2008/06/27

SHARP data analysis memo of the IRAS 20126 data taken in 2007

Hiroko

- Initial data inspection and Pointing correction:

I first analyzed the data with sharpinteg_2 with flags of "-c -f 1 -w -sil". These options were chosen solely for the purpose to derive the pointing offsets. (The flag "-w" is for replacing blank pixels to good ones that are stored in the other frame.) Firstly, I selected the data that are taken in proper condition (chop throw within 2 arcsec, chopper efficiency greater than 40%, HWP angles (checked by plotting with "readsharc" on IDL), and saturation).

After extracting the good data files, Darren's "fitgauss" is used to derive the pointing offsets of each data file. Options used were "-p -b" as all files include a bright peak feature. Pointing change was investigated carefully. Peak signal was detected at 44.6 +/- 4.7 sigma. Plots of pointing offsets of this data set are found elsewhere.

- Sharpinteg

For science data reduction, I re-ran the sharpinteg_2 with flags of "-c -f 1 -sil". Three files are identified that generate "near saturation" warning message at different times. (In case if you are interested in looking into these files, please go to a web at puuoo.submm.caltech.edu/~hs/sharpsolve_errlog/
You'll find the four fits files along with the sharp error logs for each of these files.) This is leftover from sharpsolve. Larry confirmed that sharpinteg checks saturation prior to the tossing of bad pixels. Accordingly, these messages are generated even when all pixels used are actually fine. According to Darren, the threshold that he defined is 3.5V. As long as RGM marks bad pixels, final fits files should be good. And it turned out that RGM was blocking out all saturated pixels for this case. Accordingly, we used these three files to calculate the final results. I double-checked about saturation by eye. The number of the files extracted are 141 in total for data analysis.

- sharp_combine

sharp_combine v4.25 (last updated 2008 May 22) was used to process polsharp4 to derive proper vectors angle/degree of polarization. The command used for this process is as follows:

```
sharp_combine listname listname.fits -hwp 93 -l 51 51 -ma 5 -sm 2 -ps 4.75 -pm 6.3 -q -
bg 30 0 -ip 0.0034 0.00017 0.0036 0.0 -idl
```

-idl option was used to check the process of background subtraction and identify if there were any outliers. It turned out that all cases merged, i.e., background subtraction process was done successfully for all files.

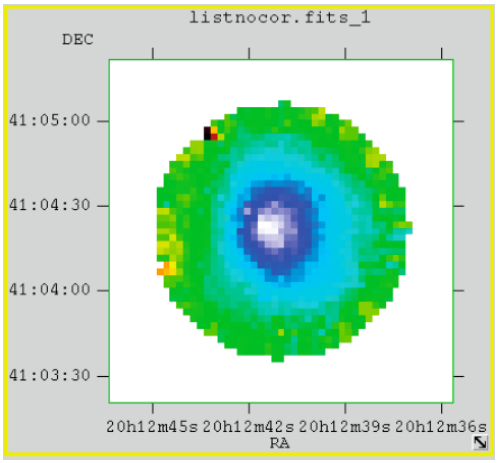
Sharp_combine v5 was used to run Mike's chi2 program.

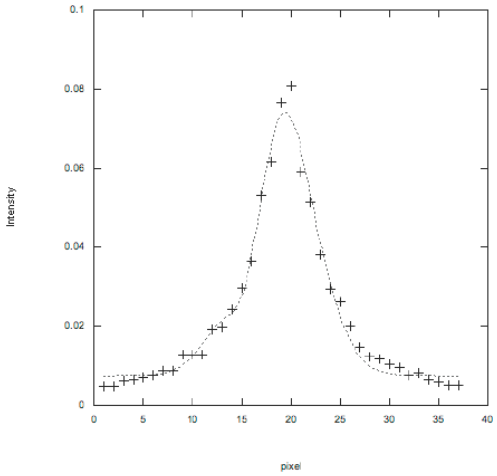
(Command used for version 5 (same as version 4):

```
sharp_combine_v5 listname listname.fits -hwp 93 -l 51 51 -ma 5 -sm 2 -ps 4.75 -pm 6.3 -q
-bg 30 0 -ip 0.0034 0.00017 0.0036 0.0 )
```

