFICATIONS

Frequency Range	10 – 88 MHz (20– 80 MHz optimized)
Effective Collecting Area	10^6 (20 MHz/ν)^{2}m^2
Number of Dipole Elements	~ 10^4
Number of Dipole Stations	~ 50
Baseline Range	0.1– 400 km
Point-Source Sensitivity (2 polarizations, 1 hour, 4 MHz BW)	1.0 mJy @ 20 MHz 0.5 mJy @ 80 MHz
Angular Resolution	15" @ 10 MHz 5" @ 30 MHz 2" @ 80 MHz
Field of View	~2° @ 80 MHz ($\propto \nu$)
Number of Independent FOV (beams)	≥ 4
Maximum Observable Bandwidth	32 MHz
Spectral Resolution	≤ 1 KHz
Image Dynamic Range	$\geq 10^4$
Digitized Bandwidth	Full RF