



LBA Operations

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The Long Baseline Array (LBA)

Operated as a National Facility by ATNF (which is part of CSIRO Astronomy & Space Science), in close cooperation with the University of Tasmania and Auckland University of Technology

Curtin University operated correlator, until recently

Core elements: ATCA (5x22m), Mopra (22m), Parkes (64m), Ceduna (30m), Hobart (26m)

+ Tidbinbilla (70m & 34m), Warkworth (12m & 30m), Hartebeesthoek (26m & 15m), ASKAP (12m), AuScope (3x12m), TIGO (6m), O'Higgins (9m), Shanghai (25m), ...

Typically ~25 days observing each year in 3~4 sessions

The Long Baseline Array (LBA)

Regular observations in 20, 13, 6, 3, 1cm bands

- (Not all telescopes support all bands)
- Also 7mm and 3mm on ATCA, Mopra, Tid

Disk-based recorders (with most data later streamed to the correlator) or/and eVLBI on a subset of the array

LBADR, Mk5, COTS (“Curtin DAS”) systems

Max. bit-rate 1 Gbps

LBA reliability greatly enhanced by real-time fringe checks

Data correlated on DiFX software correlator

- [Deller et al. 2007, PASP, 119, 318 \(DiFX\)](#)
- [Deller et al. 2011, PASP, 123, 275 \(DiFX-2\)](#)

Correlation back “in house” from Oct 2015

Baseline lengths in km

	Pa	At	Mp	Ho	Cd	Hh	Yg	Ke	Ak	Ww	Ti
Pa	0	322	207	1089	1361	9665	3128	2610	3091	2425	274
At	322	0	114	1396	1508	9847	3266	2493	3202	2409	566
Mp	207	114	0	1286	1448	9783	3213	2530	3159	2411	458
Ho	1089	1396	1286	0	1702	9167	3211	3431	3273	2415	832
Cd	1361	1508	1448	1702	0	8944	1792	1937	1756	3718	1455
Hh	9665	9847	9783	9167	8944	0	7848	9504	8019	10480	9589
Yg	3128	3266	3213	3211	1792	7848	0	2360	290	5362	3196
Ke	2610	2493	2530	3431	1937	9504	2360	0	2102	4752	2849
Ak	3091	3202	3159	3273	1756	8019	290	2102	0	5360	3184
Ww	2425	2409	2411	2415	3718	10480	5362	4752	5360	0	2301
Ti	274	566	458	832	1455	9589	3196	2849	3184	2301	0

Locations & SEFDs (in Jy) of LBA elements

		Lat.	Long.	20cm	13cm	6cm	3cm	1.5cm	9mm
ATCA	5x22m	150 E	30 S	40	40	36	39	106	180
ASKAP	1x12m	117 E	26 S	6000	--	--	3500	--	--
Ceduna	30m	134 E	32 S	1500	400	450	600	2500	--
Hobart	26m	147 E	43 S	450	650	650	560	1800	--
Hart	26m	28 E	26 S	200	210	290	340	1320	--
Mopra	22m	149 E	31 S	340	530	350	430	675	900
Parkes	64m	148 E	33 S	40	30	110	43	810	--
Tid	70m	149 E	35 S	23	16	--	25	60	--
Tid	34m	149 E	35 S	--	165	--	90	--	180
Warkworth	12m	175 E	37 S	7000	3500	--	3500	--	--