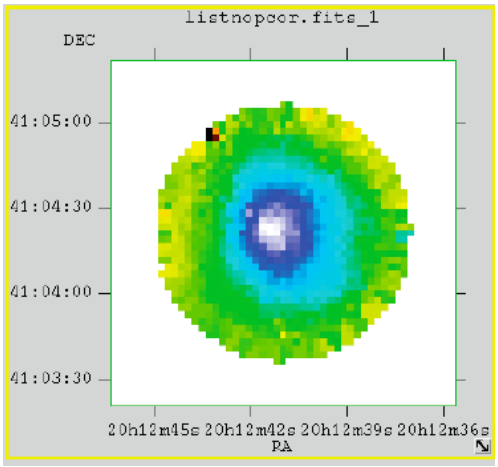
Images processed with sharp_combine v4.25

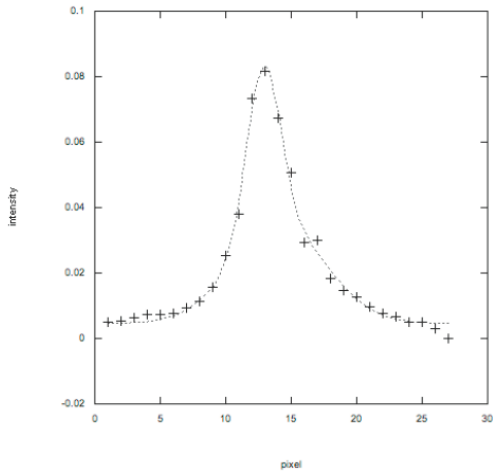
- No correction for both pointing and tau
  + peak 0.0809, + FWHM ~ 5.20 +/- 0.22 pixels (two Gaussian components plus offset)
  + map edge ~ 0.05 (chisq 0.00027, R 0.992)



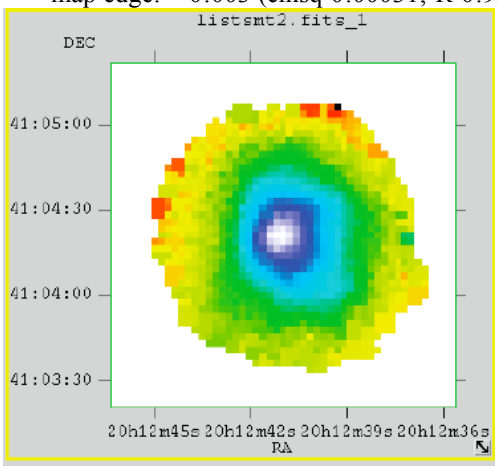


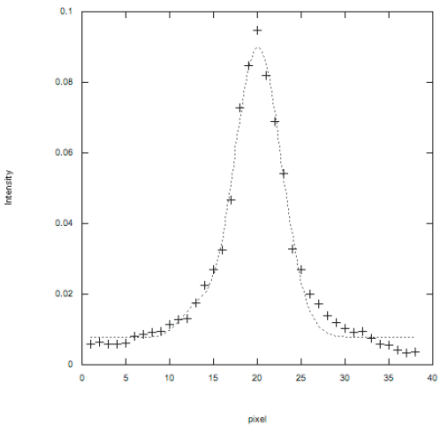
- No pointing correction but with tau correction
  + peak 0.0815, +FWHM ~ 5.24 +/- 0.21 pixels (two Gaussian components plus offset)
  + map edge ~ 0.007 (chisq 0.00028, R 0.992)





- Pointing/tau correction. Smoothed pointing correction with method 2.
  + peak 0.0946, + FWHM 3.84 pixels +/- 0.14 pixels (two Gaussian components plus offset)
  + map edge: ~ 0.003 (chisq 0.00031; R 0.993)

