

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 C band version at 5 GHz

```
indi 1
pcat
getn 4
imhe
```

```
<AIPS 1: Got(1)   disk= 1  user= 100   type=UV   19940725.C BAND.2
AIPS 1: Image=MULTI      (UV)           Filename=19940725   .C 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   216975       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    4.8851000E+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 4
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

```

```

AIPS 1: Got(1) disk= 1 user= 101 type=UV 19940725.C BAND.2
vlb054 LISTR(31DEC08) 101 13-NOV-2008 15:25:41 Page 1
File = 19940725 .C BAND. 2 Vol = 1 Userid = 101
Freq = 4.885100000 GHz Ncor = 4 No. vis = 216975
Scan summary listing

```

Scan	Source	Qual	Calcode	Sub	Timerange	FrqID
START VIS	END VIS					
1 2345-167		: 0003	A	1	0/07:41:45 - 0/07:43:25	1
1 2917						
2 A2597		: 0003		1	0/08:00:25 - 0/08:02:35	1
2918 6788						

3	2345-167	:	0003	A	1	0/08:21:05	-	0/08:22:45	1
6789	9709								
4	A2597	:	0003		1	0/08:39:45	-	0/08:41:55	1
9710	13605								
5	2345-167	:	0003	A	1	0/09:00:25	-	0/09:02:05	1
13606	16505								
6	A2597	:	0003		1	0/09:19:05	-	0/09:21:15	1
16506	20401								
7	2345-167	:	0003	A	1	0/09:39:45	-	0/09:41:25	1
20402	23322								
8	A2597	:	0003		1	0/09:58:25	-	0/10:00:35	1
23323	27218								
9	2345-167	:	0003	A	1	0/10:19:05	-	0/10:20:45	1
27219	30140								
10	A2597	:	0003		1	0/10:37:45	-	0/10:39:55	1
30141	34036								
11	2345-167	:	0003	A	1	0/10:58:25	-	0/11:00:05	1
34037	36957								
12	A2597	:	0003		1	0/11:17:05	-	0/11:19:15	1
36958	40832								
13	2345-167	:	0003	A	1	0/11:37:45	-	0/11:39:25	1
40833	43702								
14	0420+417	:	0003	B	1	0/11:48:25	-	0/11:50:05	1
43703	46624								
15	3C129	:	0003		1	0/12:12:55	-	0/12:23:05	1
46625	66120								
16	0420+417	:	0003	B	1	0/12:27:25	-	0/12:29:05	1
66121	69041								
17	3C129	:	0003		1	0/12:50:05	-	0/12:56:05	1
69042	80412								
18	3C129	:	0003		1	0/12:56:25	-	0/13:00:15	1
80413	88498								
19	0420+417	:	0003	B	1	0/13:04:35	-	0/13:06:15	1
88499	91419								
20	3C129	:	0003		1	0/13:29:05	-	0/13:39:15	1
91420	109415								
21	0420+417	:	0003	B	1	0/13:43:35	-	0/13:45:15	1
109416	112112								
22	3C129	:	0003		1	0/14:06:15	-	0/14:16:25	1
112113	130108								
23	0420+417	:	0003	B	1	0/14:20:45	-	0/14:22:25	1
130109	132636								
24	3C129	:	0003		1	0/14:45:15	-	0/14:55:25	1
132637	150081								
25	0420+417	:	0003	B	1	0/14:59:45	-	0/15:01:25	1
150082	152778								
26	3C129	:	0003		1	0/15:18:25	-	0/15:25:35	1
152779	164366								
27	0420+417	:	0003	B	1	0/15:30:05	-	0/15:31:45	1
164367	166846								

28 3C129	: 0003	1	0/15:55:05 -	0/16:05:15	1
166847 183403					
29 0420+417	: 0003 B	1	0/16:10:05 -	0/16:11:45	1
183404 185861					
30 3C129	: 0003	1	0/16:34:55 -	0/16:45:05	1
185862 203522					
31 0420+417	: 0003 B	1	0/16:49:35 -	0/16:51:15	1
203523 206216					
32 0518+165	: 0003 C	1	0/17:06:35 -	0/17:09:45	1
206217 211608					
33 0134+329	: 0003 C	1	0/17:21:45 -	0/17:24:55	1
211609 216975					

Source summary

Velocity type = ' ' Definition = ' '

ID	Source	Qual	Calcode	RA(1950.0)	Dec(1950.0)	IFlux
QFlux	UFlux	VFlux	No. vis			
1	2345-167	: 0003	A	23:45:27.6823	-16:47:52.600	0.000
0.000	0.000	0.000	20372			
	IF(2)					0.000
0.000	0.000	0.000				
2	A2597	: 0003		23:22:43.7000	-12:23:56.000	0.000
0.000	0.000	0.000	23330			
	IF(2)					0.000
0.000	0.000	0.000				
3	0420+417	: 0003	B	04:20:27.9370	41:43:08.045	0.000
0.000	0.000	0.000	24318			
	IF(2)					0.000
0.000	0.000	0.000				
4	3C129	: 0003		04:45:31.6950	44:55:19.950	0.000
0.000	0.000	0.000	138196			
	IF(2)					0.000
0.000	0.000	0.000				
5	0518+165	: 0003	C	05:18:16.5320	16:35:26.900	0.000
0.000	0.000	0.000	5392			
	IF(2)					0.000
0.000	0.000	0.000				
6	0134+329	: 0003	C	01:34:49.8320	32:54:20.520	0.000
0.000	0.000	0.000	5367			
	IF(2)					0.000
0.000	0.000	0.000				

ID	Source	Freq(GHz)	Velocity(Km/s)	Rest freq (GHz)
1	All Sources	4.8851	0.0000	0.0000
	IF(2)	4.5851	0.0000	0.0000

