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VLBA Calibrator Survey: Astrometric and Image Results

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Abstract. Positions and maps of 1608 new compact sources were obtained in twelve sessions observed during 1994–2002 at the VLBA network at 8.4/2.3 GHz. These sources are recommended for use as calibrators for phase reference imaging and as geodetic sources for astrometric/geodetic VLBI applications.

1. Introduction

The purpose of the VLBA Calibrator Survey (Beasley et al. 2002), (Fomalont et al. 2003) was to extend the list of compact sources with coordinates known at the milliarcseconds level for use as calibrators for mapping and as target sources for geodetic applications. In total, the positions of 1608 new sources were obtained. As a result of processing VCS sessions the total number of sources with precise coordinates increased by a factor of three. The goals of the survey were: a) to increase the surface density of known geodetic-grade calibrators with mas-accurate positions; b) to facilitate routine phase-referencing allowing high-resolution radio imaging of weak target sources; c) to provide a uniform image database at 2.3 and 8.4 GHz for use in scientific applications.

2. Observations

Observations were carried out in twelve 24 hour sessions. Observations used the VLBA dual-frequency geodetic mode observing simultaneously at 2.3 and 8.4 GHz. Signal was recorded at four 8 MHz wide baseband channels over a large

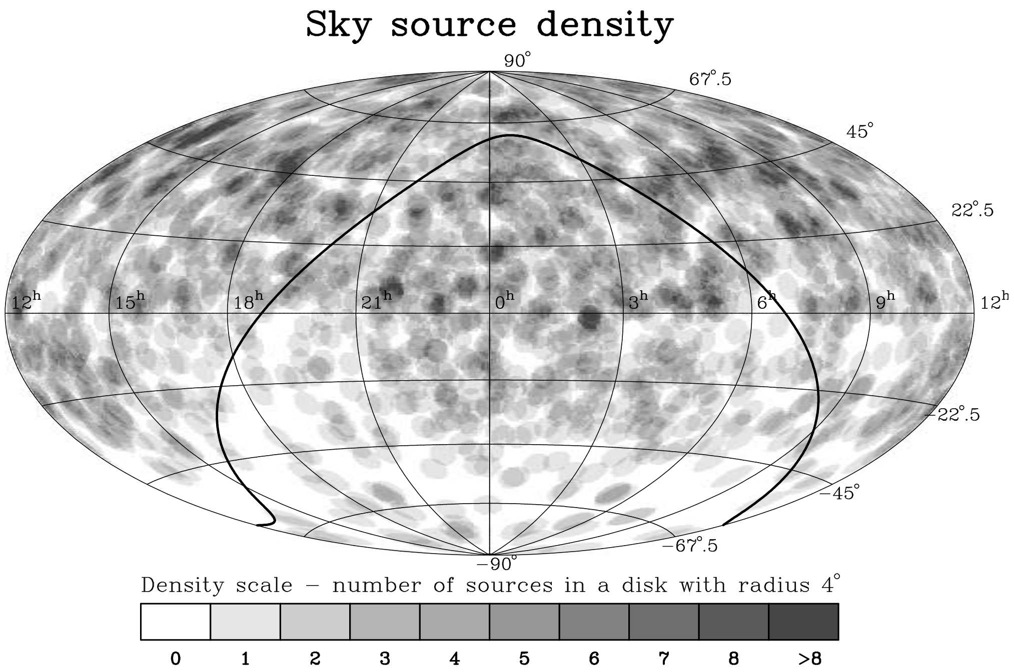

Figure 1. Sky source density. Solid line is the galactic plane.

spanned bandwidth (100 MHz at S-band and 400 MHz at X-band). Each source was observed 2–3 times for 60–90 sec.

3. Astrometric catalogue

Before analysis of the VCS sessions the number of sources observed under geodesy/astrometry programs with positions known better than 1 nrad was 615. After analysis of the VCS campaign this number increased to 2011. Now there is at least one calibrator within 4° of any target direction at 90.1% of the sky at declinations $\delta > -40°$, as shown in figure 1.

