

Starting Out With AIPS Tutorial

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This tutorial session is intended to get people familiar with the basic concepts of radio interferometry. The student will be introduced to interferometry data, visibilities, the (u,v) plane, calibration, and imaging.

Step 1 --- Figure Out What to Observe (Reduce)

I decided to try to make an image of the Sun, as the Solar KSP is a significant part of GLOW. The NRAO image archive has a nice image of the Sun at 1400 MHz located at <http://images.nrao.edu/8>



Image courtesy of NRAO/AUI

Let's try to reduce the data ourselves.

Step 2 --- Download the Data From the Archive

Conveniently, the NRAO image archive gives details about the observations used to make the image, so I downloaded the data from the NRAO data archive, making sure to select the "AIPS friendly" filename option.

This has resulted in two files on my hard drive in my current directory:

```
ls -l
total 54164
-rw-r-- 1 anderson zeall 21002240 2008-11-11 14:40 GD_1
-rw-r-- 1 anderson zeall 34392064 2008-11-11 14:41 GD_2
```

Step 3 --- Start up AIPS

aips

I have chosen to use user ID 100, at semi-random selection.

At first, most of the arcane syntax used to enter commands to AIPS will be difficult. As this is a tutorial session which intends to teach you about radio interferometry, and not how to use AIPS, we will gloss over the technical challenges of interacting with AIPS.

In AIPS you the user interact with something called POPS. You give POPS information by setting variables called ADVERBS to specific values. You can tell POPS which TASK you plan to run by setting a TASK ADVERB. If you want to check the values of ADVERBs for the current TASK, you ask for INPUTS. Because POPS will try to figure out what you mean if you only input the first few letters of an ADVERB or VERB, you can often abbreviate this to just INP. Also note that since AIPS is case-insensitive by default, you could also just type inp. If you want help on a specific topic, ask for HELP. If you want even more explanation for something, say EXPLAIN. If you don't know what it is you are trying to do, but you have some vague notion, say APROPOS SOMETHING. Note that apostrophes, and in certain locations, the lack of an apostrophe are significant.

```
dowait=true  
dohist=1  
docrt=132  
dotv=1
```

Step 4 --- Initial look at data

FILLM

The AIPS task to read raw VLA data into AIPS is called FILLM.

```
task 'fillm'  
datain = 'PWD:GD_  
nfiles=0  
ncount=2  
vlamode='S '  
band 'l'  
doweight=10  
doconcat=true  
douvcomp=0  
cparm(2)=16  
cparm(4)=28  
cparm(8)=10./60  
dparm 0  
bparm 0  
timer 0  
calcode ' '  
clron  
go
```

This sets us up to read the data, sets the VLA mode to Solar, tells AIPS not to change the source if the position appears to be moving (which the Sun does), sets the shadowing limit to 28 meters, and sets

the CL table interval to 10 seconds.

Header information

pcat

```
AIPS 1: Catalog on disk 1
AIPS 1: Cat Usid Mapname      Class  Seq Pt      Last access      Stat
AIPS 1:   1  100 19810926    .L BAND.      1 UV 14-NOV-2008 21:35:31
```

getn 2

imhe

```
AIPS 1: Image=MULTI      (UV)      Filename=19810926    .L BAND.    1
AIPS 1: Telescope=VLA      Receiver=VLA
AIPS 1: Observer=GD      User #= 100
AIPS 1: Observ. date=26-SEP-1981    Map date=14-NOV-2008
AIPS 1: # visibilities    556884    Sort order  TB
AIPS 1: Rand axes: UU-L-SIN  VV-L-SIN  WW-L-SIN  BASELINE  TIME1
AIPS 1:      SOURCE  FREQSEL
AIPS 1: -----
AIPS 1: Type      Pixels  Coord value      at Pixel      Coord incr  Rotat
AIPS 1: COMPLEX      3    1.0000000E+00      1.00    1.0000000E+00    0.00
AIPS 1: STOKES      4   -1.0000000E+00      1.00   -1.0000000E+00    0.00
AIPS 1: FREQ      1    1.4461500E+09      1.00    1.2500000E+07    0.00
AIPS 1: IF      1    1.0000000E+00      1.00    1.0000000E+00    0.00
AIPS 1: RA      1      00 00 00.000      1.00      3600.000    0.00
AIPS 1: DEC      1      00 00 00.000      1.00      3600.000    0.00
AIPS 1: -----
AIPS 1: Coordinate equinox    0.00
AIPS 1: Maximum version number of extension files of type HI is    1
AIPS 1: Maximum version number of extension files of type AN is    1
AIPS 1: Maximum version number of extension files of type NX is    1
AIPS 1: Maximum version number of extension files of type SU is    1
AIPS 1: Maximum version number of extension files of type FQ is    1
AIPS 1: Maximum version number of extension files of type CL is    1
AIPS 1: Maximum version number of extension files of type TY is    1
AIPS 1: Maximum version number of extension files of type WX is    1
AIPS 1: Maximum version number of extension files of type OF is    1
AIPS 1: Keyword = 'CORRMODE' value = '      '
AIPS 1: Keyword = 'VLAI FS ' value = 'AC      '
AIPS 1: Keyword = 'CORRCOEF' value =          -1
```

