

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

```

v1b054      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				
	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				
	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				
	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				
	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				
	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				
	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

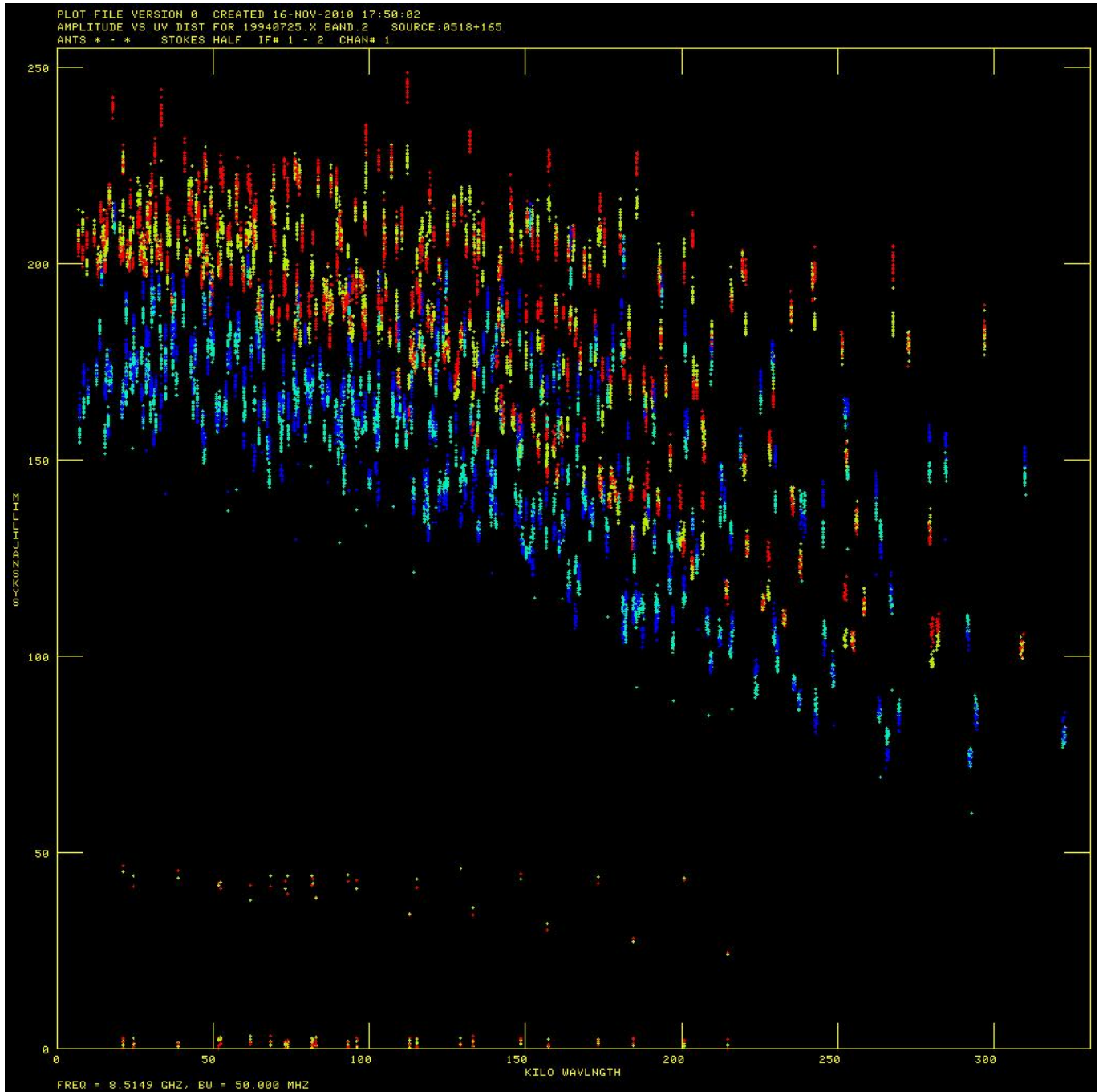
Plots