Frequency Table summary

FQID	IF#	Freq(GHz)	BW(kHz)	Ch.Sep(kHz)	Sideband
1	1	4.88510000	50000.0039	50000.0039	1
	2	4.58510000	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)
```

Flag some bad data. Just run the commands.

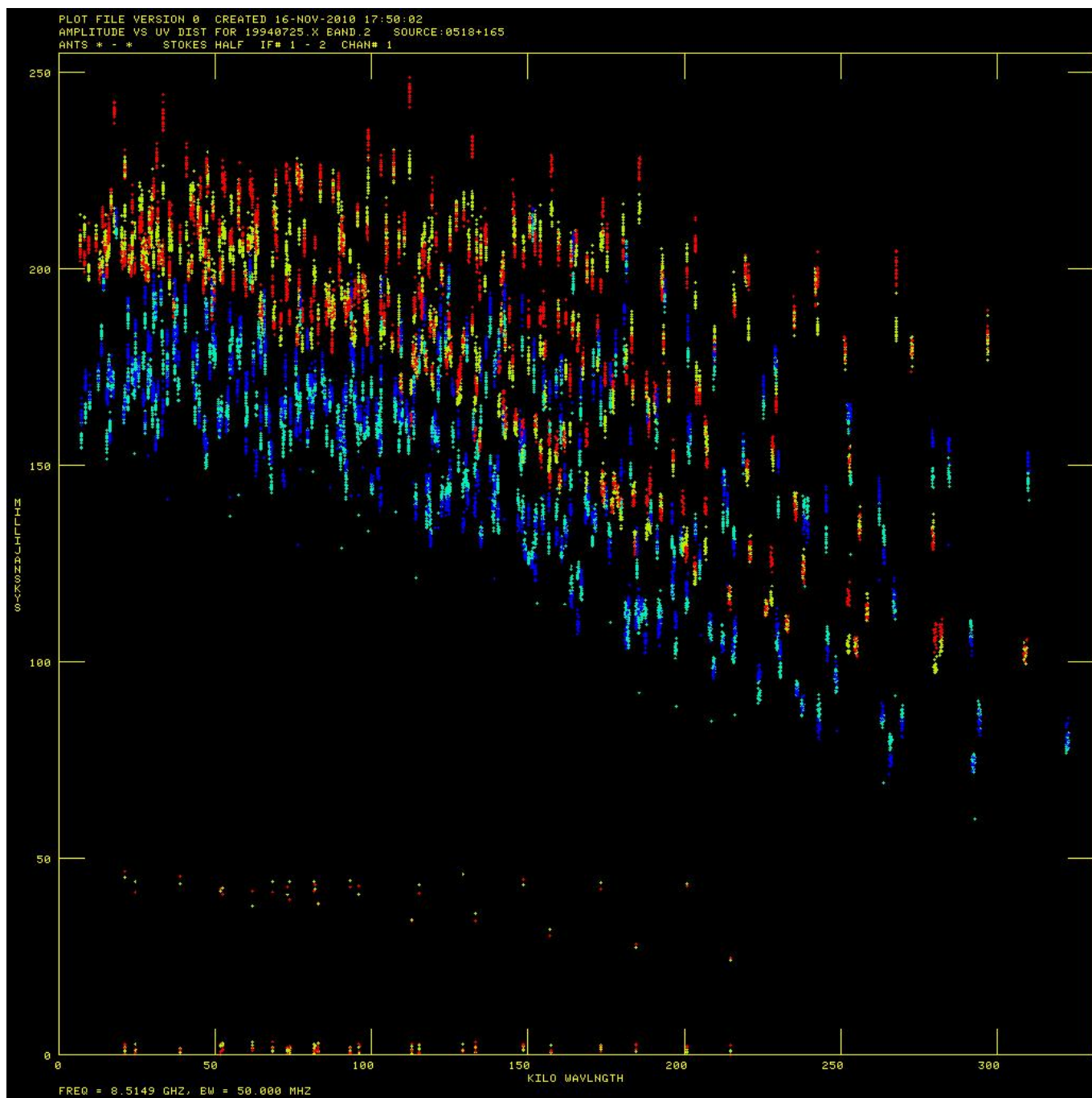
```
task 'uvflg'
default
dohist 1
getn 4
antenna 1,0
basel 0
timer 0 13 45 20 0 15 0 0
stokes ' '
opcode 'flag'
reason 'bad ant'
outfgver 1
go
antenna 14,0
timer 0 16 50 50 0 16 51 0
go
```

timer 0

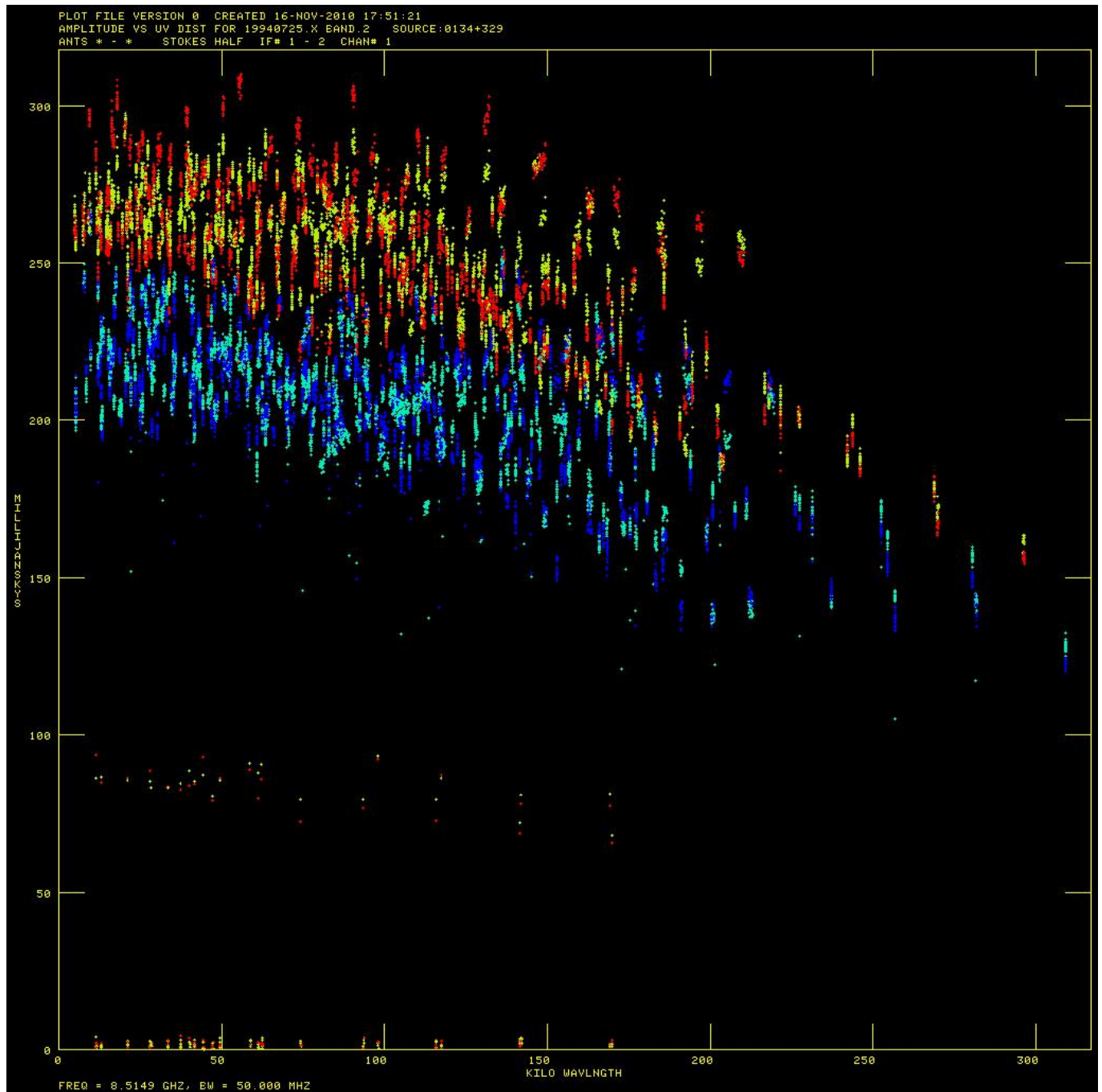
Investigate the data

Plots

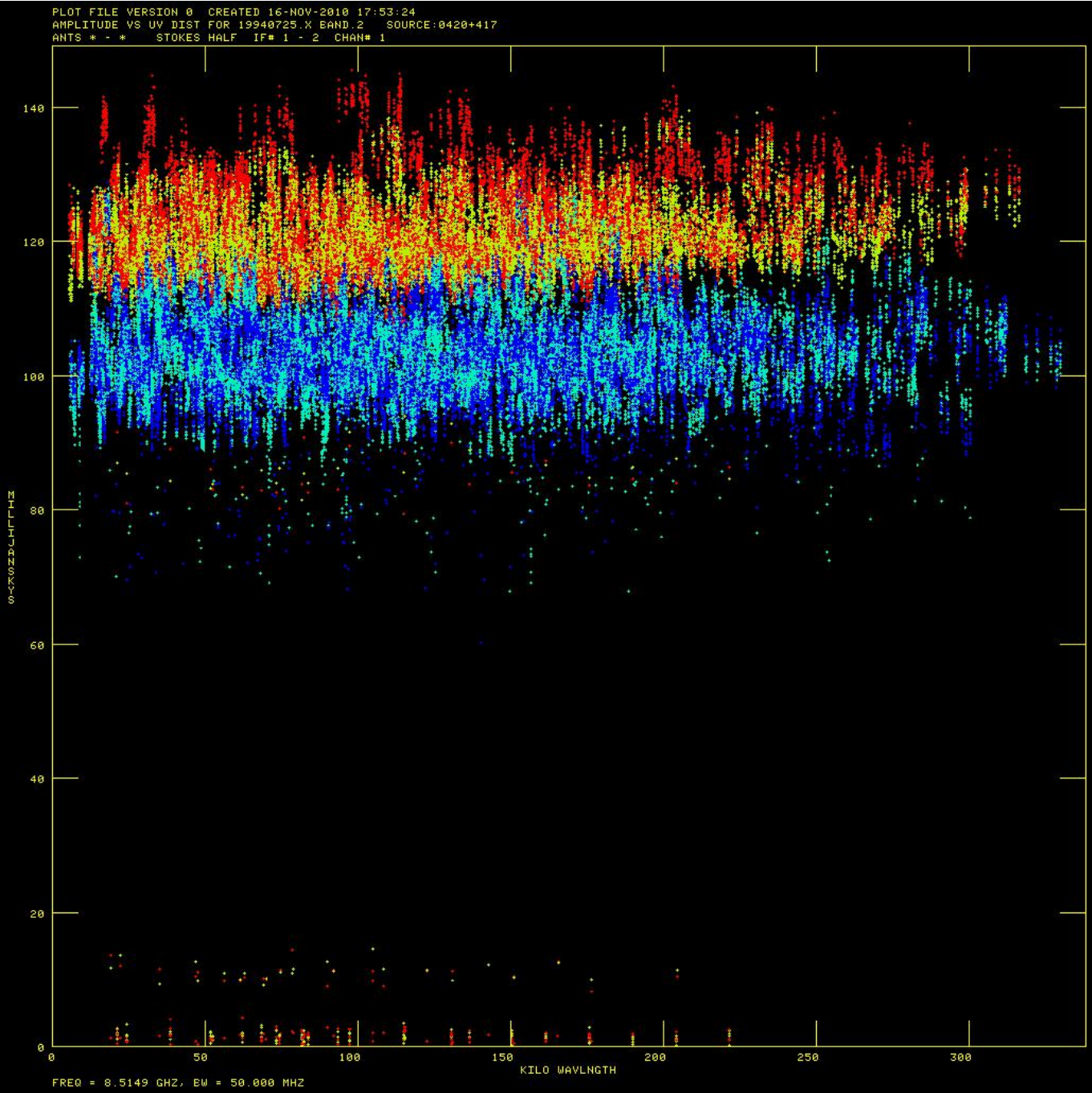