LISTR --- scan listing

default listr

task 'listr'

indi 1
getn 2
optype 'scan'
docrt=132
go

vlb054 LISTR(31DEC08) 100 14-NOV-2008 21:42:46 Page 1
File = 19810926 .L BAND. 1 Vol = 1 Userid = 100
Freq = 1.446150006 GHz Ncor = 4 No. vis = 556884
Scan summary listing

Scan	Source	Qual	Calcode	Sub	Timerange	FrqID
START VIS	END VIS					
1	1148-001	: 0000	C	1	0/13:53:25 - 0/13:53:25	1
1	351					
2	1148-001	: 0000	C	1	0/13:53:35 - 0/13:54:35	1
352	2808					
3	SUN	: 0000		1	0/13:59:05 - 0/13:59:35	1
2809	4212					
4	SUN	: 0000		1	0/14:05:15 - 0/14:09:35	1
4213	13689					
5	1148-001	: 0000	C	1	0/14:18:05 - 0/14:19:35	1
13690	17199					
6	SUN	: 0000		1	0/14:20:15 - 0/14:24:35	1
17200	26676					
7	SUN	: 0000		1	0/14:30:05 - 0/14:34:35	1
26677	36504					
8	1148-001	: 0000	C	1	0/14:43:05 - 0/14:44:35	1
36505	40014					
9	SUN	: 0000		1	0/14:45:15 - 0/14:49:35	1
40015	49491					
10	SUN	: 0000		1	0/14:55:05 - 0/14:59:25	1
49492	58968					
11	1148-001	: 0000	C	1	0/15:07:55 - 0/15:09:25	1
58969	62478					
12	SUN	: 0000		1	0/15:10:05 - 0/15:14:25	1
62479	71955					
13	SUN	: 0000		1	0/15:19:55 - 0/15:24:25	1
71956	81783					
14	1148-001	: 0000	C	1	0/15:32:55 - 0/15:34:25	1
81784	85293					
15	SUN	: 0000		1	0/15:35:05 - 0/15:39:25	1
85294	94770					
16	SUN	: 0000		1	0/15:44:55 - 0/15:49:25	1
94771	104598					
17	1148-001	: 0000	C	1	0/15:57:55 - 0/15:59:25	1
104599	108108					
18	SUN	: 0000		1	0/16:00:05 - 0/16:04:15	1
108109	117234					
19	SUN	: 0000		1	0/16:09:45 - 0/16:14:15	1

117235	127062						
20 1148-001		: 0000	C	1	0/16:22:45 -	0/16:24:15	1
127063	130572						
21 SUN		: 0000		1	0/16:24:55 -	0/16:29:15	1
130573	140049						
22 SUN		: 0000		1	0/16:34:45 -	0/16:39:15	1
140050	149877						
23 1148-001		: 0000	C	1	0/16:47:45 -	0/16:49:15	1
149878	153387						
24 SUN		: 0000		1	0/16:49:55 -	0/16:54:15	1
153388	162864						
25 SUN		: 0000		1	0/16:59:45 -	0/17:04:05	1
162865	172341						
26 1148-001		: 0000	C	1	0/17:12:35 -	0/17:14:05	1
172342	175851						
27 SUN		: 0000		1	0/17:14:45 -	0/17:19:05	1
175852	185328						
28 SUN		: 0000		1	0/17:24:35 -	0/17:29:05	1
185329	195156						
29 1148-001		: 0000	C	1	0/17:37:35 -	0/17:39:05	1
195157	198666						
30 SUN		: 0000		1	0/17:39:45 -	0/17:44:25	1
198667	208845						
31 SUN		: 0000		1	0/17:50:15 -	0/17:54:05	1
208846	217269						
32 1148-001		: 0000	C	1	0/18:02:25 -	0/18:03:55	1
217270	220779						
33 SUN		: 0000		1	0/18:04:35 -	0/18:08:55	1
220780	230256						
34 SUN		: 0000		1	0/18:14:25 -	0/18:18:55	1
230257	240084						
35 1148-001		: 0000	C	1	0/18:27:25 -	0/18:28:55	1
240085	243594						
36 SUN		: 0000		1	0/18:29:35 -	0/18:33:55	1
243595	253071						
37 SUN		: 0000		1	0/18:39:35 -	0/18:44:05	1
253072	262899						
38 1148-001		: 0000	C	1	0/18:52:35 -	0/18:53:55	1
262900	266058						
39 SUN		: 0000		1	0/18:54:45 -	0/18:59:05	1
266059	275535						
40 SUN		: 0000		1	0/19:04:25 -	0/19:08:45	1
275536	285012						
41 1148-001		: 0000	C	1	0/19:17:25 -	0/19:18:45	1
285013	288171						
42 SUN		: 0000		1	0/19:19:25 -	0/19:23:45	1
288172	297648						
43 SUN		: 0000		1	0/19:29:15 -	0/19:33:45	1
297649	307476						
44 1148-001		: 0000	C	1	0/19:42:15 -	0/19:43:45	1
307477	310986						

