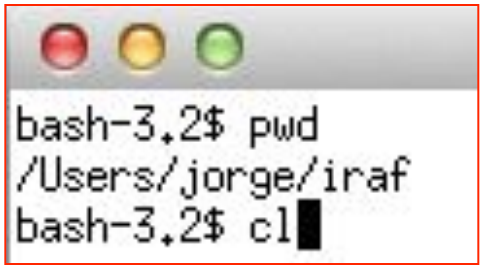
AGA5802

Data reduction of spectra taken at OPD with the Cassegrain spectrograph (600 lines/mm grating) + 1.6m telescope

(example for data taken on 4 March 2014)

Open an xgterm in your iraf diretory & initialize typing *cl*



Go to your data directory and write *ls*

```
ecl> pwd
/Users/jorge/iraf
ecl> cd /Users/jorge/Dropbox/aga0414/trabalho/14mar04/
ecl> pwd
/Users/jorge/Dropbox/aga0414/trabalho/14mar04
ecl> ls
HD036079.fits   bias_002.fits   bias_007.fits   flat_002.fits   flat_007.fits
HD036673.fits   bias_003.fits   bias_008.fits   flat_003.fits   flat_008.fits
HD045289.fits   bias_004.fits   bias_009.fits   flat_004.fits   flat_009.fits
MP0190.fits     bias_005.fits   bias_010.fits   flat_005.fits   flat_010.fits
bias_001.fits   bias_006.fits   flat_001.fits   flat_006.fits   he-ar_001.fits
ecl>
```

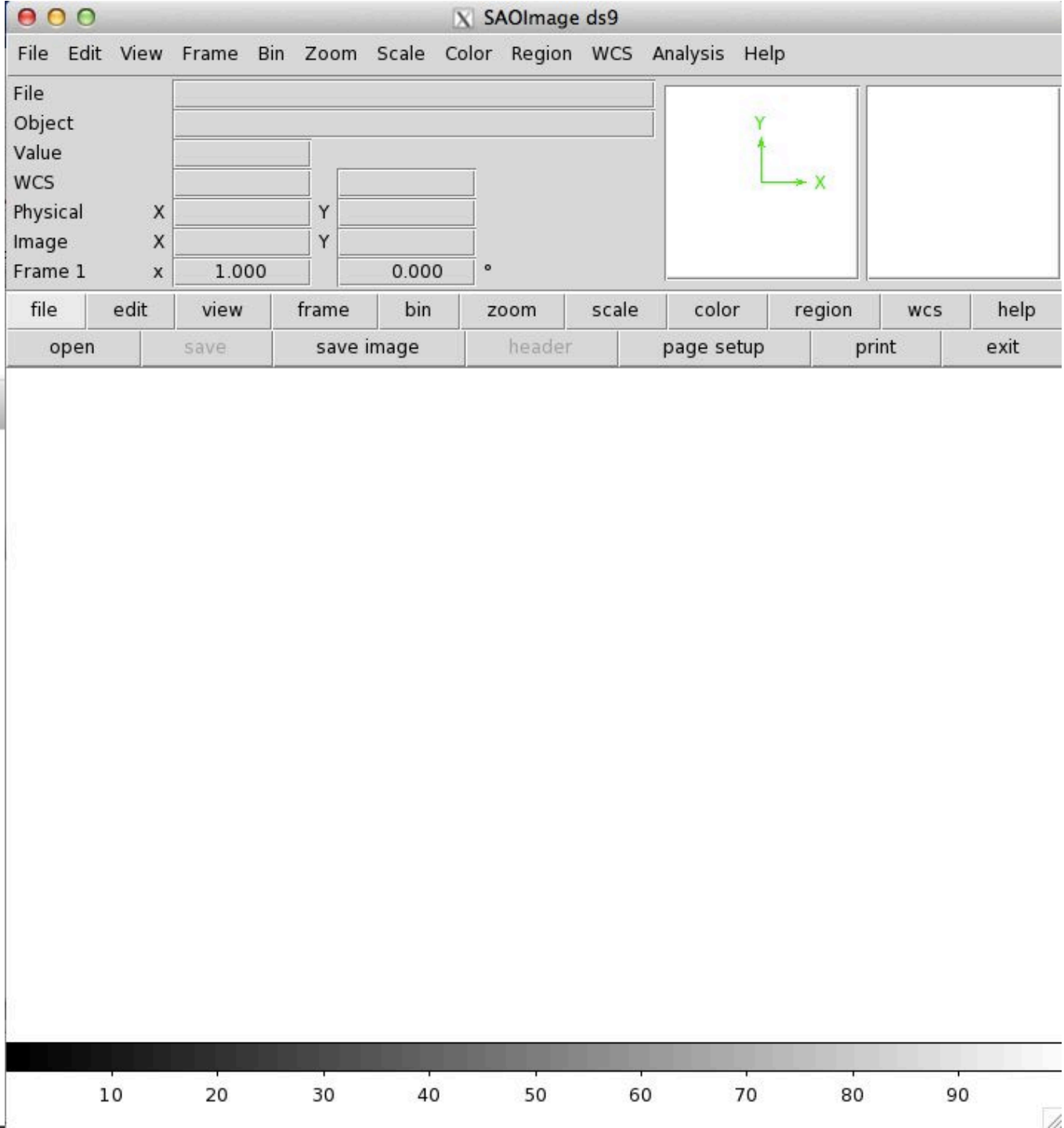
HD.fits e MP0190.fits :* **stars**

bias_*.fits : **bias** *flat_*.fits :* **flats**

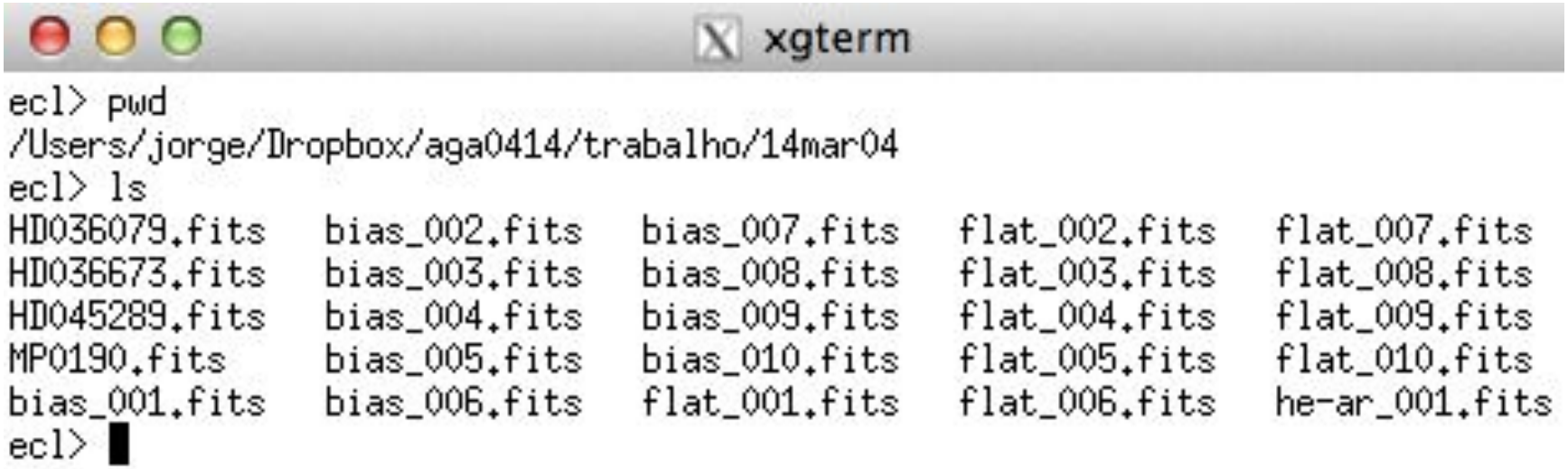
he-ar_001.fits : **He-Ar** (for wavelength calibration)

ecl> !ds9&


ecl> !ds9&
ecl>


SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File
Object
Value
WCS
Physical X Y
Image X Y
Frame 1 x 1.000 0.000 °
Y
X
file edit view frame bin zoom scale color region wcs help
open save save image header page setup print exit
10 20 30 40 50 60 70 80 90

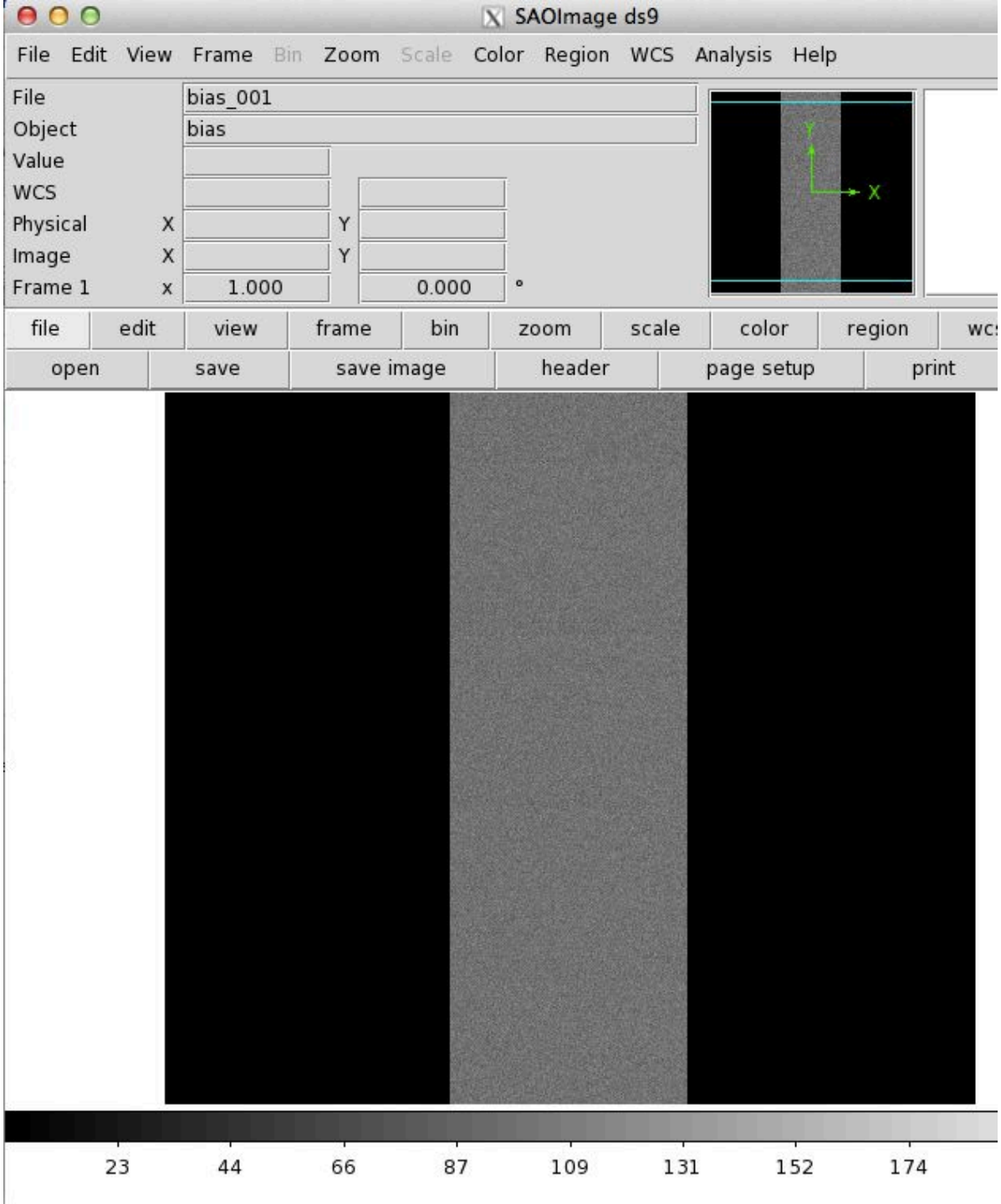
ecl>ls



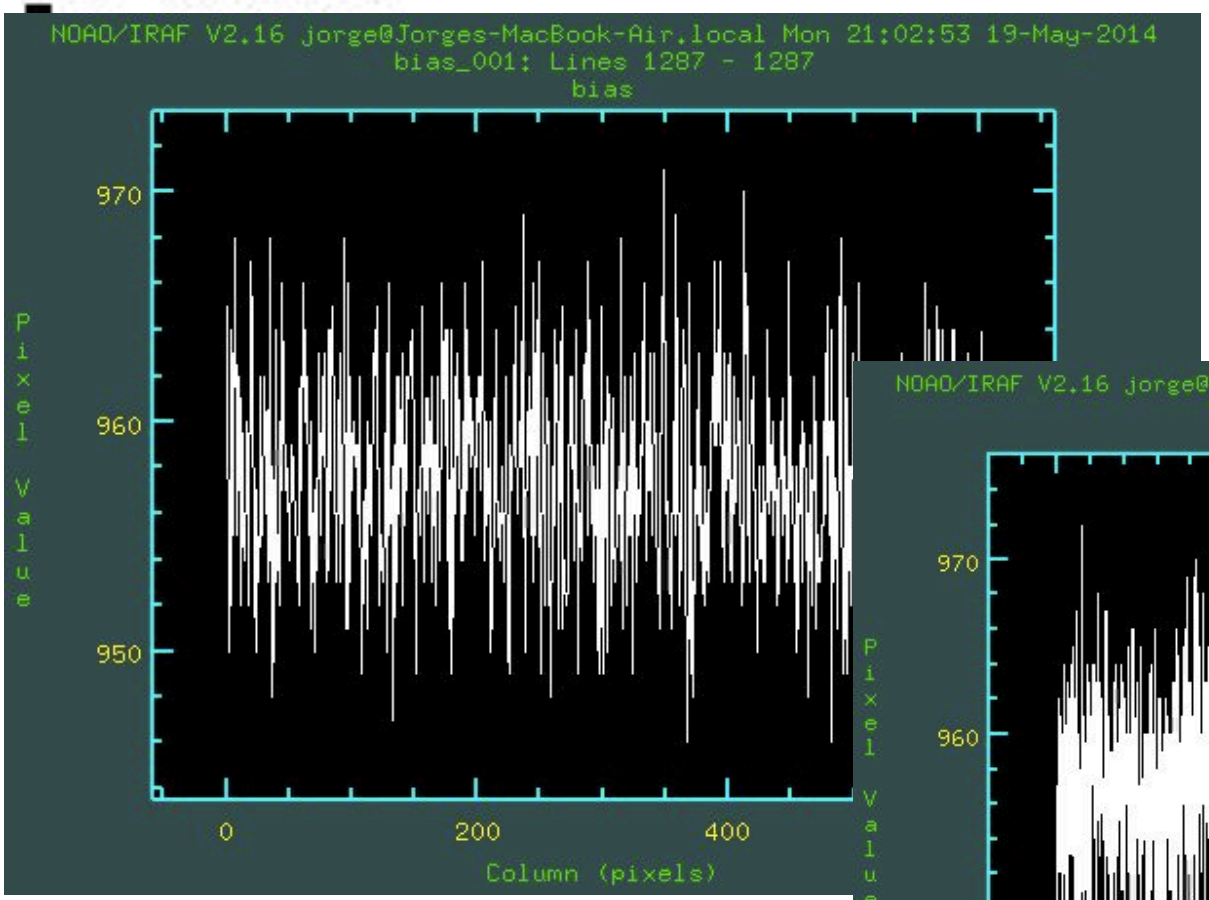
display bias_001 1 fill+

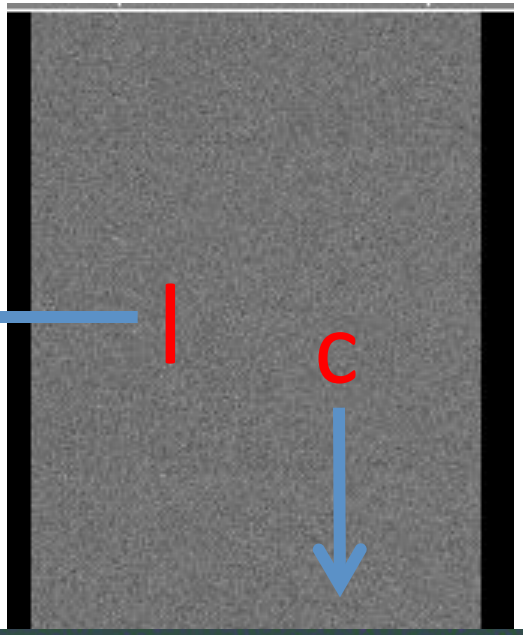
Frame # in ds9

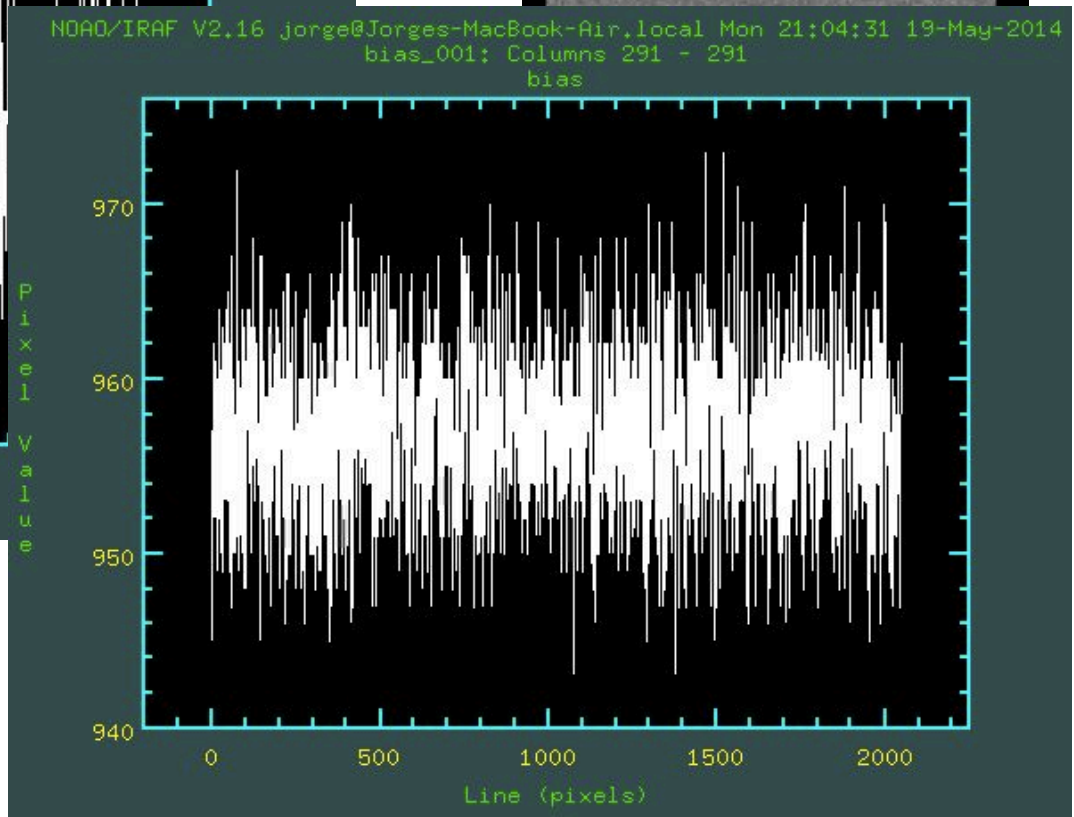
Display whole image


SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File bias_001
Object bias
Value
WCS
Physical X Y
Image X Y
Frame 1 x 1.000 0.000 °
Y
X
file edit view frame bin zoom scale color region wcs
open save save image header page setup print
23 44 66 87 109 131 152 174

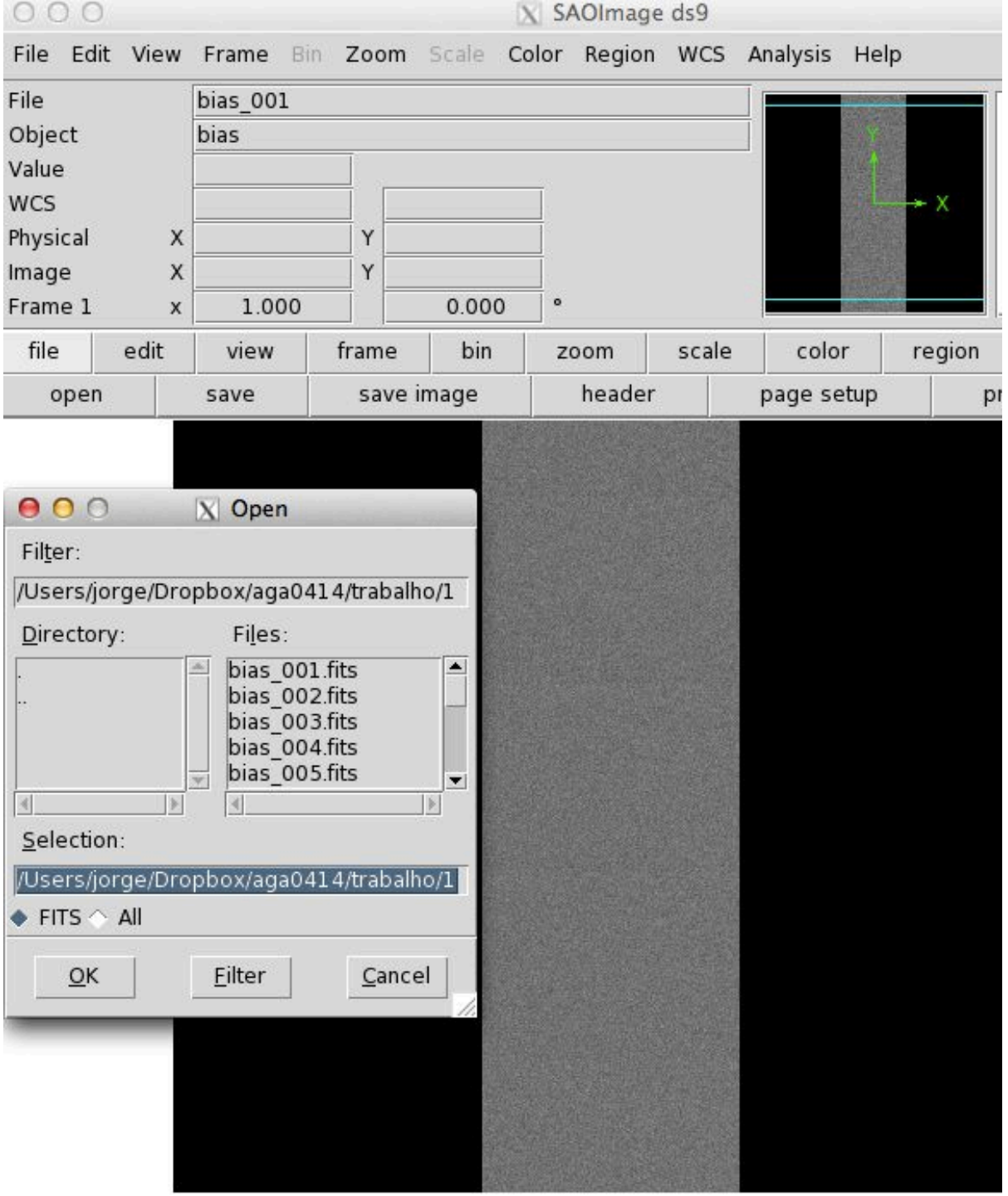
```
ecl> display bias_001 1 fill+
z1=943. z2=974.
ecl> imexamine
```

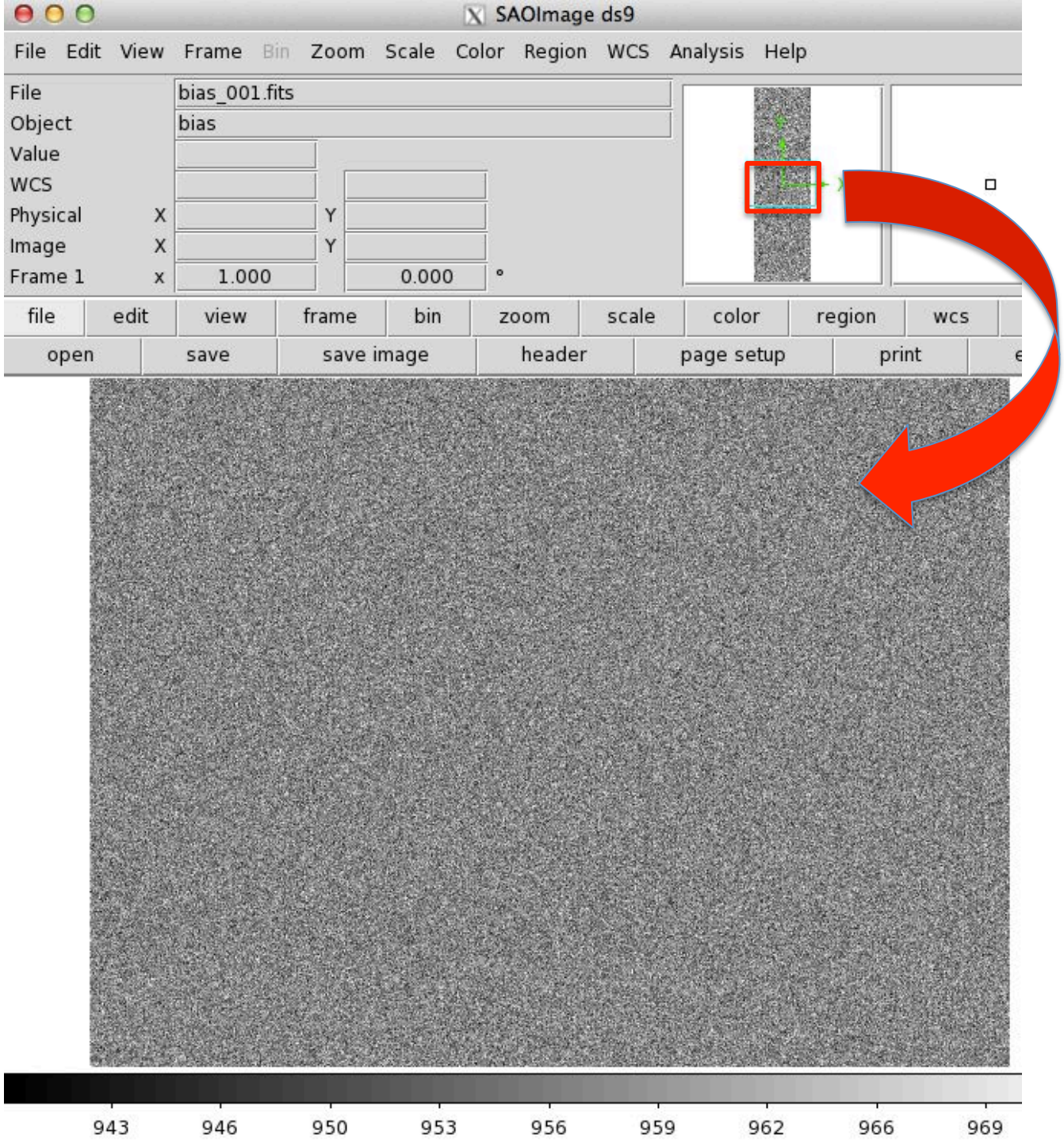


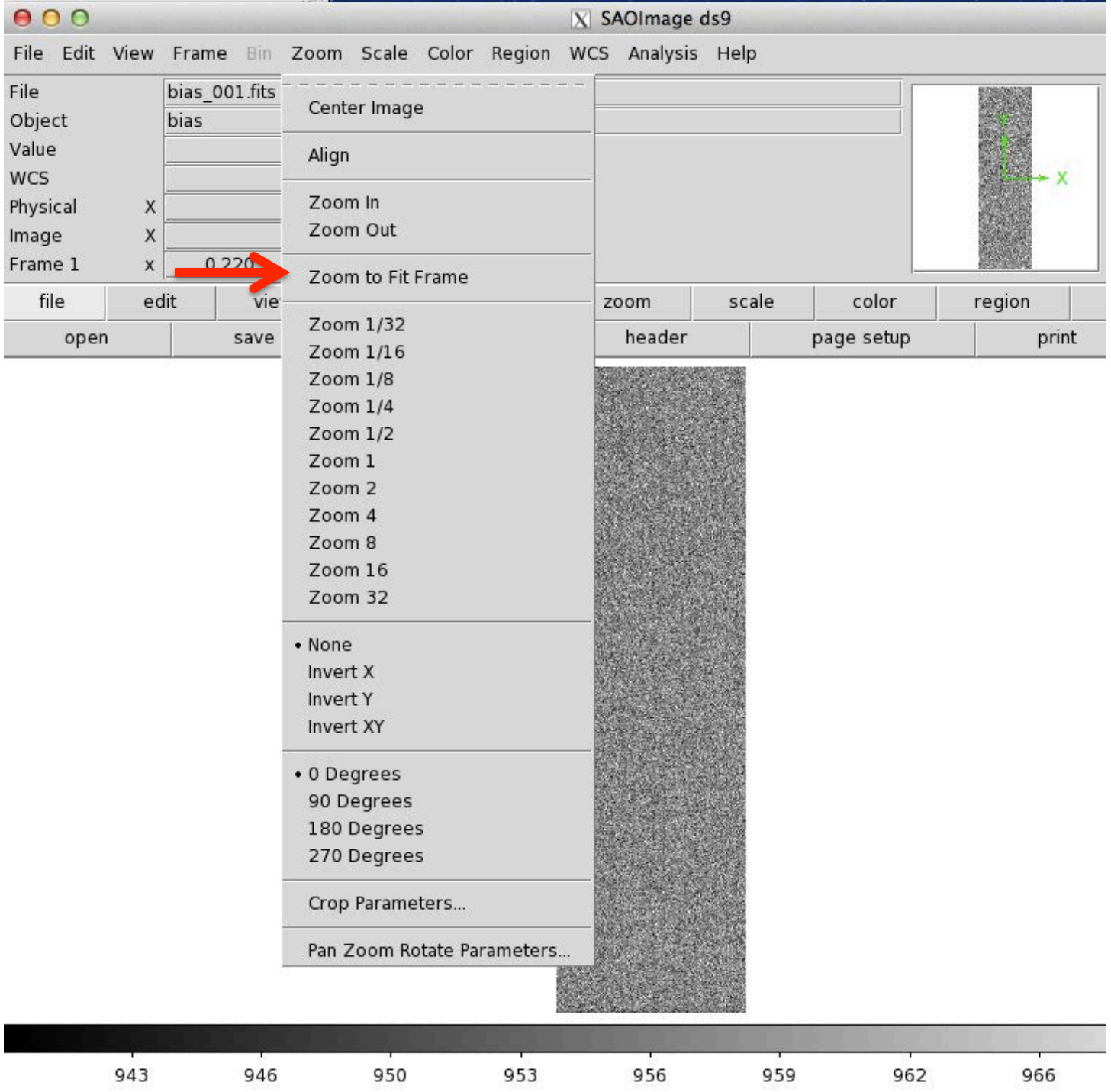


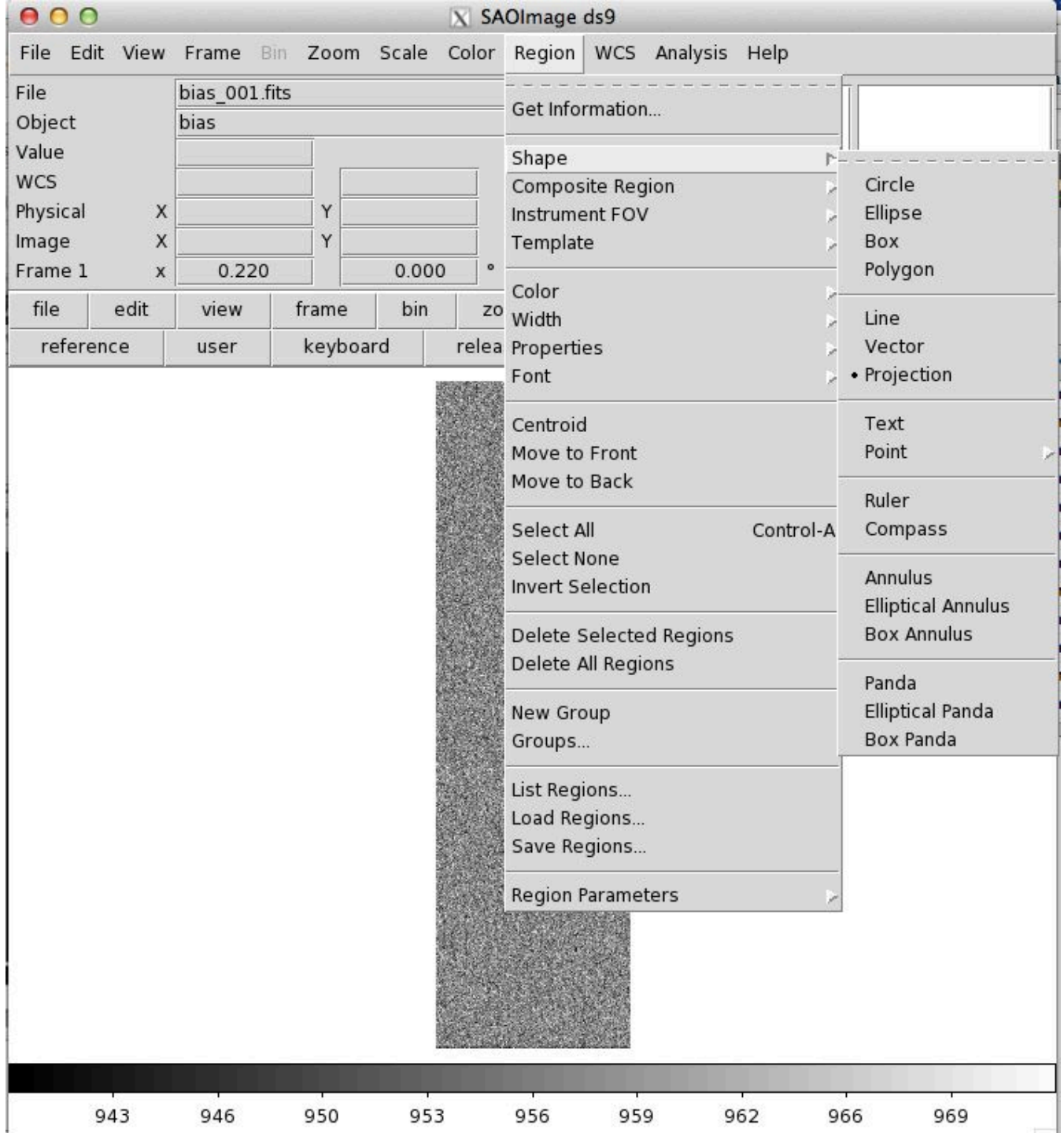


Another option (my favorite) is to load the image directly from **ds9** and use "**projection**" (this is because projection may not work adequately if you load the image using *display*)

