Spektroskopia echelle:
(+ manuale do redukcji danych echelle):

http://pendientedemigracion.ucm.es/info/Astrof/invest/actividad/echelle.Html

http://www.astro.uni.wroc.pl/ludzie/molenda/Redukcja_widm_CCD_za_pomoca_pakietu_IRAF.pdf

Dane obserwacyjne:

ESO Archive
Elodie Archive
SOPHIE Archive
SMOKA Archive
FEROS Archive
(...)

Dane testowe:

SLN (Serra la Neve) - Catania Astrophysical Observatory; OAC 1.5m, Sycylia, R~30000

Schemat redukcji i kalibracji:

Ustawiamy w irafie parametry obserwatorium Serra la Nave:
noao/observatory

observatory / set / ? / sln

```
Observatory identification (obspars): sln
# Observatory parameters for SLN - Catania Astrophysical Observatory
        observatory = sln
        timezone = -1
        altitude = 1725.
        latitude = 37:41.5
        longitude = 345:01:36
        name = 'SLN - Catania Astrophysical Observatory'
```

sprawdzamy: epar observatory

Pamiętamy o wybraniu odpowiedniego instrumentu:
setinstrument

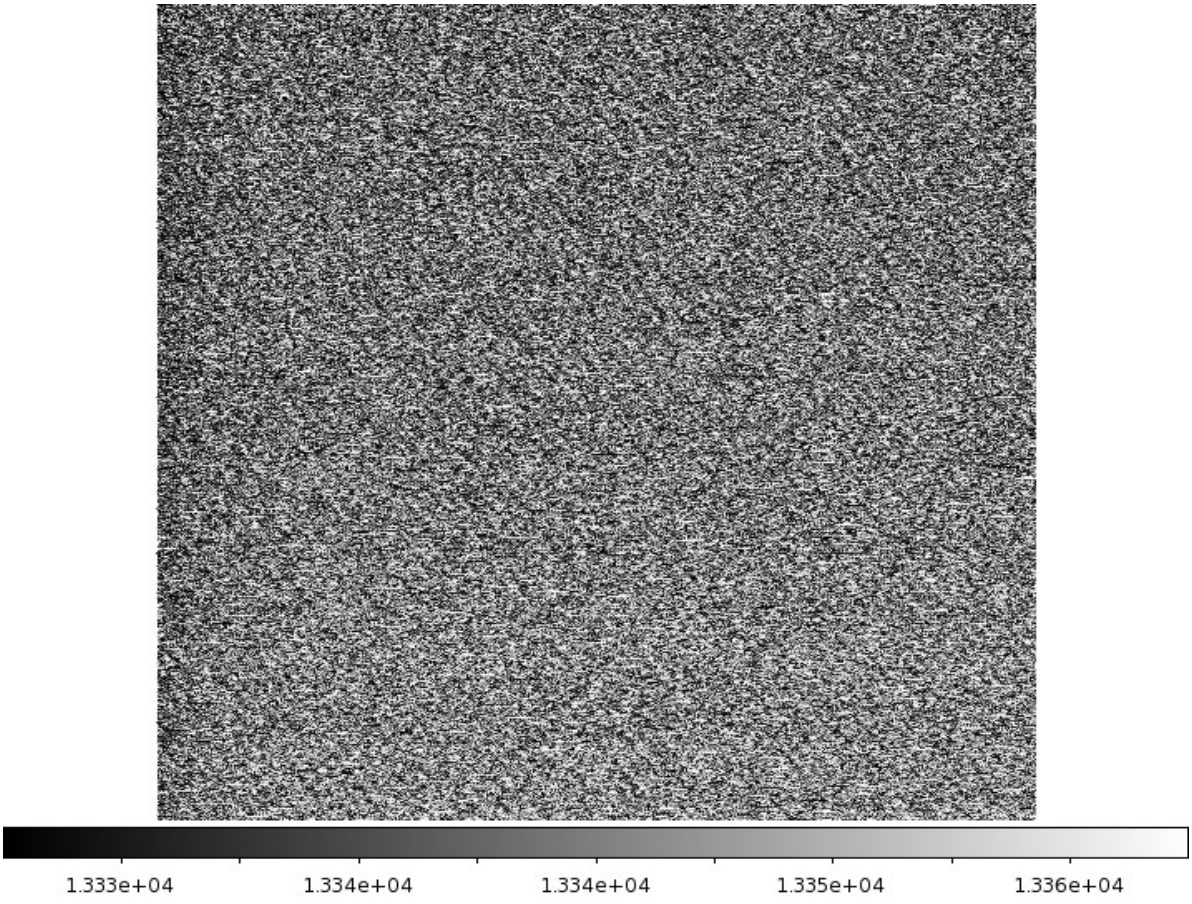
setinstrument / ? / echelle

Praca z danymi:
– jakie dane mamy? Polecenia: ccdlist, imhead

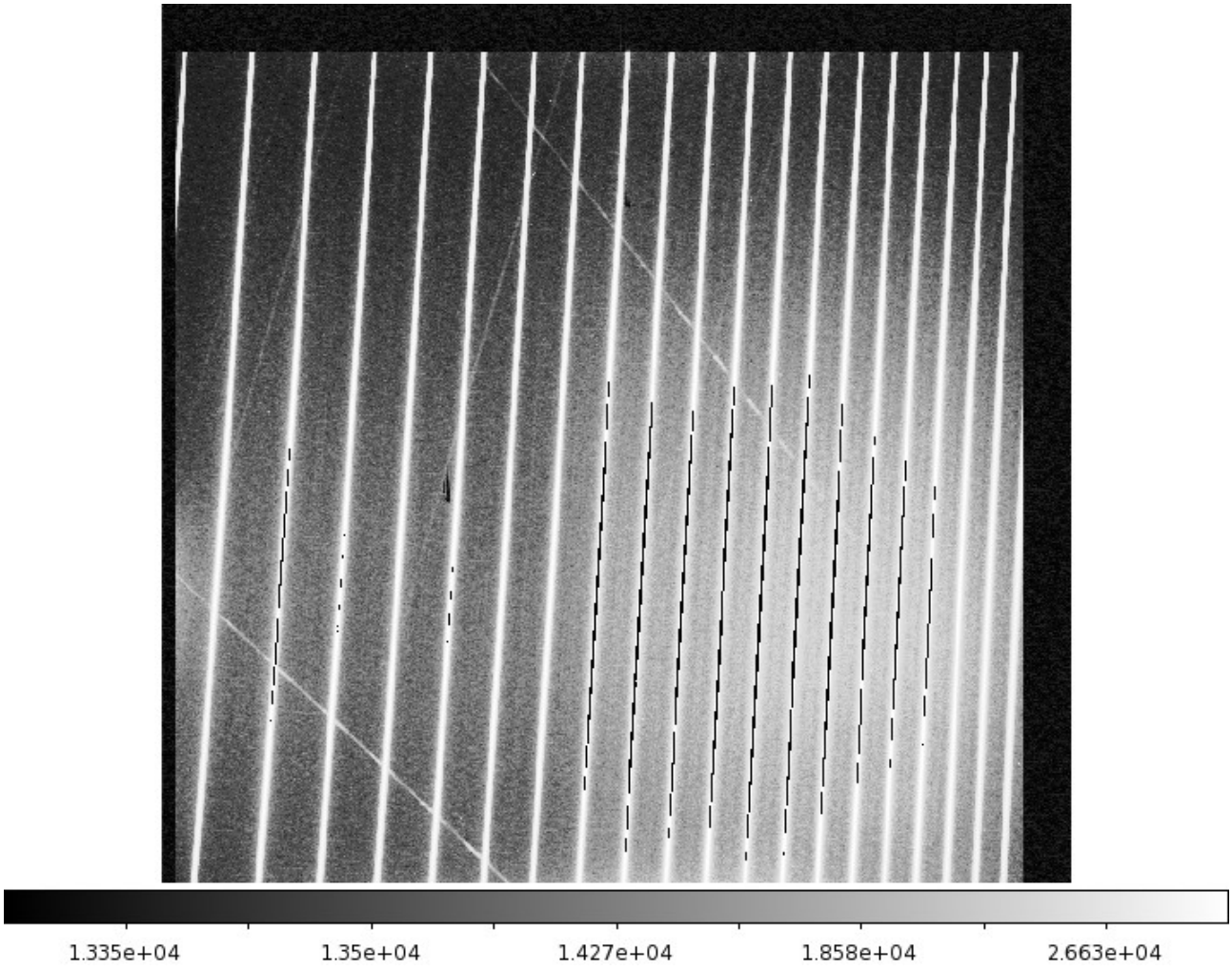
```
ccdred> imhead
OAC_B_20050703_192552.fits[1100,1100][short]: Bias
OAC_B_20050703_192620.fits[1100,1100][short]: Bias
OAC_B_20050703_192647.fits[1100,1100][short]: Bias
OAC_B_20050704_031456.fits[1100,1100][short]: Bias
OAC_B_20050704_031523.fits[1100,1100][short]: Bias
OAC_B_20050704_031551.fits[1100,1100][short]: Bias
OAC_C_20050703_193315.fits[1100,1100][short]: Calibration Lamp
OAC_C_20050703_193512.fits[1100,1100][short]: Calibration Lamp
OAC_C_20050704_030637.fits[1100,1100][short]: Calibration Lamp
OAC_F_20050703_192739.fits[1100,1100][short]: Flat Field
OAC_F_20050703_192917.fits[1100,1100][short]: Flat Field
OAC_F_20050703_193025.fits[1100,1100][short]: Flat Field
OAC_F_20050704_030901.fits[1100,1100][short]: Flat Field
```

```
OAC_F_20050704_031050.fits[1100,1100][short]: Flat Field
OAC_F_20050704_031247.fits[1100,1100][short]: Flat Field
OAC_O_20050703_204218.fits[1100,1100][short]:  Coordinates
OAC_O_20050704_002211.fits[1100,1100][short]: HD157214
OAC_O_20050704_004157.fits[1100,1100][short]: HIP94335

ccdred> ccdlist
CCD images to listed (*fits):
OAC_B_20050703_192552.fits[1100,1100][short][none][]:Bias
OAC_B_20050703_192620.fits[1100,1100][short][none][]:Bias
OAC_B_20050703_192647.fits[1100,1100][short][none][]:Bias
OAC_B_20050704_031456.fits[1100,1100][short][none][]:Bias
OAC_B_20050704_031523.fits[1100,1100][short][none][]:Bias
OAC_B_20050704_031551.fits[1100,1100][short][none][]:Bias
OAC_C_20050703_193315.fits[1100,1100][short][none][]:Calibration Lamp
OAC_C_20050703_193512.fits[1100,1100][short][none][]:Calibration Lamp
OAC_C_20050704_030637.fits[1100,1100][short][none][]:Calibration Lamp
OAC_F_20050703_192739.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050703_192917.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050703_193025.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050704_030901.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050704_031050.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050704_031247.fits[1100,1100][short][none][]:Flat Field
OAC_O_20050703_204218.fits[1100,1100][short][none][]: Coordinates
OAC_O_20050704_002211.fits[1100,1100][short][none][]:HD157214
OAC_O_20050704_004157.fits[1100,1100][short][none][]:HIP94335
```

BIAS – obraz matrycy CCD utworzony przy zerowym czasie ekspozycji; zakłócenia spowodowane odczytem danych z matrycy oraz szum spowodowany przez zakłócenia aparatury pomiarowej; wartość zarejestrowanego sygnału – punkt zerowy (sygnał zawsze dodatni). BIAS – obraz niejednorodności punktu zerowego kamery CCD w poszczególnych pikselach matrycy.



OVERSCAN – poziom zerowy kamery CCD; nienaświetlany obszar obrazu CCD.



Overscan i trim:

- ustalamy na podstawie dowolnego flatu
- wyświetlamy za pomocą ds9 dowolny flat
- overscan, np.: [1045:1095]
- trim, np.: [20:1040,25:1020]
- polecenie ccdproc: poprawiamy na overscan i wycinamy (trim) dane do analizy;

Overscan i trim wszystkich obrazków (biasy, flaty, lampy kalibracyjne, gwiazdy).

Polecenie: ccdproc

```
PACKAGE = ccdred
   TASK = ccdproc

images  =             @do_trim  List of CCD images to correct
(output =             @po_trim) List of output CCD images
(ccdtype=                     ) CCD image type to correct
(max_cac=                    0) Maximum image caching memory (in Mbytes)
(noproc =                   no) List processing steps only?

(fixpix =                   no) Fix bad CCD lines and columns?
```

```
(oversca=                   yes) Apply overscan strip correction?
(trim   =                   yes) Trim the image?
(zerocor=                    no) Apply zero level correction?
(darkcor=                    no) Apply dark count correction?
(flatcor=                    no) Apply flat field correction?
(illumco=                    no) Apply illumination correction?
(fringec=                    no) Apply fringe correction?
(readcor=                    no) Convert zero level image to readout correction?
(scancor=                    no) Convert flat field image to scan correction?

(readaxi=                  line) Read out axis (column|line)
(fixfile=                      ) File describing the bad lines and columns
(biassec=          [1045:1095]) Overscan strip image section
(trimsec=    [20:1040,25:1020]) Trim data section
(zero   =                      ) Zero level calibration image
(dark   =                      ) Dark count calibration image
(flat   =                      ) Flat field images
(illum  =                      ) Illumination correction images
(fringe =                      ) Fringe correction images
(minrepl=                   1.) Minimum flat field value
(scantyp=             shortscan) Scan type (shortscan|longscan)
(nscan  =                    1) Number of short scan lines

(interac=                   yes) Fit overscan interactively?
(functio=             chebyshev) Fitting function
(order  =                    1) Number of polynomial terms or spline pieces
(sample =                    *) Sample points to fit
(naverag=                    1) Number of sample points to combine
(niterat=                    1) Number of rejection iterations
(low_rej=                   3.) Low sigma rejection factor
(high_re=                   3.) High sigma rejection factor
(grow   =                   0.) Rejection growing radius
(mode   =                   ql)


Fit overscan vector for OAC_B_20050703_192552.fits interactively (yes): y
OAC_B_20050703_192552.fits: Apr 15 12:35 Overscan section is [1045:1095,1:1100]
with mean=13342.88
OAC_B_20050703_192620.fits: Apr 15 12:35 Trim data section is [20:1040,25:1020]
Fit overscan vector for OAC_B_20050703_192620.fits interactively (yes):
OAC_B_20050703_192620.fits: Apr 15 12:35 Overscan section is [1045:1095,1:1100]
with mean=13341.61
OAC_B_20050703_192647.fits: Apr 15 12:35 Trim data section is [20:1040,25:1020]
Fit overscan vector for OAC_B_20050703_192647.fits interactively (yes):
OAC_B_20050703_192647.fits: Apr 15 12:35 Overscan section is [1045:1095,1:1100]
with mean=13340.75
OAC_B_20050704_031456.fits: Apr 15 12:35 Trim data section is [20:1040,25:1020]


(...)


imred> ccdlist
CCD images to listed (*fits):
OAC_B_20050703_192552.fits[1100,1100][short][none][]:Bias
OAC_B_20050703_192552ot.fits[1021,996][real][none][][OT]:Bias
OAC_B_20050703_192620.fits[1100,1100][short][none][]:Bias
OAC_B_20050703_192620ot.fits[1021,996][real][none][][OT]:Bias
OAC_B_20050703_192647.fits[1100,1100][short][none][]:Bias
OAC_B_20050703_192647ot.fits[1021,996][real][none][][OT]:Bias
OAC_B_20050704_031456.fits[1100,1100][short][none][]:Bias
OAC_B_20050704_031456ot.fits[1021,996][real][none][][OT]:Bias
OAC_B_20050704_031523.fits[1100,1100][short][none][]:Bias
OAC_B_20050704_031523ot.fits[1021,996][real][none][][OT]:Bias
```

```
OAC_B_20050704_031551.fits[1100,1100][short][none][]:Bias
OAC_B_20050704_031551ot.fits[1021,996][real][none][][OT]:Bias
OAC_C_20050703_193315.fits[1100,1100][short][none][]:Calibration Lamp
OAC_C_20050703_193315ot.fits[1021,996][real][none][][OT]:Calibration Lamp
OAC_C_20050703_193512.fits[1100,1100][short][none][]:Calibration Lamp
OAC_C_20050703_193512ot.fits[1021,996][real][none][][OT]:Calibration Lamp
OAC_C_20050704_030637.fits[1100,1100][short][none][]:Calibration Lamp
OAC_C_20050704_030637ot.fits[1021,996][real][none][][OT]:Calibration Lamp
OAC_F_20050703_192739.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050703_192739ot.fits[1021,996][real][none][][OT]:Flat Field
OAC_F_20050703_192917.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050703_192917ot.fits[1021,996][real][none][][OT]:Flat Field
OAC_F_20050703_193025.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050703_193025ot.fits[1021,996][real][none][][OT]:Flat Field
OAC_F_20050704_030901.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050704_030901ot.fits[1021,996][real][none][][OT]:Flat Field
OAC_F_20050704_031050.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050704_031050ot.fits[1021,996][real][none][][OT]:Flat Field
OAC_F_20050704_031247.fits[1100,1100][short][none][]:Flat Field
OAC_F_20050704_031247ot.fits[1021,996][real][none][][OT]:Flat Field
OAC_O_20050703_204218.fits[1100,1100][short][none][]: Coordinates
OAC_O_20050703_204218ot.fits[1021,996][real][none][][OT]: Coordinates
OAC_O_20050704_002211.fits[1100,1100][short][none][]:HD157214
OAC_O_20050704_002211ot.fits[1021,996][real][none][][OT]:HD157214
OAC_O_20050704_004157.fits[1100,1100][short][none][]:HIP94335
OAC_O_20050704_004157ot.fits[1021,996][real][none][][OT]:HIP94335
```