45 SUN		: 0000	1	0/19:44:25 -	0/19:53:05	1
310987	329589					
46 SUN		: 0000	1	0/19:54:25 -	0/19:58:45	1
329590	339066					
47 1148-001		: 0000 C	1	0/20:07:05 -	0/20:08:35	1
339067	342576					
48 SUN		: 0000	1	0/20:09:15 -	0/20:13:35	1
342577	352053					
49 SUN		: 0000	1	0/20:19:05 -	0/20:23:35	1
352054	361881					
50 1148-001		: 0000 C	1	0/20:32:05 -	0/20:33:35	1
361882	365391					
51 SUN		: 0000	1	0/20:34:15 -	0/20:38:35	1
365392	374868					
52 SUN		: 0000	1	0/20:44:05 -	0/20:48:35	1
374869	384696					
53 1148-001		: 0000 C	1	0/20:57:05 -	0/20:58:35	1
384697	388206					
54 SUN		: 0000	1	0/20:59:15 -	0/21:03:35	1
388207	397657					
55 SUN		: 0000	1	0/21:08:55 -	0/21:13:25	1
397658	407485					
56 1148-001		: 0000 C	1	0/21:21:55 -	0/21:23:25	1
407486	410969					
57 SUN		: 0000	1	0/21:24:05 -	0/21:28:25	1
410970	420446					
58 SUN		: 0000	1	0/21:33:55 -	0/21:38:25	1
420447	430274					
59 1148-001		: 0000 C	1	0/21:47:05 -	0/21:48:25	1
430275	433433					
60 SUN		: 0000	1	0/21:49:05 -	0/21:53:25	1
433434	442858					
61 SUN		: 0000	1	0/21:58:55 -	0/22:03:25	1
442859	452686					
62 1148-001		: 0000 C	1	0/22:11:45 -	0/22:13:15	1
452687	456196					
63 SUN		: 0000	1	0/22:13:55 -	0/22:18:15	1
456197	465647					
64 SUN		: 0000	1	0/22:23:55 -	0/22:28:15	1
465648	475124					
65 1148-001		: 0000 C	1	0/22:36:55 -	0/22:38:15	1
475125	478283					
66 SUN		: 0000	1	0/22:38:55 -	0/22:43:15	1
478284	487734					
67 SUN		: 0000	1	0/22:48:55 -	0/22:53:25	1
487735	497562					
68 1148-001		: 0000 C	1	0/23:01:55 -	0/23:03:15	1
497563	500721					
69 SUN		: 0000	1	0/23:03:55 -	0/23:08:05	1
500722	509847					

70	SUN	:	0000		1	0/23:13:45	-	0/23:18:05	1
509848	519324								
71	1148-001	:	0000	C	1	0/23:26:45	-	0/23:28:05	1
519325	522249								
72	SUN	:	0000		1	0/23:28:45	-	0/23:33:05	1
522250	531700								
73	SUN	:	0000		1	0/23:38:45	-	0/23:43:05	1
531701	540450								
74	1148-001	:	0000	C	1	0/23:51:45	-	0/23:53:05	1
540451	543350								
75	SUN	:	0000		1	0/23:53:45	-	0/23:58:05	1
543351	552125								
76	SUN	:	0000		1	1/00:01:15	-	1/00:01:15	1
552126	552450								
77	SUN	:	0000		1	1/00:07:25	-	1/00:07:55	1
552451	553725								
78	3C286	:	0000	B	1	1/00:21:35	-	1/00:22:55	1
553726	556884								
Source summary									
Velocity type = ' ' Definition = ' '									
ID	Source	Qual	Calcode	RA(0.0)	Dec(0.0)	IFlux			
QFlux	UFlux	VFlux	No. vis						
1	1148-001	: 0000	C	11:48:10.1300	-00:07:13.300	0.000			
0.000	0.000	0.000	84072						
2	SUN	: 0000		12:10:30.1272	-01:08:22.648	0.000			
0.000	0.000	0.000	469653						
3	3C286	: 0000	B	13:28:49.6570	30:45:58.640	0.000			
0.000	0.000	0.000	3159						
ID	Source	Freq(GHz)	Velocity(Km/s)	Rest freq (GHz)					
1	All Sources	1.4462	0.0000	0.0000					
Frequency Table summary									
FQID	IF#	Freq(GHz)	BW(kHz)	Ch.Sep(kHz)	Sideband				
1	1	1.44615001	12500.0010	12500.0010	1				
AIPS 1: Resumes									