```

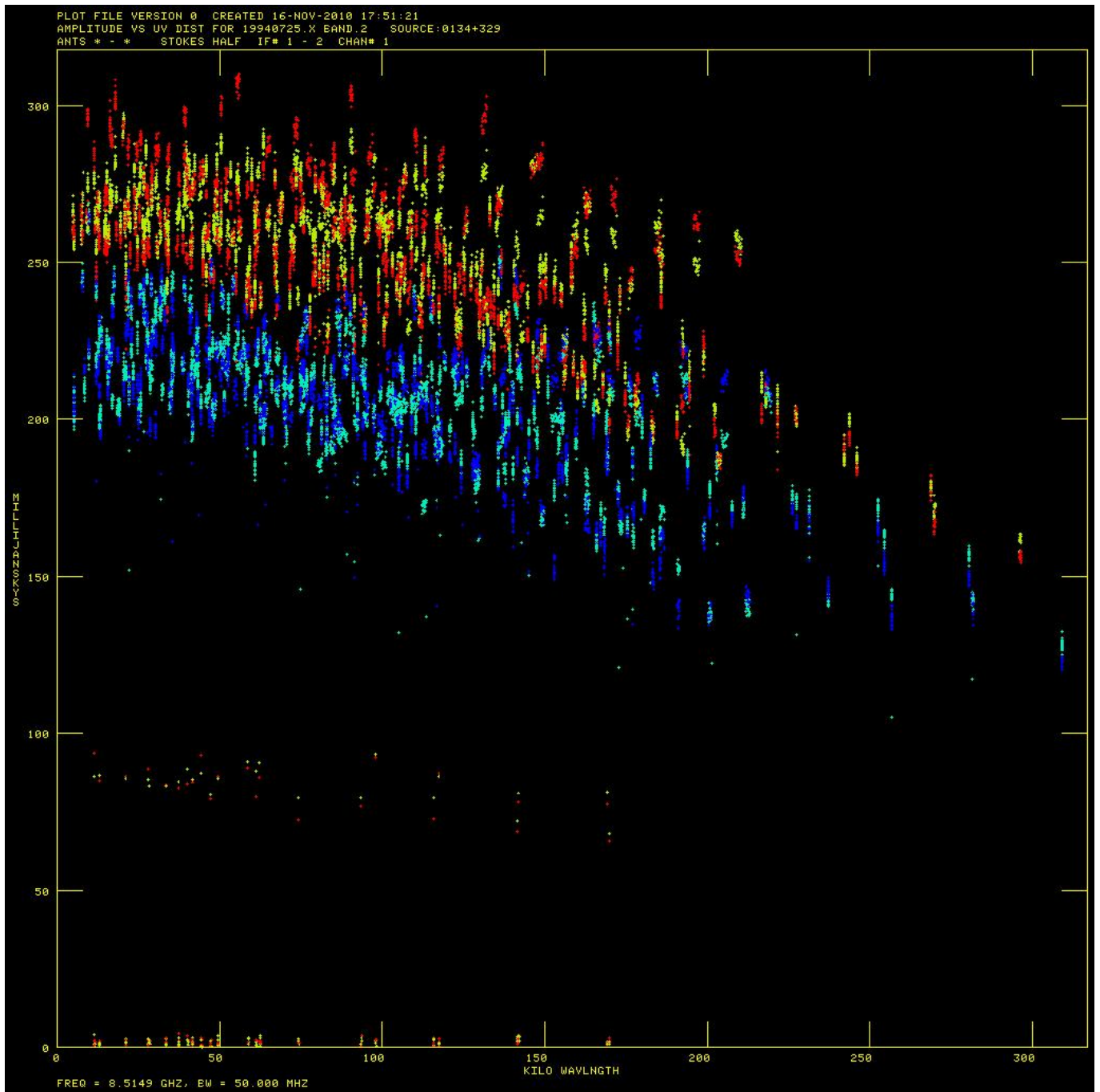
task 'uvplt'
source '0518+165',' '
calcode ' '
stokes 'half'
timer 0
uvrange 0
bif 0
eif 0

```

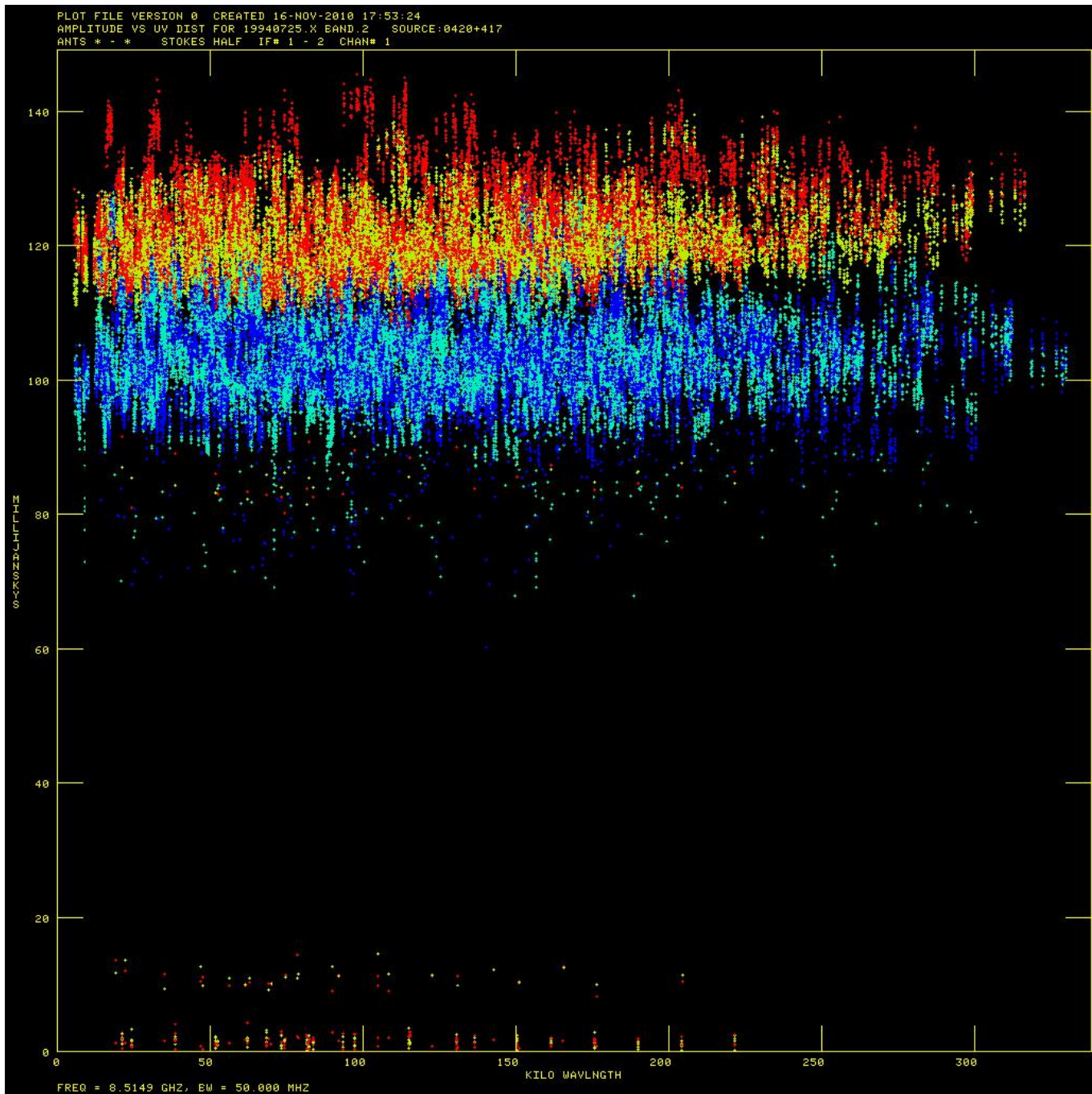
```
docalib 0  
gainuse 1  
bparm 0 1  
aparm 0  
refant 22  
do3col 1  
dotv 1  
tvinit  
go
```



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



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

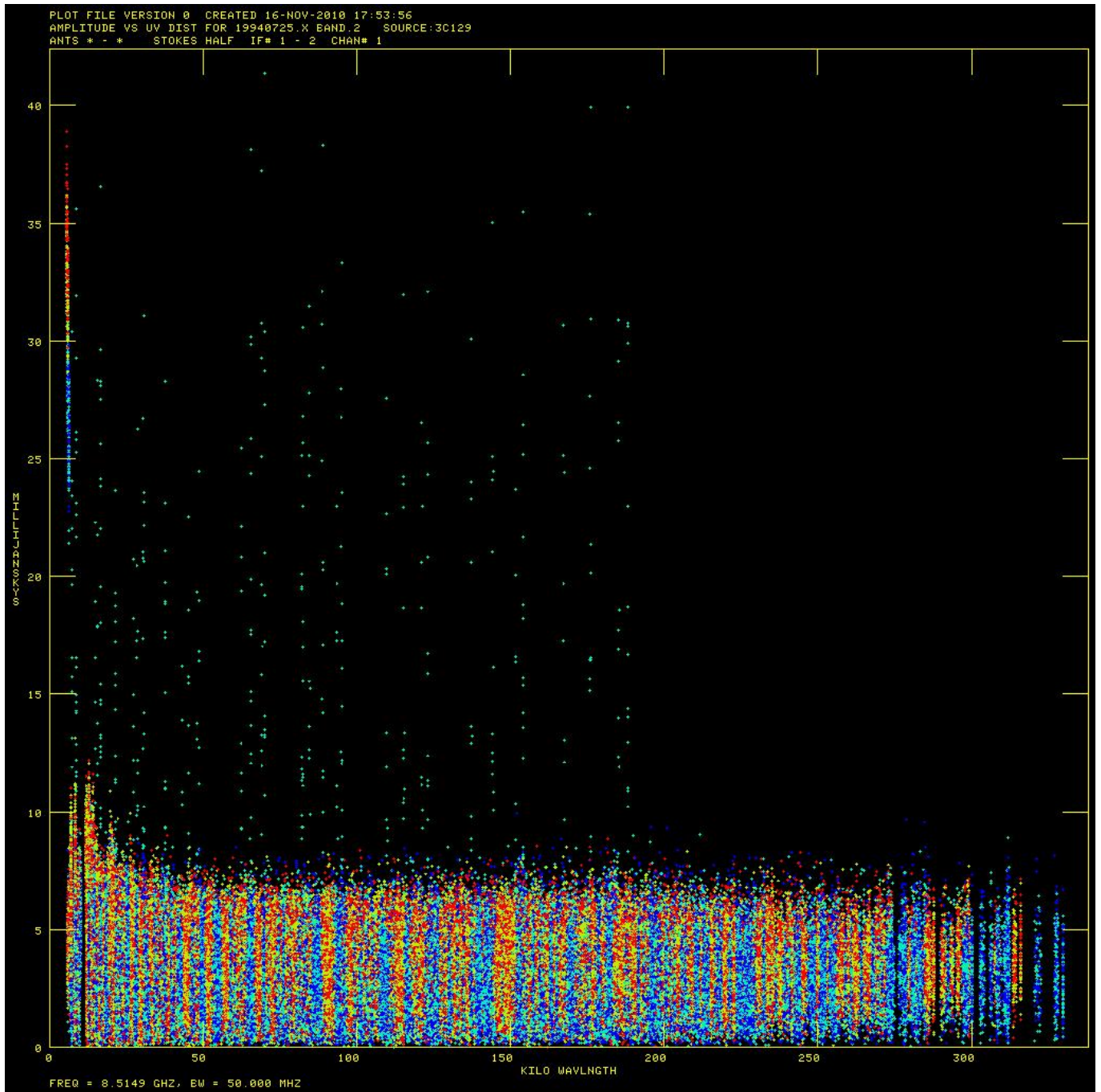
Note that the VLA Calibrator Manual says for this source:

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

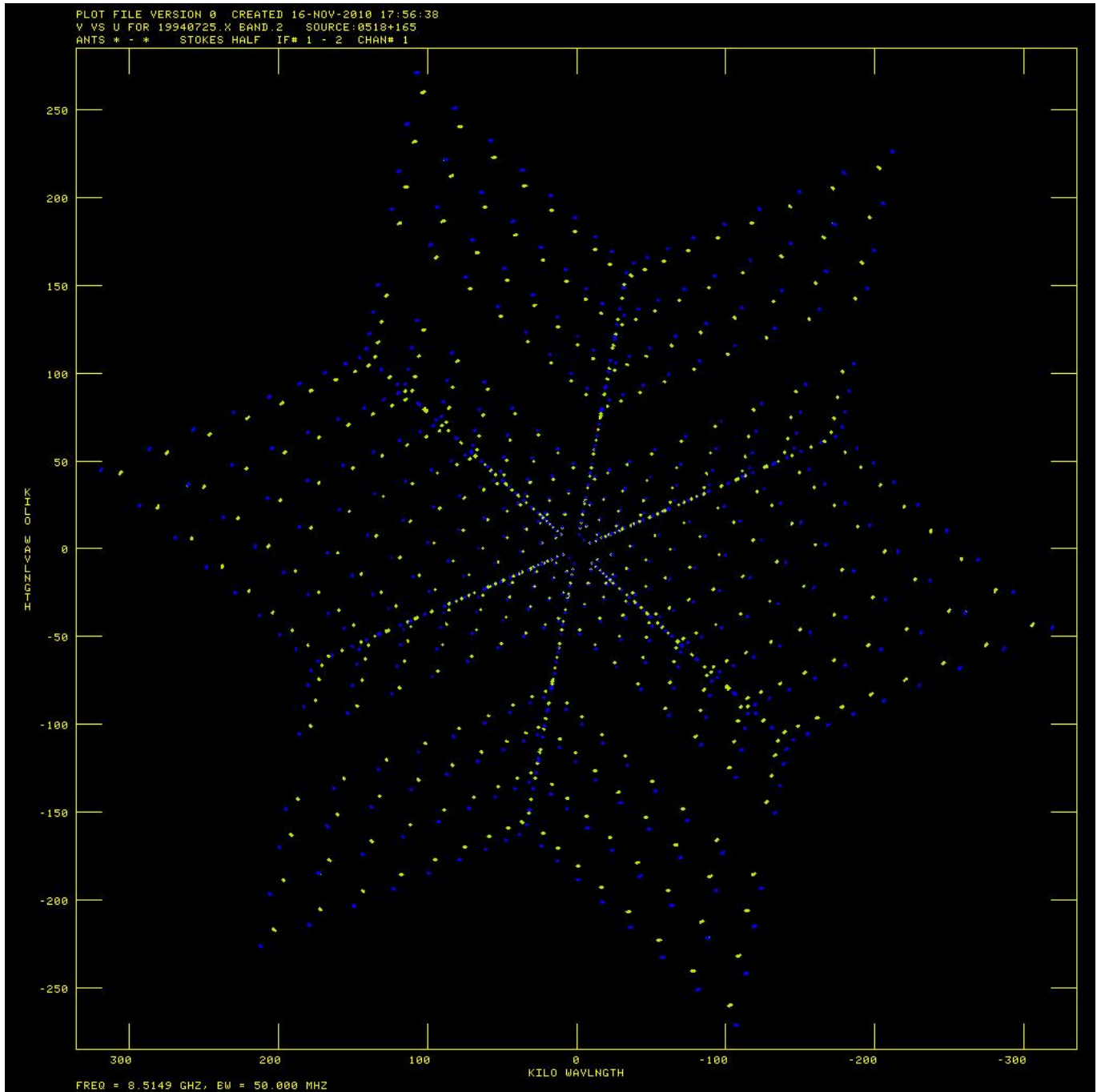
BAND	A	B	C	D	FLUX(Jy)	UVMIN(kL)	UVMAX(kL)