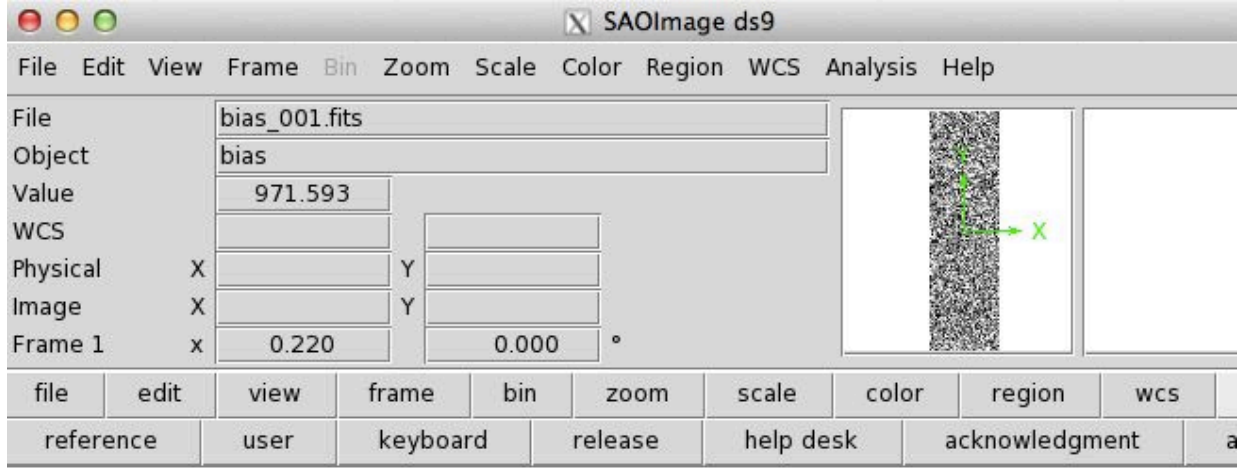


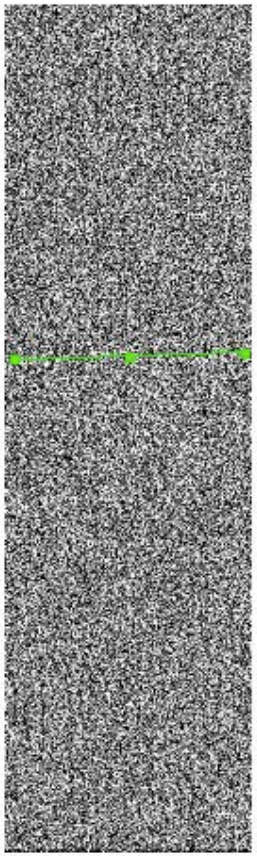

SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File bias_001.fits
Object bias
Value
WCS
Physical X Y
Image X Y
Frame 1 x 1.000 0.000 °
file edit view frame bin zoom scale color region wcs
open save save image header page setup print
943 946 950 953 956 959 962 966 969

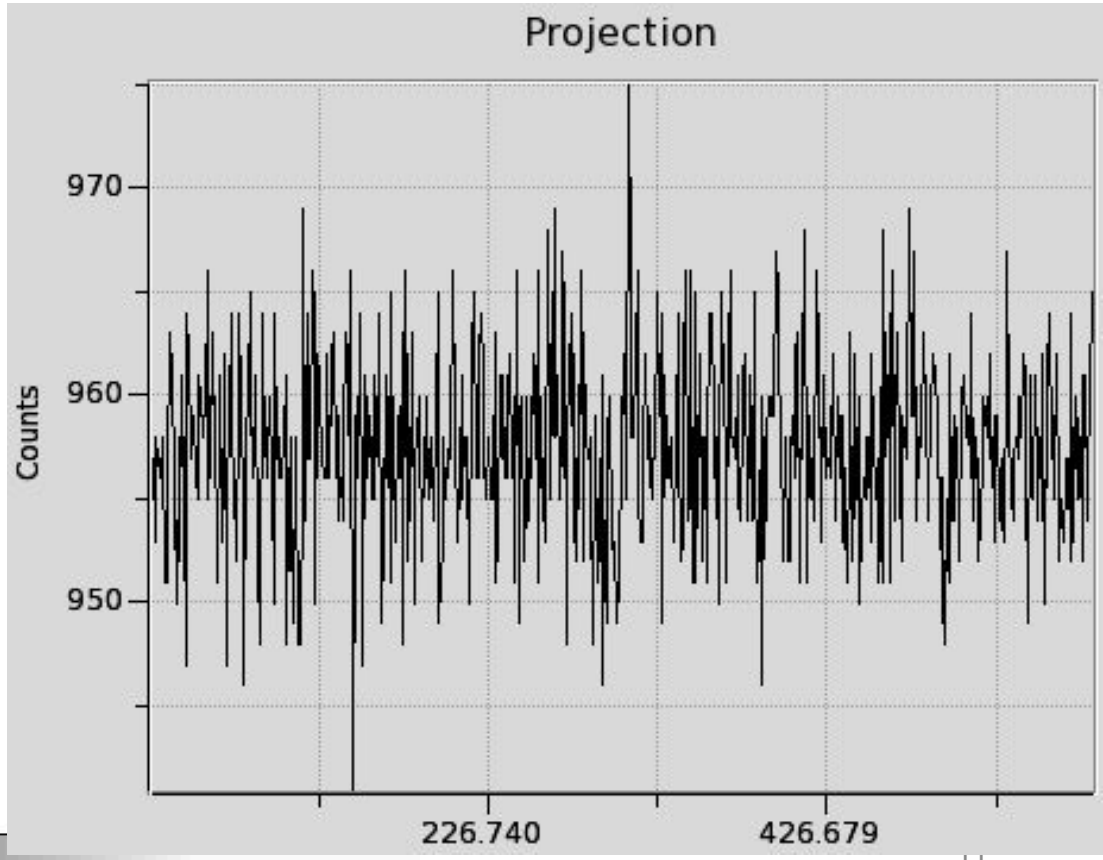

SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File bias_001.fits
Object bias
Value
WCS
Physical X
Image X
Frame 1 x
Center Image
Align
Zoom In
Zoom Out
Zoom to Fit Frame
Zoom 1/32
Zoom 1/16
Zoom 1/8
Zoom 1/4
Zoom 1/2
Zoom 1
Zoom 2
Zoom 4
Zoom 8
Zoom 16
Zoom 32
None
Invert X
Invert Y
Invert XY
0 Degrees
90 Degrees
180 Degrees
270 Degrees
Crop Parameters...
Pan Zoom Rotate Parameters...
file edit
zoom scale color region
open save
header page setup print
943 946 950 953 956 959 962 966

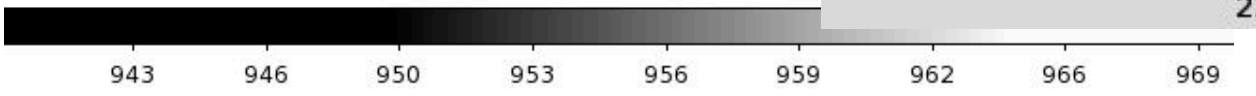


Region
Shape
Projection


SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File bias_001.fits
Object bias
Value 971.593
WCS
Physical X Y
Image X Y
Frame 1 x 0.220 0.000 °
file edit view frame bin zoom scale color region wcs
reference user keyboard release help desk acknowledgment




Projection
970
960
950
Counts
226.740
426.679


943 946 950 953 956 959 962 966 969

ecl> imstat bias*

# IMAGE	NPIX	MEAN	STDDEV	MIN	MAX
bias_001.fits	1230848	957.3	4.613	934.	982.
bias_002.fits	1230848	957.3	4.628	933.	982.
bias_003.fits	1230848	957.2	4.628	934.	980.
bias_004.fits	1230848	957.2	4.627	932.	980.
bias_005.fits	1230848	957.3	4.608	934.	980.
bias_006.fits	1230848	957.3	4.626	935.	981.
bias_007.fits	1230848	957.4	4.613	935.	981.
bias_008.fits	1230848	957.3	4.632	932.	982.
bias_009.fits	1230848	957.3	4.625	935.	979.
bias_010.fits	1230848	957.3	4.612	932.	981.

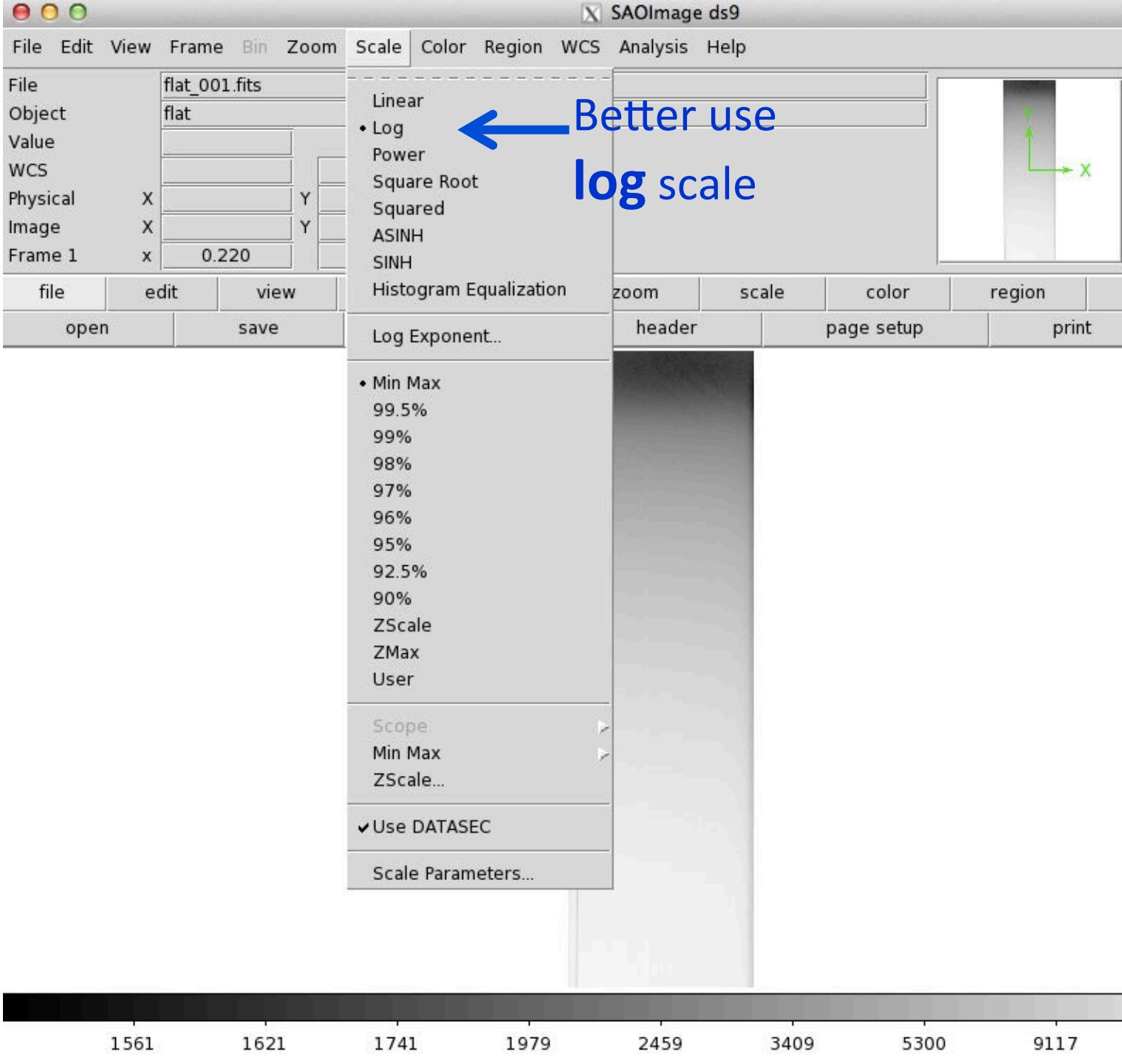
ecl> imcombine bias* bias.fits comb=median

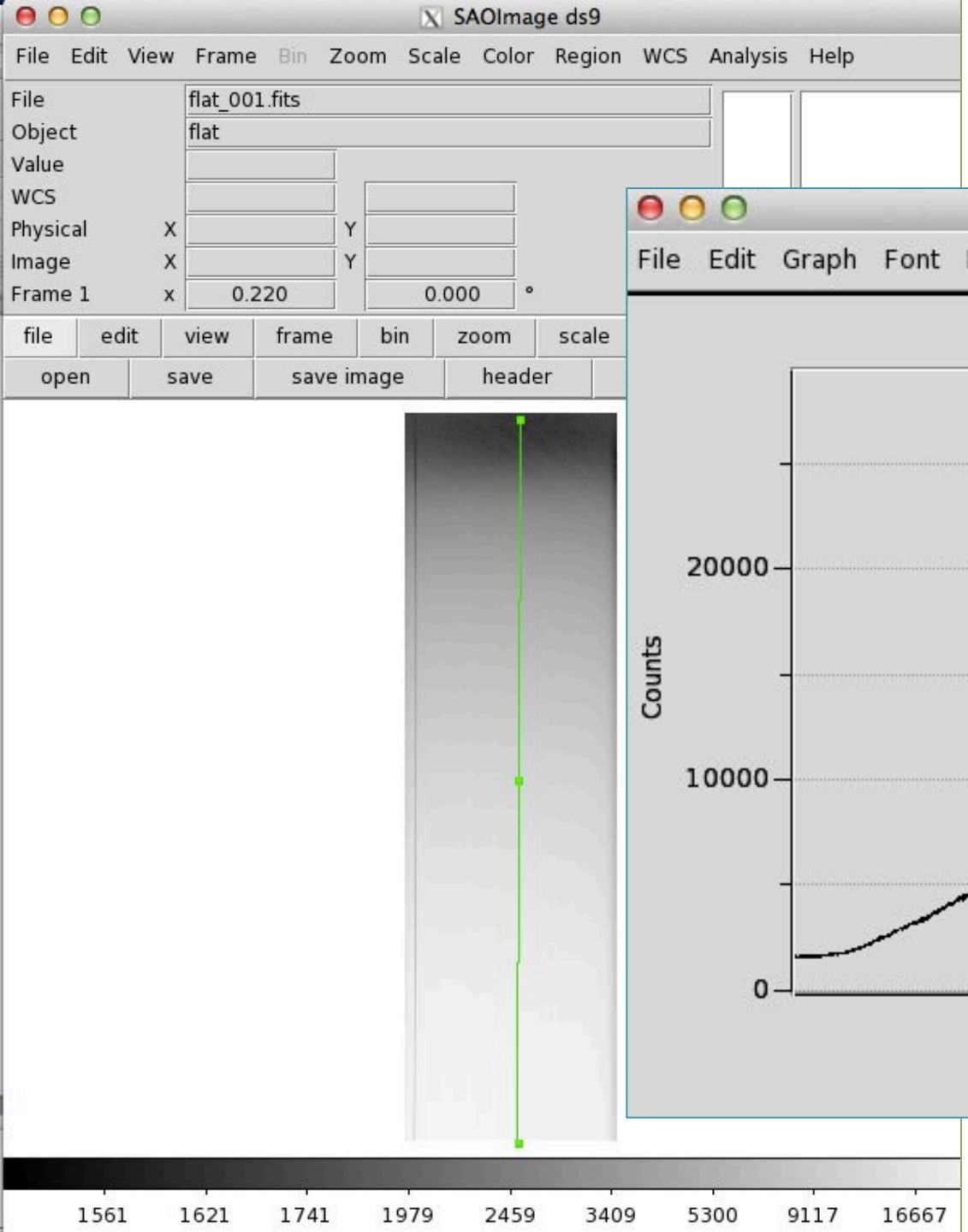
```
combine = median, scale = none, zero = none, weight = none
blank = 0.
        Images
bias_001.fits
bias_002.fits
bias_003.fits
bias_004.fits
bias_005.fits
bias_006.fits
bias_007.fits
bias_008.fits
bias_009.fits
bias_010.fits
Output image = bias.fits, ncombine = 10
```

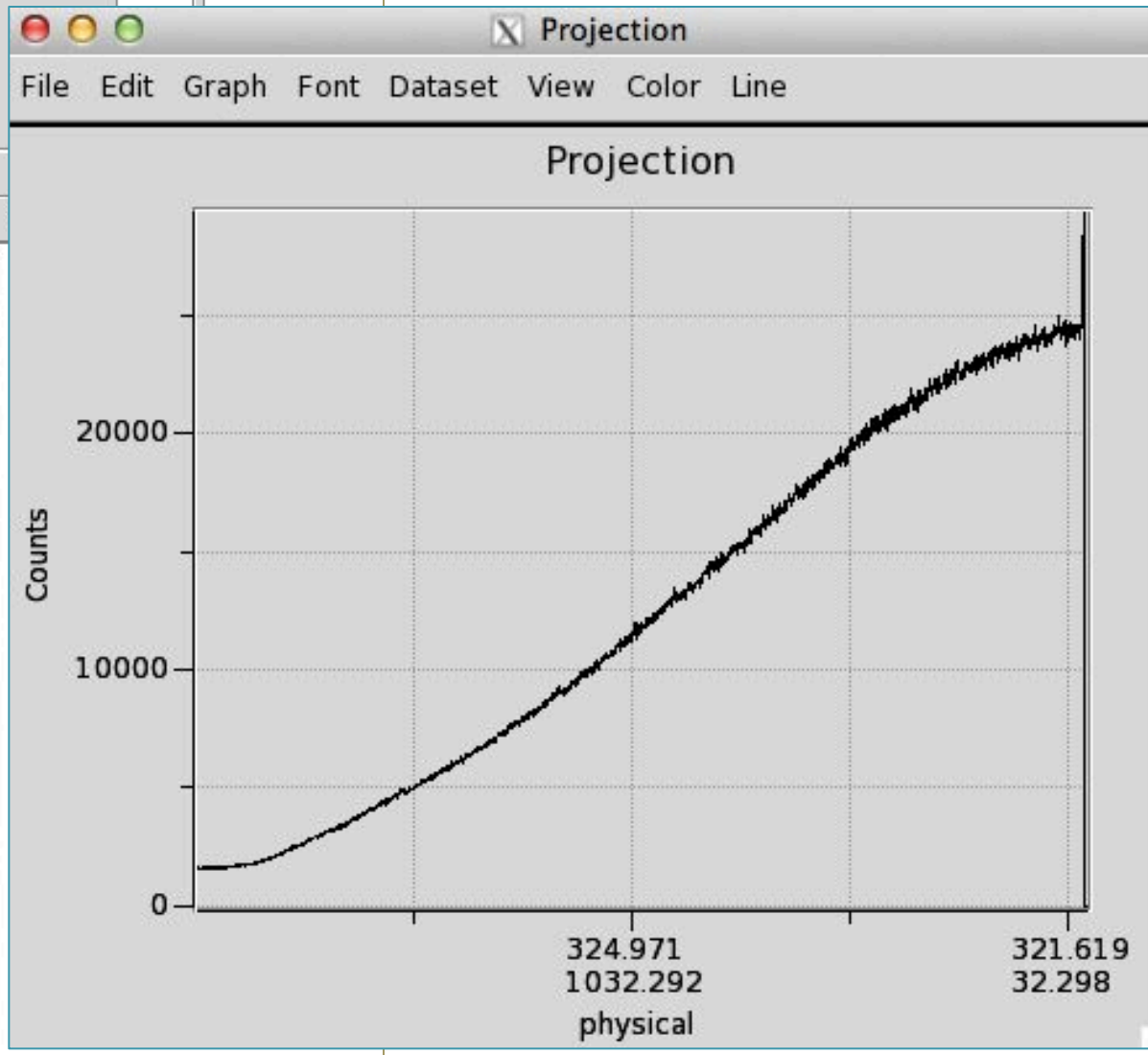
ecl> imstat bias.fits

# IMAGE	NPIX	MEAN	STDDEV	MIN	MAX
bias.fits	1230848	957.3	1.746	946.5	965.5

Check the flat




SAOImage ds9
File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help
File flat_001.fits
Object flat
Value
WCS
Physical X Y
Image X Y
Frame 1 x 0.220 0.000 °
file edit view frame bin zoom scale
open save save image header
1561 1621 1741 1979 2459 3409 5300 9117 16667


Projection
File Edit Graph Font Dataset View Color Line
Projection
Counts
20000
10000
0
324.971
1032.292
321.619
32.298
physical

Combine flats in flat.fits

```
ecl> imstat flat*
#                IMAGE      NPIX      MEAN    STDDEV       MIN       MAX
        flat_001.fits   1230848     12000.      7659.     1531.     31731.
        flat_002.fits   1230848     11998.      7658.     1526.     31716.
        flat_003.fits   1230848     11953.      7628.     1533.     31642.
        flat_004.fits   1230848     12009.      7662.     1525.     31772.
        flat_005.fits   1230848     12043.      7682.     1523.     31817.
        flat_006.fits   1230848     12061.      7691.     1529.     31828.
        flat_007.fits   1230848     12054.      7687.     1512.     31944.
        flat_008.fits   1230848     12095.      7711.     1540.     31903.
        flat_009.fits   1230848     12138.      7739.     1542.     31927.
        flat_010.fits   1230848     12107.      7718.     1526.     31933.
```

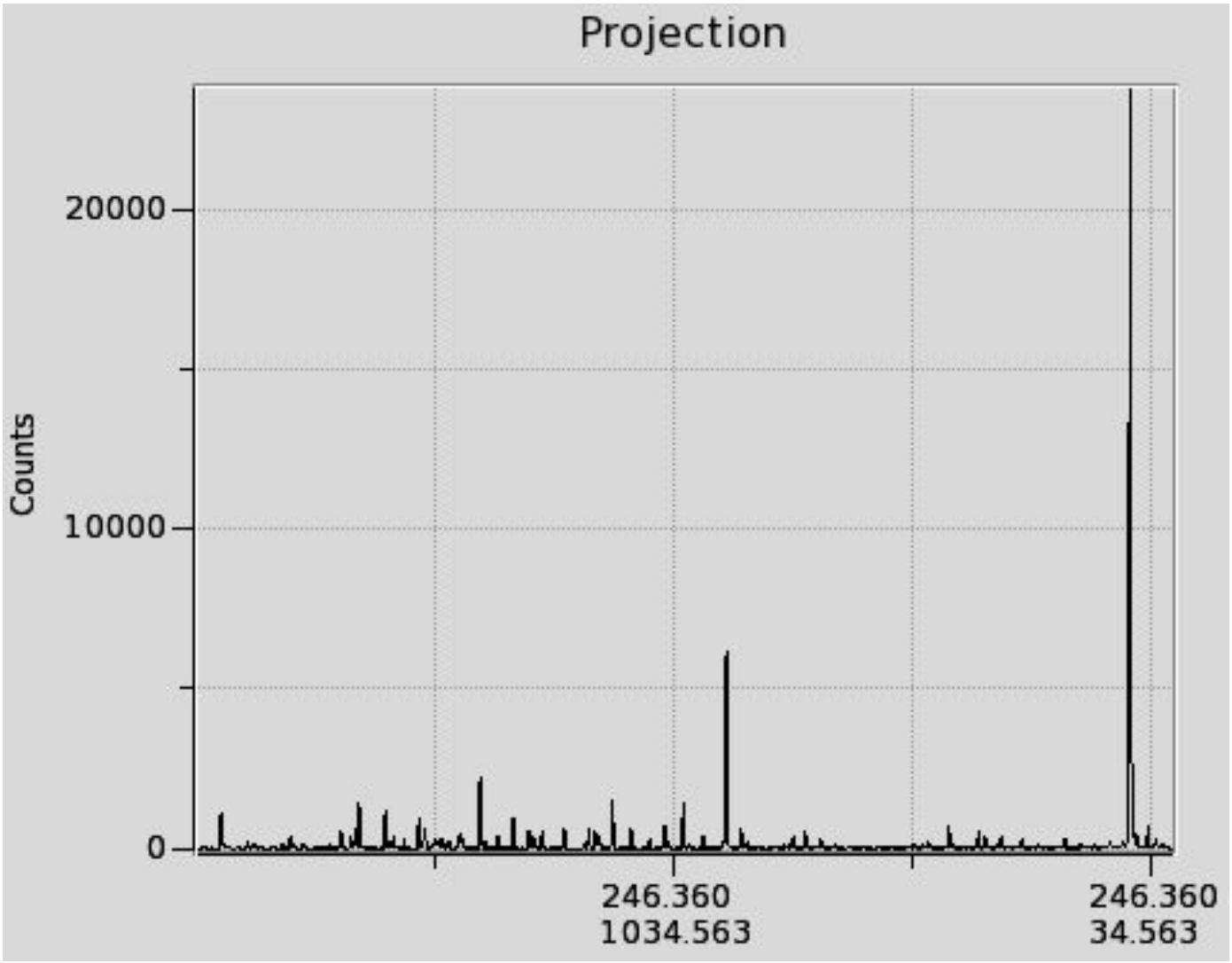
```
ecl> imcombine flat* flat.fits combine=median
May 20 10:23: IMCOMBINE
  combine = median, scale = none, zero = none, weight = none blank = 0.
        Images
  flat_001.fits
  flat_002.fits
  flat_003.fits
  flat_004.fits
  flat_005.fits
  flat_006.fits
  flat_007.fits
  flat_008.fits
  flat_009.fits
  flat_010.fits

Output image = flat.fits, ncombine = 10
```

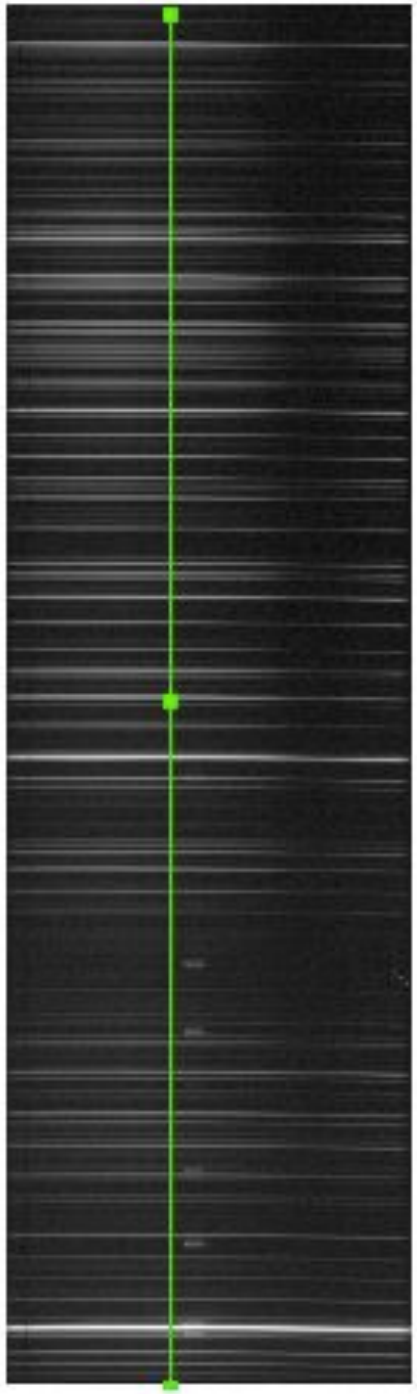
flat-bias and normalize flat

```
ecl> imarith flat - bias flatb.fits

ecl> imstat flatb.fits fields=midpt,mean
#     MIDPT       MEAN
     10045.    11088.

ecl> imarith flatb / 10045 flatn.fits

ecl> imstat flatn fields=midpt,mean,stddev,min,max
#     MIDPT       MEAN    STDDEV        MIN        MAX
         1.     1.104    0.7648   0.05829      3.073
```

HeAr - bias

```
ecl> imarith he-ar_001.fits - bias hear.fits
```





Verify observed stars

hselect HD*,MP* $I,RA,DEC,exptime,title

```
ecl> hselect HD*,MP* $I,RA,DEC,exptime,title
boolean expression governing selection: yes
HD036079.fits   05:28:14        -20:45:34       8,00000 HD036079
HD036673.fits   05:32:43        -17:49:20       8,00000 HD036673
HD045289.fits   06:24:24        -42:50:51       200,00000       HD045289
MP0190.fits     04:53:24        +02:34:28       1000,00000      HD036673
```

ecl> hedit MP0190.fits title ”MP0190" verify- update+

```
MP0190.fits,i_title: HD036673 -> MP0190
MP0190.fits updated
```

Subtract the bias from the HD stars

HD036079.fits
HD036673.fits
HD045289.fits

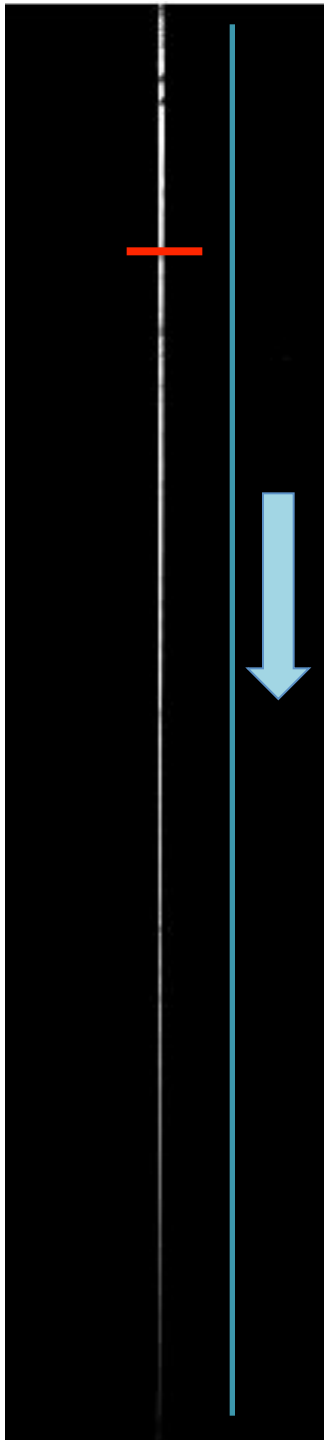
imarith HD*.fits - bias.fits HD*%.fits%b.fits%

