

GLOW Interferometry Tutorial: Wednesday

We will reduce the 3C129 polarization continuum dataset from the 2008 NRAO summer school. (See <http://casa.nrao.edu/Tutorial/Slworkshop2008/>) The summer school used CASA for the data reduction. You are welcome to try to use CASA for the data reduction on your own (but see also the warnings about what to do what CASA crashes frequently), but we will do the basic reduction in AIPS.

2010 Nov 16: JMA updated for 31DEC10 AIPS

Web Image of 3C129



Wide-field 90 cm image of the large head-tail radio galaxy 3C129 (right). The bright source at the left is 3C129.1. From Lane et al., AJ, 123, 2985, 2002.

The 8.5 GHz observations being reduced here will only look at the central, brightest, portion of this source.

Data Reduction

Remember, the purpose of this exercise is not to teach you how to reduce radio interferometry data with AIPS. Consider all of the arcane incantations below as just that, magic incantations. You should instead try to figure out what each step is actually doing to the data. The [AIPS Cookbook](#) has quite a bit of information to help guide you. Check out chapters 4 and 5. (Note that you probably have a copy of the cookbook in your local AIPS installation if you don't have full web access.) However, at some of the most important points, the cookbook is relatively useless for **understanding what is going on**, as opposed to knowing which buttons to push, so ask your tutorial leader for help in this area.

Download the data from <http://casa.nrao.edu/Data/VLA/3C129/3c129data.tgz> and untar it in some directory. (If you are in Garching, there should be a local copy. Ask Sven.) Then, from that same directory, start aips. Login with a new user ID number.

Basic Environment

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

Load the raw data: FILLM

```
task 'fillm'
default
nfiles 0
prtlev 0
datain 'PWD:AT166_
doconcat true
clron
doweight 10
ncount 3
cparm(4)=28
cparm(8)=10./60
dparm 0
bparm 0
timer 0
vlamode = ' '
band = ' '
calcode ' '
clron
outdisk 1
go
```

Check where it went. You will need the X band version at 8.5 GHz

Note that there are multiple sequence numbers for the same bands, as the observation was done using different frequency settings. We want the initial 8.5 GHz observation.

```
indi 1
pcat
getn 3
imhe
```

```
AIPS 1: Got(1)   disk= 1  user= 100   type=UV   19940725.X BAND.2
AIPS 1: Image=MULTI      (UV)          Filename=19940725   .X BAND.   2
AIPS 1: Telescope=VLA                      Receiver=VLA
AIPS 1: Observer=AT166                      User #= 100
AIPS 1: Observ. date=25-JUL-1994           Map date=16-NOV-2010
AIPS 1: # visibilities 284570              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    8.5149000E+09      1.00    5.0000000E+07    0.00
AIPS 1: IF           2    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 1950.00
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 OF is 1
AIPS 1: Keyword = 'CORRMODE' value = '
AIPS 1: Keyword = 'VLAIIFS ' value = 'ABCD '
AIPS 1: Keyword = 'CORRCOEF' value = -1

```

Print out some useful information

```

task 'listr'
default
getn 3
optype 'scan'
doweight 1
docrt=132
flagver 0
sources ' '
stokes ' '
docalib 0
gainuse 1
dopol -1
dparm 0
antenna 0
basel 0
stokes ' '
inext ' '
inver 0
bif 0
eif 0
uvrange 0
go

```

```

vlb054 LISTR(31DEC10) 100 16-NOV-2010 17:47:48 Page 1
File = 19940725 .X BAND. 2 Vol = 1 Userid = 100
Freq = 8.514900000 GHz Ncor = 4 No. vis = 284570
Scan summary listing

```

Scan	Source	Qual	Calcode	Sub	Timerange	FrqID
START	VIS					
END	VIS					
1	2345-167	: 0002	A	1	0/07:38:45 - 0/07:41:35	1
1	5236					

2	A2597	:	0002	1	0/07:53:05 -	0/08:00:15	1
5237	18977						
3	2345-167	:	0002 A	1	0/08:19:15 -	0/08:20:55	1
18978	22007						
4	A2597	:	0002	1	0/08:32:25 -	0/08:39:35	1
22008	35677						
5	2345-167	:	0002 A	1	0/08:58:25 -	0/09:00:15	1
35678	39018						
6	A2597	:	0002	1	0/09:11:35 -	0/09:18:55	1
39019	53084						
7	2345-167	:	0002 A	1	0/09:37:45 -	0/09:39:35	1
53085	56355						
8	A2597	:	0002	1	0/09:50:55 -	0/09:58:15	1
56356	70435						
9	2345-167	:	0002 A	1	0/10:17:05 -	0/10:18:55	1
70436	73790						
10	A2597	:	0002	1	0/10:30:15 -	0/10:37:35	1
73791	87870						
11	2345-167	:	0002 A	1	0/10:56:25 -	0/10:58:15	1
87871	91211						
12	A2597	:	0002	1	0/11:09:35 -	0/11:16:55	1
91212	105291						
13	2345-167	:	0002 A	1	0/11:35:45 -	0/11:37:35	1
105292	108646						
14	0420+417	:	0002 B	1	0/11:46:35 -	0/11:48:15	1
108647	111676						
15	3C129	:	0002	1	0/12:02:35 -	0/12:12:45	1
111677	131281						
16	0420+417	:	0002 B	1	0/12:25:25 -	0/12:27:15	1
131282	134636						
17	3C129	:	0002	1	0/12:39:45 -	0/12:49:55	1
134637	154172						
18	0420+417	:	0002 B	1	0/13:02:35 -	0/13:04:25	1
154173	157527						
19	3C129	:	0002	1	0/13:18:45 -	0/13:28:55	1
157528	175547						
20	0420+417	:	0002 B	1	0/13:41:35 -	0/13:43:25	1
175548	178625						
21	3C129	:	0002	1	0/13:55:55 -	0/14:06:05	1
178626	196645						
22	0420+417	:	0002 B	1	0/14:18:45 -	0/14:20:35	1
196646	199665						
23	3C129	:	0002	1	0/14:34:55 -	0/14:45:05	1
199666	216239						
24	0420+417	:	0002 B	1	0/14:57:45 -	0/14:59:35	1
216240	219330						
25	3C129	:	0002	1	0/15:10:55 -	0/15:18:15	1
219331	231264						
26	0420+417	:	0002 B	1	0/15:28:05 -	0/15:29:55	1
231265	234102						

```

 27 3C129      : 0002      1 0/15:44:45 - 0/15:54:55      1
234103      250648
 28 0420+417   : 0002  B    1 0/16:08:05 - 0/16:09:55      1
250649      253428
 29 3C129      : 0002      1 0/16:24:35 - 0/16:34:45      1
253429      269933
 30 0420+417   : 0002  B    1 0/16:47:35 - 0/16:49:25      1
269934      273011
 31 0518+165   : 0002  C    1 0/17:03:05 - 0/17:06:25      1
273012      278789
 32 0134+329   : 0002  C    1 0/17:18:15 - 0/17:21:35      1
278790      284570

```

Type Q to stop, just hit RETURN to continue

```

vlb054  LISTR(31DEC10)  100    16-NOV-2010 17:48:06    Page    2
File = 19940725    .X BAND.    2 Vol = 1  Userid = 100

```

Source summary

Velocity type = ' ' Definition = ' '

ID	Source	Qual	Calcode	RA(1950.0)	Dec(1950.0)	IFlux
1	2345-167	: 0002	A	23:45:27.6823	-16:47:52.600	0.000
	0.000 0.000 0.000					
	24929					
	IF(2)					0.000
	0.000 0.000 0.000					
2	A2597	: 0002		23:22:43.7000	-12:23:56.000	0.000
	0.000 0.000 0.000					
	83717					
	IF(2)					0.000
	0.000 0.000 0.000					
3	0420+417	: 0002	B	04:20:27.9370	41:43:08.045	0.000
	0.000 0.000 0.000					
	27625					
	IF(2)					0.000
	0.000 0.000 0.000					
4	3C129	: 0002		04:45:31.6950	44:55:19.950	0.000
	0.000 0.000 0.000					
	136740					
	IF(2)					0.000
	0.000 0.000 0.000					
5	0518+165	: 0002	C	05:18:16.5320	16:35:26.900	0.000
	0.000 0.000 0.000					
	5778					
	IF(2)					0.000
	0.000 0.000 0.000					
6	0134+329	: 0002	C	01:34:49.8320	32:54:20.520	0.000
	0.000 0.000 0.000					
	5781					
	IF(2)					0.000
	0.000 0.000 0.000					

ID	Source	Freq(GHz)	Velocity(Km/s)	Rest freq (GHz)
1	All Sources	8.5149	0.0000	0.0000
	IF(2)	8.8851	0.0000	0.0000

Frequency Table summary

FQID	IF#	Freq(GHz)	BW(kHz)	Ch.Sep(kHz)	Sideband
1	1	8.51490000	50000.0039	50000.0039	1
	2	8.88510000	50000.0039	50000.0039	1

AIPS 1: Resumes

Where are the antennas located?

go prtan

Location Of VLA Antennas

```

N36 (26)
N32 ( 1)
N28 (19)
N24 (11)
N20 (15)
N16 (25)
N12 (13)
N8  (27)
N4  (14)
(12) W4    E4 (22)
( 8) W8    E8 ( 4)
( 3) W12   E12 (16)
(28) W16   E16 ( 7)
( 2) W20   E20 (17)
(21) W24   E24 (24)
(10) W28   E28 ( 5)
(18) W32   E32 (23)
(20) W36   E36 ( 6)

VLA:_OUT ( 9)
VPT:_OUT (29)