```
task 'uvplt'  
source '0518+165', ' '  
calcode ' '  
stokes 'half'  
timer 0  
uvrange 0  
bif 0  
eif 0  
docalib 0  
gainuse 1  
bparm 0 1  
aparm 0  
refant 22  
do3col 1  
dotv 1  
tvinit  
go
```



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



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



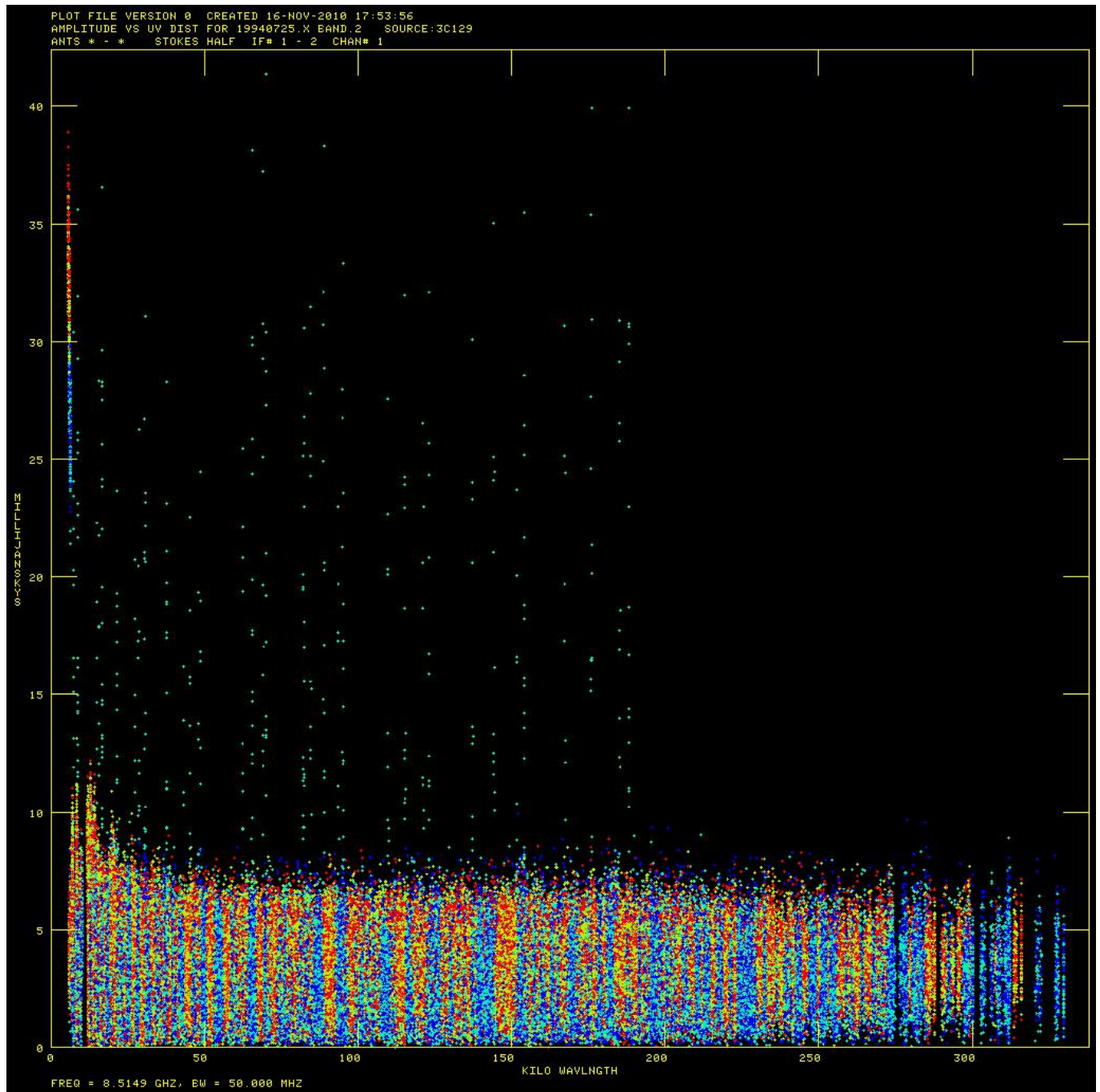
Note that the VLA Calibrator Manual says for this source:

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

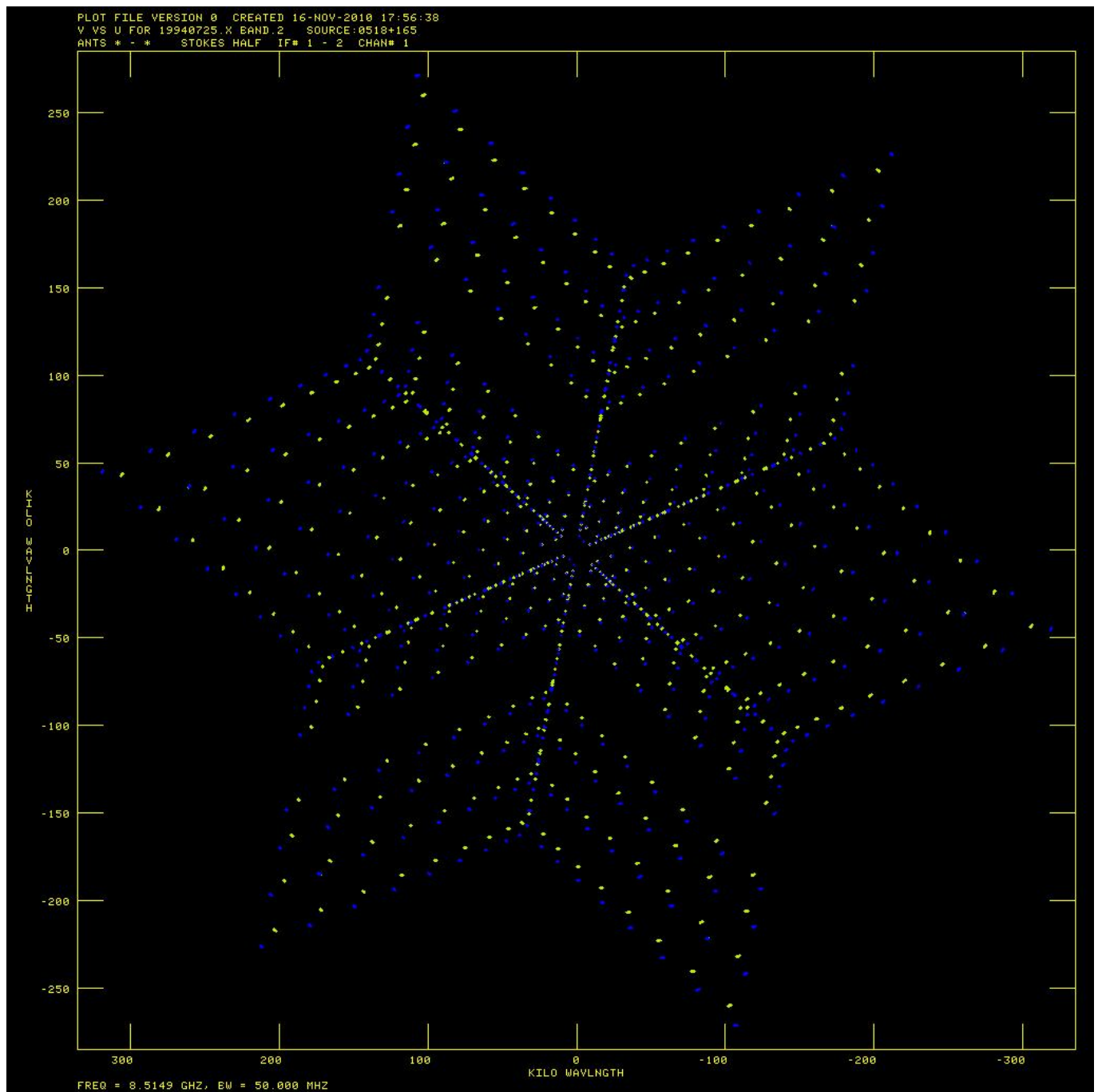
BAND	A	B	C	D	FLUX(Jy) UVMIN(kL) UVMAX(kL)