Some 15% of sources from the VCS lists were observed previously in astrometric/geodetic programs. Analysis of the differences between the VCS catalogues and Goddard gsf2003c catalogue allowed us to assess the error model. As a result of this analysis the formal uncertainties were inflated in this way:

$$\sigma(\alpha)_r = \sqrt{(1.5\sigma_\alpha)^2 + E(\alpha)^2/cos^2\delta} \qquad \sigma(\delta)_r = \sqrt{(1.5\sigma_\delta)^2 + E(\delta)^2} \quad (1)$$

$E(\alpha)$ and $E(\delta)$ are declination dependent:

Dec Zone (deg)	$E(\alpha)$ (mas)	$E(\delta)$ (mas)
$[+20°, +90°]$	0.3	0.3
$(-30°, +20°]$	0.3	0.6
$(-46°, -30°]$	0.6	1.1

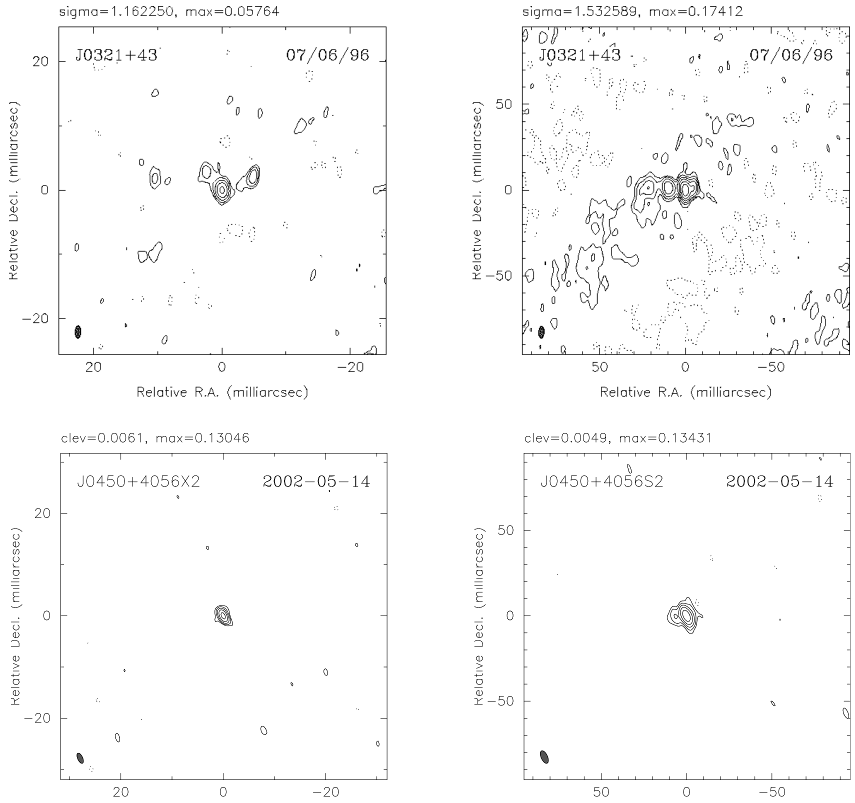

Figure 2. Example of images at X-band (left column) and S-band (right column)

4. Image results

Amplitude and initial phase calibration was done by AIPS software. Sources were imaged by the Caltech DIFMAP package. Some 70% of sources were imaged automatically, the others were imaged manually. The typical image rms is 2–3 mJy, with dynamic range 30:1 or better.

The image database and a source search engine are available on the Web at `http://magnolia.vlba.nrao.edu/vlba_calib` . The astrometric catalogue is in `http://gemini.gsfc.nasa.gov/solutions/astro` .

References

Beasley, A.J., Gordon, D., Peck, A.B., Petrov, L., MacMillan, D.S., Fomalont E.B., Ma, C., 2002, ApJS, 141, 13.

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