Sprawdzanie biasów (imstat, imhist, implot, ds9)

np.

```
imred> imstat OAC_B_*
#               IMAGE      NPIX      MEAN    STDDEV       MIN       MAX
 OAC_B_20050703_192552.fits   1210000    13343.     6.307    13165.    15047.
 OAC_B_20050703_192620.fits   1210000    13342.     6.685    12924.    14804.
 OAC_B_20050703_192647.fits   1210000    13341.     6.552    13156.    15925.
 OAC_B_20050704_031456.fits   1210000    13320.     6.132    12946.    14812.
 OAC_B_20050704_031523.fits   1210000    13313.     6.005    13223.    14866.
 OAC_B_20050704_031551.fits   1210000    13313.     6.128    13249.    15437.
```

Tworzenie średniego biasu:

zerocombine:

```
PACKAGE = ccdred
   TASK = zerocombine

input   =               @biasy  List of zero level images to combine
(output =          Master_bias) Output zero level name
(combine=               median) Type of combine operation
(reject =              sigclip) Type of rejection
(ccdtype=                     ) CCD image type to combine
(process=                   no) Process images before combining?
(delete =                   no) Delete input images after combining?
(clobber=                   no) Clobber existing output image?
(scale  =                 none) Image scaling
(statsec=                     ) Image section for computing statistics
(nlow   =                   10) minmax: Number of low pixels to reject
(nhigh  =                   10) minmax: Number of high pixels to reject
(nkeep  =                    1) Minimum to keep (pos) or maximum to reject (neg)
(mclip  =                  yes) Use median in sigma clipping algorithms?
(lsigma =                   3.) Lower sigma clipping factor
(hsigma =                   3.) Upper sigma clipping factor
(rdnoise=                  2.5) ccdclip: CCD readout noise (electrons)
```

```
(gain    =                   12) ccdclip: CCD gain (electrons/DN)
(snoise =                    0.) ccdclip: Sensitivity noise (fraction)
(pclip   =                 -0.5) pclip: Percentile clipping parameter
(blank   =                    0.) Value if there are no pixels
(mode    =                   ql)


Apr 15  1:55: IMCOMBINE
  combine = median, scale = none, zero = none, weight = none
  reject = sigclip, nlow = 0, nhigh = 1
  blank = 0.
                Images
  OAC_B_20050703_192552ot.fits
  OAC_B_20050703_192620ot.fits
  OAC_B_20050703_192647ot.fits
  OAC_B_20050704_031456ot.fits
  OAC_B_20050704_031523ot.fits
  OAC_B_20050704_031551ot.fits

  Output image = Master_bias, ncombine = 6


imred> imstat @biasy
#               IMAGE      NPIX      MEAN    STDDEV       MIN       MAX
 OAC_B_20050703_192552ot.fits   1016916   0.03385     6.223    -29.85     1704.
 OAC_B_20050703_192620ot.fits   1016916   0.07041     6.285    -29.55     1462.
 OAC_B_20050703_192647ot.fits   1016916  0.005394     6.506    -31.75     2584.
 OAC_B_20050704_031456ot.fits   1016916    0.0287     5.565    -28.31     1143.
 OAC_B_20050704_031523ot.fits   1016916   0.04596     5.983    -25.81     1553.
 OAC_B_20050704_031551ot.fits   1016916    0.0573     5.612    -30.93     1096.
imred> imstat Master_bias
#               IMAGE      NPIX      MEAN    STDDEV       MIN       MAX
          Master_bias   1016916    -1.408      2.25    -12.68     76.51
```

Poprawiamy wszystkie pozostałe pliki na Master_bias: ccdproc

```
PACKAGE = ccdred
   TASK = ccdproc

images  =             @do_bias  List of CCD images to correct
(output =             @po_bias) List of output CCD images
(ccdtype=                     ) CCD image type to correct
(max_cac=                    0) Maximum image caching memory (in Mbytes)
(noproc =                   no) List processing steps only?

(fixpix =                   no) Fix bad CCD lines and columns?
(oversca=                   no) Apply overscan strip correction?
(trim   =                   no) Trim the image?
(zerocor=                  yes) Apply zero level correction?
(darkcor=                   no) Apply dark count correction?
(flatcor=                   no) Apply flat field correction?
(illumco=                   no) Apply illumination correction?
(fringec=                   no) Apply fringe correction?
(readcor=                   no) Convert zero level image to readout correction?
(scancor=                   no) Convert flat field image to scan correction?

(readaxi=                 line) Read out axis (column|line)
(fixfile=                     ) File describing the bad lines and columns
(biassec=          [1045:1095]) Overscan strip image section
(trimsec=    [20:1040,25:1020]) Trim data section
(zero   =          Master_bias) Zero level calibration image
```

```
(dark   =                     ) Dark count calibration image
(flat   =                     ) Flat field images
(illum  =                     ) Illumination correction images
(fringe =                     ) Fringe correction images
(minrepl=                   1.) Minimum flat field value
(scantyp=             shortscan) Scan type (shortscan|longscan)
(nscan  =                     1) Number of short scan lines

(interac=                   yes) Fit overscan interactively?
(functio=             chebyshev) Fitting function
(order  =                     1) Number of polynomial terms or spline pieces
(sample =                     *) Sample points to fit
(naverag=                     1) Number of sample points to combine
(niterat=                     1) Number of rejection iterations
(low_rej=                   3.) Low sigma rejection factor
(high_re=                   3.) High sigma rejection factor
(grow   =                   0.) Rejection growing radius
(mode   =                   ql)


OAC_C_20050703_193315ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_C_20050703_193512ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_C_20050704_030637ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_F_20050703_192739ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_F_20050703_192917ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_F_20050703_193025ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_F_20050704_030901ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_F_20050704_031050ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_F_20050704_031247ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_O_20050703_204218ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_O_20050704_002211ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
OAC_O_20050704_004157ot.fits: Apr 15  1:59 Zero level correction image is
Master_bias
```

Sprawdzanie flatów: imstat, ds9 (lub skycat), wyrzucamy flaty prześwietlone

```
ccdred> imstat OAC_F*b.fits
#               IMAGE      NPIX      MEAN    STDDEV       MIN       MAX
 OAC_F_20050703_192739otb.fits   1016916     355.9     5480.   -46109.    19432.
 OAC_F_20050703_192917otb.fits   1016916     351.4     5500.   -46110.    19428.
 OAC_F_20050703_193025otb.fits   1016916     348.5     5511.   -46110.    19431.
 OAC_F_20050704_031050otb.fits   1016916     381.9     5584.   -46087.    19447.
 OAC_F_20050704_031247otb.fits   1016916     384.4     5574.   -46085.    19449.
```

Tworzymy średni flat: Master_flat

```
flatcombine

PACKAGE = ccdred
   TASK = flatcombine
```

```
input   =                @flaty  List of flat field images to combine
(output =          Master_flat) Output flat field root name
(combine=              average) Type of combine operation
(reject =              sigclip) Type of rejection
(ccdtype=                     ) CCD image type to combine
(process=                   no) Process images before combining?
(subsets=                   no) Combine images by subset parameter?
(delete =                   no) Delete input images after combining?
(clobber=                   no) Clobber existing output image?
(scale  =                 none) Image scaling
(statsec=                     ) Image section for computing statistics
(nlow   =                    1) minmax: Number of low pixels to reject
(nhigh  =                    1) minmax: Number of high pixels to reject
(nkeep  =                    1) Minimum to keep (pos) or maximum to reject (neg)
(mclip  =                  yes) Use median in sigma clipping algorithms?
(lsigma =                  10.) Lower sigma clipping factor
(hsigma =                  10.) Upper sigma clipping factor
(rdnoise=                   12) ccdclip: CCD readout noise (electrons)
(gain   =                  2.5) ccdclip: CCD gain (electrons/DN)
(snoise =                   0.) ccdclip: Sensitivity noise (fraction)
(pclip  =                 -0.5) pclip: Percentile clipping parameter
(blank  =                   1.) Value if there are no pixels
(mode   =                   ql)

Apr 15  3:17: IMCOMBINE
  combine = average, scale = none, zero = none, weight = none
  reject = crreject, mclip = yes, nkeep = 1
  rdnoise = 12, gain = 2.5, snoise = 0., hsigma = 7.
  blank = 1.
                Images     Exp
  OAC_F_20050703_192739otb.fits   40.0
  OAC_F_20050703_192917otb.fits   40.0
  OAC_F_20050703_193025otb.fits   40.0
  OAC_F_20050704_031050otb.fits   90.0
  OAC_F_20050704_031247otb.fits   90.0

  Output image = Master_flat, ncombine = 5
```

Modelowanie apertur
Budujemy bazę apertur na podstawie widma jednej z gwiazd
(pamiętamy o zdefiniowaniu tła dla każdej apertury!!!)

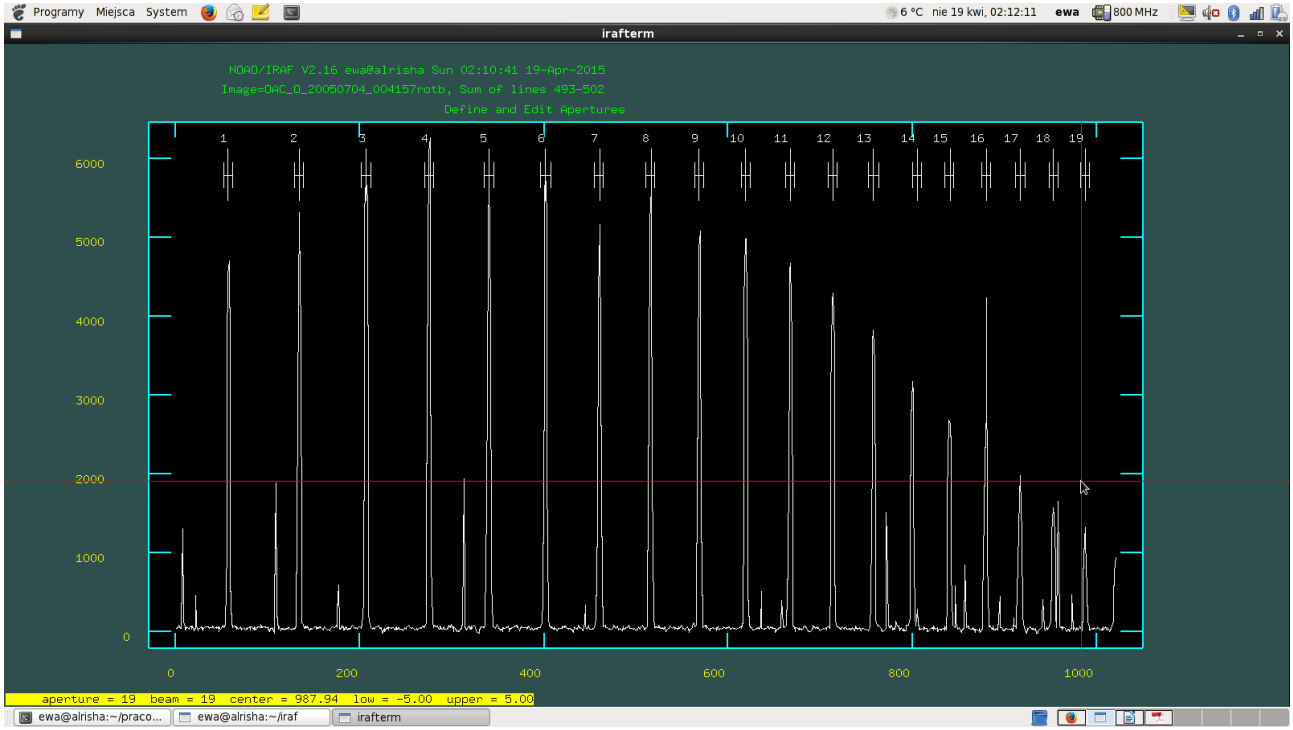
```
PACKAGE = apextract
   TASK = apall

input   = OAC_O_20050704_004157otb.fits  List of input images
(output =                     ) List of output spectra
(apertur=                     ) Apertures
(format =              echelle) Extracted spectra format
(referen=                     ) List of aperture reference images
(profile=                     ) List of aperture profile images

(interac=                   yes) Run task interactively?
(find   =                   yes) Find apertures?
(recente=                   yes) Recenter apertures?
(resize =                   yes) Resize apertures?
(edit   =                   yes) Edit apertures?
(trace  =                   yes) Trace apertures?
(fittrac=                   yes) Fit the traced points interactively?
```

```
(extract=                    no) Extract spectra?
(extras =                    no) Extract sky, sigma, etc.?
(review =                    no) Review extractions?

(line   =                INDEF) Dispersion line
(nsum   =                   10) Number of dispersion lines to sum or median

                                # DEFAULT APERTURE PARAMETERS

(lower  =                  -5.) Lower aperture limit relative to center
(upper  =                   5.) Upper aperture limit relative to center
(apidtab=                     ) Aperture ID table (optional)

                                # DEFAULT BACKGROUND PARAMETERS

(b_funct=             chebyshev) Background function
(b_order=                    1) Background function order
(b_sampl=          -10:-6,6:10) Background sample regions
(b_naver=                   -3) Background average or median
(b_niter=                    0) Background rejection iterations
(b_low_r=                   3.) Background lower rejection sigma
(b_high_=                   3.) Background upper rejection sigma
(b_grow =                   0.) Background rejection growing radius

                                # APERTURE CENTERING PARAMETERS

(width  =                   5.) Profile centering width
(radius =                  10.) Profile centering radius
(thresho=                   0.) Detection threshold for profile centering

                                # AUTOMATIC FINDING AND ORDERING PARAMETERS

nfind   =                   19  Number of apertures to be found automatically
(minsep =                   5.) Minimum separation between spectra
(maxsep =                1000.) Maximum separation between spectra
(order  =            increasing) Order of apertures

(...)

:go
```

