Southern Hemisphere VLBI and GLAST

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Abstract:

For sources south of about -40 degrees declination, the Australian Long Baseline Array (LBA) and its affiliates are the only way to obtain high resolution information on milliarcsecond scales. We summarize the current capabilities and constraints of the LBA, with examples from our ongoing survey of the Southern Hemisphere ICRF (International Celestial Reference Frame) objects, in the context of blazar observations in conjunction with GLAST.

Background:

The USNO (United States Naval Observatory) has a VLBI imaging program using the VLBA and associated telescopes (including southern hemisphere telescopes) that has been ongoing for ~15 years. This program has multi-epoch images of a significant number of southern hemisphere radio sources.

In addition, the USNO has teamed up with the ATNF (Australia Telescope National Facility, CSIRO) for a VLBI imaging program using the Australian Long Baseline Array (LBA) and associated telescopes targeting southern hemisphere sources. Here we give examples from both programs, discuss current capabilities and problems, and mention enhancements that are promised in the near future.

Given the distribution of VLBI telescopes worldwide (see Fig 1), the imaging of southern hemisphere sources, particularly those south of about -40 degrees declination must involve the telescopes making up the Australian Long Baseline Array (LBA) and its associates.

Fig1: VLBI Telescopes

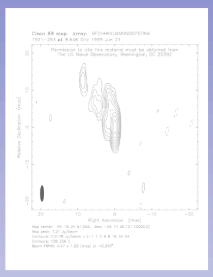

Fig 2: VLBA+ image of 1921-293

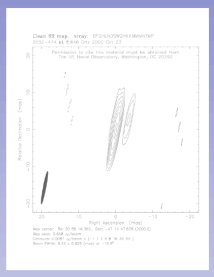

Fig 3: VLBA+ image of 2052-474

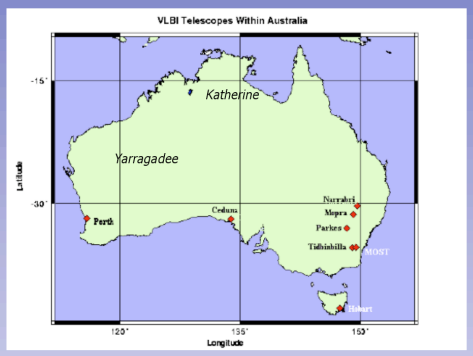

Figure 4: Existing and New VLBI Telescopes

VLBA+:

Use VLBA antennas plus several including Hobart and Tigo

Have ~ 140 southern hemisphere sources at 2.3/8.4GHz band and ~80 at 22/43GHz band. Decent images to -30 declination (e.g. Fig 2)

25 sources south of -30 when image quality quickly deteriorates though can still get some useful images (e.g. Fig 3)

Images, visibility and uv- plots available at http://rorf.usno.navy.mil/rrfid.shtml for images from:

- VLBA+ 2.3/8.4GHz Band
- VLBA 22/43GHz Band
- LBA+ 8.4GHz Band
- Geodetic VLBI

The Australian Long Baseline Array (LBA)+:

Typically used (Fig 4) Parkes (64), ATCA (5x22m), Mopra (22m), Hobart (26m), Ceduna (30m) all in Australia, Hartebeesthoek (26m) , South Africa, Kokee Park (20m), Hawaii and Kashima (34m), Japan (Fig 1)

Observe in back-to-back 24-hour sessions with Australia+Hart and then Australia+Kokee+Kashima. Data calibrated separately and then combined to get the best uv-coverage.

Reasonable images (Fig 7) even with snapshots, typical onsource time of ~75 minutes. Observed in typically 8 scans. Typical angular resolution of 1.5 x 0.7 mas

Biggest constraint is uv-coverage gap between intra-Australian and trans-Oceanic telescopes (Fig 5). E.g. to study 1934-638 (Fig 8, Ojha et al. 2004 AJ 127 1977) we had to throw away trans-Oceanic baselines

LBA++

New telescopes at Yarragadee (Western Australia), Katherine (Northern Territory) and Auckland (New Zealand) to be built in ~2 years (AUSCOPE VLBI Array). Will mitigate uv-coverage problems (Fig 6). But only 12m diameter.

Access to 35m ESA antenna at New Norcia (near Perth, Western Australia) could provide sensitive antenna at prime location

70m DSN antenna at Tidbinbilla (near Canberra) primarily for greater sensitivity.

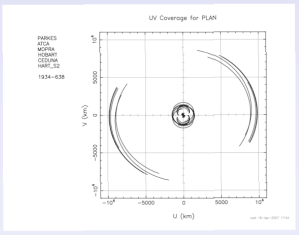

Figure 5: Current VLBI Coverage

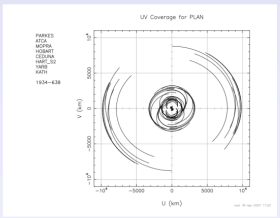

Figure 6: Future VLBI Coverage

Summary:

Current LBA+ facilities allow VLBI imaging. In the interests of the GLAST community to familiarize themselves with it and use it.

Constrained by poor uv-coverage

Expected to improve soon

ATNF/USNO imaging program will have information on many sources of interest to the GLAST community.

This information is publicly available

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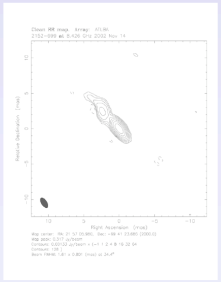

Figure 7: LBA+ image of 2162-699

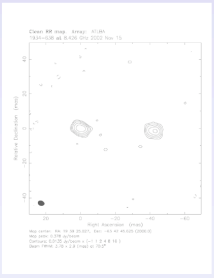

Figure 8: LBA+ image of 1934-638