PRTAN

Print the Antenna positions — useful for thinking about calibration.

go prtan

vlb054	PRTAN(31DEC08)	100	14-NOV-2008	21:45:10	Page	1
File=19810926	.L BAND.	1	An.ver= 1	Vol= 1	User=	100
Array= VLA	Freq=	1446.150006 MHz	Ref.date=	26-SEP-1981		

Array reference position in meters (Earth centered)

Array BX= -1601185.36500 BY= -5041977.54700 BZ= 3554875.87000

Polar X = 0.00000 Polar Y = 0.00000 arcsec

Earth rotation rate = 360.9856449713 degrees / IAT day

GST at UT=0 = 364.7139688925 degrees

UT1-UTC= 0.0000000 Data time(IAT)-UTC= 0.0000000 seconds

Solutions not yet determined for a particular FREQID

Ant 1 = VLA:_N2 BX= -30.0602 BY= -4.7835 BZ= 45.7022
Mount=ALAZ Axis offset= 0.0000 meters IFA IFB
Feed polarization type = R L

Ant 2 = VLA:_E5 BX= 51.8719 BY= 195.8466 BZ= -75.1013
Mount=ALAZ Axis offset= 0.0000 meters IFA IFB
Feed polarization type = R L

Ant 3 = VLA:_E9 BX= 139.6430 BY= 536.8956 BZ= -207.7424
Mount=ALAZ Axis offset= -0.0033 meters IFA IFB
Feed polarization type = R L

Ant 4 = VLA:_E6 BX= 70.6548 BY= 267.7575 BZ= -102.8996
Mount=ALAZ Axis offset= 0.0078 meters IFA IFB
Feed polarization type = R L

Ant 5 = VLA:_N3 BX= -52.4373 BY= -8.2629 BZ= 78.6643
Mount=ALAZ Axis offset= 0.0000 meters IFA IFB
Feed polarization type = R L

Ant 6 = VLA:_W2 BX= 14.7735 BY= -37.1404 BZ= -20.2135
Mount=ALAZ Axis offset= 0.0000 meters IFA IFB
Feed polarization type = R L

Ant 7 = VLA:_W3 BX= 28.9195 BY= -74.4876 BZ= -41.0524
Mount=ALAZ Axis offset= -0.0036 meters IFA IFB
Feed polarization type = R L

Ant 8 = VLA:_W1 BX= 22.9920 BY= 3.4974 BZ= -32.4864
Mount=ALAZ Axis offset= 0.0084 meters IFA IFB
Feed polarization type = R L

Ant 9 = VLA:_E2 BX= 11.3328 BY= 40.6638 BZ= -15.1624
Mount=ALAZ Axis offset= 0.0000 meters IFA IFB
Feed polarization type = R L

Ant 10 = VLA:_OUT BX= 0.0000 BY= 0.0000 BZ= 0.0000
Mount=ALAZ Axis offset= 0.0000 meters IFA IFB
Feed polarization type = R L

Ant 11 = VLA:_E8 BX= 114.4257 BY= 438.6941 BZ= -169.4880
Mount=ALAZ Axis offset= 0.0048 meters IFA IFB

Feed polarization type =	R	L
Ant 12 = VLA:_E3 BX= 21.9945 BY= 81.5250 BZ= -30.9498		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 13 = VLA:_E7 BX= 91.5227 BY= 348.8871 BZ= -134.4449		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 14 = VLA:_W7 BX= 121.6261 BY= -319.1264 BZ= -177.5842		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 15 = VLA:_W9 BX= 186.8061 BY= -491.1158 BZ= -273.5624		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 16 = VLA:_E4 BX= 35.6150 BY= 133.6310 BZ= -51.1099		
Mount=ALAZ Axis offset= -0.0051 meters	IFA	IFB
Feed polarization type =	R	L
Ant 17 = VLA:_W8 BX= 152.7524 BY= -401.2839 BZ= -223.4146		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 18 = VLA:_E1 BX= 45.3386 BY= 7.0026 BZ= -65.4888		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 19 = VLA:_N7 BX= -193.6105 BY= -30.2503 BZ= 286.4580		
Mount=ALAZ Axis offset= -0.0030 meters	IFA	IFB
Feed polarization type =	R	L
Ant 20 = VLA:_N1 BX= 0.6703 BY= 0.0144 BZ= 0.5135		
Mount=ALAZ Axis offset= 0.0045 meters	IFA	IFB
Feed polarization type =	R	L
Ant 21 = VLA:_N8 BX= -243.6039 BY= -38.0389 BZ= 360.0340		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 22 = VLA:_W5 BX= 68.6012 BY= -179.2282 BZ= -99.5242		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 23 = VLA:_N5 BX= -108.4301 BY= -16.9862 BZ= 161.0152		
Mount=ALAZ Axis offset= 0.0000 meters	IFA	IFB
Feed polarization type =	R	L
Ant 24 = VLA:_N9 BX= -298.3837 BY= -46.5620 BZ= 440.6260		

