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APPENDICES

APPENDIX A

CALIBRATION PROCEDURES

This appendix describes the procedures for calibrating spectral lines which include the calibrators in wide-band, narrow-band and target-source data.

The flowcharts show introduction to reducing line data. S140-IRS1 1665 and 6035 MHz OH maser 512 channels in 0.25 MHz, Ph-ref 2221+625 1 channel, 16 MHz, BP-cal 3C84 in both configurations.

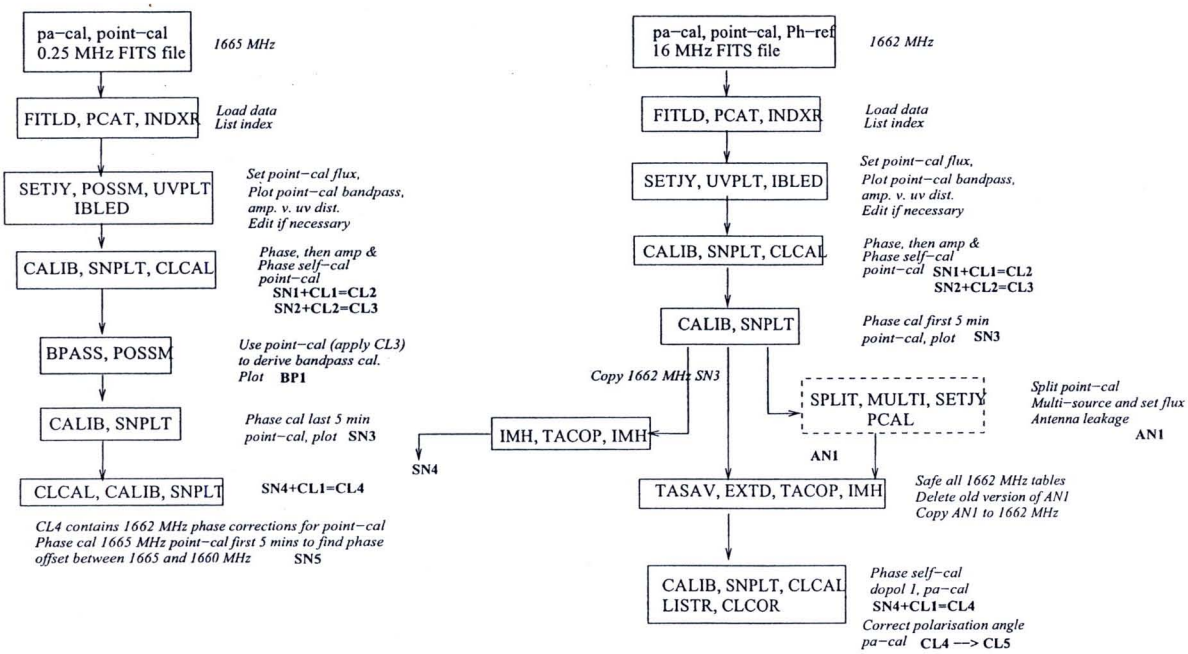

Figure A.1 Initial calibration of the calibrators at 1662 and 1665 MHz.