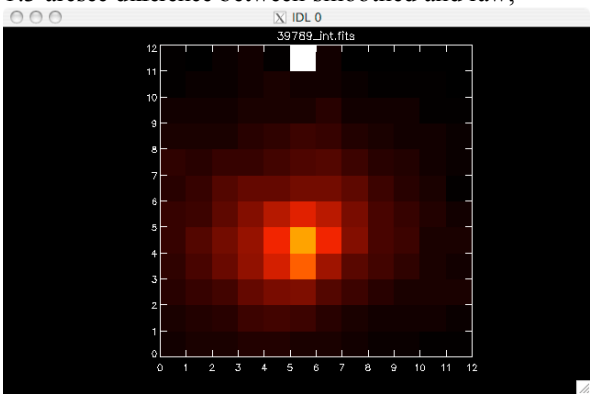




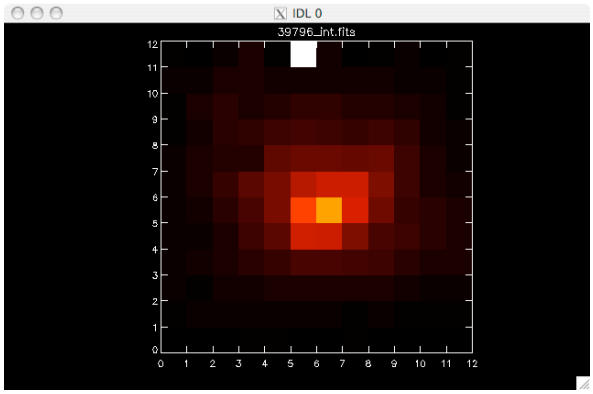
→ Pointing correction plus smoothed tau correction significantly improved the image. (In other words, it greatly helped concentrating the flux of the object to the center.)

Examples of the images to check which methods are better.

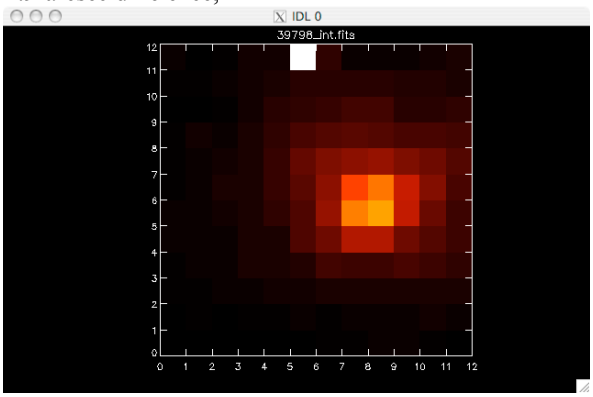
1.3 arcsec difference between smoothed and raw,