HD036079b.fits
HD036673b.fits
HD045289b.fits

Flat fielding

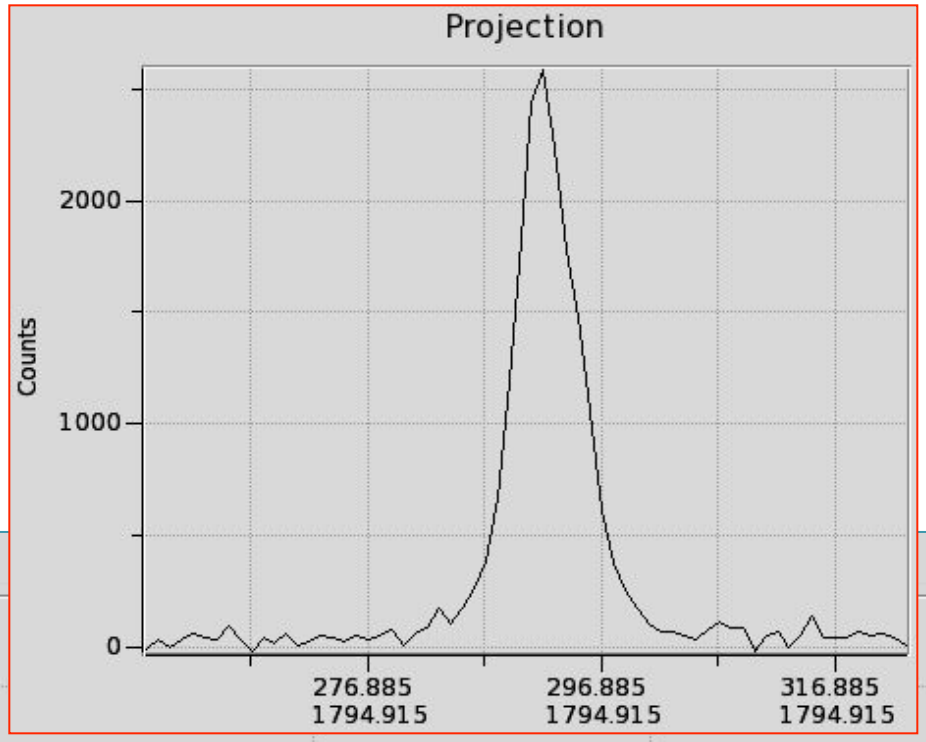
imarith HD*b.fits / flatn.fits HD*%b.fits%f.fits%

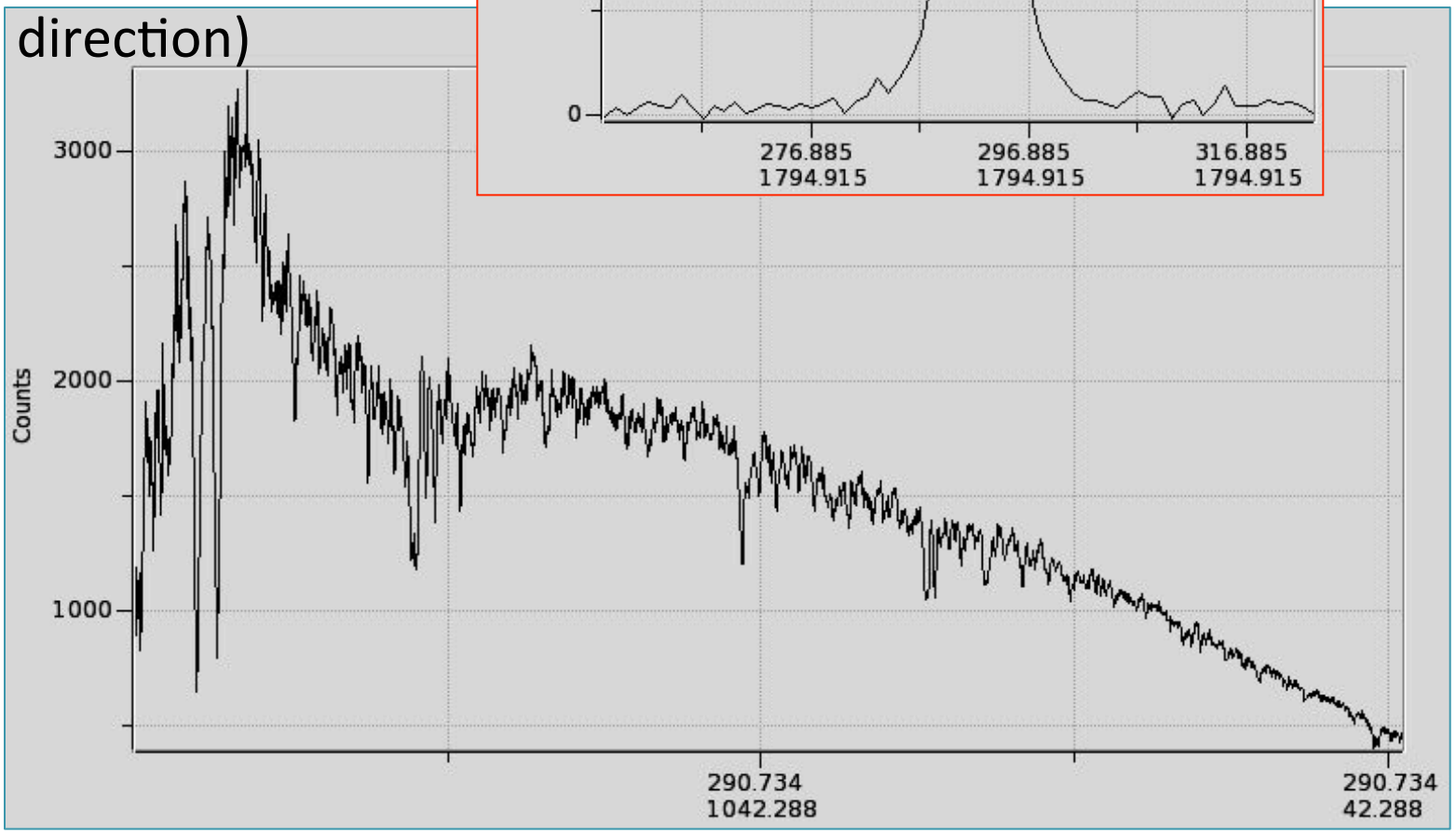
HD036079f.fits
HD036673f.fits
HD045289f.fits



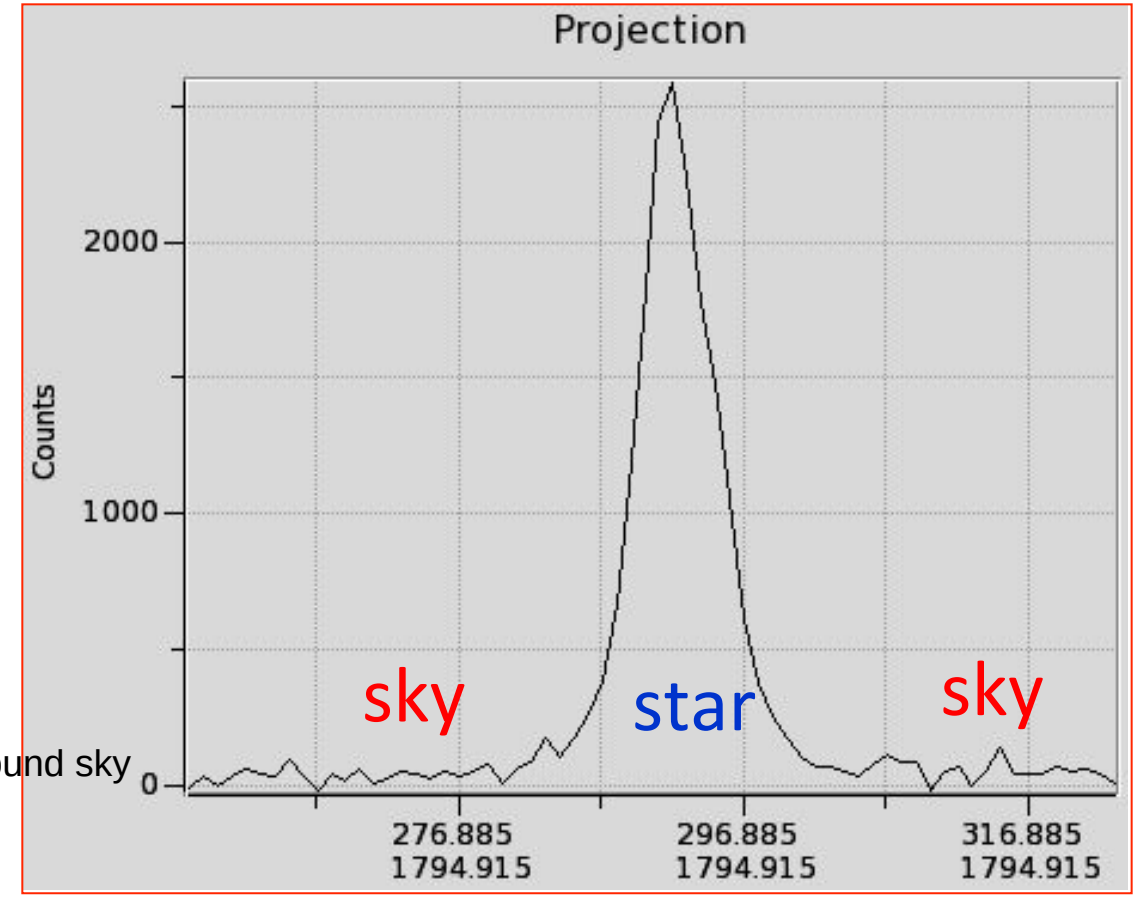
Spatial direction (slit)

Dispersion (spectral direction)





Extracting the spectrum
(simply adding counts inside star's profile)



Background sky

Extract spectrum using **apall**, which is part of *noao.twodspec.apextract*

noao> two

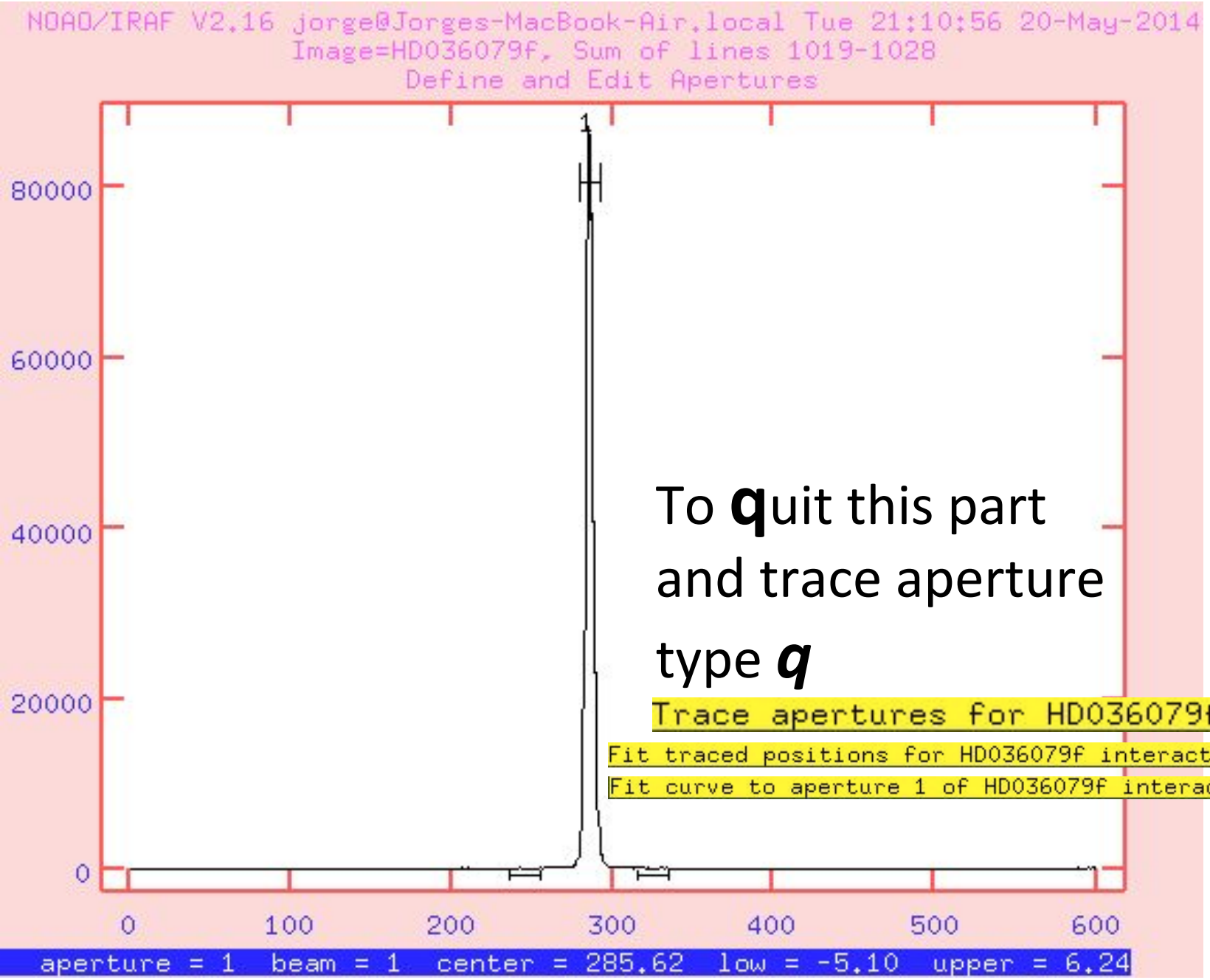
apextract. longslit.

twodspec> ap

apextract> dispax=2

ap> apall HD*f.fits format=oned extras-
b_sampl="-50:-30,30:50" ylevel=0.05 backgro=median clean+
sat=100000 readnoise=18.0 gain=4.0 t_order=6

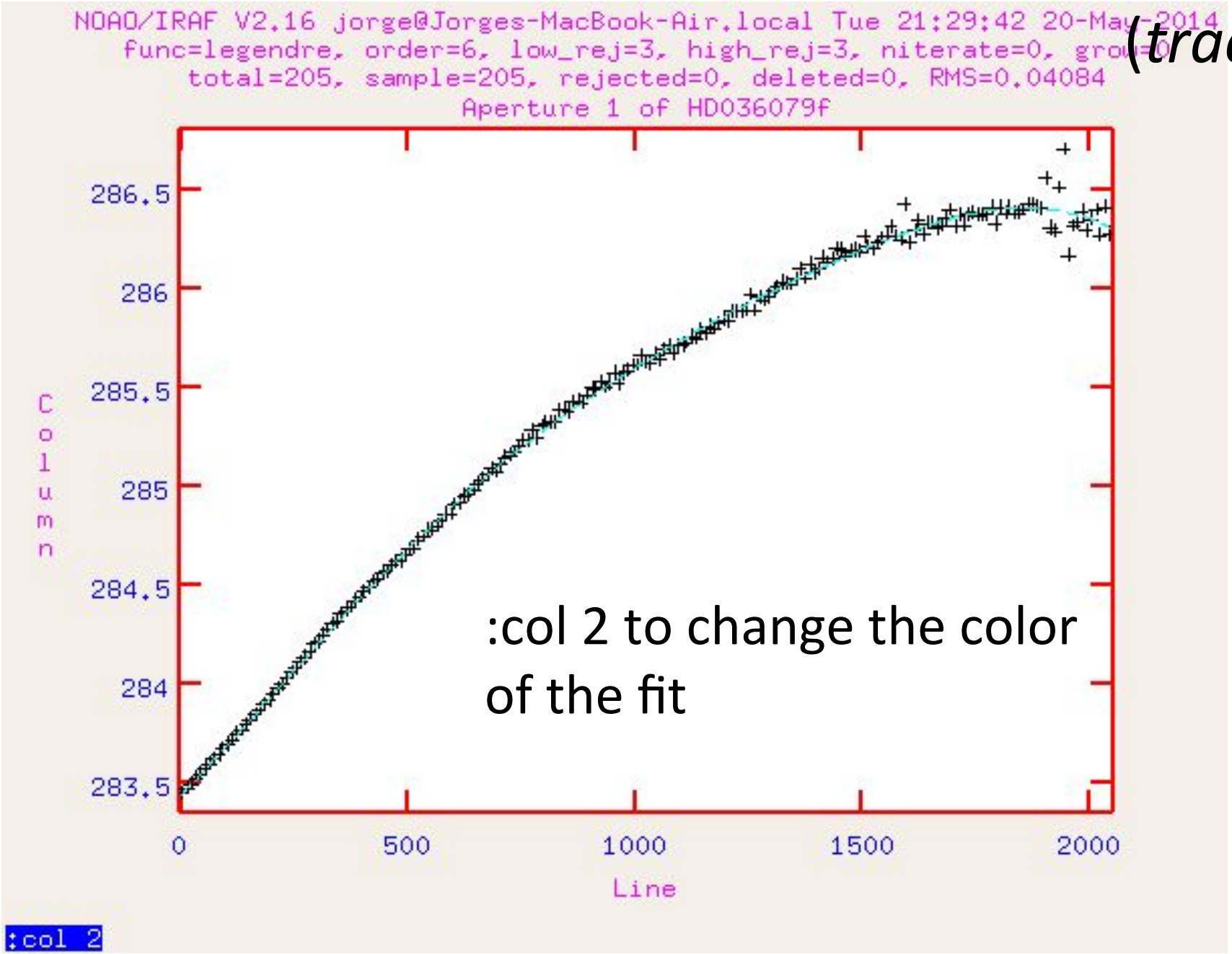
```
Find apertures for HD036079f?  (yes):
Number of apertures to be found automatically: 1
Resize apertures for HD036079f?  (yes):
Edit apertures for HD036079f?  (yes):
```



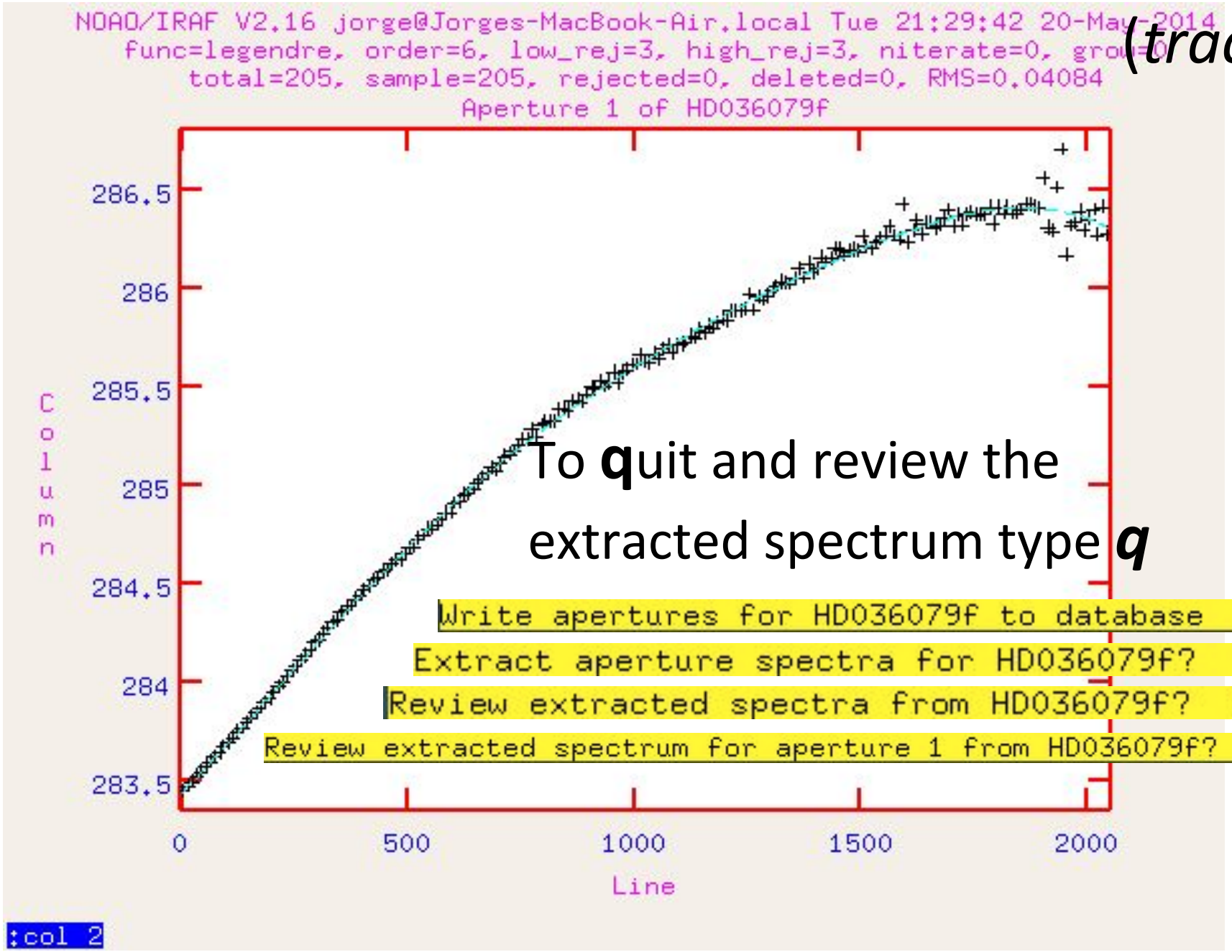
To **q**uit this part and trace aperture type ***q***

```
Trace apertures for HD036079f?  (yes):
Fit traced positions for HD036079f interactively?  (yes):
Fit curve to aperture 1 of HD036079f interactively  (yes):
```

Fitting the position of maximum flux in the spectrum (*tracing*)

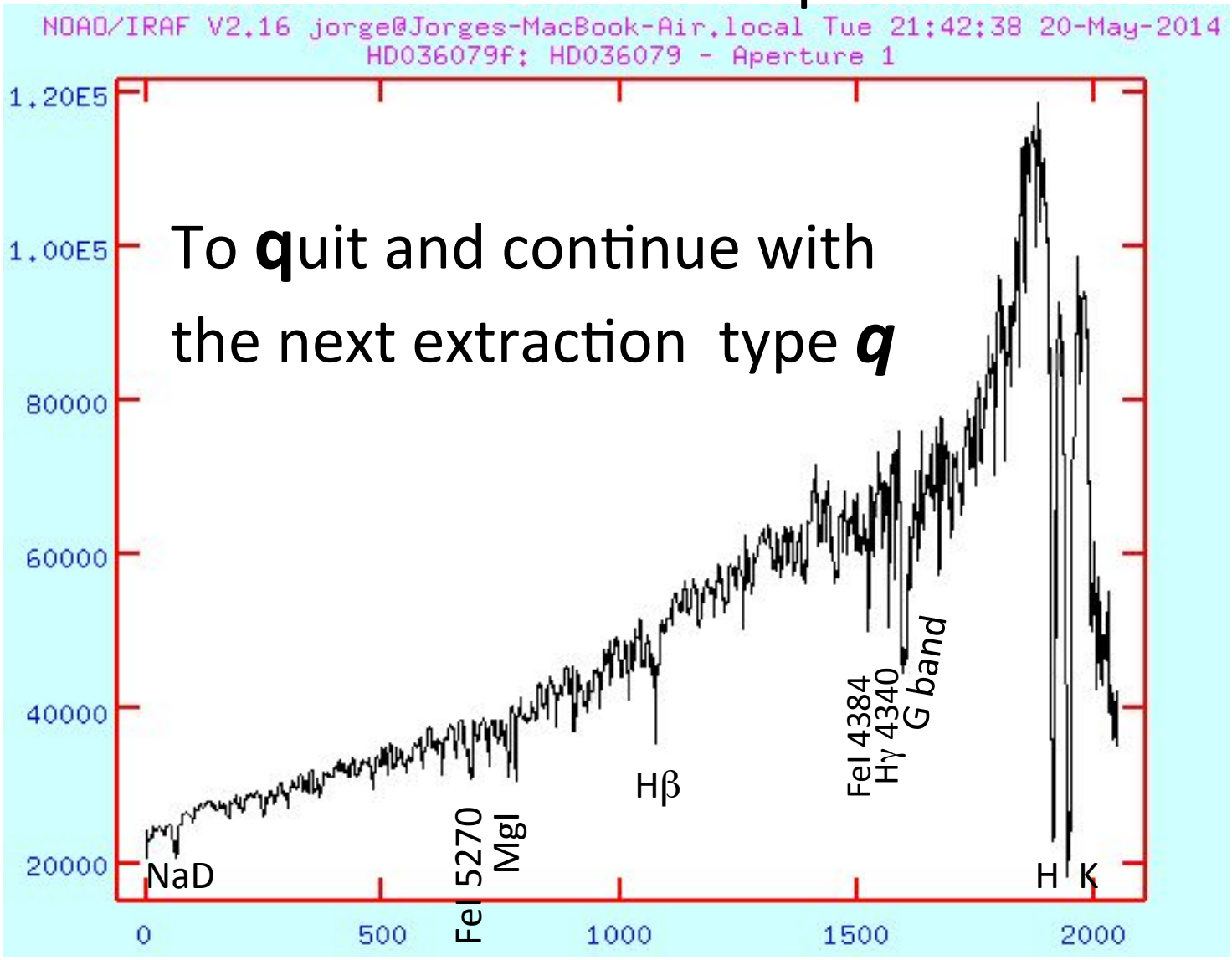


Fitting the position of maximum flux in the spectrum (*tracing*)



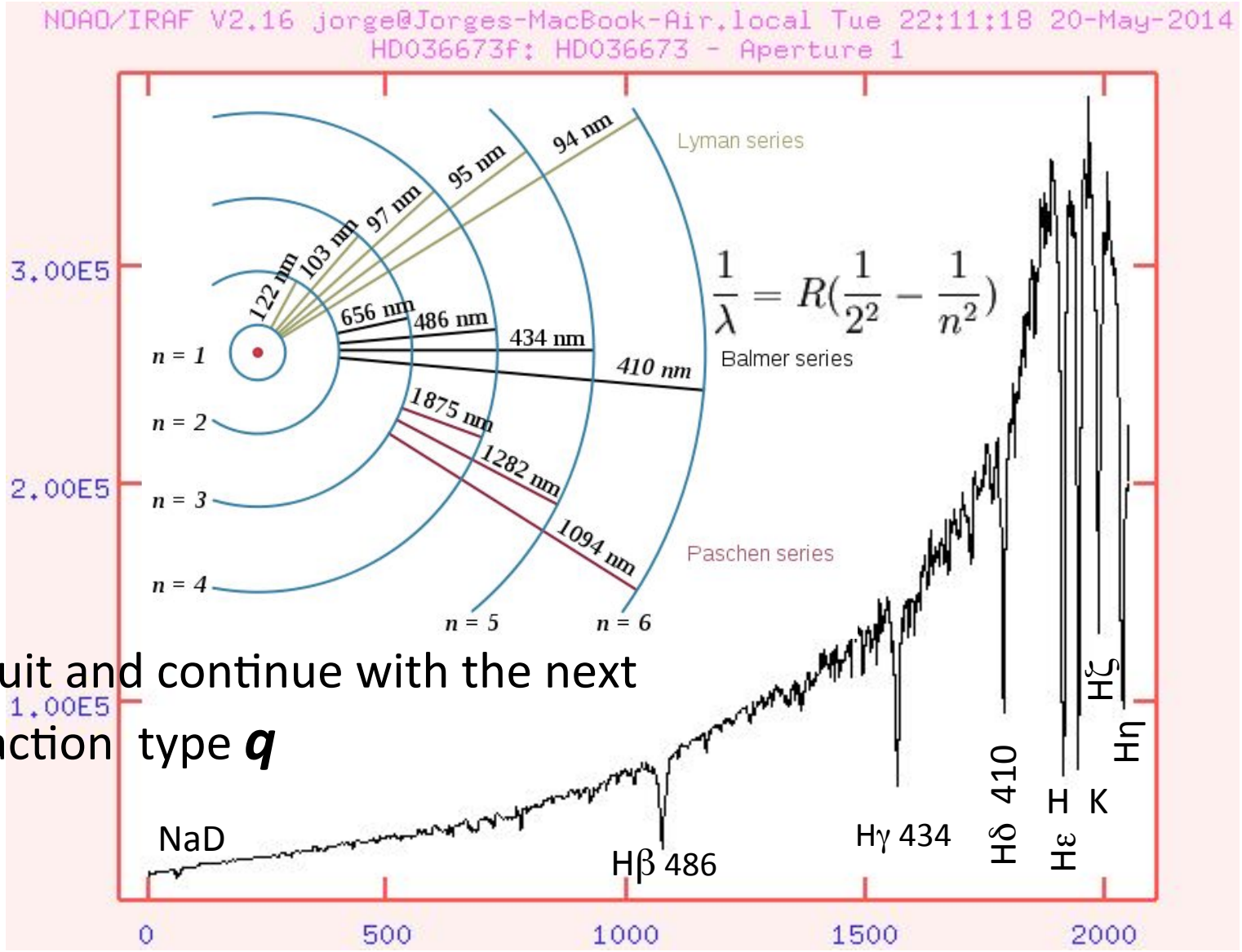
Example of reduced spectrum of HD036079

Counts as a function of pixel number




```
Output image name [use # to skip output] (HD036079f):
Find apertures for HD036673f?  (yes):
```

Example of reduced spectrum of HD036673



To **q**uit and continue with the next extraction type ***q***

```
Output image name [use # to skip output] (HD036673f):
Find apertures for HD045289f?  (yes):
```

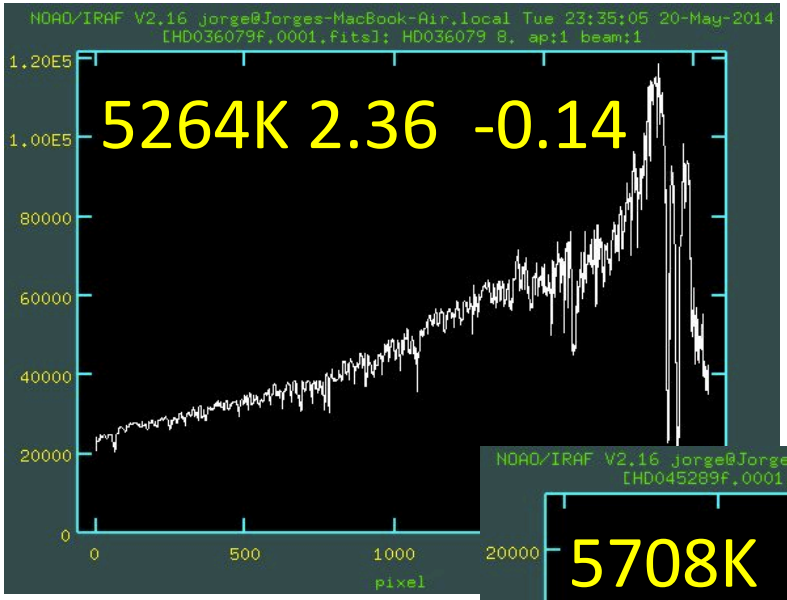
Example of reduced spectrum of HD045289

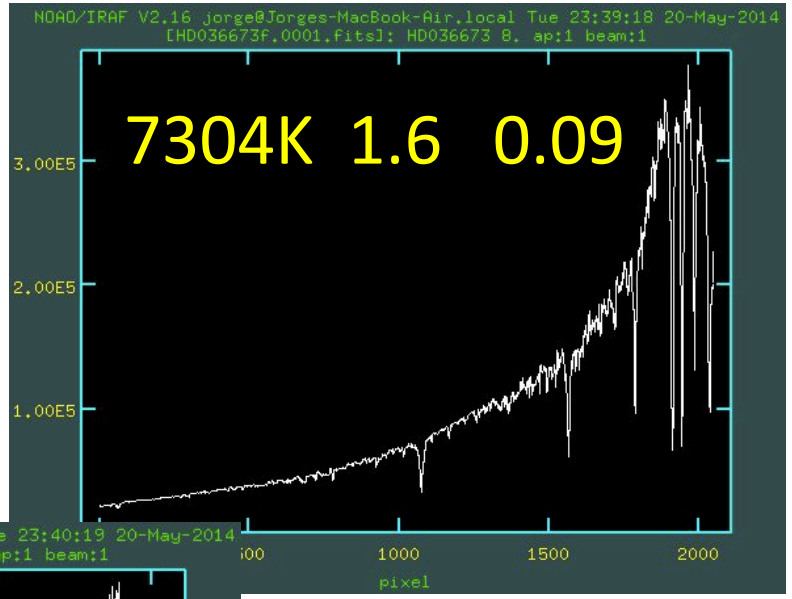
Visualize the spectra using splot

Use **splot** (noao.onedspec)

