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Article *in* Proceedings of the International Astronomical Union · August 2010

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Proceedings IAU Symposium No. 264, 2009
A. G. Kosovichev, A. H. Andrei & J.-P. Rozelot, eds.
© International Astronomical Union 2010
doi:10.1017/S1743921309993188

Brazilian Decimetric Array (BDA) project - Phase II

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Abstract. The configuration of the second phase of the Brazilian Decimetric Array (BDA), installed at Cachoeira Paulista, Brazil (Longitude 45° 0' 20" W and Latitude 22° 41' 19" S), is a T-shaped array where 21 antennas are being added to existing 5 antennas of the first phase. In the third phase, in each arm of the T array, four more antennas will be added and baselines will be increased to 2.5×1.25 km in east-west and south directions, respectively. The antennas will be equally spaced at the distances of 250 meters from the central antenna of the T-array. Also, the frequency range will be increased to 1.2–1.7, 2.8 and 5.6 GHz. The Second phase of the BDA should be operational by the middle of 2010 and will operate in the frequency range of (1.2–1.7) GHz for solar and non solar observations. Here, we present the characteristics of the second phase of the BDA project, details of the array configuration, the u-v coverage, the synthesized beam obtained for the proposed configuration.

Keywords. instrumentation: interferometers; techniques: interferometric, image processing

1. Introduction

The Brazilian Decimetric Array (BDA) is a radio interferometeric array that is being developed by the National Institute for Space Research (INPE, Brazil) as an international collaborative program (Sawant *et al.* 2000). The images of active regions provided by BDA will be analyzed by using spectral tomography technique being developed for application to space weather forecasting (Rosa *et al.* 2000). Also analysis of the flare component will lead to better understanding of the fundamental problems in solar physics (Sawant *et al.* 2002; Sawant *et al.* 2003). BDA also will be useful for galactic and extra-galactic investigations of the southern sky that is not accessible to Very Large Array (VLA) (Napier *et al.* 1983). The BDA site is located at INPE campus in Cachoeira Paulista, SP. This site has a valley with dimensions 400m $\times$ 300m where will be constructed a central compact Tee array and a control room with facilities to have on line data processing. The BDA project is been developed in three phases:

(*a*) **BDA Phase I**: In the first phase of the BDA project an east-west five-element interferometer was developed and installed at INPE using a 4-meter diameter parabolic dish with alt-azimuth mount and complete tracking capability. BDA phase I operates in the frequency range of 1.2–1.7 GHz. The five antennas had been laid out over a distance of 216 meters in the west-east direction getting a spatial resolution about 3 minutes of arc at 1.5 GHz.

(*b*) **BDA Phase II**: in the second phase 21 antennas is being laid out over the distance of 252 meters in the east-west direction and 9 antennas will be laid out over a distance of 166 meters in the southern direction, forming a T-shaped array. The frequency range is being increased to 2.8 and 5.6 GHz.

(*c*) **BDA phase III**: finally, in the third phase, 8 more antennas will be added in the east-west direction and 4 antennas will be added in the south direction. The baselines will be increased in both directions to 2.5 km and 1.25 km, respectively, to increase the spatial resolution of the array up to approximately 4.5 arc seconds at 5.6 GHz.

2. Antennas Configuration for BDA - Phase II

Radio interferometric arrays measure the Fourier transform of the sky brightness distribution (visiblity) on a finite set of points in the Fourier plane. The sky brightness distribution can be reconstructed by the inverse Fourier transform of the sampled visibility. The quality of the reconstructed images strongly depends on the array configuration, since it determines the sampling function of the Fourier plane. Several approaches have been proposed to optimize the response of one radio interferometric array (Cornwell, 1988; Keto, 1997; Kogan, 2000). It is clear that the best array configuration is dependent on the scientific goals intended for the array. However, the optimization of the antenna positioning involves several others aspects, that may be conflicting, such as cost or geographic constraints. The BDA is being designed to obtain optimized images of the radio sources at the decimetric band with high temporal and spatial resolutions. This precludes the use of earth rotation synthesis, requiring snapshot image acquisition. The BDA "T" shape configuration is suitable since it yields a uniform sampling in a retangular region using a regular spacing between antennas. In addition, this shape is good considering site constraints and also implementation and maintenance costs. The proposed BDA array configuration presents a dense array near the intersection of the "T", with a fundamental spacing of 9 meters between adjacent antennas. In each arm of the "T" this spacing is increased to 18 and 36 meters, after the fourth and seventh antennas respectively. The Fig. 1 shows the BDA site and the antennas configuration for BDA - Phase II.