Recent developments

Fewer receiver changes at Parkes

Routine L-band at Ceduna

Mopra 2013 bushfire recovery

Reliable 32 GHz fringes ATCA/Mopra/Tid-34m

ATCA split array capability: 7mm/3mm obs with KVN

Inclusion of UTAS AuScope antenna, when available

Fringes demonstrated with ASKAP PAF data

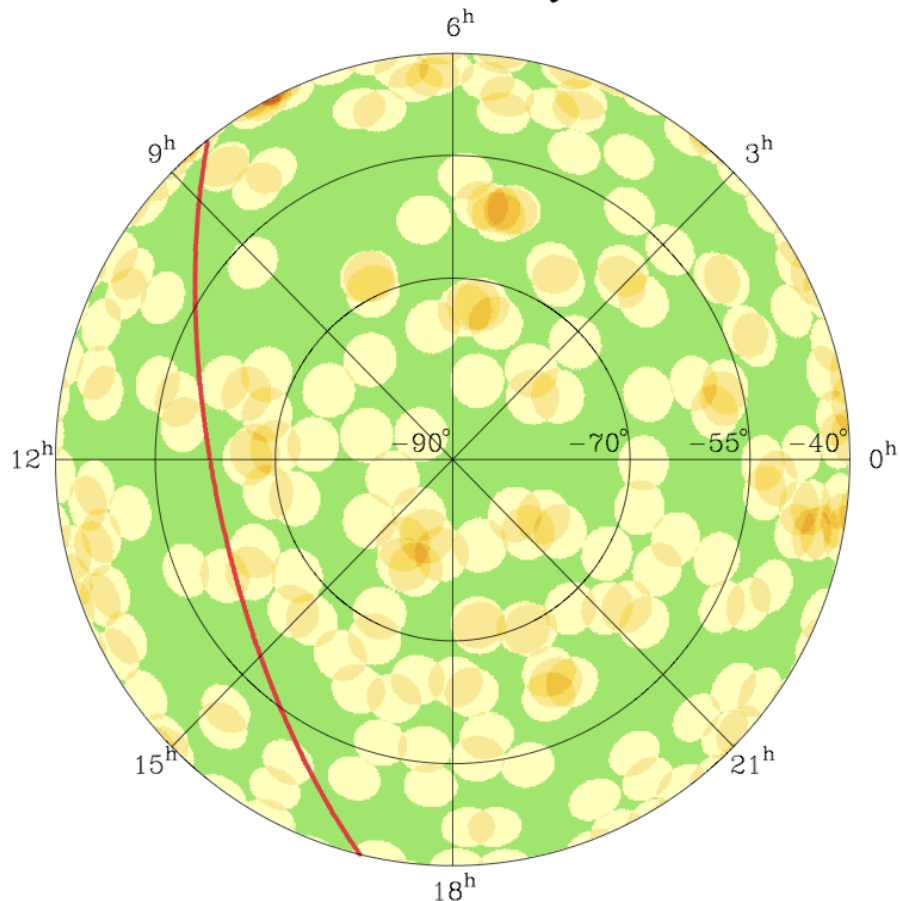
Warkworth 30m first fringes

New Tidbinbilla 34 m antenna commissioned (DSS-35), another under construction (DSS-36)