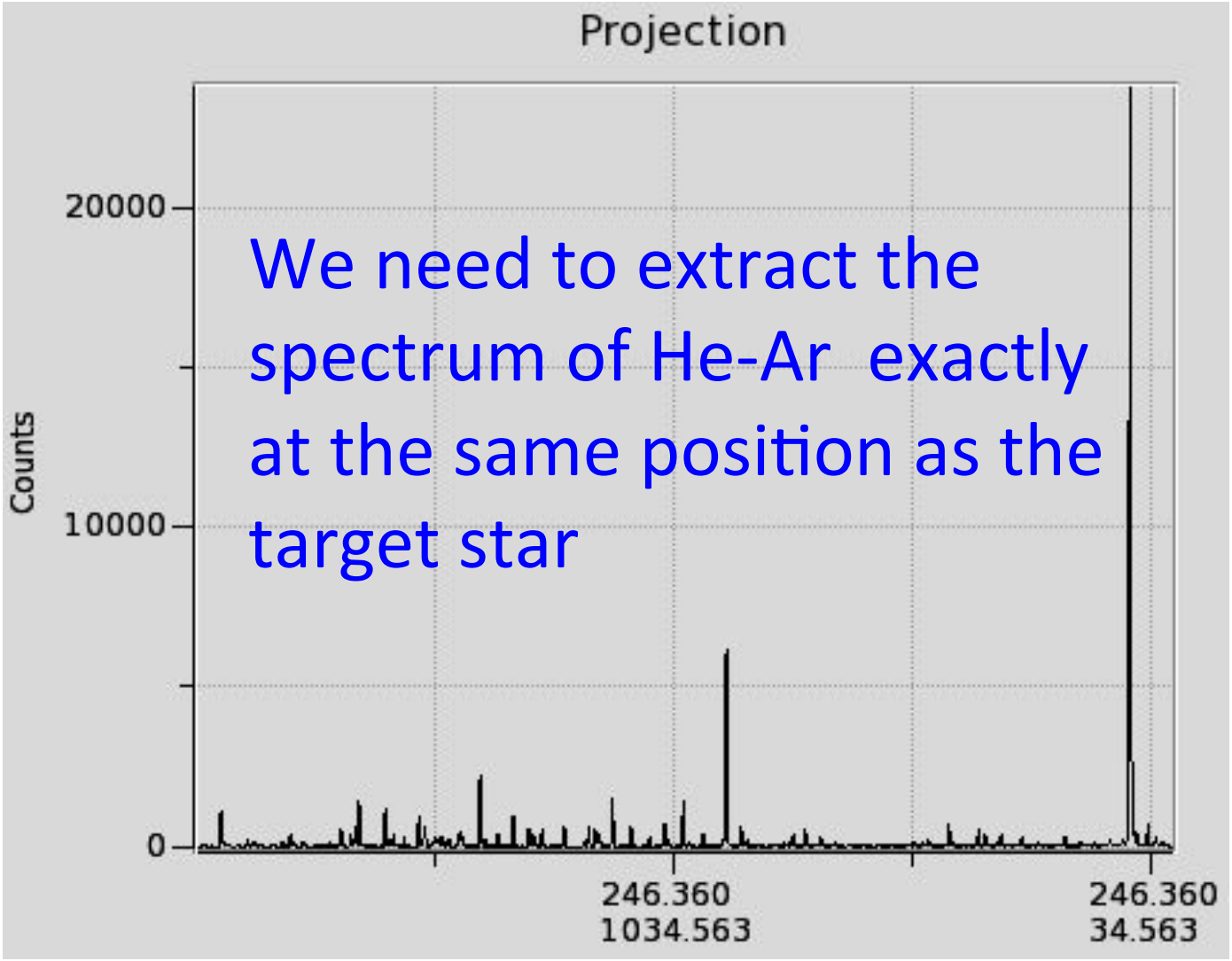
To visualize next spectrum type *q*

onedspec> splot HD*f.0001.fits

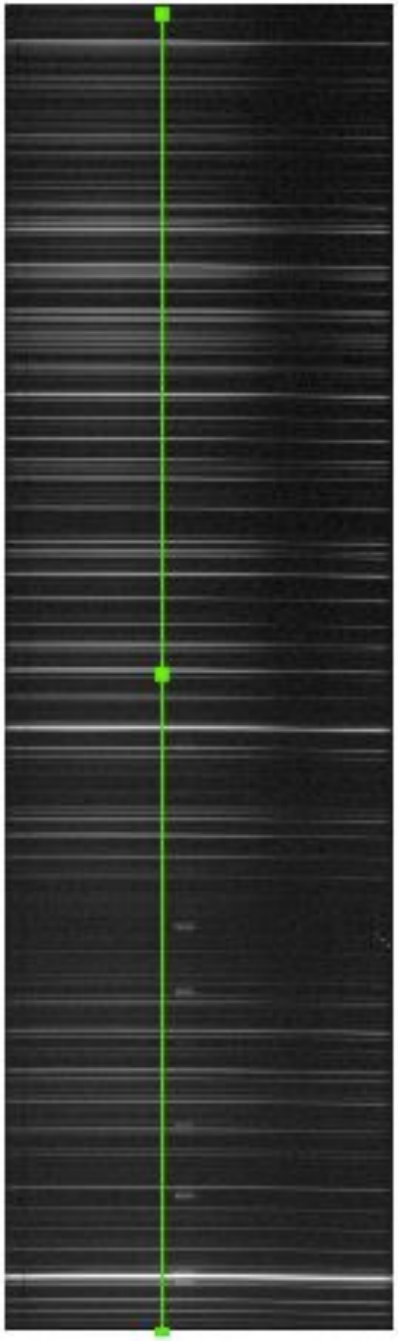




Wavelength calibration: He-Ar (file *hear.fits*)



We need to extract the spectrum of He-Ar exactly at the same position as the target star



Extracting the spectrum of He-Ar at the same position as the reference (star) object

apall hear.fits out=hear_estrela.fits ref=estrela.fits inter- recen- trace- extras- backgro=none

- **hear.fits**: He-Ar image
- **out=hear_comp.fits**: extracted spectrum of He-Ar
- **ref =estrela.fits** the star's file name (before the extraction with *apall*)

Preparing the files to extract He-Ar for each star

> ls -1 *f.fits > lista_in

> !more lista_in

```
HD036079f.fits
HD036673f.fits
HD045289f.fits
```

> !sed “s/HD/hear_HD/g” lista_in > lista_out

> !more lista_out

```
hear_HD036079f.fits
hear_HD036673f.fits
hear_HD045289f.fits
```

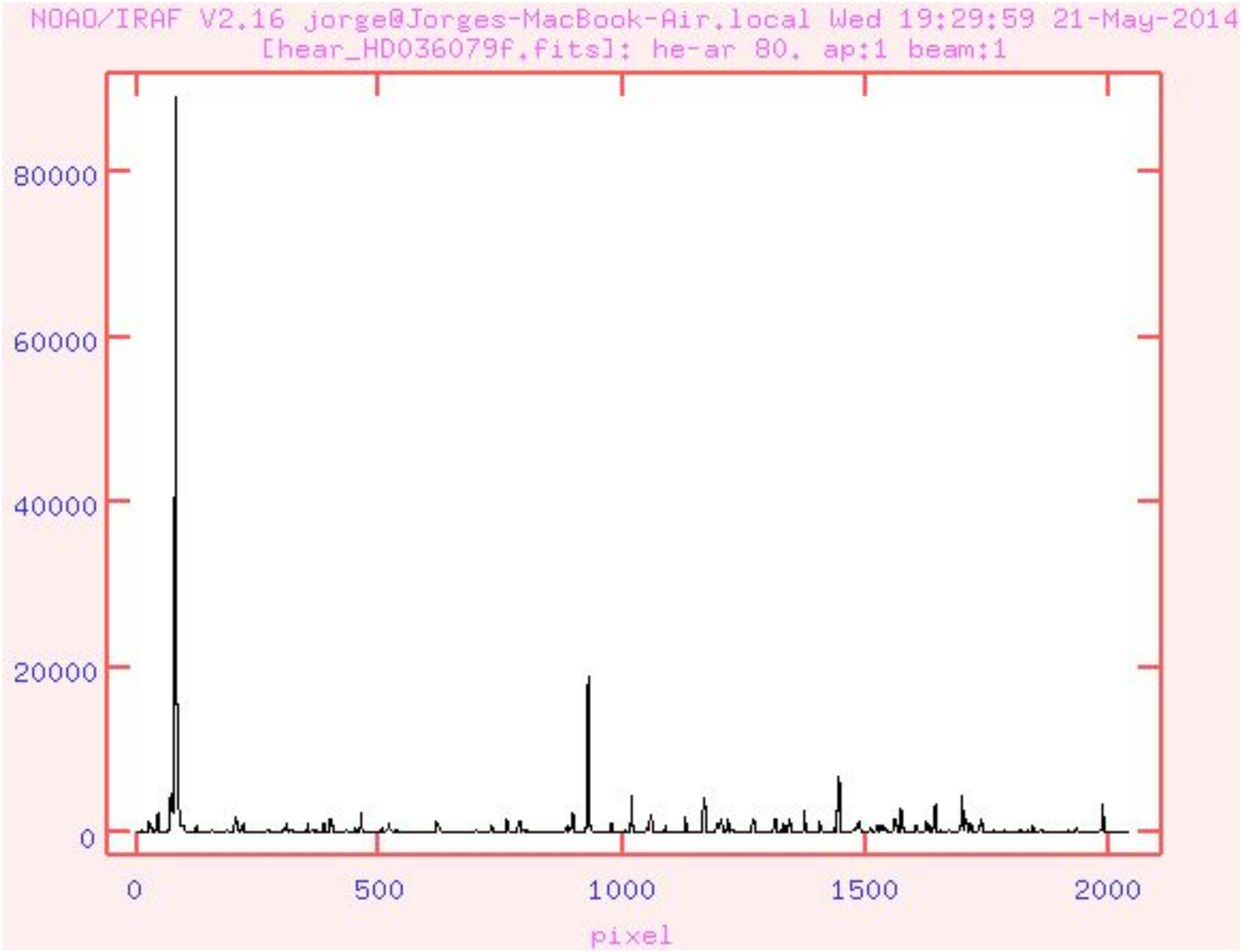
> !printf "hear.fits\n%.0s" {1..3} > lista_hear

> !more lista_hear

```
hear.fits
hear.fits
hear.fits
```

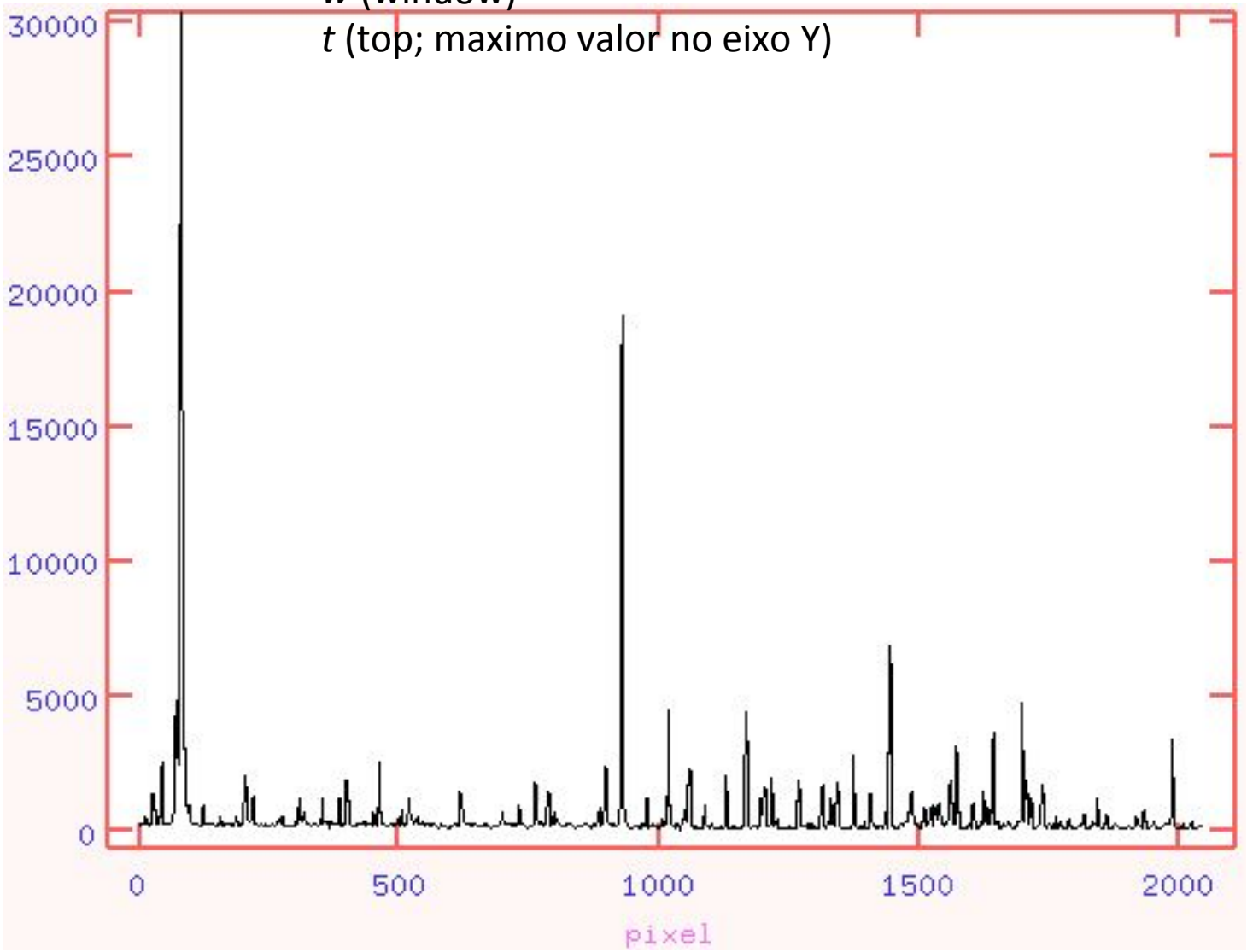
apall @lista_hear out=@lista_out ref=@lista_in inter- recen- trace- extras- backgro=none clean- sat=100000 readnoise=18.0 gain=4.0 t_order=6

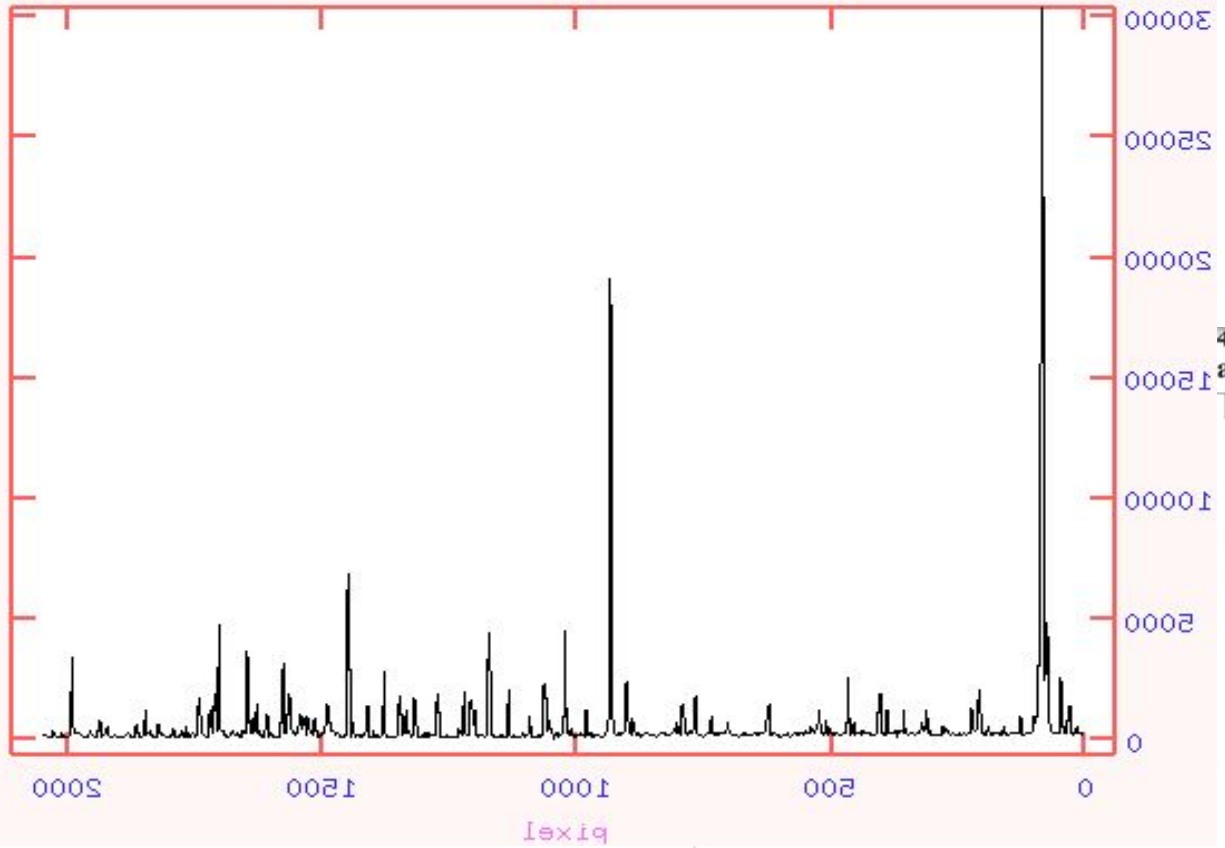
onedspec> splot hear_HD*

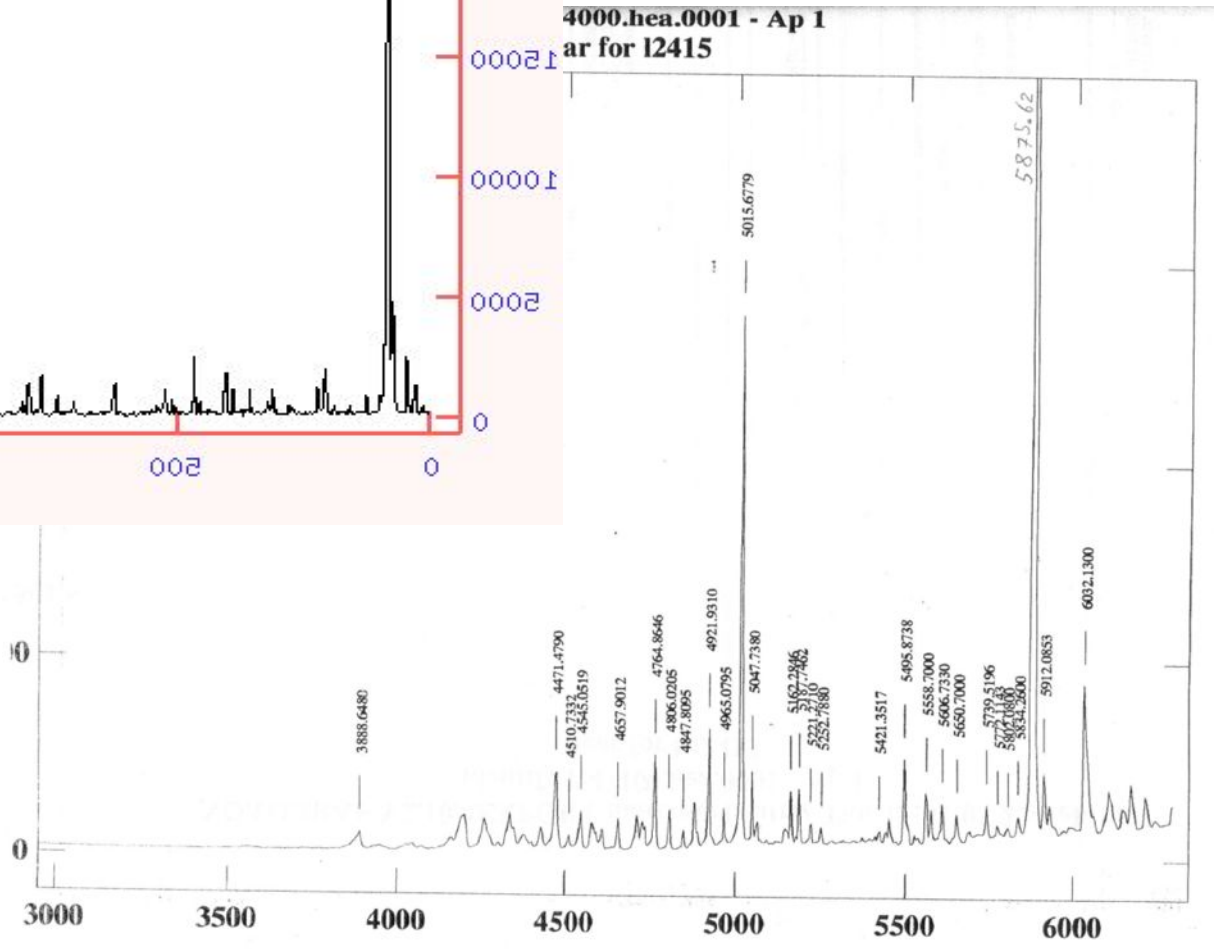


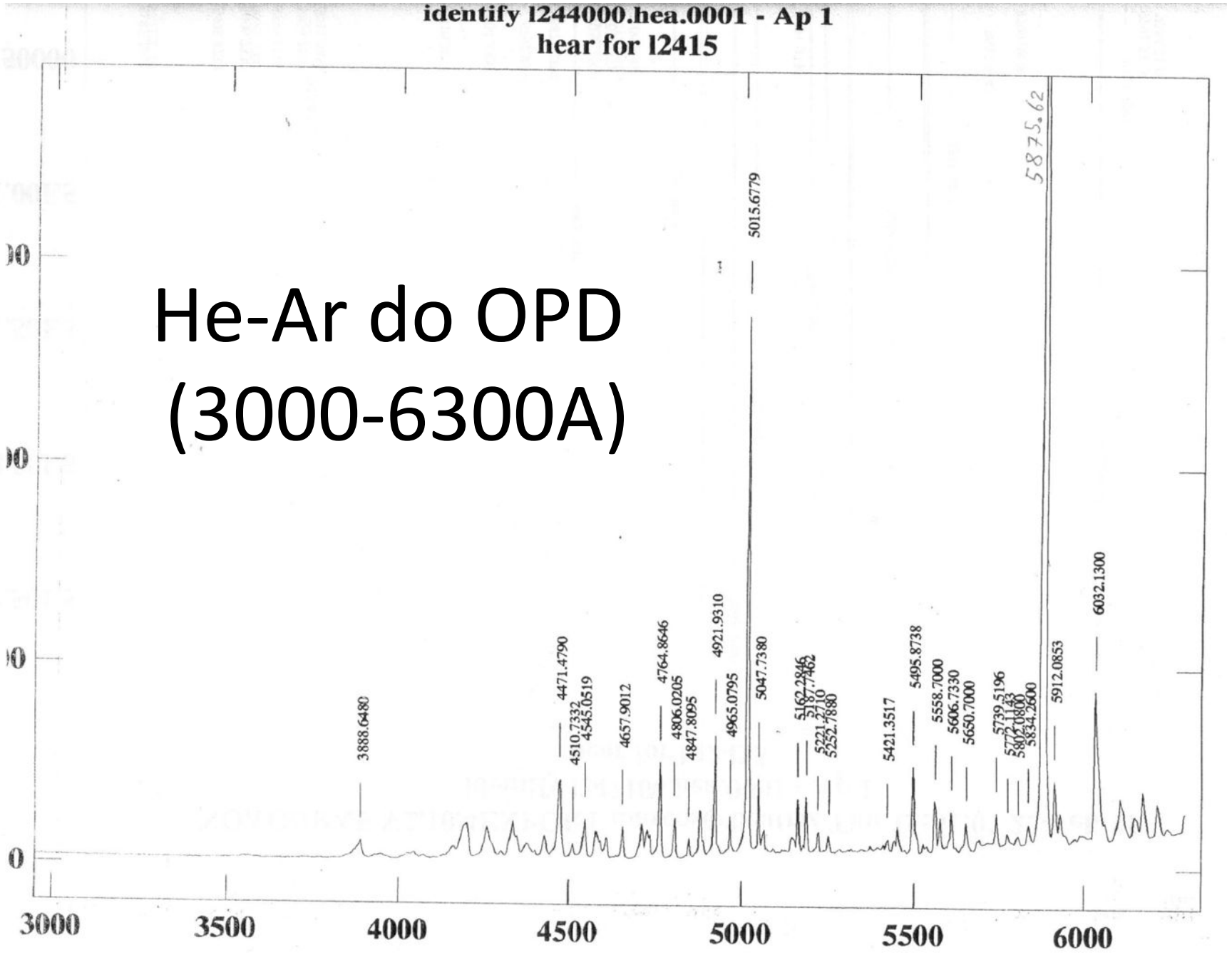
onedspec> splot hear_HD*

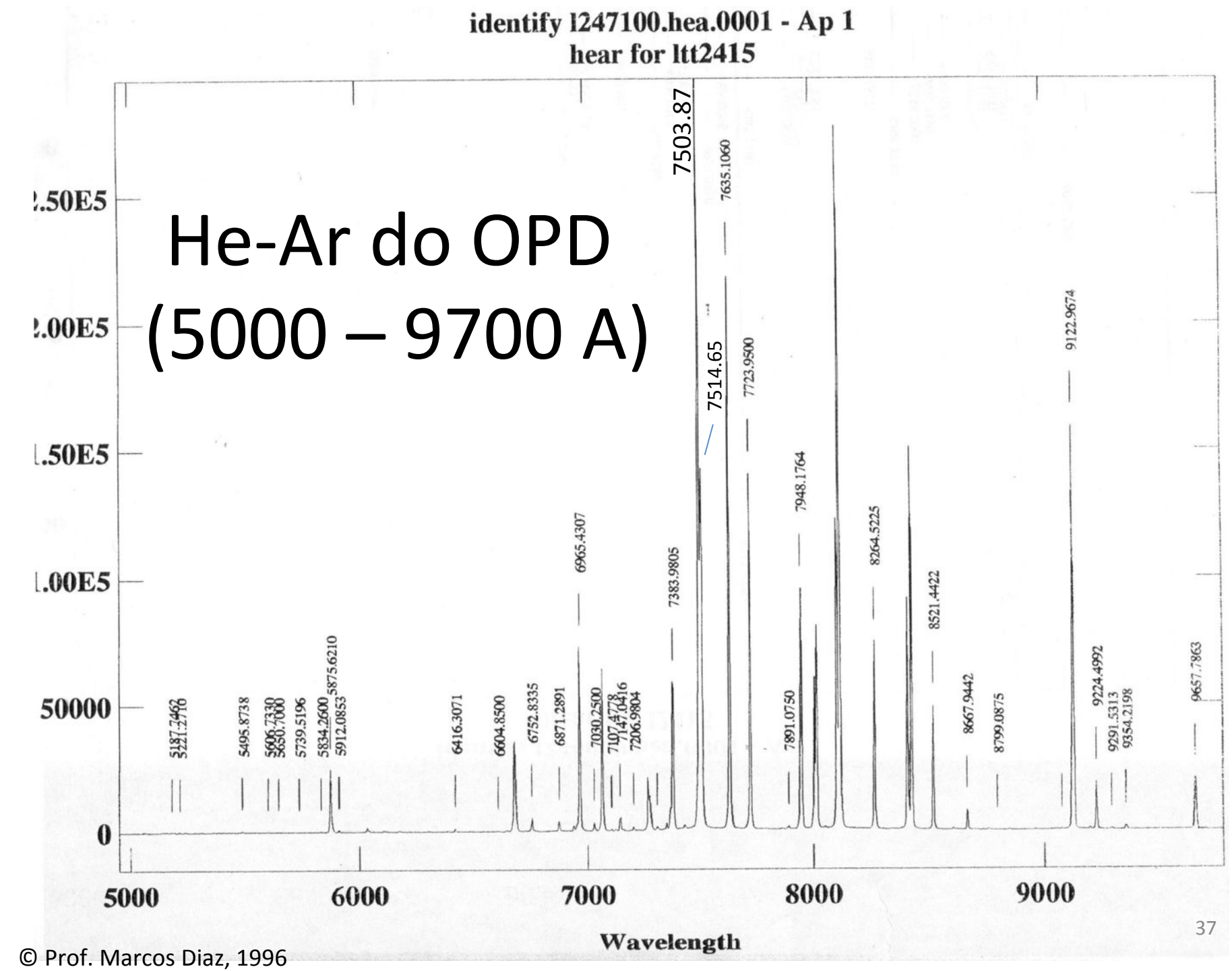
w (window)
t (top; maximo valor no eixo Y)



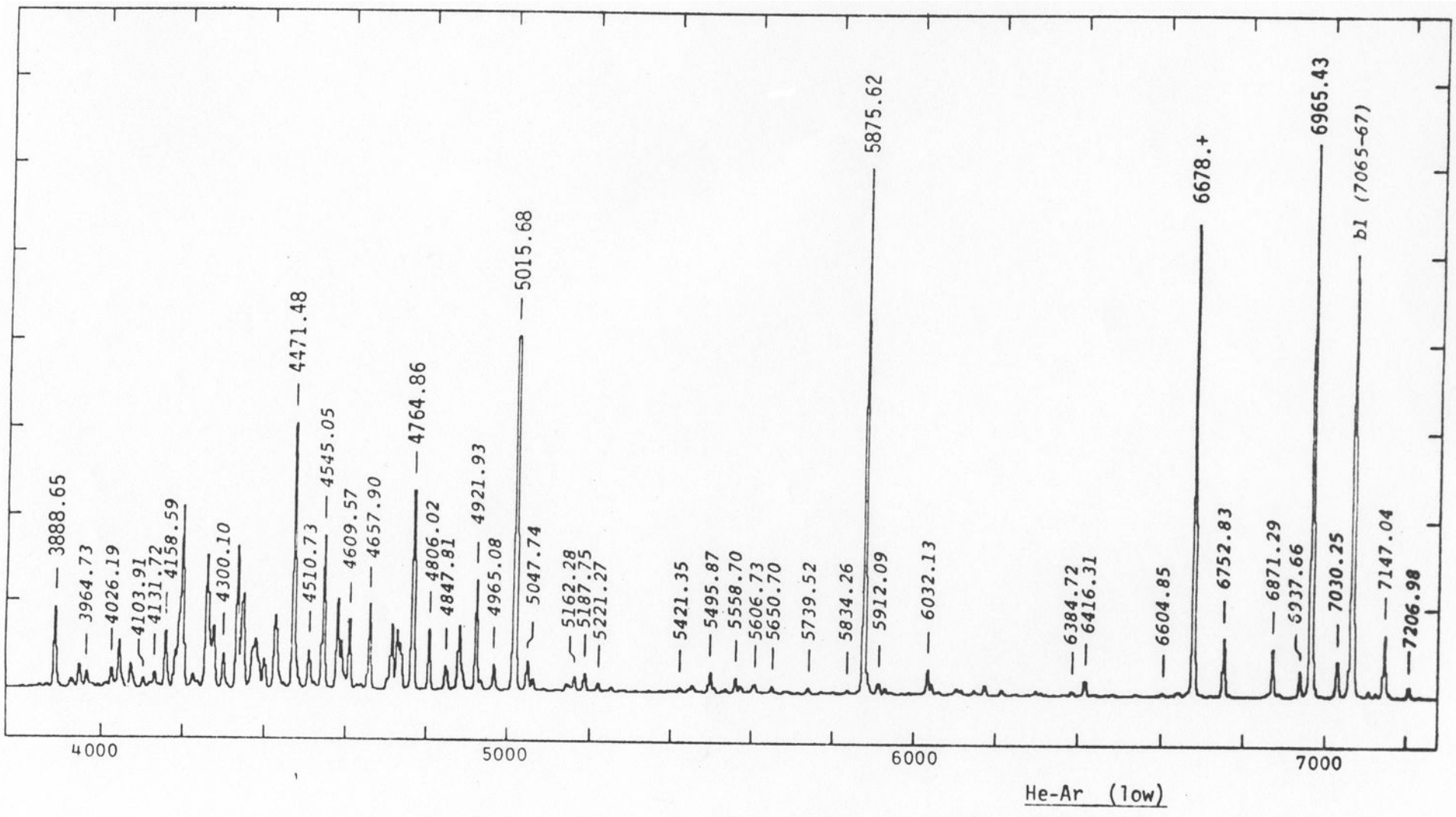

30000
25000
20000
15000
10000
5000
0
2000
1500
1000
500
0
pixel


4000.hea.0001 - Ap 1
ar for l2415
5875.62
5015.6779
6032.1300
5912.0853
5495.8738
5421.3517
5047.7380
4965.0795
4921.9310
4764.8646
4657.9012
4471.4790
3888.6480
3000
3500
4000
4500
5000
5500
6000