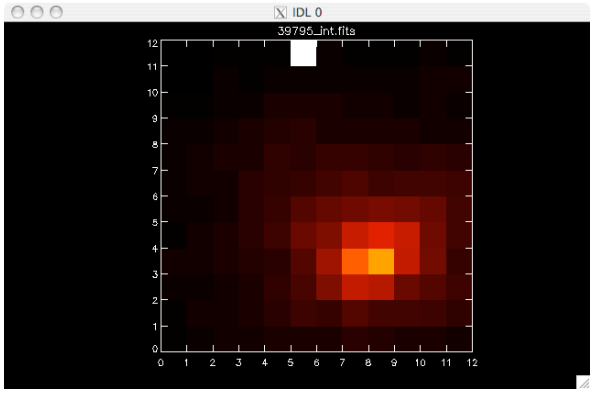
4.1 arcsec difference



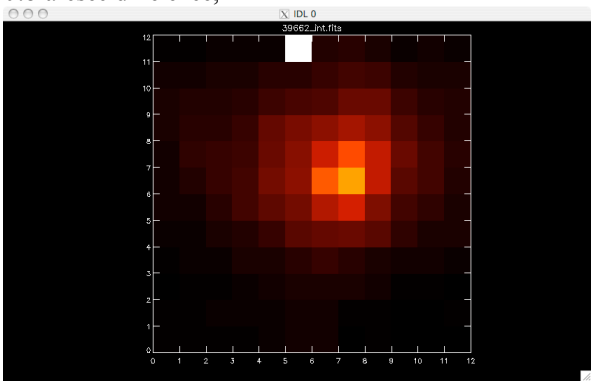
2.9 arcsec difference,



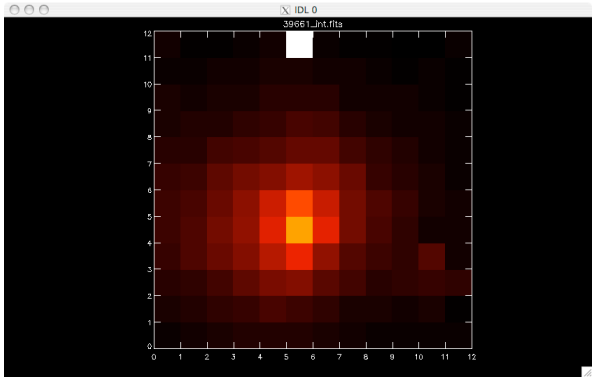
3.6 arcsec difference



0.8 arcsec difference,

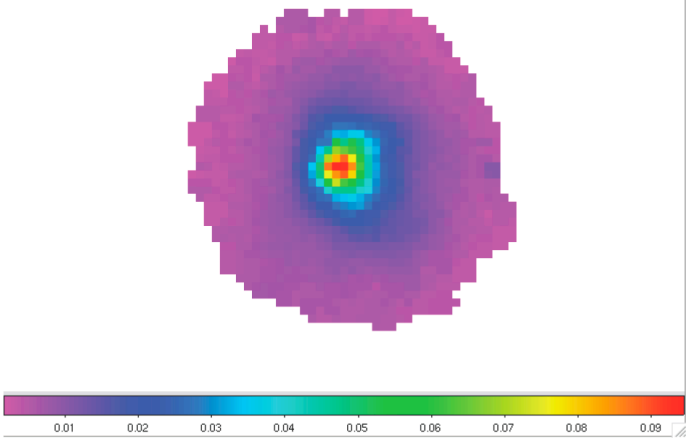


0.7 arcsec difference

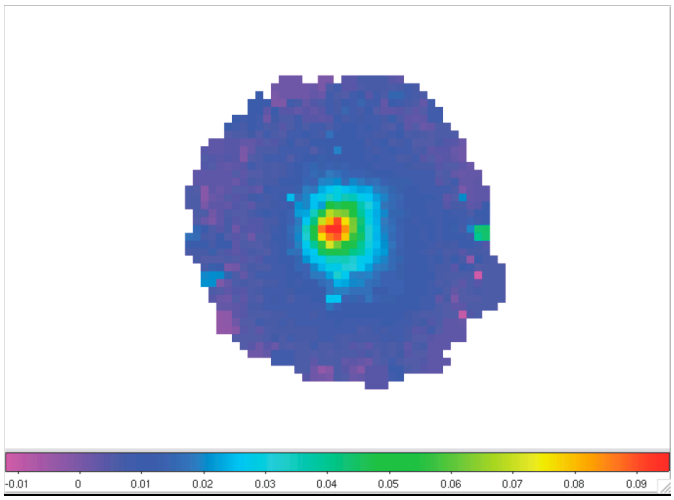


Fitting seems to be done properly for all selected files. → decided to use pointing offsets that fitgauss derived.

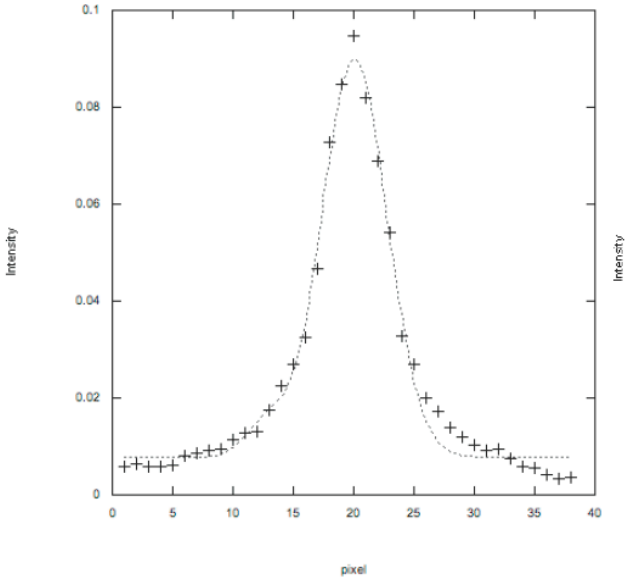
- With background subtraction,

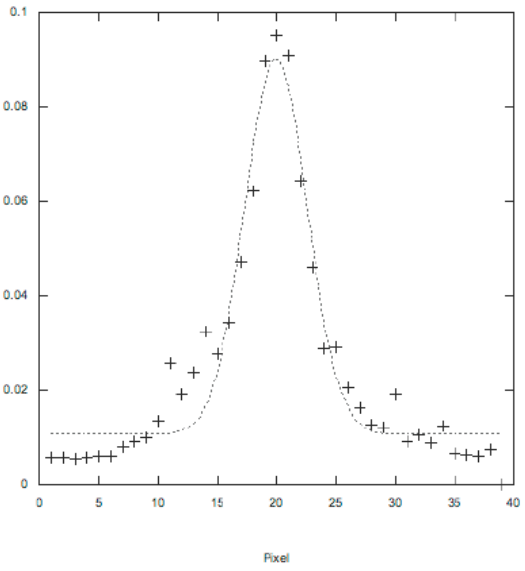


- Without background subtraction



- With background subtraction (FWHM 3.84 pixels +/- 0.14 pixels), - Without background subtraction (FWHM 3.71 +/- 0.21)