Cessation of CSIRO funding of Mopra in Oct 2015

LBA Calibrator Survey

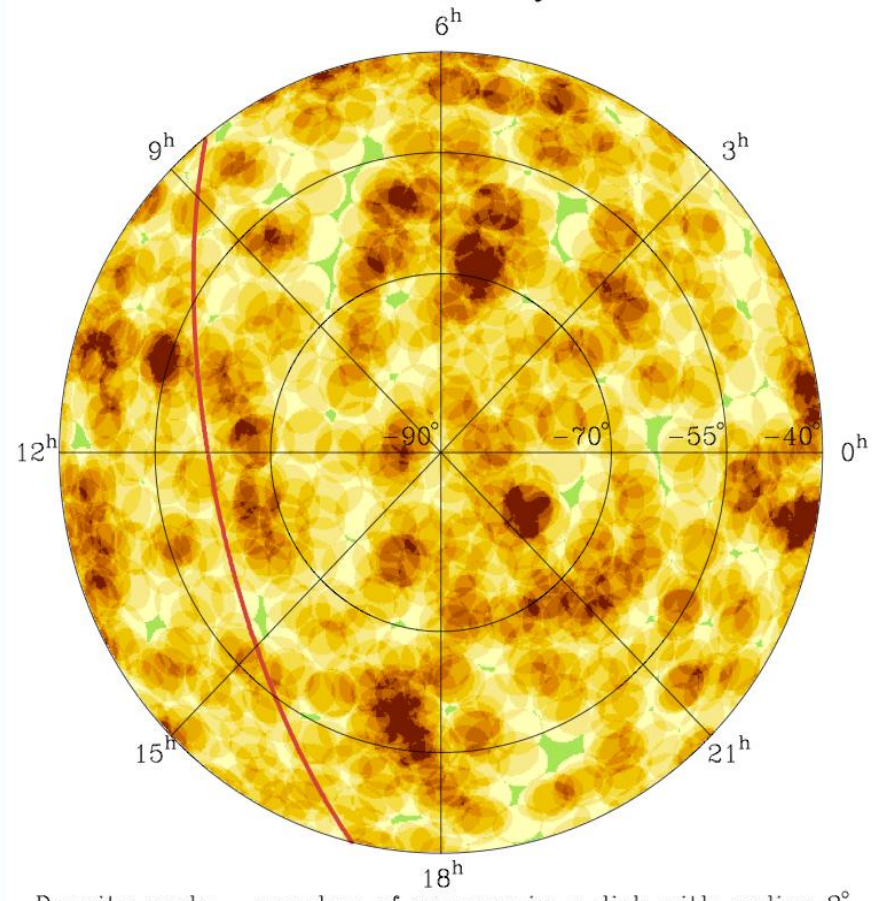
VLBI source density in 2007



Density scale - number of sources in a disk with radius 3°

Petrov et al. 2011 MNRAS, 414, 2528

VLBI source density in 2013



Density scale - number of sources in a disk with radius 3°

<http://astrogeo.org/lcs/>

ATNF Telescope Technical Availability

- ASKAP – Single pixel 1 GHz and 8 GHz room temp receiver on two “unused” telescopes
 - 700-1800 MHz PAFs on all 36 telescopes by 2017
- Mopra: 1.3-3, 4.5-6.7, 9-9.2, 16-27, 30-50, 76-117 GHz
 - Not simultaneously – no S/X capability
 - No Mark5 type backend
 - CSIRO no longer funding operations
 - UNSW funding for one year 7/3mm operations
 - Utas contributed for some money for VLBI operations
- ATCA: 1.1-3.1, 3.9-11, 16-25, 30-50, 83-105 GHz
 - Some split frequency capability with subarrays. 7/3mm used S/X possible
 - No Mark5 type backend
 - No broadband VLBI capability

ATNF Telescope Technical Availability (cont)

- Parkes: Large Receiver fleet
 - 700-764, 2600-3600, 1230-1530 (Multibeam), 1200-1800, 2150-2500, 5900-6800, 8100-8500, 12000-15000, 16000-26000 MHz, S/X
 - Not simultaneously (except S/X and 700/3000 MHz)
 - Building 700-4000 MHz UWB Rx
 - Installing ASKAP PAF for 2016, prospects of permanent PAF
 - Mark4/Mark5b backend available
 - Limited receiver changes
 - UTAS had to pay for last installation of S/X receiver

LBA Monitoring

- All ATNF telescopes are operated remotely
 - Single observers monitors all 4 telescopes
 - Observers are staff, PhD students or astronomers
 - Wide range of observing experience
 - Some only do VLBI observing 1-2 times per year
 - Observing from from VNC sessions
 - Every observatory different observing software!
- Enabled LBA wide web based monitoring of recorders and telescopes

LBA Monitor

- All ATNF telescopes use “MoniCA” software
 - Designed for ATCA – polls and logs 1000’s monitor points every second
 - Available via web interface

<https://github.com/davidbrodrick/open-monica>

- Javascript based monitor page
 - Client polls MoniCA every 2 seconds for MoniCA enabled telescopes
 - Telescopes without MoniCA publish JSON format file with current parameters
 - Shows antenna location, expected location, windspeed etc

http://www.narrabri.atnf.csiro.au/vlbi/lba_monitor.html

Long Baseline Array Monitoring Page

Experiment:	v493b
Time until end:	18h 30m 24s

Show:
 Wark12m
 Wark30m
 ATCA
 Mopra
 Tidbinbilla
 Parkes
 Hobart
 Ceduna
 ASKAP
 Hart15m

UTC: 22:29:35	ATCA	Parkes	Hobart	Ceduna
LMST	12:18:22	12:13:13	12:09:55	11:15:24
R.A. (J2000)	17:18:22.3	17:18:22.31	17:18:22.6	17:18:22.0
Dec. (J2000)	-43:59:35.4	-43:59:35.7	-43:59:32.0	-43:59:28.0
Azimuth	126.113	125.12	119.867	129.687
Elevation	30.558	31.23	35.972	20.882
State	TRACKING	TRACKING	TRACKING	TRACKING
Receiver	20/13cm	GALILEO_B		
Freqs. (MHz)	2285 / 2285			
Tick Phase (µs)	-0.22	0.43		
Wind Speed (km/h)	6.44	3.22	15	23.2
Temperature (°C)	27.8	30.4		
VSIC Cable	Unknown	Unknown		
Recording	Not recording	Not recording	Not recording	Not recording
Experiment	N/A	N/A	N/A	N/A
Rec. Time	N/A	N/A	N/A	N/A
Free Time	N/A	N/A	N/A	N/A
BIGBUF	N/A	N/A	N/A	N/A
PPS Skips	N/A	N/A	N/A	N/A
VEX Check	OK	OK	OK	OK
VEX Expected	1714-439 (No0080)	1714-439 (No0080)	1714-439 (No0080)	1714-439 (No0080)
VEX Scan End	22:33:09	22:33:09	22:33:09	22:33:09
Latest Update (UTC)	2015-11-18 22:29:35	2015-11-18 22:29:35	2015-11-18 22:29:35	2015-11-18 22:29:35