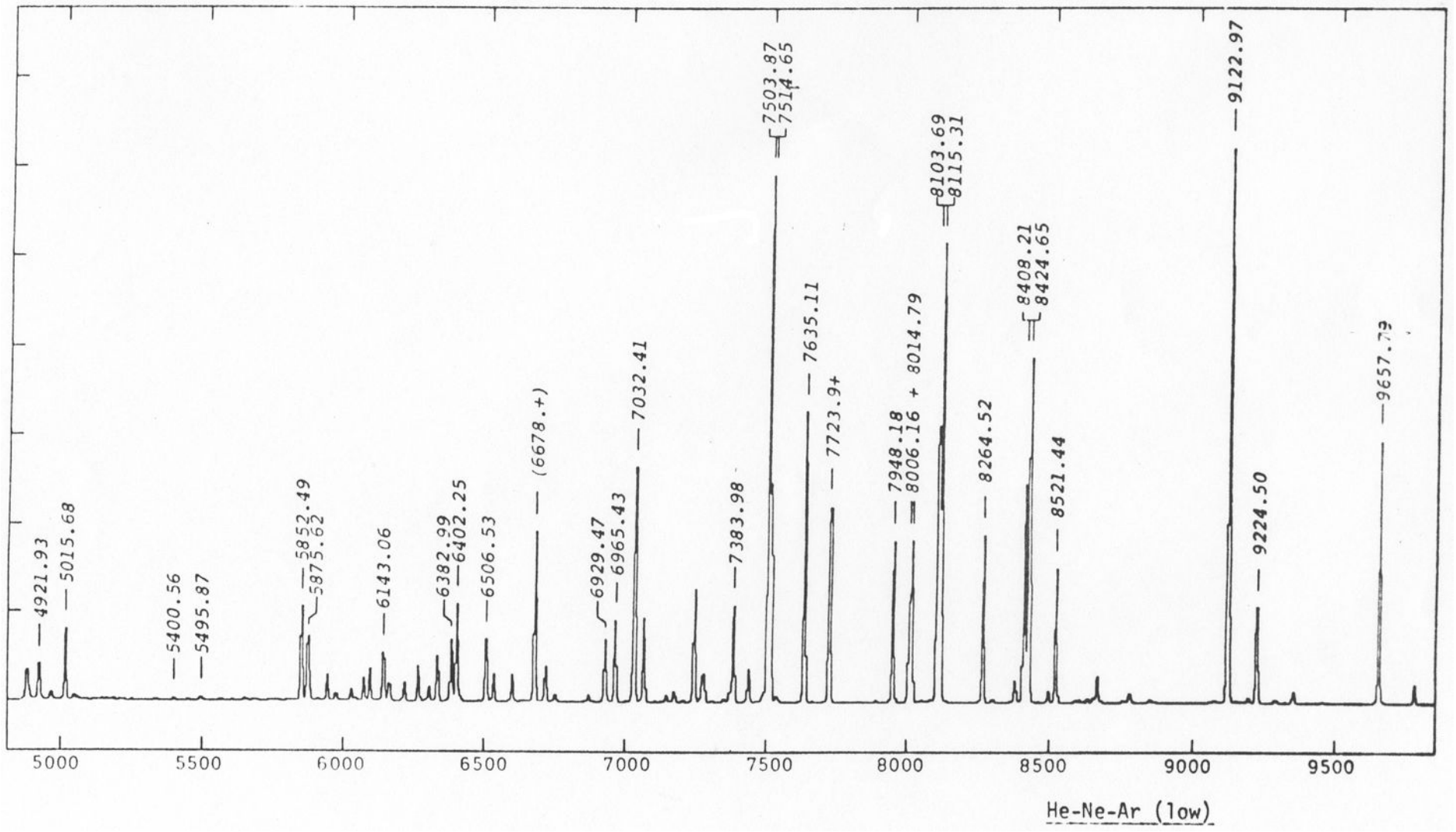




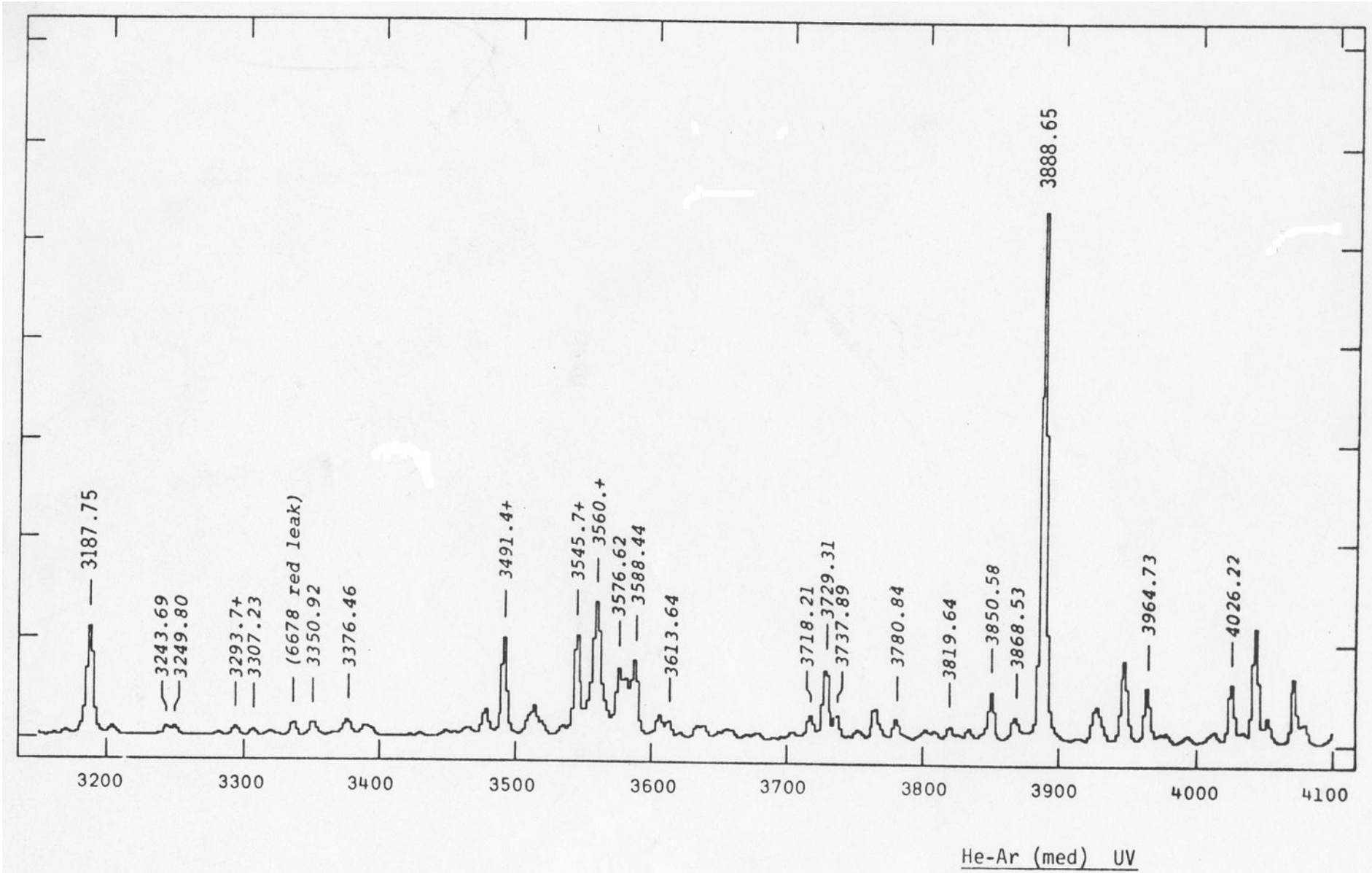
He-Ar do CTIO (3800-7200A)
(low resolution)



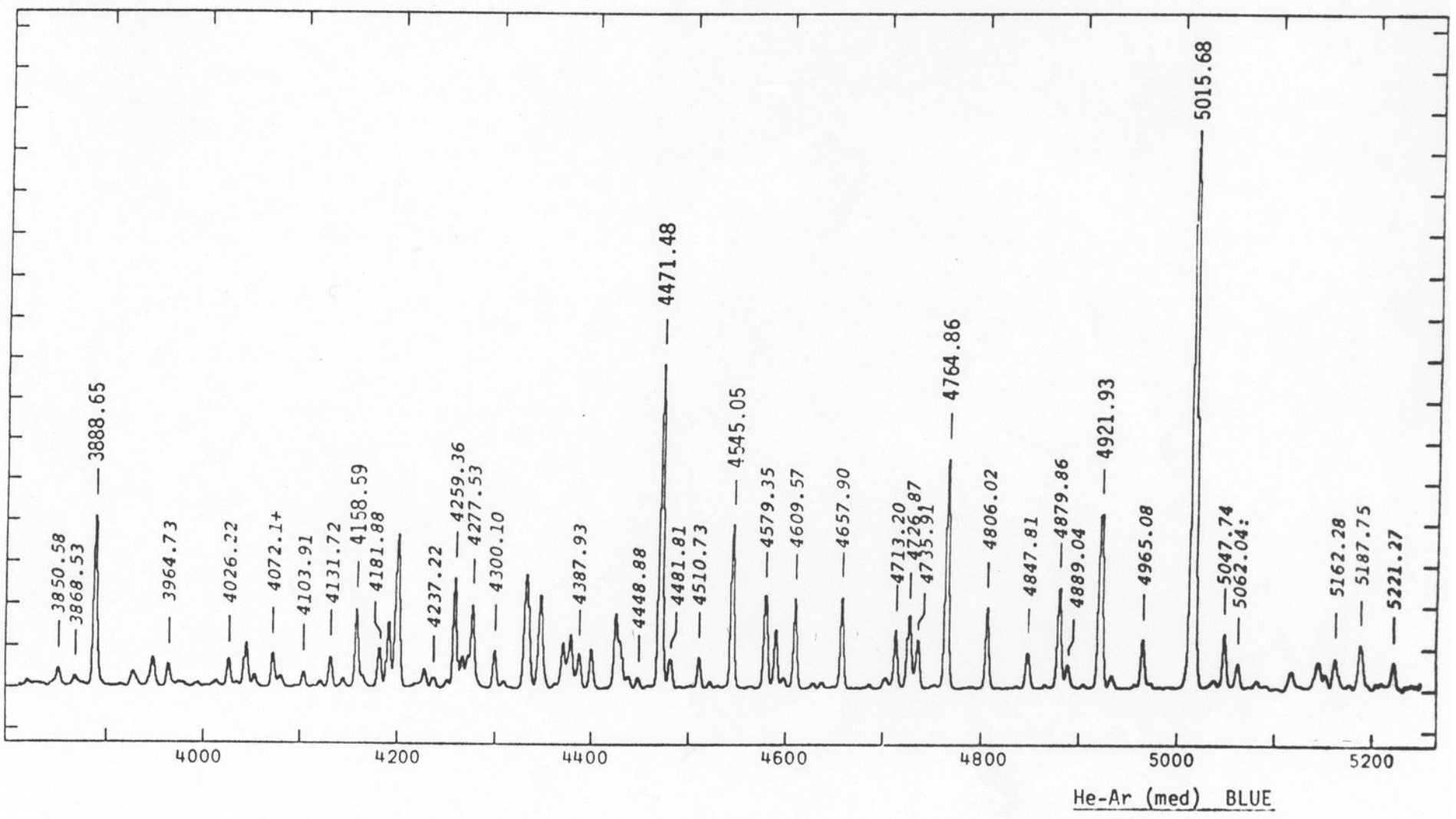
He-Ar-Ne do CTIO (4900-9700A)
(low resolution)



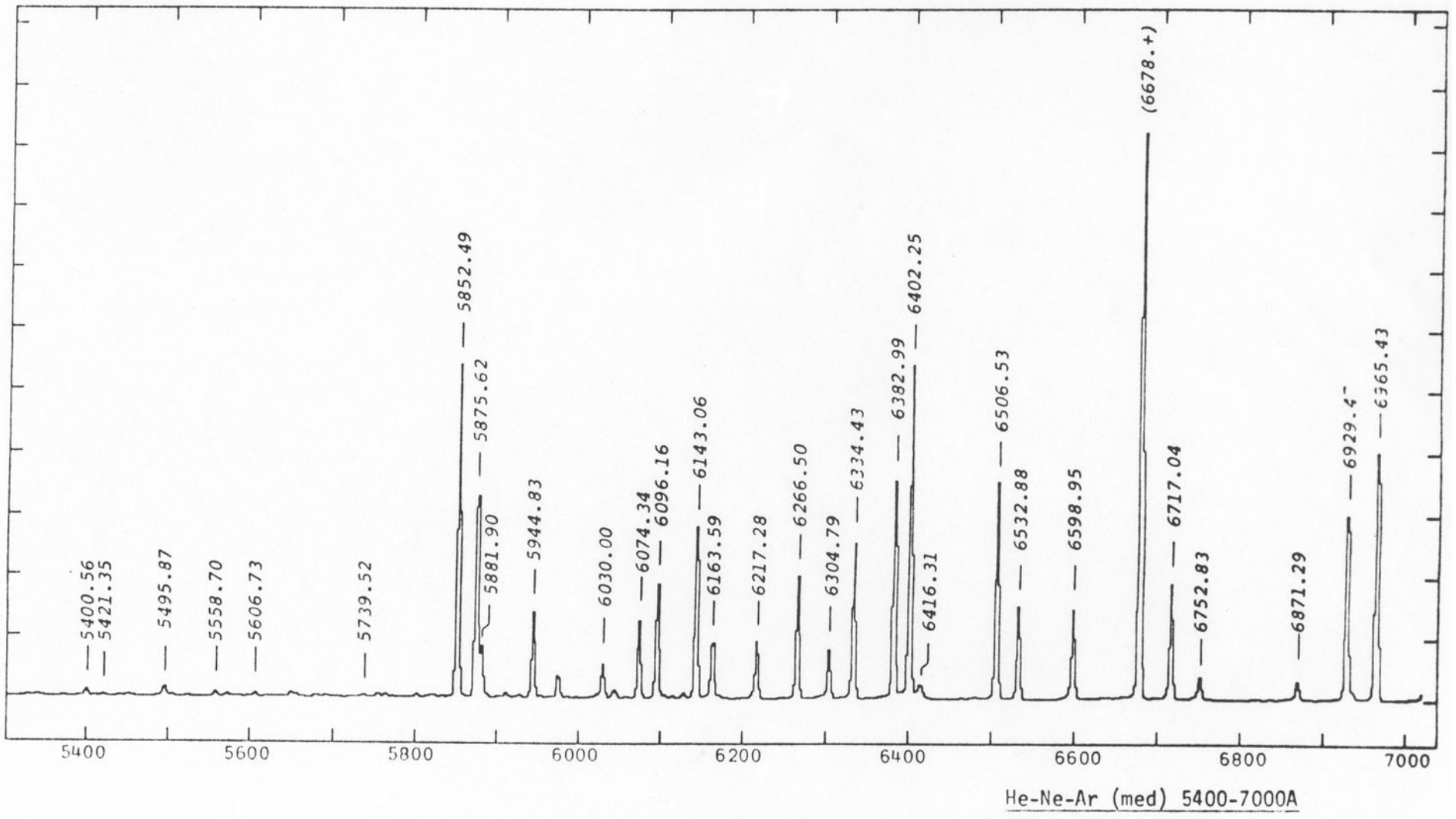
He-Ar do CTIO (3100-4100A)
(medium resolution)



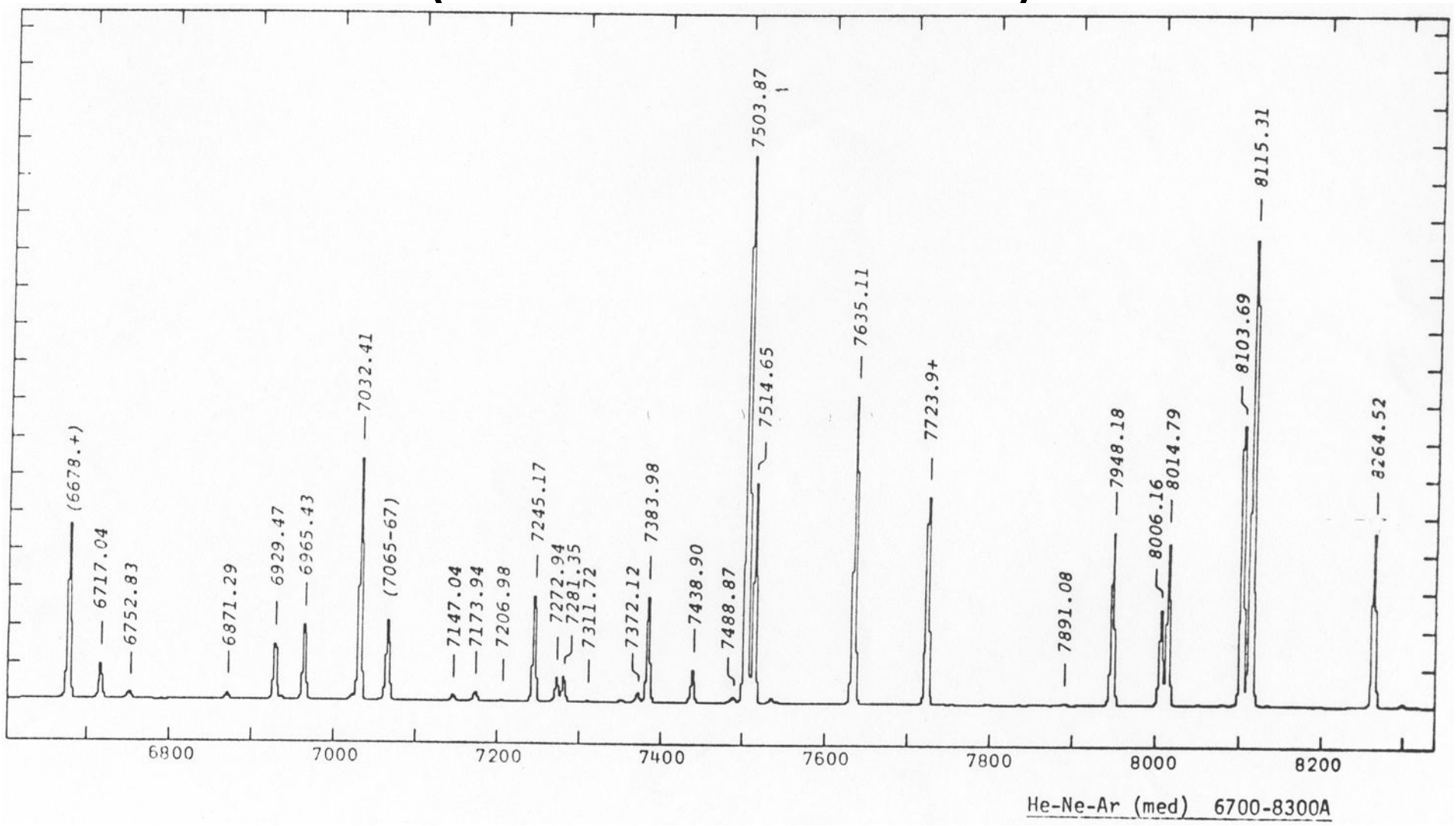
He-Ar do CTIO (3800-5250A)
(medium resolution)



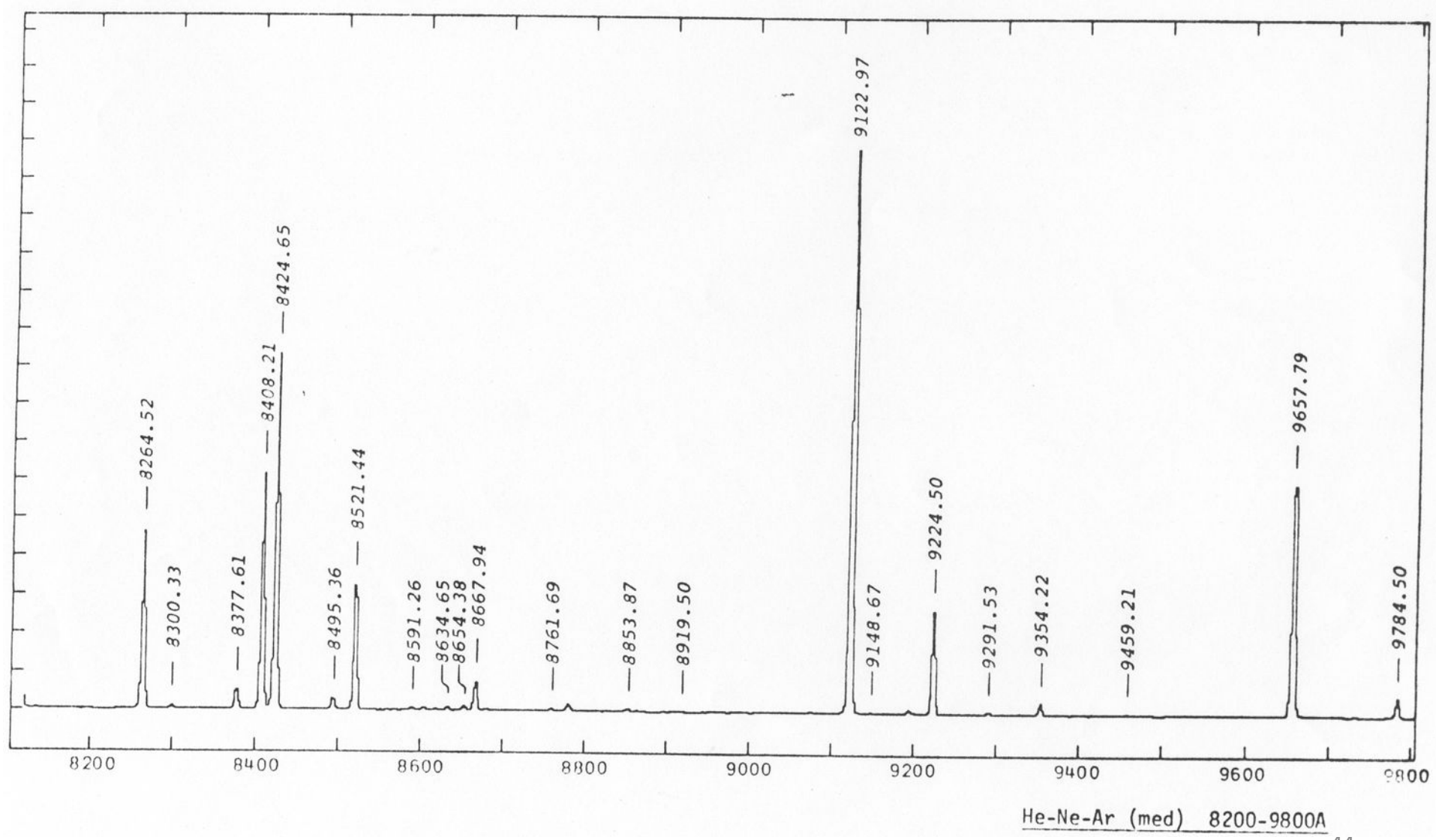
He-Ar-Ne do CTIO (5300-7000A)
(medium resolution)



He-Ar-Ne do CTIO (6700-8300A)
(medium resolution)



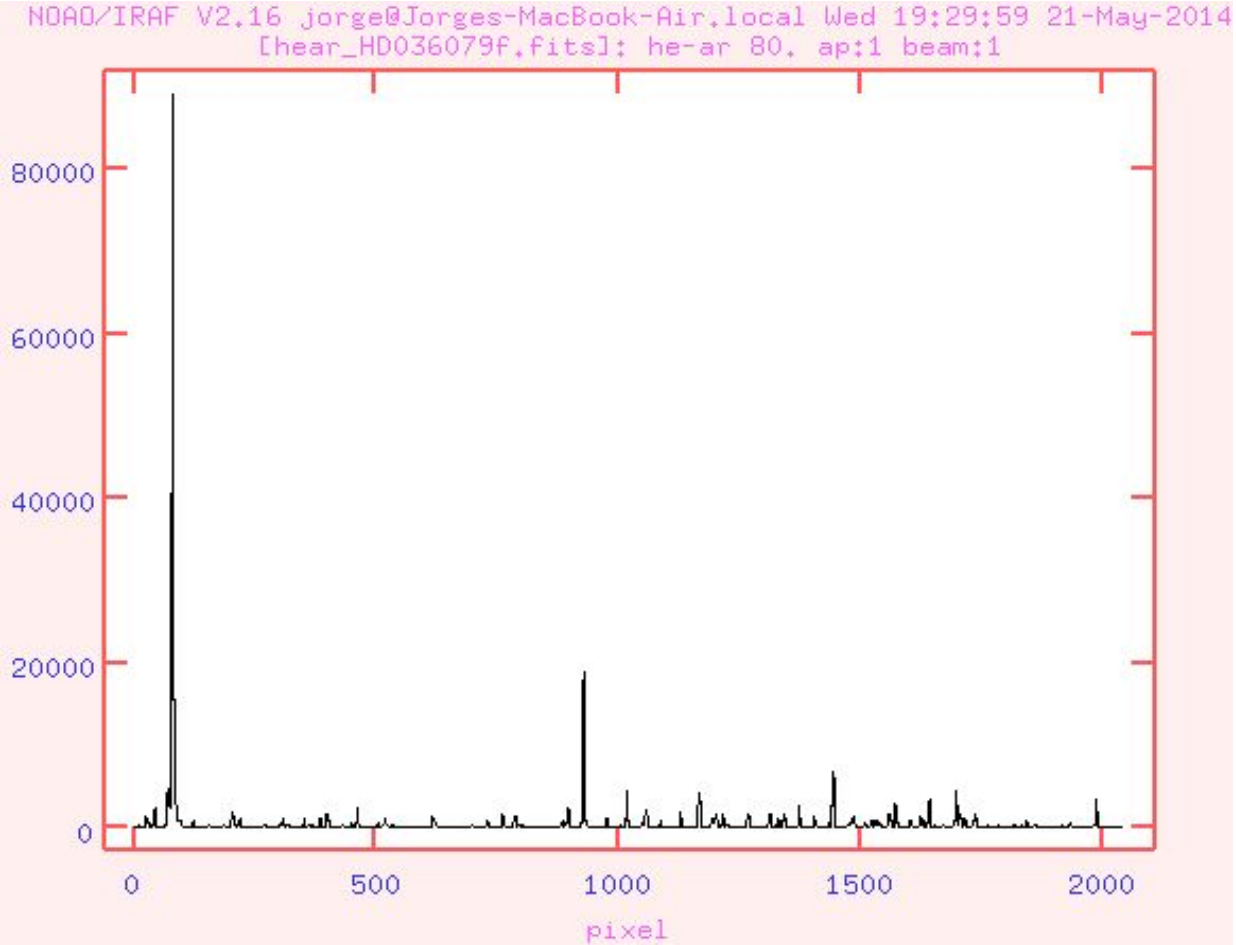
He-Ar-Ne do CTIO (8200-9800A)
(medium resolution)