```

Investigate the data

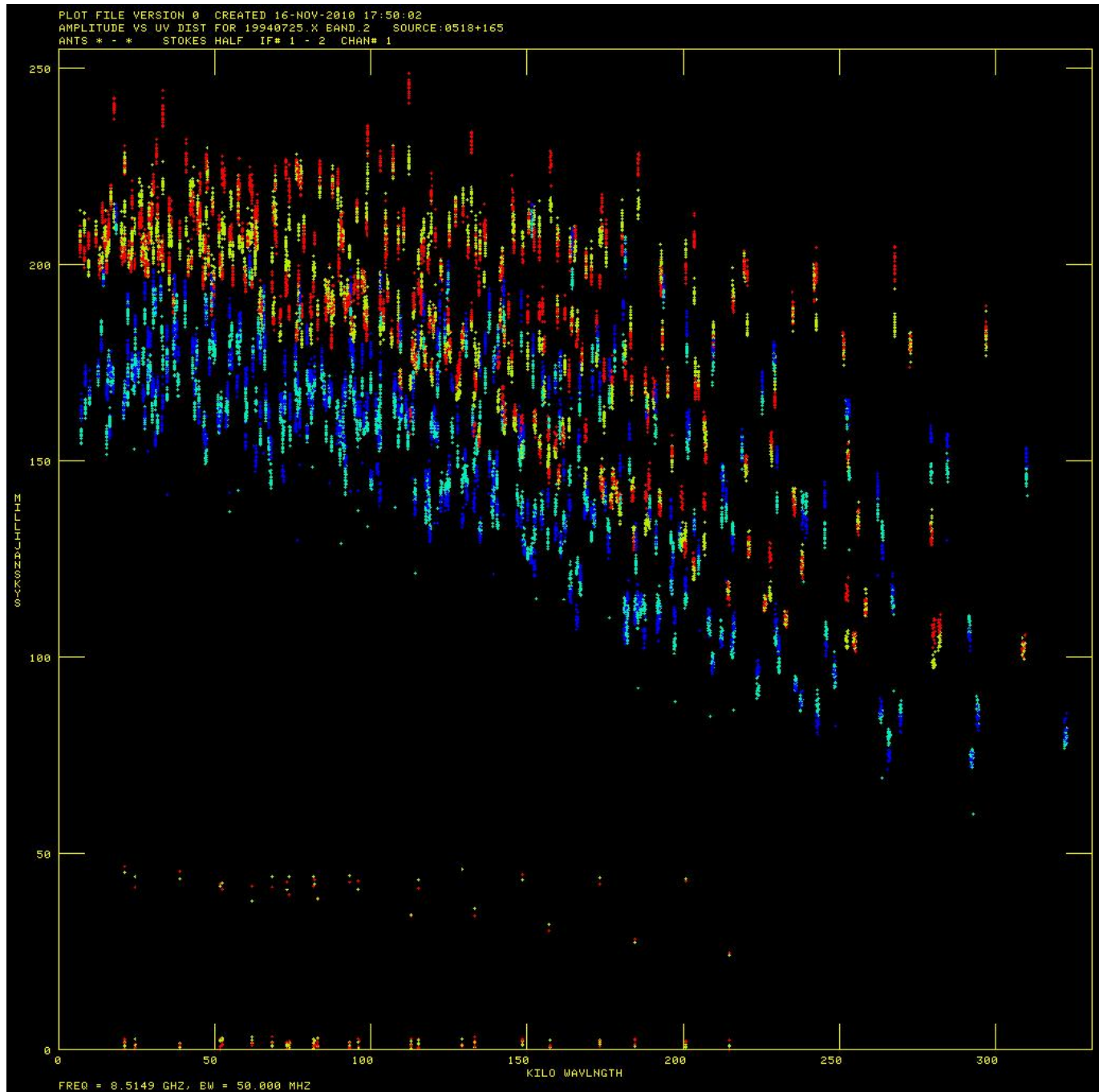
Plots

```

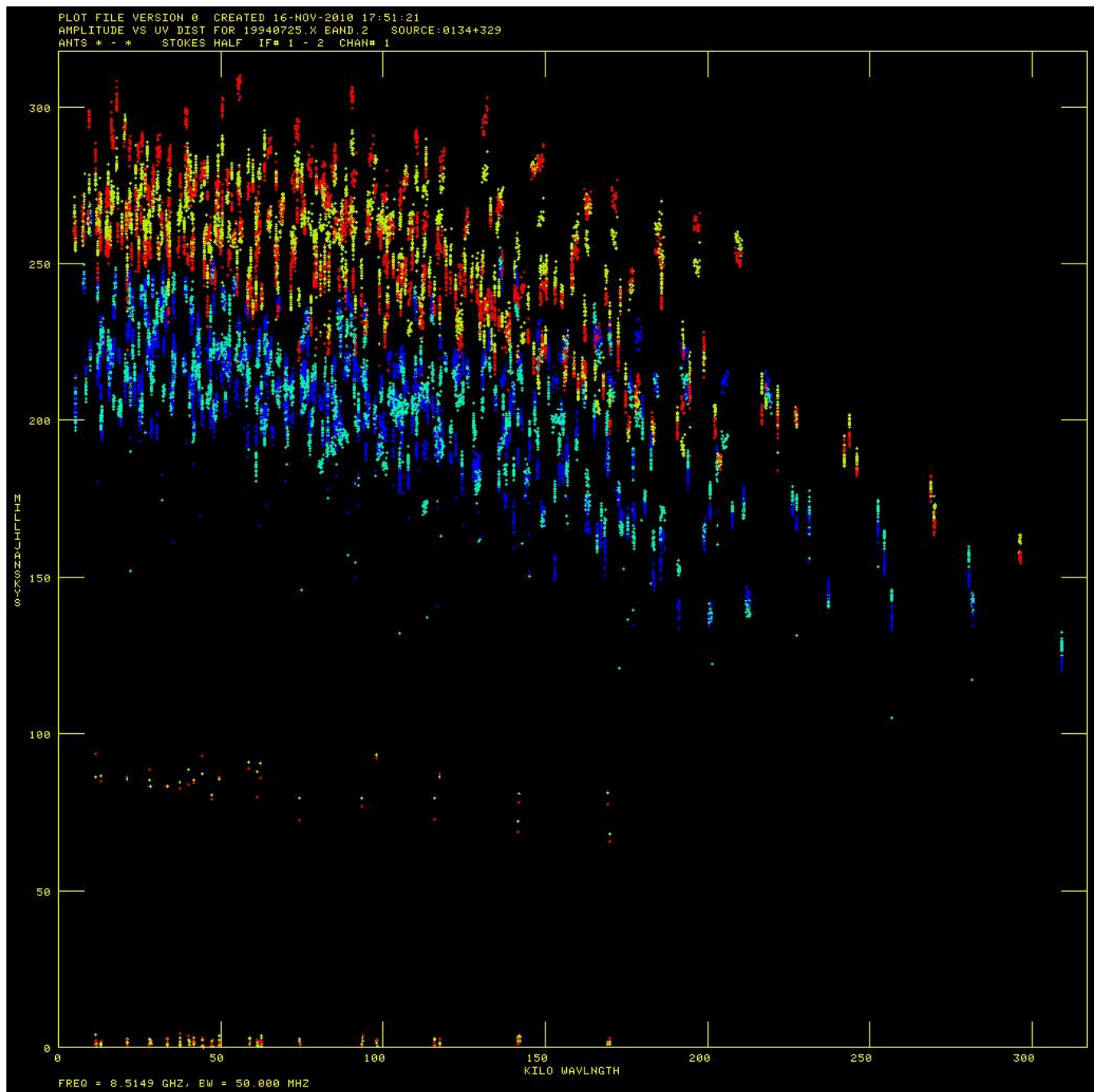
task 'uvplt'
source '0518+165', ' '
calcode ' '
stokes 'half'
timer 0
uvrange 0
bif 0
eif 0
docalib 0

```

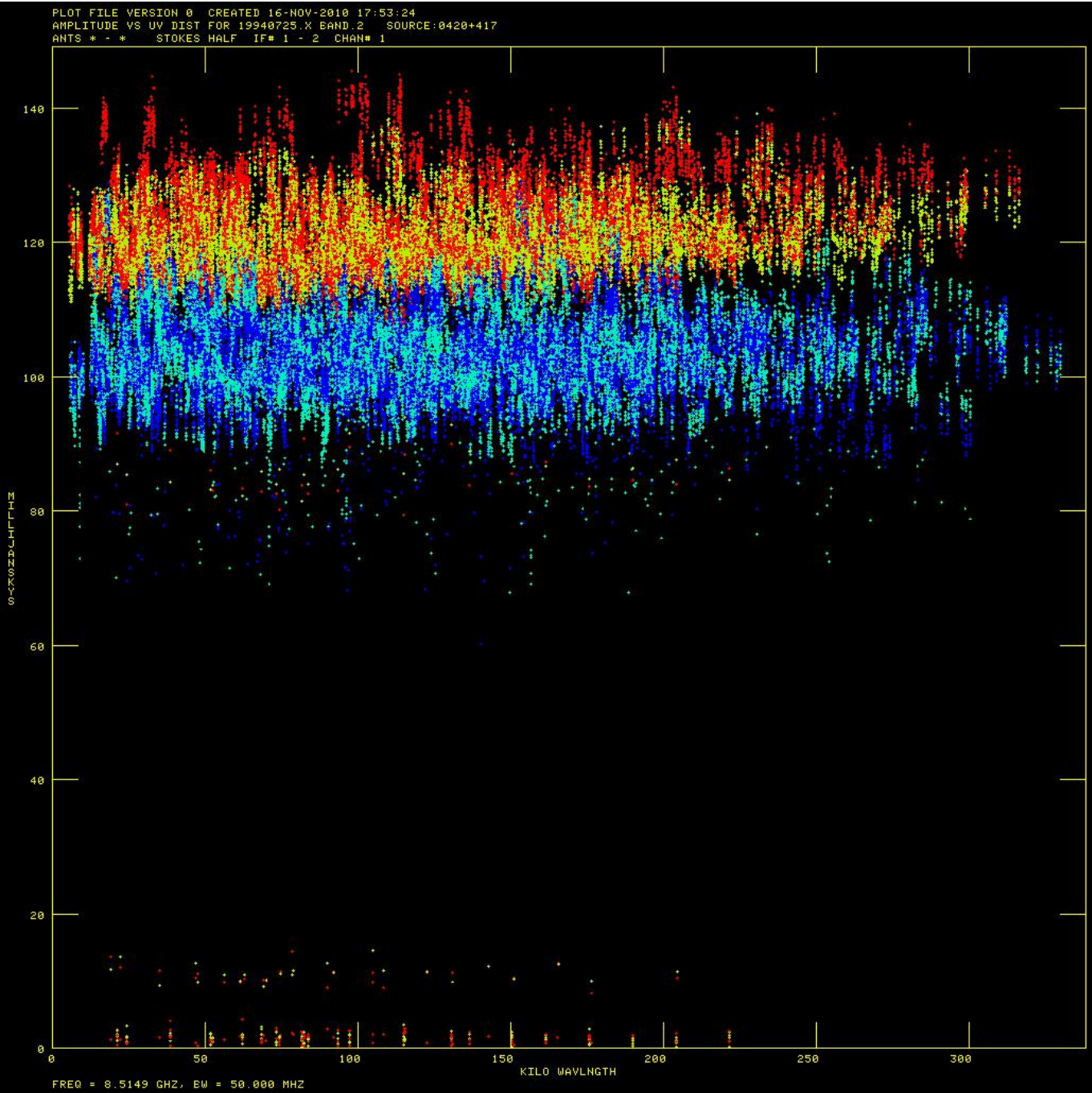
```
gainuse 1
bparm 0 1
aparm 0
refant 22
do3col 1
dotv 1
tvinit
go
```



```
source '0134+329', ' '
tvinit
go
```



```
source '0420+417', ' '  
tvinit  
go
```



Note that the VLA Calibrator Manual says for this source:

0423+418	J2000	A	04h23m56.009795s	41d50'02.712770"	Aug01
0420+417	B1950	A	04h20m27.936900s	41d43'08.039000"	