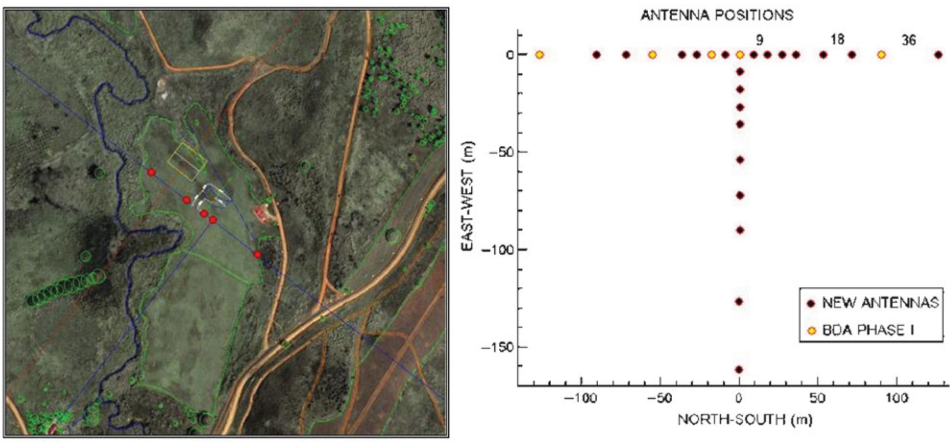

Figure 1. Aerial view of the BDA site (left) and proposed antennas configuration for BDA - Phase II (right). The red circles in the left image correspond to the antennas of BDA Phase I.

3. Configuration Results for BDA Phase II

The results obtained with proposed configuration is presented in Fig. 2, which shows the uv coverage (a), the synthesized beam (b) obtained with the configuration at frequency of 1.4 GHz and the one-dimensional profile of the beam (c) at 2.8 GHz.

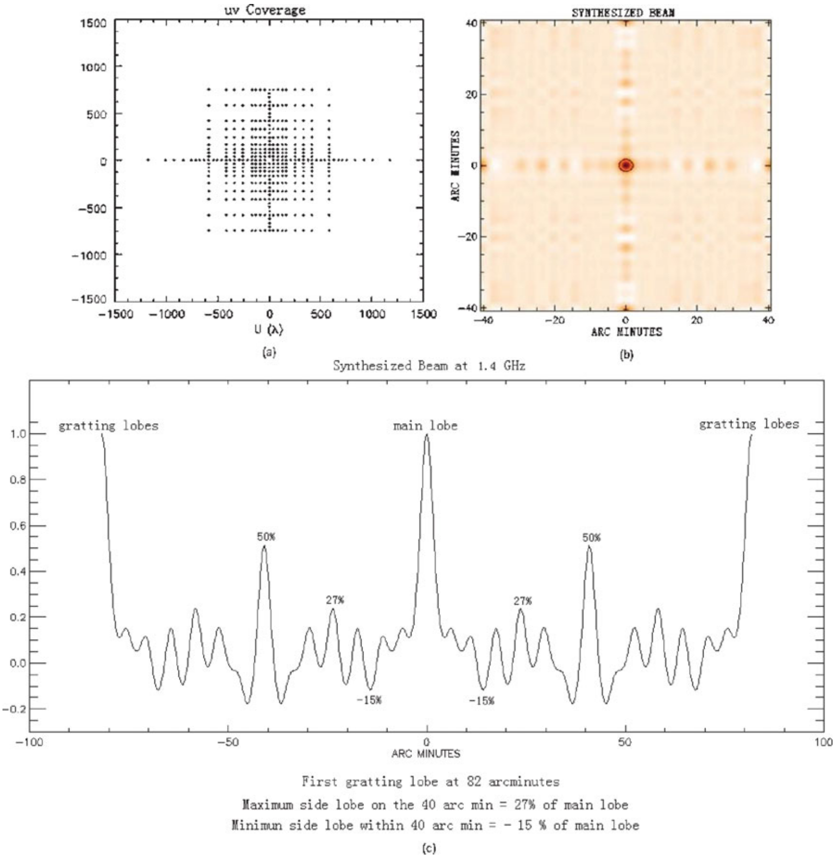

Figure 2. Resulting uv coverage (left) and synthesized beam (right) obtained with the proposed configuration at 1.4 GHz.

4. Final Considerations

This work presented the array configuration of the BDA phase II. The proposed configuration presents a regular spacing between adjacent antennas in the centre of the array. This compact array results in a good uniform uv coverage in the centre of the uv plane. Configuration results show that BDA phase II presents one synthesized beam with side lobes minimized below 20 percent of the main lobe inside of Field of View (FOV). The Central T will have spatial resolution 2x3 of arc minutes, field of view of 3 degrees at 1.4 GHz.

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