Line identification

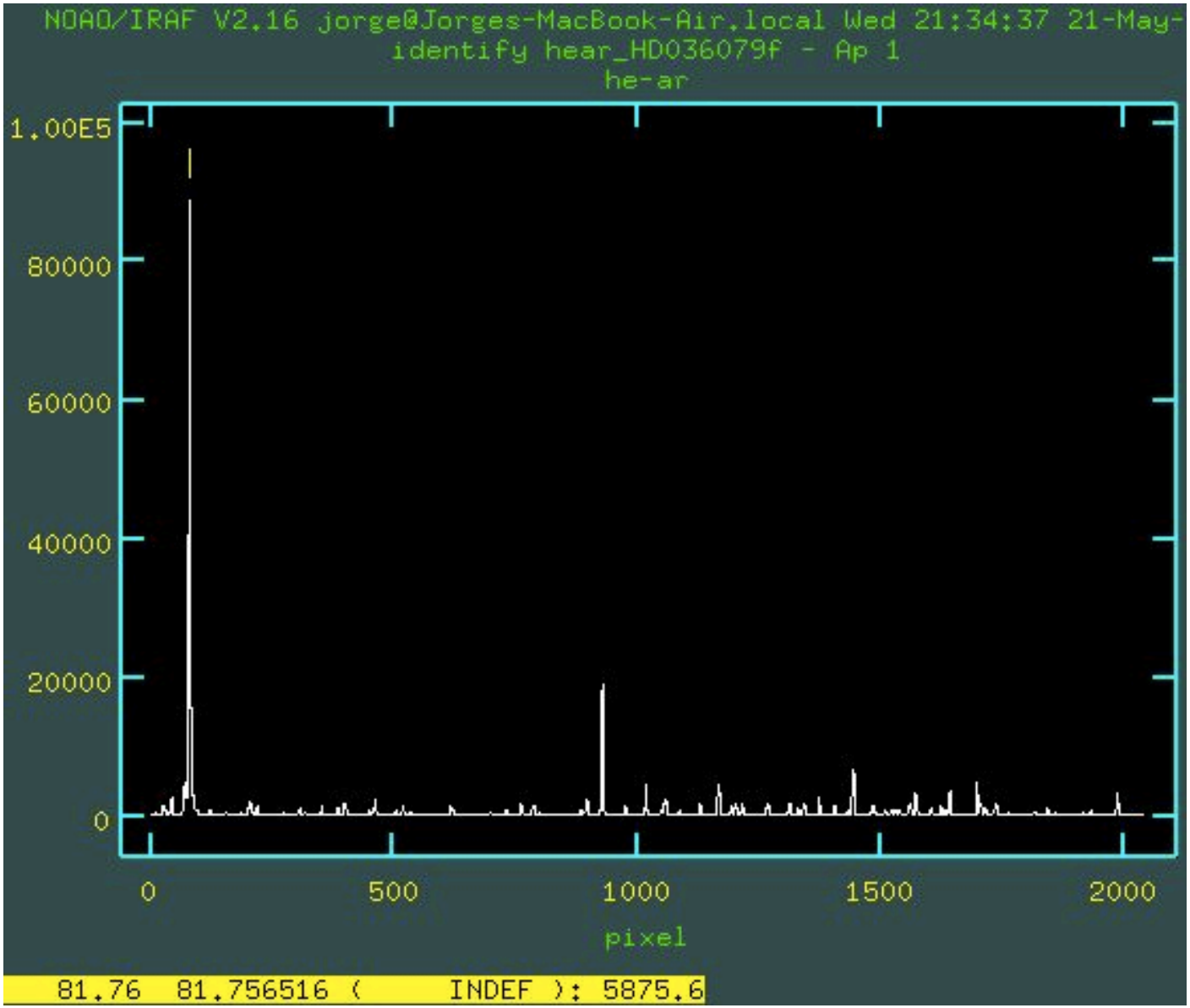
ap> ls -1 hear_*

hear_HD036079f.fits
hear_HD036673f.fits
hear_HD045289f.fits



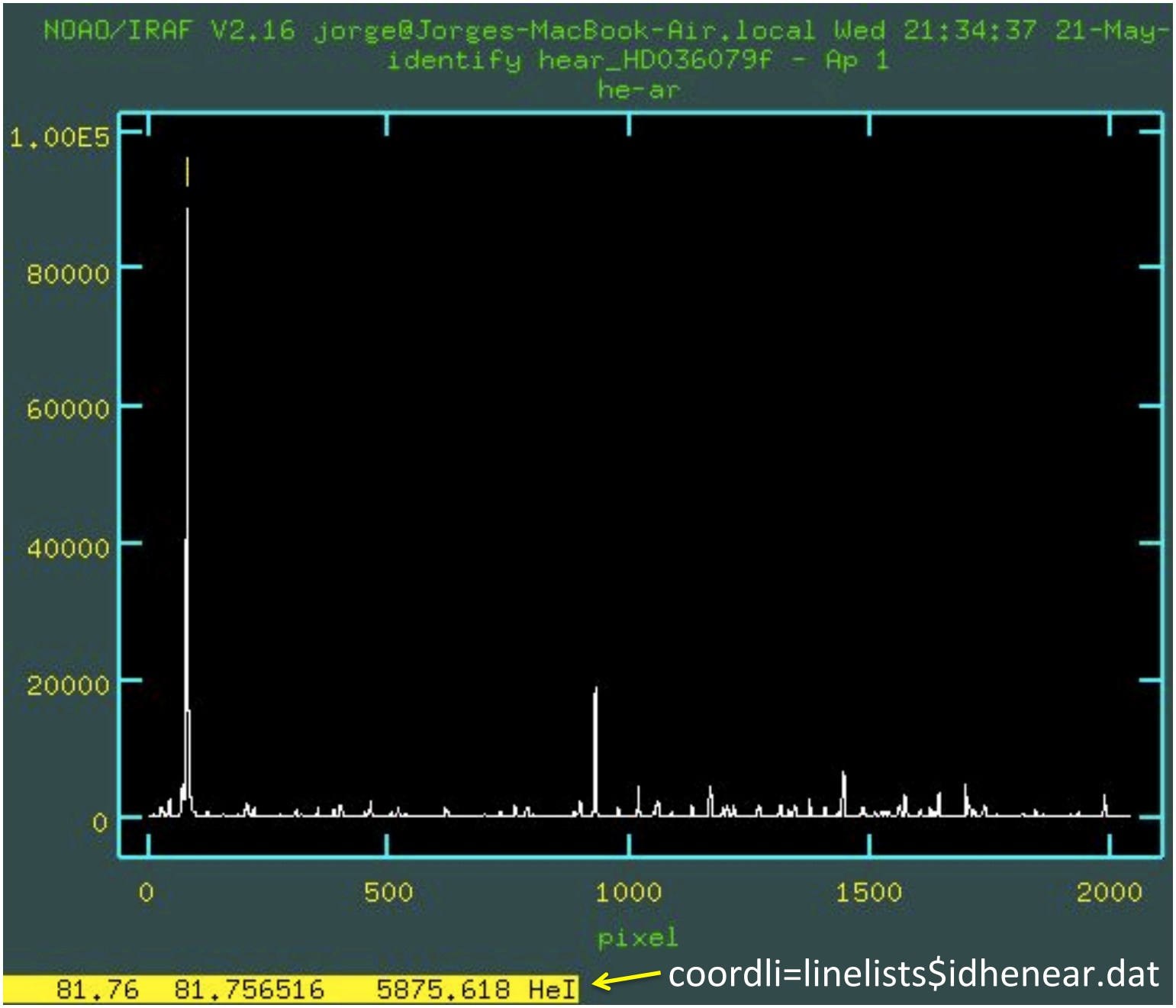
Line identification

ap> identify hear_HD036079f.fits coordli=linelists$idhenear.dat

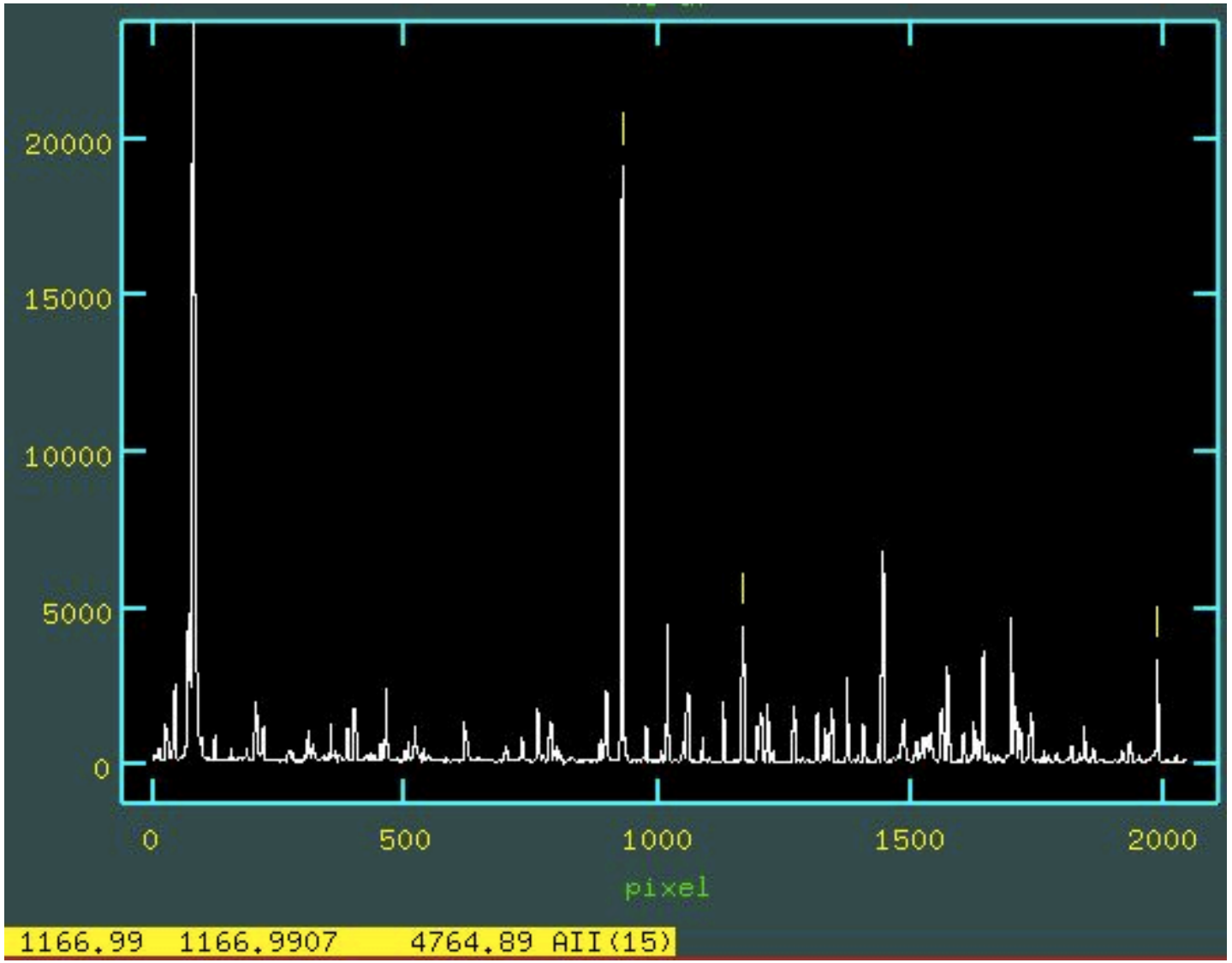


IRAF's line list for He-Ne-Ar

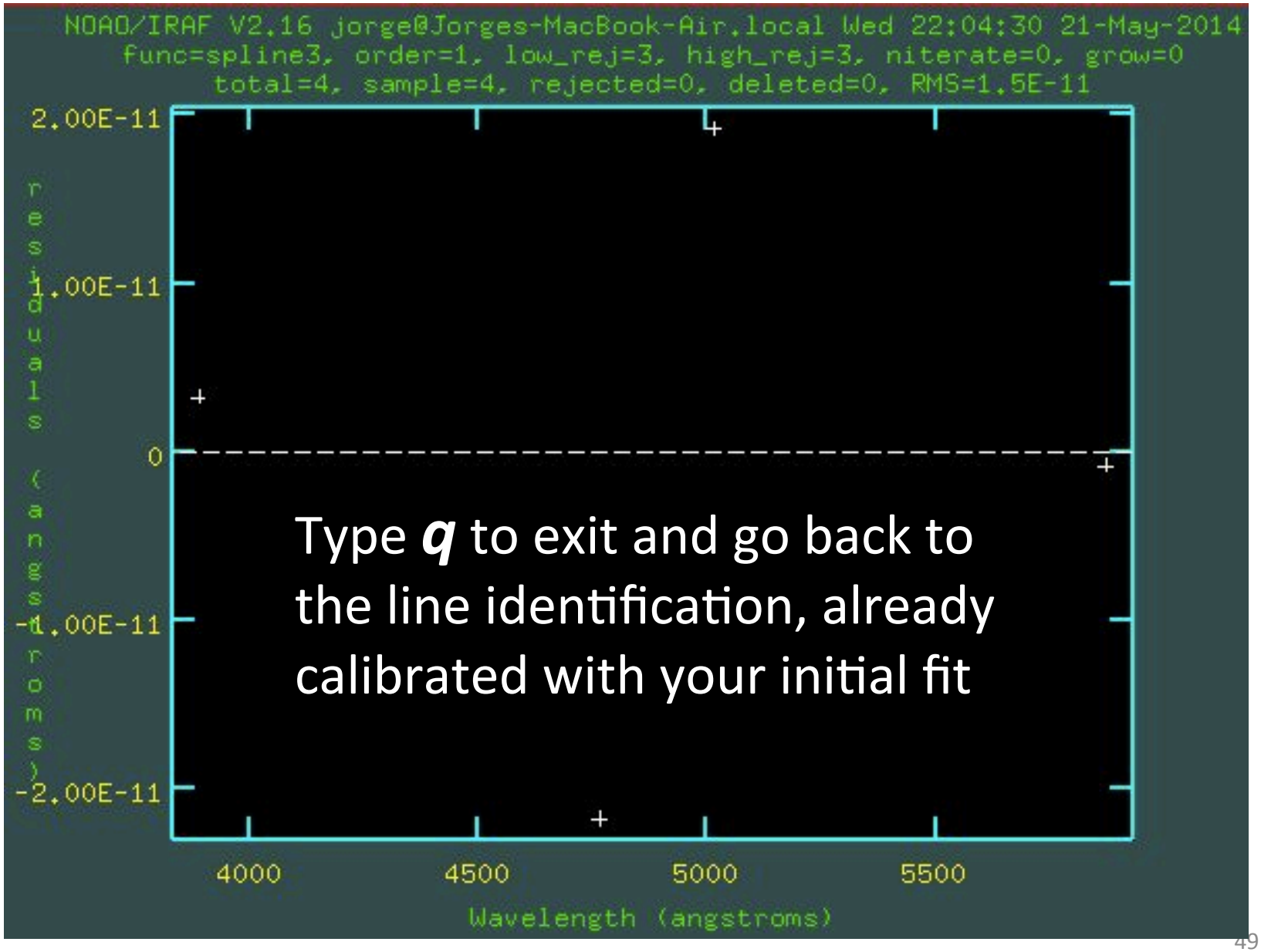
Mark the line with ***m***, then write the wavelength and hit *return (enter)*


NOAO/IRAF V2.16 jorge@Jorges-MacBook-Air.local Wed 21:34:37 21-May-
identify hear_HD036079f - Ap 1
he-ar
1.00E5
80000
60000
40000
20000
0
0
500
1000
1500
2000
pixel
81.76 81.756516 5875.618 HeI
coordli=linelists$idhenear.dat

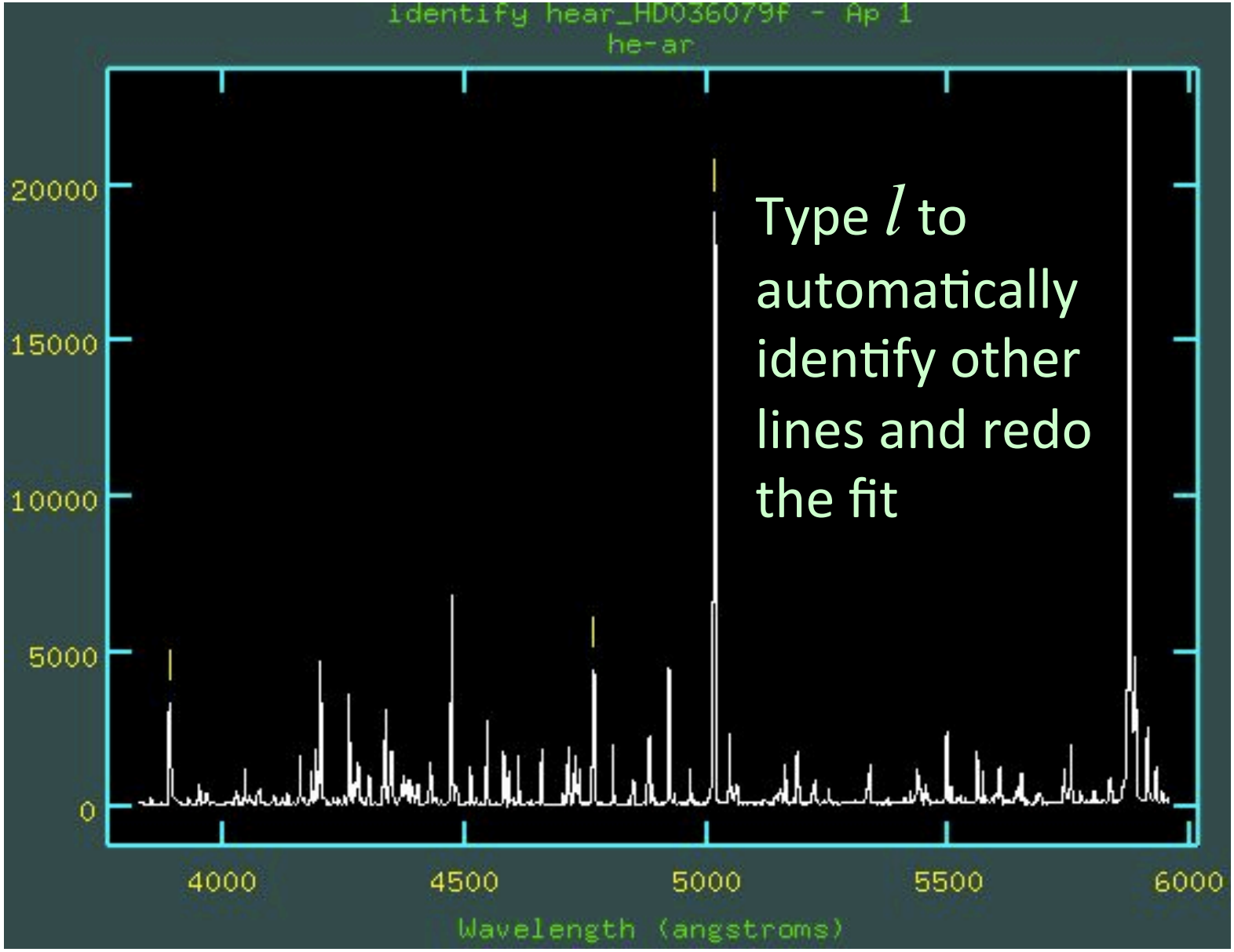
After identifying at least 4 lines (well spaced) type ***f*** (meaning ***f****it*)



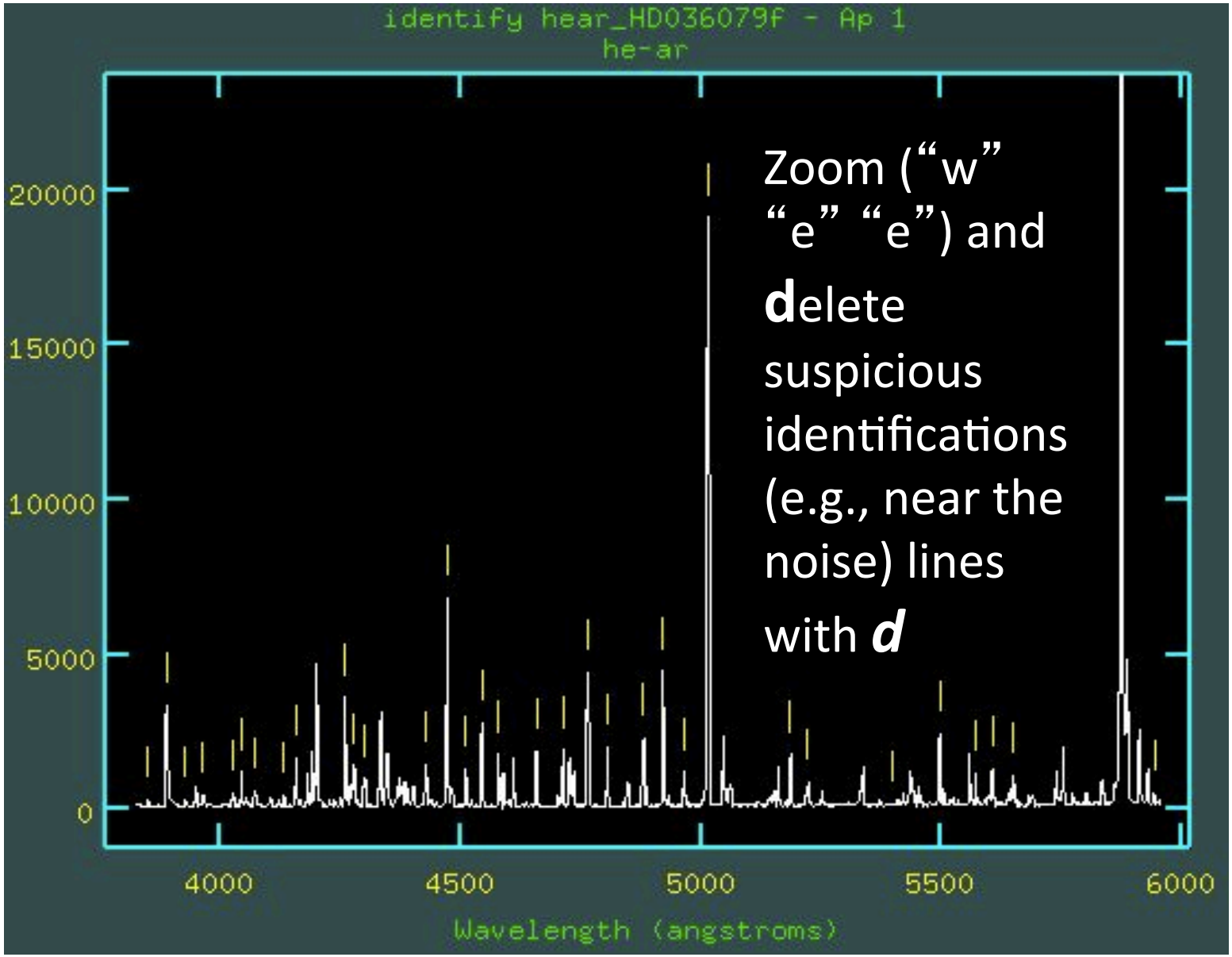
Residuals of the fit of pixel vs. wavelength

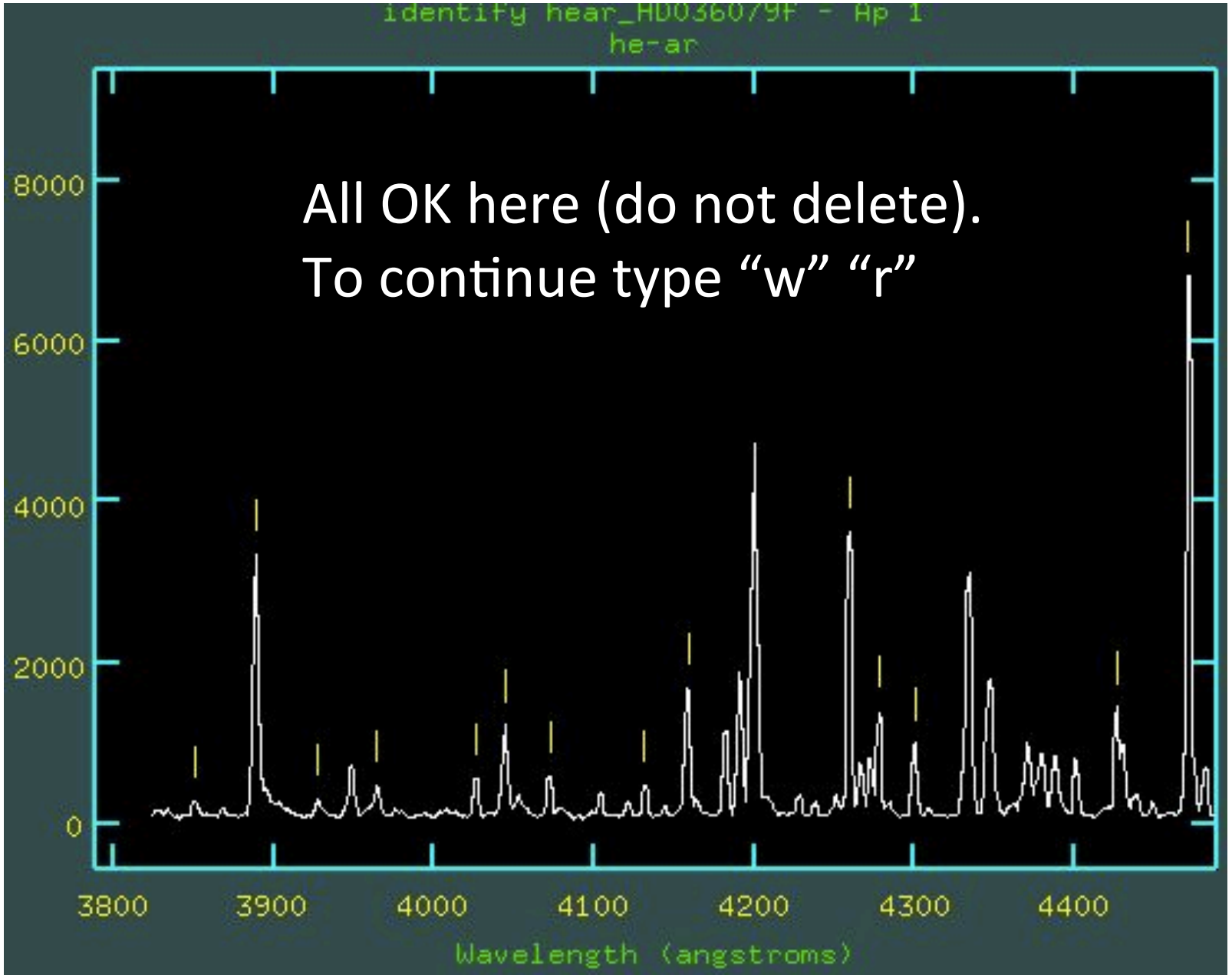


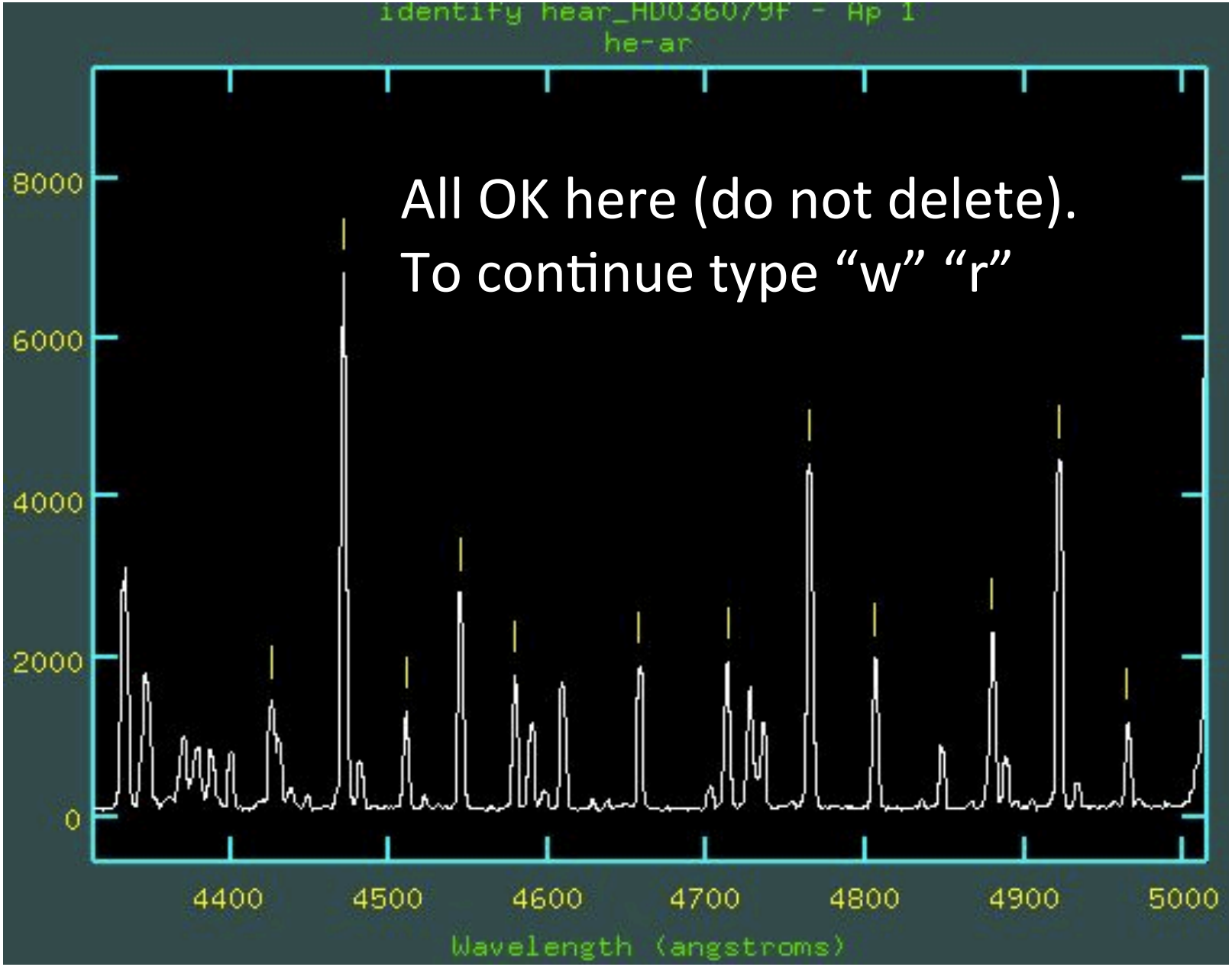
First estimate of the wavelength calibration

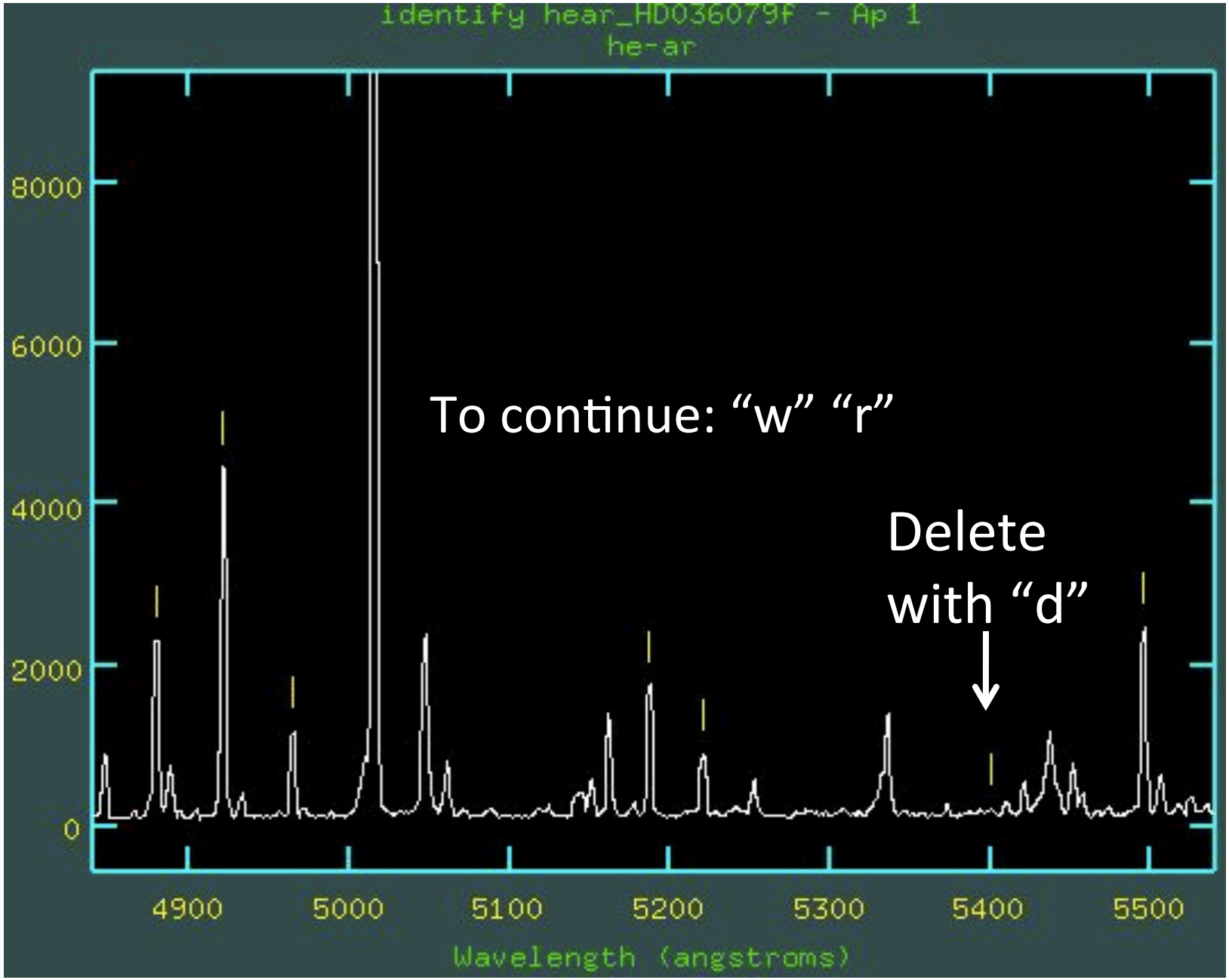


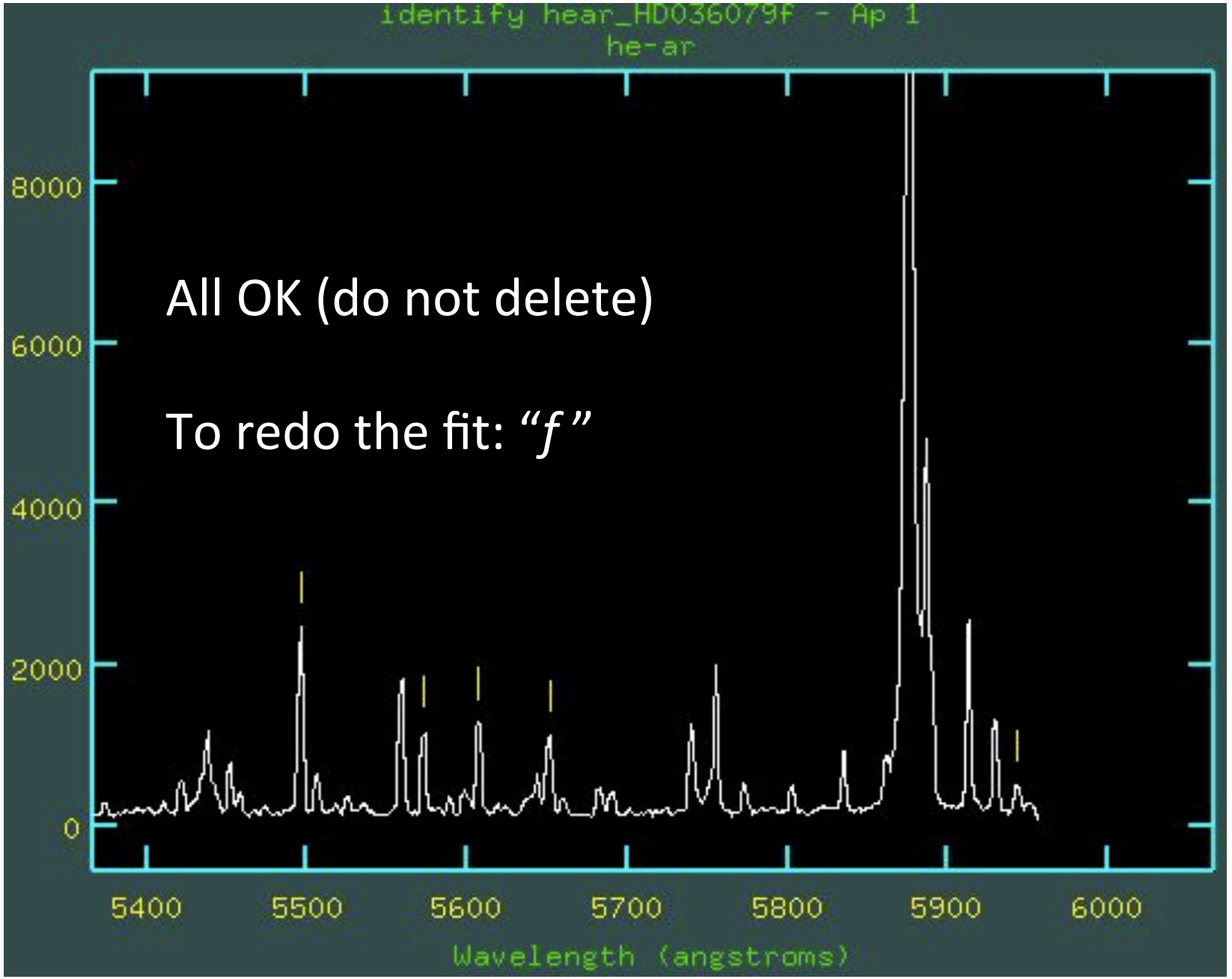
Lines automatically identified

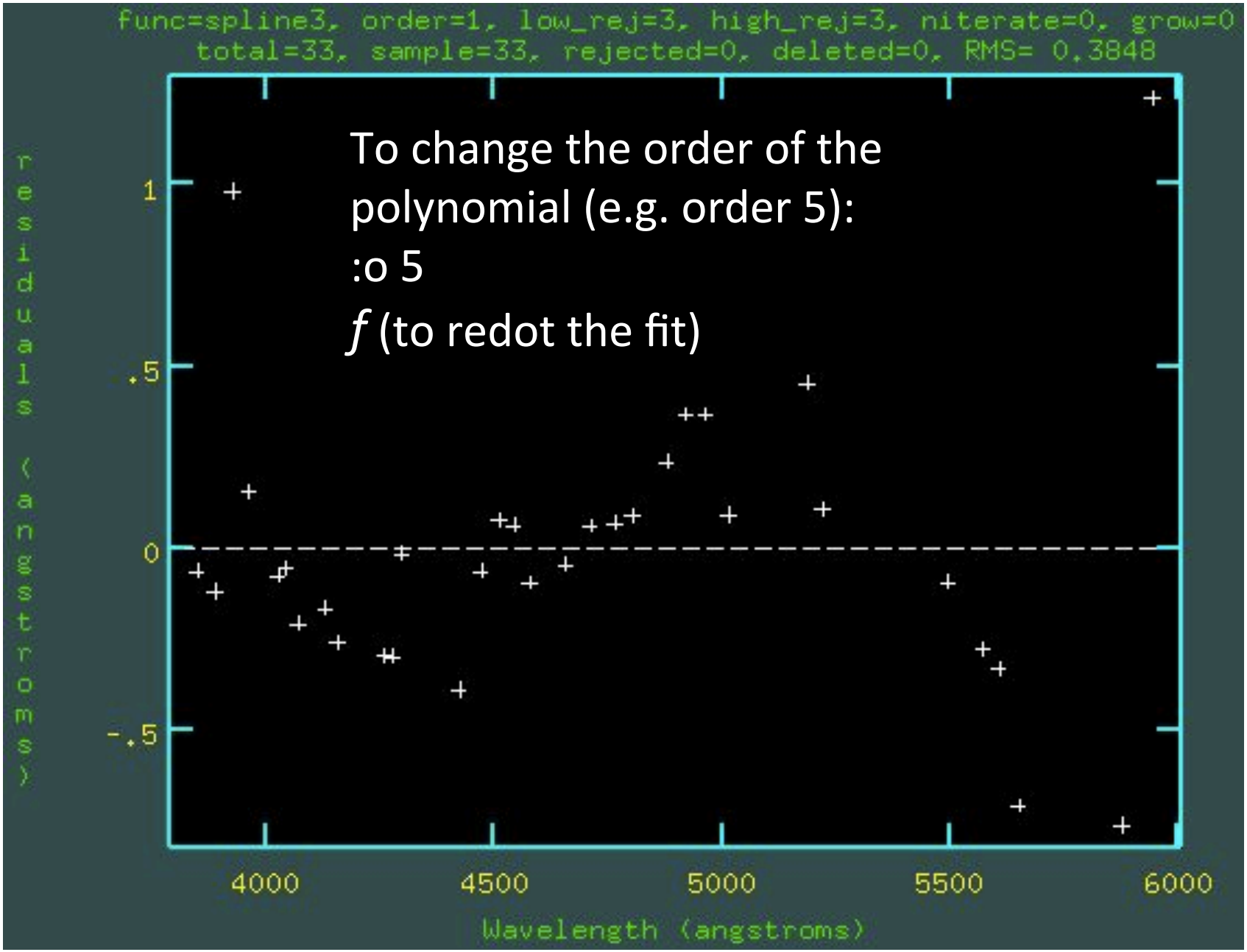



identify hear_HD036079f - Ap 1
he-ar
All OK here (do not delete).
To continue type “w” “r”
8000
6000
4000
2000
0
3800
3900
4000
4100
4200
4300
4400
Wavelength (angstroms)


identify hear_HD036079f - Ap 1
he-ar
All OK here (do not delete).
To continue type “w” “r”
8000
6000
4000
2000
0
4400
4500
4600
4700
4800
4900
5000
Wavelength (angstroms)


identify hear_HD036079f - Ap 1
he-ar
8000
6000
4000
2000
0
To continue: “w” “r”
Delete
with “d”
4900
5000
5100
5200
5300
5400
5500
Wavelength (angstroms)