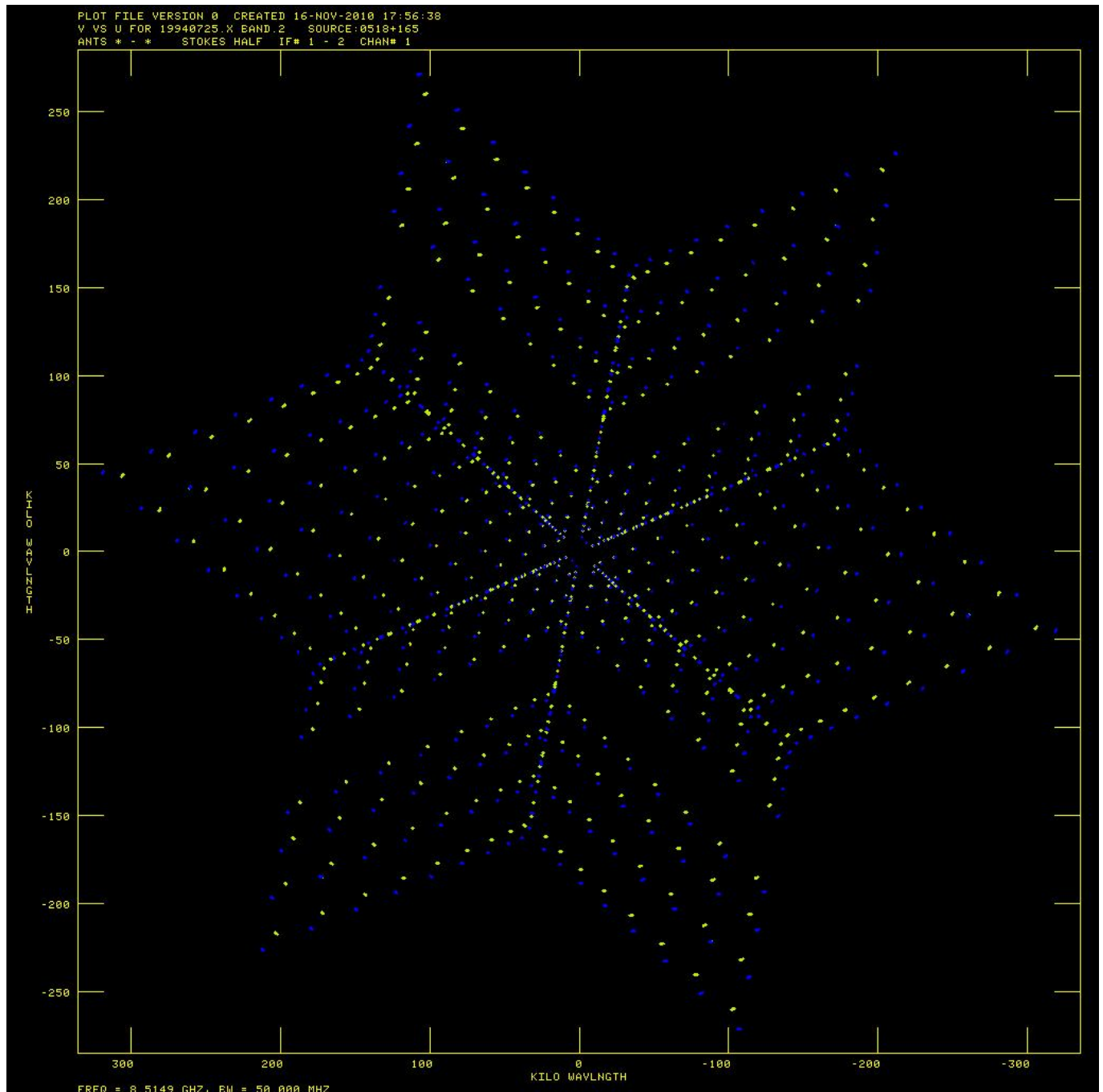
BAND	A	B	C	D	FLUX(Jy) UVMIN(kL) UVMAX(kL)
=====					
20cm	L	X	X	P	2.00 visplot
3.7cm	X	P	P	P	1.12 visplot
2cm	U	P	P	P	0.72 visplot
0.7cm	Q	S	S	S	1.00 visplot

So we are not exactly sure at C band (5 GHz, 6 cm) what the source structure is like for the B configuration from the manual. Is it ok to use? For what (u,v) range?

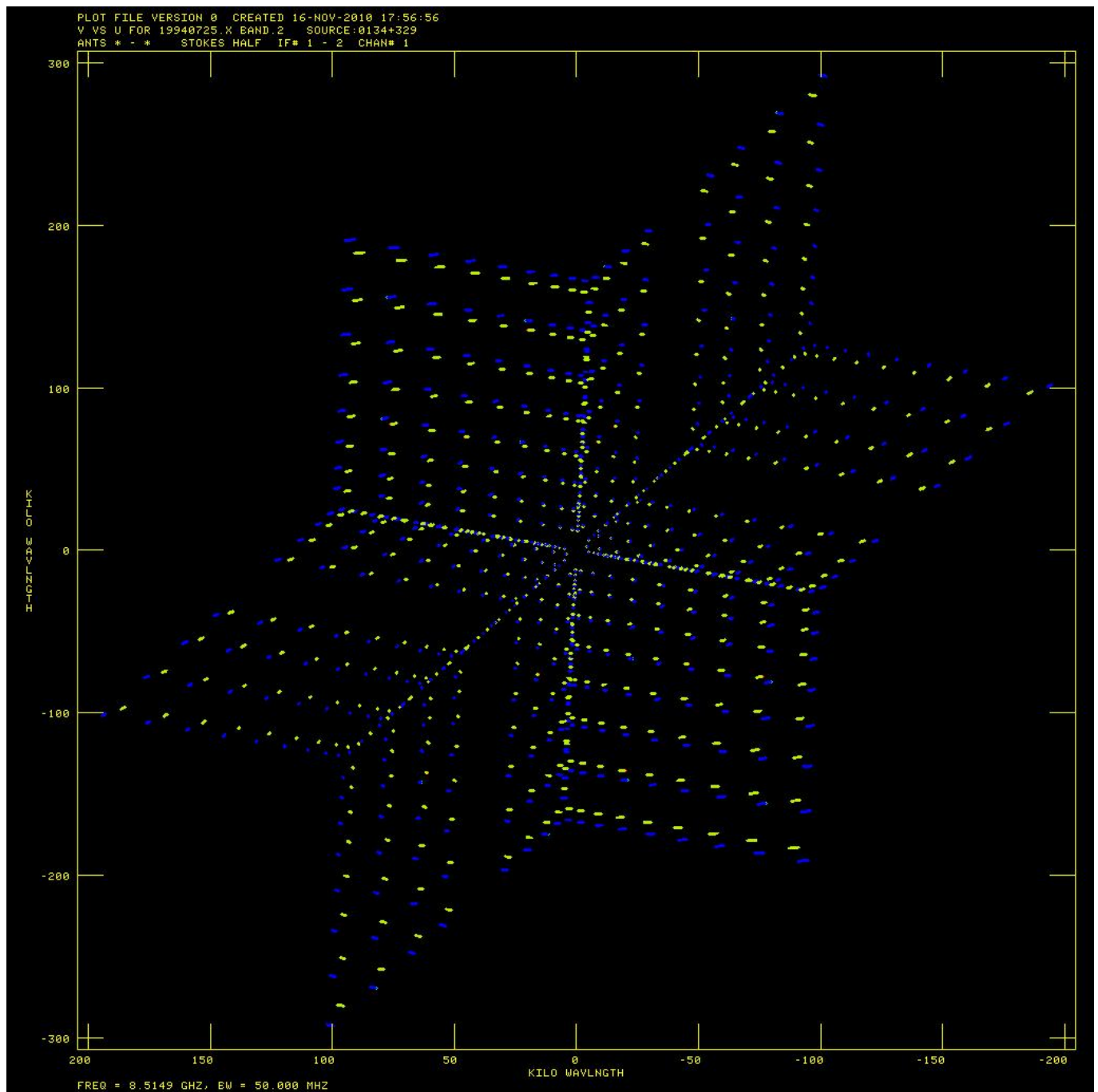
```
source '3C129', ' '  
tvinit  
go
```



```
bparm 6 7  
source '0518+165', ' '  
tvinit  
go
```



```
source '0134+329', ' '  
tvinit  
go
```



source '0420+417', ' '
tvinit
go



```
source '3C129', ' '  
tvinit  
go
```



```
bparm 11,15,0
sources '0518+165','0134+329','0420+417','3C129',' '
xinc=10
go
```



bparm 11,16,0
go



```
xinc=1
bparm 0
```

Raw visibilities

```
task 'listr'
optype 'list'
antenna 22,0
basel 0
sources '0518+165','0134+329','0420+417', '3C129', ' '
calcode '*'
bif 0
eif 0
```

```
docalib 0
dparm 0
go
```

```
Source=0420+417      : 0002, Stokes=RR , IF= 1, Chans= 1- 1
Flux = 0.0000 Jy, Calcode = B , Freq = 8.514900000 GHz
Amplitudes, 1000 = 1.000000 Jy, averging type = Vector
```

Baselines

```
0122022203220422052206220722082210221122122213221422152216221722182219222022
2122222322242225222622272228
```

```
0/16:47:55 120 117 124 124 129 135 121 122 131 122 123 126
120 125 124 122 124 135 122 119 124 128
0/16:48:05 119 117 115 120 120 129 132 116 121 128 118 120 124
119 123 122 123 121 130 117 117 119 120 126
0/16:48:15 116 113 116 121 121 127 130 115 121 128 119 120 124
116 122 122 120 120 128 116 114 119 121 123
0/16:48:25 118 115 113 119 121 126 133 115 122 129 119 118 124
117 121 124 119 120 128 117 115 120 122 124
0/16:48:35 117 114 116 119 121 127 136 117 123 127 118 120 122
117 122 121 121 120 127 117 115 116 121 126
0/16:48:45 119 112 114 119 122 126 133 117 120 127 120 118 123
117 122 122 120 119 130 118 117 118 119 125
0/16:48:55 117 114 118 120 121 124 133 118 120 130 119 121 124
115 121 122 119 119 128 117 114 119 120 125
0/16:49:05 119 113 115 122 121 127 132 115 121 129 121 121 124
115 121 122 120 120 129 118 117 116 119 125
0/16:49:15 119 116 116 121 120 127 133 117 121 128 117 121 123
117 122 120 119 121 128 120 116 119 120 125
0/16:49:25 118 113 116 123 120 125 132 115 120 127 118 120 126
117 122 121 122 120 131 119 117 120 122 123
```

```
Source=0518+165      : 0002, Stokes=RR , IF= 1, Chans= 1- 1
Flux = 0.0000 Jy, Calcode = C , Freq = 8.514900000 GHz
Amplitudes, 1000 = 1.000000 Jy, averging type = Vector
```

```
0/17:03:25 212 191 205 212 198 177 232 213 183 226 207 210 221
2 165 216 148 195 192 196 204 211 218
0/17:03:35 205 187 199 205 193 171 227 209 179 224 205 206 216
2 161 212 145 188 189 191 201 203 208 212
0/17:03:45 202 186 199 206 192 170 226 206 177 223 202 204 215
2 160 212 143 191 190 190 200 203 207 211
0/17:03:55 205 184 198 205 190 169 228 207 174 224 202 203 216
1 160 210 142 188 187 191 199 202 205 209
0/17:04:05 205 187 197 204 192 171 227 208 176 226 202 206 218
42 160 209 145 188 187 191 198 201 206 213
0/17:04:15 205 185 197 208 190 169 224 207 176 222 202 205 216
197 163 208 145 189 188 190 198 202 205 210
0/17:04:25 204 188 198 206 189 170 224 206 176 226 202 202 216
196 164 210 144 189 190 190 199 204 207 212
Type Q to stop, just hit RETURN to continue
```

vlb054	LISTR(31DEC10)	100	16-NOV-2010	18:12:30	Page	3
Source=0518+165	: 0002, Stokes=RR		IF= 1, Chans=	1-	1	
Baselines						
0122022203220422052206220722082210221122122213221422152216221722182219222022	2122222322242225222622272228					
0/17:04:35	204	187	197	206	190	170
194	161	210	144	189	190	193
0/17:04:45	206	188	198	208	191	169
197	161	211	145	190	188	191
0/17:04:55	207	188	199	207	190	170
196	161	210	144	191	188	191
0/17:05:05	205	186	200	207	192	171
196	160	210	142	189	189	191
0/17:05:15	206	190	198	208	189	171
197	161	207	141	189	190	191
0/17:05:25	203	189	199	205	189	169
195	160	206	144	188	190	188
0/17:05:35	203	189	200	206	193	170
196	162	207	145	188	187	191
0/17:05:45	202	188	199	207	192	170
196	160	208	143	188	188	190
0/17:05:55	202	189	200	207	190	170
195	158	208	143	190	190	191
0/17:06:05	203	188	197	207	191	173
194	162	208	141	189	188	191
0/17:06:15	204	187	200	206	190	170
196	162	206	145	189	189	191
0/17:06:25	204	190	200	208	192	173
194	162	210	144	188	189	190
Source=0134+329 : 0002, Stokes=RR , IF= 1, Chans= 1- 1						
Flux = 0.0000 Jy, Calcode = C , Freq = 8.514900000 GHz						
Amplitudes, 1000 = 1.000000 Jy, averging type = Vector						
Baselines						
0122022203220422052206220722082210221122122213221422152216221722182219222022	2122222322242225222622272228					
0/17:18:35	247	246	256	263	275	264
2	236	267	219	251	287	265
0/17:18:45	242	241	253	262	272	261
1	234	264	215	250	282	262
0/17:18:55	246	241	252	265	273	263
2	238	264	217	248	283	262
0/17:19:05	241	239	249	260	268	264
3	234	262	216	223	282	262
0/17:19:15	240	239	248	257	264	257
84	234	262	214	245	280	262
0/17:19:25	245	235	247	259	266	261
259	236	261	214	246	278	258
0/17:19:35	244	238	249	259	269	263