Mount=ALAZ	Axis offset=	0.0000 meters	IFA	IFB
Feed polarization type =			R	L
Ant 25 = VLA:_N6	BX=	-148.4545	BY=	-23.2162 BZ=
Mount=ALAZ	Axis offset=	0.0000 meters	IFA	IFB
Feed polarization type =			R	L
Ant 26 = VLA:_N4	BX=	-74.8318	BY=	-11.7331 BZ=
Mount=ALAZ	Axis offset=	0.0000 meters	IFA	IFB
Feed polarization type =			R	L
Ant 27 = VLA:_W6	BX=	93.5170	BY=	-245.0012 BZ=
Mount=ALAZ	Axis offset=	0.0000 meters	IFA	IFB
Feed polarization type =			R	L
Ant 28 = VLA:_W4	BX=	46.9220	BY=	-122.0267 BZ=
Mount=ALAZ	Axis offset=	0.0000 meters	IFA	IFB
Feed polarization type =			R	L
Ant 29 = VPT:_OUT	BX=	0.0000	BY=	0.0000 BZ=
Mount=ALAZ	Axis offset=	0.0000 meters	IFA	IFB
Feed polarization type =			R	L

Location Of VLA Antennas

```

          N9 (24)
          N8 (21)
          N7 (19)
          N6 (25)
          N5 (23)
          N4 (26)
          N3 ( 5)
          N2 ( 1)
          N1 (20)
      ( 8) W1    E1 (18)
    ( 6) W2      E2 ( 9)
  ( 7) W3        E3 (12)
(28) W4          E4 (16)
(22) W5          E5 ( 2)
(27) W6          E6 ( 4)
(14) W7          E7 (13)
(17) W8          E8 (11)
(15) W9          E9 ( 3)

VLA:_OUT (10)
VPT:_OUT (29)

```

AIPS 1: Resumes

The really important part for you, the data reducer, is the antenna layout at the bottom. This tells you in a nice graphical form where each antenna is located. This helps you to figure out which baselines are small, and which baselines are long. This is also useful for figuring out other things related to

antenna position and baseline direction.

```

vlb054    LISTR(31DEC08)    100    14-NOV-2008  22:05:45    Page    1
File = 19810926    .L BAND.    1 Vol = 1  Userid = 100    Channels = 1-    1
IF = 1
Freq= 1.446150006 GHz    Ncor= 1    No. vis=    3159
Stokes = RR    Subarray = 1

Source=3C286          : 0000, Stokes=RR , IF= 1, Chans= 1-    1
Flux = 0.0000 Jy, Calcode = B , Freq = 1.446150006 GHz
Amplitudes, 1000 = 1.000 Jy, averging type = Vector

Baselines    1 3 2 3 3 4 3 5 3 6 3 7 3 8 3 9 310 311 312 313 314 315 316
317 318 319 320 321 322 323 324 325 326 327 328 329
1/00:21:35 293 259 258 282 45 360 431 333    563 326 247 264 256 469
287 127 283 84 56 455 12 344 307 313 321 347
Amplitudes, 1000 = 10.000 Jy, averging type = Vector
1/00:21:45 195 180 182 168 15 212 234 203    247 135 160 177 169 187
174 156 178 129 66 205 1 185 186 189 158 158
1/00:21:55 206 196 194 176 67 223 246 214    252 139 169 192 183 193
183 185 190 188 205 214 1 192 199 199 165 168
1/00:22:05 209 197 197 179 165 223 246 217    251 144 172 193 185 194
186 186 193 190 235 216 1 193 201 202 167 169
1/00:22:15 205 194 196 178 198 223 244 214    246 140 170 189 182 193
183 186 190 190 235 212 0 193 198 199 164 169
1/00:22:25 206 192 197 177 196 222 243 214    242 139 165 189 180 193
183 184 190 186 231 212 1 191 197 199 164 168
1/00:22:35 207 195 196 178 198 223 246 215    240 140 166 192 182 192
184 185 190 190 233 214 0 192 199 199 165 168
1/00:22:45 206 192 192 177 199 222 243 213    232 141 168 191 183 190
183 185 191 187 233 214 1 191 197 198 164 169
1/00:22:55 206 193 195 179 199 223 243 213    230 140 170 190 182 193
183 185 190 186 233 215 1 191 197 199 164 169
AIPS 1: Resumes