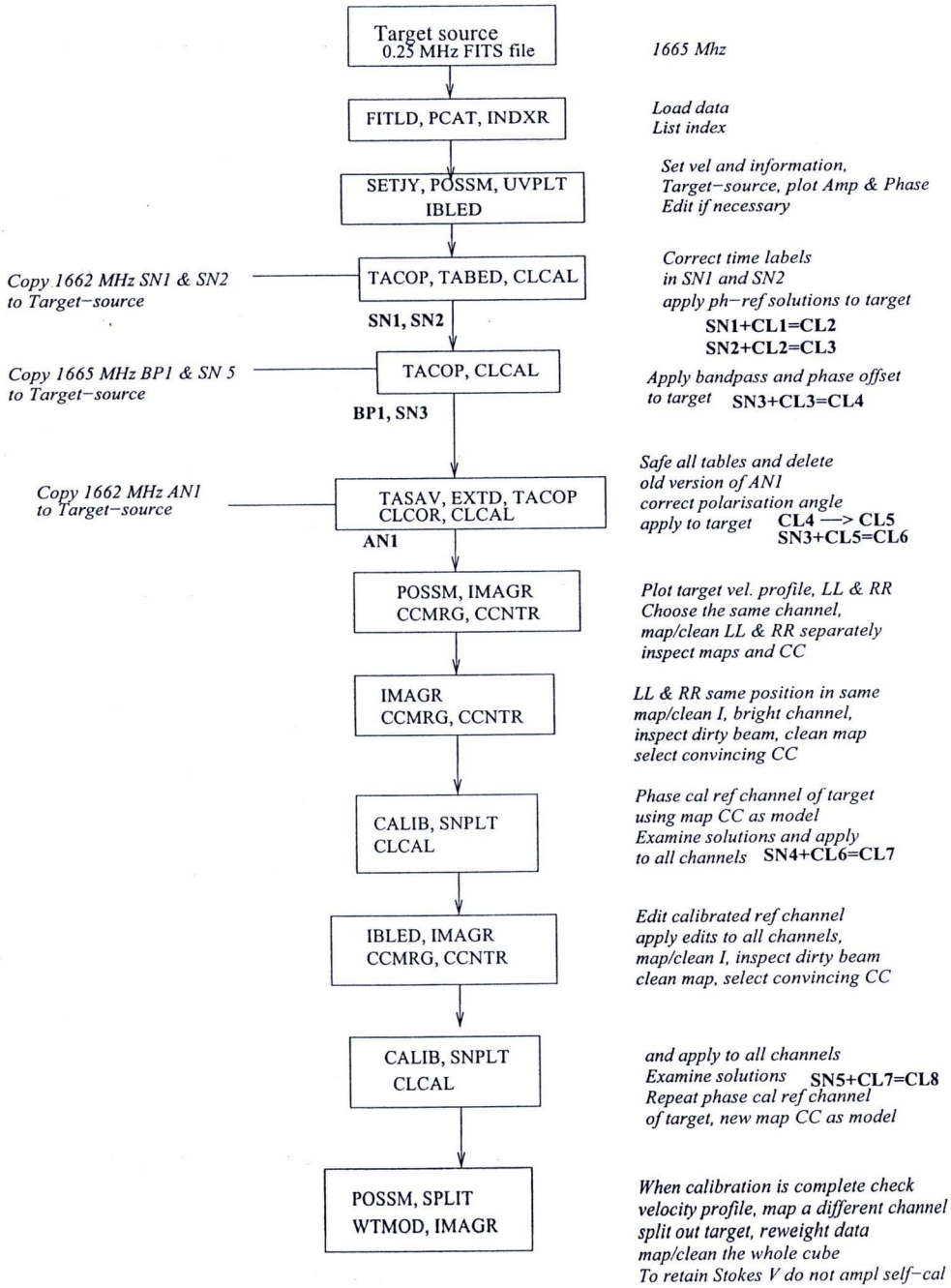

Figure A.2 Initial calibration of the target source at 1665 MHz.

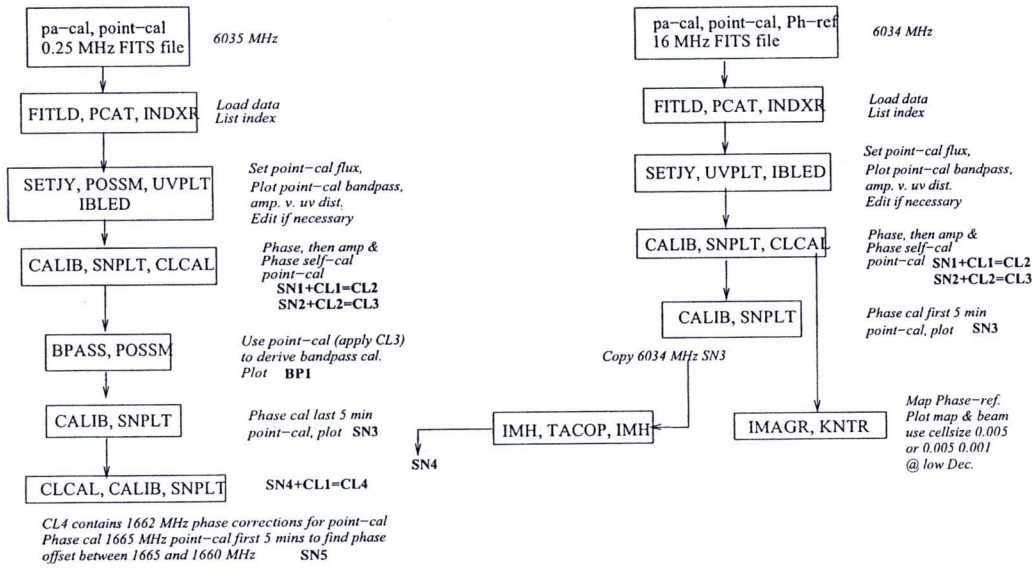

Figure A.3 Initial calibration of the calibrators at 6034 and 6035 MHz.