Those Fits files can be found on a web at
http://www.cso.caltech.edu/~hs/sharp/fits/withbgndsubt.fits
http://www.cso.caltech.edu/~hs/sharp/fits/withoutbgndsubt.fits

If the background subtraction process is not done, source flux is spread out in broader area, as you see from the diagrams above.

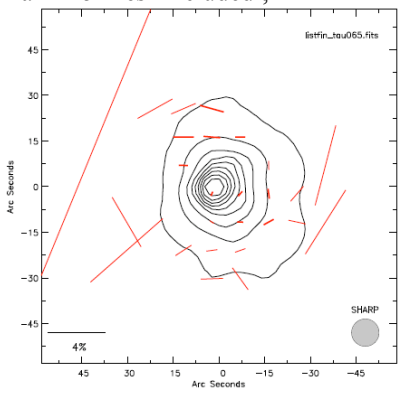
(Without background subtraction, peak ~ 0.095, noisy outskirt area.

```
sharp_combine listname listname.fits -hwp 93 -l 51 51 -ma 5 -sm 2 -ps 4.75 -pm 6.3 -q -
ip 0.0034 0.00017 0.0036 0.0 )
```

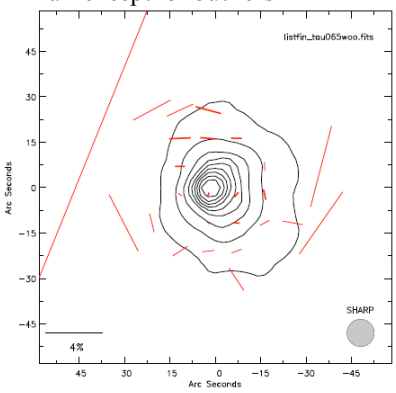
John's background subtraction routine built in sharp_combine helped increasing the signal to noise ratio.

(IDL command: polsharp4,'file.fits',/vec,sig2=2,color=2)