=====					
20cm	L	X	X	P	2.00 visplot
3.7cm	X	P	P	P	1.12 visplot
2cm	U	P	P	P	0.72 visplot
0.7cm	Q	S	S	S	1.00 visplot

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?

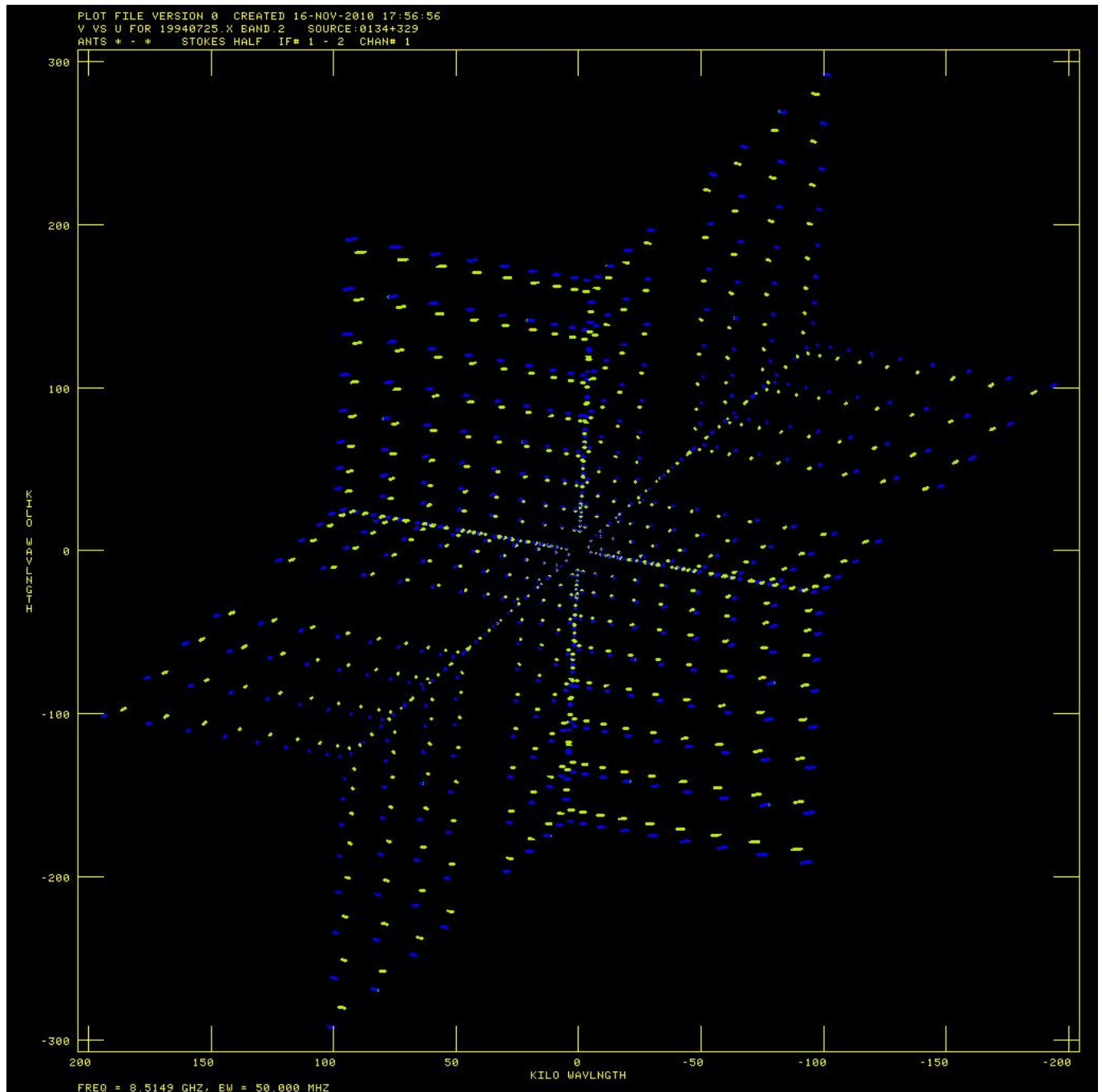
```
source '3C129', ' '
tvinit
go
```



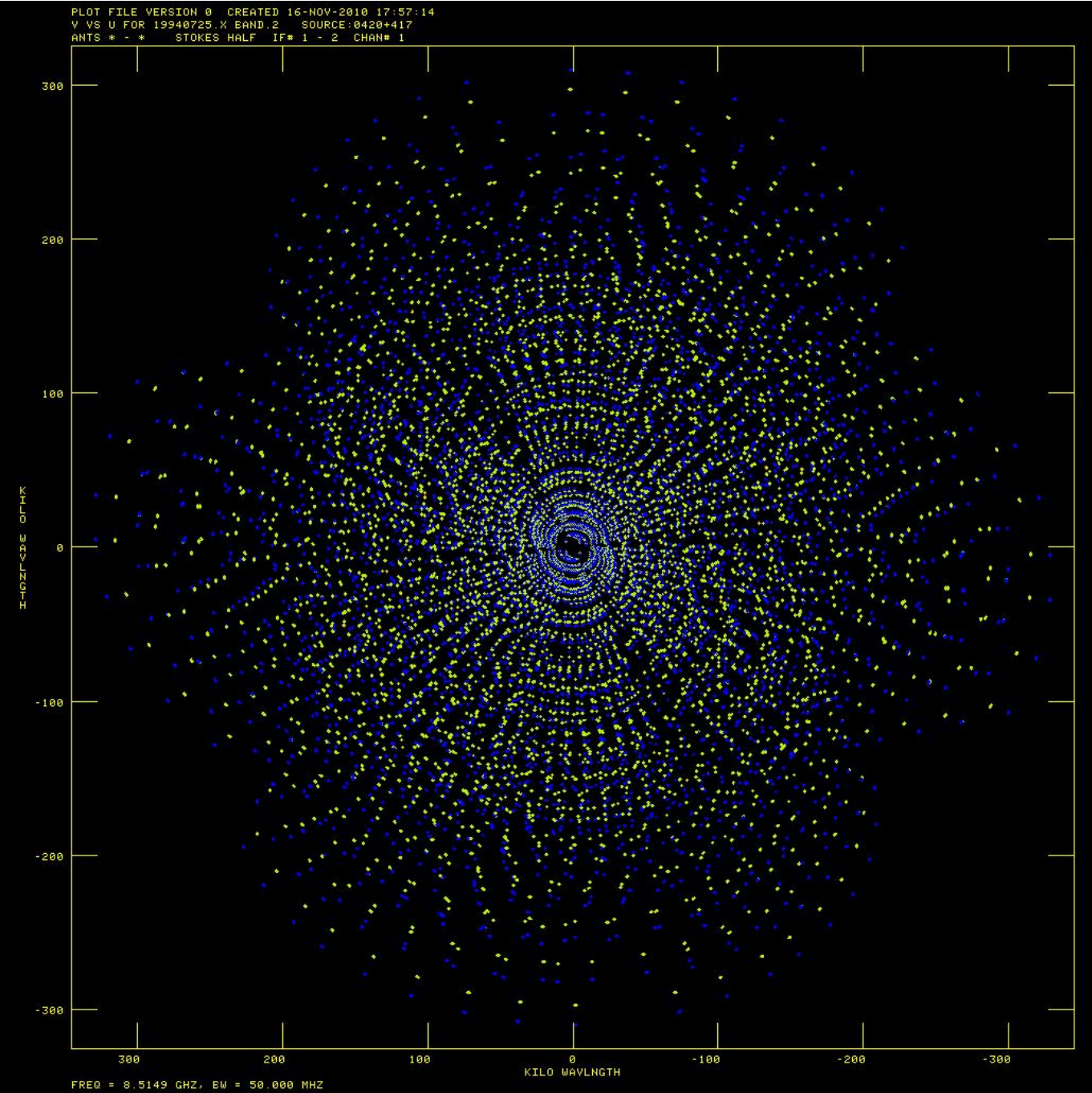
```
bparm 6 7
source '0518+165', ' '
tvinit
go
```



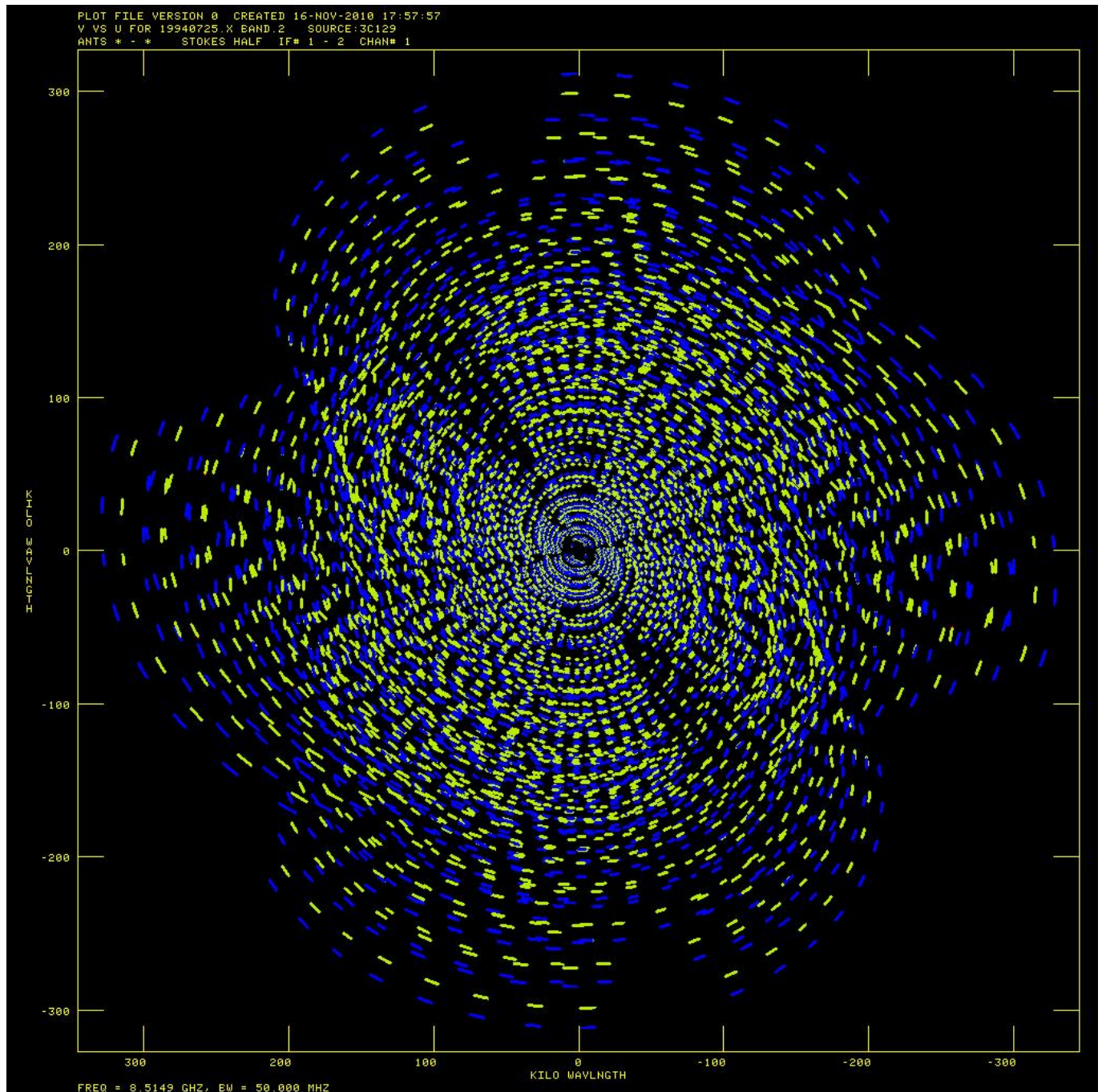
source '0134+329', ' '
tvinit
go



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



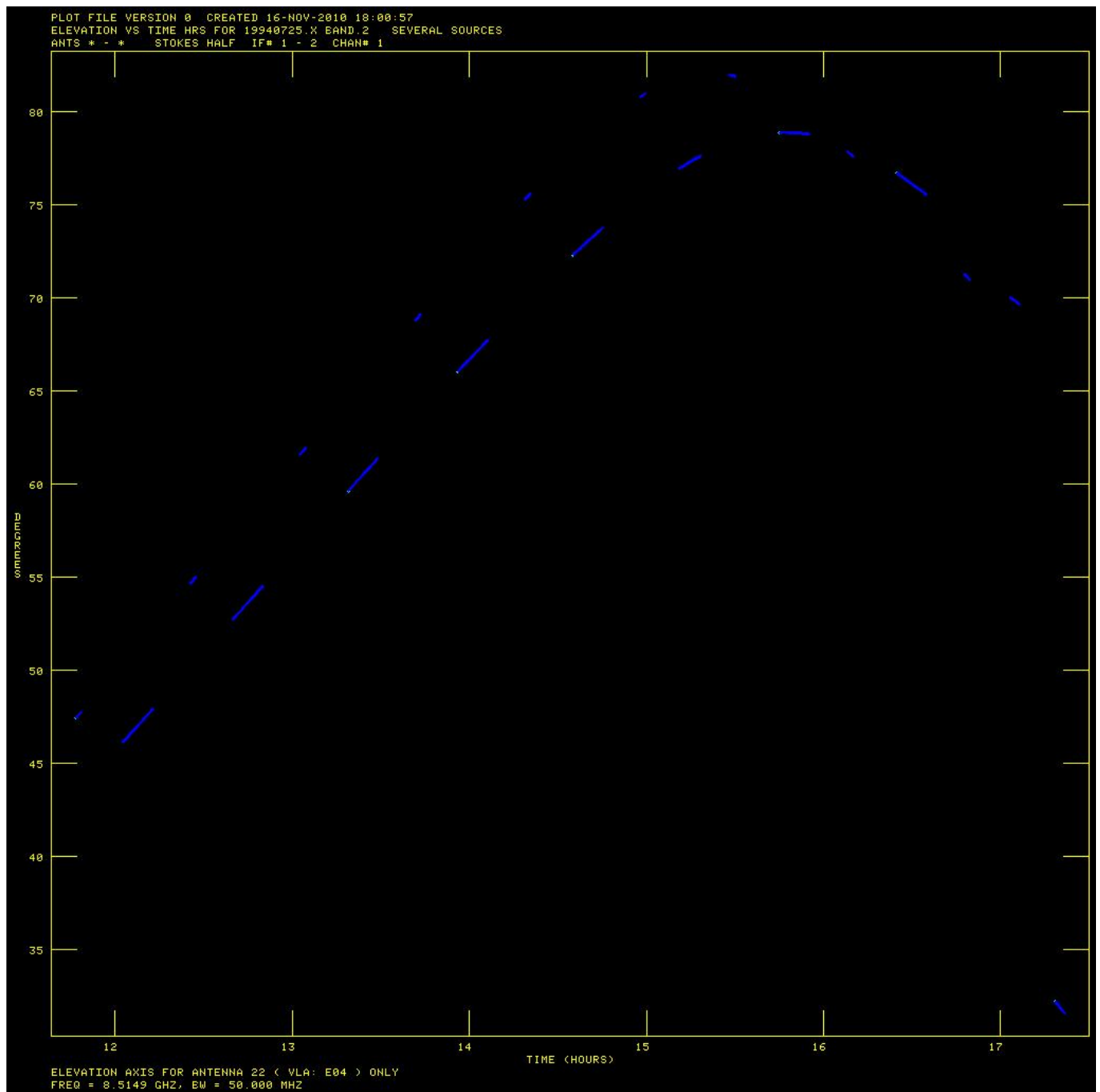
source '3C129', ' '
tvinit
go