Recorder Monitor

- LBADR recorder controlled by daemon which allows remote monitoring of state
 - Sampler stats, free disk space, various errors etc
- PHP script polls recorders and saves state into SQL database
 - Retains permanently list of recorder experiments and location
- PHP webpages display current state of recorder
- Sounds alarm if various conditions “bad” for a period of time
 - Can enable/disable individual recorders

LBA Recorder Monitor

vlbi is logged in

Logout

Monitor Disk Labels Configuration Recorders Alarms Delete

	pkvsi1	pkvsi2	cavsi1	cavsi2	mpvsi1	mpvsi2	hovsi	cdvsi	tidvsi	cira10
Monitoring On	pkvsi1	pkvsi2	cavsi1	cavsi2	mpvsi1	mpvsi2	hovsi	cdvsi	tidvsi	cira10
Location	Parkes	Parkes	ATCA	ATCA	Mopra	Mopra	Hobart	Ceduna	Tidbinbilla	ASKAP
System Time	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30	2015-11-17 02:32:30
Status	Recording	Not Recording	Recording	Not Recording	Not Recording	Not Recording	Recording	Recording	Not connected	Recording
Logged Time	2015-11-17 02:32:20	2015-11-17 02:32:20	2015-11-17 02:32:20	2015-11-17 02:32:21	2015-11-17 02:32:21	2015-11-17 02:32:21	2015-11-17 02:32:21	2015-11-17 02:32:22		2015-11-17 02:32:22
Recorder Time	2015-11-17 02:32:03	2015-11-17 02:32:13	2015-11-17 02:32:16	2015-11-17 02:32:11	2015-11-17 02:32:13	2015-11-17 02:32:02	2015-11-17 02:32:06	2015-11-17 02:32:02		2015-11-17 02:32:23
Experiment	v541a		v541a				v541a	v541a		v541a
Recorder	<u>pam_store</u>		<u>xcube</u>				<u>Flexbuf</u>	<u>local</u>		<u>local</u>
Output Disk	/data		/data2				/disk1/	/exports/xraid/Ar_1		/mnt/raid_2
Disk Label	N/A		N/A				N/A	ATNF V021		raid_2
Time to End	09:36:57		11:11:44				12:08:29	11:44:37		10:32:00
Time Remaining	2d 23:40:58		10d 12:27:21				9d 13:01:44	13:17:49		20:27:46
Channel Stats	Ok		Ok				Ok	Ok		Ok
Bigbuf	100%		100%				100%	100%		100%
1PPS Signal	Ok		Ok				Ok	Ok		Ok
1PPS Missed	0/100		0/100				0/100	0/100		0/100
Channels	4		4				4	4		2
Bandwidth	16		16				16	16		64
Bits	8		8				8	8		16
Bit Rate	256		256				256	256		512
Compression	xxxx		xxxx				xxxx	xxxx		xxxx