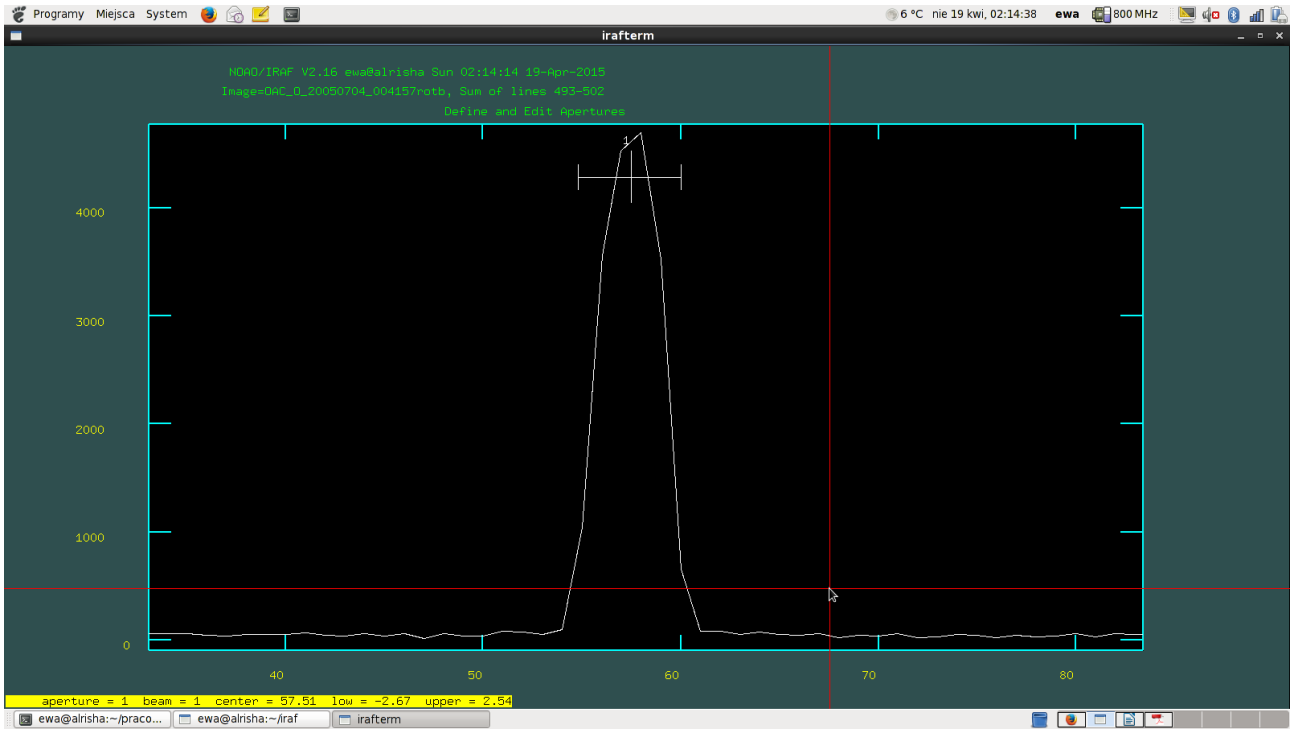
d – kasowanie automatycznie dopasowanych apertur (jeśli są złe)
m – definiowanie nowych apertur
c – center (wyśrodkowujemy na danej aperturze)
u, l – poprawiamy apertury
q – jeśli skończymy

w dalszej kolejności poprawiamy dopasowanie poprzez zmianę funkcji i/lub rzędu.

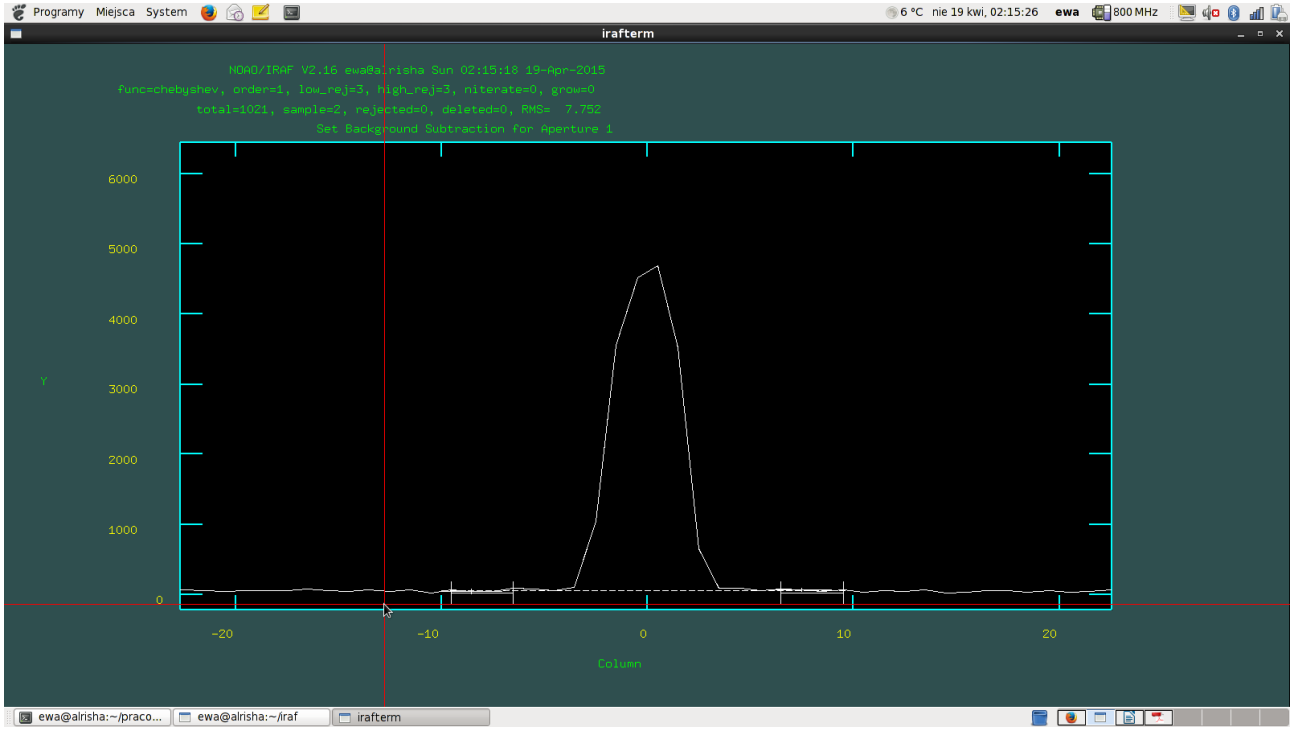
1. Dopasowanie apertur:



2. Zmiana szerokości apertur



3. Dopasowanie tła



Dopasowujemy apertury dla Master_flata:
(sprawdzamy każdą aperturę, poprawiamy jeśli to konieczne)

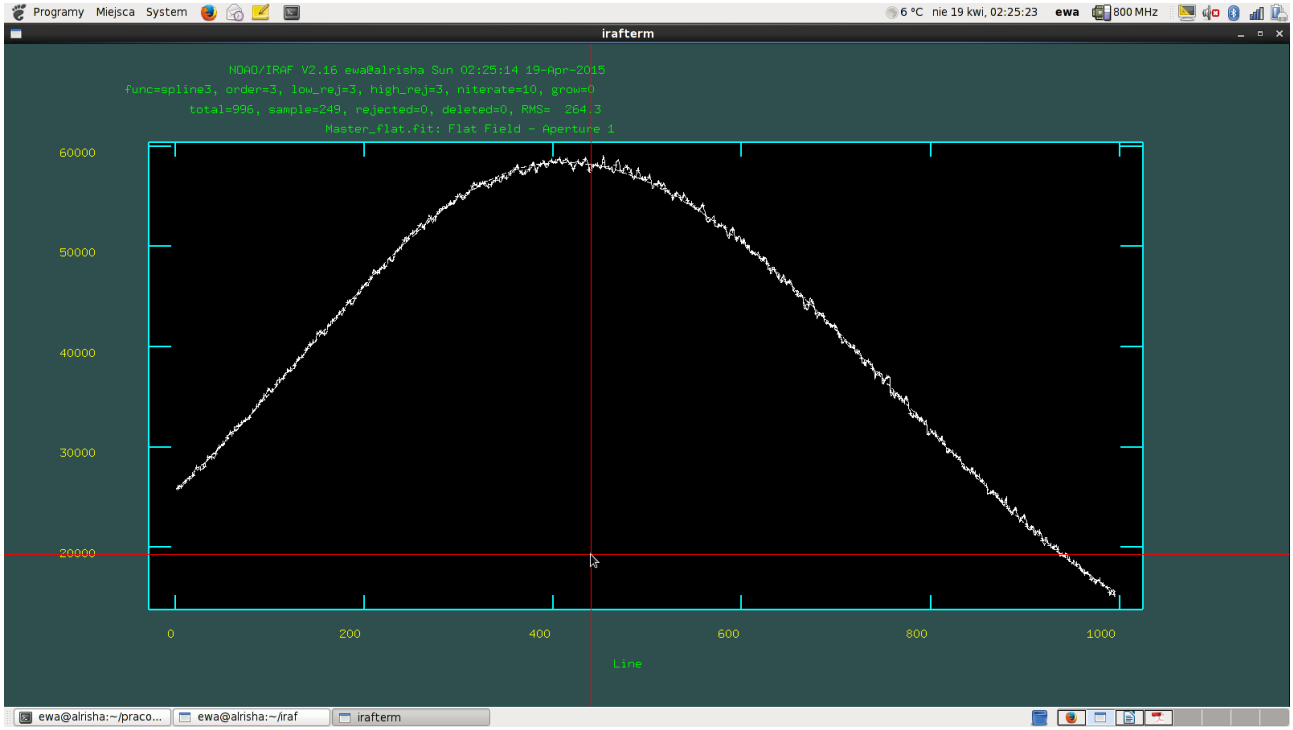
```
PACKAGE = echelle
   TASK = apall

input   =           Master_flat  List of input images
(output =                      ) List of output spectra
(apertur=                      ) Apertures
(format =                echelle) Extracted spectra format
(referen= OAC_O_20050703_204218otb.fits) List of aperture reference images
(profile=                      ) List of aperture profile images

(interac=                    yes) Run task interactively?
(find   =                     no) Find apertures?
(recente=                     no) Recenter apertures?
(resize =                    yes) Resize apertures?
(edit   =                    yes) Edit apertures?
(trace  =                     no) Trace apertures?
(fittrac=                     no) Fit the traced points interactively?
(extract=                     no) Extract spectra?
(extras =                     no) Extract sky, sigma, etc.?
(review =                     no) Review extractions?

(line   =                    900) Dispersion line
(nsum   =                     10) Number of dispersion lines to sum or median

                                  # DEFAULT APERTURE PARAMETERS

(lower  =                   -5.) Lower aperture limit relative to center
(upper  =                    5.) Upper aperture limit relative to center
(apidtab=                      ) Aperture ID table (optional)
```

```
                                # DEFAULT BACKGROUND PARAMETERS

(b_funct=             chebyshev) Background function
(b_order=                     1) Background function order
(b_sampl=           -10:-6,6:10) Background sample regions
(b_naver=                    -3) Background average or median
(b_niter=                     0) Background rejection iterations
(b_low_r=                    3.) Background lower rejection sigma
(b_high_=                    3.) Background upper rejection sigma
(b_grow =                    0.) Background rejection growing radius

(...)
```

Normowanie Master_flata
(trudne; jeśli flat jest źle unormowany – widma są zepsute)

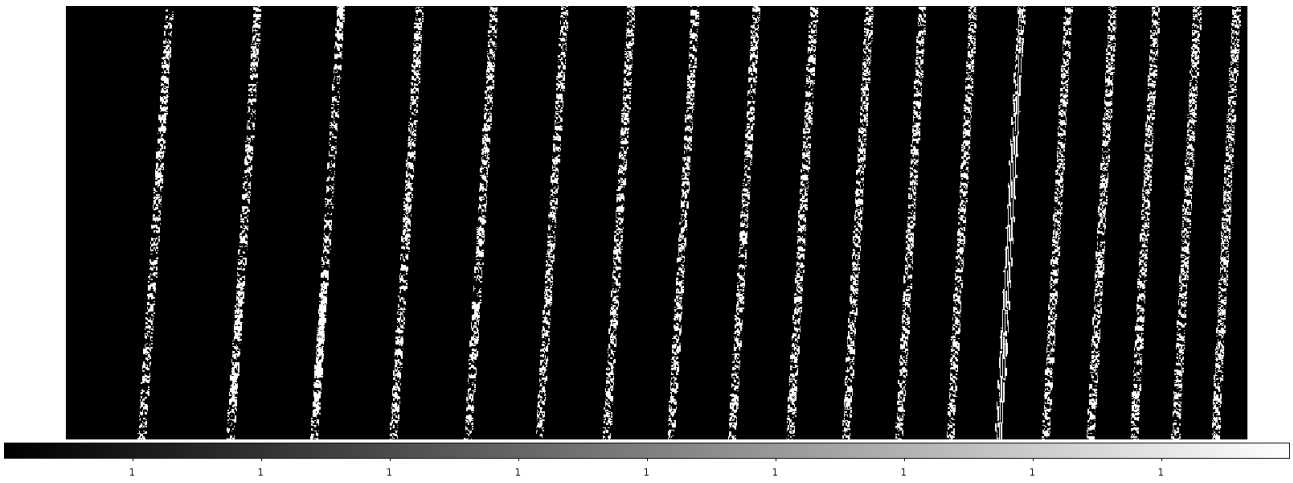
Polecenie: apflatten

```
PACKAGE = echelle
   TASK = apflatten

input   =           Master_flat  List of images to flatten
output  =          Master_flatn  List of output flatten images
(apertur=                      ) Apertures
(referen=                      ) List of reference images

(interac=                   yes) Run task interactively?
(find   =                    no) Find apertures?
(recente=                    no) Recenter apertures?
(resize =                    no) Resize apertures?
(edit   =                    no) Edit apertures?
(trace  =                    no) Trace apertures?
(fittrac=                    no) Fit traced points interactively?
(flatten=                   yes) Flatten spectra?
(fitspec=                   yes) Fit normalization spectra interactively?

(line   =                 INDEF) Dispersion line
(nsum   =                    10) Number of dispersion lines to sum or median
(thresho=                   10.) Threshold for flattening spectra

(pfit   =                 fit1d) Profile fitting type (fit1d|fit2d)
(clean  =                    no) Detect and replace bad pixels?
(saturat=                 INDEF) Saturation level
(readnoi=                    0.) Read out noise sigma (photons)
(gain   =                    1.) Photon gain (photons/data number)
(lsigma =                    4.) Lower rejection threshold
(usigma =                    4.) Upper rejection threshold

(functio=               spline3) Fitting function for normalization spectra
(order  =                     3) Fitting function order
(sample =                     *) Sample regions
(naverag=                     4) Average or median
(niterat=                    10) Number of rejection iterations
(low_rej=                    3.) Lower rejection sigma
(high_re=                    3.) High upper rejection sigma
(grow   =                    0.) Rejection growing radius
(mode   =                    ql)
```



Sprawdzamy unormowany flatfield

ds9



Poprawiamy pozostałe obrazki na średni i unormowany flatfield
Polecenie: ccdproc
Polecenie: imarith (zasada działania: imarith widmo / Master_flatn widmof)

ccdproc: jak zwykle

@do_flat:
OAC_C_20050703_193315otb.fits
OAC_C_20050703_193512otb.fits
OAC_C_20050704_030637otb.fits
OAC_O_20050703_204218otb.fits

```
OAC_O_20050704_002211otb.fits
OAC_O_20050704_004157otb.fits

@po_flat
OAC_C_20050703_193315otbf.fits
OAC_C_20050703_193512otbf.fits
OAC_C_20050704_030637otbf.fits
OAC_O_20050703_204218otbf.fits
OAC_O_20050704_002211otbf.fits
OAC_O_20050704_004157otbf.fits
```

Część 2:

Proszę postępować zgodnie z instrukcjami, w razie potrzeby skorzystać z ogólnie dostępnych podręczników do redukcji widm echelle. Proszę zapisywać kolejne etapy swojej pracy (polecenia i rysunki).