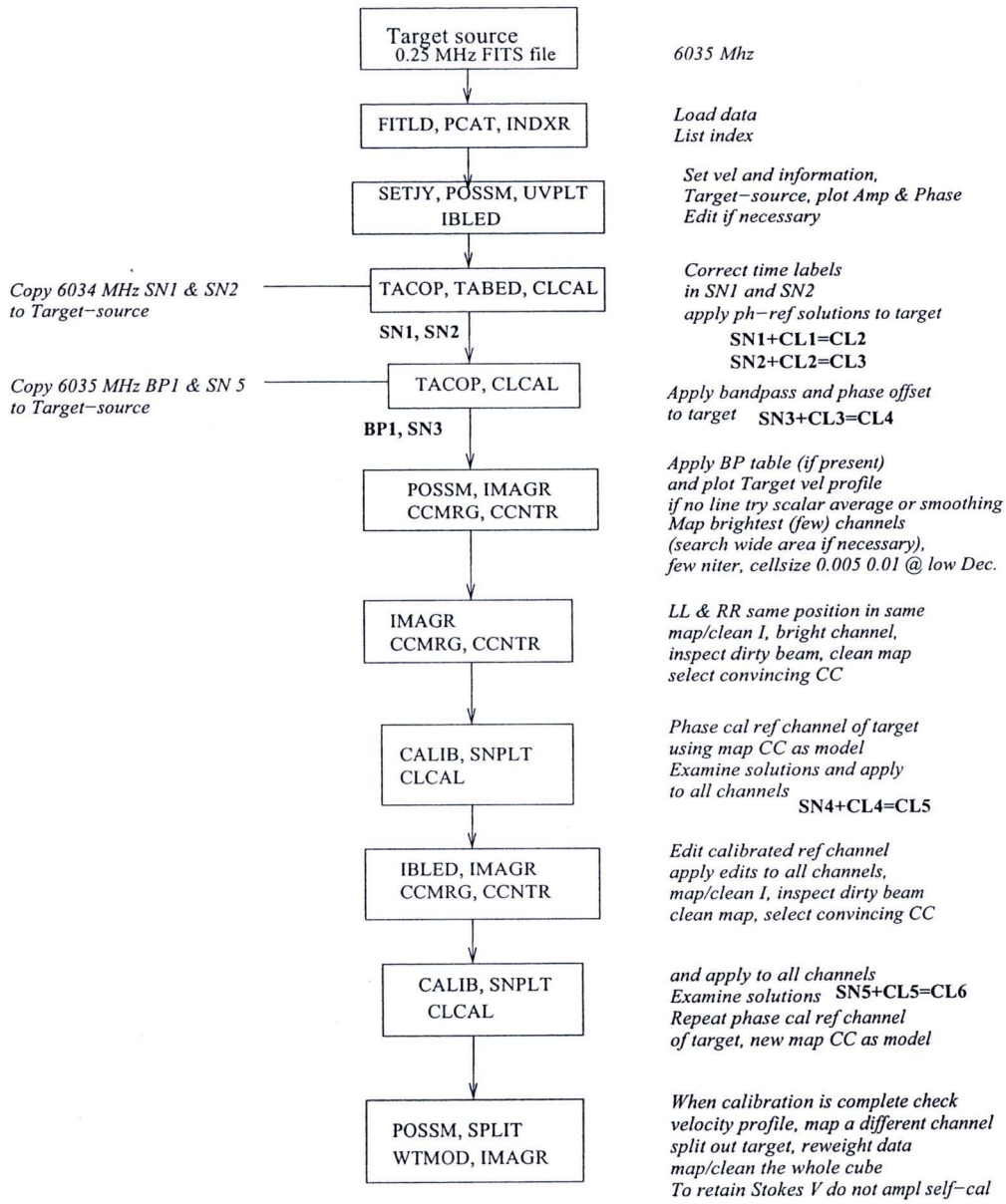

Figure A.4 Initial calibration of the target source at 6035 MHz.

APPENDIX B

RUN FILES

The method to analyse the map of S140-IRS1 has been described in Chapter 3 with Section 3.4.3. This appendix describes three runfile scripts which use IMAGR and SAD task respectively.

B.1 Big map script

This runfile script makes 1024×1024 maps in an area 10' across and prints minimum & maximum peak flux in each region before delete the big images. The script was developed by Dr.Anita M. S. Richards who is a staff at Jodrell Bank Centre for Astrophysics. The process is described as a flow chart in Figure B.1.