RecMon Ver 2.3.2
Web Development

Alarm Test

Mute

Volume

Next update



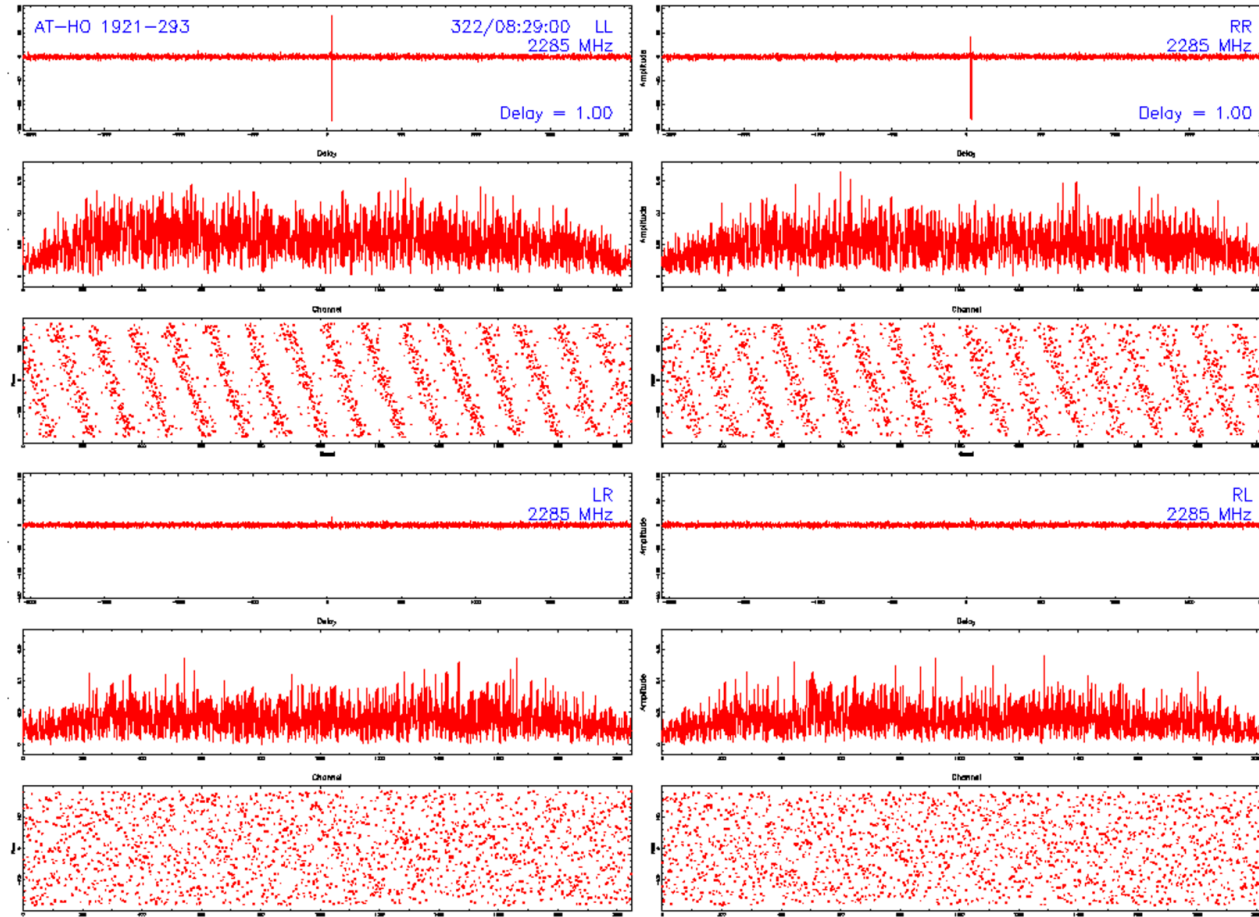
Real Time Fringe Tests

- Interactively test fringes at start of every experiment
 - No requirement for “scheduled” fringe test for LBADR
- Supports LBADR and Mark5
- Suite of Perl processes grab data then automatically correlate using DiFX a small chunk of data (~1 second) and display on web
- Relatively easy to automate

However

- Very slow on long distances (e.g. Hart)
- Sockets connections time out while idle

	At	Cd	Ho	Km	Pa	T6	Ti
At	2269, 2285	2269, 2285	2269, 2285	-	2269, 2285	-	-
Cd		2269, 2285	2269, 2285	-	2269, 2285	-	-
Ho			2269, 2285	-	2269, 2285	-	-
Km				-	-	-	-
Pa					2269, 2285	-	-
T6						-	-
Ti						-	-



Questions for *YOU*

- Is split ATCA S/X of interest? Is someone willing to process a few hours of data taken during a geodetic experiment?
 - 24hr inclusion may be then possible on a test basis
- How can we convince CSIRO importance of Geodetic involvement (e.g. Parkes)?
 - National interest arguments?
- Are there any other options we should consider?

Next proposal deadline December 15 (for obs from Apr 2016)

<http://www.atnf.csiro.au/vlbi/>

Thank you

CASS/ATNF

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