

# USNO Analysis Center for Source Structure Report

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## Abstract

This report summarizes the activities of the United States Naval Observatory Analysis Center for Source Structure for calendar year 2007. VLBA RDV experiments RDV61, RDV63, and RDV65 were calibrated and imaged. VLBA high frequency experiment BL122D was calibrated and imaged. Images from these four experiments, together with images from RDV28, were added to the USNO Radio Reference Frame Image Database. A Southern Hemisphere imaging and astrometry program for maintenance of the ICRF continued. Activities planned for the year 2008 include continued imaging of ICRF sources at standard and higher frequencies and continued analysis of source structure and its variation.

## 1. Analysis Center Operation

The Analysis Center for Source Structure is supported and operated by the United States Naval Observatory (USNO). The charter of the Analysis Center is to provide products directly related to the IVS determination of the “definition and maintenance of the celestial reference frame.” These include, primarily, radio frequency images of ICRF sources, intrinsic structure models derived from the radio images, and an assessment of the astrometric quality of the ICRF sources based on their intrinsic structure.

The Web server for the Analysis Center is hosted by the USNO and can be accessed by pointing your browser to

[http://rorf.usno.navy.mil/ivs\\_saac/](http://rorf.usno.navy.mil/ivs_saac/)

The primary service of the Analysis Center is the Radio Reference Frame Image Database (RRFID), a Web accessible database of radio frequency images of ICRF sources. The RRFID contains 4980 Very Long Baseline Array (VLBA) images (a 20% increase over the previous year) of 636 sources (a 23% increase over the previous year) at radio frequencies of 2.3 GHz and 8.4 GHz. Additionally, the RRFID contains 1339 images (a 16% increase over the previous year) of 270 sources (a 1% increase over the previous year) at frequencies of 24 GHz and 43 GHz. The RRFID can be accessed from the Analysis Center Web page or directly at

<http://www.usno.navy.mil/rrfid.shtml>

The RRFID also contains 74 Australian Long Baseline Array (LBA) images of 69 southern hemisphere ICRF sources at a radio frequency of 8.4 GHz.

Shown in Figure 1 is the distribution throughout the sky of the sources which have been imaged at 2.3 GHz and 8.4 GHz.

## 2. Current Activities

### 2.1. VLBA Imaging

VLBA experiment RDV65 (2007AUG01) was calibrated and imaged, adding 203 (102 S-band; 101 X-band) images to the RRFID, including images of 48 sources (0048-427, 0054+161, 0102+511, 0103+127, 0111+131, 0137+012, 0137+467, 0208-512, 0209+168, 0325+395, 0410+110,

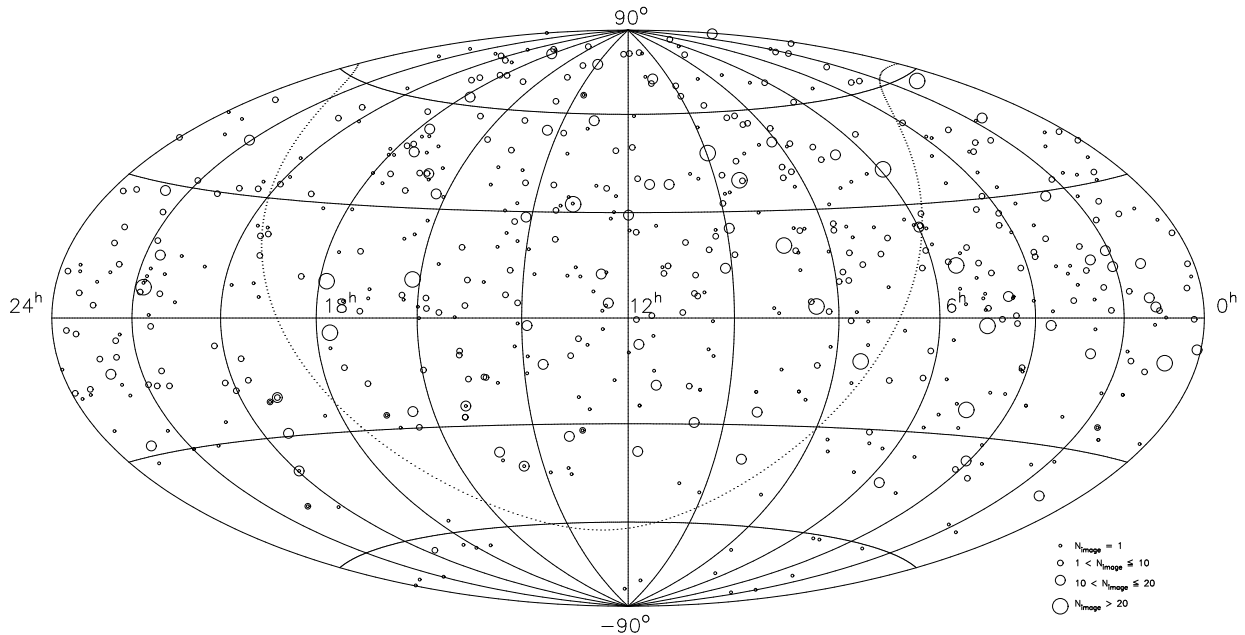


Figure 1. Distribution of the sources which have been imaged at 2.3 GHz and 8.4 GHz shown on an Aitoff equal area projection of the celestial sphere. The size of the open circles indicates roughly the number of times each source has been imaged as indicated by the key.