===== 20cm	L	X	X	P	P	2.00	visplot
3.7cm	X	P	P	P	P	1.12	visplot
2cm	U	P	P	P	P	0.72	visplot
0.7cm	Q	S	S	S	S	1.00	visplot

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?

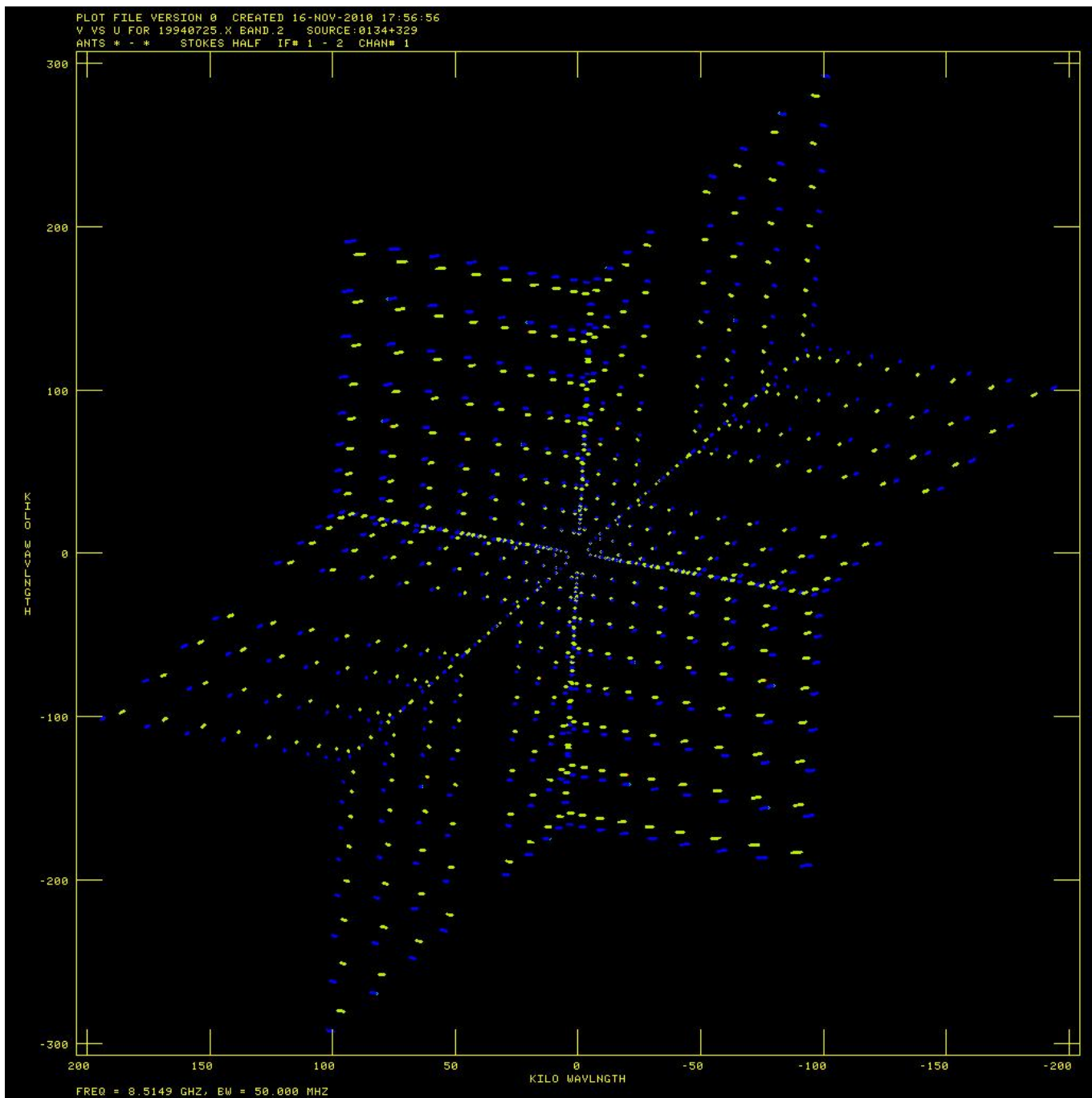
```
source '3C129', ' '  
tvinit  
go
```



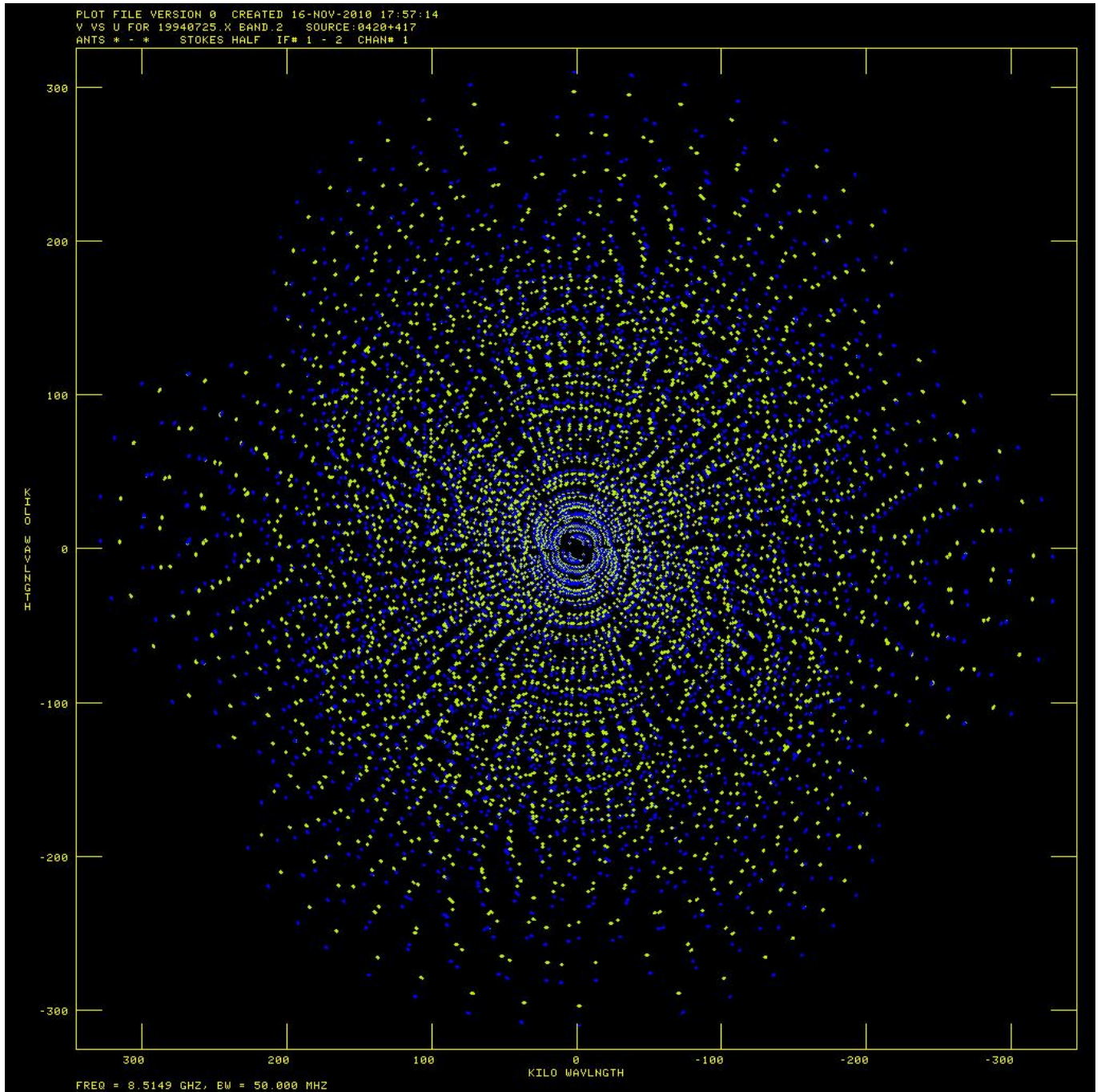
```
bparm 6 7  
source '0518+165', ' '  
tvinit  
go
```



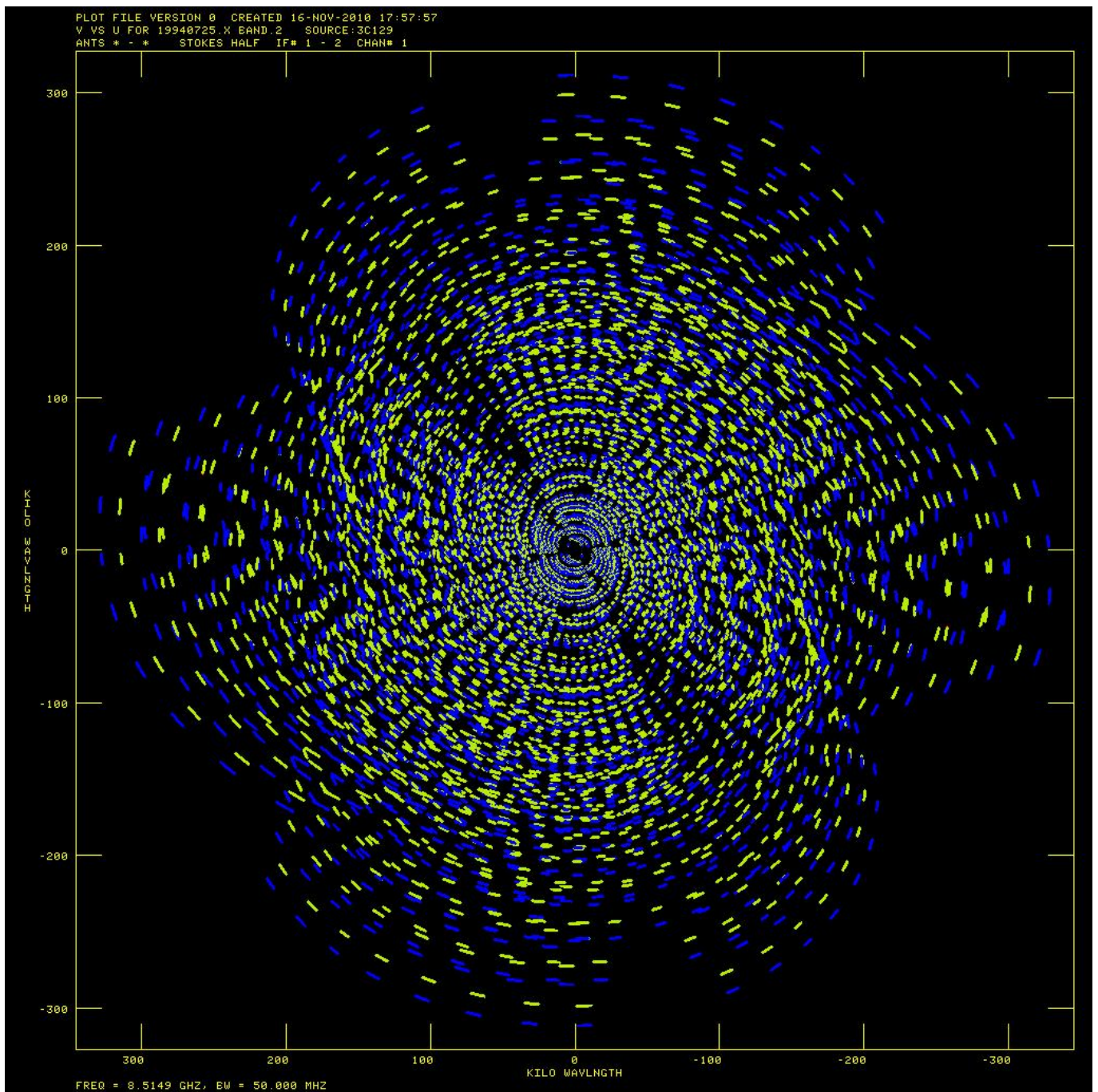
```
source '0134+329', ' '  
tvinit  
go
```



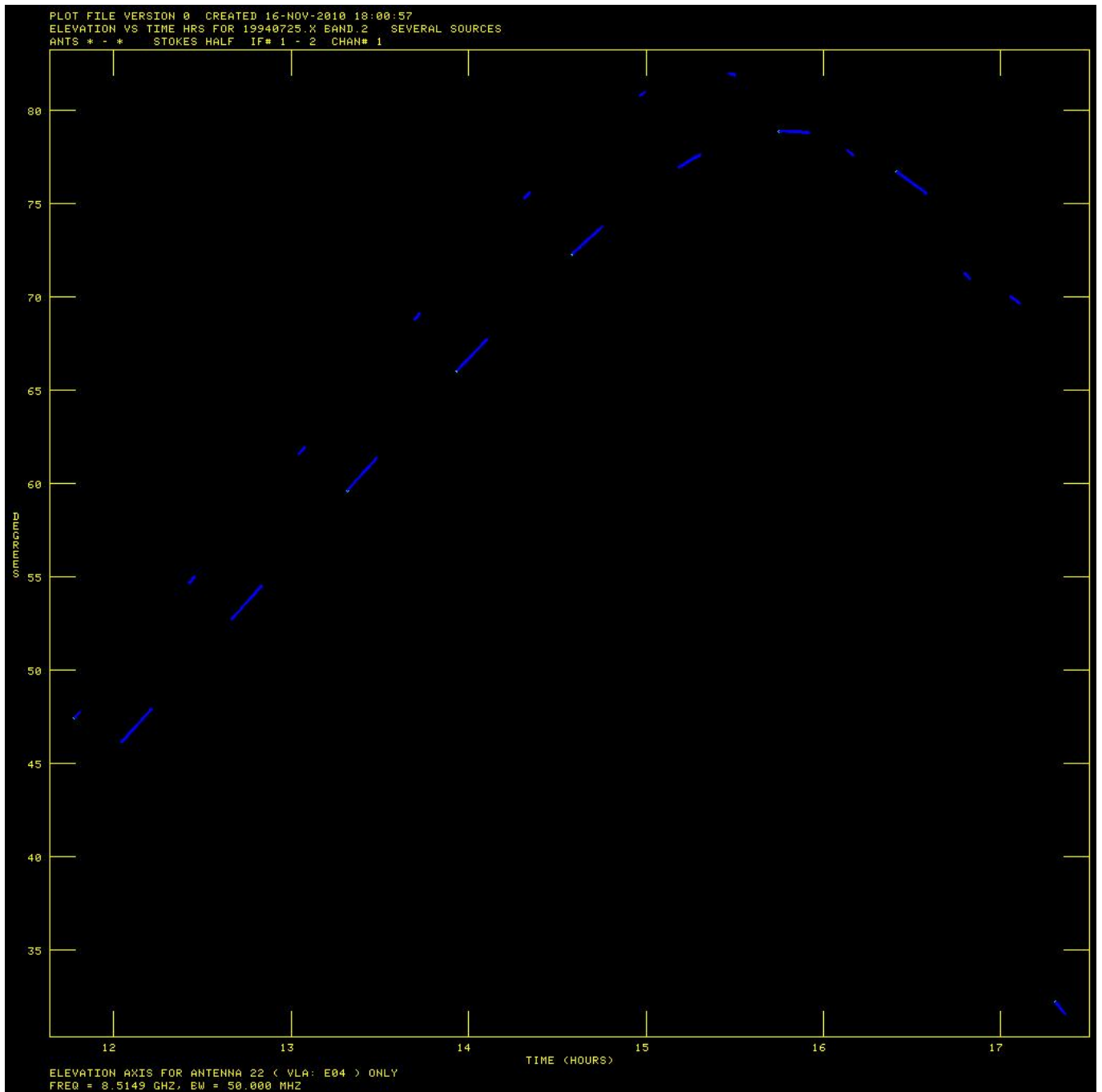
source '0420+417', ' '
tvinit
go



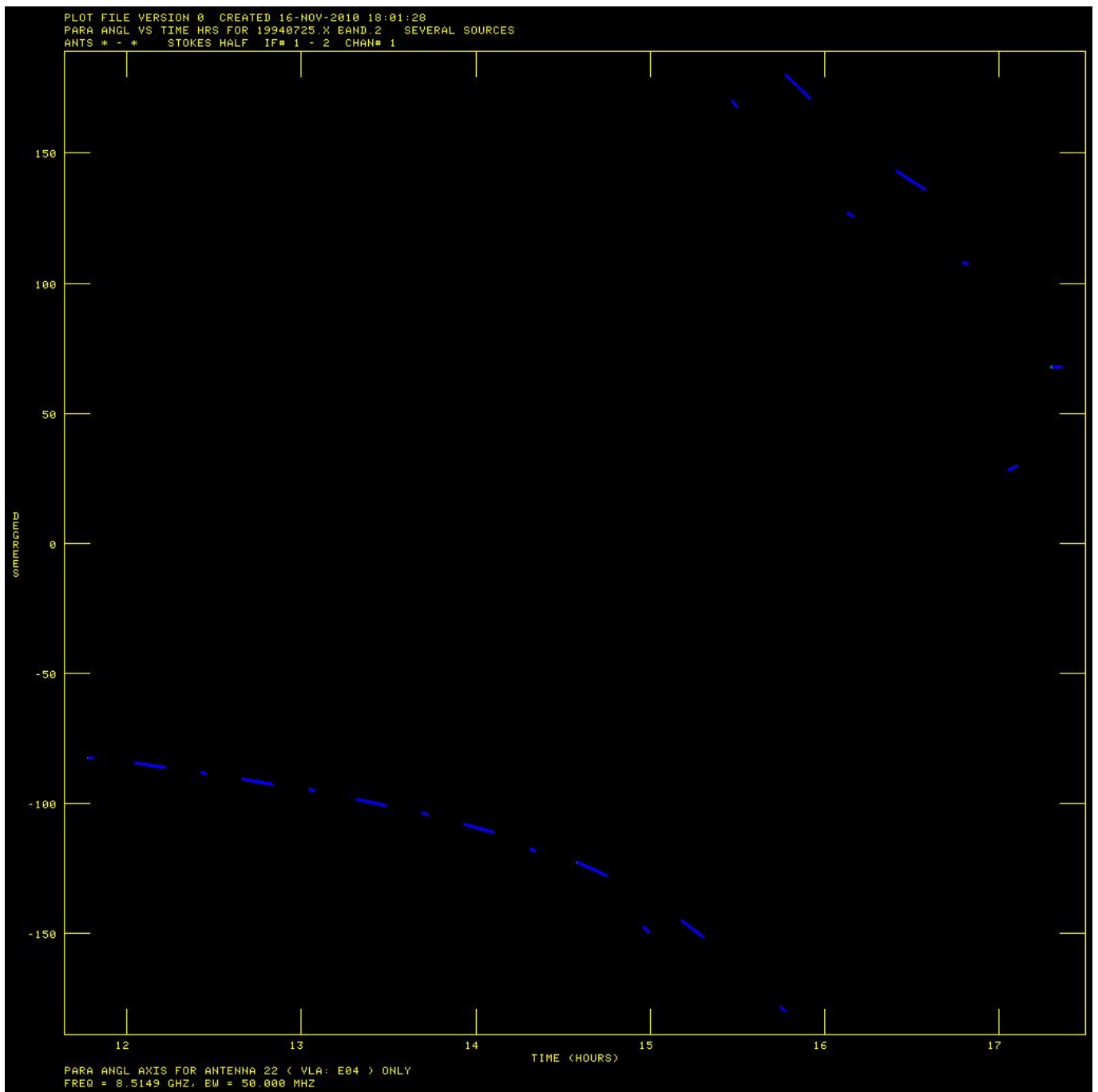
```
source '3C129', ' '  
tvinit  
go
```