```

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 ' '
calcode '*'
bif 0
eif 0
docalib 0
```

dparm 0
go

Source=0518+165 : 0003, Stokes=RR , IF= 2, Chans= 1- 1
Flux = 0.0000 Jy, Calcode = C , Freq = 4.585100000 GHz
Amplitudes, 1000 = 1.000000 Jy, averging type = Vector

0/17:06:55	442 464 454	442 462	497	432 454	471
460 430	418	436 456 456 471 443 453			
0/17:07:05	442 463 448 460 456 438 460 441 421 503			435 443	466
452 427 487 415	440 453 455 471 443 452				
0/17:07:15	442 459 446 466 454 437 458 439 421 504			440 445	466
451 423 481 415	442 450 459 476 442 458				
0/17:07:25	443 462 450 464 455 433 460 445 419 502			435 441	465
452 428 483 417	443 453 456 472 441 453				
0/17:07:35	443 464 449 463 455 433 460 442 420 499			435 444	466
451 429 481 420	440 450 457 483 438 456				
0/17:07:45	438 459 451 467 453 433 458 440 420 500			432 443	462
453 426 480 415	441 449 456 478 439 454				
0/17:07:55	441 461 452 467 453 438 460 438 418 504			438 446	468
456 431 480 415	442 451 458 480 443 453				
0/17:08:05	437 460 447 460 454 434 459 445 413 500			439 445	464
454 430 478 419	441 450 458 480 443 453				
0/17:08:15	436 459 447 465 459 434 456 443 419 501			440 445	466
452 429 478 416 451 440 450 459 481 440 456					
0/17:08:25	438 461 448 464 456 437 460 440 415 504			436 444	465
454 429 475 416 452 442 452 459 476 442 451					

Type Q to stop, just hit RETURN to continue

v1b054 LISTR(31DEC10) 100 16-NOV-2010 14:51:57 Page 6
Source=0518+165 : 0003, Stokes=RR , IF= 2, Chans= 1- 1
Baselines
0122022203220422052206220722082210221122122213221422152216221722182219222022
2122222322242225222622272228

0/17:08:35	436 459 445 462 456 434 459 440 418 500	438 438	467
452 431 476 418 455 442 449 462 474 442 455			
0/17:08:45	433 455 449 465 455 440 459 439 414 499	435 444	465
453 430 474 414 454 439 447 456 473 441 451			
0/17:08:55	437 460 447 462 454 436 458 439 418 499	437 442	466
454 428 480 415 454 441 448 460 472 443 452			
0/17:09:05	433 457 448 465 456 436 457 441 416 498	436 445	465
454 433 477 415 451 439 450 459 473 441 456			
0/17:09:15	432 464 447 469 454 436 462 441 419 498	438 445	465
453 431 476 417 455 441 452 464 473 444 456			
0/17:09:25	428 457 449 468 457 436 459 440 418 493	438 438	462
455 428 470 420 455 441 445 462 469 442 453			
0/17:09:35	431 456 446 464 455 434 459 442 414 498	435 441	460
449 426 473 414 449 437 450 458 474 442 454			
0/17:09:45	429 458 445 463 451 434 456 442 415 492	437 445	465
450 429 471 419 452 437 449 459 466 439 457			

Source=0134+329 : 0003, Stokes=RR , IF= 2, Chans= 1- 1
 Flux = 0.0000 Jy, Calcode = C , Freq = 4.585100000 GHz
 Amplitudes, 1000 = 1.000000 Jy, averging type = Vector

Baselines

0122022203220422052206220722082210221122122213221422152216221722182219222022
 2122222322242225222622272228

0/17:22:05	629 683 677	671 687	719	653	704
677 647 685	695 663 676 661 672 643 658				
0/17:22:15	630 683 673 666 690 669 685 655 630 723		662 653		692
670 646 694 643 689 666 672 664 681 643 659					
0/17:22:25	635 687 671 677 690 671 685 652 631 732		662 651		693
670 646 697 641 694 671 674 664 674 643 660					
0/17:22:35	632 683 669 671 692 669 687 651 632 727		663 651		689
667 642 694 639 692 669 667 662 678 640 657					
0/17:22:45	629 680 675 668 689 672 687 657 639 730		662 653		691
670 645 694 643 693 671 670 664 679 639 657					
0/17:22:55	627 684 670 672 695 669 684 652 629 729		658 651		690
669 644 692 638 684 669 672 664 679 640 656					
0/17:23:05	632 685 673 680 695 669 686 649 640 728		658 653		694
676 646 698 643 689 671 672 668 681 635 659					
0/17:23:15	635 683 670 673 694 675 689 651 637 728		662 652		695
675 643 696 642 695 667 675 663 682 640 656					
0/17:23:25	635 679 672 676 696 667 687 657 631 724		658 648		693
670 649 699 641 694 671 674 662 677 637 664					
0/17:23:35	634 684 668 673 690 662 682 653 634 726		659 648		691
670 640 692 639 692 668 669 662 677 639 656					
0/17:23:45	628 685 668 678 684 666 684 651 638 732		660 650		690
672 643 695 647 693 676 671 664 678 640 660					
0/17:23:55	629 680 672 674 690 671 682 650 637 729		664 655		692
674 643 696 646 692 670 676 666 676 646 659					
0/17:24:05	632 686 672 679 695 672 680 654 639 727		663 656		689
675 647 694 647 692 669 670 665 678 641 658					
0/17:24:15	630 686 672 674 693 671 689 658 636 728		659 653		691
676 649 698 643 690 669 674 661 684 643 656					
0/17:24:25	630 685 674 680 690 676 683 657 637 729		658 652		688
679 645 699 642 697 674 675 666 682 641 659					
0/17:24:35	637 681 673 678 693 670 687 658 634 732		659 655		689
678 644 696 644 691 672 675 668 680 642 658					
0/17:24:45	632 686 670 677 692 670 685 655 634 722		661 653		689
671 646 698 645 691 669 671 662 677 642 660					
0/17:24:55	634 685 675 678 697 675 682 657 632 727		658 654		691
671 643 699 643 693 669 673 666 677 641 658					

AIPS 1: Resumes

dparm 1,0
 go

Source=0518+165 : 0003, Stokes=RR , IF= 2, Chans= 1- 1
 Flux = 0.0000 Jy, Calcode = C , Freq = 4.585100000 GHz
 Phase, 1000 = 1000.00000 degrees, averging type = Vector