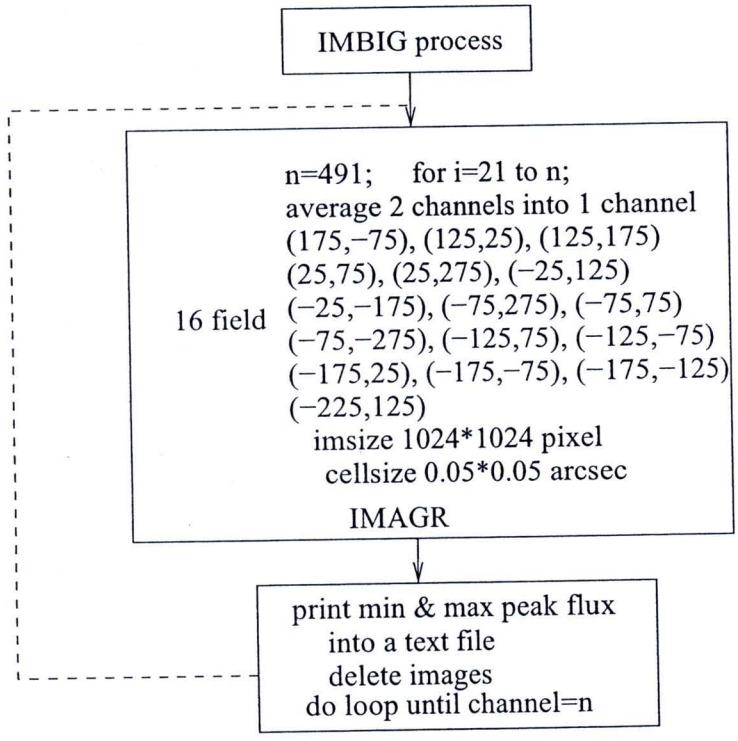

Figure B.1 The flowchart shows 'Big map' runfile script.

```
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

$ This is a runfile to make 1024x1024 maps in an area 10' across
$ Copy to a file name with your aips number in ehex as the extension
$ Before you start aips type
$ setenv RUNFIL (pwd)
```

```
$ where (pwd) is the directory where your runfile is.

$ Set the INNAME etc. to your calibrated UV data (see **).
$ Check the IMAGR inputs
$ (Here, I assume that you have a calibrated WTMOD file
$   - change if necessary).
$ Make sure that the outdisk has plenty of room
$ Set the outname if you want;

$ I use a 0.05 arcsec cellsize and the maps are spaced by 1000 pixels,
$ i.e. with a small overlap
$
$ If you change the number of fields, change nfield
$ I average every 5 chans - change if wanted.
$
$ This makes 12 cubes at a time, without any cleaning, and writes
$ the max and min values from the message file to BIGMAPLOG.TXT
$ You will have to make sure you keep the output in order
$ - it is for one row at a time, starting at the top
$
$ If you edit this make sure there are no 'tab's
$ I have set 'do3dim -1' and requested a small dirty beam-map
$ for speed & to save space;
$ for real maps use do3d 1; imagrprm(10) 0

dowait 1

prtask 'imagr';clrm
docrt -1
outprint 'pwd:OUTSIDE2.TXT'

proc IMBIG
task 'IMAGR'
indisk 1;outdisk 1
inname 'W49-UM1665'
source 'W49-UM'
ffinclass 'WTMOD'; inseq 1;inty ''
source '';timer 0;anten 0;docal -1;doband -1;dopol -1
bchan 21;echan 491;nchav 2;chinc 2
nfield 16
outn 'outside';outse 0;outver 0
clr2n;clr3n;clr4n
cells 0.05 0.05;imsiz 1024 1024
uvtaper 0;uvrange 0;uvwtfn 'n';minpatch 255
bmaj 0;bmin 0;imagrprm 0;dotv -1
do3dim -1; niter 0
Imagrprm (10) 0.25

rashift 175,125,125,25,25,-25,-25,-75,-75,-75,-125,
       -125,-175,-175,-175,-225
decshift -75,25,175,75,275,125,-175,275,75,-275,75,
       -75,25,-75,-125,125

go imagr

$ Print messages for this run
prtm
clrm
fin

$ Run this

imbig
$ Delete image files
inty 'ma';inn 'outside';incl '';inse 0;alld
y

end
dowait -1
```