```
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
```


eof 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

v1b054 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
0/17:04:35 204 187 197 206 190 170 227 208 175 225 203 208 217
194 161 210 144 189 190 193 198 206 205 209
0/17:04:45 206 188 198 208 191 169 227 206 176 226 203 207 214
197 161 211 145 190 188 191 198 206 207 211
0/17:04:55 207 188 199 207 190 170 227 207 177 224 204 206 216
196 161 210 144 191 188 191 199 205 205 209
0/17:05:05 205 186 200 207 192 171 226 205 175 225 201 207 219
196 160 210 142 189 189 191 197 209 206 212
0/17:05:15 206 190 198 208 189 171 227 208 175 224 204 205 217
197 161 207 141 189 190 191 197 208 205 211
0/17:05:25 203 189 199 205 189 169 228 207 174 224 202 204 216
195 160 206 144 188 190 188 199 204 208 213
0/17:05:35 203 189 200 206 193 170 226 208 176 226 202 205 215
196 162 207 145 188 187 191 198 206 206 207
0/17:05:45 202 188 199 207 192 170 225 205 175 223 202 204 216
196 160 208 143 188 188 190 197 208 206 213
0/17:05:55 202 189 200 207 190 170 228 206 175 223 203 205 219
195 158 208 143 190 190 191 201 207 208 210
0/17:06:05 203 188 197 207 191 173 231 206 174 221 203 203 217
194 162 208 141 189 188 191 200 205 205 211
0/17:06:15 204 187 200 206 190 170 227 206 177 222 206 205 217
196 162 206 145 189 189 191 197 202 207 209
0/17:06:25 204 190 200 208 192 173 226 207 175 220 204 207 216
194 162 210 144 188 189 190 199 206 205 212

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
0/17:18:35 247 246 256 263 275 264 291 261 253 281 270 266 271
2 236 267 219 251 287 265 261 271 285
0/17:18:45 242 241 253 262 272 261 287 256 250 280 263 265 268
1 234 264 215 250 282 262 259 243 269 282
0/17:18:55 246 241 252 265 273 263 289 257 252 280 265 265 267
2 238 264 217 248 283 262 257 243 266 282
0/17:19:05 241 239 249 260 268 264 287 257 249 279 263 263 271
3 234 262 216 223 282 262 258 244 266 279
0/17:19:15 240 239 248 257 264 257 288 255 248 277 263 259 269
84 234 262 214 245 280 262 255 240 264 280

0/17:19:25	245	235	247	259	266	261	284	257	247	276	259	262	268
259	236	261	214	246	278	258	256	239	263	277			
0/17:19:35	244	238	249	259	269	263	283	258	248	277	263	261	269
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

v1b054 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 3
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 13 25 30 0 13 27 40
go
timer 0 13 59 0 0 14 2 20
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
```