```

```

vlb054    LISTR(31DEC08)    100    14-NOV-2008  22:35:27    Page    1
File = 19810926    .L BAND.    1 Vol = 1  Userid = 100    Channels = 1-    1
IF = 1
Freq= 1.446150006 GHz    Ncor= 1    No. vis=    84072
Stokes = RR    Subarray = 1
Applying flag table 1

Source=1148-001      : 0000, Stokes=RR , IF= 1, Chans= 1-    1
Flux = 0.0000 Jy, Calcode = C , Freq = 1.446150006 GHz
Amplitudes, 1000 = 10.000 Jy, averging type = Vector

Baselines    1 3 2 3 3 4 3 5 3 6 3 7 3 8 3 9 310 311 312 313 314 315 316
317 318 319 320 321 322 323 324 325 326 327 328 329
0/13:53:55 57 126 58 53    86 123 73    195 32 57 13 23 66

```

30	36	27	75	30	89		24	20	28	45	103						
	0/13:54:05			67	134	66	24		65	155	47	213	26	66	28	28	92
30	53	35	60	26	63		28	33	55	77	103						
	0/13:54:15			43	124	77	29	43	26	144	44	184	36	77	40	29	96
19	39	29	34	31	34		26	34	76	62	134						
	0/13:54:25			6	104	91	62	40	68	96	73	177	59	93	30	30	87
35	4	26	41	45	78		32	31	74	14	139						
	0/13:54:35			28	84	94	70	21	93	69	80	191	56	104	19	31	61
34	50	31	68	42	94		31	24	41	46	99						

```
Source=1148-001      : 0000, Stokes=RR  , IF=  1, Chans=  1-  1
Flux =  0.0000 Jy, Calcode = C    , Freq =  1.446150006 GHz
Amplitudes, 1000 =  10.000 Jy, averging type = Vector
```

[illegible]

```
Source=1148-001      : 0000, Stokes=RR  , IF=  1, Chans=  1-  1
Flux =  0.0000 Jy, Calcode = C    , Freq =  1.446150006 GHz
Amplitudes, 1000 =  10.000 Jy, averging type = Vector
```

Baselines	1	3	2	3	3	4	3	5	3	6	3	7	3	8	3	9	310	311	312	313	314	315	316
317	318	319	320	321	322	323	324	325	326	327	328	329											
	0/14:43:25			32	32	95	40			47	27	55					237	14	83	30	33	58	
31	33	38	40	20	35		34	35	13	28	35												
	0/14:43:35			34	56	91	30			44	48	60					173	29	80	34	33	46	
32	29	36	38	35	37		34	33	38	29	37												
	0/14:43:45			27	59	103	14	27	21	51	54						130	51	66	25	25	72	
24	23	22	14	27	26		21	23	48	23	26												
	0/14:43:55			22	49	112	29	24	18	35	23						182	49	43	19	26	95	
23	30	20	9	30	28		27	22	32	20	21												
	0/14:44:05			39	59	141	41	28	42	36	2						163	35	32	32	33	112	
31	32	37	35	41	35		34	35	29	30	30												
	0/14:44:15			36	49	157	37	23	50	28	29						179	16	17	31	32	98	

```

32  31  38  44  36  34      29  33  18  28  35
    0/14:44:25  27  28 159  25  22  37  38  54      200  17  17  30  29  71
28  26  27  38  33  31      27  28  36  28  31
    0/14:44:35  28   1 150  20  31  23  47  60      242  39  22  29  30  42
28  29  27  22  39  34      30  29  51  28  27

```

```

Source=1148-001      : 0000, Stokes=RR , IF=  1, Chans=  1-  1
Flux =  0.0000 Jy, Calcode = C   , Freq =  1.446150006 GHz
Amplitudes, 1000 =  10.000 Jy, averging type = Vector