259 236 260 215 243 279 259 254 238 262 276		
0/17:19:45 240 237 251 260 266 260 284 255 248 274	262 261	269
258 234 262 215 244 279 261 255 241 264 276		
0/17:19:55 245 240 250 258 267 259 287 258 247 276	259 259	267
257 236 261 217 249 281 259 255 237 265 275		
0/17:20:05 240 238 249 259 266 259 286 256 247 277	262 259	267
259 235 263 216 243 283 259 256 240 264 278		
0/17:20:15 242 234 251 257 264 259 284 254 247 274	260 257	272
258 233 263 215 245 278 258 253 241 261 276		
0/17:20:25 245 235 253 259 270 261 286 257 252 277	262 260	271
259 234 263 216 250 280 260 256 240 266 279		
0/17:20:35 240 239 253 261 269 263 289 260 249 276	264 261	272
261 235 262 220 250 280 261 258 240 268 279		
0/17:20:45 245 236 253 260 266 258 286 259 248 276	262 261	270
261 232 261 217 244 283 258 255 244 264 280		
0/17:20:55 245 238 254 257 267 260 284 260 248 277	265 261	272
261 237 263 217 249 282 260 254 242 265 280		
0/17:21:05 242 238 251 259 267 259 281 258 245 275	262 259	268
259 232 260 219 244 280 260 256 242 267 277		
0/17:21:15 242 238 254 260 268 261 288 262 247 274	262 260	269
263 233 260 217 246 285 260 257 238 267 279		
0/17:21:25 246 235 251 257 268 256 286 257 246 276	260 261	268
261 228 262 216 246 281 257 253 242 265 277		
0/17:21:35 247 238 254 260 271 267 287 261 249 276	264 265	269
260 237 262 218 251 282 256 256 242 266 281		

dparm 1,0

go

Source=0420+417 : 0002, Stokes=RR , IF= 1, Chans= 1- 1
 Flux = 0.0000 Jy, Calcode = B , Freq = 8.514900000 GHz
 Phase, 1000 = 1000.00000 degrees, averging type = Vector

Baselines

0122022203220422052206220722082210221122122213221422152216221722182219222022		
2122222322242225222622272228		
0/16:47:55 -85 -95 90-159-108 170 91 167-133	-69 -83	142
-6-110-177 -27 62 -90 -40 -45 136 59		
0/16:48:05 -82 27 -93 92-155-106 171 92 168-131	-70 -84	145
-4-106-172 -25 67 -92 -40 -46-100 131 57		
0/16:48:15 -77 30 -89 96-155-104 175 95 172-128	-69 -83	146
-4-106-171 -23 72 -95 -45 -47-104 131 52		
0/16:48:25 -72 34 -81 101-147 -96 172 100 176-125	-64 -80	151
3 -98-167 -19 73 -99 -46 -50-109 128 47		
0/16:48:35 -74 34 -82 95-147 -97 166 98 176-126	-62 -80	146
2 -94-166 -19 71-100 -47 -45-106 126 45		
0/16:48:45 -73 36 -80 96-149 -95 169 98 175-122	-61 -80	142
2 -94-162 -18 71-101 -45 -48-110 127 48		
0/16:48:55 -73 34 -82 96-148 -96 175 99 176-121	-62 -82	143
3 -95-161 -17 70-101 -46 -47-108 129 49		
0/16:49:05 -72 34 -85 92-146 -94 172 100 176-121	-64 -84	141

```
-1 -98-160 -17 67-101 -44 -47-107 129 46
    0/16:49:15 -72 36 -85 92-148 -92 171 92 177-121 -60 -84 142
1 -97-159 -16 67-102 -45 -43-107 127 46
    0/16:49:25 -74 34 -87 92-148 -91 169 99 174-122 -60 -85 142
1 -96-159 -13 66-102 -45 -46-106 129 46
```

Source=0518+165 : 0002, Stokes=RR , IF= 1, Chans= 1- 1
 Flux = 0.0000 Jy, Calcode = C , Freq = 8.514900000 GHz
 Phase, 1000 = 1000.00000 degrees, averging type = Vector

```
    0/17:03:25 -99 26 -80 109-155-110 174 103 -82-130 -65 -79 135
70 -93 159 -37 24 -97 -37 -49 118 42
    0/17:03:35 -100 28 -80 110-151-110 173 103 -81-131 -65 -79 137
85 -91 160 -36 22 -96 -38 -49-104 119 42
    0/17:03:45 -103 24 -85 104-156-112 169 100 -86-136 -70 -81 133
19 -92 159 -40 22 -93 -32 -43-101 126 47
    0/17:03:55 -102 22 -88 102-157-113 169 100 -87-135 -72 -79 136
30 -90 158 -39 23 -90 -34 -44 -99 123 45
    0/17:04:05 -105 23 -92 99-160-116 167 98 -88-142 -76 -82 133
23 -91 154 -40 16 -88 -31 -43 -94 129 44
    0/17:04:15 -104 26 -88 101-156-114 169 103 -84-140 -73 -80 130
20 -89 156 -38 23 -89 -32 -48 -98 129 40
    0/17:04:25 -105 26 -89 99-157-113 169 103 -84-141 -76 -83 131
17 -90 157 -32 23 -89 -31 -45 -96 127 42
```

Type Q to stop, just hit RETURN to continue

vlb054 LISTR(31DEC10) 100 16-NOV-2010 18:13:14 Page 3

Source=0518+165 : 0002, Stokes=RR , IF= 1, Chans= 1- 1

Baselines

0122022203220422052206220722082210221122122213221422152216221722182219222022
 2122222322242225222622272228

```
    0/17:04:35 -100 32 -80 108-147-103 175 109 -76-135 -69 -77 140
25 -81 165 -22 29 -98 -42 -49-100 120 33
    0/17:04:45 -101 31 -80 107-147-103 167 108 -76-142 -70 -78 142
23 -81 165 -22 28-100 -41 -45 -99 124 33
    0/17:04:55 -100 33 -80 109-145-102 173 109 -76-141 -68 -80 142
23 -82 164 -21 27-101 -40 -45 -98 124 31
    0/17:05:05 -102 30 -81 111-147-100 172 110 -74-141 -69 -81 141
22 -83 162 -21 28-103 -40 -45 -98 125 32
    0/17:05:15 -104 34 -81 112-142 -99 170 109 -71-142 -68 -80 145
23 -85 165 -16 30-103 -41 -45-100 124 26
    0/17:05:25 -105 32 -82 109-141 -96 176 109 -70-143 -68 -84 148
22 -86 168 -13 33-100 -40 -44-100 125 25
    0/17:05:35 -108 32 -83 111-141 -94 174 110 -71-142 -69 -78 151
20 -90 168 -11 34 -98 -41 -45 -98 125 25
    0/17:05:45 -111 33 -83 110-140 -94 172 108 -72-140 -69 -79 149
18 -94 166 -11 34 -97 -40 -44 -96 127 27
    0/17:05:55 -112 35 -81 110-140 -91 174 108 -68-142 -64 -76 151
18 -93 166 -9 39 -97 -40 -45 -95 127 24
    0/17:06:05 -111 34 -83 110-141 -94 174 108 -70-143 -66 -78 150
```

```

16 -95 163 -10 41 -96 -40 -43 -96 128 24
    0/17:06:15 -113 32 -85 108-143 -93 171 108 -72-145 -69 -79 151
15 -97 161 -12 41 -97 -41 -42 -92 131 27
    0/17:06:25 -112 32 -85 108-144 -95 171 109 -73-147 -69 -79 148
14 -98 161 -15 42 -97 -38 -42 -91 132 25

```

Source=0134+329 : 0002, Stokes=RR , IF= 1, Chans= 1- 1
 Flux = 0.0000 Jy, Calcode = C , Freq = 8.514900000 GHz
 Phase, 1000 = 1000.00000 degrees, averging type = Vector

Baselines

```

0122022203220422052206220722082210221122122213221422152216221722182219222022
2122222322242225222622272228
    0/17:18:35 -138 62 -85 125-129 -67 172 106 28-170 -47 -92 -172
-15 -54 159 87 132-105 -17 -13 136 30
    0/17:18:45 -139 55 -87 121-130 -71 169 105 25-172 -49 -94
-172-162 -57 155 86 129-100 -15 -9 -42 137 30
    0/17:18:55 -139 54 -84 124-132 -70 163 104 22-174 -49 -92 -171
104 -56 149 82 127 -97 -12 -11 -45 135 28
    0/17:19:05 -144 48 -86 118-130 -74 153 100 13 175 -56 -99 -177
112 -64 139 79 93 -87 -1 -3 -39 138 31
    0/17:19:15 -147 46 -87 117-135 -81 152 100 7 172 -62-105 177
-19 -69 133 67 88 -80 2 6 -32 142 35
    0/17:19:25 -147 42 -91 114-131 -87 149 97 -2 164 -68-108 177
-21 -76 126 62 79 -74 7 10 -28 145 39
    0/17:19:35 -144 41 -86 119-130 -83 153 99 -6 165 -69-106 177
-16 -77 134 65 110 -75 2 9 -29 140 35
    0/17:19:45 -147 38 -89 115-134 -88 147 93 -9 163 -79-107 170
-21 -80 129 58 101 -67 0 13 -25 142 37
    0/17:19:55 -150 37 -90 115-139 -93 145 90 -15 165 -82-104 169
-21 -81 132 51 97 -64 -6 16 -24 141 39
    0/17:20:05 -150 40 -83 116-143 -91 144 89 -16 167 -82 -99 168
-17 -81 136 49 94 -67 -4 16 -27 138 40
    0/17:20:15 -149 41 -76 120-135 -89 148 94 -13 173 -83 -97 170
-16 -79 139 46 107 -70 -7 11 -30 132 40
    0/17:20:25 -146 43 -73 123-139 -87 150 94 -13 177 -85 -96 173
-17 -77 145 46 105 -72 -4 6 -34 131 40
    0/17:20:35 -147 46 -73 122-133 -91 151 94 -14 178 -85 -96 171
-21 -81 144 45 106 -68 -3 10 -36 128 44
    0/17:20:45 -146 45 -71 120-137 -88 154 97 -15-178 -84 -87 172
-18 -80 150 46 93 -67 -8 11 -40 123 49
    0/17:20:55 -143 49 -66 121-131 -81 160 103 -6-169 -78 -81 177
-13 -78 151 54 111 -72 -10 5 -47 117 44
    0/17:21:05 -149 40 -70 114-137 -82 159 99 -9-165 -86 -83 173
-15 -82 148 53 75 -69 -7 5 -45 120 47
    0/17:21:15 -153 38 -71 108-142 -82 160 98 -11-164 -92 -85 162
-16 -83 147 51 93 -70 -6 11 -40 122 50
    0/17:21:25 -156 37 -74 105-144 -84 157 92 -19-170 -101 -87 154
-14 -89 140 48 99 -66 0 13 -36 124 51
    0/17:21:35 -152 43 -76 104-142 -78 161 94 -13-164 -103 -84 155
-13 -85 145 52 102 -72 0 13 -39 121 47