The is an example result from 'Big map' script.

```
1   5   02-JUL-2008  19:49:05     IMAGR     Task IMAGR  (release of 31DEC06) begins
1   2   02-JUL-2008  19:49:05     IMAGR     Create W49-UM1665  .IMAGR .   1 (UV)  on disk  1  cno  167
1   4   02-JUL-2008  19:49:05     IMAGR     Beginning channel   21 through   22 with  1 IFs
1   3   02-JUL-2008  19:49:09     IMAGR     IMACPY: Copied    12900 visibilities to be imaged
1   2   02-JUL-2008  19:49:26     IMAGR     Create OUTSIDE     .IBM001.  10 (MA)  on disk  1  cno  240
1   2   02-JUL-2008  19:49:43     IMAGR     Create OUTSIDE     .IIM001.  10 (MA)  on disk  1  cno  241
1   2   02-JUL-2008  19:49:59     IMAGR     Create OUTSIDE     .IIM002.  10 (MA)  on disk  1  cno  242
1   2   02-JUL-2008  19:50:15     IMAGR     Create OUTSIDE     .IIM003.  10 (MA)  on disk  1  cno  243
1   2   02-JUL-2008  19:50:32     IMAGR     Create OUTSIDE     .IIM004.  10 (MA)  on disk  1  cno  244
1   2   02-JUL-2008  19:50:48     IMAGR     Create OUTSIDE     .IIM005.  10 (MA)  on disk  1  cno  245
1   2   02-JUL-2008  19:51:05     IMAGR     Create OUTSIDE     .IIM006.  10 (MA)  on disk  1  cno  246
1   2   02-JUL-2008  19:51:22     IMAGR     Create OUTSIDE     .IIM007.  10 (MA)  on disk  1  cno  247
1   2   02-JUL-2008  19:51:22     IMAGR     GRDFLT: X and Y convolution type = SPHEROIDAL
1   2   02-JUL-2008  19:51:22     IMAGR     GRDFLT: X and Y parms =  3.0000  1.0000
1   2   02-JUL-2008  19:51:22     IMAGR     GRDFLT: convolution function sampled every 1/100 of a cell
1   2   02-JUL-2008  19:51:22     IMAGR     GRDMEM: Ave    2 Channels; 1.665173E+09 to 1.665173E+09 Hz
1   4   02-JUL-2008  19:51:22     IMAGR     Field   1 Sum of gridding weights =  5.14250E+05
1   4   02-JUL-2008  19:51:23     IMAGR     Field   1 Beam min = -145.9 MilliJy, max =    1.0      Jy
1   4   02-JUL-2008  19:51:23     IMAGR     Field   1 fit FWHM =  277.449 x  137.321 Milliarcsec, PA=   23.8
1   4   02-JUL-2008  19:51:23     IMAGR     CLBHIS: minimum component 0.500 of current peak
1   4   02-JUL-2008  19:51:23     IMAGR     Field   1 min = -101.1 MilliJy,max =  106.5 MilliJy
1   4   02-JUL-2008  19:51:24     IMAGR     Field   2 min = -106.6 MilliJy,max =  106.6 MilliJy
1   4   02-JUL-2008  19:51:24     IMAGR     Field   3 min = -107.7 MilliJy,max =   95.1 MilliJy
1   4   02-JUL-2008  19:51:25     IMAGR     Field   4 min = -111.5 MilliJy,max =  106.7 MilliJy
1   4   02-JUL-2008  19:51:25     IMAGR     Field   5 min = -101.9 MilliJy,max =   95.7 MilliJy
1   4   02-JUL-2008  19:51:26     IMAGR     Field   6 min = -108.8 MilliJy,max =  117.2 MilliJy
1   4   02-JUL-2008  19:51:26     IMAGR     Field   7 min = -112.8 MilliJy,max =  105.1 MilliJy
1   4   02-JUL-2008  19:51:27     IMAGR     No Cleaning requested
```

B.2 Linesad script

This runfile script has a name 'LINESAD' and uses for displaying the map of a given channel and find components in it using the AIPS commands ¡TVLOD¿ and ¡SAD¿ respectively. It was developed by Dr.Sandra Etoka who was a postdocteral student at Jodrell Bank Centre for Astrophysics.

The procedure for using 'LINESAD' script as follow;

1. Find out what your 'ehex' extension number is [this is the convertion number of your AIPS number that should be put as an extension to any <runfile> you want to use under a specific AIPS number] i.e., [SunMachine] for example ehex 1234 [will return say 'OYA']

2. Add as an extension to this file your EHEX number e.g.: for example LINESAD.OYA

3. Set the environment variable <RUNFIL> so that it points to where your Runfile (namely LINESAD.OYA] is located for example `setenv RUNFIL /home/myHomeAera/WhereLINESADis` eg. /home/sandra/Runfiles

4. Run this in AIPS [i.e., > run LINESAD]

5. List it to make sure everything went fine [i.e.. > list findcpts]

6. Call each individual procedure with the appropriate number of parameters required as well as a valid range of values of course ! ex. > DISPA(200) Will display the CC.200 of the current image ex. > findcpts(200, 10, 7, 3, 1, 20) Will do a a search of components over 3 rounds with first first cutoff at 10*rms, and the third and last one at 3*rms; letting the SAD guess completely the size of the gaussian and using a [min] size for the island of 20 cells.