```

```

Baselines      1 3 2 3 3 4 3 5 3 6 3 7 3 8 3 9 310 311 312 313 314 315 316
317 318 319 320 321 322 323 324 325 326 327 328 329
    0/15:08:15   17  35  52  25      33  42  35      148  14  29  28  29  49
29  31  30  27  15  38      29  32  35  25  33
    0/15:08:25   29  38  64  22      27  33  32      146  14  38  27  25  52
25  31  33  18  29  30      27  22  23  22  35
    0/15:08:35   33  25  70  27  23  25  27  25      135  25  35  21  25  49
21  29  26  17  30  25      24  19  18  18  29
    0/15:08:45   50  35  91  34  35  42  44  43      185  32  52  37  34  49
34  34  30  38  45  40      36  39  43  33  33
    0/15:08:55   30  28  84  30  32  37  43  34      188  26  53  32  33  26
32  26  29  42  37  40      32  36  41  27  26
    0/15:09:05   21  27  72  28  31  37  46  35      185  26  56  31  32   9
31  27  37  36  37  39      32  30  35  29  35

```

```

vlb054    LISTR(31DEC08)    100    14-NOV-2008  22:36:24    Page    1
File = 19810926    .L BAND.    1 Vol = 1  Userid =  100  Channels =  1-  1
IF = 1
Freq=  1.446150006 GHz  Ncor=  1  No. vis=      84072
Stokes = RR  Subarray =  1
Applying flag table  1

```

```

Source=1148-001      : 0000, Stokes=RR , IF=  1, Chans=  1-  1
Flux =  0.0000 Jy, Calcode = C   , Freq =  1.446150006 GHz
Phase, 1000 = 1000.00 degrees, averging type = Vector

```

```

Baselines      1 3 2 3 3 4 3 5 3 6 3 7 3 8 3 9 310 311 312 313 314 315 316
317 318 319 320 321 322 323 324 325 326 327 328 329
    0/13:53:55 -154 176 177-145      82  59 -83      -35-118 -77 101  41   3
59  63 114  69 -97  80      76  88 -57  67 121
    0/13:54:05  163 138-130 -83      141 119 -21      -20 -30 -50  52  43  52
78  97 122 122-106 147      78  88  46 166-137
    0/13:54:15  127 100 -91  65-134-101 172  78      -173  44 -26  79  44  90
51 137 129-158-129 -79      72 102  95-124 -55
    0/13:54:25  118  61 -61 125 -91  13-128 145      172 105  -3  99  45 126
51-125 122 -51-119  21      73 111 140   2  12
    0/13:54:35 -125   9 -32 168 -49  68 -31-164      161 144  17  64  39 167
75  31 115  12-106  79      77  97-174 142  90

```

```

Source=1148-001      : 0000, Stokes=RR , IF=  1, Chans=  1-  1

```

Flux = 0.0000 Jy, Calcode = C , Freq = 1.446150006 GHz
Phase, 1000 = 1000.00 degrees, averging type = Vector

Baselines	1	3	2	3	3	4	3	5	3	6	3	7	3	8	3	9	310	311	312	313	314	315	316
317	318	319	320	321	322	323	324	325	326	327	328	329											
0/14:18:25	135	174	69	167				66	121	-173							51	109	26	75	39	58	
61	136	118	27	-117	30		73	88	140	-157	-8												
0/14:18:35	-72	153	124	160				123	168	-128							93	145	32	67	42	93	
49	-154	126	72	-128	56		67	111	-158	177	13												
0/14:18:45	-131	132	173	146	-116	-171	-153	-91									147	-177	42	68	36	129	
50	-56	105	107	-120	83		73	112	25	160	-43												
0/14:18:55	-165	103	-132	149	-123	-19	-9	-18									6	-122	55	73	40	167	
61	23	101	-175	-110	89		76	81	66	-175	-41												
0/14:19:05	162	87	-88	160	-120	46	81	143									-37	33	72	73	37	23	
53	78	112	-3	-118	46		73	83	112	-159	-16												
0/14:19:15	141	-86	-66	164	-116	89	113	174									-114	69	87	66	40	22	
49	120	122	26	-126	54		73	98	143	165	-7												
0/14:19:25	-137	-143	-42	155	-114	141	151	-151									118	111	94	69	35	50	
56	167	112	65	-120	78		73	111	155	166	-18												
0/14:19:35	-139	-164	-20	142	-130	-91	-161	-118									166	144	107	72	37	79	
55	-66	99	109	-114	88		78	99	37	-168	-38												

Source=1148-001 : 0000, Stokes=RR , IF= 1, Chans= 1- 1
Flux = 0.0000 Jy, Calcode = C , Freq = 1.446150006 GHz
Phase, 1000 = 1000.00 degrees, averging type = Vector