- all 125 files[1] included ,

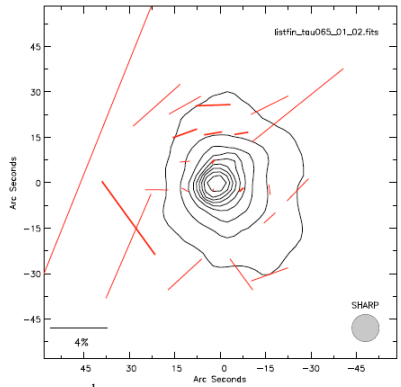


- all except for outliers

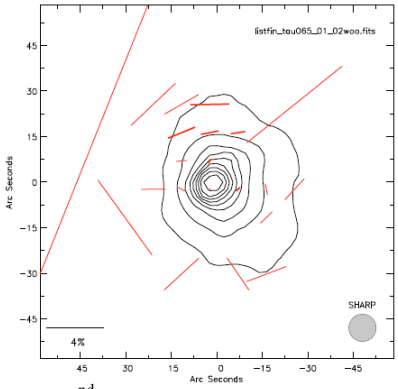


- Data divided into two bins

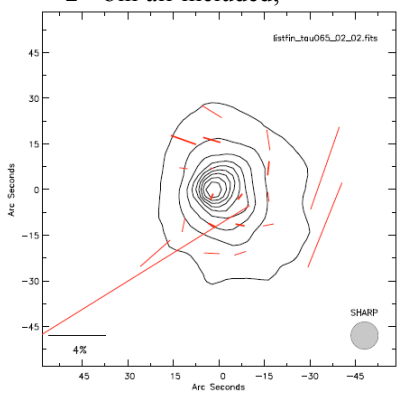
  * 1st bin all included,



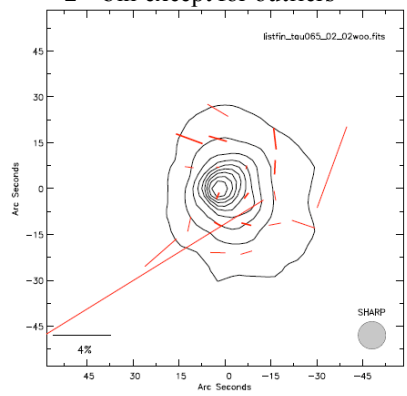
  * 1st bin except for outliers



  * 2nd bin all included,

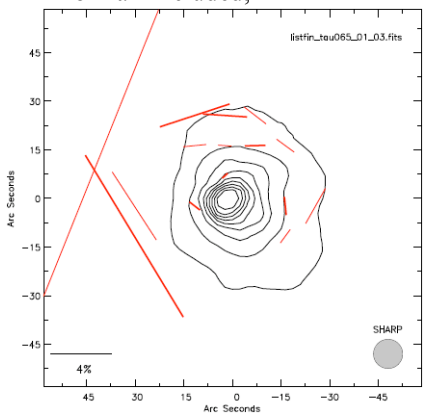


  * 2nd bin except for outliers

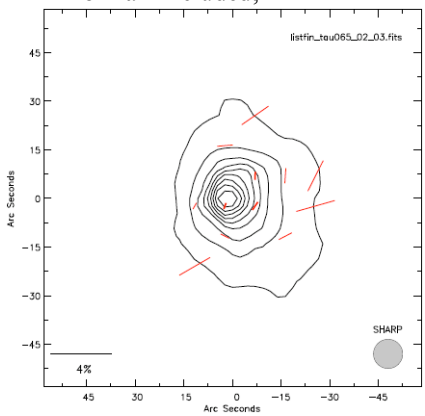


- Data divided into three bins

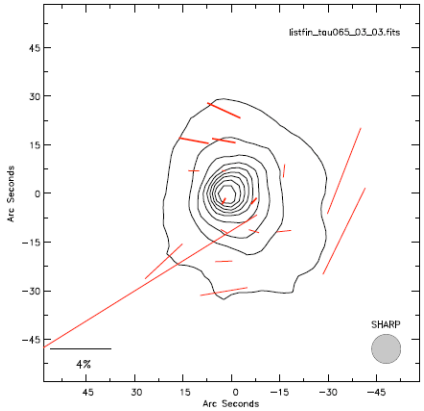
  * 1st bin all included,



  * 2nd bin all included,

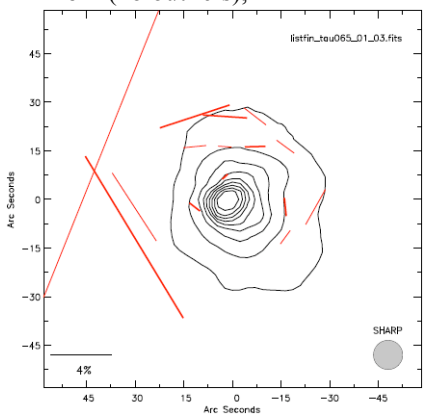


  * 3rd bin all included

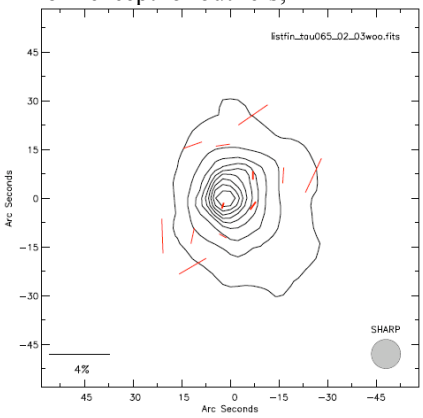


[1] 125 files were taken under a condition of tau 225 < 0.065.