The script is described as a flow chart in Figure B.2.

```
*  S. ETOKA 03 June 2009
*   last modif: 18.06.09
*  ====================
*  Series of procedures to display the map of a given channel and find
*  components in it using the AIPS commands <TVLOD> and <SAD> respectively
*
* ------------------------------------------------------------------------
*.
PROC LINEDEF
     scalar kcut, k1cut, k2cut, k3cut, y1, x3, y3, kwid
     scalar rms1, dparm4, kparm
     scalar Chi_value, U, Q
     array savblc(7), savtrc(7)
     string*6 savcls, savincl
     finish

*.
*.   proc to display channels on the TV
*.
*..
*.. This procedure displays the whole size of the channel selected
*.. with the full intensity range

PROC DISP (I)
   tblc = 0, 0, i, 0
   ttrc = 0, 0, i, 0
   blc = tblc
   trc = ttrc
   imstat
   pixr(1) = pix2val
   pixr(2) = pixval
   tvlod
   ret; finish
*..
*.. This procedure allows you to select a given image size for the channel to
*.. be displayed BUT with the full intensity range
PROC DISPA (I)
   tblc(3) = i
   ttrc(3) = i
   blc = tblc
   trc = ttrc
   imstat
   pixr(1) = pix2val
   pixr(2) = pixval
   tvlod
   ret; finish
*..
*..
*.. This procedure allows you to select a given image size for the channel to
*.. be displayed AND the lower intensity cutoff of pixrang
PROC DISPB (I,J)
   tblc(3) = i
   ttrc(3) = i
   blc = tblc
   trc = ttrc
   imstat
   pixr(1) = j * pixstd
   pixr(2) = pixval
   tvlod
   ret; finish
*.
*. finding of components (with cutoff, dowidth &dparm(4) as a free paramaters)
*.
*. Descritpion: find comps with the island size (i.e., dparm(4))
*.              [parameter 6] as a free parameter
*.              (suggestion for a typical range is: 10  to 30)
*.               This procedure runs 1 iteration of SAD  but with 3
*.               successive cut off.
```

```
*.              /\ CUTOFF [parameters 2-4] is x*rms
*.              /\ WIDTH of the component [parameter 5] works as
*.                 follows: <0: beam size [0;1[: starts from beam size
*.                          >1: SAD decides
*.              /\ Size of the island [parameter 6]
*.
proc findcpts(i, k1cut, k2cut, k3cut, kwid, dparm4)
type '++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++'
type '+  find comps with the island size (i.e., dparm(4))  +'
type '+  [parameter 6] as a free parameter (suggestion for +'
type '+  a typical range is: 10  to 30).                    +'
type '+              e.g. findcpts(200,10,7,3,1,20)         +'
type '++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++'
blc = savblc
trc = savtrc
dispa(i); rms1=pixstd
task 'sad'
outname ' '
outclass ' '
outdis indisk
blc = savblc; blc(3)=i
trc = savtrc; trc(3)=i
doresid 1
outseq i
ngauss 100
CPARM 0
CPARM(1) = k1cut * pixstd
CPARM(2) = k2cut * pixstd
CPARM(3) = k3cut * pixstd
icut .01
sort ' '
docrt 1
*.fitout 'print:sad_I1665.txt'
inver i
outver -1
doall 1
dowidth kwid
dparm 0
dparm(4)=dparm4
go sad; wait sad
savcls = inclas; y1=inseq
incl='resid'; inseq=outs
type '********** LOADING RESIDUAL IMAGE ************'
type 'that is:', inname, inclas, inseq
type '----------> statistics of the residual image: '
imstat
type ' '
type 'RMS in input image = ', rms1
type 'RMS in residual image = ', pixstd
type '- - - - - - - - - - - - - - - - - - - - - - -'
tvlod; zap
incl=savcls; inseq=y1; indisk=outd
type ''
type '++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++'
type '+  if the result is not satisfacotry (i.e. too many +'
type '+  comps. not fitted still present), then exdt the  +'
type '+  MF and try again modulating on the cutoff levels +'
type '+  used and/or the gaussian size and/or the size of +'
type '+  the island                                       +'
type '++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++'
type ''
type ' end of the procedure'
return; finish

PROC  CHI(U,Q)
   print '************************************'
   Print 'Reminder: Chi=0.5*atan(U/Q)'
   print 'which ** IN AIPS ** is calculated'
   print 'as follow: <0.5*atan2(Q,U)>'
   CHi_Value=0.5*atan2(Q,U)
```

```
   PRINT Chi_value
   print '************************************'
ret; finish

PROC QUV (I)
   inver i
   blc = 0, 0, i, 0
   trc = 0, 0, i, 0
   outver i+500
   go mfquv
ret; finish
```