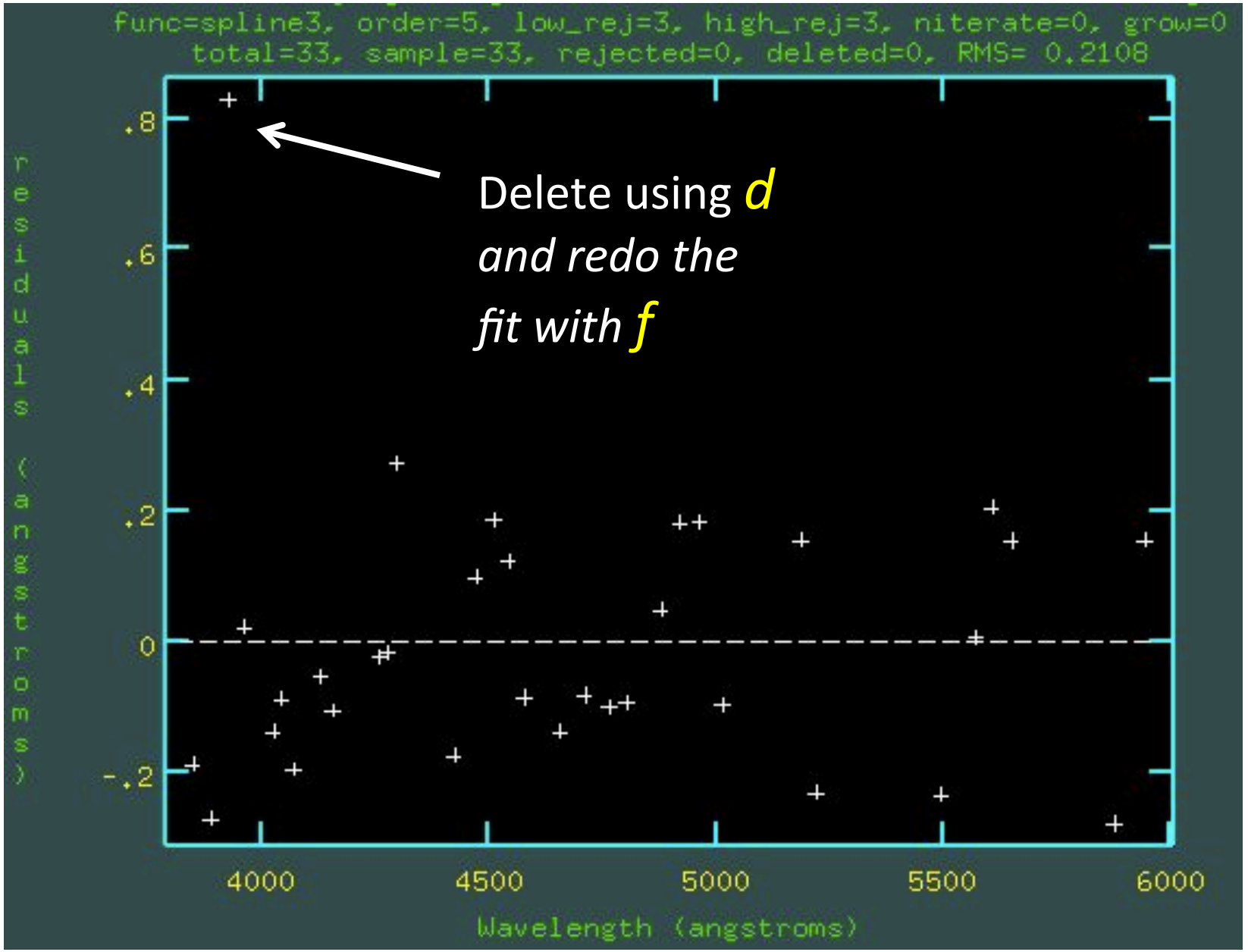

identify hear_HD036079f - Ap 1
he-ar
8000
6000
4000
2000
0
All OK (do not delete)
To redo the fit: "f"
5400
5500
5600
5700
5800
5900
6000
Wavelength (angstroms)

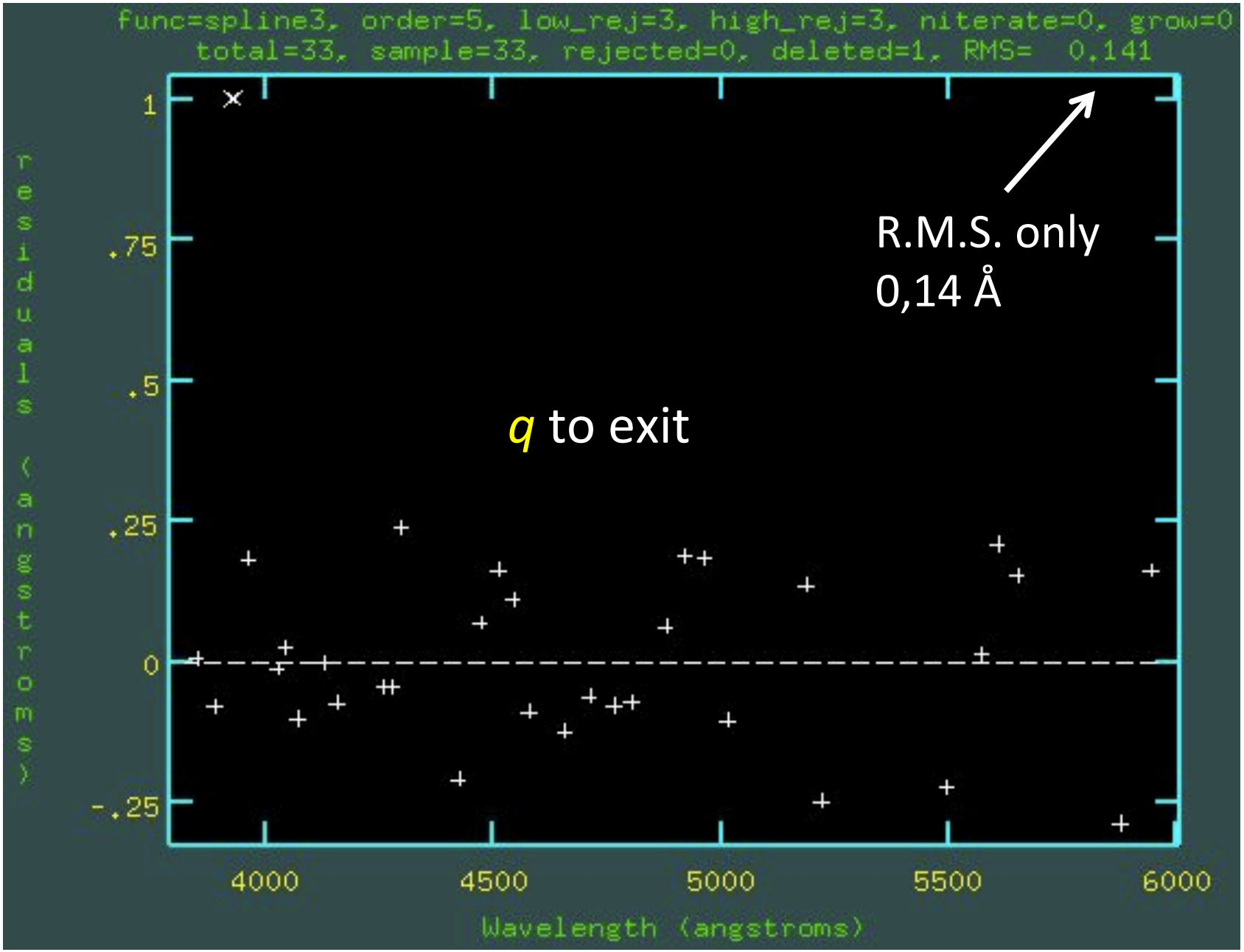


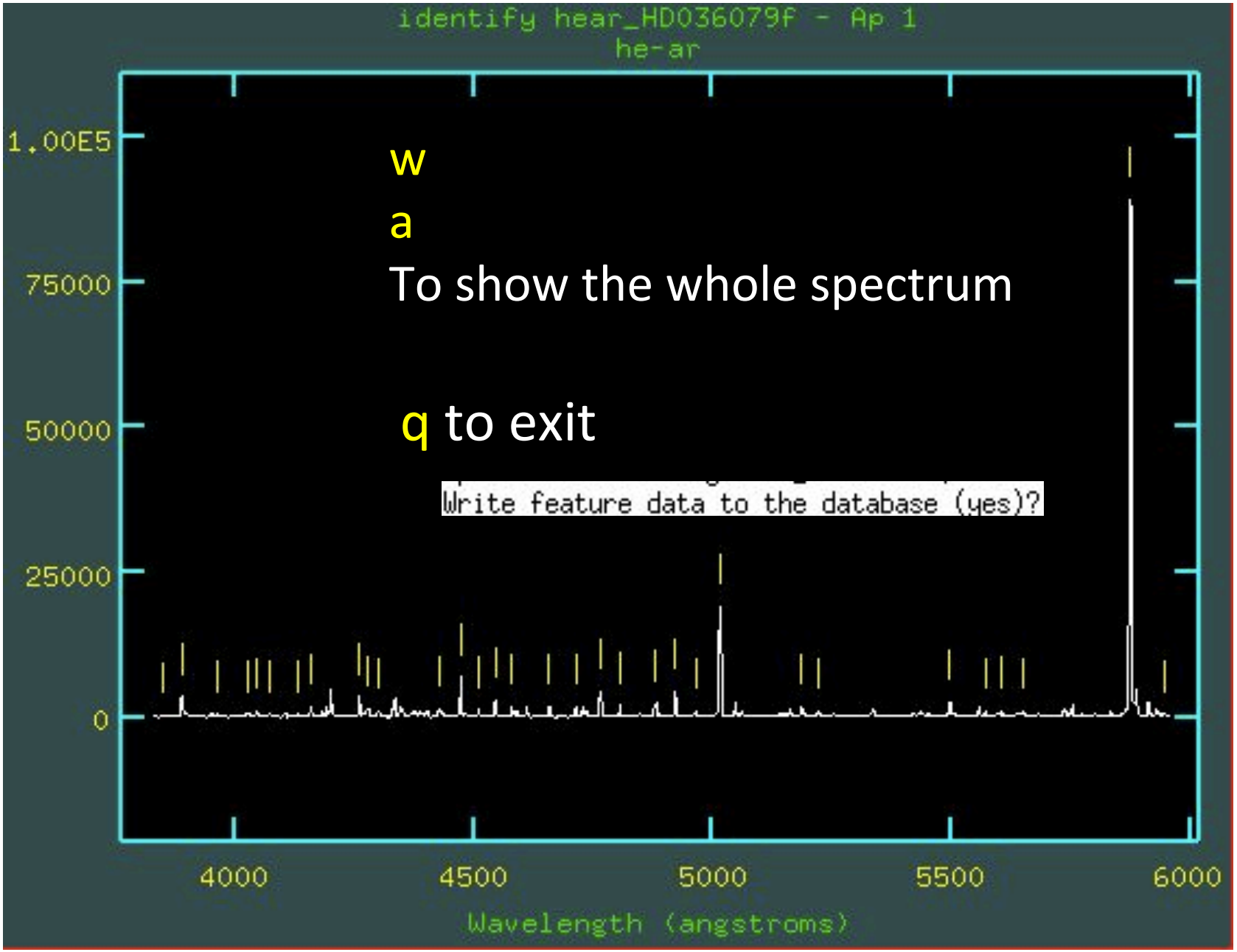
To change the order of the polynomial (e.g. order 5):

:o 5

f (to redot the fit)


func=spline3, order=5, low_rej=3, high_rej=3, niterate=0, grow=0
total=33, sample=33, rejected=0, deleted=0, RMS= 0.2108
residuals (angstroms)
.8
.6
.4
.2
0
-.2
4000
4500
5000
5500
6000
Wavelength (angstroms)
Delete using d
and redo the
fit with f


func=spline3, order=5, low_rej=3, high_rej=3, niterate=0, grow=0
total=33, sample=33, rejected=0, deleted=1, RMS= 0.141
residuals (angstroms)
1
.75
.5
.25
0
-.25
4000
4500
5000
5500
6000
Wavelength (angstroms)
R.M.S. only
0,14 Å
q to exit


identify hear_HD036079f - Ap 1
he-ar
1.00E5
75000
50000
25000
0
w
a
To show the whole spectrum
q to exit
Write feature data to the database (yes)?
4000
4500
5000
5500
6000
Wavelength (angstroms)

ecl> !more database/idhear_HD036079f

```
begin   identify hear_HD036079f - Ap 1
        id          hear_HD036079f
        task        identify
        image       hear_HD036079f - Ap 1
        aperture          1
        aplow       283.25
        aphigh      286.85
        units       Angstroms
        features          32
          13.36 5944.67304  5944.8342   4.0 1 1 NeI(1)
          81.76 5875.90795   5875.618   4.0 1 1 HeI
         307.84 5650.55171   5650.703   4.0 1 1 AI(12)
         351.94 5606.52455   5606.732   4.0 1 1 AI
         385.88 5572.53501   5572.548   4.0 1 1 AI
         461.78  5496.0989   5495.872   4.0 1 1 AI(14)
         730.06 5221.51883    5221.27   4.0 1 1 AI
         762.83 5187.61148   5187.746   4.0 1 1 AI
         928.05 5015.78031   5015.675   4.0 1 1 HeI
         976.69 4964.93737    4965.12   4.0 1 1 AII(14)
        1017.94 4921.74167   4921.929   4.0 1 1 HeI
        1057.87 4879.83806     4879.9   4.0 1 1 AII(14)
        1127.94 4806.14317    4806.07   4.0 1 1 AII(6)
```

Pixel #

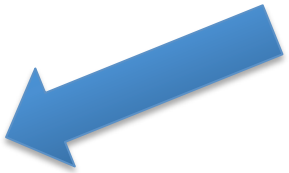
Computed wavelength

Laboratory wavelength

species

tail is useful to visualize the last lines of the file (in the case below, the last 22 lines)

```
onedspec> !tail -22 database/idhear_HD036079f
        function spline3
        order 5
        sample *
        naverage 1
        niterate 0
        low_reject 3.
        high_reject 3.
        grow 0.
        coefficients    12
                3.
                5.
                1.
                2048.
                1063.1812771222
                992.1992068207723
                925.1840099637536
                854.9771910623752
                783.419179499576
                710.5804652246801
                637.434633320564
                563.5349304446175
```



In the file idhear_HD036079f we have the coefficients of the polynomial fit of pixel vs. wavelength

We only need to identify once the He-Ar lines in one star. For the others it could be done automatically

Identify automatically the He-Ar for the other stars using as reference the identification of HD036079f:

> reidentify hear_HD036079f hear_HD* nlost=2 inter-

Verify:

```
onedspec> ls -1 database/id*
database/idhear_HD036079f
database/idhear_HD036673f
database/idhear_HD045289f
```

To apply the calibration in wavelength, first we need to write in the header the information of the reference star

Reduced stellar spectra are *.0001.fits:

```
onedspec> ls *.0001.fits
HD036079f.0001.fits     HD036673f.0001.fits     HD045289f.0001.fits
```

The spectra for wavelength calibration are:

```
onedspec> ls hear_HD*
hear_HD036079f.fits     hear_HD036673f.fits     hear_HD045289f.fits
```

For the first star:

refspec HD036079f.0001.fits reference=hear_HD036079f.fits sort=none group=none

But we could do it for all stars using lists

> ls -1 *.0001.fits > listared_in

```
HD036079f.0001.fits
HD036673f.0001.fits
HD045289f.0001.fits
```

> ls -1 hear_HD* > listahear_in

```
hear_HD036079f.fits
hear_HD036673f.fits
hear_HD045289f.fits
```

>!sed 's/HD/refspec HD/g' listared_in > lista1

>!sed 's/hear/reference=hear/g;s/fits/fits sort=none group=none'/g listahear_in > lista2

>!paste -d " " lista1 lista2 > lista_refspec

espaço

VERIFY:

> !more lista_refspec

```
refspec HD036079f.0001.fits reference=hear_HD036079f.fits sort=none group=none
refspec HD036673f.0001.fits reference=hear_HD036673f.fits sort=none group=none
refspec HD045289f.0001.fits reference=hear_HD045289f.fits sort=none group=none
```

Assign the reference He-Ar:
(write in the header the reference He-Ar file)

cl < lista_refspec

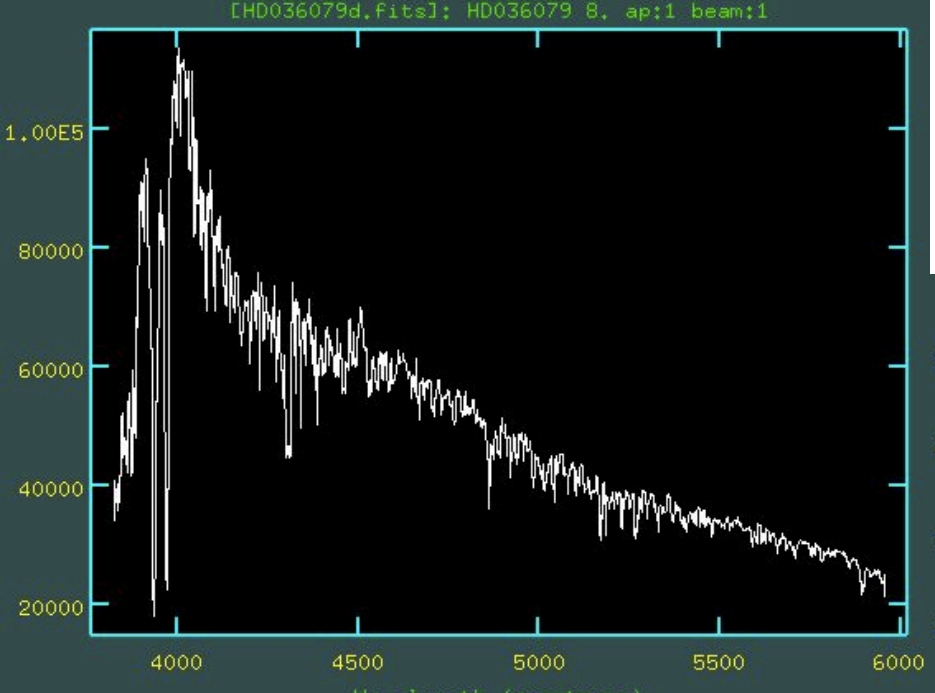
```
[HD036079f.0001] refspec1='hear_HD036079f'   Accept assignment? (no|yes|YES): YES
[HD036079f.0001] refspec1='hear_HD036079f'
[HD036673f.0001] refspec1='hear_HD036673f'   Accept assignment? (no|yes|YES): YES
[HD036673f.0001] refspec1='hear_HD036673f'
[HD045289f.0001] refspec1='hear_HD045289f'   Accept assignment? (no|yes|YES): YES
[HD045289f.0001] refspec1='hear_HD045289f'
```

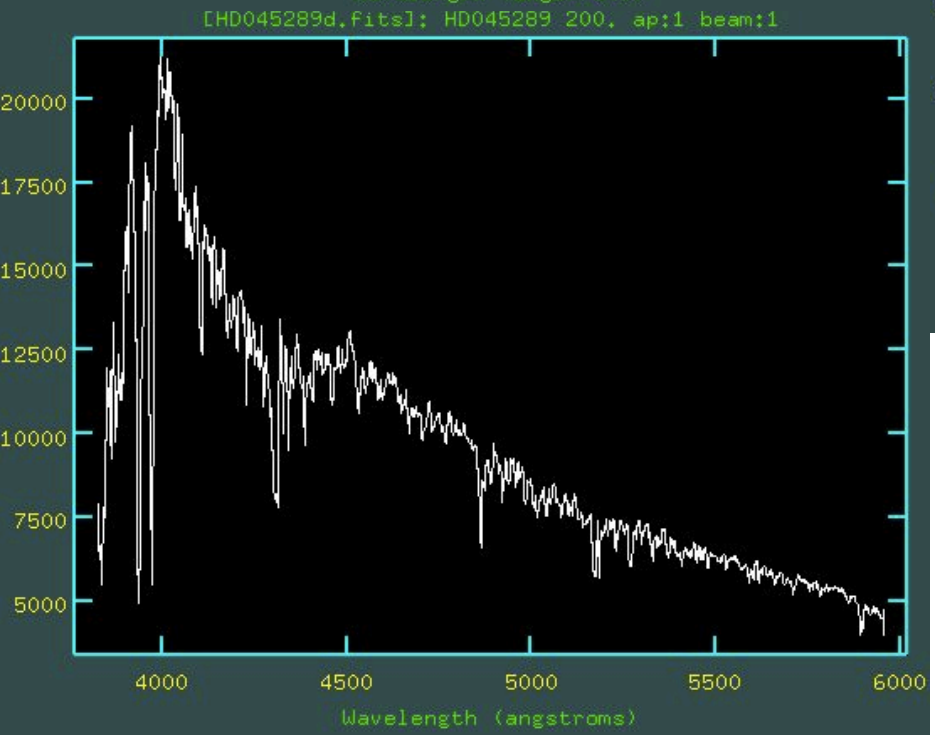
Apply the calibration in wavelength:

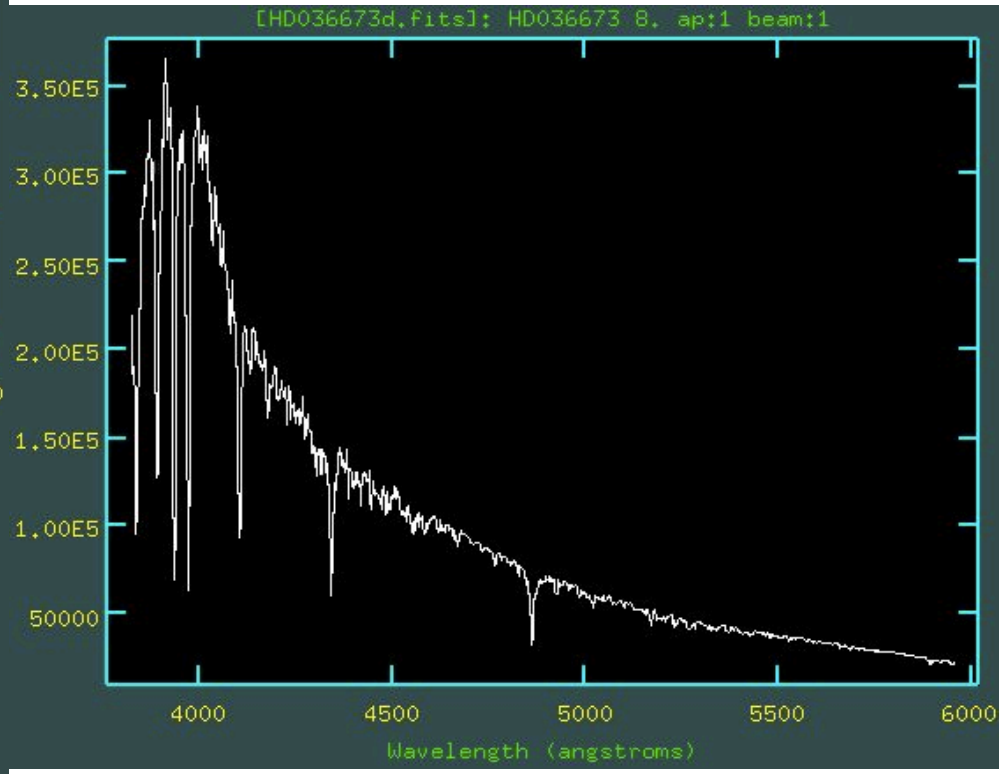
ap> dispcor *f.0001.fits *%f.0001.fits%d.fits%

```
HD036079f.0001.fits: REFSPEC1 = 'hear_HD036079f 1.'
HD036079d.fits: ap = 1, w1 = 3823.854, w2 = 5957.162, dw = 1.042163, nw = 2048
HD036673f.0001.fits: REFSPEC1 = 'hear_HD036673f 1.'
HD036673d.fits: ap = 1, w1 = 3823.725, w2 = 5956.925, dw =  1.04211, nw = 2048
HD045289f.0001.fits: REFSPEC1 = 'hear_HD045289f 1.'
HD045289d.fits: ap = 1, w1 =  3823.66, w2 = 5956.661, dw = 1.042013, nw = 2048
```

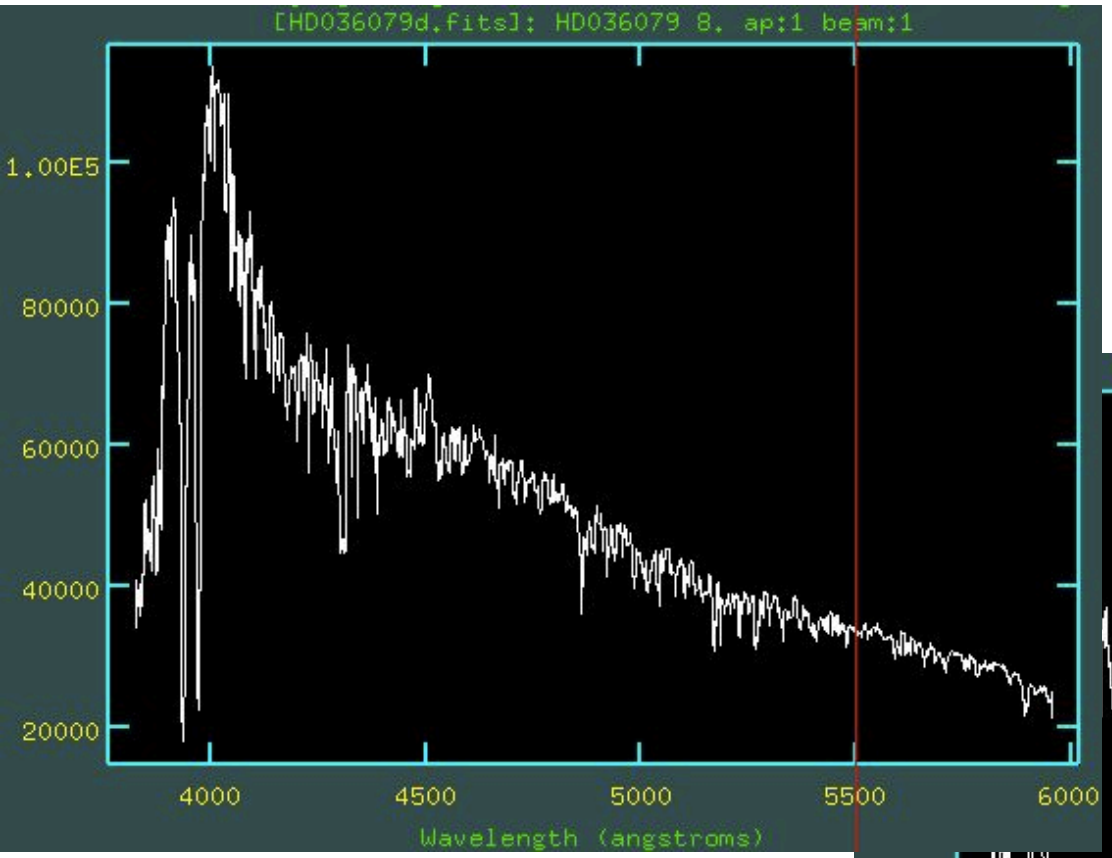
splot HD*d.fits





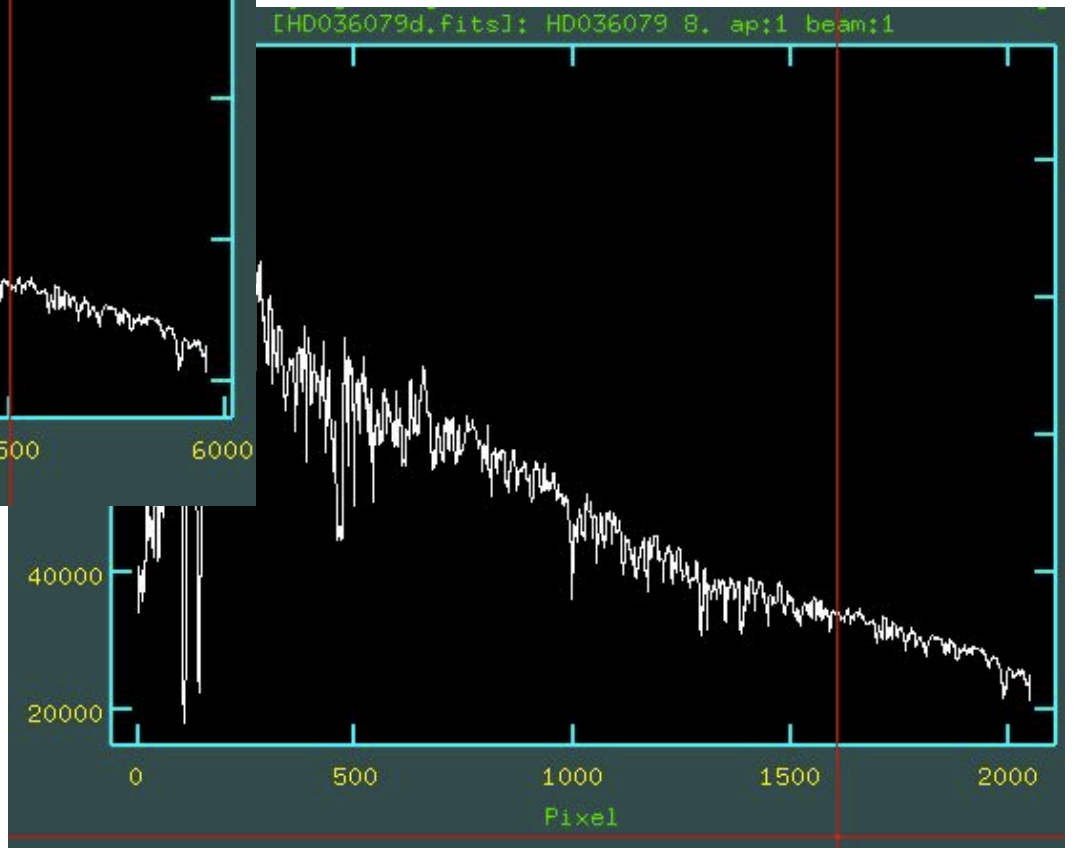


If you like you can normalize to a given flux value (e.g. 5500A) or in absolute flux



use $:

