

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 2005. VLBA high frequency experiments BL115C, BL122A and BL122B were calibrated and imaged. A Southern Hemisphere imaging and astrometry program for maintenance of the ICRF continued. Imaging of an additional 42 southern hemisphere ICRF sources at 8.4 GHz was completed. Activities planned for the year 2006 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/

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 3450 Very Long Baseline Array (VLBA) images of 497 sources at radio frequencies of 2.3 GHz and 8.4 GHz. Additionally, the RRFID contains 976 images of 255 sources 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/>

A recent addition to the RRFID are Australian Long Baseline Array (LBA) images of 69 southern hemisphere ICRF sources at a radio frequency of 8.4 GHz.

2. Current Activities

2.1. RDV Imaging

During calendar year 2005, the USNO did not produce images for any of the VLBA RDV experiments. Collaborations are underway with Glenn Piner at Whitier College and Patrick Charlot of Bordeaux University to calibrate and image several of the RDV experiments.

2.2. VLBA High Frequency Imaging

VLBA observations to extend the ICRF to 24 and 43 GHz continued in 2005. 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 2005, three VLBA high frequency experiments (BL115C, BL122A and BL122B) were calibrated and imaged adding 65 images at 2.3 GHz, 100 images at 8.4 GHz and 193 images at 24 GHz to the Radio Reference Frame Image Database.

2.3. ICRF Maintenance in the Southern Hemisphere

The USNO and the Australia Telescope National Facility (ATNF) are collaborating in a continuing VLBI research program in 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 by a) increasing the reference source density with additional bandwidth-synthesis astrometric VLBI observations, and b) VLBI imaging at 8.4 GHz of ICRF sources south of $\delta = -20^\circ$.

VLBI images for a total of 69 Southern Hemisphere ICRF sources at a frequency of 8.4 GHz using the Australian Long Baseline Array were published by Ojha, et al. (2004, AJ, 127, 3609). Additional images of 48 southern hemisphere extragalactic sources were published by Ojha, et al. (2005, AJ, 130, 2529) bringing the total number of observed sources to 111. These data were used to calculate a “structure index” for the sources; the structure index yields an estimate of their astrometric quality. Approximately 35% of sources in this sample were found to have a structure index indicative of compact or very compact structures. The remaining two-thirds of the sources were found to be less compact and should probably be avoided in astrometric and geodetic VLBI experiments requiring the highest accuracy unless intrinsic source structure can be accounted for in the astrometric/geodetic analysis. Images for an additional ~ 50 sources have been made and are being prepared for publication.

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, 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 2006 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
- Fey et al. (2004, AAS, 205, 9112) developed an algorithm to use images from the RRFID to classify sources in terms of their suitability for astrometric use based on their spatial compactness. Initially applied to the high frequency (24/43 GHz) data, the method will be applied to the study of ICRF sources at the standard frequencies (2.3/8.4 GHz).