This is an example result of LINESAD runfile script.

```
>findcpts(267,10,7,3,1,20)
   #      Peak      Flux      RA---SIN   DEC--SIN    Maj      Min      PA
   1    11.295    13.202    -30.56188    4.33438   0.28682 0.15448   17
Type Q to stop, just hit RETURN to continue

 indus      SAD  (31DEC06)    4218      19-JUN-2009  11:01:22     Page    2
W49-1665     .RCL002.       1      Disk  1      Plane  267      User    4218
   #      Peak      Flux      RA---SIN   DEC--SIN    Maj      Min      PA
       (  0.023) (  0.045) (  0.00015    0.00024) (0.00059 0.00032    0)
   2 S    0.256     0.056    -30.48238    4.67504   0.56407 0.01476   95
       (  0.024) (  0.016) (  0.02191    0.00215) (0.05182 0.00136    0)
   3 S    0.222     0.548    -30.42119    4.78626   0.73692 0.12714   39
       (  0.022) (  0.073) (  0.02019    0.02428) (0.07329 0.01264    1)
   4 L    1.836     1.680    -30.31670    4.28476   0.24765 0.14014   18
       (  0.024) (  0.038) (  0.00083    0.00131) (0.00318 0.00180    1)
   5      2.311     2.383    -30.28218    6.34198   0.26383 0.14811   18
       (  0.024) (  0.042) (  0.00071    0.00110) (0.00269 0.00151    1)
   6 L    0.265     0.373    -22.40838    4.61690   0.26282 0.20304  179
       (  0.023) (  0.050) (  0.00749    0.00969) (0.02282 0.01763   13)
   7 H    0.388     0.509    -21.51783    4.87438   0.29061 0.17097   27
       (  0.023) (  0.048) (  0.00510    0.00685) (0.01733 0.01019    4)

Component widths & PA: deconvolved at fit & 1 sigma low & high from fit
   #  MAJ-dec MIN-dec   PA  MAJ-low MIN-low   PA   MAJ-hi  MIN-hi   PA

   1  0.10272 0.05272  173  0.10077 0.05040  171  0.10464 0.05487  175
   2  0.54367 0.00000   97  0.48971 0.00000   97  0.59727 0.00000   98
Type Q to stop, just hit RETURN to continue

 indus      SAD  (31DEC06)    4218      19-JUN-2009  11:01:24     Page    3
W49-1665     .RCL002.       1      Disk  1      Plane  267 *** Deconvolution ***
   #  MAJ-dec MIN-dec   PA  MAJ-low MIN-low   PA   MAJ-hi  MIN-hi   PA
   3  0.69022 0.00000   41  0.61074 0.00000   39  0.76851 0.00000   43
   4  0.01858 0.00000   29  ---     ---      ---  0.03457 0.00000   57
   5  0.05149 0.00000   33  0.04426 0.00000   23  0.05944 0.00000   40
   6  0.16574 0.00000   35  ---     ---      ---  0.18095 0.21080   48
   7  0.13029 0.06243   65  ---     ---      ---  0.17140 0.13501   99
 SAD  1: Copied MF file from vol/cno/vers  1  127  96 to  1  139   1
 SAD  1: Appears to have ended successfully
 SAD  1: indus        31DEC06 NEW: Cpu=       0.3  Real=       3
 AIPS 1: Resumes
```