```

dparm 0

Flag some bad data. Just run the commands.

```
task 'quack'  
reason 'slow start'  
sources ' '  
calcode ' '  
stokes ' '  
timer 0  
antenna 17 0  
flagver 1  
opcode 'beg'  
basel 0  
bif 1  
eif 1  
aparm 0  
aparm(2) 72.5/60  
go
```

```
reason 'quack'  
sources ' '  
calcode ' '  
stokes ' '  
timer 0  
antenna 0  
flagver 1  
opcode 'beg'  
basel 0  
bif 2  
eif 2  
aparm 0  
aparm(2) 22.5/60  
go
```

```
task 'uvflg'  
default  
dohist 1  
getn 12  
antenna 14,0  
basel 0  
timer 0 15 10 50 0 15 55 0  
stokes ' '  
bif 2  
eif 2  
opcode 'flag'  
reason 'bad ant'
```

```
outfgver 1
go
timer 0
bif 0
eif 0
antenna 0
```

Start the calibration

Set the flux values of the known calibrators

```
task 'setjy'
default
getn 3
source '0518+165', ' '
bif 0
eif 0
optype 'calc'
aparm(2) 3
go
```

```
vlb054> SETJY1: Task SETJY (release of 31DEC10) 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 is available
vlb054> SETJY1: Consult the help file for CALRD for assistance
vlb054> SETJY1: / Flux calculated using known spectrum
vlb054> SETJY1: BIF = 1 EIF = 2 /Range of IFs
vlb054> SETJY1: '0518+165 ' IF = 1 FLUX = 2.4983 (Jy calcd)
vlb054> SETJY1: '0518+165 ' IF = 2 FLUX = 2.4166 (Jy calcd)
vlb054> SETJY1: / Using (1995.2) VLA or Reynolds (1934-638) coefficients
vlb054> SETJY1: Appears to have ended successfully
vlb054> SETJY1: vlb054 31DEC10 TST: Cpu= 0.0 Real= 0
```

```
bif 1
eif 1
optype ' '
zerosp 2.4983, 0.3092, -0.0628, 0.0
go
bif 2
eif 2
zerosp 2.4166, 0.2990, -0.0607, 0.0
go

bif 0
eif 0
zerosp 0
optype 'calc'
```

```
source = '0134+329', ' '  
go
```

```
vlb054> SETJY1: Task SETJY (release of 31DEC10) 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 is available  
vlb054> SETJY1: Consult the help file for CALRD for assistance  
vlb054> SETJY1: / Flux calculated using known spectrum  
vlb054> SETJY1: BIF = 1 EIF = 2 /Range of IFs  
vlb054> SETJY1: '0134+329 ' IF = 1 FLUX = 3.2045 (Jy calcd)  
vlb054> SETJY1: '0134+329 ' IF = 2 FLUX = 3.0714 (Jy calcd)  
vlb054> SETJY1: / Using (1995.2) VLA or Reynolds (1934-638) coefficients  
vlb054> SETJY1: Appears to have ended successfully  
vlb054> SETJY1: vlb054 31DEC10 TST: Cpu= 0.0 Real= 0
```

```
bif 1  
eif 1  
optype ' '  
zerosp 3.2045, 0.0772, -0.1722, 0.0  
go  
bif 2  
eif 2  
zerosp 3.0714, 0.0740, -0.1650, 0.0  
go  
  
bif 0  
eif 0
```

Get images (and thus clean components) for the calibrators

```
task 'calrd'  
object '3c138'  
band 'c'  
go
```

```
object '3c48'  
band 'c'  
go
```

```
pcat
```

```
AIPS 1: Catalog on disk 1  
AIPS 1: Cat Usid Mapname Class Seq Pt Last access Stat  
AIPS 1: 1 100 19940725 .C BAND. 1 UV 16-NOV-2010 13:15:34  
AIPS 1: 2 100 19940725 .X BAND. 1 UV 16-NOV-2010 13:15:34  
AIPS 1: 3 100 19940725 .X BAND. 2 UV 16-NOV-2010 13:15:34  
AIPS 1: 4 100 19940725 .C BAND. 2 UV 16-NOV-2010 15:02:52
```

AIPS 1:	5	100	19940725	.U BAND.	1	UV	16-NOV-2010	13:15:34
AIPS 1:	6	100	19940725	.C BAND.	3	UV	16-NOV-2010	13:15:45
AIPS 1:	7	100	19940725	.C BAND.	4	UV	16-NOV-2010	13:15:44
AIPS 1:	8	100	19940725	.X BAND.	3	UV	16-NOV-2010	13:15:44
AIPS 1:	9	100	19940725	.X BAND.	4	UV	16-NOV-2010	13:15:45
AIPS 1:	10	100	3C138_C	.MODEL .	1	MA	16-NOV-2010	15:03:51
AIPS 1:	11	100	3C48_C	.MODEL .	1	MA	16-NOV-2010	15:03:55

Convert the (u,v) data to the epoch of the calibration images

Note: it is possible to change the epoch of the calibration image headers to B1950, but there would remain a small error in the rotation of the coordinate system. The proper fix is to convert the (u,v) coordinates or to rotate the images.

```
task 'uvfix'
clron
outdisk 1
shift 0
uvfixprm 0
go
```

Now fix the index table.

```
pcat

task 'indxr'
getn 12
cparm 0
cparm(3)= -1
bparm 0
go
cparm 0
```

Do the actual calibration. Start with 3C138

```
task 'calib'
default
getn 12
calsour '0518+165', ' '
uvrange 0
antenna 0
refant 22
minamper 10
minphser 10
weightit 1
get2n 10
ncomp 0
solmode 'A&P'
aparm(6) 2
```

```
solint 2
solsub 2
cparm(3) 10
cparm(4) 10
go
clrmsg
```

Calibrate 3C48

```
calsour '0134+329', ' '
get2n 11
go
clrmsg
```

Calibrate the phase calibrator

```
clr2n
calsour '0420+417', ' '
solint 0
uvrange 20 0
go
clrmsg
```

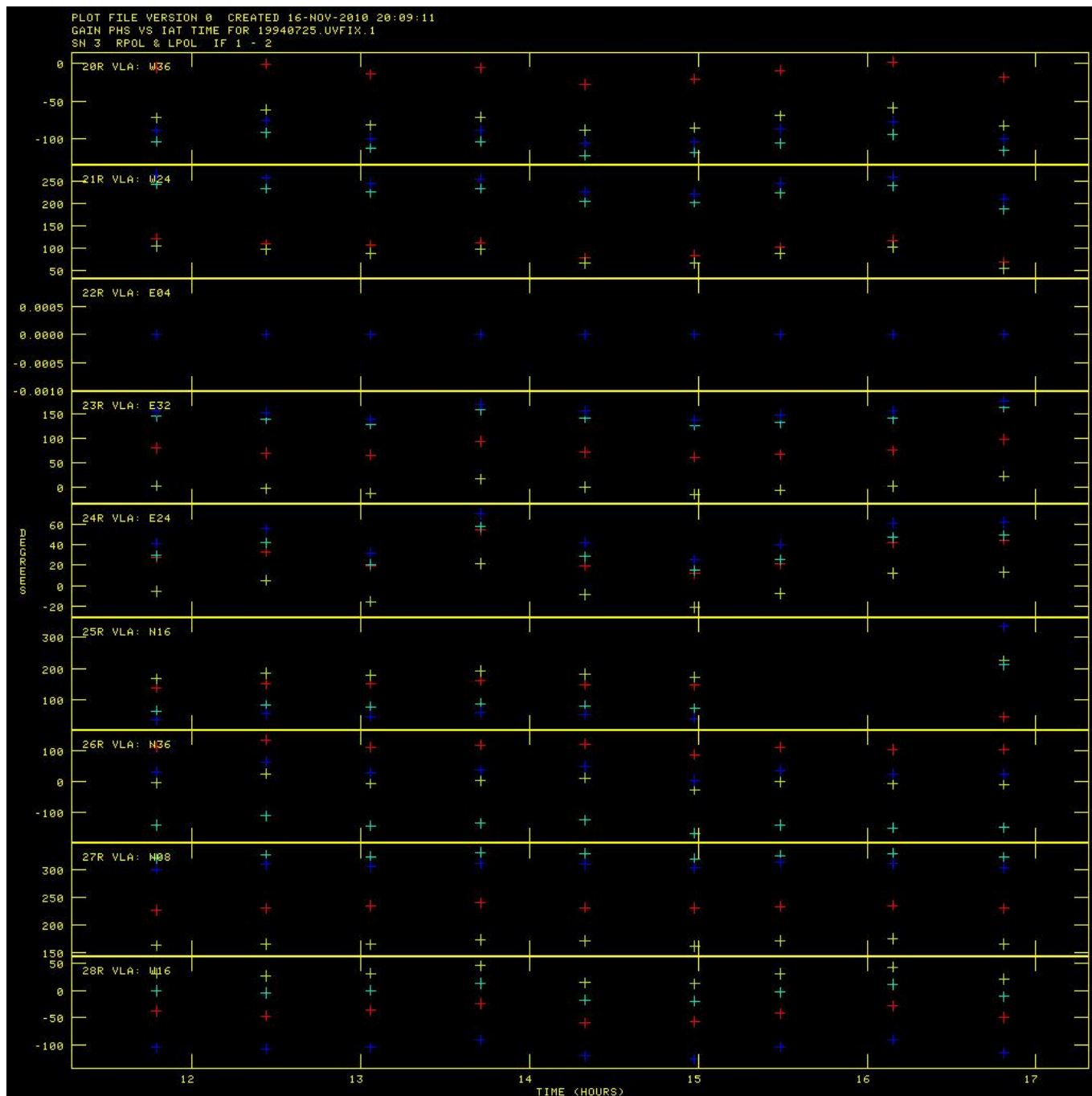
Check the results

```
task 'snplt'
antenna 0
stokes ' '
inext 'sn'
inver 1
sources ' '
timer 0
optype 'amp'
opcode 'alsi'
do3col 1
dotv 1
xinc 1
nplots 9
tvinit
go
optype 'phas'
go
inver 2
optype 'amp'
go
optype 'phas'
```

```

go
inver 3
optype 'amp'
go
optype 'phas'
go

```



Apply the calibration to the phase calibrator

```

task 'getjy'
sources '0420+417', ' '
calsour '0518+165','0134+329',' '
calcode ' '
bif 0

```

```

eif 0
antenna 0
timer 0
snver 0
go

```

```

vlb054> GETJY1: Task GETJY (release of 31DEC10) begins
vlb054> GETJY1: Calibrator robust averaging used 800 of 800 gain
samples
vlb054> GETJY1: Source:Qual CALCODE IF Flux (Jy)
vlb054> GETJY1: 0420+417 : 2 B 1 1.41467 +/- 0.00432
0.00431
vlb054> GETJY1: 2 1.40570 +/- 0.00445
0.00445
vlb054> GETJY1: Source:Qual CALCODE used total bad used tot
bad
vlb054> GETJY1: 0420+417 : 2 B 904 904 0 100 100
0
vlb054> GETJY1: Appears to have ended successfully
vlb054> GETJY1: vlb054 31DEC10 TST: Cpu= 0.0 Real= 0 IO=
1

```

Redo the phase calibrator calibration

Now that the flux density of the phase calibrator has been found, redo its calibration (just to make sure there are no remnants of some subtle assumptions about its flux density left in AIPS).

```

inext 'sn'
inver 3
extdest
inver 0
tget calib
go
clrmsg