Poprawiamy widma gwiazd i lamp kalibracyjnych na światło rozproszone

(UWAGA: proszę poprawić pozostałe widma gwiazd i widma lampa kalibracyjnych; pamiętamy, że dla każdego obrazka sprawdzamy dopasowanie do linii i kolumn na początku, w środku i na końcu obrazka);

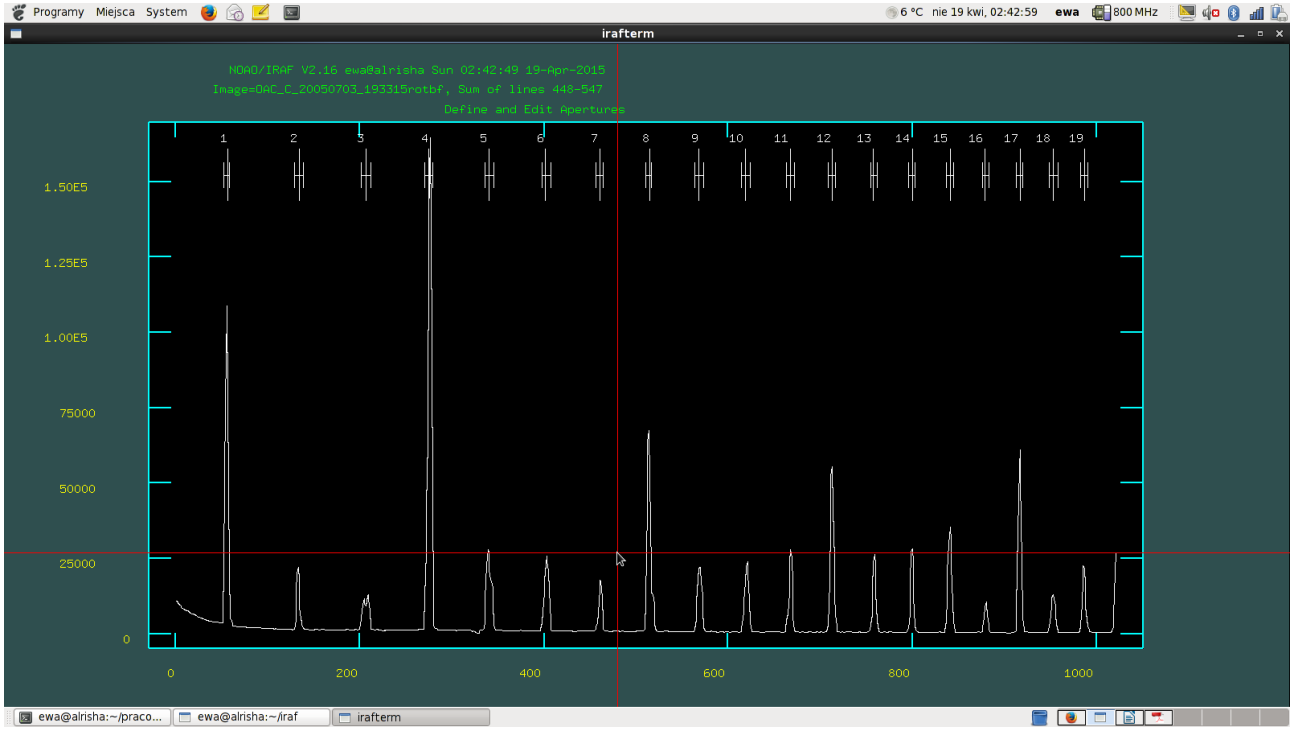
```
ccdred> ccdlist *bf*.fits
OAC_C_20050703_193315otbf.fits[1021,996][real][none][][OTZF]:Calibration Lamp
OAC_C_20050703_193512otbf.fits[1021,996][real][none][][OTZF]:Calibration Lamp
OAC_C_20050704_030637otbf.fits[1021,996][real][none][][OTZF]:Calibration Lamp
OAC_O_20050703_204218otbf.fits[1021,996][real][none][][OTZF]: Coordinates
OAC_O_20050704_002211otbf.fits[1021,996][real][none][][OTZF]:HD157214
OAC_O_20050704_004157otbf.fits[1021,996][real][none][][OTZF]:HIP94335
```

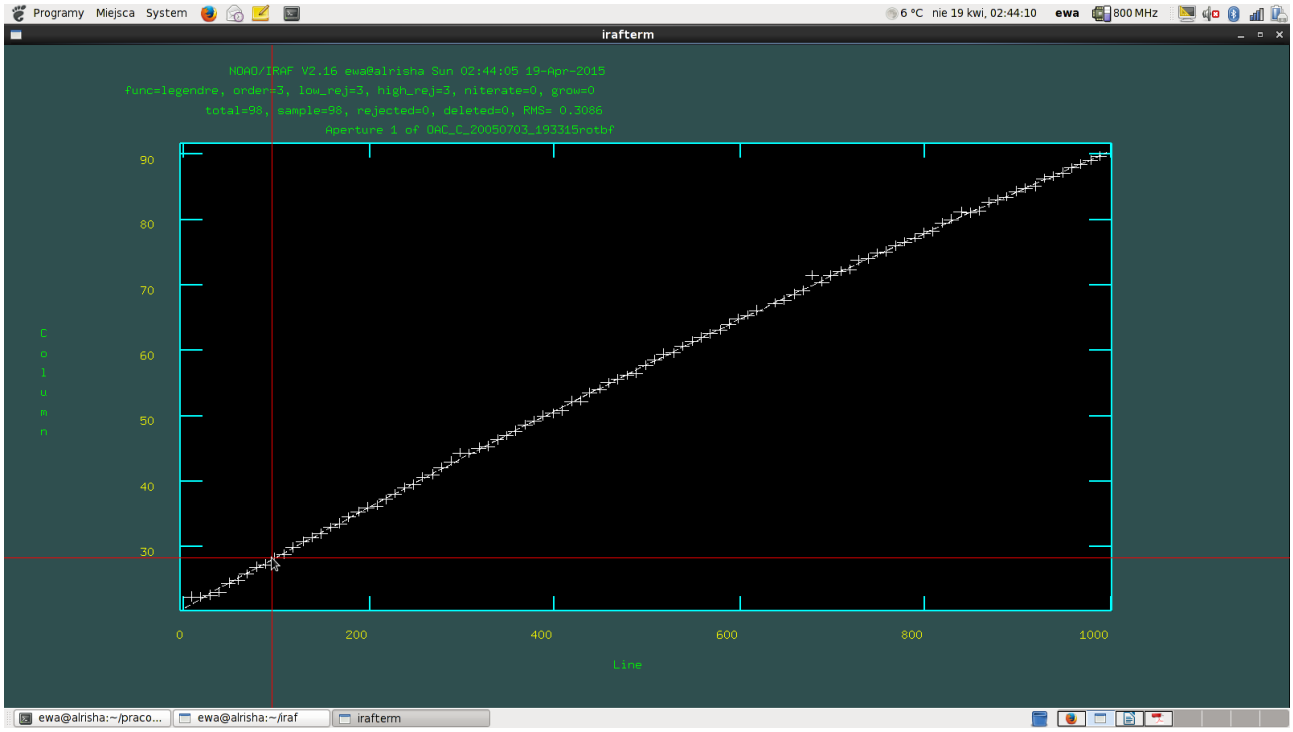
Polecenie: apscatter

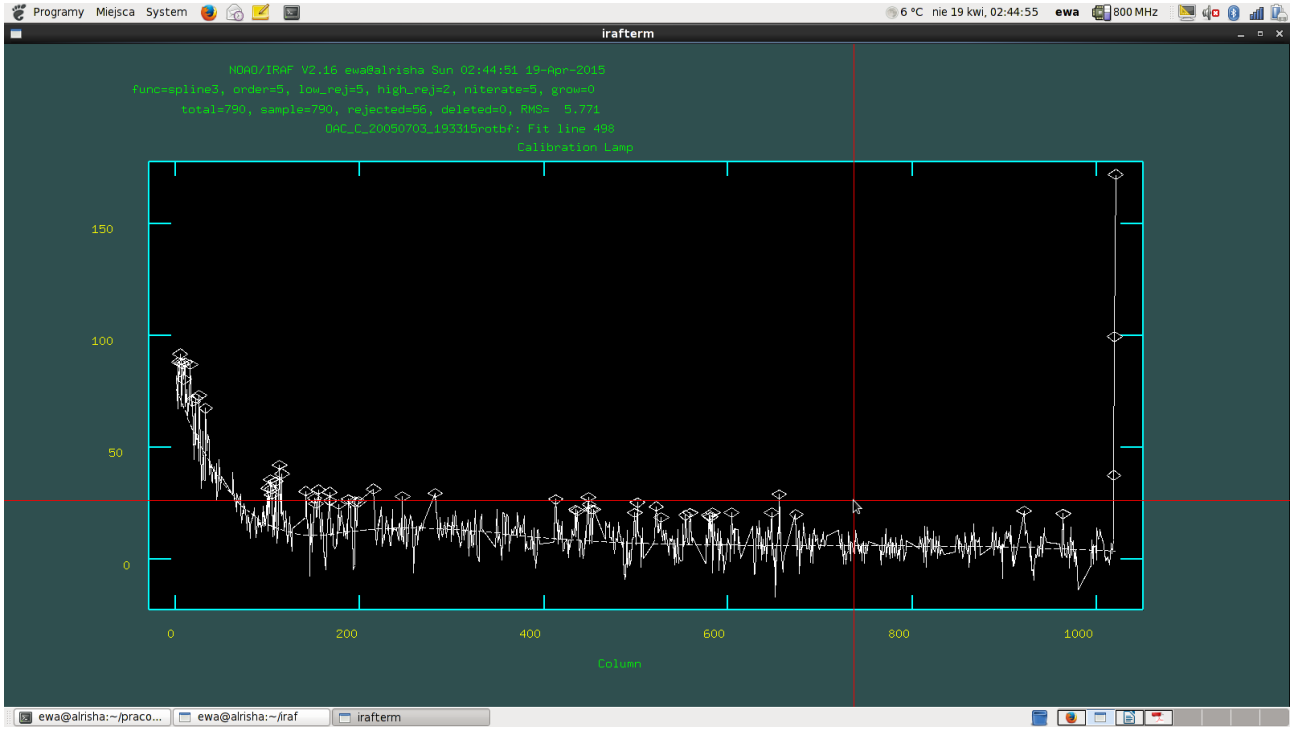
```
PACKAGE = echelle
   TASK = apscatter

input   = OAC_C_20050703_193315otbf.fits  List of input images to subtract
scattered light
output  = OAC_C_20050703_193315otbfs  List of output corrected images
(apertur=                       ) Apertures
(scatter=                       ) List of scattered light images (optional)
(referen= OAC_O_20050703_204218otb) List of aperture reference images

(interac=                    yes) Run task interactively?
(find   =                    yes) Find apertures?
(recente=                    yes) Recenter apertures?
(resize =                    yes) Resize apertures?
(edit   =                    yes) Edit apertures?
(trace  =                    yes) Trace apertures?
(fittrac=                    yes) Fit the traced points interactively?
(subtrac=                    yes) Subtract scattered light?
(smooth =                    yes) Smooth scattered light along the dispersion?
(fitscat=                    yes) Fit scattered light interactively?
(fitsmoo=                    yes) Smooth the scattered light interactively?

(line   =                 INDEF) Dispersion line
(nsum   =                   100) Number of dispersion lines to sum or median
```

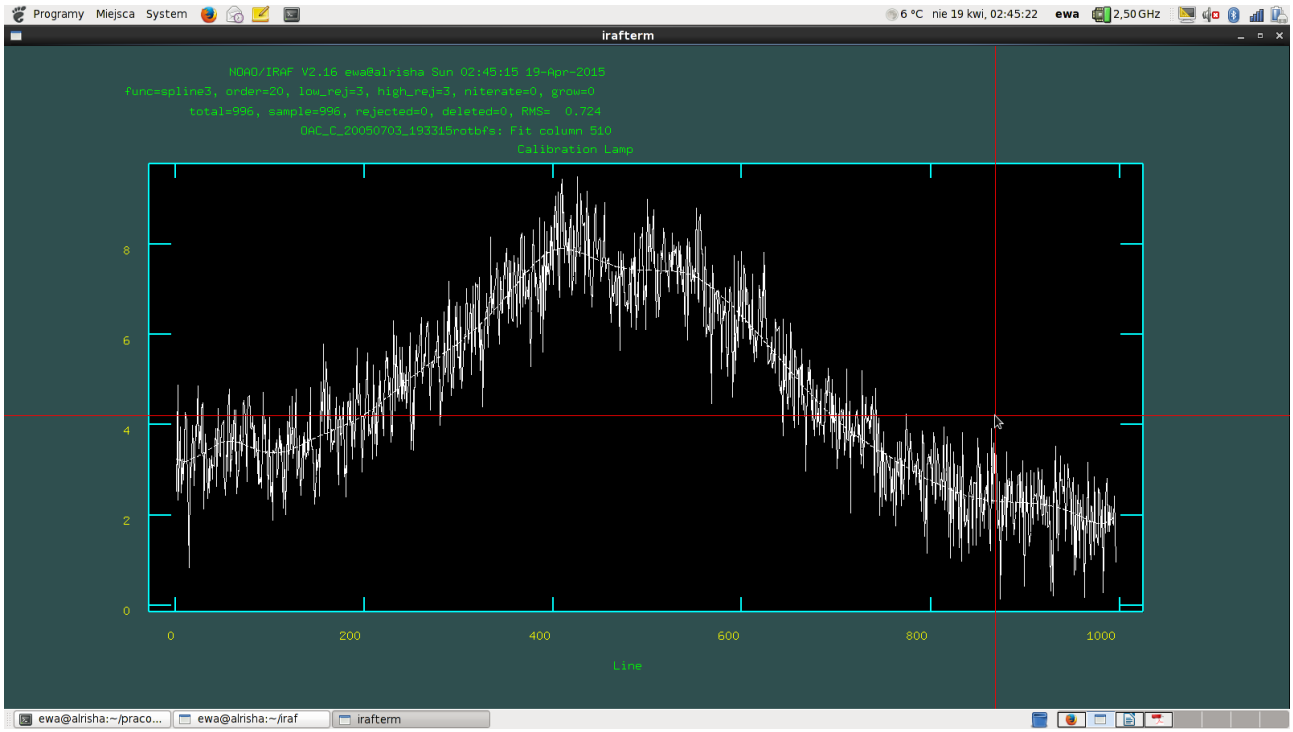
```
(buffer =                    1.) Buffer distance from apertures
(apscat1=                      ) Fitting parameters across the dispersion
(apscat2=                      ) Fitting parameters along the dispersion
(mode   =                    ql)
```

Kolejne kroki apscatter:









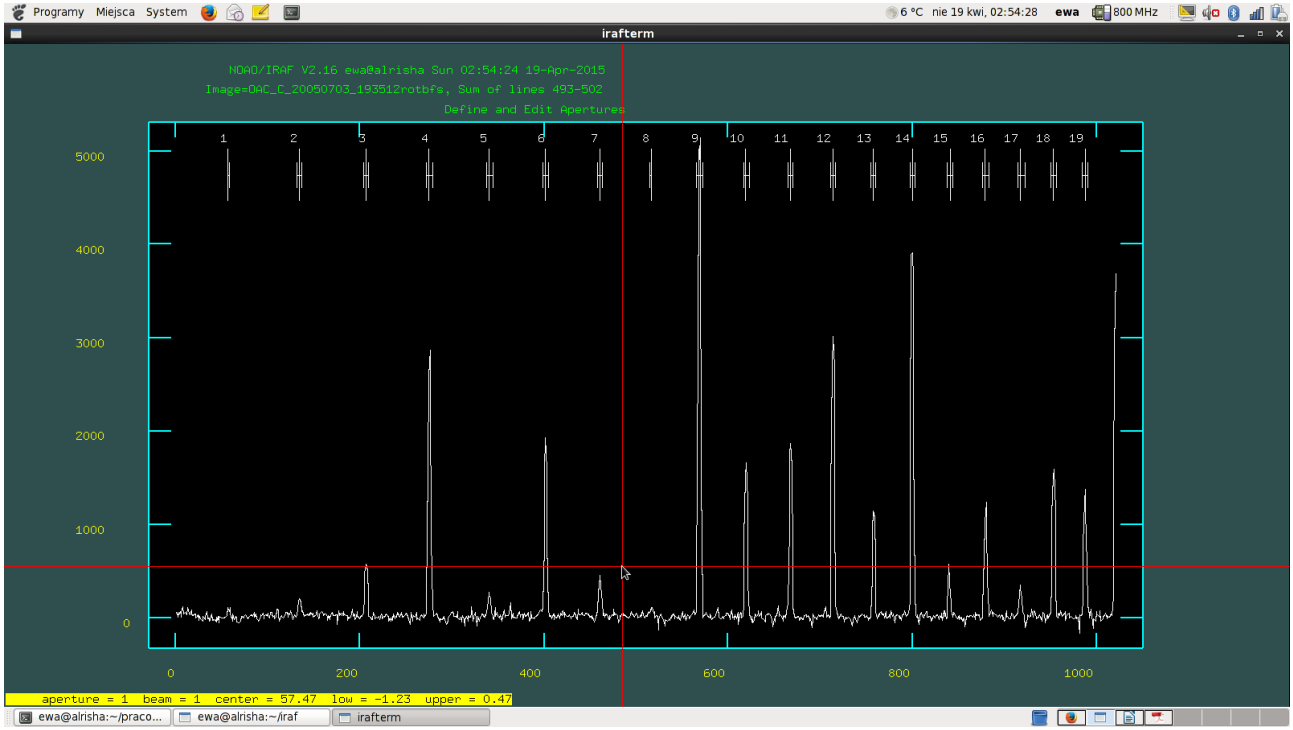

```
ccdred> ccdlist *bfs.fit
OAC_C_20050703_193315otbfs.fit[1021,996][real][none][][OTZF]:Calibration Lamp
OAC_C_20050703_193512otbfs.fit[1021,996][real][none][][OTZF]:Calibration Lamp
OAC_C_20050704_030637otbfs.fit[1021,996][real][none][][OTZF]:Calibration Lamp
OAC_O_20050703_204218otbfs.fit[1021,996][real][none][][OTZF]: Coordinates
OAC_O_20050704_002211otbfs.fit[1021,996][real][none][][OTZF]:HD157214
OAC_O_20050704_004157otbfs.fit[1021,996][real][none][][OTZF]:HIP94335
```

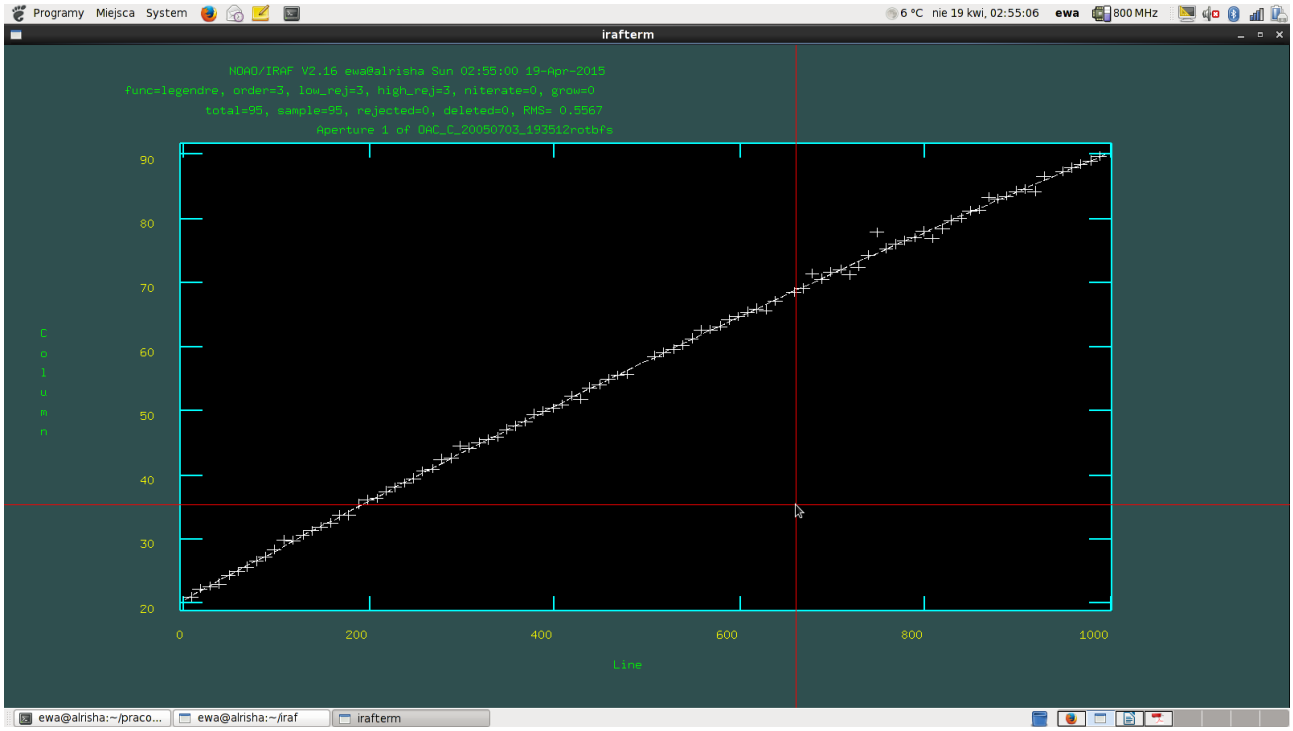
Ekstrakcja widm gwiazd i widm lamp kalibracyjnych

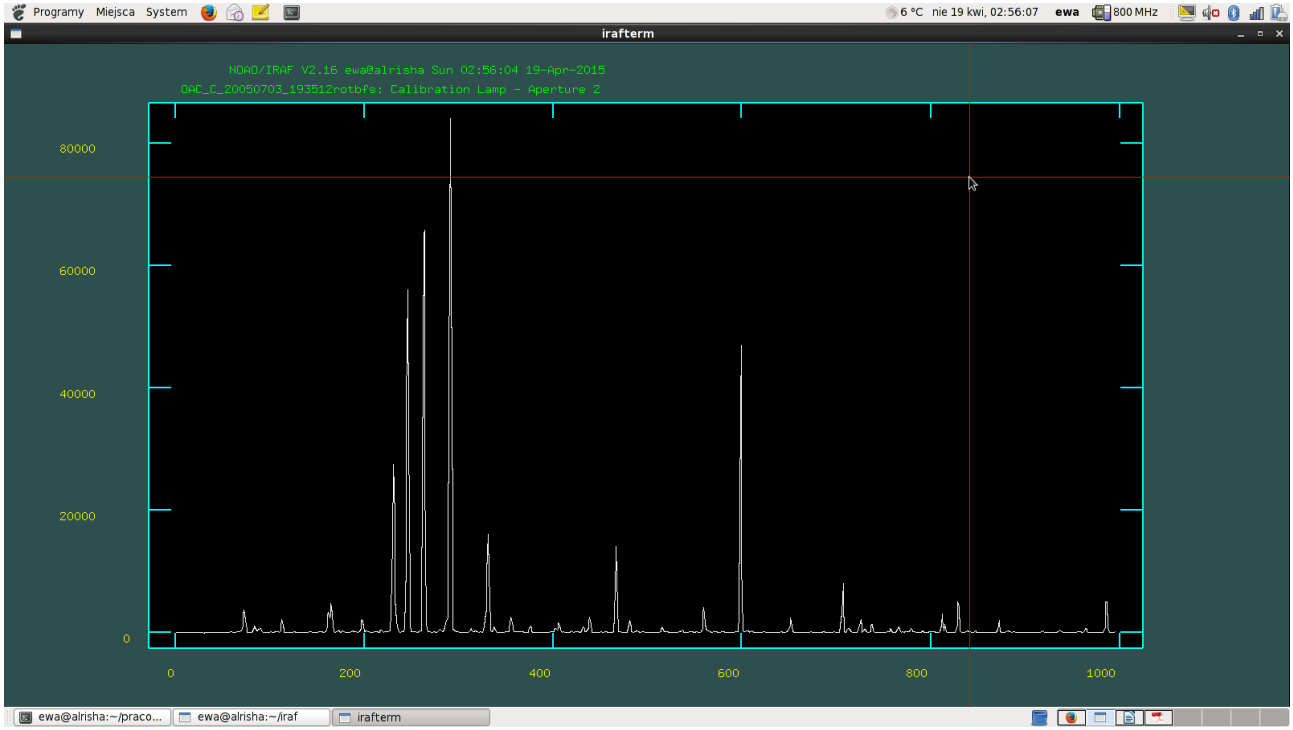
Polecenie: apall

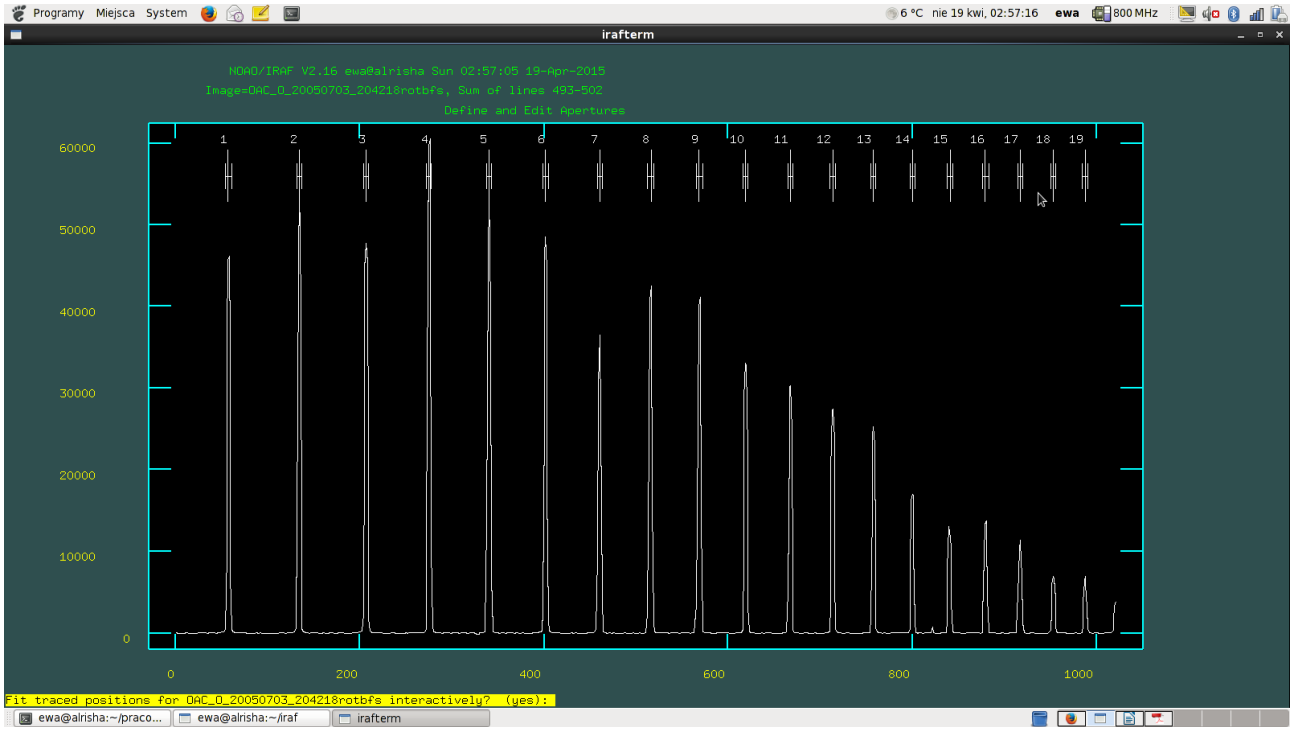
```
OAC_C_20050703_193315otbfs.fit  OAC_O_20050703_204218otbfs.fit
OAC_C_20050703_193512otbfs.fit  OAC_O_20050704_002211otbfs.fit
OAC_C_20050704_030637otbfs.fit  OAC_O_20050704_004157otbfs.fit


PACKAGE = echelle
   TASK = apall

input   = OAC_O_20050703_204218otbfs.fit  List of input images
(output =                       ) List of output spectra
(apertur=                       ) Apertures
(format =                echelle) Extracted spectra format
(referen= OAC_O_20050703_204218otb.fits) List of aperture reference images
(profile=                       ) List of aperture profile images

(interac=                     yes) Run task interactively?
(find   =                      no) Find apertures?
(recente=                      no) Recenter apertures?
(resize =                     yes) Resize apertures?
(edit   =                     yes) Edit apertures?
(trace  =                     yes) Trace apertures?
(fittrac=                     yes) Fit the traced points interactively?
(extract=                     yes) Extract spectra?
(extras =                      no) Extract sky, sigma, etc.?
(review =                     yes) Review extractions?

(line   =                     900) Dispersion line
(nsum   =                      10) Number of dispersion lines to sum or median

                                   # DEFAULT APERTURE PARAMETERS

(lower  =                    -5.) Lower aperture limit relative to center
(upper  =                     5.) Upper aperture limit relative to center
(apidtab=                       ) Aperture ID table (optional)

                                   # DEFAULT BACKGROUND PARAMETERS

(b_funct=              chebyshev) Background function
(b_order=                      1) Background function order
(b_sampl=           -10:-6,6:10) Background sample regions
(b_naver=                     -3) Background average or median
(b_niter=                      0) Background rejection iterations
(b_low_r=                     3.) Background lower rejection sigma
(b_high_=                     3.) Background upper rejection sigma
(b_grow =                     0.) Background rejection growing radius

(...)
```

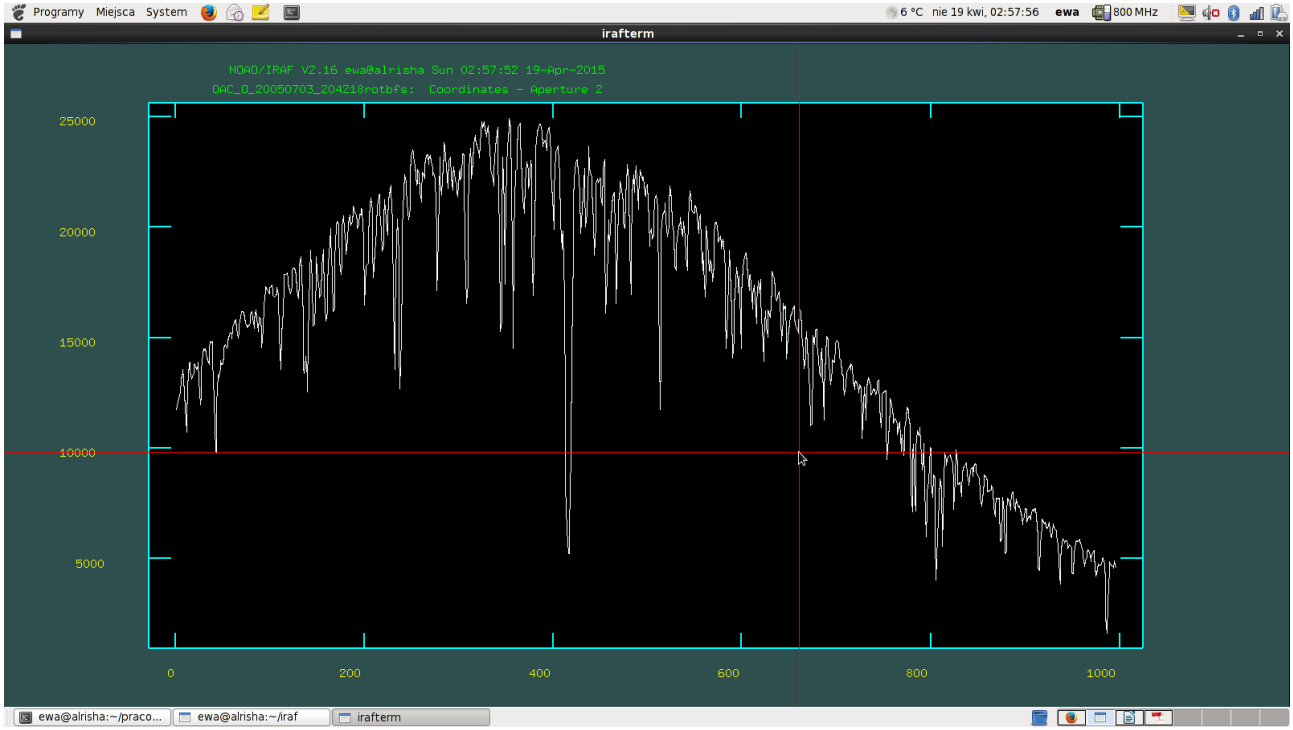
Kolejne kroki:

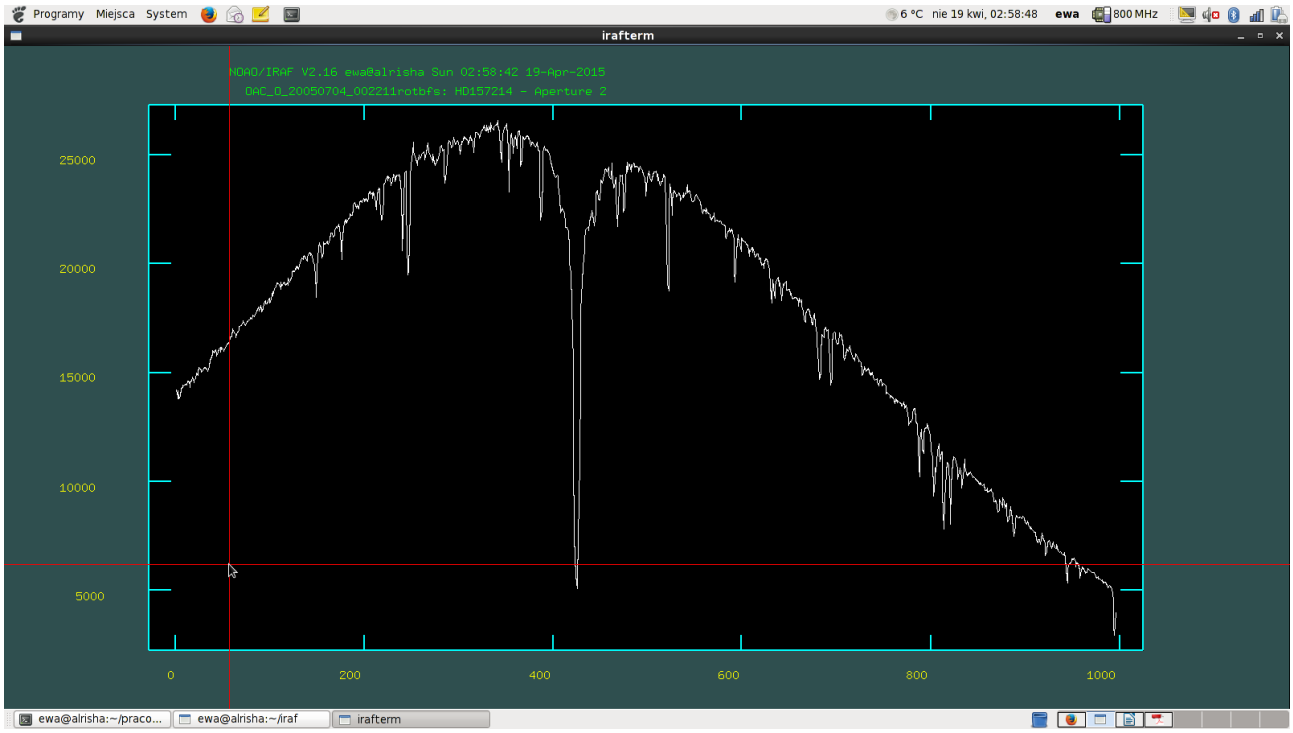

Programy Miejsca System
6 °C nie 19 kwi, 02:54:28 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 02:54:24 19-Apr-2015
Image=DAC_C_20050703_193512rotbfs, Sum of lines 493-502
Define and Edit Apertures
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
5000
4000
3000
2000
1000
0
0 200 400 600 800 1000
aperture = 1 beam = 1 center = 57.47 low = -1.23 upper = 0.47
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm

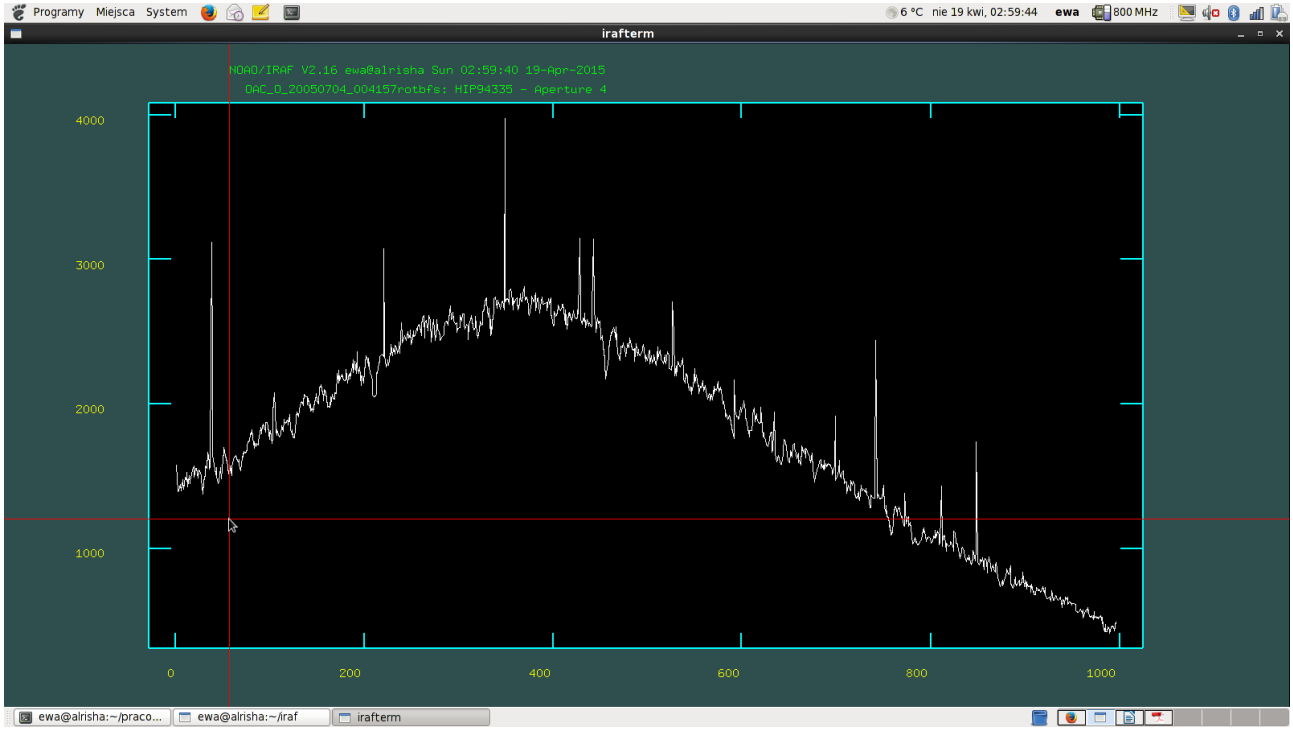

Programy Miejsca System
6 °C nie 19 kwi, 02:55:06 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 02:55:00 19-Apr-2015
func=legendre, order=3, low_rej=3, high_rej=3, niterate=0, grow=0
total=95, sample=95, rejected=0, deleted=0, RMS= 0.5567
Aperture 1 of DAC_C_20050703_193512rotbfs
90
80
70
60
50
40
30
20
Column
0 200 400 600 800 1000
Line
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm


Programy Miejsca System
6 °C nie 19 kwi, 02:56:07 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 02:56:04 19-Apr-2015
OAC_C_20050703_193512rotbfs: Calibration Lamp - Aperture 2
80000
60000
40000
20000
0
0
200
400
600
800
1000
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm


Programy Miejsca System
6 °C nie 19 kwi, 02:57:16 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 02:57:05 19-Apr-2015
Image=OAC_O_20050703_204218rotbfs, Sum of lines 493-502
Define and Edit Apertures
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
60000
50000
40000
30000
20000
10000
0
0
200
400
600
800
1000
Fit traced positions for OAC_O_20050703_204218rotbfs interactively? (yes):
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm


Programy Miejsca System
6 °C nie 19 kwi, 02:57:56 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 02:57:52 19-Apr-2015
DAC_O_20050703_204218rotbfs: Coordinates - Aperture 2
25000
20000
15000
10000
5000
0
200
400
600
800
1000
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm


Programy Miejsca System
6 °C nie 19 kwi, 02:58:48 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 02:58:42 19-Apr-2015
DAC_O_20050704_002211rotbfs: HD157214 - Aperture 2
25000
20000
15000
10000
5000
0
200
400
600
800
1000
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm




```
ccdred> ccdlist *ec*
OAC_C_20050703_193315otbfs.ec.fit[996,19][real][none][][OTZF]:Calibration Lamp
OAC_C_20050703_193512otbfs.ec.fit[996,19][real][none][][OTZF]:Calibration Lamp
OAC_C_20050704_030637otbfs.ec.fit[996,19][real][none][][OTZF]:Calibration Lamp
OAC_O_20050703_204218otbfs.ec.fit[996,19][real][none][][OTZF]: Coordinates
OAC_O_20050704_002211otbfs.ec.fit[996,19][real][none][][OTZF]:HD157214
OAC_O_20050704_004157otbfs.ec.fit[996,19][real][none][][OTZF]:HIP94335
```

Kalibracja długości fali

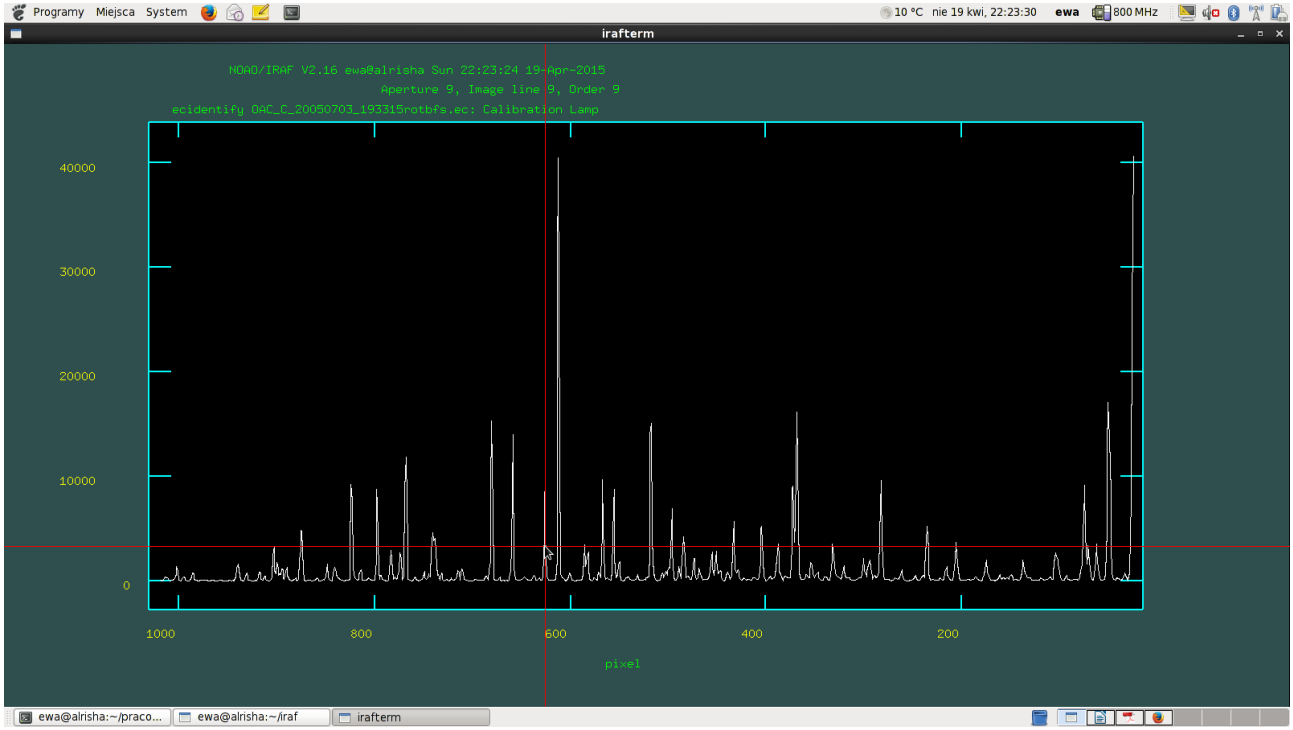
```
Pliki z widmami kalibracyjnymi:

OAC_C_20050703_193315rotbfs.ec.fit
OAC_C_20050704_030637rotbfs.ec.fit
OAC_C_20050703_193512rotbfs.ec.fit

Plik z identyfikacją linii ThAr: ThAr.pdf

Polecenie: ecidentify

Metoda postępowania: jak poprzednio, ale należy zidentyfikować 1-2 linie w
każdym rzędzie.
```

1. Uruchamiamy ecidentify
2. Zwróć uwagę na to, że skala na obrazku jest odwrócona. Należy odbić oś X względem Y poleceniem w e e (pierwsze e naciskasz, gdy kursor jest w miejscu, które ma się stać lewym dolnym rogiem obrazka, drugie e, w miejscu które ma się stać prawym górnym rogiem obrazka). Aby zaznaczyć linię użyj m. Następnie podaj jej długość w skali angstremów. „k” przechodzi do następnej apertury. Gdy skończysz ze wszystkimi 19 rzędami, zostań w 19tym rzędzie i użyj f aby znaleźć dopasowanie. Zwróć uwagę, że miara dopasowania musi być rzędu 0.01. Absolutnie nie może przekraczać kilku setnych! Jeśli jest większa, wróć do apertur przez q i znajdź źródło problemu. Gdy dopasowanie jest satysfakcjonujące, naciśnij q, a następnie wpisz :threshold 500 aby zmniejszyć próg identyfikacji, oraz l aby pobrać więcej linii. Sprawdź jakość dopasowania przez f i gdy skończysz, wyjdź przez q, q.

