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SH21A-01 POSTER

ACTIVE ANTENNAS DESIGNS FOR LOW FREQUENCY RADIO ASTRONOMY

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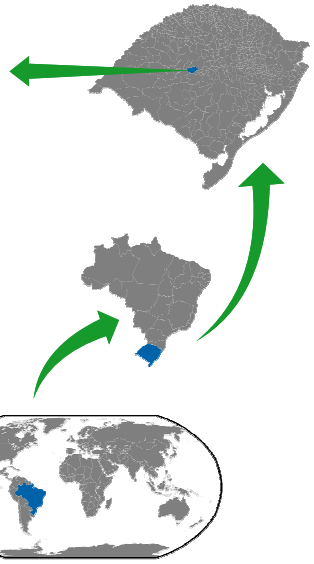
ABSTRACT

An interferometric array similar to the LOFAR Prototype Station – LOPES and to the Eight-meter-wavelength Transient Array – ETA is being developed by using active antennas, more specifically thin inverted-V dipole antenna, which is designed to cover the LOFAR frequency range under 100 MHz. This paper presents the design and evaluation of an active antenna for a prototype interferometric array which is being developed at the site of the Southern Space Observatory – SSO/CRS/CCR/INPE-MCT (29.4° S, 53.8° W, 480 m. a. s.), in São Martinho da Serra (see Figure 1), approximately 54 km distant far from the city of Santa Maria, in Rio Grande do Sul state, South of Brazil. The next generation of large telescopes for radio astronomy at low frequency, below 100 MHz, will consist of thousands of wide-band dipole-like antennas. At this frequency range, the sensitivity of a telescope is limited by the Galactic Noise, for this reason a thin inverted-V dipole was combined with a simple active balun in order to provide the necessary sensitivity and a high useable bandwidth. The results show that an active antenna can present a satisfactory performance, although its VSWR varies greatly with frequency, and are consistent with our recent theoretical analysis, which are similar to LOPES and ETA radio telescopes conclusions. Therefore, this instrumentation is adequate for multi-wavelength solar observations.

Figure 1: Main gate and buildings 1, 2, 3, 5 and 6 at São Martinho da Serra, RS, Brazil.



Geographic Coordination

Latitude: 29° 26' 24" S
Longitude: 53° 48' 38" W
Ellipsoidal Altitude: 480 m

Geomagnetic Coordination

Latitude: 19° 13' 48" S
Longitude: 16° 30' E
Inclination or "dip": 33° S
Total Geomagnetic Field: 22,800 nT

CONCEPT

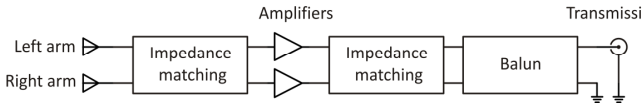


Figure 2: Basic concept for a low frequency radio astronomy active antenna of LOFAR.

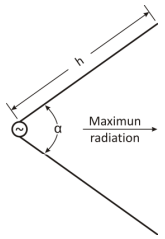


Figure 3: A thin inverted-V dipole antenna.

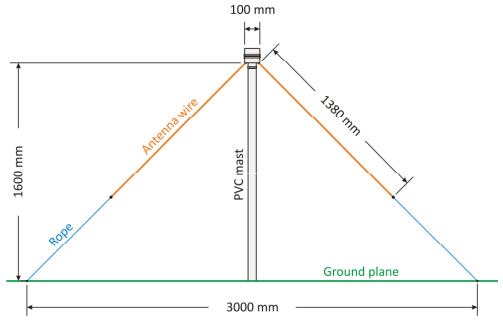


Figure 4: A LOFAR Low Band Antenna (LBA) like, proposed by [1].

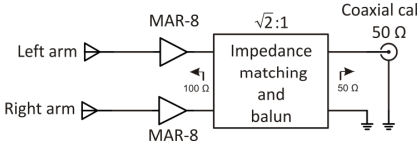


Figure 5: An active antenna concept using two *Mini-Circuits MAR-8* monolithic amplifier. The feedline use a RF coaxial cable RG-58 (50 Ω). A RF transformer determines the impedance matching between the amplifiers output and the feedline. One of transformer coil terminals, on the side of a feedline, is grounded and unbalanced transmission line.

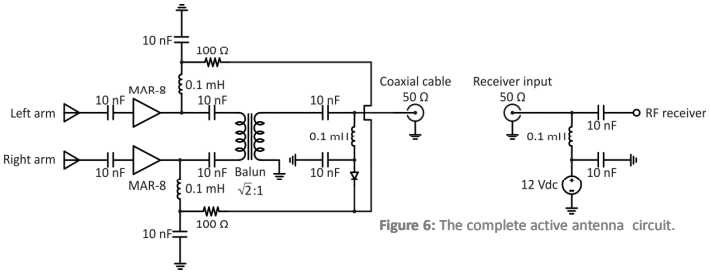


Figure 6: The complete active antenna circuit.

GALACTIC NOISE-LIMITED OPERATION

The primary requirement of the active antenna system is that it delivers to the receiver a signal in which the dominant noise contribution is the unavoidable Galactic noise. It means that the signal at the receiver input (S) must be greater than the instrumental noise of the antenna (contributions of preamplifier N_p and the feedline N_f).

$$\gamma = \frac{S}{N_p + N_f} > 1$$

SIMULATIONS

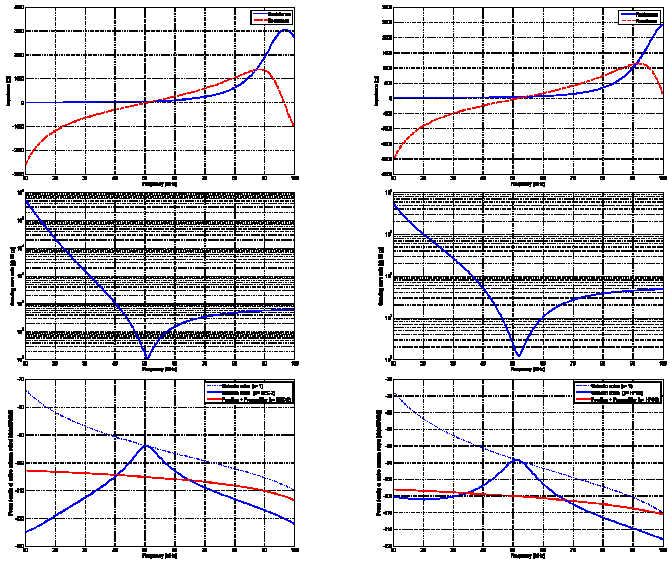


Figure 7: Simulations results using a NEC-2 and HFSS methods. The Galactic noise model proposed by [2] was employed along with the simulations antenna data.

CONCLUSIONS

We conclude that the active antenna designed can operate satisfactorily in the frequency range of 41 – 65 MHz.

REFERENCES

[1] W. A. van Cappellen, M. Ruiter and G. W. Kant, LOFAR-ASTRON-ADD-009, ver. 2.1, 2007.
[2] H. V. Cane, Monthly Notice Royal Astronomical Society, vol. 189, pp. 465 – 478, 1979.

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