```

Apply the calibration to all sources of interest.

```

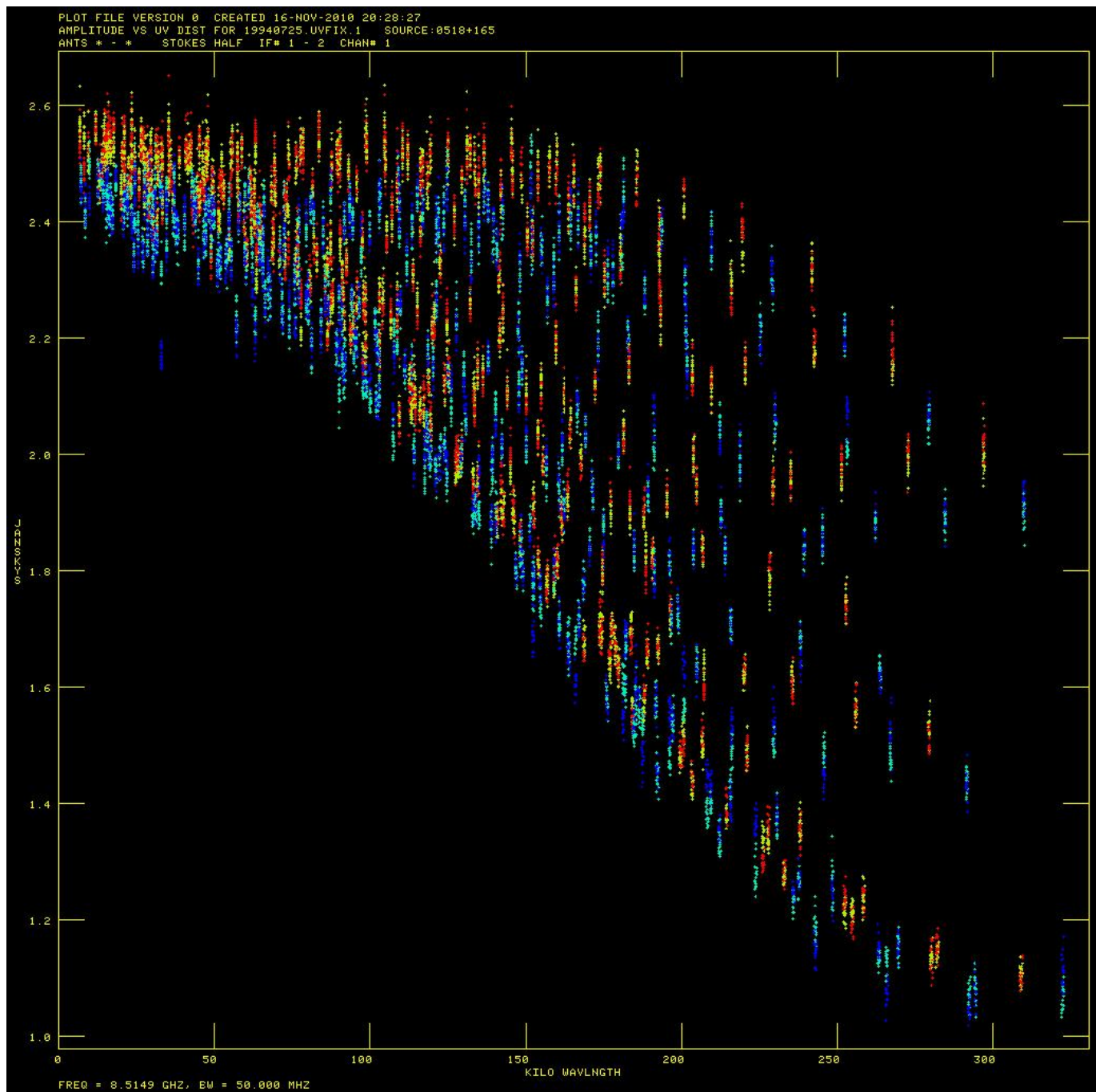
task 'clcal'
sources '0518+165','0134+329','0420+417','3C129',' '
calsour '0518+165','0134+329','0420+417',' '
opcode 'cali'
gainver 1
gainuse 2
refant 22
interp '2pt'
doblank 1
go

```

Have a look at the calibration

Plots

```
task 'uvplt'  
source '0518+165', ' '  
calcode ' '  
stokes 'half'  
timer 0  
uvrange 0  
bif 0  
eif 0  
docalib 1  
gainuse 2  
bparm 0 1  
aparm 0  
refant 22  
do3col 1  
dotv 1  
tvinit  
go
```



Why are the different colored points for the different subbands and polarizations not overlapping?

source '0134+329', ' '
 tvinit
 go



Again the different colors do not overlap. Why not?

```
source '0420+417', ' '
tvinit
go
```



But here they do overlap. Why? How has this changed from before?

```
source '3C129', ' '
tvinit
go
```



Start the polarization calibration

Check the parallactic angle change

```
task 'listr'  
sources '0518+165','0134+329','0420+417', ' '  
inext 'cl'  
inver 2  
optype 'gain'  
dparm 9,0  
stokes ' '  
go
```

Or just look at the PA plot above in the initial UVPLT section.

Make a backup of calibration values, in case we mess up

```
task 'tasav'  
clro  
outdi 1  
go
```

Now do the polarization calibration using the phase calibrator

```
task 'pcal'  
calsour '0420+417', ' '  
timer 0  
antenna 0  
uvrange 20,0  
bif 0  
eif 0  
docalib 1  
gainuse 2  
clr2n  
pmodel 0  
solint 3  
soltype 'appr'  
prtlev 1  
refant 22  
bparm 0  
cparm 0  
go  
clrmsg
```

```
vlb054> PCAL 1: Calibration source 1 0420+417  
vlb054> PCAL 1: Q+iU=( -0.01034, 0.03759) +/- ( 0.000106, 0.000106)  
Jy  
vlb054> PCAL 1: Pol. inten. = 0.03899 +/- 0.000150 Jy  
vlb054> PCAL 1: Pol. angle = 52.69 +/- 0.078 deg  
vlb054> PCAL 1: 0420+417 I,Q,U,V= 1.4671 -0.01034 0.03759  
0.00000 Jy  
vlb054> PCAL 1: Calibration source 1 0420+417  
vlb054> PCAL 1: Q+iU=( -0.03422, 0.00814) +/- ( 0.000113, 0.000113)  
Jy  
vlb054> PCAL 1: Pol. inten. = 0.03518 +/- 0.000160 Jy  
vlb054> PCAL 1: Pol. angle = 83.31 +/- 0.092 deg  
vlb054> PCAL 1: 0420+417 I,Q,U,V= 1.4715 -0.03422 0.00814  
0.00000 Jy
```

Using the calibration, check the difference between polarizations on a polarized calibrator

```
task 'rldif'
source '0518+165', ' '
timer 0
antenna 0
uvrange 0,45
docalib 1
gainuse 2
dopol true
go
```

```
Ampscalar average of matrix = -30.20( 0.091) sigma = 1.307= 1.160
Ampscalar average of matrix = 33.92( 0.103) sigma = 1.487= 1.389
```

outputs

```
AIPS 1: RLDIF: Task to return/apply Right - Left phase difference
AIPS 1: Adverbs      Values                               Comments
AIPS 1: -----
AIPS 1: CLCORPRM    -30.2029      33.9241    R-L phase difference returned
AIPS 1:              *rest 0
```

Another save, just in case

```
task 'tasav'
clro
outdi 1
go
```

What is the angle supposed to be for this calibrator?

Polarization data for C band from <http://www.vla.nrao.edu/astro/calib/polar/1999/>

Correct number is -21.71

Correct the measured values

```
for i=1 to 2;clcorp(i) = -21.71 - clcorp(i);end
```

Apply them

```
task 'clcor'
source ' '

```

```
antenna 0
timer 0
bif 0
eif 0
gainver 2
gainuse 0
opcode 'polr'
stokes 'l'
go
```

Check that the angles match what we expect

```
task 'rldif'
source '0518+165', ' '
timer 0
antenna 0
uvrange 0,45
docalib 1
gainuse 3
dopol true
go
```

Look at what AIPS gave back

outputs

```
AIPS 1: RLDIF: Task to return Right - Left phase difference
AIPS 1: Adverbs      Values      Comments
AIPS 1: -----
AIPS 1: CLCORPRM    -21.71    -21.71    R-L phase difference returned
AIPS 1:              *rest 0
```

#####

Now start with the smaller array data. Load it in

(Actually, in the 2010 Nov 16 version of these instructions, it is already loaded in slot 7. You can skip this step if you want.)

FILLM

```
task 'fillm'
default
nfiles 2
```

```

prtleve 0
datain 'PWD:AT166_
doconcat true
clron
doweight 10
ncount 1
cparm(4)=28
cparm(8)=10./60
go

```

Check where it went

```
pcat
```

```

AIPS 1: Catalog on disk 1
AIPS 1:  Cat Usid Mapname      Class  Seq  Pt      Last access      Stat
AIPS 1:   1  100 19940725      .C BAND.    1  UV  16-NOV-2010 13:15:34
AIPS 1:   2  100 19940725      .X BAND.    1  UV  16-NOV-2010 13:15:34
AIPS 1:   3  100 19940725      .X BAND.    2  UV  16-NOV-2010 13:15:34
AIPS 1:   4  100 19940725      .C BAND.    2  UV  16-NOV-2010 15:08:27
AIPS 1:   5  100 19940725      .U BAND.    1  UV  16-NOV-2010 13:15:34
AIPS 1:   6  100 19940725      .C BAND.    3  UV  16-NOV-2010 13:15:45
AIPS 1:   7  100 19940725      .C BAND.    4  UV  16-NOV-2010 16:08:46
AIPS 1:   8  100 19940725      .X BAND.    3  UV  16-NOV-2010 13:15:44
AIPS 1:   9  100 19940725      .X BAND.    4  UV  16-NOV-2010 13:15:45
AIPS 1:  10  100 3C138_C      .MODEL .    1  MA  16-NOV-2010 15:17:52
AIPS 1:  11  100 3C48_C      .MODEL .    1  MA  16-NOV-2010 15:24:38
AIPS 1:  12  100 19940725      .UVFIX .    1  UV  16-NOV-2010 16:03:44
AIPS 1:  13  100 19940725      .TASAV .    1  UV  16-NOV-2010 15:49:48

```

Makre sure we have the right one

```

getn 6
imhe

```

Get the scan information

```

task 'listr'
default
getn 7
optype 'scan'
doweight 1
go

```

```

vlb054    LISTR(31DEC10)    100    16-NOV-2010 16:10:46    Page    1
File = 19940725      .C BAND.    4 Vol = 1  Userid = 100
Freq = 7.814900000 GHz  Ncor = 4   No. vis = 313007

