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# Low frequency astronomy in New Mexico:

## The LWA station one and the EVLA low band upgrade

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**Abstract.** The Long Wavelength Array (LWA) is a new digitally steerable radio telescope which operates in the range of 10 to 88 MHz. The full LWA will consist of 53 phased array "stations" with a maximum baseline of ~400 km. The full system will reach mJy sensitivities and arcsecond resolution. Each station will consist of 256 pairs of active dipole-based antennas. We present details of the commissioning of the first station (LWA-1) which has all 256 dipole antennas in place. We also discuss the upcoming NRAO Expanded Very Large Array (EVLA) broadband low frequency receiver upgrade to expand the EVLA coverage in the range of 50 to 436 MHz. The new EVLA system will initially access the 68 to 86 MHz and 230 to 436 MHz sub-bands by working with the existing 74 and 330 MHz feeds, respectively. The improved bandwidth and system temperature, coupled with the power of the EVLA WIDAR correlator, will significantly enhance the performance in both bands. This new EVLA system also has the potential to expand the power of the initial LWA stations through combining signals within the EVLA correlator.

**Key words.** Instrumentation: interferometers

### 1. Introduction

Low frequency radio astronomy is experiencing a global resurgence due to recent improvements in computing, software and hardware. We present a brief overview of two new low frequency initiatives being undertaken in New Mexico: the Long Wavelength Array Station One under development by the LWA consortium, and the collaboration between the National Radio Astronomy Observatory and the Naval Research Laboratory to upgrade the Low Band system ($\nu$ < 1 GHz) on the Expanded Very Large Array.

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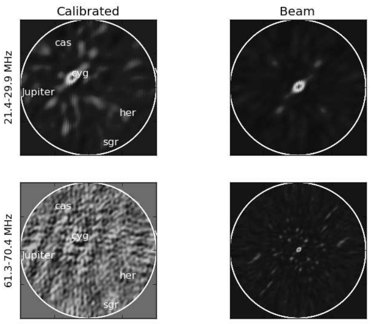


**Fig. 1.** Top and bottom show respectively the low and high frequency LWA-1 all-sky calibrated image (left) and beam pattern (right) taken using the TBW during commissioning.

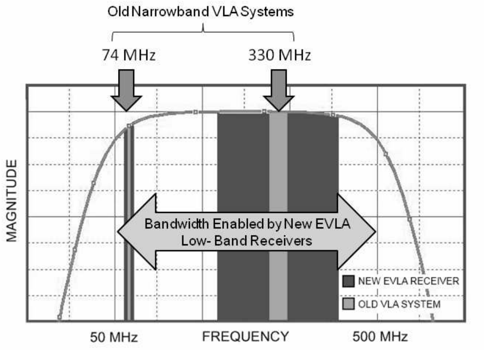


**Fig. 2.** Available bandwidth for new EVLA broadband low frequency receiver. Old VLA bandwidth shown in light grey and new EVLA bandwidth shown in dark grey. Additional channels exist for future broadband feeds and the curve shows the full available bandwidth.

## 2. Long Wavelength Array Station One

The Long Wavelength Array is designed for a range of scientific applications including studies of cosmic evolution, acceleration of relativistic particles, physics of the interstellar and intergalactic medium, solar science, space weather, ionospheric remote sensing, transients and discovery science.

The first station installation (LWA-1) is nearing completion and initial modes of the transient buffer wideband (TBW) and transient buffer narrowband (TBN) have been commissioned. In Fig. 1, we show a 57 msec capture from the TBW of an all-sky image at two narrow frequency bands near the low and high ends of the frequency range. Commissioning of the final digital receiver mode (DRX), which will allow for 4 independent beams, each with two polarizations and two tunings, will be completed in 2011. The first station is expected to be fully operational the same year.

## 3. EVLA low band upgrade

The transition of the NRAO Very Large Array to the digital electronics of the Expanded Very Large Array resulted in the temporary loss of low frequency capabilities. The Naval Research Laboratory and NRAO are collaborating to develop a single new low-noise, broadband receiver for the EVLA that can function with the existing 74 and 330 MHz feeds and replace the previous narrow band receivers.

The new receiver is capable of functioning across the frequency range of 50 to 436 MHz, as shown in Fig. 2. At 74 MHz, the bandwidth will increase from 1.5 MHz to 16 MHz, while at 330 MHz the bandwidth will increase from 40 MHz to 240 MHz. This system includes two expansion channels for future broadband feed development.

Initial deployment in 2011 will be undertaken using the current narrowband feeds. This system should have significant improvement in sensitivity due to the lower receiver noise temperature and somewhat broader bandwidths and will be well suited to a wide range of science, including deep studies of diffuse radio emission in galaxy clusters. The new EVLA low band system is anticipated to be fully operational in 2012.

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