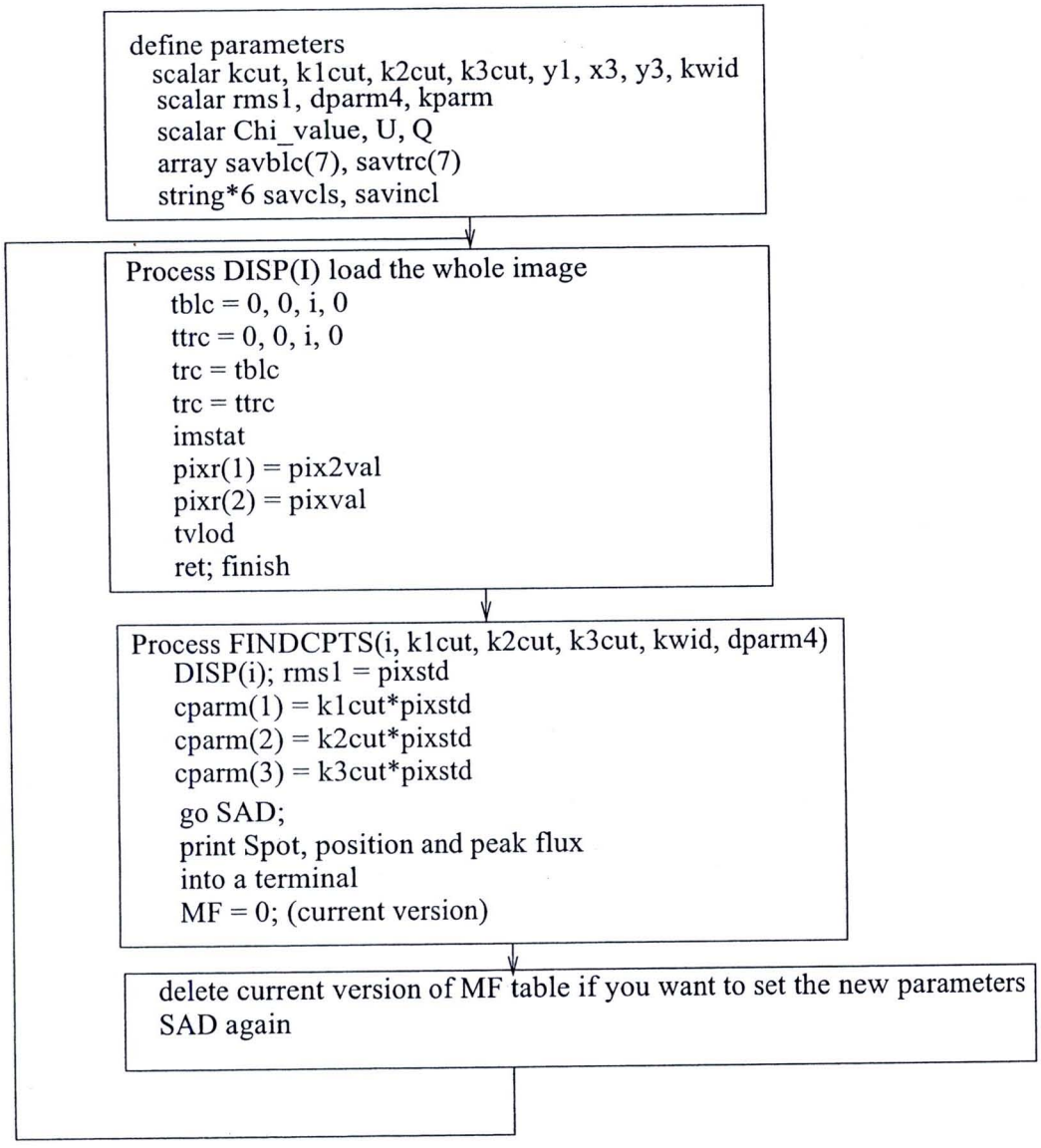

Figure B.2 The flowchart shows 'LINESAD' runfile script.

APPENDIX C

RESEARCH PUBLICATIONS

1. **Asanok K**, Etoka S, Gray M, Thomasson P, Richards AMS. OH MERLIN observations towards the star forming region S140-IRS1. In: Soonthornthum B, Komonjinda K, Cheng KS, Leung KC, editors. Astronomical Society of the Pacific Conference Series. The Eighth Pacific Rim Conference on Stellar Astrophysics: A Tribute to Kam-Ching Leung ASP Conference Series, Vol. 404; May 5-8, 2008; Merlin Beach Hotel, Phuket, Thailand. San Francisco: Astronomical Society of the Pacific; 2009.
2. **Asanok K**, Etoka S, Gray M, Thomasson P, Richards AMS, Hutawarakorn Kramer B. MERLIN polarization Measurements of the OH 18-cm and 6-cm and H_2O 1.25-cm maser emission from the complex star-forming source, S140-IRS1. Paper presented at the Siam Physics Congress 2009: Physics for Dynamics Society; March 19 – 21, 2009; Petchaburi, Thailand.
3. **Asanok K**, Etoka S, Gray M, Richards AMS, Hutawarakorn Kramer B, Thomasson P. MERLIN observations toward the massive star-forming regions: S140-IRS1 and W49 A. Paper presented at the Siam Physics Congress 2010: Physics for Creative Society; March 25 – 27, 2010; Kanchanaburi, Thailand.
4. **Asanok K**, Etoka S, Gray M, Thomasson P, Richards AMS, Hutawarakorn Kramer B. OH and H_2O masers towards the star-forming region S140-IRS1. **Mon Not R Astron Soc** 2010; 404(1): 120-33.
5. **Asanok K**. OH maser in the W49 A molecular cloud complex. Paper presented at the 3rd Thailand and Korea joint workshop on astrophysics, February 1-5, 2010; Chiang Mai, Thailand.

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