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The new VLA low-band system

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Abstract. We present an overview of the new (50–500 MHz) Low-Band system on the Very Large Array. Initially using the legacy 4- and P-band feeds, this joint development effort of the Naval Research Laboratory and the National Radio Astronomy Observatory provides an order of magnitude improvement in available bandwidth (approx. 55–85 MHz and 230–470 MHz, at 4- and P-band respectively) over the legacy narrow-band receivers. The new P-band system has been made available to the community for observing since the fall of 2013. The new 4-band system is being commissioned.

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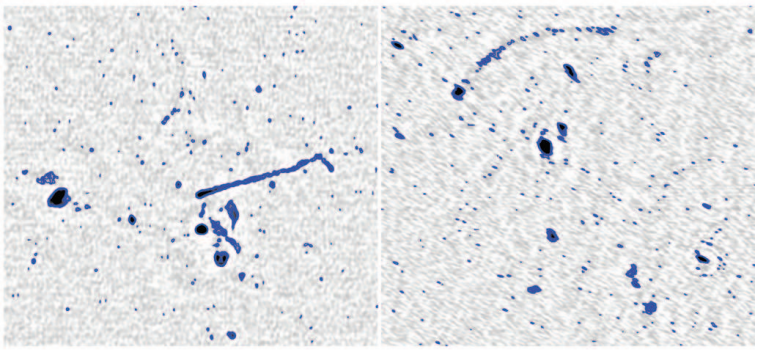
1. Overview

Since the availability of the P-band (330 MHz) system in the late 1980's and the 4-band (74 MHz) system in the 1990's the Karl G. Jansky Very Large Array (VLA) has made a significant impact on meter-wavelength radio astronomy, by providing higher resolution (in A-configuration approx. 25″ and 6″, respectively) and better sensitivity (for $\sim$ 10 hours on target approx. 25 mJy beam^{-1} and 0.5 mJy beam^{-1}, respectively) than was available before. The low-frequency bands offer research interests in astrophysics, ionospheric physics, radio-frequency interference (RFI) mitigation and wide-field imaging.

After several years of absence due to expanded VLA (EVLA) upgrade activities, all 27 (+1) antennas of the VLA have recently been outfitted with new low-noise, low-frequency receivers, enabling continuous frequency coverage from 50 to 500 MHz. The wider bandwidth and lower system temperature, coupled with the power of the WIDAR correlator, promises significantly enhanced performance and flexibility.

The currently available frequency ranges for Low-Band observing, approx. 55–85 MHz and 230–470 MHz, are determined by a combination of the legacy 4- and P-band feed sensitivity, internal hardware bandpass filters, and the actual RFI environment during observing. This readily provides more than an order of magnitude increase in raw bandwidth over the 1.5 MHz and 6–12 MHz of the legacy 4- and P-band systems. For both 4-band and P-band we find that the RFI environment is fairly mild, with typically 60–70 percent of the bandwidth being virtually free of RFI, and 10–20 percent more available after basic RFI flagging.

During P-band commissioning, with 10 outfitted VLA antennas in BnA configuration (Sept. 2012), two well-known merging galaxy clusters were observed for 3 hours each (see figure below: left Abell 2256 and right the *sausage* CIZA J2242.8+5301). Images were made using 40 percent (87.5 MHz) of the available bandwidth, yielding an RMS image noise of 0.5 mJy beam^{-1} in both maps, thereby demonstrating the superior performance compared to the legacy P-band system.



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