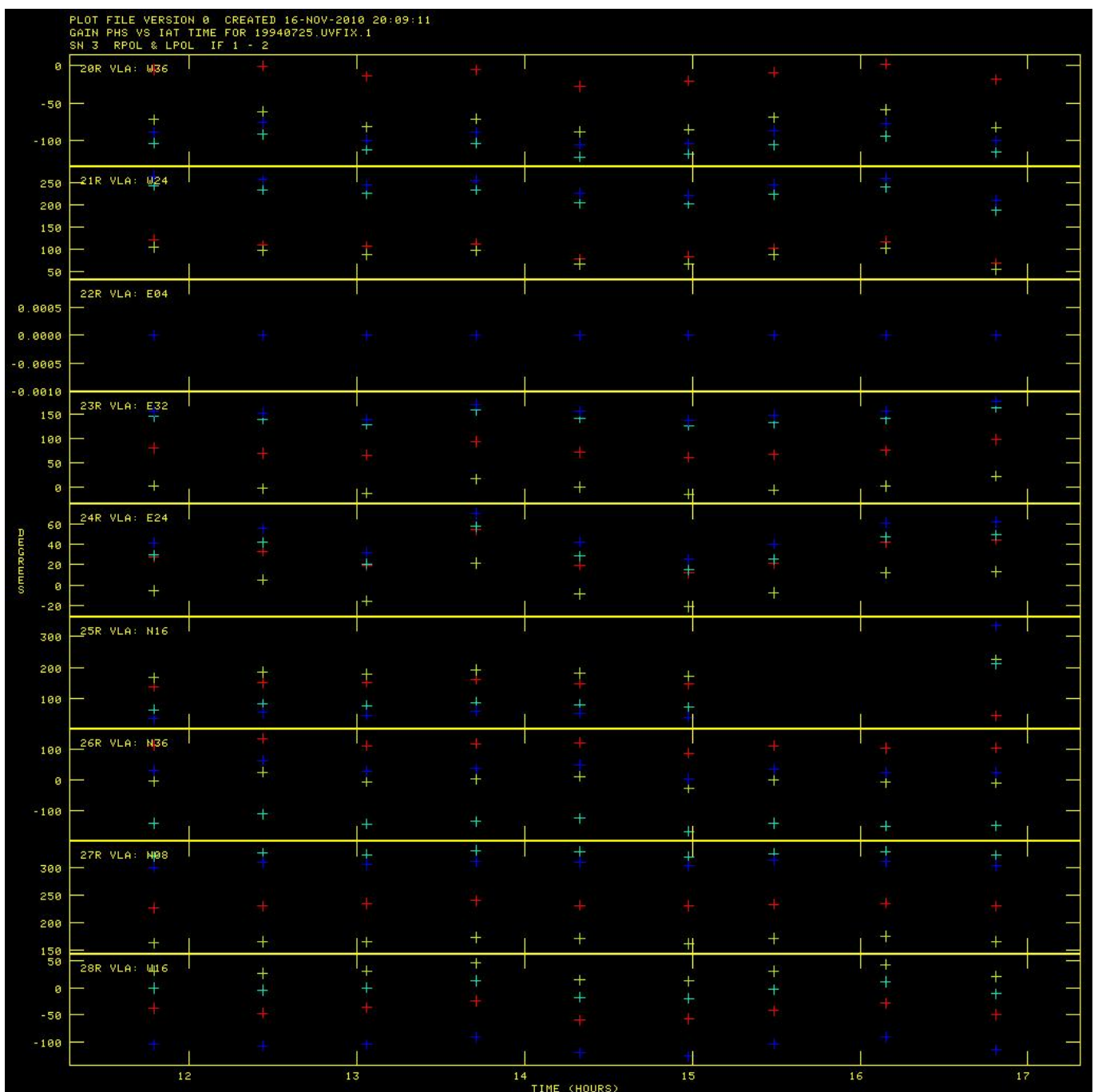
Calibrate the phase calibrator

```
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 1.40641 +/- 0.00455  
0.00455  
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.

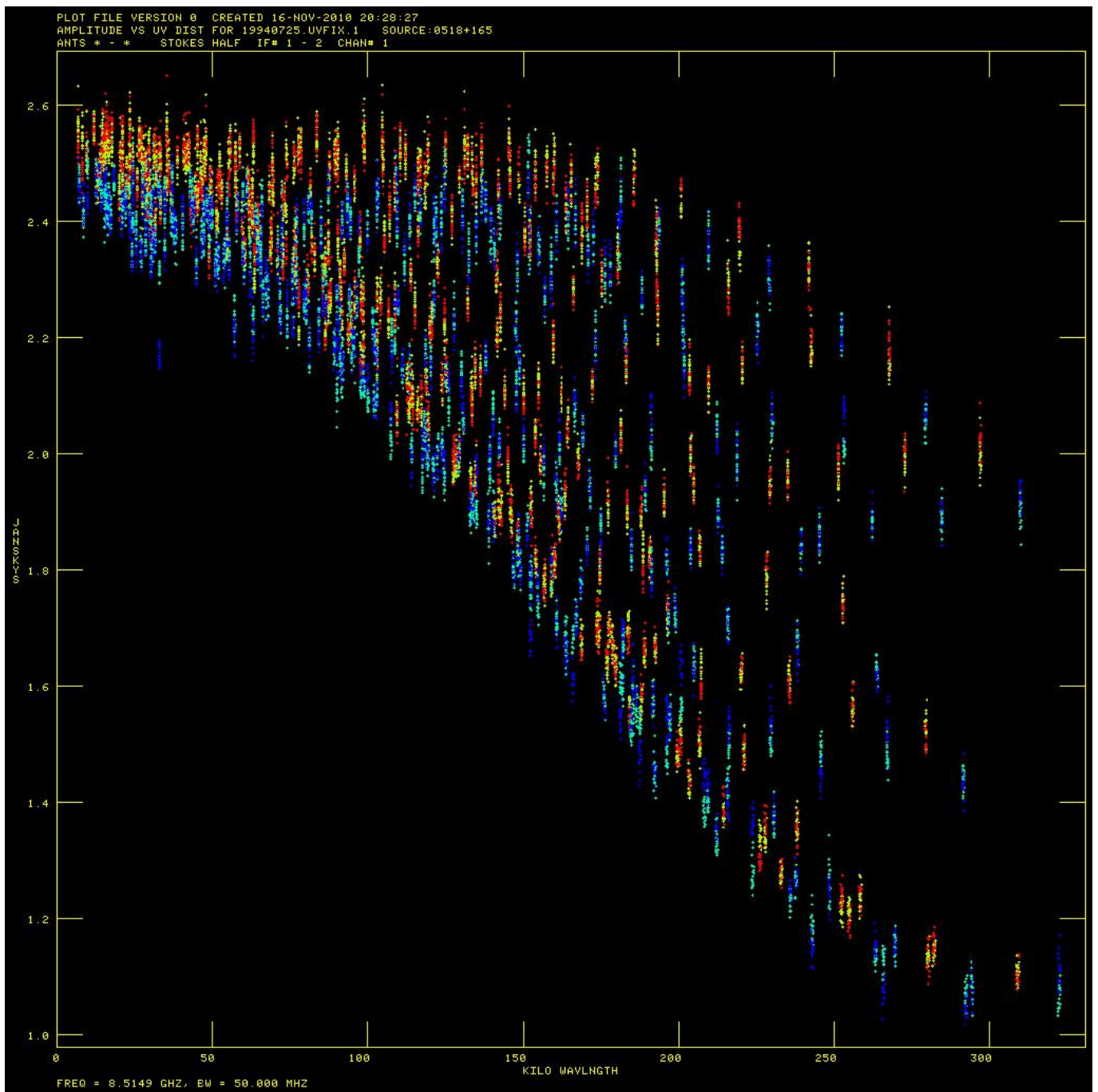
```
task 'clcal'  
sources '0518+165', '0134+329', '0420+417', '3C129', ' '
```