0411+054, 0423+237, 0537-286, 0645+209, 0723+219, 0906-048, 0927+469, 1003+351, 1010+495, 1046-026, 1055-242, 1100+122, 1107+485, 1117-248, 1143-332, 1200+468, 1241+166, 1246+489, 1412+461, 1421+122, 1541+050, 1623-243, 1627+476, 1639-062, 1645+174, 1645+271, 1648+084, 1745+670, 1746+470, 1820-274, 1822+033, 1908+484, 2013+508, 2018+282, 2135-184, 2304+377 and 2319+317) not previously imaged.

VLBA experiment RDV63 (2007JUN26) was calibrated and imaged, adding 210 (105 S-band; 105 X-band) images to the RRFID, including images of 49 sources (0025+197, 0134+311, 0211+171, 0239+175, 0307+380, 0312+100, 0415+398, 0442+389, 0548+378, 0641+392, 0729+259, 0743+277, 0747+185, 0828-222, 0951+268, 0958+346, 1013+127, 1040+244, 1054+004, 1059+282, 1125+366, 1145+268, 1212+171, 1218+339, 1306+360, 1348+308, 1424+366, 1441+252, 1520+319, 1608+243, 1639+230, 1651+391, 1722+330, 1725+123, 1736+324, 1754+155, 1846+322, 1909+161, 2000+148, 2013+163, 2029+024, 2155+312, 2201+044, 2205+166, 2205+743, 2214+350, 2216+178, 2318-195, and 2358+189) not previously imaged.

VLBA experiment RDV61 (2007JAN24) was calibrated and imaged, adding 217 (109 S-band; 108 X-band) images to the RRFID, including images of 17 sources (0035-024, 0459+252, 0521-365, 0629+160, 0812+020, 1056+212, 1104-445, 1119+183, 1142+052, 1200+045, 1216+061, 1337-033, 1508-055, 1721+343, 1933-400, 2329-384 and OL224) not previously imaged.

VLBA experiment RDV28 (2001MAY09) was calibrated and imaged, adding 186 (93 S-band; 93 X-band) images to the RRFID, including images of 4 sources (0528-250, 0826-373, 1239+376 and NGC6454) not previously imaged. These results were contributed by Glenn Piner and Corey Nichols of Whittier College who calibrated, edited, and imaged the data.

Two 24-hour epochs of full polarization VLBA observations of AGN whose scintillation status

(i.e. whether they exhibit scintillation or not) is known, were calibrated, imaged and model fit. This is part of an ongoing program to study the morphology of scintillating and non-scintillating extragalactic sources and to explore the possibility of using the presence of scintillation to identify good new candidate reference frame sources.

Collaborations continue with Glenn Piner at Whittier College and Patrick Charlot of Bordeaux University to calibrate and image several of the VLBA RDV experiments.

## 2.2. VLBA High Frequency Imaging

VLBA observations to extend the ICRF to 24 and 43 GHz continued in 2007. These observations are part of a joint program between the National Aeronautics and Space Administration, the USNO, the National Radio Astronomy Observatory (NRAO) and Bordeaux Observatory. During the calendar year 2007 one VLBA high frequency experiment, BL122D (2007MAR30), was calibrated and imaged adding 185 (K-band only) images to the RRFID including images of 4 sources not previously imaged.

## 2.3. ICRF Maintenance in the Southern Hemisphere

The USNO and the Australia Telescope National Facility (ATNF) continue a collaborative program of VLBI research on Southern Hemisphere source imaging and astrometry using USNO, ATNF and ATNF-accessible facilities. These observations are aimed specifically toward improvement of the ICRF in the Southern Hemisphere. One celestial reference frame experiment, CRF-S11, was scheduled with antennas at Hobart, Australia, Hartebeesthoek, South Africa and the 70-meter Deep Space Network antenna at Tidbinbilla, Australia.

A program to monitor the structure of quasars south of declination  $-30^\circ$  that are either known to be gamma-ray loud or are expected to be gamma-ray loud was initiated. The program, called TANAMI (Tracking Active galactic Nuclei with Australia Milliarcsecond Interferometry), will observe a sample of about 44 quasars at 8 GHz and 24 GHz bands, with half of the sample observed every two months. The first epoch of observations was scheduled and observed.

## 3. Staff

The staff of the Analysis Center is drawn from individuals who work at the USNO. The staff are: Alan L. Fey, David A. Boboltz, Roopesh Ojha, Ralph A. Gaume and Kerry A. Kingham.

## 4. Future Activities

The Analysis Center currently has a program of active research investigating the effects of intrinsic source structure on astrometric position determination. Results of this program are published in the scientific literature.

The following activities for 2008 are planned:

- Continue imaging and analysis of VLBA 2.3/8.4/24/43 GHz experiments
- Make additional astrometric and imaging observations in the Southern Hemisphere in collaboration with ATNF partners