```

0/17:06:55 105 80-114 -18-170 123 -164 -93 79
57 45 107 -113-174-124 29 -85 -25
0/17:07:05 106 81-112 -76 142 -16-169 98 12 124 -162 -93 80
57 46 -84 109 -113-175-125 28 -87 -25
0/17:07:15 103 78-112 -79 140 -18-169 97 10 121 -164 -95 78
55 43 -86 108 -110-175-124 30 -87 -24
0/17:07:25 104 78-111 -78 141 -17-168 99 9 120 -164 -95 78
55 43 -85 107 -112-176-124 30 -90 -23
0/17:07:35 102 77-112 -78 139 -19-169 98 9 121 -164-100 76
54 42 -88 106 -109-174-122 31 -86 -21
0/17:07:45 102 77-113 -79 138 -19-169 98 9 120 -163-100 75
54 42 -89 106 -109-174-121 31 -86 -21
0/17:07:55 100 74-116 -77 137 -21-171 97 8 118 -165-100 73
53 41 -89 106 -109-173-119 31 -86 -19
0/17:08:05 101 76-114 -77 138 -19-171 99 9 122 -163 -98 74
54 43 -88 108 -110-173-120 29 -86 -20
0/17:08:15 100 78-115 -76 139 -18-171 99 10 121 -163 -98 76
55 44 -89 110 -85-110-174-119 28 -86 -20
0/17:08:25 101 79-115 -75 139 -19-167 101 10 120 -163 -98 75
55 45 -88 109 -83-111-175-121 28 -88 -21

```

Type Q to stop, just hit RETURN to continue

```

v1b054 LISTR(31DEC10) 100 16-NOV-2010 14:54:07 Page 6
Source=0518+165 : 0003, Stokes=RR , IF= 2, Chans= 1- 1
Baselines
0122022203220422052206220722082210221122122213221422152216221722182219222022
2122222322242225222622272228
0/17:08:35 103 80-113 -76 141 -17-167 102 13 120 -160 -95 75
55 47 -87 110 -81-113-177-121 27 -87 -22
0/17:08:45 106 80-112 -75 140 -16-168 102 15 122 -159 -94 78
55 50 -87 111 -81-114 176-122 26 -88 -23
0/17:08:55 108 80-110 -76 141 -15-168 106 17 122 -157 -92 79
55 51 -85 111 -79-115 175-123 26 -92 -26
0/17:09:05 105 77-110 -76 140 -17-169 105 16 121 -158 -94 78
53 49 -87 109 -81-113 176-123 28 -90 -23
0/17:09:15 105 78-109 -78 139 -18-168 105 17 123 -159 -98 80
53 48 -88 108 -82-113 177-123 29 -92 -24
0/17:09:25 108 77-108 -77 140 -18-166 107 20 124 -159 -97 81
56 47 -86 109 -81-113 176-123 28 -95 -27
0/17:09:35 112 80-106 -74 141 -16-165 107 23 126 -156 -94 84
57 48 -84 107 -78-114 180-126 24 -96 -31
0/17:09:45 108 81-102 -75 140 -15-165 105 22 125 -156 -93 83
57 46 -85 107 -78-114-179-125 25 -96 -28

```

Source=0134+329 : 0003, Stokes=RR , IF= 2, Chans= 1- 1
Flux = 0.0000 Jy, Calcode = C , Freq = 4.585100000 GHz
Phase, 1000 = 1000.00000 degrees, averging type = Vector

Baselines
0122022203220422052206220722082210221122122213221422152216221722182219222022

```

2122222322242225222622272228
  0/17:22:05   84  88-111          -5-173          107      171      71
41  51 -98      -66-102-153 -91  54 -86 -12
  0/17:22:15   85  88-109 -80 148 -2-172  89  42 110      172-102      76
43  55 -96 145 -70-104-154 -93  51 -88 -12
  0/17:22:25   84  91-108 -84 146 -7-176  86  41 105      172-102      73
40  53-100 142 -76-103-152 -93  52 -85 -10
  0/17:22:35   82  91-110 -85 148 -5-176  85  42 102      175-100      76
41  50-100 143 -80-106-153 -96  50 -84 -10
  0/17:22:45   81  90-113 -83 150 -4-176  84  43 103      176 -99      79
42  53-100 144 -81-108-155 -96  50 -82 -13
  0/17:22:55   81  90-114 -84 152 -2-177  83  43  98      175-106      75
41  53-101 144 -72-111-155 -95  48 -79 -20
  0/17:23:05   79  86-119 -88 151 -3-179  79  39  96      173-109      71
36  50-102 143 -72-110-153 -94  48 -73 -19
  0/17:23:15   82  85-116 -88 154  1-177  84  43  99      175-105      73
36  54 -98 145 -77-116-157 -96  46 -74 -26
  0/17:23:25   87  90-113 -86 159  4-173  88  45  99      179-101      76
38  60 -94 150 -75-118-161 -99  42 -76 -25
  0/17:23:35   90  90-108 -82 161  9-170  89  48 101      -179 -98      78
41  64 -91 152 -73-120-164-101 41 -76 -29
  0/17:23:45   86  82-114 -87 154  6-175  84  42  97      175-103      71
37  60 -93 146 -76-114-161 -99  45 -71 -26
  0/17:23:55   92  81-115 -86 152  5-174  85  40  98      175-102      71
39  62 -92 148 -77-116-162-102 43 -72 -27
  0/17:24:05   99  82-114 -85 152  5-173  87  42  99      177 -98      71
39  66 -90 150 -76-118-164-102 41 -74 -26
  0/17:24:15   96  80-114 -81 155  7-172  88  44 103      -179 -98      72
41  69 -89 154 -73-121-167-107 37 -75 -27
  0/17:24:25   95  78-119 -79 153  4-175  84  39  97      180 -99      69
40  67 -91 153 -76-119-165-105 37 -69 -25
  0/17:24:35   96  79-120 -79 153  5-177  85  41  96      -180 -98      68
42  68 -91 152 -75-118-165-104 35 -68 -20
  0/17:24:45   98  75-117 -80 152  5 179  86  38 100      178 -97      68
43  68 -90 149 -74-118-163-105 34 -68 -15
  0/17:24:55   99  74-117 -81 151  7 178  88  37 100      176-101      67
45  67 -88 150 -74-117-162-104 33 -69 -12
AIPS 1: Resumes

```

dparm 0

Start the calibration

Set the flux values of the known calibrators

```

task 'setjy'
default
getn 4

```

```
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
```

```
v1b054> SETJY1: v1b054      31DEC08 TST: Cpu=      0.0  Real=      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

