VLBI progress Down-under

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Outline

- "Down-under" == Southern hemisphere

- VLBI in Australia (LBA)
- **Progress** in the last few years
  - Disks and software correlation
  - e-VLBI
- Status and capabilities

- OPEN network – proposals (15 June & Dec)

Long baseline Array (LBA)

- Telescopes in Australia
  - CSIRO ATNF (ATCA, Mopra, Parkes)
  - U.Tasmania (Hobart, Ceduna)
  - NASA (Tidbinbilla)
  - + NZ ; AuScope; New Norcia (ESA); ASKAP
- International connections
  - + South Africa *(9000 km baselines)*
  - + Telescopes in Asia Pacific: Japan, China, Hawaii, VLBA,…
    - Asia Pacific Telescope (APT)
    - East Asia VLBI Network (EAVN) – see Kobayashi talk.
- Frequency range: 1-22 GHz
  - L: 1.2-1.8 GHz; S: 2.0-2.5 GHz;
  - C: 4.5-6.7 GHz (includes methanol)
  - X: 8.0-9.5 GHz; Q: 16-25 GHz (20-22 GHz circular)
  - (ATCA & Mopra: 30-50 GHz; 85-110 GHz – mm-VLBI??)

LBA Radio Telescopes in Australia

-15°

-30°

Latitude

120°

Longitude

x Katherine

x ASKAP

x Yarragadee

x New Norcia

Perth

Ceduna

Narrabri

Mopra

Parkes

Tidbinbilla

x

Latest developments – recording

- Until 2006 – limited to 128 Mbps
  - S2 VCR tape system
  - CSIRO LBA hardware correlator (7-stations)
  - System decommissioned at end-2006

- New Disk recording system (LBADR)
  - based on EVN-PC developments (Metsahovi)
  - 256/512 Mbps with 16 MHz bands
  - 512/1024 Mbps with 64 MHz bands
  - Recorded on “normal” disks
    - 2 x 500 GB internal disks (tests & urgent response)
    - 4 x 500 GB removable SATA disks (not shipped; fast response)
    - 7 TB Xserve RAID disks (bulk recording & shipping)
  - Remote disk recording over the network
  - Can record in Mk5b format - compatibility

Latest developments – correlation

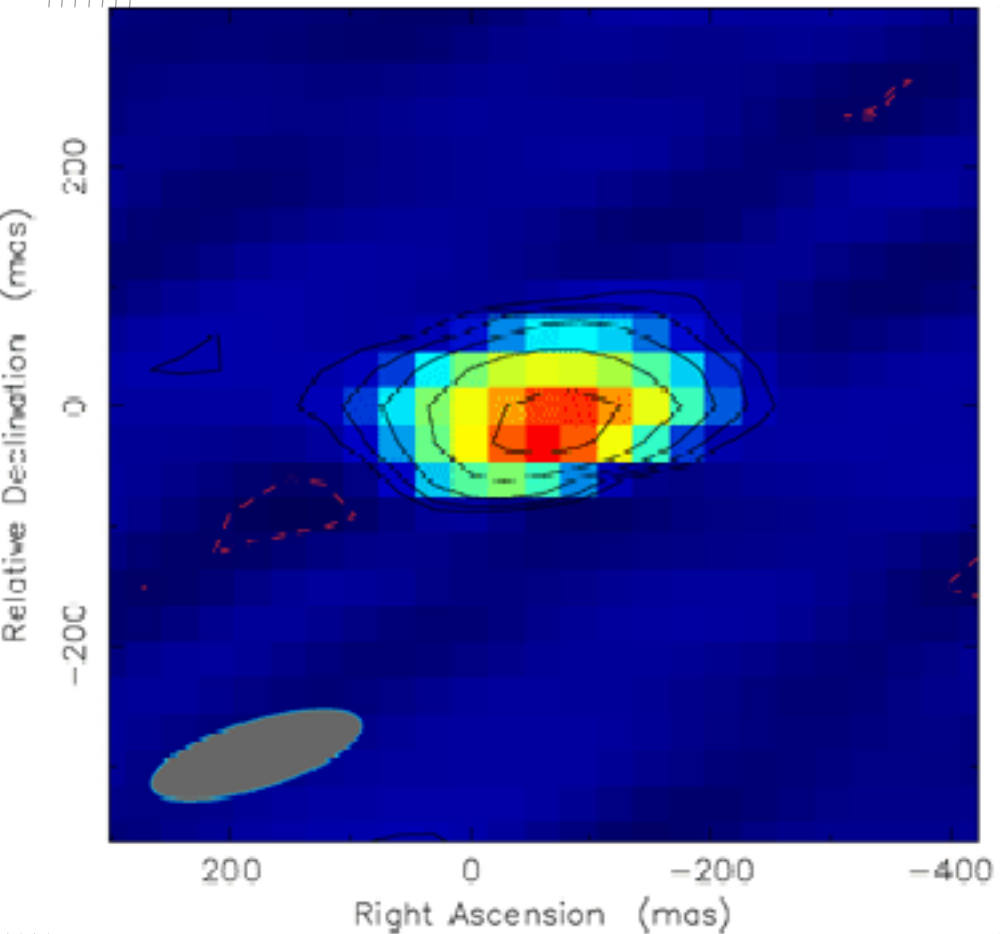
- Software correlation **only** - DiFX
  - Developed at Swinburne by Deller
  - Runs on computer clusters – many correlation centres
    - Swinburne; CSIRO (2); Curtin
  - Very versatile (e.g. many 1000s of spectral channels)
  - Very scalable
  - Can accept many formats: LBA, Mk5, K5…
  - Has also been adopted by VLBA & Bonn
    - International development and support
  - only VLBI correlator in Australia
  - RPFITS output → IDI-FITS (vlba)
- "Real-time" fringe testing → reliability
  - Direct "streaming" inputs → eVLBI capable