```
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

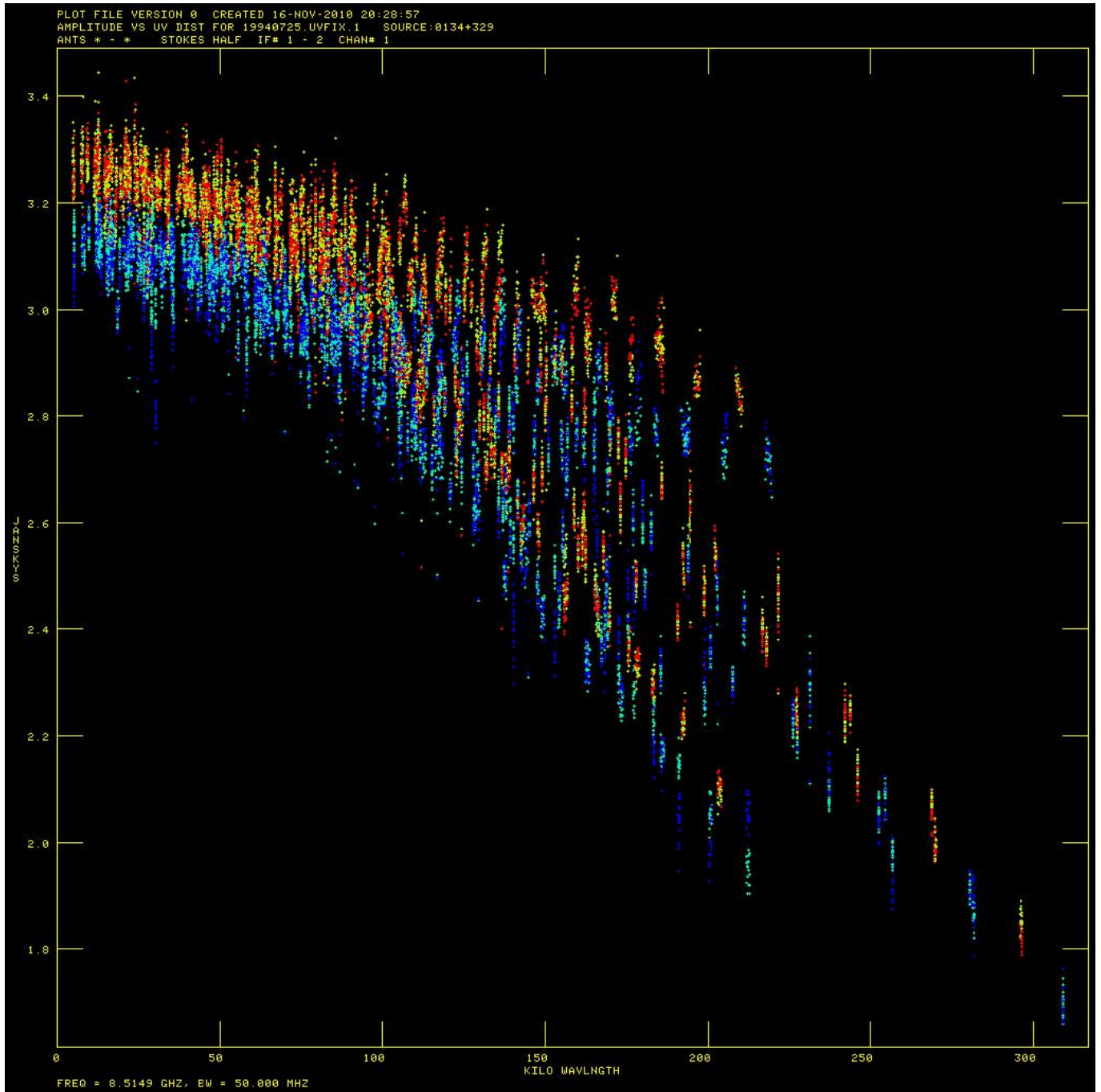
Plots

```
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
```



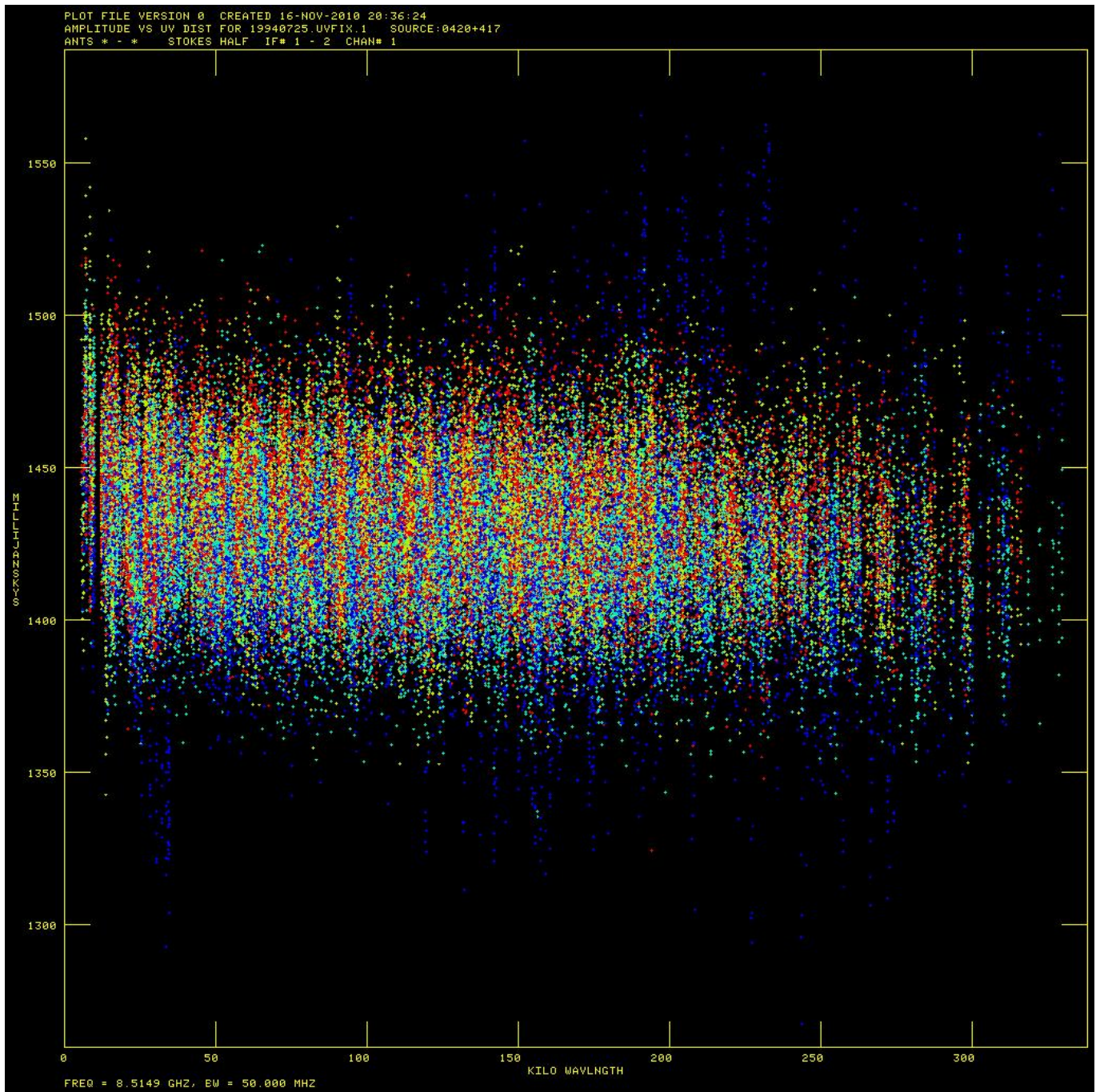
Why are the different colored points for the different subbands and polarizations not overlapping?