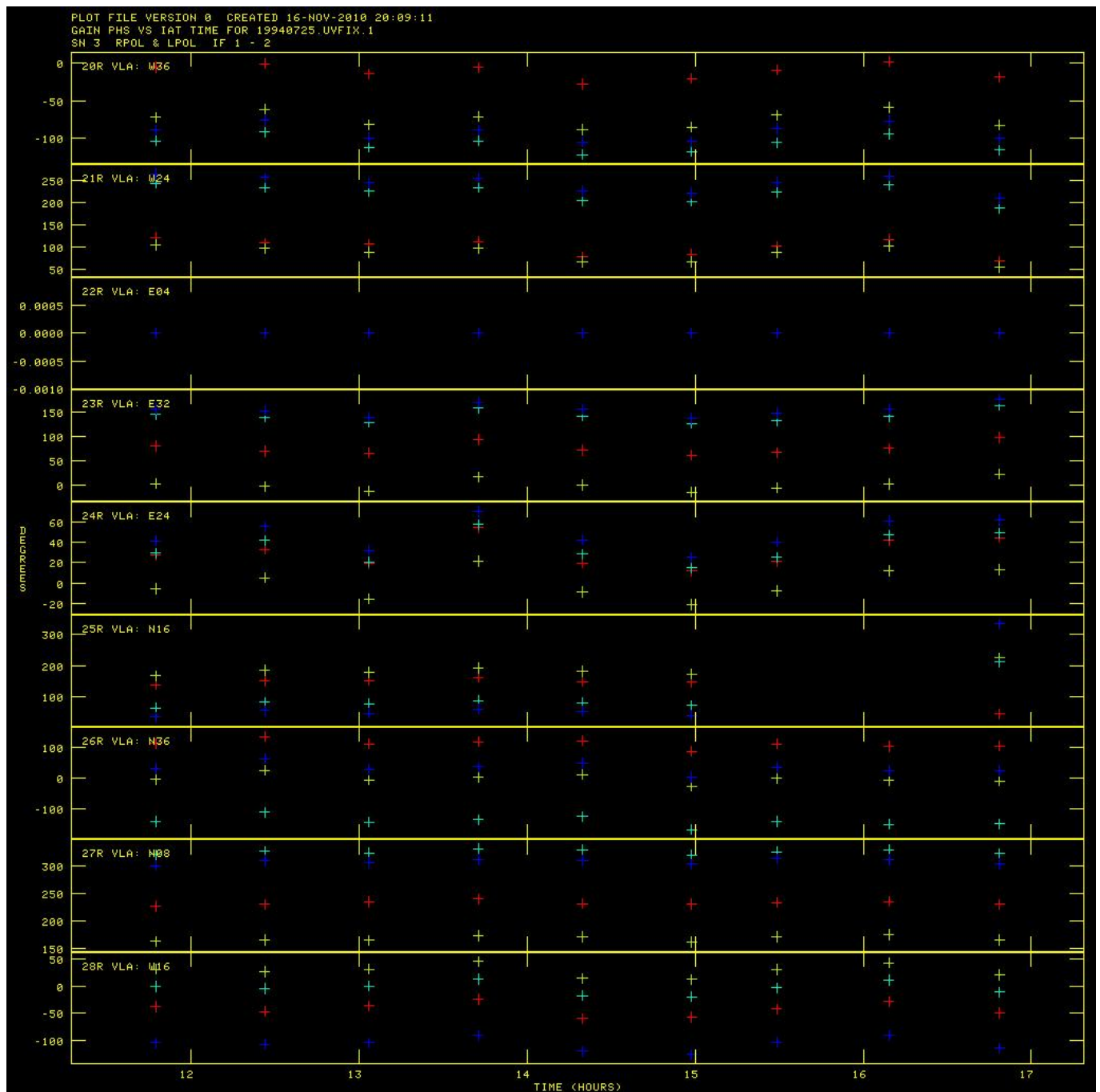
```
calsour '0134+329', ' '  
get2n 11  
go  
clrmsg
```

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  
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 200 of 200 gain
samples
vlb054> GETJY1: Source:Qual CALCODE IF Flux (Jy)
vlb054> GETJY1: 0420+417 : 3 B 1 1.46712 +/- 0.00294
0.00294
vlb054> GETJY1: 2 1.47148 +/- 0.00234
0.00344
vlb054> GETJY1: Source:Qual CALCODE used total bad used tot
bad
vlb054> GETJY1: 0420+417 : 3 B 900 900 0 97 100
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 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

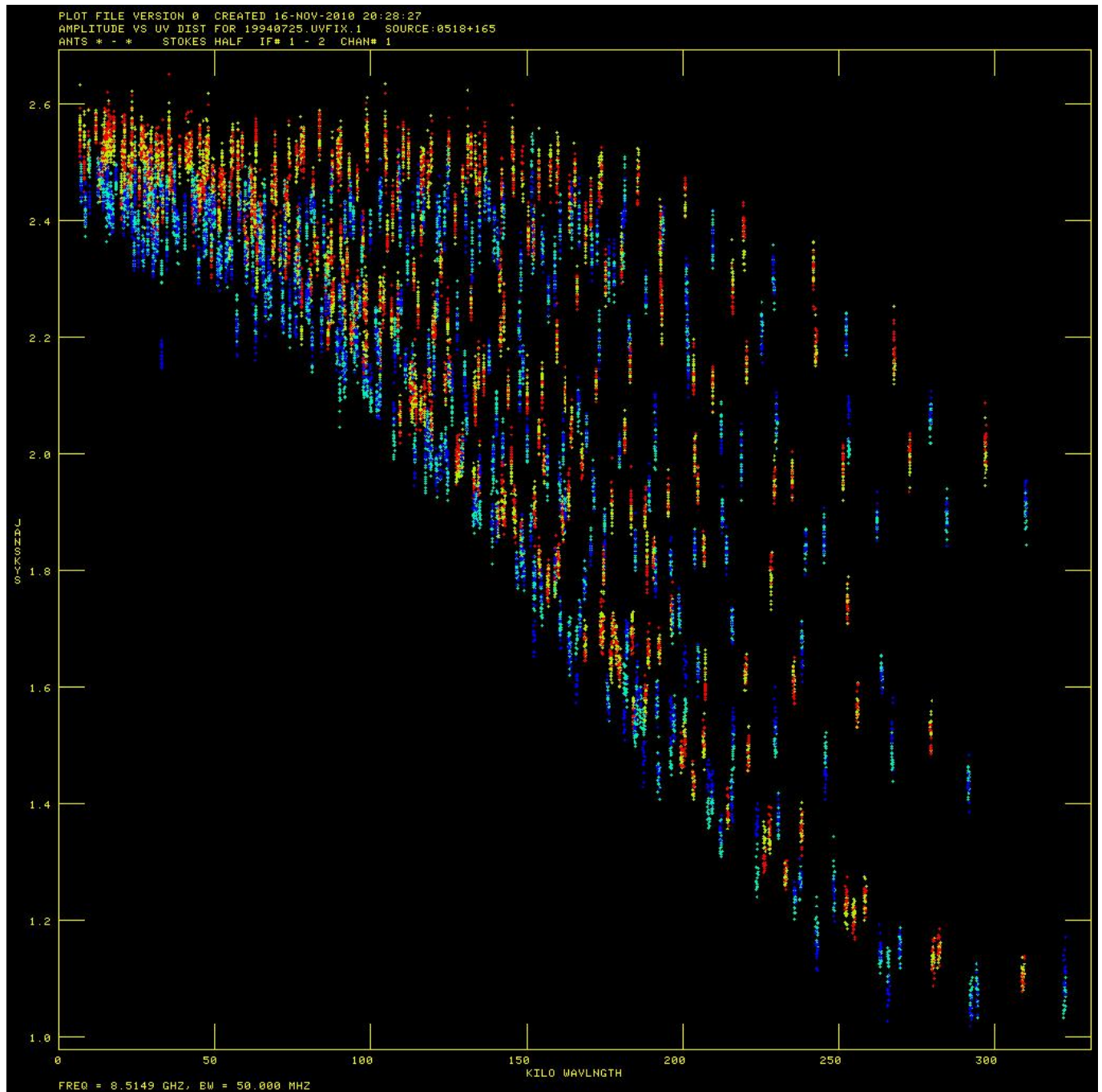
```

Have a look at the calibration

Plots

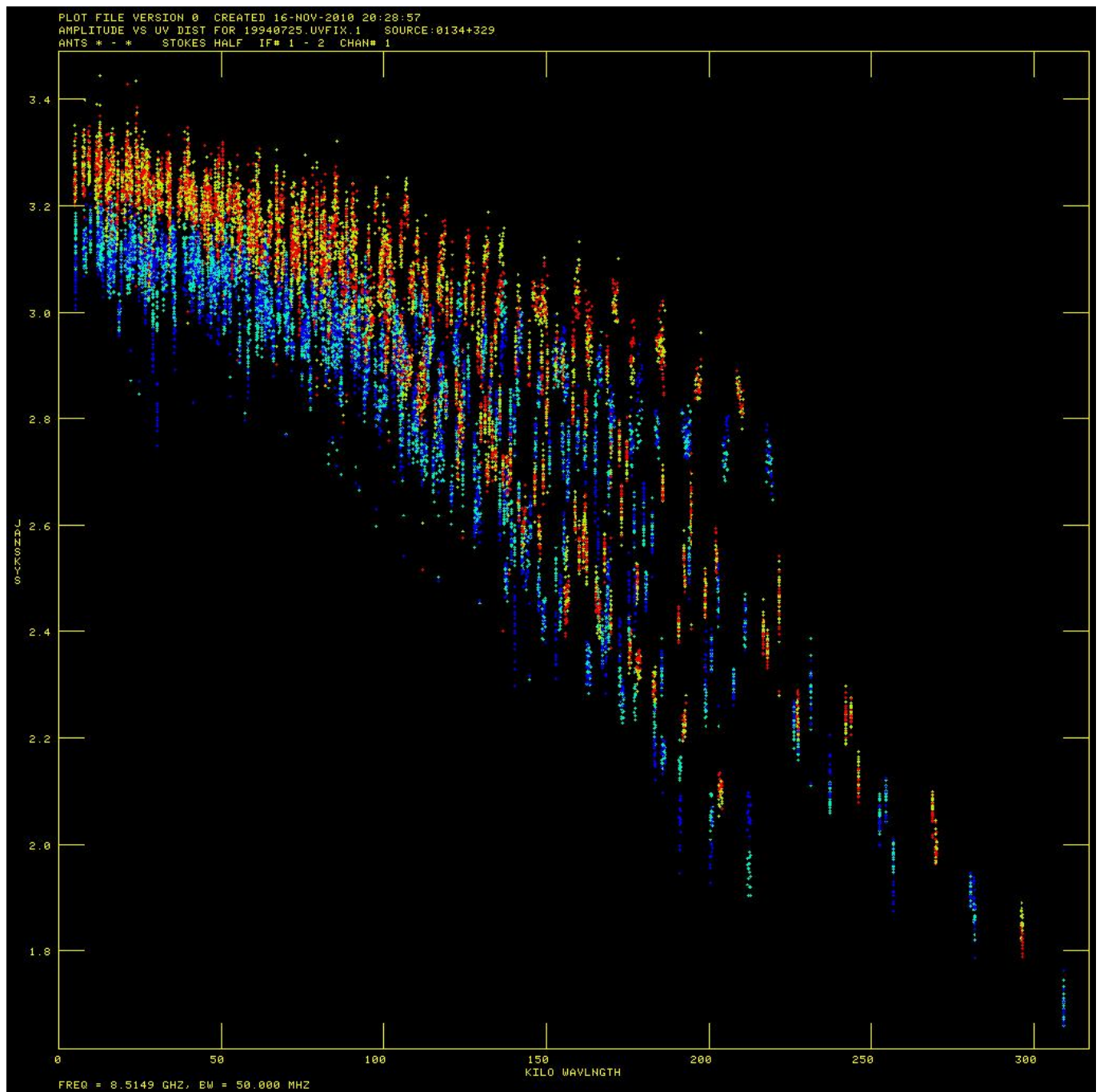
Plots