```

Scan summary listing

Scan	Source	Qual	Calcode	Sub	Timerange	FrqID
START VIS	END VIS					
1	0134+329	: 0001	C		1101/03:50:05 - 101/03:50:05	1
1	351					
2	0134+329	: 0001	C		1101/03:50:15 - 101/04:01:35	1
352	24492					
3	0056-001	: 0001	C		1101/04:09:15 - 101/04:11:15	1
24493	24525					
4	0053-016	: 0001			1101/04:14:05 - 101/04:22:05	1
24526	41158					
5	0053-015	: 0001			1101/04:30:55 - 101/04:38:55	1
41159	57845					
6	0056-001	: 0001	C		1101/04:47:35 - 101/04:49:36	1
57846	61842					
7	0053-016	: 0001			1101/04:52:25 - 101/05:00:25	1
61843	78492					
8	0053-015	: 0001			1101/05:09:15 - 101/05:17:15	1
78493	95142					
9	0056-001	: 0001	C		1101/05:25:55 - 101/05:27:55	1
95143	99139					
10	0053-016	: 0001			1101/05:30:45 - 101/05:38:45	1
99140	115772					
11	0053-015	: 0001			1101/05:47:35 - 101/05:55:35	1
115773	132440					
12	0056-001	: 0001	C		1101/06:04:05 - 101/06:06:14	1
132441	136762					
13	0053-016	: 0001			1101/06:09:05 - 101/06:17:05	1
136763	153395					
14	0053-015	: 0001			1101/06:25:55 - 101/06:33:55	1
153396	170063					
15	0056-001	: 0001	C		1101/06:42:35 - 101/06:44:35	1
170064	174077					
16	0053-016	: 0001			1101/06:47:25 - 101/06:55:25	1
174078	190710					
17	0053-015	: 0001			1101/07:04:15 - 101/07:12:15	1
190711	207378					
18	0056-001	: 0001	C		1101/07:20:55 - 101/07:22:55	1
207379	211375					
19	0420+417	: 0001	B		1101/07:29:35 - 101/07:31:26	1
211376	214487					
20	0518+165	: 0001	C		1101/07:36:55 - 101/07:38:55	1
214488	218426					
21	3C129	: 0001			1101/07:47:35 - 101/08:02:35	1
218427	249671					
22	0420+417	: 0001	B		1101/08:23:55 - 101/08:25:25	1
249672	252804					
23	3C129	: 0001			1101/08:29:46 - 101/08:44:45	1
252805	283300					

24	0420+417	:	0001	B	1101/08:45:45	-	101/08:47:15	1
283301	286784							
25	0420+417	:	0001	B	1101/09:13:26	-	101/09:14:55	1
286785	289484							
26	3C129	:	0001		1101/09:19:45	-	101/09:29:45	1
289485	309848							
27	0420+417	:	0001	B	1101/09:45:55	-	101/09:47:25	1
309849	313007							

Type Q to stop, just hit RETURN to continue

```
vlb054      LISTR(31DEC10)    100    16-NOV-2010  16:11:06    Page    2
File = 19940725      .C BAND.    4 Vol = 1  Userid = 100
```

Source summary

Velocity type = ' ' Definition = ' '

ID	Source	Qual	Calcode	RA(1950.0)	Dec(1950.0)	IFlux
QFlux	UFlux	VFlux	No. vis			
1	0134+329	:	0001 C	01:34:49.8320	32:54:20.520	0.000
0.000	0.000	0.000	24492			
2	0056-001	:	0001 C	00:56:31.7550	-00:09:18.750	0.000
0.000	0.000	0.000	20360			
3	0053-016	:	0001	00:53:28.0000	-01:36:45.000	0.000
0.000	0.000	0.000	83182			
4	0053-015	:	0001	00:53:52.2350	-01:31:57.790	0.000
0.000	0.000	0.000	83341			
5	0420+417	:	0001 B	04:20:27.9370	41:43:08.045	0.000
0.000	0.000	0.000	15588			
6	0518+165	:	0001 C	05:18:16.5320	16:35:26.900	0.000
0.000	0.000	0.000	3939			
7	3C129	:	0001	04:45:31.6950	44:55:19.950	0.000
0.000	0.000	0.000	82105			

ID	Source	Freq(GHz)	Velocity(Km/s)	Rest freq (GHz)
1	All Sources	7.8149	0.0000	0.0000

Frequency Table summary

FQID	IF#	Freq(GHz)	BW(kHz)	Ch.Sep(kHz)	Sideband
1	1	7.81490000	50000.0039	50000.0039	1

Get antenna positions

go prtan

Location Of VLA Antennas

N18 (26)
N16 (1)
N14 (9)
N12 (11)

```

                                N10 (15)
                                N8  (27)
                                N6  (25)
                                N4  (14)
                                N2  (13)
                                ( 3) W2    E2 ( 4)
                                (12) W4    E4 (22)
                                (21) W6    E6 (16)
                                ( 8) W8    E8 (17)
                                ( 2) W10   E10 (24)
                                (10) W12   E12 ( 5)
                                (18) W14   E14 (23)
                                (28) W16   E16 ( 7)
                                (20) W18   E18 ( 6)
                                VLA:_OUT (19)
                                VPT:_OUT (29)
```

AIPS 1: Resumes

Check out some properties of the raw data

Plots

```
task 'uvplt'
source '0518+165', ' '
calcode ' '
stokes 'half'
timer 0
uvrange 0
bif 0
eif 0
docalib 0
gainuse 1
bparm 0 1
aparm 0
refant 4
antennas 0
do3col 1
dotv 1
tvinit
go
source '0134+329', ' '
tvinit
go
source '0420+417', ' '
tvinit
go
source '3C129', ' '

```

```
tvinit
go
bparm 6 7
source '0518+165', ' '
tvinit
go
source '0134+329', ' '
tvinit
go
source '0420+417', ' '
tvinit
go
source '3C129', ' '
tvinit
go
bparm 0
```

Raw numbers

```
task 'listr'
optype 'list'
antenna 4,0
basel 0
sources '0518+165','0134+329','0420+417','3C129',' '
calcode '*'
bif 0
eif 0
docalib 0
stokes ' '
dparm 0
go

dparm 1 0
go
dparm 0
```

Flag some bad data. Just run the commands and think about this later.

```
task 'uvflg'
default
dohist 1
getn 7
antenna 4 0
basel 0
timer 101 4 0 50 101 4 5 0
stokes ' '
```

```
opcode 'flag'
reason 'bad ant
outfgver 1
go
```

Begin the calibration

Apply the flux densities for the known calibrators

```
task 'setjy'
default
getn 6
source '0518+165', ' '
bif 0
eif 0
optype 'calc'
aparm(2) 3
go
```

```
vlb054> SETJY1: Task SETJY (release of 31DEC10) 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 is available
vlb054> SETJY1: Consult the help file for CALRD for assistance
vlb054> SETJY1: / Flux calculated using known spectrum
vlb054> SETJY1: BIF = 1 EIF = 2 /Range of IFs
vlb054> SETJY1: '0518+165 ' IF = 1 FLUX = 3.7742 (Jy calcd)
vlb054> SETJY1: '0518+165 ' IF = 2 FLUX = 3.9464 (Jy calcd)
vlb054> SETJY1: / Using (1995.2) VLA or Reynolds (1934-638) coefficients
vlb054> SETJY1: Appears to have ended successfully
vlb054> SETJY1: vlb054 31DEC10 TST: Cpu= 0.0 Real= 0
```

```
bif 1
eif 1
optype ' '
zerosp 3.7742, 0.380, -0.153, 0.0
go
bif 2
eif 2
zerosp 3.9464, 0.397, -0.161, 0.0
go
```

```
bif 0
eif 0
zerosp 0
optype 'calc'
source = '0134+329', ' '
```

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: 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 = 2 /Range of IFs
vlb054> SETJY1: '0134+329 ' IF = 1 FLUX = 5.4891 (Jy calcd)
vlb054> SETJY1: '0134+329 ' IF = 2 FLUX = 5.8249 (Jy calcd)
vlb054> SETJY1: / Using (1995.2) VLA or Reynolds (1934-638) coefficients
vlb054> SETJY1: Appears to have ended successfully
vlb054> SETJY1: vlb054 31DEC08 TST: Cpu= 0.0 Real= 0
```

Run the calibration for 3C138

```
task 'calib'
default
getn 13
calsour '0518+165', ' '
uvrange 0
antenna 0
refant 4
minamper 10
minphser 10
weightit 1
get2n 6
ncomp 0
solmode 'A&P'
aparm(6) 2
solint 2
solsub 2
cparm(3) 10
cparm(4) 10
go
clrmsg
```

Calibrate the phase calibrator

```
clr2n
calsour '0420+417', ' '
solint 0
uvrange 0
go
clrmsg
```

Check the results

```
task 'snplt'
antenna 0
stokes ' '
inext 'sn'
inver 1
sources ' '
timer 0
optype 'amp'
opcode 'alsi'
do3col 1
dotv 1
nplots 9
tvinit
go
optype 'phas'
go
inver 2
optype 'amp'
go
optype 'phas'
go
```

Use the amplitude calibrator to get the phase calibrator flux density

```
task 'getjy'
sources '0420+417', ' '
calsour '0518+165', ' '
calcode ' '
bif 0
eif 0
antenna 0
timer 0
snver 0
go
```

```
vlb054> GETJY1: Task GETJY (release of 31DEC08) begins\\
vlb054> GETJY1: Source:Qual CALCODE IF Flux (Jy)
vlb054> GETJY1: 0420+417 : 3 B 1 1.33893 +/- 0.00641
vlb054> GETJY1: 2 1.34714 +/- 0.00525
vlb054> GETJY1: Appears to have ended successfully
vlb054> GETJY1: vlb054 31DEC08 TST: Cpu= 0.0 Real= 0
```

Redo the phase calibrator calibration

Now that we know the flux density of the phase calibrator, run through its calibration again, just to be sure AIPS doesn't have some information left around from calibrating before with an unknown flux density.

```
inext 'sn'  
inver 2  
extdest  
inver 0  
tget calib  
go  
clrmsg
```

Apply the calibration to all sources

```
task 'clcal'  
sources '0518+165','0420+417','3C129',' '  
calsour '0518+165','0420+417',' '  
opcode 'cali'  
gainver 1  
gainuse 2  
refant 4  
interp '2pt'  
doblank 1  
go
```

Check the results

Plots

```
task 'uvplt'  
docalib 1  
gainuse 2  
source '0420+417',' '  
stokes 'half'  
aparm 0  
bparm 0 1  
doweight 1  
uvrange 0  
tvinit  
go
```

Now start the polarization calibration

Check the parallactic angles

```
task 'litr'  
sources '0518+165','0420+417', ' '  
inext 'cl'  
inver 2  
optype 'gain'  
dparm 9,0  
go
```

Make a backup of calibration information

```
task 'tasav'  
clro  
go
```

Run the polarization calibration on the phase calibrator

```
task 'pcal'  
calsour '0420+417', ' '  
timer 0  
antenna 0  
uvrange 0  
bif 0  
eif 0  
docalib 1  
gainuse 2  
clr2n  
pmodel 0  
solint 3  
soltype 'appr'  
prtlev 1  
refant 4  
bparm 0  
cparm 0  
go  
clrmsg
```

```
vlb054> PCAL 1: Calibration source    1  
vlb054> PCAL 1:   Q+iU=(   0.00444,  -0.04706) +/- (   0.000273,   0.000273)  
Jy  
vlb054> PCAL 1:   Pol. inten. =   0.04727 +/-   0.000386 Jy, angle = -42.30  
+/-  
vlb054>           0.165 deg  
vlb054> PCAL 1: 0420+417           I,Q,U,V =   1.3389   0.00444 -0.04706  
0.00000 J
```

```

vlb054>          y
vlb054> PCAL 1: Calibration source    1
vlb054> PCAL 1:  Q+IU=(  0.02002,  0.03901) +/- (  0.000277,  0.000277)
Jy
vlb054> PCAL 1:  Pol. inten. =  0.04385 +/-  0.000392 Jy, angle =  31.42
+/-
vlb054>          0.181 deg
vlb054> PCAL 1: 0420+417              I,Q,U,V =  1.3471  0.02002  0.03901
0.00000 J
vlb054>          y

```

Check the phase difference between polarizations on a polarization calibrator

```

task 'rldif'
source '0518+165', ' '
timer 0
antenna 0
uvrange 0,45
docalib 1
gainuse 2
dopol true
go

```

outputs