Latest developments – e-VLBI

- Direct network connections
  - 2 x 1 Gbps connections/telescope for 3 ATNF antennas
  - 1 Gbps Hobart-University (only 2 x 155 Mbps outside)
- e-VLBI software correlator
  - Pulsar processing clusters (~ 16 nodes) at Parkes
- e-VLBI tests and observations
  - 1st observations in March 2007 @ 256 Mbps (paper!)
  - Demonstrations & EXPReS participation
    - APAN demo in August 2007 (huge publicity)
    - Oct'07: 3 x 512 Mbps into JIVE (lightpaths) – SN1987A image
    - Jun'08: 5 x 512 Mbps into Parkes(3xOz; Shanghai; Kashima)

First e-VLBI images from the LBA

Circinus X-1



SN1987A

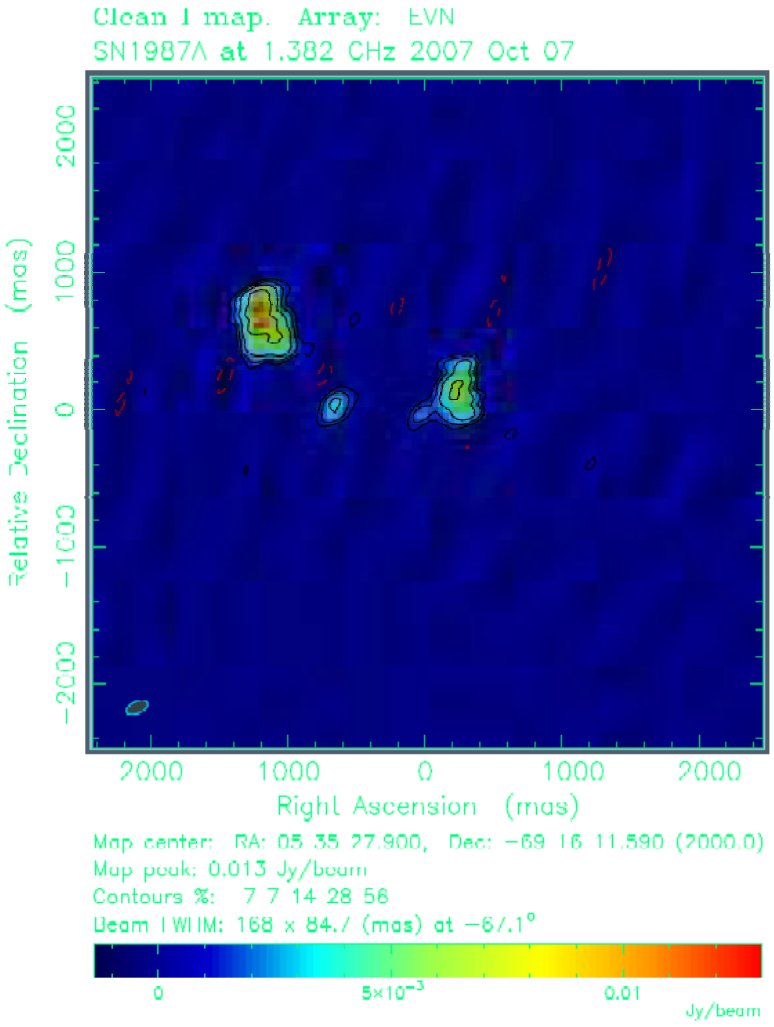


Image created by Paul Boven

Satellite image: Blue Marble Next Generation, courtesy of NASA Visibible Earth

Further LBA developments (1)

- 2nd computer cluster eVLBI correlator (ATCA)
  - 2 x 1024 Mbps achieved; 3 x 1024 Mbps in 2008
- Parallel e-VLBI & recorded observations
  - Fast response (3 ant) & later imaging (5+ ant)
- Recorded VLBI correlation at Curtin
  - Steven Tingay's growing VLBI group
  - Disk shipping → network data transfers
  - Contract to streamline scheduling & calibration
- → Better user support !!

Further LBA developments (2)

- 2008-9 planned developments:
  - Network connectivity to Curtin cluster
    - Data transfers & e-VLBI
  - National and international e-VLBI capabilities and demonstrations (IDEA Internet2 award…)
  - 10 Gbps connections
  - Wideband DAS (based on DPFB)
    - 1-2 GHz bandwidths
    - 10 GE output only (Mk5c?)
  - Broadband antenna receivers (ongoing)
  - Incoporate 12m NZ geodetic antenna (in construction)
- 2010+: Australian SKA Pathfinder (ASKAP)
  - Work with and complenetary to ASKAP (e.g. transients)

Current LBA capabilities and status

- Sensitivity increased by ~ x 3 times
  - LBA sensitivity and uv calculator
  - http://www.atnf.csiro.au/vlbi/calculator/
- Recorded and e-VLBI offered to users
  - Proposals on 15 Dec and 15 June
  - Any new developments offered to users quickly!
- Scheduling: “standard” SCHED & VEX files
- Observing: Automated and often remote
  - Wiki: http://www.atnf.csiro.au/vlbi/wiki/
  - “real-time” fringe testing for every observation → reliability
- Calibration/analysis: “standard” via AIPS/DIFMAP
- “**Niche**” instrument – contact us for any “specials”
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