Baselines	1	3	2	3	3	4	3	5	3	6	3	7	3	8	3	9	310	311	312	313	314	315	316
317	318	319	320	321	322	323	324	325	326	327	328	329											
0/14:43:25	-174	-121	103	162				65	109	166							41	37	70	66	32	-169	
49	86	97	42	-121	64		64	91	89	-178	-29												
0/14:43:35	-169	-148	150	173				81	104	-159							138	70	88	65	32	-85	
48	76	109	66	-129	60		67	92	71	178	-20												
0/14:43:45	-165	-171	-168	150	-127	97	120	-123									116	107	114	64	28	-20	
54	69	109	87	-132	61		56	94	90	170	-18												
0/14:43:55	-170	163	-127	133	-123	58	147	-84									90	142	139	68	35	32	
53	74	91	6	-133	61		58	85	121	175	-25												
0/14:44:05	-177	139	-92	148	-112	53	149	-32									72	177	164	69	35	70	
47	82	97	19	-127	64		64	90	134	-174	-30												
0/14:44:15	180	123	-62	162	-122	68	116	147									62	-116	-143	65	32	105	
54	81	109	35	-124	64		66	90	87	175	-30												
0/14:44:25	-176	101	-37	168	-136	85	105	177									51	15	-85	66	30	145	
50	76	112	59	-132	57		64	88	72	171	-20												
0/14:44:35	-162	105	-7	146	-133	79	117	-152									41	68	-46	68	30	-163	
47	71	96	67	-132	61		59	87	97	173	-24												

Source=1148-001 : 0000, Stokes=RR , IF= 1, Chans= 1- 1
Flux = 0.0000 Jy, Calcode = C , Freq = 1.446150006 GHz
Phase, 1000 = 1000.00 degrees, averging type = Vector

Baselines	1	3	2	3	3	4	3	5	3	6	3	7	3	8	3	9	310	311	312	313	314	315	316
-----------	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----	-----	-----	-----

```

317 318 319 320 321 322 323 324 325 326 327 328 329
    0/15:08:15 -152 172-105 148      73 125-161      -32 127 -46 69 28 39
48  65  87  38-129 62      62  93 108 179 -40
    0/15:08:25 -136 152 -86 139      76 126-157      -27  89 -36 66 28 63
53  80  95  41-139 66      61  96 114 175 -30
    0/15:08:35 -164 140 -63 149-130 64 135-148      -15 107 -11 67 22 87
50  78 114   9-134 60      67  80  93 177 -17
    0/15:08:45 178 144 -39 151-126 66 128-148      -3 119   9 68 28 106
51  90 108 12-127 58      65  82  91-177 -16
    0/15:08:55 167 150 -18 151-124 70 124-149      9 132 23 69 27 121
48  70  87  27-127 57      62  87 101-179 -33
    0/15:09:05 -160 162   3 151-129 72 126-157      21 135 33 65 28 74
51  48  93  40-134 67      61  96 111 177 -36

```

SETJY

```

task 'setjy'
source '3c286',' '
optype 'calc'
aparm(2)=3
go

```

```

vlb054> SETJY1: Task SETJY (release of 31DEC08) begins
vlb054> SETJY1: **WARNING: OPCODE=CALC AND FREQID = -1
vlb054> SETJY1: FREQID WILL BE RESET TO 1, CHECK YOUR RESULTS CAREFULLY
vlb054> SETJY1: A source model for this calibrator may be available
vlb054> SETJY1: Use the verb CALDIR to see if there is one
vlb054> SETJY1: / Flux calculated using known spectrum
vlb054> SETJY1: BIF = 1 EIF = 1 /Range of IFs
vlb054> SETJY1: '3C286' IF = 1 FLUX =14.5979 (Jy calcd)
vlb054> SETJY1: / Using (1990) VLA or Reynolds (1934-638) coefficients
vlb054> SETJY1: Appears to have ended successfully
vlb054> SETJY1: vlb054 31DEC08 TST: Cpu= 0.0 Real= 0

```

CALRD

```

task 'calrd'
object '3c286'
band 'l'
go

```

```

vlb054> CALRD1: Task CALRD (release of 31DEC08) begins
vlb054> CALRD1: Reading disk file AIPSTARS:3C286_L.MODEL
vlb054> CALRD1: Create 3C286_L.MODEL . 1 (MA) on disk 1 cno 2
vlb054> CALRD1: Appears to have ended successfully
vlb054> CALRD1: vlb054 31DEC08 TST: Cpu= 0.0 Real= 0

```

So it looks like the calibration data image was put into catalog entry number 5.

CALIB

```
task 'calib'  
getn 2  
calsour '3c286', ' '  
uvrange 0  
antennas 0  
refant 24  
weightit 1  
in2di 1  
get2n 5  
ncomp 0  
solmode 'A&P'  
aparm(6) 2  
minamper 10  
minphser 10  
docalib 1  
solint 1  
solsub 2  
cparm(3) 10  
cparm(4) 10
```

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Last update: **2008-11-14 23:06**