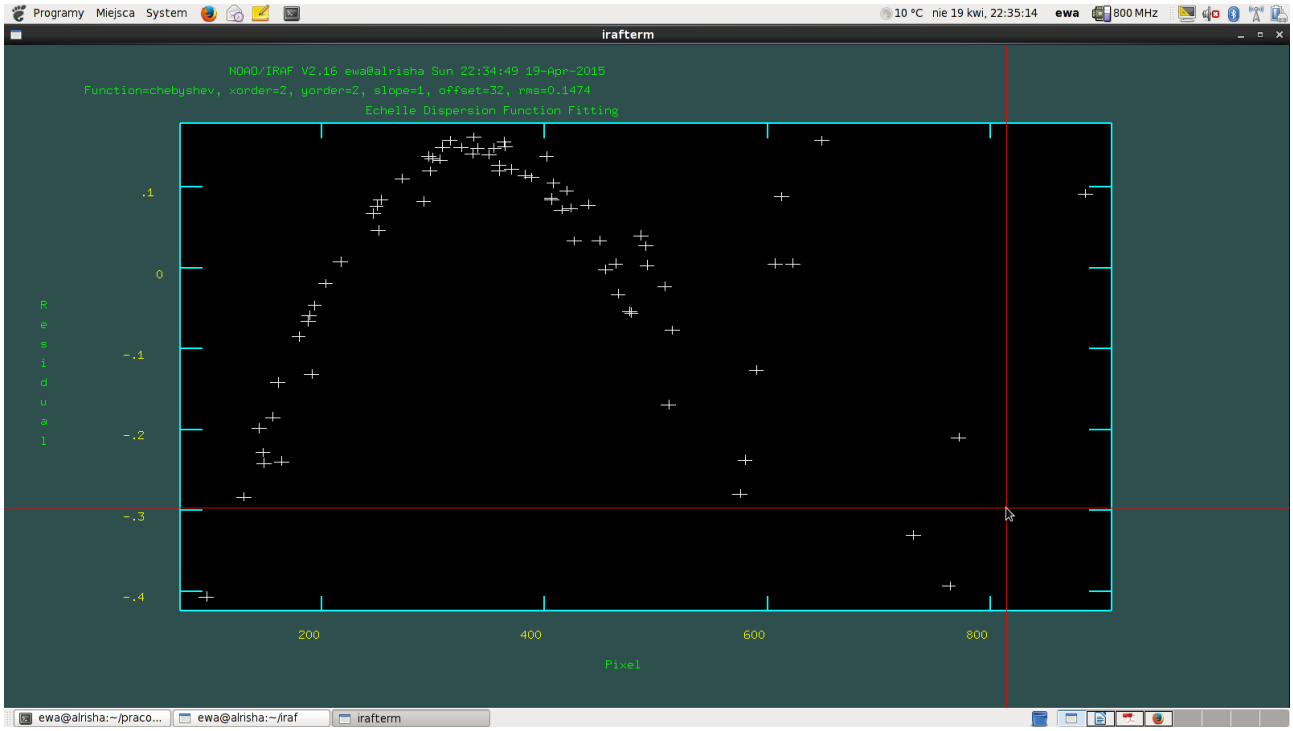
ECIDENTIFY CURSOR KEY SUMMARY

? Help
c Center feature(s)
d Delete feature(s)
f Fit dispersion
g Fit zero point shift
i Initialize
j Go to previous order
k Go to next order
l Match coordinate list
m Mark feature
n Next feature
o Go to specified order
q Quit
z Zoom graph
. Nearest feature
+ Next feature
- Previous feature
I Interrupt

```
PACKAGE = echelle
   TASK = ecidentify

images  = OAC_C_20050703_193315otbfs.ec.fit  Images containing features to be
identified
(databas=             database) Database in which to record feature data
(coordli=   linelists$thar.dat) User coordinate list
(units  =                    ) Coordinate units
(match  =                  1.) Coordinate list matching limit in user units
(maxfeat=                 100) Maximum number of features for automatic
identification
(zwidth =                 10.) Zoom graph width in user units
(ftype  =            emission) Feature type
(fwidth =                  4.) Feature width in pixels
(cradius=                  5.) Centering radius in pixels
(thresho=                 10.) Feature threshold for centering
(minsep =                  2.) Minimum pixel separation
(functio=           chebyshev) Coordinate function
(xorder =                   2) Order of coordinate function along dispersion
(yorder =                   2) Order of coordinate function across dispersion
(niterat=                   0) Rejection iterations
(lowreje=                  3.) Lower rejection sigma
(highrej=                  3.) Upper rejection sigma
(autowri=                  no) Automatically write to database?
(graphic=            stdgraph) Graphics output device
(cursor =                    ) Graphics cursor input
(mode   =                  ql)
```



tak jest źle:



Dobrze: nie ma trendu, zakres na osi y jest rzędu 0.01.

Pozostałe pliki kalibracyjne:

Polecenie: ecreidentify

```
PACKAGE = echelle
   TASK = ecreidentify

images  = OAC_C_20050703_193512otbfs.ec.fit  Spectra to be reidentified
referenc= OAC_C_20050703_193315otbfs.ec  Reference spectrum
(shift  =                   0.) Shift to add to reference features
(cradius=                   5.) Centering radius
(thresho=                 500.) Feature threshold for centering
(refit  =                 yes) Refit coordinate function?
(databas=              database) Database
(logfile=       STDOUT,logfile) List of log files
(mode   =                  ql)
```

```
ECREIDENTIFY: NOAO/IRAF V2.16 ewa@alrisha Sun 22:43:59 19-Apr-2015
  Reference image = OAC_C_20050703_193315rotbfs.ec, Refit = yes
               Image    Found     Fit Pix Shift  User Shift  Z Shift      RMS
OAC_C_20050704_030637rotbfs.ec   68/70   68/68    0.00346     -0.0199  -8.5E-8
0.158
```

Zapisywanie widm gwiazd w jednostkach długości fali:

1. Dopisywanie informacji o widmach lamp kalibracyjnych do nagłówków:

Polecenie: refspectra

w terminalu:

```
ls OAC_C*ec* >widma_lampy

ls OAC_O*ec* >widma_gwiazd
```

```
PACKAGE = echelle
   TASK = refspectra

input   =        @widma_gwiazd  List of input spectra
(referen=         @widma_lampy) List of reference spectra
(apertur=                     ) Input aperture selection list
(refaps =                     ) Reference aperture selection list
(ignorea=                  yes) Ignore input and reference apertures?
(select =               interp) Selection method for reference spectra
(sort   =              UTMIDDLE) Sort key
(group  =                     ) Group key
(time   =                  yes) Is sort key a time?
(timewra=                  17.) Time wrap point for time sorting
(overrid=                  yes) Override previous assignments?
(confirm=                  yes) Confirm reference spectrum assignments?
(assign =                  yes) Assign the reference spectra to the input
spectrum?
(logfile=       STDOUT,logfile) List of logfiles
(verbose=                   no) Verbose log output?
answer  =                       Accept assignment?
(mode   =                  ql)
```

```
[OAC_O_20050703_204218rotbfs.ec] refspec1='OAC_C_20050703_193512rotbfs.ec
0.82208228'
[OAC_O_20050703_204218rotbfs.ec] refspec2='OAC_C_20050704_030637rotbfs.ec
0.17791773'
Accept assignment? (no|yes|YES): YES
[OAC_O_20050703_204218rotbfs.ec] refspec1='OAC_C_20050703_193512rotbfs.ec
0.82208228'
[OAC_O_20050703_204218rotbfs.ec] refspec2='OAC_C_20050704_030637rotbfs.ec
0.17791773'
[OAC_O_20050704_002211rotbfs.ec] refspec1='OAC_C_20050703_193512rotbfs.ec
0.32044873'
[OAC_O_20050704_002211rotbfs.ec] refspec2='OAC_C_20050704_030637rotbfs.ec
0.67955124'
[OAC_O_20050704_004157rotbfs.ec] refspec1='OAC_C_20050703_193512rotbfs.ec
0.22653021'
[OAC_O_20050704_004157rotbfs.ec] refspec2='OAC_C_20050704_030637rotbfs.ec
0.77346981'
```

2. Zapisywanie widm obiektów w jednostkach długości fali:

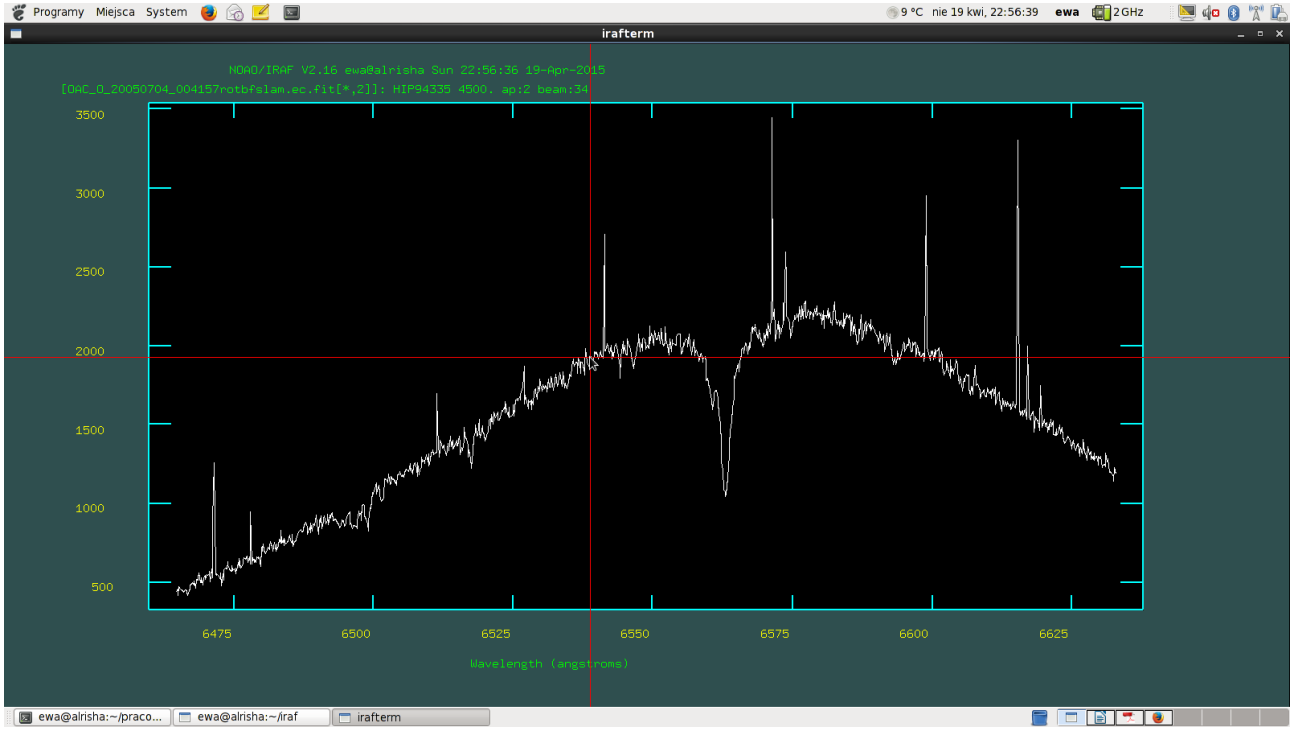
Polecenie: dispcor

```
more widma_gwiazd
OAC_O_20050703_204218rotbfs.ec.fit
OAC_O_20050704_002211rotbfs.ec.fit
OAC_O_20050704_004157rotbfs.ec.fit

more widma_gwiazd_ang
OAC_O_20050703_204218rotbfslam.ec.fit
OAC_O_20050704_002211rotbfslam.ec.fit
OAC_O_20050704_004157rotbfslam.ec.fit


PACKAGE = echelle
   TASK = dispcor

input   =        @widma_gwiazd  List of input spectra
output  =    @widma_gwiazd_ang  List of output spectra
(lineari=                  yes) Linearize (interpolate) spectra?
(databas=             database) Dispersion solution database
(table  =                    ) Wavelength table for apertures
(w1     =               INDEF) Starting wavelength
(w2     =               INDEF) Ending wavelength
(dw     =               INDEF) Wavelength interval per pixel
(nw     =               INDEF) Number of output pixels
(log    =                  no) Logarithmic wavelength scale?
(flux   =                 yes) Conserve total flux?
(blank  =                  0.) Output value of points not in input
(samedis=                  no) Same dispersion in all apertures?
(global =                  no) Apply global defaults?
(ignorea=                  no) Ignore apertures?
(confirm=                  no) Confirm dispersion coordinates?
(listonl=                  no) List the dispersion coordinates only?
(verbose=                 yes) Print linear dispersion assignments?
(logfile=                    ) Log file
(mode   =                  ql)
```

(...)

```
OAC_O_20050704_004157rotbfs.ec.fit: REFSPEC1 = 'OAC_C_20050703_193512rotbfs.ec
0.22653021'
OAC_O_20050704_004157rotbfs.ec.fit: REFSPEC2 = 'OAC_C_20050704_030637rotbfs.ec
0.77346981'
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 1, w1 = 6660.542, w2 = 6833.959, dw
= 0.174289, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 2, w1 = 6464.599, w2 = 6632.925, dw
= 0.169172, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 3, w1 = 6279.853, w2 = 6443.379, dw
= 0.164347, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 4, w1 = 6105.371, w2 = 6264.362, dw
=  0.15979, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 5, w1 =  5940.32, w2 = 6095.023, dw
=  0.15548, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 6, w1 = 5783.956, w2 = 5934.596, dw
= 0.151396, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 7, w1 = 5635.611, w2 = 5782.396, dw
= 0.147522, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 8, w1 = 5494.683, w2 = 5637.806, dw
= 0.143842, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 9, w1 =  5360.63, w2 = 5500.269, dw
= 0.140341, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 10, w1 =  5232.96, w2 = 5369.281, dw
= 0.137007, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 11, w1 = 5111.228, w2 = 5244.386, dw
= 0.133828, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 12, w1 = 4995.029, w2 = 5125.168, dw
= 0.130793, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 13, w1 = 4883.995, w2 = 5011.249, dw
= 0.127893, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 14, w1 = 4777.789, w2 = 4902.283, dw
=  0.12512, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 15, w1 = 4676.101, w2 = 4797.953, dw
= 0.122464, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 16, w1 = 4578.651, w2 = 4697.971, dw
= 0.119919, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 17, w1 = 4485.179, w2 = 4602.069, dw
= 0.117478, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 18, w1 = 4395.445, w2 = 4510.004, dw
= 0.115134, nw = 996
OAC_O_20050704_004157rotbfslam.ec.fit: ap = 19, w1 =  4309.23, w2 = 4421.549, dw
= 0.112883, nw = 996
```

Wyświetlamy widmo: polecenie splot
Każdy rząd wyświetla się osobno, przejście do kolejnego rzędu: „)” na obrazku, przejście do poprzedniego rzędu: „(”