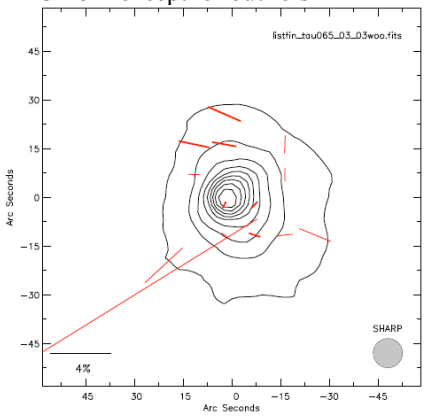
* 1st bin (no outliers),



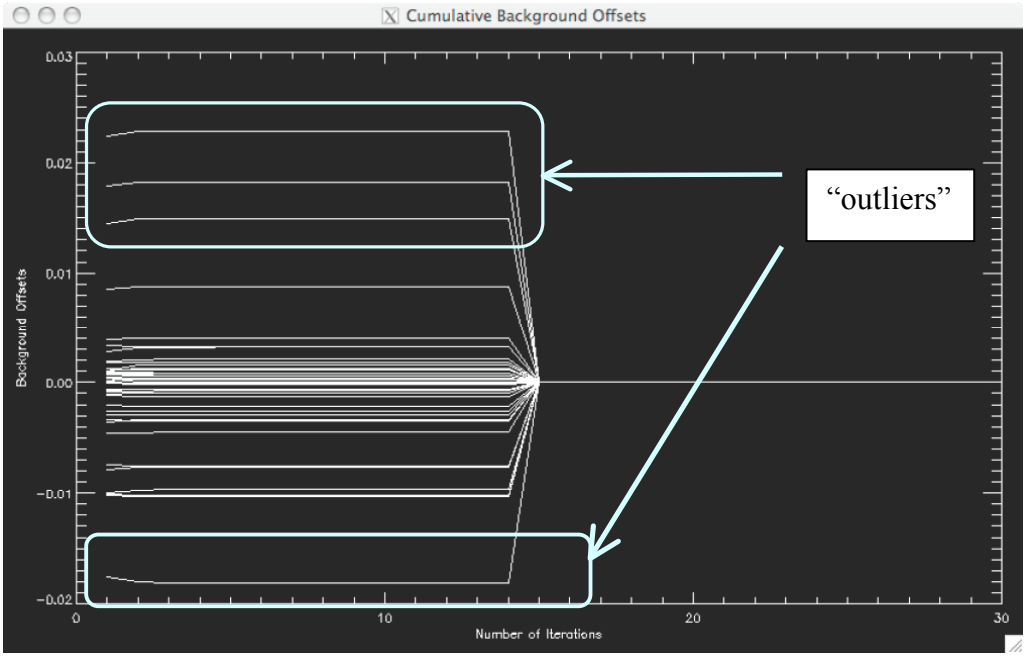
* 2nd bin except for outliers,



* 3rd bin except for outliers

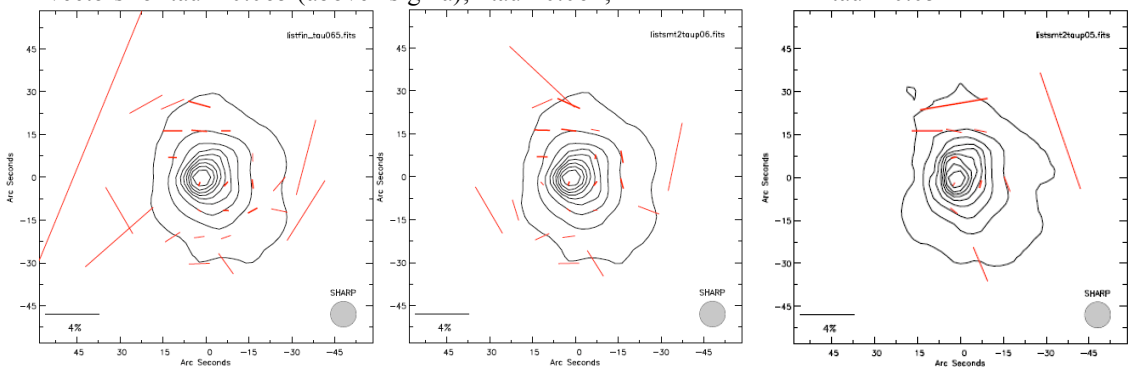


"outliers"



files tau < 0.065 … 125 files total
files tau < 0.06 … 97 files total
files tau < 0.05 … 19 files total

E vectors for tau < 0.065 (above 2sigma); tau< 0.06 ; tau < 0.05



- Chi Square

chi2 -f chi2list -c points.list –update

* Twelve bins fits files plus the final fits that includes all data files

Summary of results for whole map:
Reduced Chi Squared mean and standard dev. for the I map: 11.029792, 25.840155
Reduced Chi Squared mean and standard dev. for the Q map: 1.484432, 0.884387
Reduced Chi Squared mean and standard dev. for the U map: 1.746142, 0.787574

→ We detected polarization of this object at 350 micron with reasonable reproducibility and fidelity.

- Polarization map made in November 2007,