```
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
```



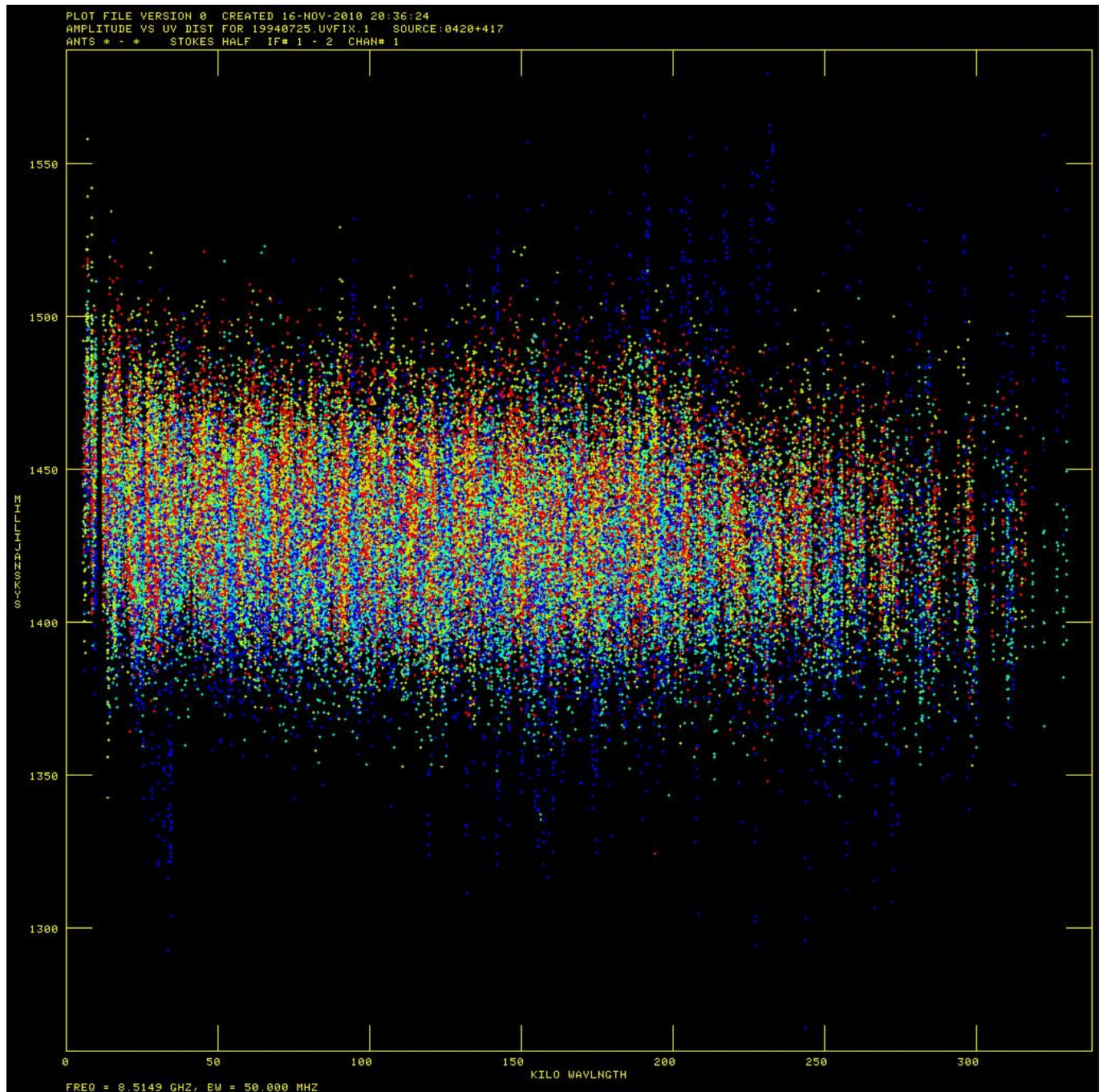
Why are the different colored points for the different subbands and polarizations not overlapping?

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



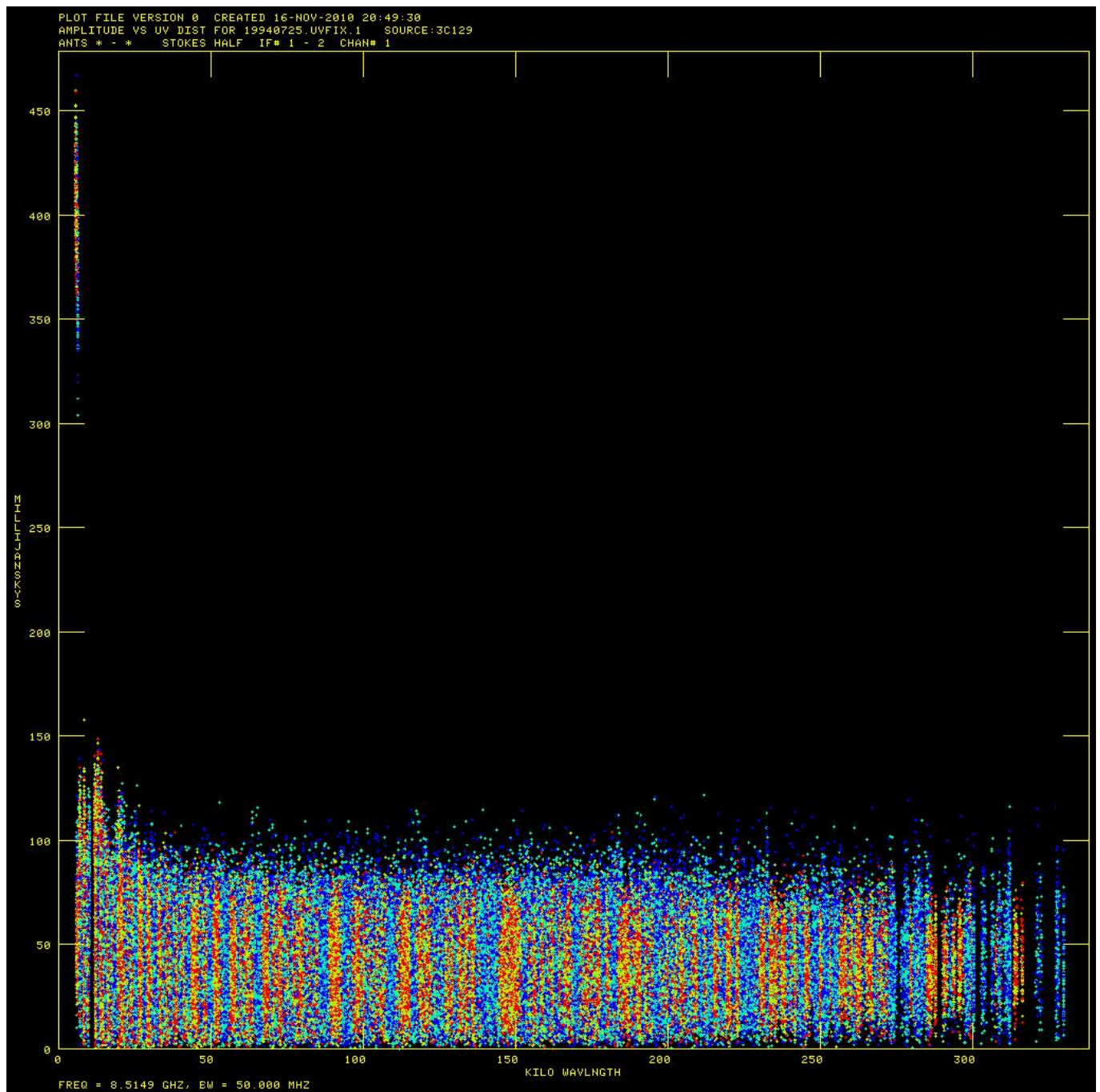
Again the different colors do not overlap. Why not?

```
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
clon
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
```

```
base1 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	.DBC0N .	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
```

