

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.

Step 4 --- Initial look at data

FILLM

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

```
dowait=true
dohist=1
docrt=132
dotv=1
task 'fillm'
default
datain = 'PWD:GD_
nfiles=0
ncount=2
vlamode='S '
doweight=10
doconcat=true
douvcomp=0
cparm(2)=16
cparm(4)=28
cparm(8)=10./60
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 = 'VLAIFS ' 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= 219.9871
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=      111.6208
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=     -136.2284
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=     -67.6047
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=      0.0000
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

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			37	65	58	31		101	107	83						230	68	57	35	34	81	
33	90	40	56	18	32		32	45	69	32	47												
	0/14:18:35			4	65	55	22		78	85	80						191	67	58	28	28	78	
26	58	28	58	33	50		29	39	28	17	39												
	0/14:18:45			36	62	56	30	17	32	45	47						128	48	57	28	32	61	
32	48	24	31	44	48		34	26	18	29	17												
	0/14:18:55			54	54	70	40	24	39	15	18						194	27	61	30	36	28	
33	80	34	6	45	27		34	25	52	36	35												
	0/14:19:05			48	27	87	54	30	90	70	24						176	21	56	29	47	14	
39	114	42	29	50	42		43	44	63	24	47												
	0/14:19:15			38	7	105	40	33	117	116	67						113	59	63	42	43	51	
44	105	45	70	51	62		44	58	66	29	39												
	0/14:19:25			23	48	112	35	30	75	117	92						198	80	50	46	44	84	
46	57	38	74	59	63		47	48	21	50	30												
	0/14:19:35			58	72	99	36	26	39	70	66						123	60	31	38	40	86	
34	35	41	42	49	31		42	27	33	46	35												

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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