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



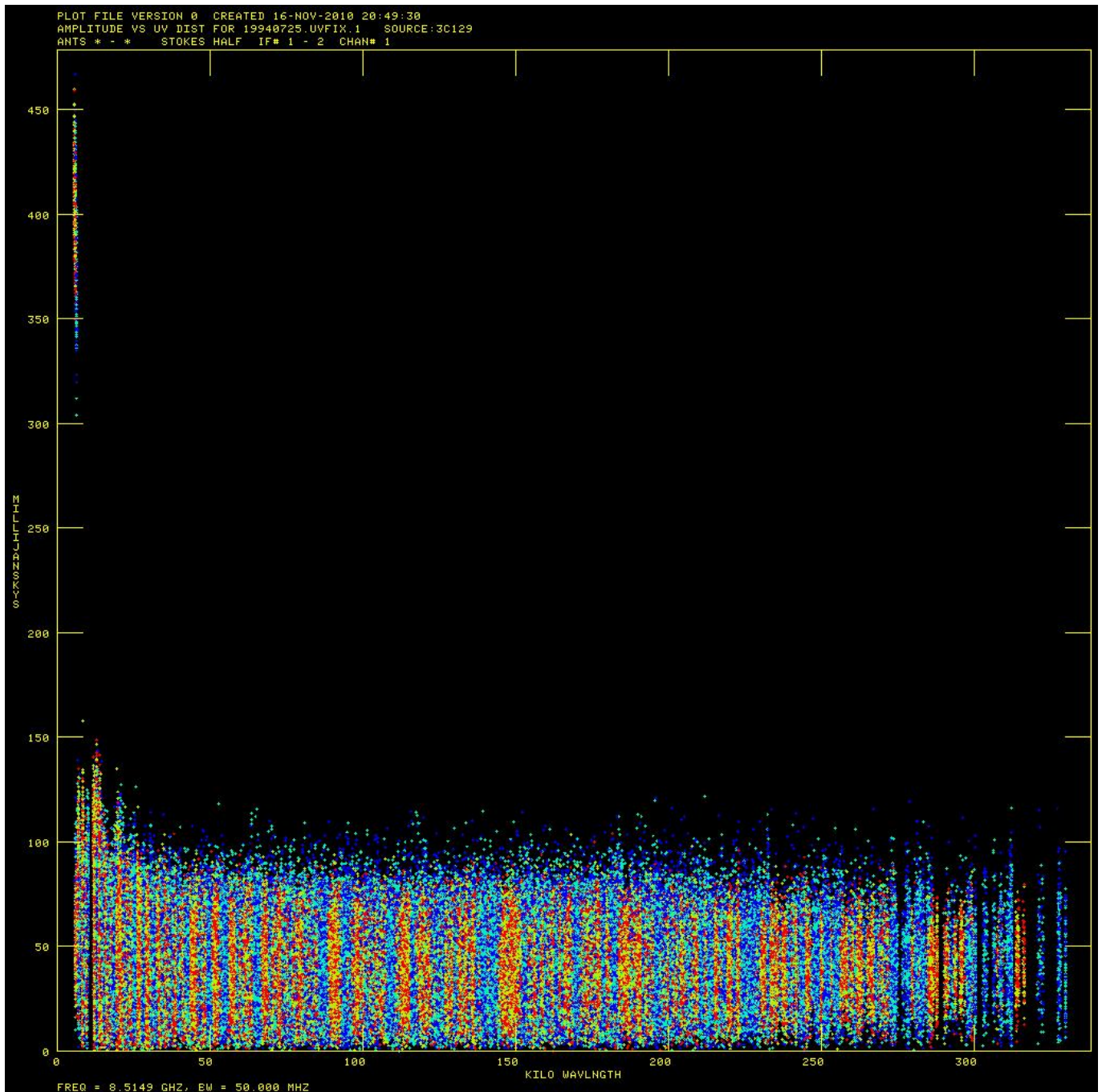
Again the different colors do not overlap. Why not?

```
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=( -0.02115, -0.06575) +/- ( 0.000088, 0.000088)  
Jy  
vlb054> PCAL 1: Pol. inten. = 0.06906 +/- 0.000124 Jy  
vlb054> PCAL 1: Pol. angle = -53.92 +/- 0.036 deg  
vlb054> PCAL 1: 0420+417 I,Q,U,V= 1.4147 -0.02115 -0.06575  
0.00000 Jy  
vlb054> PCAL 1: Calibration source 1 0420+417  
vlb054> PCAL 1: Q+iU=( 0.03641, 0.05888) +/- ( 0.000116, 0.000116)  
Jy  
vlb054> PCAL 1: Pol. inten. = 0.06922 +/- 0.000163 Jy  
vlb054> PCAL 1: Pol. angle = 29.14 +/- 0.048 deg  
vlb054> PCAL 1: 0420+417 I,Q,U,V= 1.4064 0.03641 0.05888  
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
docalib 1
gainuse 2
dopol true
go
```

```
Ampscalar average of matrix = 90.43( 0.020) sigma = 0.496
Ampscalar average of matrix = -102.71( 0.065) sigma = 1.583
```

outputs

```
AIPS 1: RLDIF: Task to return/apply Right - Left phase difference
AIPS 1: Adverbs      Values                      Comments
AIPS 1: -----
AIPS 1: CLCORPRM    90.4283    -102.7064    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 -22.98

Correct the measured values

```
for i=1 to 2;clcorp(i) = -22.98 - 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
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    -22.98      -22.98      R-L phase difference returned
AIPS 1:              *rest 0
```

Save the tables again

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

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 9. You can skip this step if you want.)

FILLM

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

Make sure we have the right one

```
getn 9
imhe
```

Get the scan information

```
task 'listr'
default
getn 9
optype 'scan'
```

doweight 1
go

vlb054 LISTR(31DEC10) 100 16-NOV-2010 21:19:54 Page 1
File = 19940725 .X BAND. 4 Vol = 1 Userid = 100
Freq = 8.514900000 GHz Ncor = 4 No. vis = 287494
Scan summary listing

Scan	Source	Qual	Calcode	Sub	Timerange	FrqID
START VIS	END VIS					
1	0134+329	: 0002	C		1101/04:01:46 - 101/04:03:55	1
1	3635					
2	0134+329	: 0002	C		1101/04:04:15 - 101/04:05:05	1
3636	5560					
3	0056-001	: 0002	C		1101/04:11:25 - 101/04:13:45	1
5561	7731					
4	0053-016	: 0002			1101/04:22:15 - 101/04:30:35	1
7732	23734					
5	0053-015	: 0002			1101/04:39:04 - 101/04:47:15	1
23735	39425					
6	0056-001	: 0002	C		1101/04:49:45 - 101/04:52:05	1
39426	43741					
7	0053-016	: 0002			1101/05:00:35 - 101/05:08:55	1
43742	59757					
8	0053-015	: 0002			1101/05:17:25 - 101/05:25:35	1
59758	74973					
9	0056-001	: 0002	C		1101/05:28:05 - 101/05:30:25	1
74974	79289					
10	0053-016	: 0002			1101/05:38:55 - 101/05:47:15	1
79290	95250					
11	0053-015	: 0002			1101/05:55:45 - 101/06:03:45	1
95251	110616					
12	0056-001	: 0002	C		1101/06:06:25 - 101/06:08:45	1
110617	114932					
13	0053-016	: 0002			1101/06:17:15 - 101/06:25:36	1
114933	130948					
14	0053-015	: 0002			1101/06:34:05 - 101/06:42:15	1
130949	146625					
15	0056-001	: 0002	C		1101/06:44:45 - 101/06:47:05	1
146626	150928					
16	0053-016	: 0002			1101/06:55:34 - 101/07:03:55	1
150929	166906					
17	0053-015	: 0002			1101/07:12:25 - 101/07:20:36	1
166907	182583					
18	0056-001	: 0002	C		1101/07:23:05 - 101/07:25:24	1
182584	186886					
19	0420+417	: 0002	B		1101/07:31:35 - 101/07:33:26	1
186887	190226					
20	0518+165	: 0002	C		1101/07:39:04 - 101/07:42:25	1

```

190227    196417
  21 3C129      : 0002      1101/08:02:45 - 101/08:17:55    1
196418    225758
  22 0420+417   : 0002 B    1101/08:25:34 - 101/08:27:25    1
225759    228387
  23 0420+417   : 0002 B    1101/08:47:25 - 101/08:49:15    1
228388    231675
  24 3C129      : 0002      1101/08:51:55 - 101/09:06:55    1
231676    260851
  25 0420+417   : 0002 B    1101/09:15:04 - 101/09:16:55    1
260852    264196
  26 3C129      : 0002      1101/09:29:56 - 101/09:40:15    1
264197    284173
  27 0420+417   : 0002 B    1101/09:47:34 - 101/09:49:25    1
284174    287494
    
```

Type Q to stop, just hit RETURN to continue

```

vlb054    LISTR(31DEC10)    100    16-NOV-2010  21:19:56    Page    2
File = 19940725    .X BAND.    4 Vol = 1    Userid = 100
    