```

AIPS 1: RLDIF: Task to return Right - Left phase difference
AIPS 1: Adverbs      Values                      Comments
AIPS 1: -----
AIPS 1: CLCORPRM    132.6554    -74.984    R-L phase difference returned
AIPS 1:              *rest 0

```

Make backups again

```

task 'tasav'
clro
go

```

Find out what the polarization angle on the sky is supposed to be

Polarization data for C band from <http://www.vla.nrao.edu/astro/calib/polar/1999/>

Correct number is -21.71

Correct the measured values

```

for i=1 to 2;clcorp(i) = -21.71 - clcorp(i);end

```

Apply the corrections

```
task 'clcor'  
source ' '  
antenna 0  
timer 0  
bif 0  
eif 0  
gainver 2  
gainuse 0  
opcode 'polr'  
stokes 'l'  
go
```

Check that the angles are now correct

```
task 'rldif'  
source '0518+165', ' '  
timer 0  
antenna 0  
uvrange 0,45  
docalib 1  
gainuse 3  
dopol true  
go
```

outputs

```
AIPS 1: RLDIF: Task to return Right - Left phase difference  
AIPS 1: Adverbs      Values                               Comments  
AIPS 1: -----  
AIPS 1: CLCORPRM    -21.71          -21.71      R-L phase difference returned  
AIPS 1:              *rest 0
```

#####

Work on just the target data now

Run SPLIT on the two datasets

```
task 'split'  
getn 4  
source '3C129', ' '  
timer 0  
bif 0
```

```

eif 0
docalib 1
gainuse 3
dopol true
stokes ' '
douvcomp false
aparm 0
go
getn 13
go
clrmsg

```

Check for where the new datafiles are stored

```
pcat
```

```

AIPS 1: Catalog on disk 1
AIPS 1:  Cat Usid Mapname      Class   Seq  Pt      Last access      Stat
AIPS 1:   1   101 19940725     .C BAND.    1  UV  13-NOV-2008 17:24:12
AIPS 1:   2   101 19940725     .X BAND.    1  UV  13-NOV-2008 17:24:13
AIPS 1:   3   101 19940725     .X BAND.    2  UV  13-NOV-2008 17:24:13
AIPS 1:   4   101 19940725     .C BAND.    2  UV  13-NOV-2008 18:24:07
AIPS 1:   5   101 19940725     .U BAND.    1  UV  13-NOV-2008 17:24:13
AIPS 1:   6   101 3C138_C      .MODEL .    1  MA  13-NOV-2008 17:51:33
AIPS 1:   7   101 3C48_C      .MODEL .    1  MA  13-NOV-2008 16:19:09
AIPS 1:   8   101 19940725     .TASAV .    1  UV  13-NOV-2008 17:24:13
AIPS 1:   9   101 19940725     .TASAV .    2  UV  13-NOV-2008 17:24:13
AIPS 1:  10   101 19941103     .C BAND.    1  UV  13-NOV-2008 17:24:36
AIPS 1:  11   101 19941103     .X BAND.    1  UV  13-NOV-2008 17:24:36
AIPS 1:  12   101 19941103     .X BAND.    2  UV  13-NOV-2008 17:24:36
AIPS 1:  13   101 19941103     .C BAND.    2  UV  13-NOV-2008 18:24:18
AIPS 1:  14   101 19941103     .TASAV .    1  UV  13-NOV-2008 17:54:20
AIPS 1:  15   101 19941103     .TASAV .    2  UV  13-NOV-2008 17:56:30
AIPS 1:  16   101 3C129       .SPLIT .    1  UV  13-NOV-2008 18:24:07
AIPS 1:  17   101 3C129       .SPLIT .    2  UV  13-NOV-2008 18:24:18

```

Combine the two different observations into one big one

```

task 'dbcon'
getn 16
get2n 17
go
pcat

```

```

AIPS 1:   18   101 3C129       .DBCON .    1  UV  13-NOV-2008 18:28:31

```

Imaging

IMAGR is the standard imaging tool for AIPS

This will start up an imaging/cleaning session. Draw boxes and clean the source structure. Do this for all 4 Stokes parameters. (Unfortunately, IMAGR requires separate runs for the different Stokes parameters.)

```
task 'imagr'
getn 18
stokes 'i'
dopol 0
cellsize 0.25,0.25
imsize 2048,2048
clr2n
do3dimag 1
docalib 0
uvrange 0
niter 20000
overlap 1
go
clrmsg
stokes 'q'
go
clrmsg
stokes 'u'
go
clrmsg
stokes 'v'
go
clrmsg
```

Check where the files went

pcat

AIPS 1:	29	101	3C129	.IBM001.	3	MA	13-NOV-2008	19:46:00
AIPS 1:	30	101	3C129	.ICL001.	5	MA	13-NOV-2008	19:46:00
AIPS 1:	31	101	3C129	.QBM001.	1	MA	13-NOV-2008	19:47:30
AIPS 1:	32	101	3C129	.QCL001.	1	MA	13-NOV-2008	19:47:30
AIPS 1:	33	101	3C129	.UBM001.	1	MA	13-NOV-2008	19:49:06
AIPS 1:	34	101	3C129	.UCL001.	1	MA	13-NOV-2008	19:49:06
AIPS 1:	35	101	3C129	.VBM001.	1	MA	13-NOV-2008	19:49:39
AIPS 1:	36	101	3C129	.VCL001.	1	MA	13-NOV-2008	19:49:39

Polarization images

Combine Q and U to get linear polarization

```
task 'comb'
opcode 'polc'
getn 32
get2n 34
aparm 0
bparm(1) 28E-6
bparm(2) 28E-6
go
```

Get the linear polarization angle

```
opcode 'pola'
go
```

Check where file went

```
pcat
```

AIPS 1:	28	101	3C129	.PPOLC .	1	MA	13-NOV-2008	19:59:45
AIPS 1:	37	101	3C129	.PANG .	1	MA	13-NOV-2008	20:00:28

Look at the images

Linear Polarization

```
getn 28
tvinit
tvlod
tvfiddle
tvstat
```

AIPS 1:	Mean=	1.3417E-05	rms=	2.8180E-05	JY/BEAM	over	178694.	pixels
---------	-------	------------	------	------------	---------	------	---------	--------

Polarization Angle

```
getn 37
tvinit
tvlod
tvfiddle
```

I

```
getn 30
tvinit
tvlod
tvfiddle
tvstat
```

Clip the data so we only see information where there is good S/N

```
task 'comb'
getn 37
get2n 28
opcode 'clip'
aparm(1) 100E-6
aparm(10) 100E-6
bparm 0
outclass 'PANGC'
go
task 'comb'
getn 28
get2n 28
opcode 'clip'
aparm(1) 100E-6
aparm(10) 100E-6
bparm 0
outclass 'POLCC'
go
```

Check where these files went

pcat

AIPS 1:	38	101	3C129	.PANGC .	1	MA	13-NOV-2008	20:31:21
AIPS 1:	39	101	3C129	.POLCC .	1	MA	13-NOV-2008	20:31:21

Look at the polarization angle

```
getn 38
tvinit
tvlod
tvfiddle
```

Plotting your data

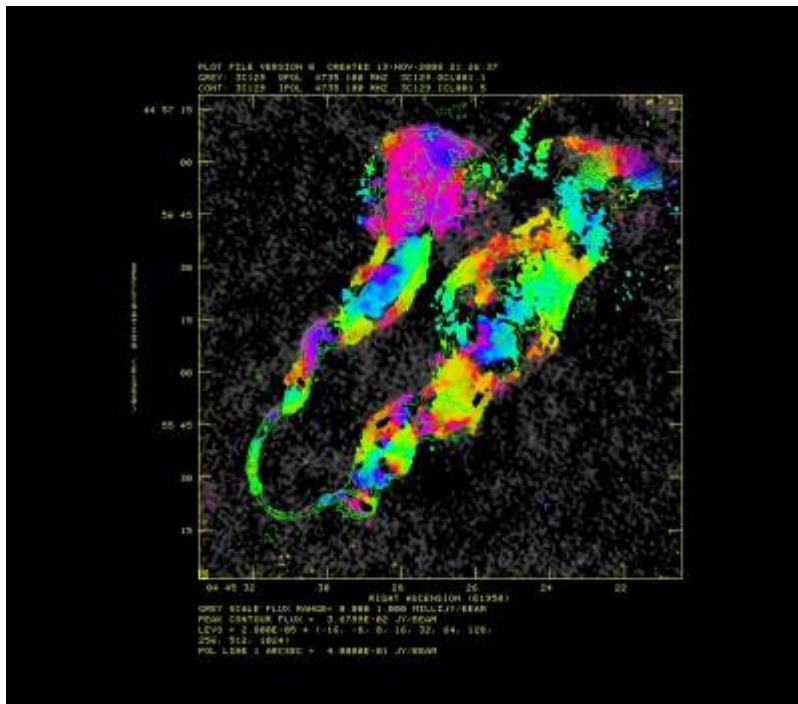
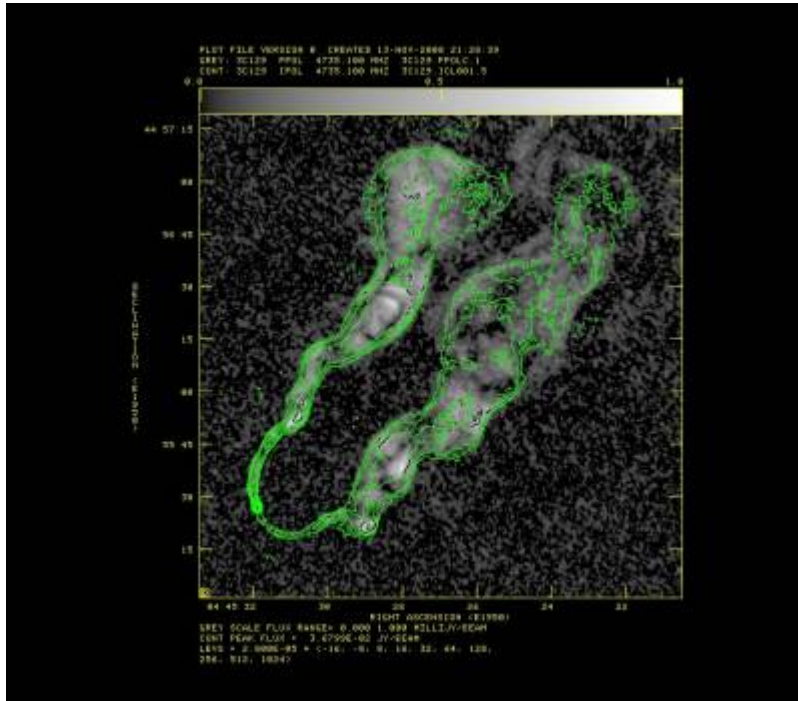
Plot I contours and P greyscale

```
task 'kntr'  
getn 30  
get2n 28  
docont 1  
dogrey 2  
dovect 0  
pixrange 0 1E-3  
clev 28E-6  
levs=-16,-8,8,16,32,64,128,256,512,1024  
dowedge true  
cbplot 1  
dotv 1  
blc 950 950  
trc 1500 1500  
go
```

Plot I contours and colors for polarization angle

```
task 'pcntr'  
getn 30  
get2n 32  
get3n 34  
docont 1  
dogrey 2  
dovect 1  
pixrange 0 1E-3  
clev 28E-6  
levs=-16,-8,8,16,32,64,128,256,512,1024  
factor 5  
pol3col 1  
pcut 80E-6  
icut 0  
dowedge 0  
cbplot 1  
dotv 1  
blc 950 950  
trc 1500 1500  
go
```

Final Images



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