Radio-Optical Imaging of ATLBS Survey

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Abstract. We present the radio-optical imaging of ATLBS, a sensitive radio survey (Subrahmanyan *et al.* 2010). The primary aim of the ATLBS survey is to image low-power radio sources which form the bulk of the radio source population to moderately high red-shifts ($z \sim 1.0$). The accompanying multiband optical and near infra-red observations provide information about the hosts and environments of the radio sources. We give here details of the imaging of the radio data and optical data for the ATLBS survey.

Key words. ATLBS—radio survey—optical.

1. Introduction

The Australia Telescope Low Brightness Survey (ATLBS) (Subrahmanyan *et al.* 2010) is a deep radio survey designed to detect diffuse relativistic plasma associated with low luminosity radio galaxies. The radio observations were done using the ATCA, Australia. For details of initial radio observations (see Subrahmanyan *et al.* 2010). Follow up radio observations have filled up the UV coverage between 750 m and 6 km, which was sparsely sampled in the initial observations, using 4 array configurations: 6A, 6B, 6C, 6D. All the observations were combined to get images with beam FWHM 6".

Supporting broadband optical observations were obtained by using the CTIO 4 meter Blanco telescope. These observations give information about the environments of the radio sources up to a red-shift of ~ 1.0 . In addition, spectroscopic observations of host galaxies of a subsample of extended radio sources in the ATLBS survey are also available. The multiband observations will help in examining the radio source sample in the ATLBS survey in a variety of studies including estimation of radio source counts, feedback processes, evolution of optical environments among others.

2. Radio and optical imaging

Radio: The radio observations were carried out at 1.4 GHz in full polarization mode in two adjacent regions in the sky, centered at $00^{\text{h}}35^{\text{m}}00^{\text{s}}$, $-67^{\circ}00'00''$ and $00^{\text{h}}59^{\text{m}}17^{\text{s}}$, $-67^{\circ}00'00''$, with a total area of 8.42 sq. deg.

The radio observations were processed with the MIRIAD software. The sources in the primary beam sidelobes were modeled and removed from the UV data for initial as well as follow up observations. For the sources within the primary beam main lobe, all the UV data (initial as well as follow-up) were combined. The sources were then imaged using iterative application of multi-frequency deconvolution (Sault and Wieringa 1994) and self-calibration (phase and amplitude). The deconvolution was carried out in regions in the presence of sources, identified using images smoothed to lower resolution. The final mosaic images show a nearly uniform r.m.s. noise of $68 \mu\text{Jy}$ and are free of any artefacts above 3σ level. The final images have a beam FWHM of $6''$.

Optical: The ATLBS survey fields were observed in the optical bands of SDSS r' , g' and z' by (Thorat *et al.* 2011). In this work we give details only about the observation in SDSS r' band. Each region was covered with 14 optical images, each of size $37' \times 37'$. Each image is composed of 5 dithers. Apart from the science frames, we have also made observations of flat frames and standard star fields.

The imaging of the optical data was carried out using IRAF software. Each image was corrected for crosstalk, bias and pixel saturation. The world coordinate system of the images was fixed using the USNO A 2.0 astrometric catalog, showing a positional r.m.s. error of $0.3''$ in the images. The dithers were finally stacked to get deep optical images, where we have used the dithers to reject spurious objects in the images. The standard star field observations were used for photometric calibration of the images. The optical catalogs were generated using the Source Extractor software (Bertin & Arnouts 1996).

3. Summary and preliminary results

We have imaged 8.42 square degrees of southern sky producing deep radio and optical images. We have detected approximately 1400 radio sources at a detection threshold of 5σ in our images. Our simulations show that the counts obtained are free of source blending. The accompanying optical images are 90% complete up to 22.75 magnitude. The galaxy counts obtained from the images are comparable to those in literature.

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References

- Bertin, E., Arnouts, S. 1996, *Astron. Astrophys. Suppl.*, **117**, 393.
- Sault, R. J., Wieringa, M. H. 1994, *Astron. Astrophys. Suppl.*, **105**, 585.
- Subrahmanyan, R., Ekers, R. D., Saripalli, L., Sadler, E. M. 2010, *Mon. Not. R. Astron. Soc.*, **402**, 2792.
- Thorat, K., Subrahmanyan, R., Saripalli, L. 2011, in preparation.