```

Source summary

Velocity type = ' ' Definition = ' '

ID	Source	Qual	Calcode	RA(1950.0)	Dec(1950.0)	IFlux
1	0134+329	: 0002	C	01:34:49.8320	32:54:20.520	0.000
0.000	0.000	0.000	5560			
	IF(2)					0.000
0.000	0.000	0.000				
2	0056-001	: 0002	C	00:56:31.7550	-00:09:18.750	0.000
0.000	0.000	0.000	23725			
	IF(2)					0.000
0.000	0.000	0.000				
3	0053-016	: 0002		00:53:28.0000	-01:36:45.000	0.000
0.000	0.000	0.000	79974			
	IF(2)					0.000
0.000	0.000	0.000				
4	0053-015	: 0002		00:53:52.2350	-01:31:57.790	0.000
0.000	0.000	0.000	77627			
	IF(2)					0.000
0.000	0.000	0.000				
5	0420+417	: 0002	B	04:20:27.9370	41:43:08.045	0.000
0.000	0.000	0.000	15923			
	IF(2)					0.000
0.000	0.000	0.000				
6	0518+165	: 0002	C	05:18:16.5320	16:35:26.900	0.000
0.000	0.000	0.000	6191			
	IF(2)					0.000
0.000	0.000	0.000				
7	3C129	: 0002		04:45:31.6950	44:55:19.950	0.000
0.000	0.000	0.000	78494			

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

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

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
(12) W4
(21) W6
(8) W8
(2) W10
(10) W12
(18) W14
(28) W16
(20) W18
E2 (4)
E4 (22)
E6 (16)
E8 (17)
E10 (24)
E12 (5)
E14 (23)
E16 (7)
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 3
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 'quack'
reason 'quack'
sources ' '
calcode ' '
stokes ' '
timer 0
antenna 0
flagver 1
opcode 'beg'
basel 0
bif 0
EIF 0
aparm 0
aparm(2) 22.5/60
go
```

```
task 'uvflg'
default
dohist 1
getn 9
antenna 0
basel 0
timer 101 4 3 50 101 4 4 20
stokes ' '
bif 0
EIF 0
opcode 'flag'
reason 'dropout'
outfgver 1
go
timer 0
bif 0
EIF 0
antenna 0
```

Begin the calibration

Apply the flux densities for the known calibrators

```
task 'setjy'
default
getn 9
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
```

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 16
cparm 0
cparm(3)= -1
bparm 0
go
cparm 0
```

Run the calibration for 3C138

```
task 'calib'
```

```
default
getn 16
calsour '0518+165', ' '
uvrange 0
antenna 0
refant 3
minamper 10
minphser 10
weightit 1
get2n 10
ncomp 0
solmode 'A&P'
aparm(6) 2
solint 1
solsub 2
cparm(3) 10
cparm(4) 10
go
clrmsg
```

Calibrate 3C48

```
get2n 11
calsour '0134+329', ' '
solint 1
uvrange 0
go
clrmsg
```

Calibrate the phase calibrator

In this step we will try to get an amplitude calibration of the phase calibrator. Only the first scan seems to be good in amplitude, so set the time range for just it.

```
clr2n
calsour '0420+417', ' '
solint 40./60
uvrange 0
timer 101 0 0 0 101 8 0 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  
inver 3  
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','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 818 of 818 gain  
samples  
vlb054> GETJY1: Source:Qual CALCODE IF Flux (Jy)  
vlb054> GETJY1: 0420+417 : 2 B 1 1.50919 +/- 0.00369  
0.00369  
vlb054> GETJY1: 2 1.50224 +/- 0.00401  
0.00401  
vlb054> GETJY1: Source:Qual CALCODE used total bad used tot  
bad  
vlb054> GETJY1: 0420+417 : 2 B 416 416 0 104 104
```

```
0
vlb054> GETJY1: Appears to have ended successfully
vlb054> GETJY1: vlb054          31DEC10 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. This time, run through the entire time range.

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

Apply the calibration to all sources

```
task 'clcal'
sources '0518+165', '0420+417', '0134+329', '3C129', ' '
calsour '0518+165', '0420+417', '0134+329', ' '
opcode 'cali'
gainver 1
gainuse 2
refant 3
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 'listr'
sources '0518+165','0420+417', ' '
inext 'cl'
inver 2
optype 'gain'
dparm 9,0
go
```

Make a backup of calibration information

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

Run the polarization calibration on 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 3
bparm 0
cparm 0
go
clrmsg
```



```

vlb054> PCAL 1: Calibration source 1 0420+417
vlb054> PCAL 1: Q+iU=( -0.01935, 0.08692) +/- ( 0.000536, 0.000536)
Jy
vlb054> PCAL 1: Pol. inten. = 0.08905 +/- 0.000758 Jy
vlb054> PCAL 1: Pol. angle = 51.28 +/- 0.172 deg
vlb054> PCAL 1: 0420+417 I,Q,U,V= 1.5092 -0.01935 0.08692
0.00000 Jy
vlb054> PCAL 1: Calibration source 1 0420+417
vlb054> PCAL 1: Q+iU=( 0.08929, -0.01579) +/- ( 0.000699, 0.000699)
Jy
vlb054> PCAL 1: Pol. inten. = 0.09068 +/- 0.000988 Jy
vlb054> PCAL 1: Pol. angle = -5.02 +/- 0.221 deg
vlb054> PCAL 1: 0420+417 I,Q,U,V= 1.5022 0.08929 -0.01579
0.00000 Jy

```

Check the phase difference between polarizations on a polarization calibrator

```

task 'rldif'
source '0518+165', ' '
timer 0
antenna 0
uvrange 0
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    -55.2632   -171.0893   R-L phase difference returned
AIPS 1:              *rest 0

```

Make backups again

```

task 'tasav'
clro
outdi 1
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 -22.98

Correct the measured values

```
for i=1 to 2;clcorp(i) = -22.98 - 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  
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 12
source '0518+165', '0134+329', '0420+417', '3C129', ' '
timer 0
bif 0
eif 0
docalib 1
gainuse 3
dopol true
stokes ' '
douvcomp false
aparm 0
go
getn 16
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 20
```

```
get2n 26
go
pcat
```

```
AIPS 1: 27 100 3C129 .DBCON . 1 UV 16-NOV-2010 22:13:56
```

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'
default
getn 27
stokes 'i'
dopol 0
cellsize 0.15,0.15
imsize 2048,2048
clr2n
do3dimag 1
docalib 0
uvrange 0
niter 20000
overlap 1
dotv 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

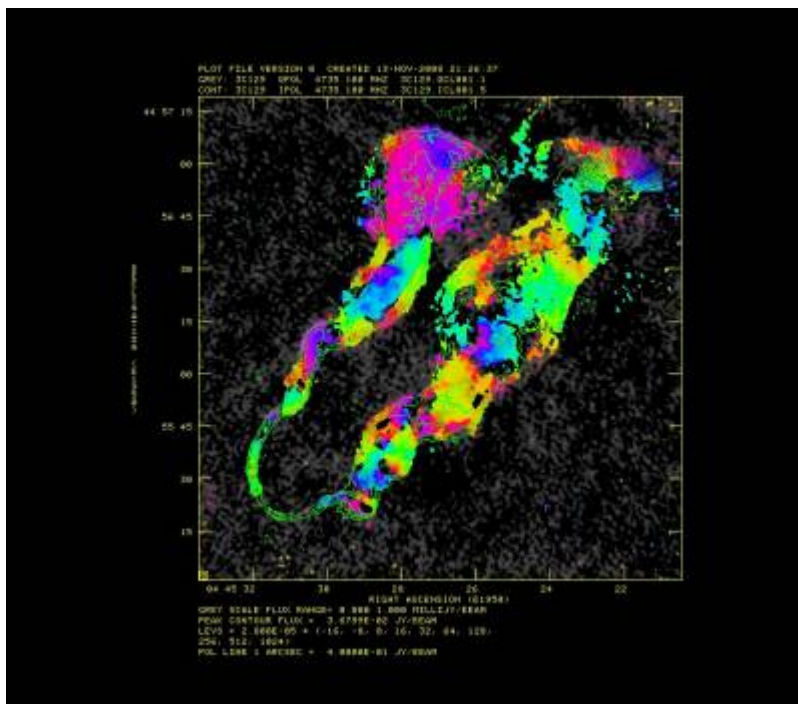
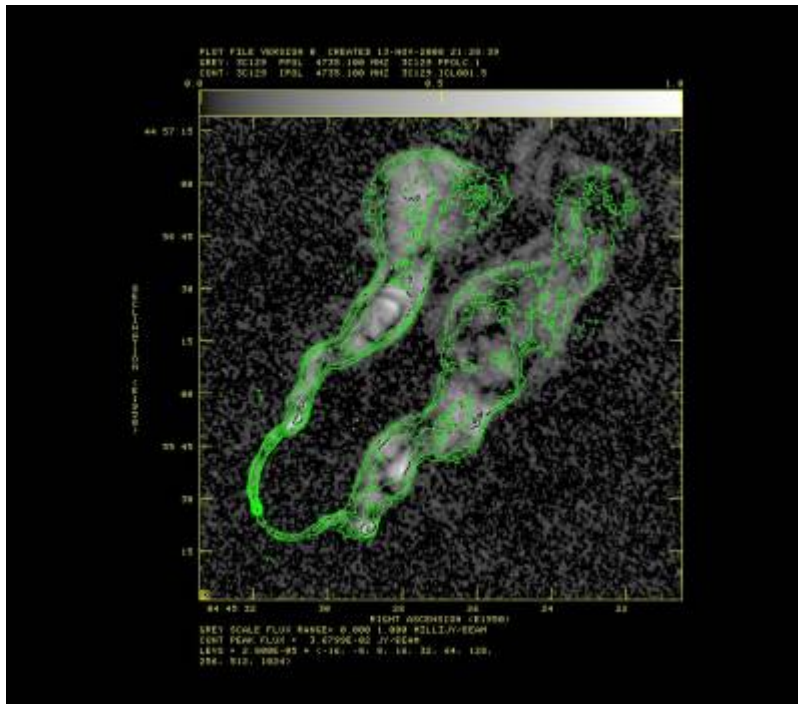
```
task 'kntr'
getn 30
get2n 28
docont 1
dogrey 2
dovect 0
pixrange 0 1E-3
clev 28E-6
levs=-16, -8, 8, 16, 32, 64, 128, 256, 512, 1024
dowedge true
cbplot 1
dotv 1
blc 950 950
trc 1500 1500
go
```

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



From:

<https://www.astron.nl/lofarwiki/> - **LOFAR Wiki**

Permanent link:

https://www.astron.nl/lofarwiki/doku.php?id=public:meetings:glowbi2008:tutorial_wednesday

Last update: **2017-03-08 15:27**