5500 A → pixel 1605



> imstat HD*d.fits[1600:1610] fields="midpt" > medtempo

!sed 1d medtempo > mediana (to delete the first line [comment])

!ls -1 *d.fits > listad1

!sed 's/HD/imarith HD/g;s/fits/fits /g' listad1 > listad2

!paste -d "/" listad2 mediana > listad3

!sed 's/d.fits/n.fits/g' listad1 > listad4

!paste -d " " listad3 listad4 > listan

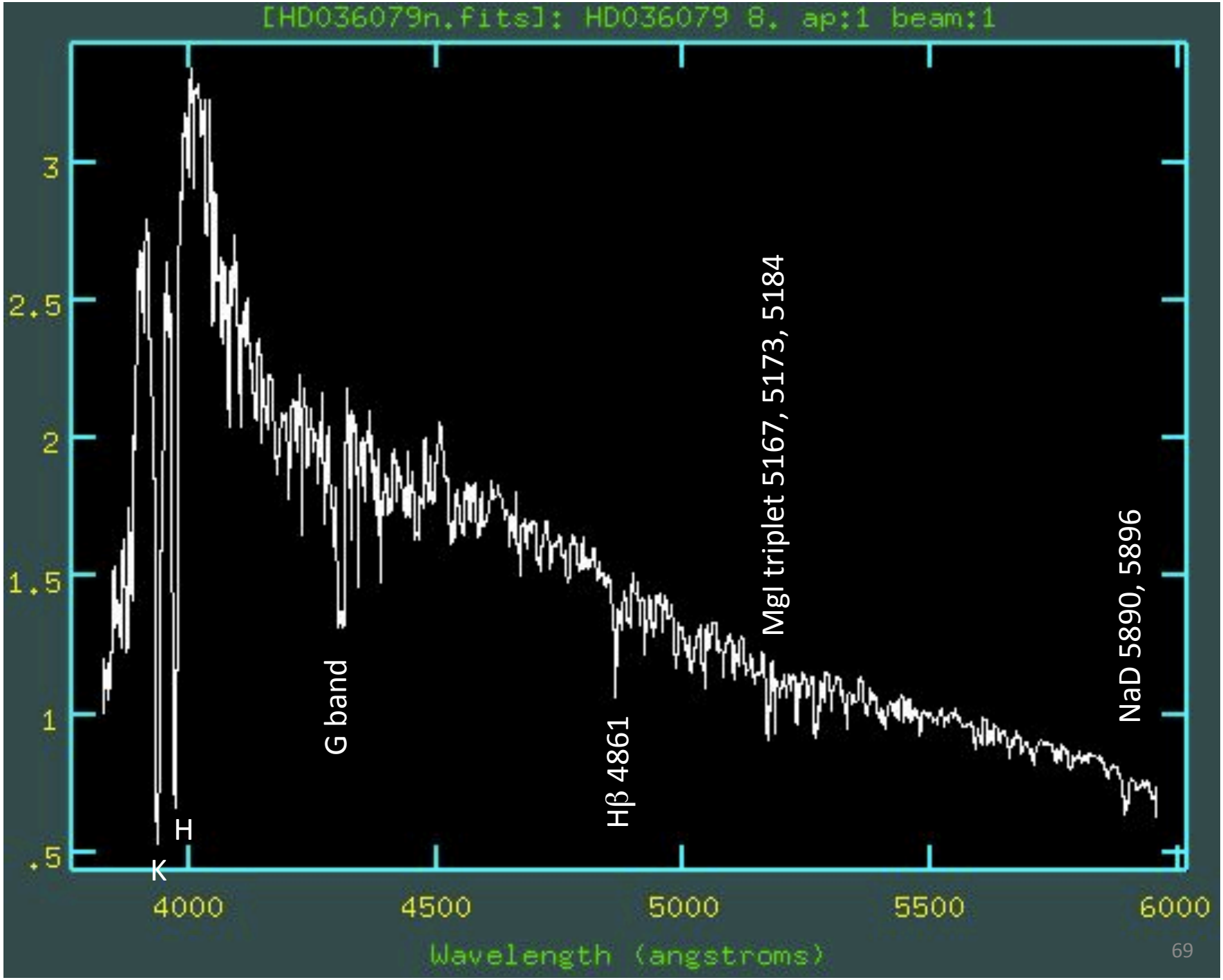
VERIFY

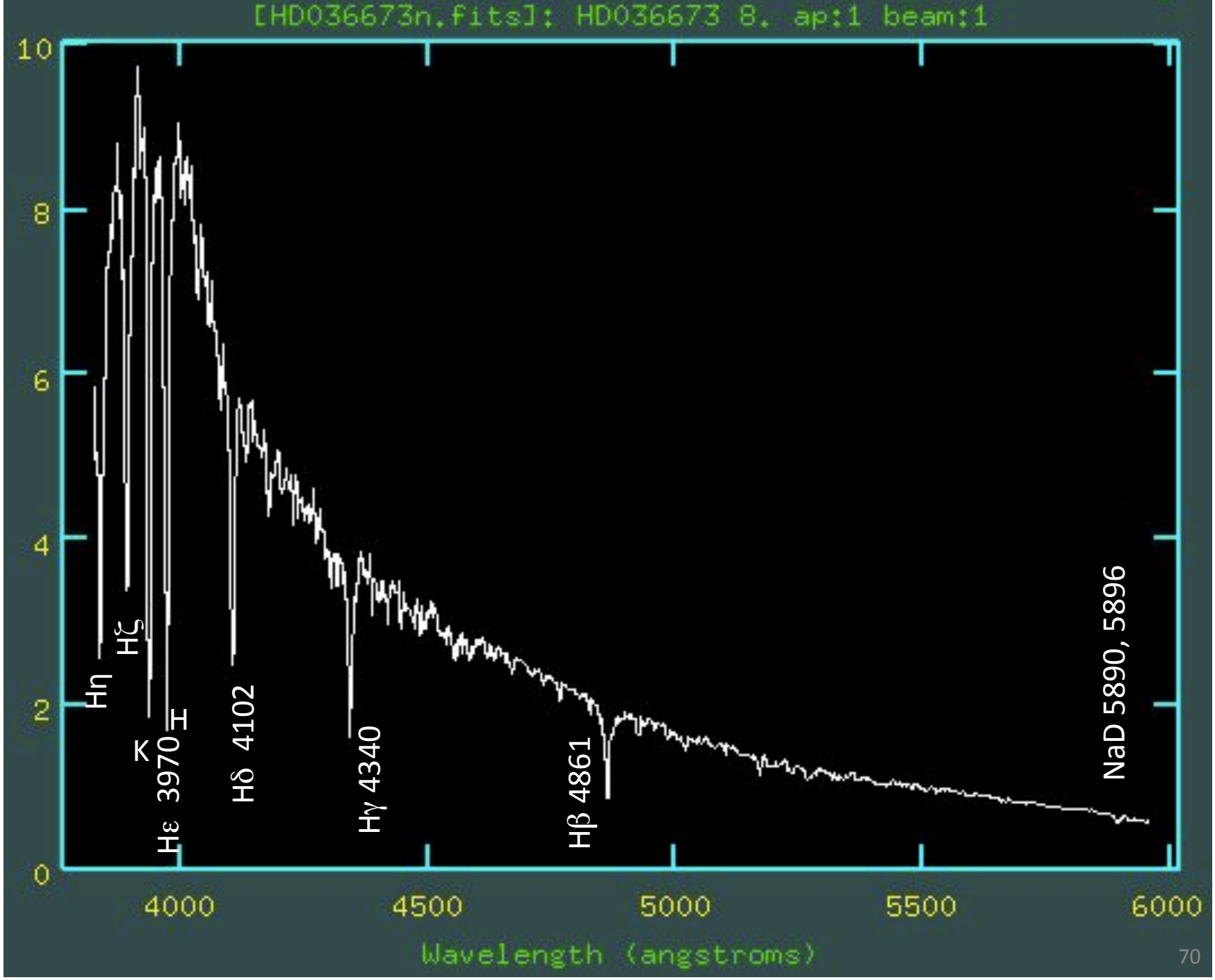
> !more listan

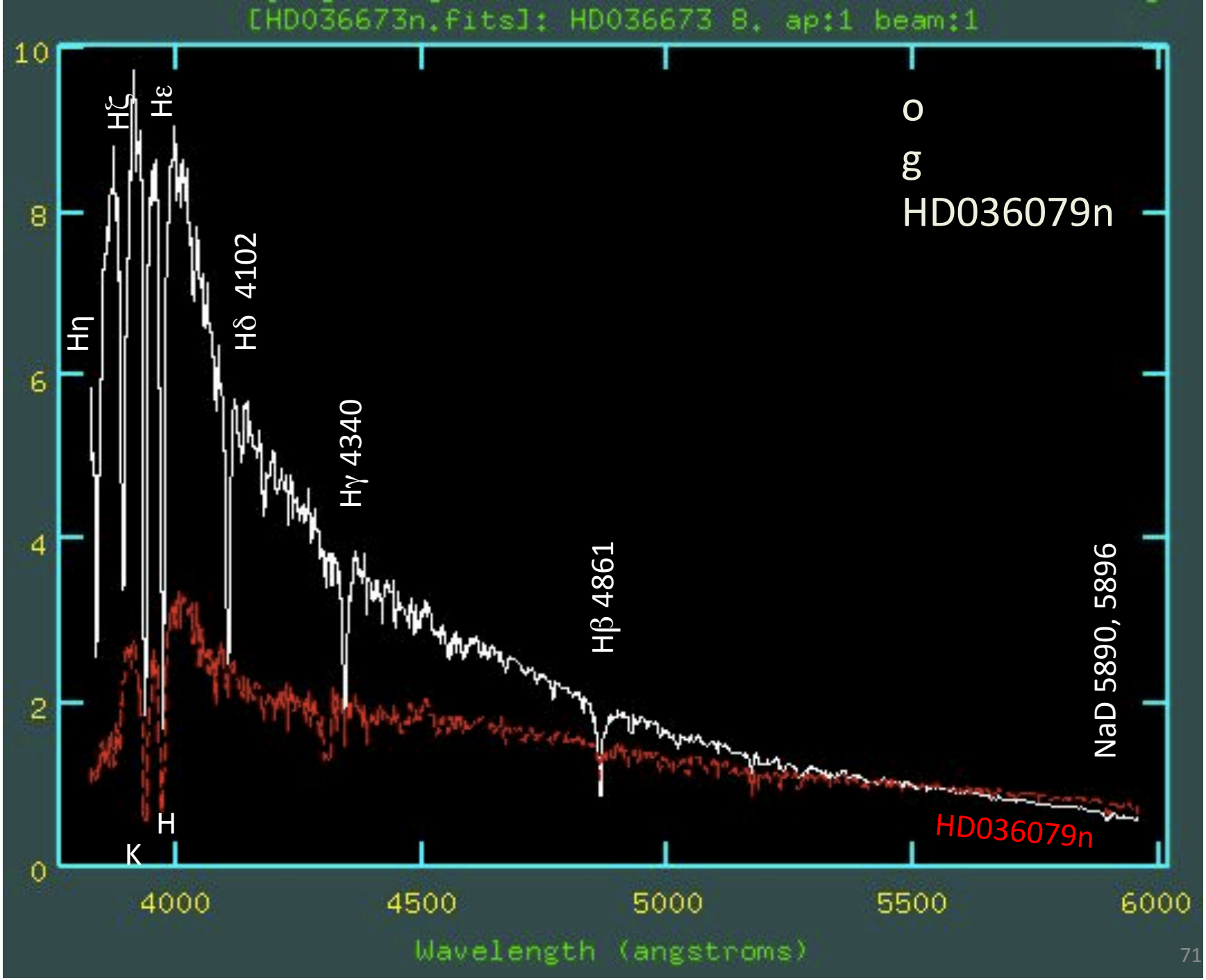
```
imarith HD036079d.fits /     33947. HD036079n.fits
imarith HD036673d.fits /     37505. HD036673n.fits
imarith HD045289d.fits /      6358. HD045289n.fits
```

> cl < listan

> splot HD*n.fits


[HD036079n.fits]: HD036079 8. ap:1 beam:1
3
2.5
2
1.5
1
.5
4000
4500
5000
5500
6000
Wavelength (angstroms)
K
H
G band
Hβ 4861
MgI triplet 5167, 5173, 5184
NaD 5890, 5896


[HD036673n.fits]: HD036673 8. ap:1 beam:1
10
8
6
4
2
0
4000
4500
5000
5500
6000
Wavelength (angstroms)
Hη
Hζ
K
Hε 3970
H
Hδ 4102
Hγ 4340
Hβ 4861
NaD 5890, 5896


[HD036673n.fits]: HD036673 8, ap:1 beam:1
10
8
6
4
2
0
4000
4500
5000
5500
6000
Wavelength (angstroms)
Hη
Hζ
Hε
K
H
Hδ 4102
Hγ 4340
Hβ 4861
NaD 5890, 5896
o
g
HD036079n
HD036079n

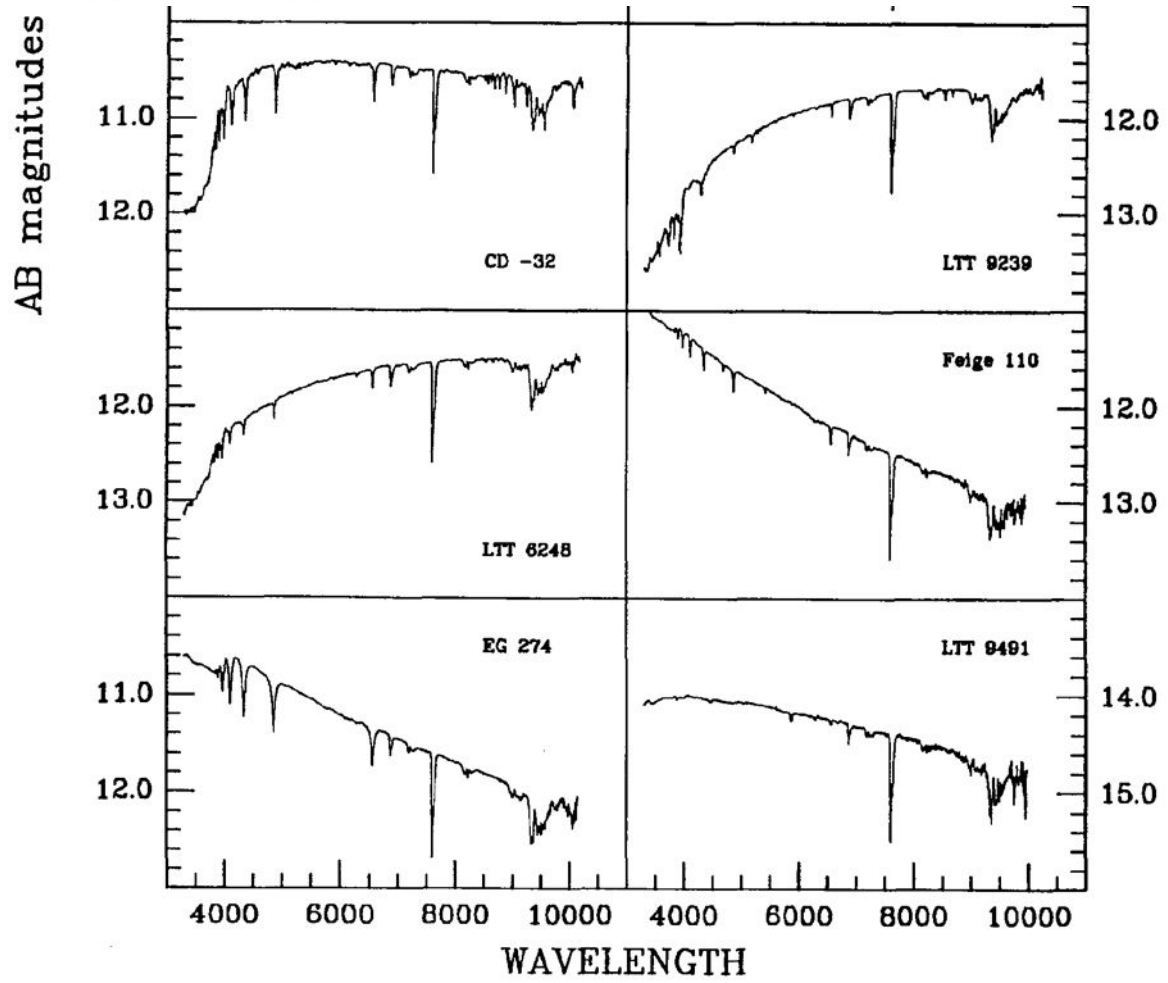
Absolute flux calibration

Publications of the Astronomical Society of the Pacific
106: 566–589, 1994 June

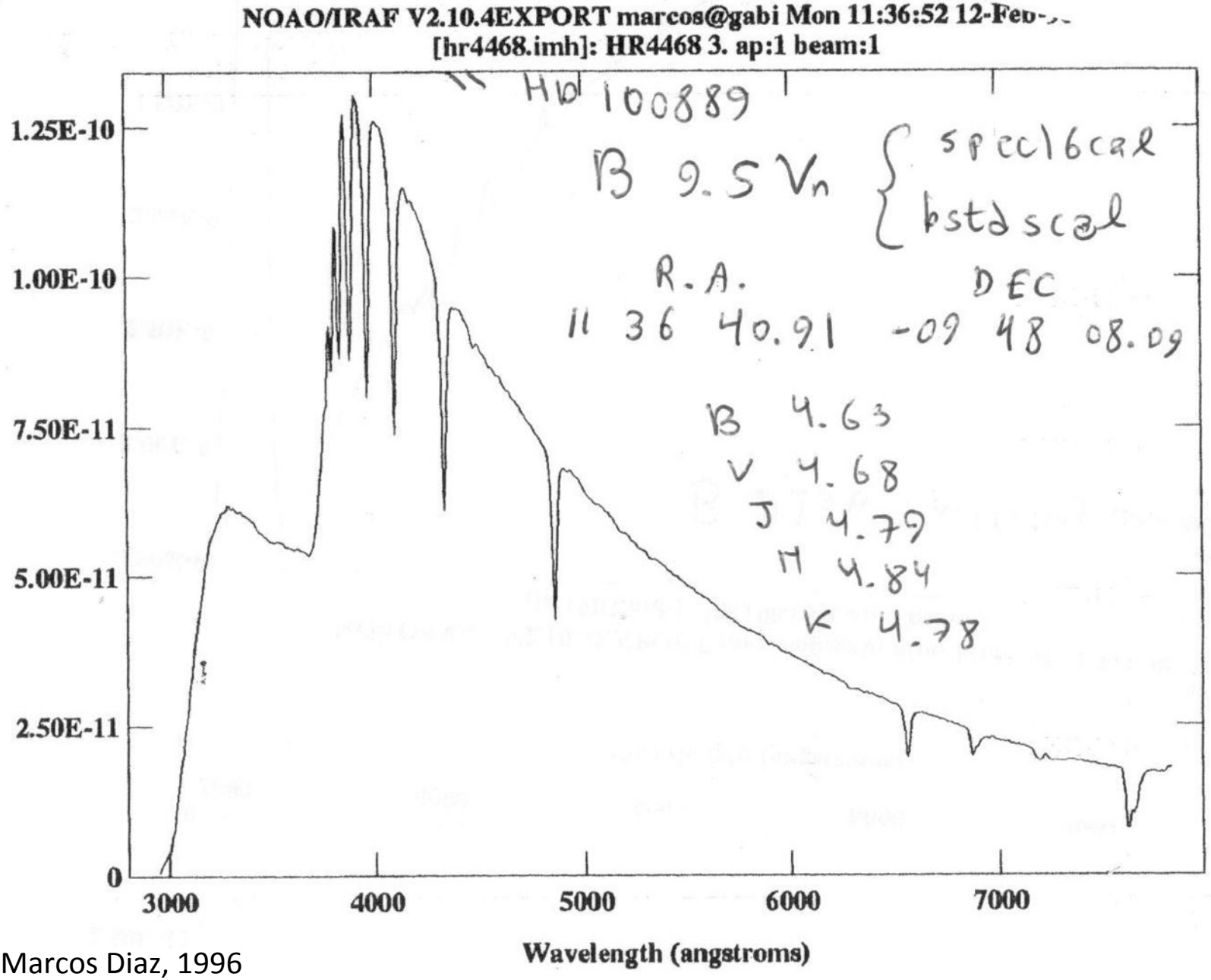
Southern Spectrophotometric Standards. II.

MARIO HAMUY, N. B. SUNTZEFF, S. R. HEATHCOTE, A. R. WALKER, P. GIGOUX, AND M. M. PHILLIPS

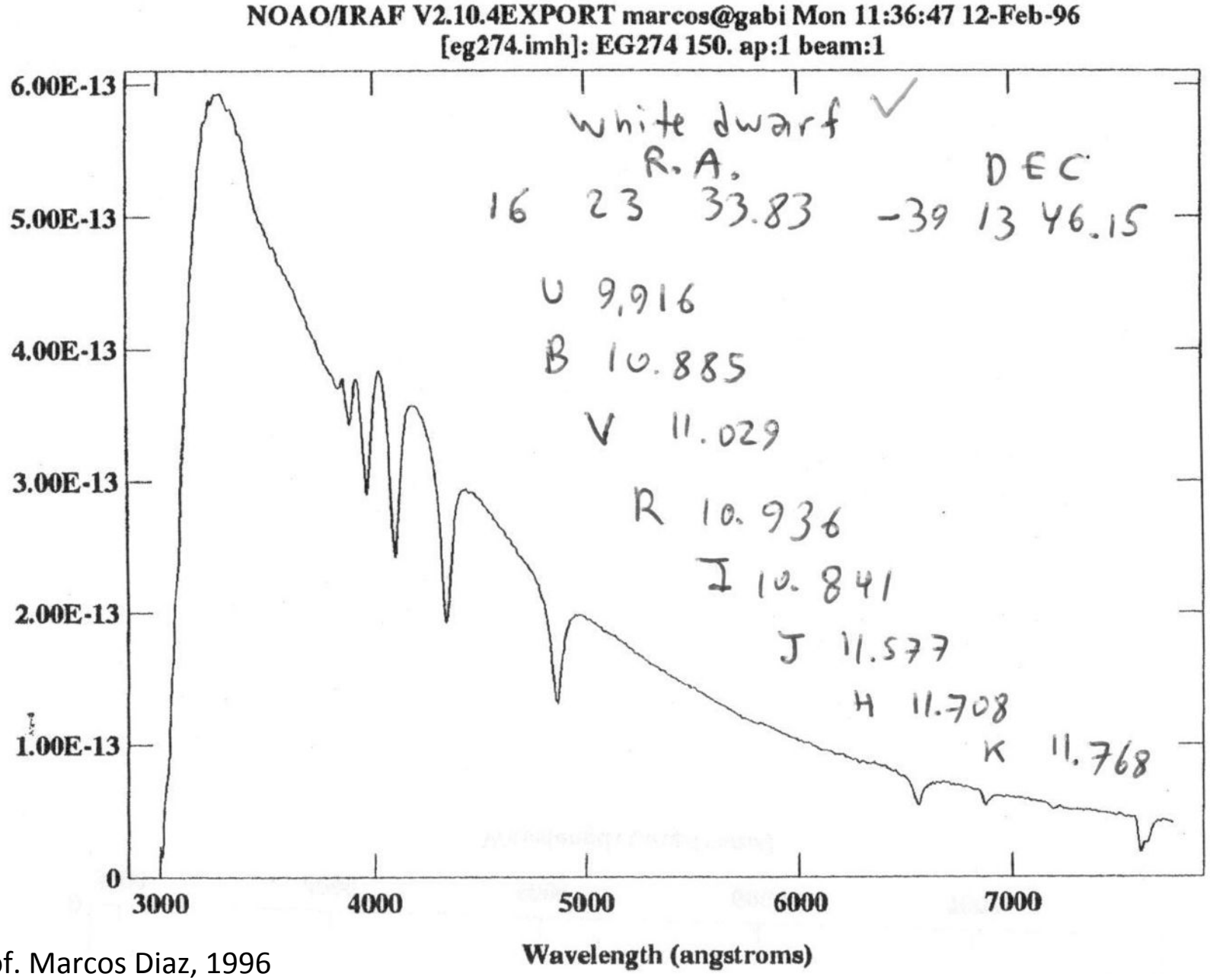
$$m_\nu \equiv -2.5 \log_{10}(f_\nu) - 48.590$$



Flux standard HR4468 (HD 100889): B9.5Vn



Flux standard EG 274: white dwarf



The onedstds$ directory contains standard calibration data for extinction and sensitivity calibration

EXTINCTION TABLES (eg extinction = onedstds $ctioextinct.dat)

- ctioextinct.dat - CTIO extinction table for ONEDSPEC (in A)
- kpnoextinct.dat - KPNO extinction table for ONEDSPEC (in A)

FLUX STANDARD DIRECTORIES

(eg caldir = onedstds$bstdscal/):

- **blackbody** (blackbody flux distributions
- **bstdscal** (brighter KPNO standards)
- **ctionewcal** (Directory containing fluxes at 50A steps in the blue and red ranges
- **spec16cal** - Directory containing fluxes at 16A steps

For example

- **bstdscal** (brighter KPNO standards)

Standard stars in onedstds$bstdscal/

hr718 hr3454 hr3982 hr4468 hr4534 hr5191 hr5511 hr7001 hr7596 hr7950 hr8634 hr9087 hd15318 hd74280 hd100889 hd188350 hd198001 hd214923 hd224926

Notice that hd188350=hr7596 and hr4468=hd100889

To see all lists available in IRAF (cl):

> cd onedstds

> ls

> cd bstdscal *(similar procedure for other lists)*

The full list at: http://star.pst.qub.ac.uk/~jrm/iraf/speclis

epar kpnoslit (salvar com CTRL-D)

*probably you could use **ctioslit**?*

```
                                I R A F
                  Image Reduction and Analysis Facility
PACKAGE = imred
   TASK = kpnoslit

(extinct= onedstds$ctioextinct.dat) Extinction file
(caldir =  onedstds$spec50cal/) Standard star calibration directory
(observa=           observatory) Observatory of data
(interp =                poly5) Interpolation type

(databas=              database) Database
(verbose=                   yes) Verbose output?
(logfile=               logfile) Log file
(plotfil=                      ) Plot file

(nsum   =                     1) Aperture sum for 2D images
(records=                      ) Record number extensions
(version= KPNOSLIT V3: January 1992)
(mode   =                    ql)
($nargs =                     0)
```

ctioextinct.dat OK para o OPD

No Hemisfério Sul escolher ctionewcal ao invés de spec50cal. Para estrelas brilhantes temos outras opções (p.ex., bstdscal). Procurar as padrões em onedstds

Figure 19: The package parameters for **kpnoslit**, modified to specify the ctio atmospheric extinction table. Note the final "/" on the subdirectory for **caldir**.

(absolute) flux calibration

We need to observe absolute flux standards (e.g. Hamuy et al. 1994, PASP 106, 566)

standard (noao.onedspec) p/todas as padrões

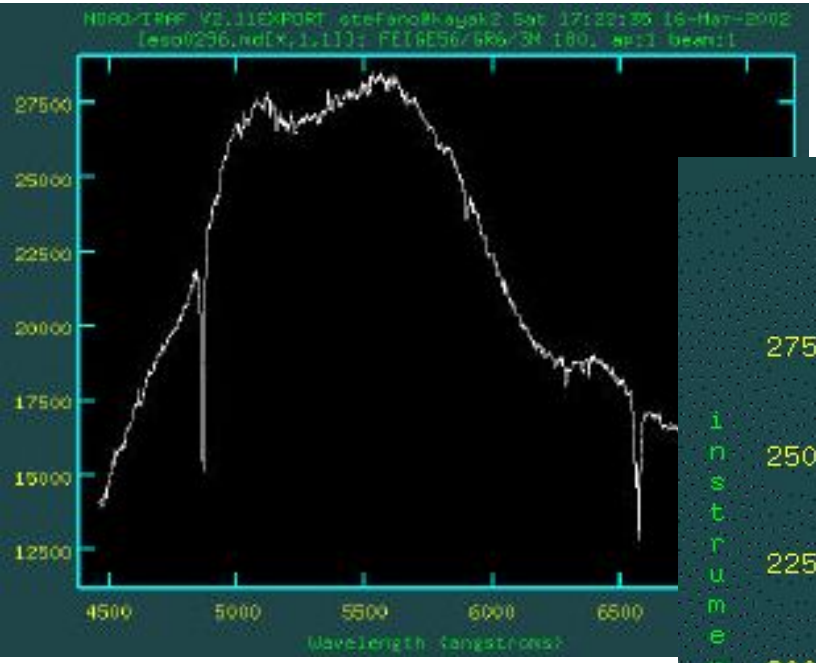
sensfunc (noao.onedspec) (do output de standard)

calibrate (noao.twodspec.longslit) aplica sensfunc

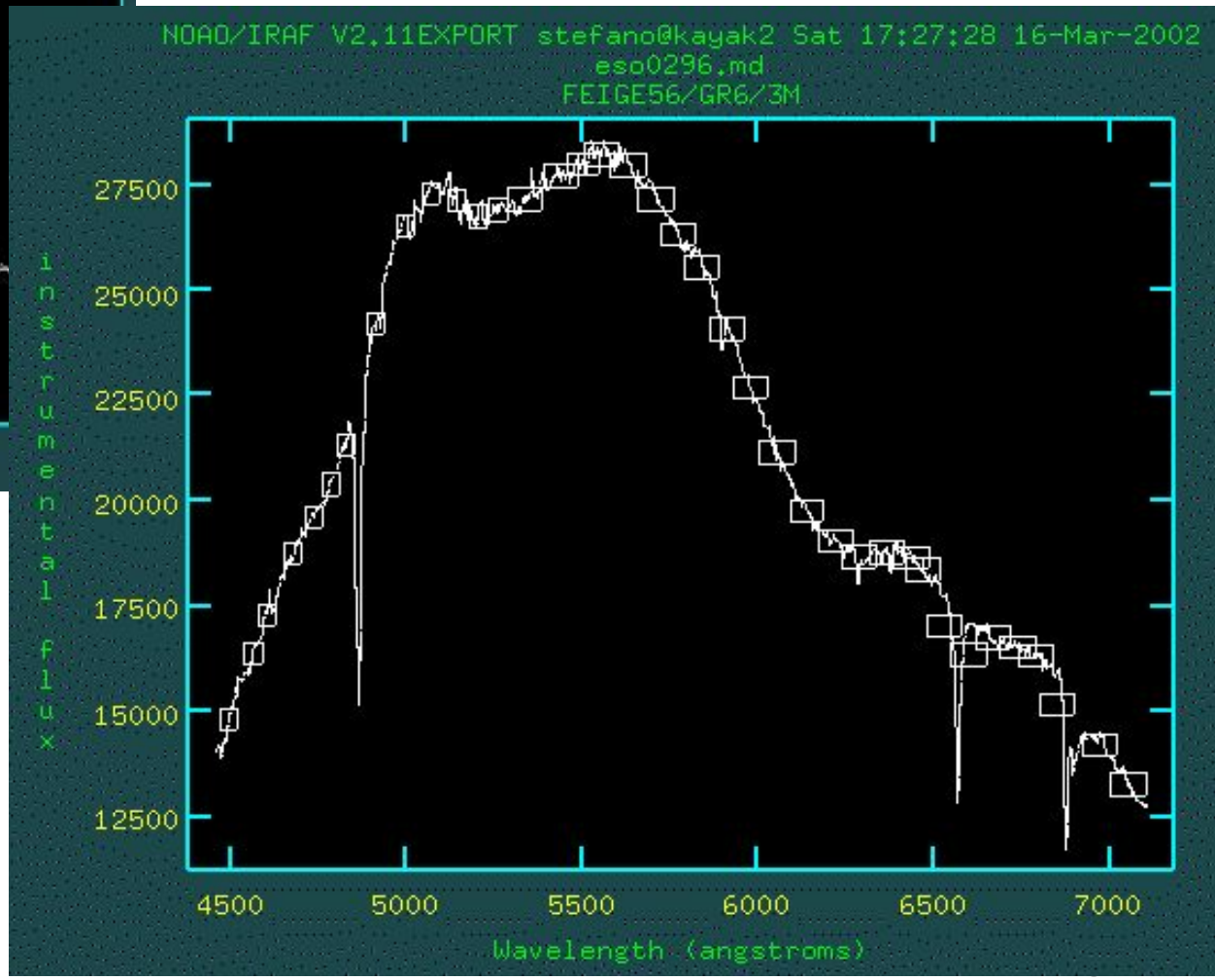
Details in pp 29-35 from IRAF manual:

http://www.astro.iag.usp.br/~jorge/aga5802/spect_iraf_reducao.pdf

Extract the standard star



Select only continuum regions (without lines)



Fit a polynomial transformation from counts to flux (erg cm^{-2} s^{-1} $Å^{-1}$)