Kolejny krok: dopasowanie kontinuum

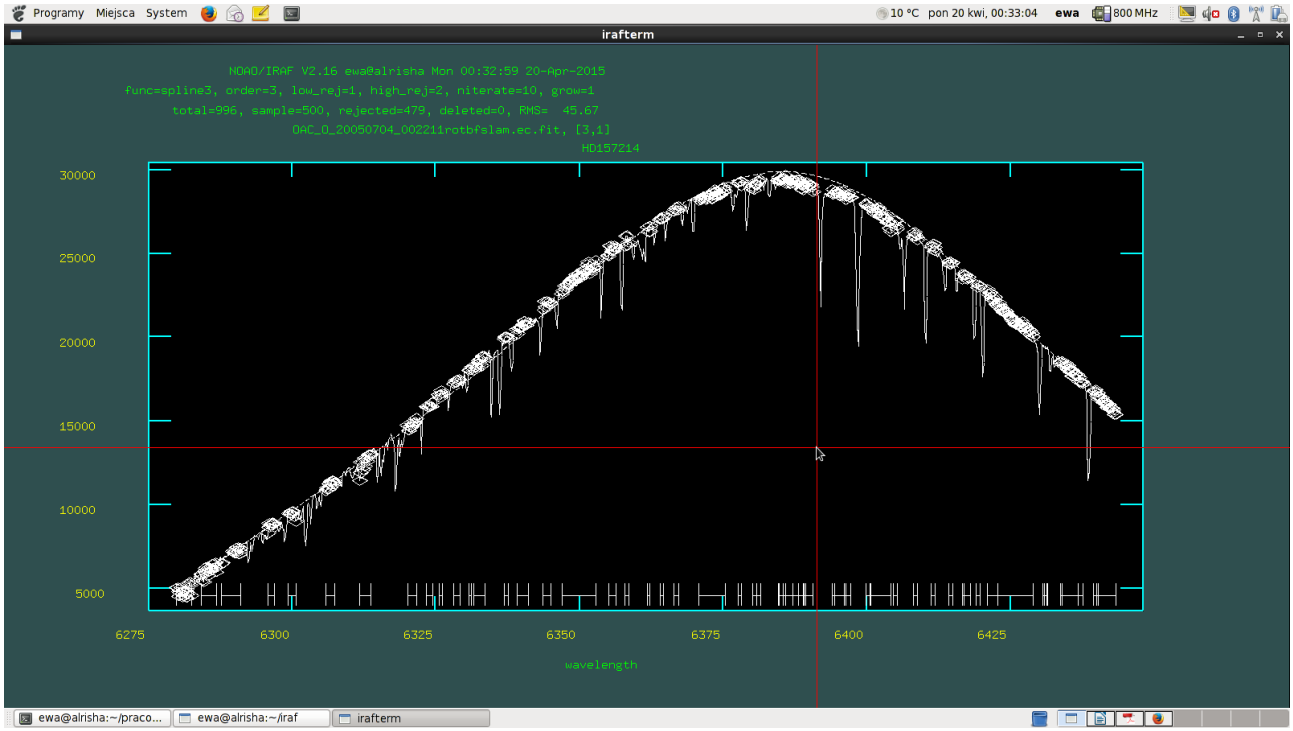
Polecenie: continuum

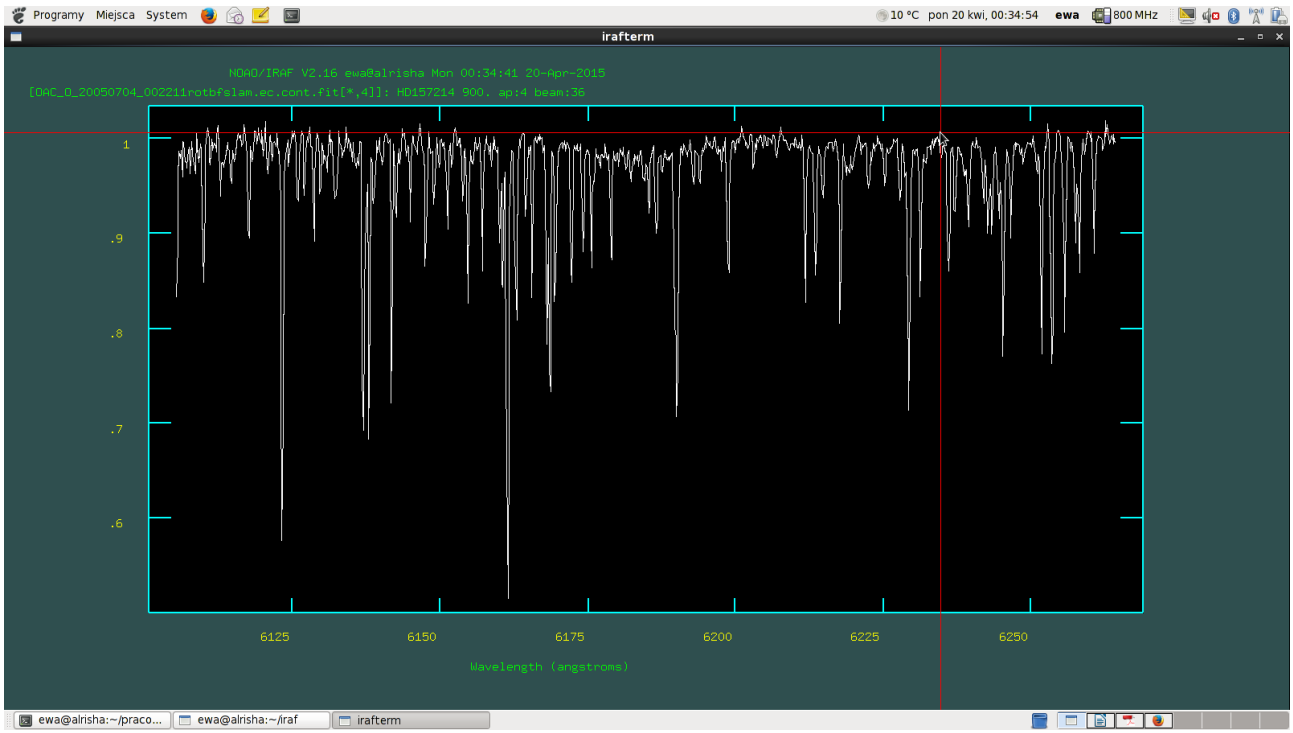
Dopasowujemy kontinuum osobno w każdym rzędzie.

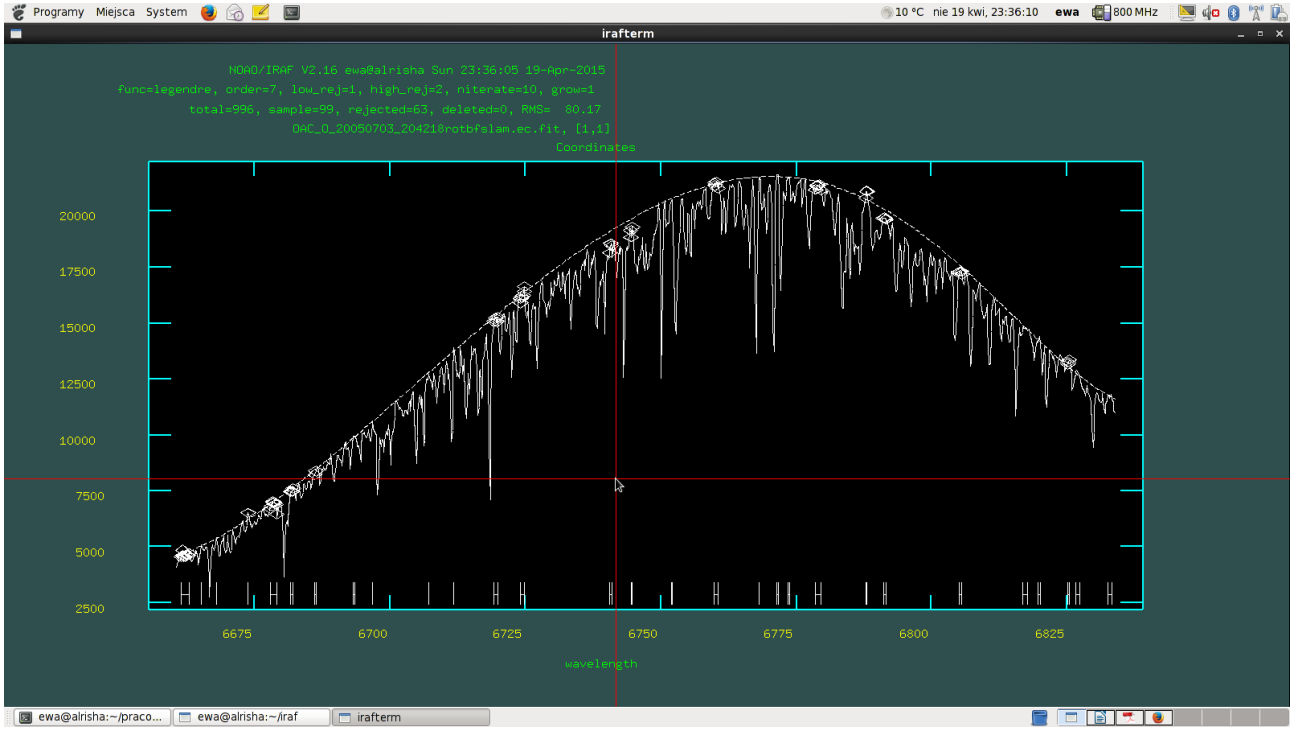
Proszę zacząć normowanie od widma: OAC_O_20050704_002211otbfslam.ec.fit

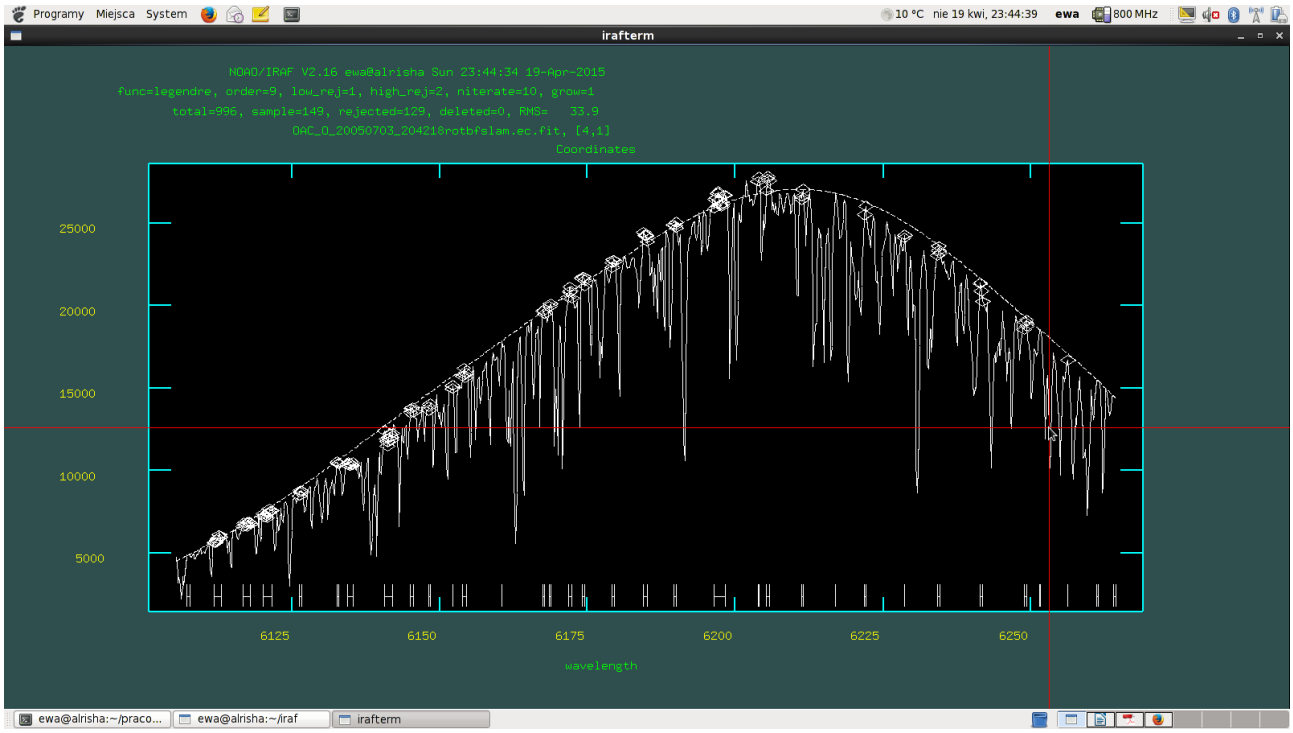
```
PACKAGE = echelle
   TASK = continuum

input   = OAC_O_20050704_002211otbfslam.ec.fit  Input images
output  = OAC_O_20050704_002211rotbfslam.ec.cont  Output images
(lines  =                      *) Image lines to be fit
(bands  =                      *) Image bands to be fit
(type   =                  ratio) Type of output
(replace=                     no) Replace rejected points by fit?
(wavesca=                    yes) Scale the X axis with wavelength?
(logscal=                     no) Take the log (base 10) of both axes?
(overrid=                     no) Override previously fit lines?
(listonl=                     no) List fit but don't modify any images?
(logfile=                logfile) List of log files
(interac=                    yes) Set fitting parameters interactively?
(sample =                      *) Sample points to use in fit
(naverag=                      1) Number of points in sample averaging
(functio=              legendre) Fitting function
(order  =                      4) Order of fitting function
(low_rej=                    1.4) Low rejection in sigma of fit
(high_re=                    2.5) High rejection in sigma of fit
(niterat=                     10) Number of rejection iterations
(grow   =                     1.) Rejection growing radius
(markrej=                    yes) Mark rejected points?
(graphic=               stdgraph) Graphics output device
(cursor =                      ) Graphics cursor input
ask     =                     NO
(mode   =                     ql)
```

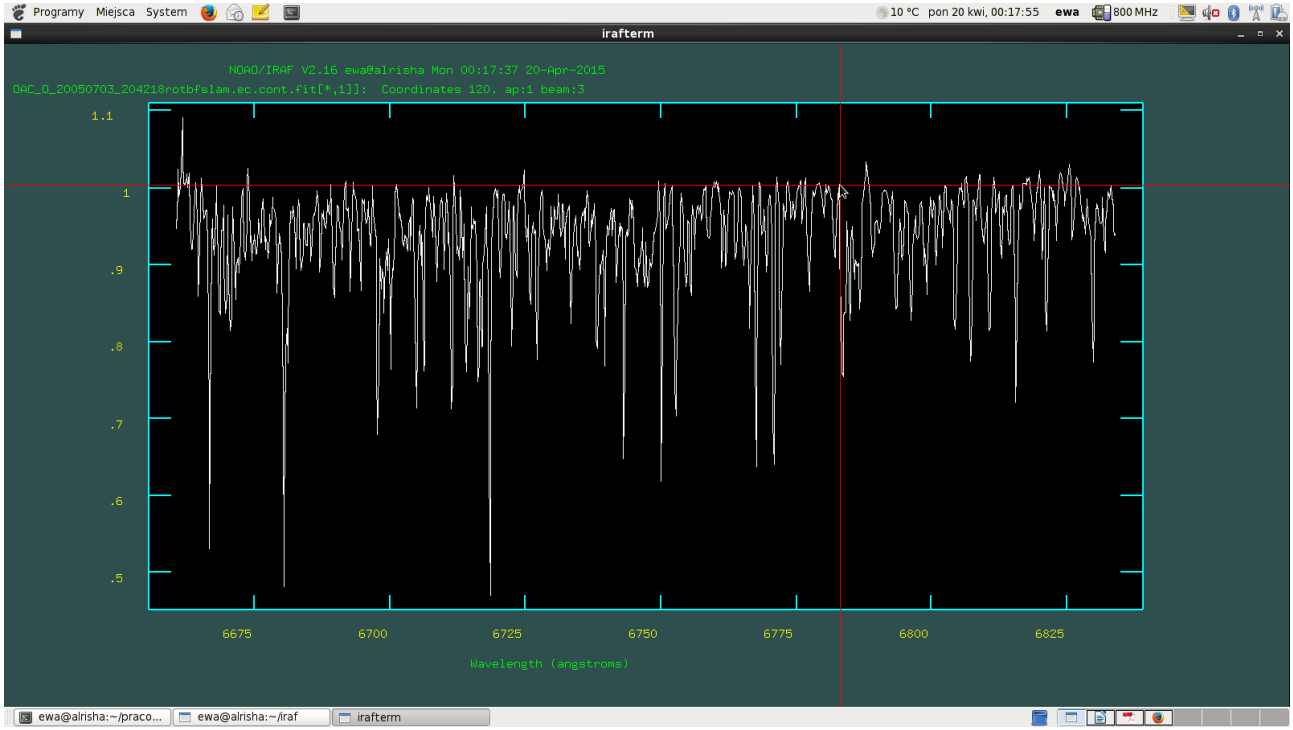
```
Fit [1,1] of OAC_O_20050704_002211ot  (yes|no|skip|YES|NO|SKIP) (NO): YES
```






Programy Miejsca System
10 °C nie 19 kwi, 23:36:10 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 23:36:05 19-Apr-2015
func=legendre, order=7, low_rej=1, high_rej=2, niterate=10, grow=1
total=996, sample=99, rejected=63, deleted=0, RMS= 80.17
OAC_0_20050703_204218rotbfslam.ec.fit, [1,1]
Coordinates
20000
17500
15000
12500
10000
7500
5000
2500
6675
6700
6725
6750
6775
6800
6825
wavelength
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm


Programy Miejsca System
10 °C nie 19 kwi, 23:44:39 ewa 800 MHz
irafterm
NOAO/IRAF V2.16 ewa@alrisha Sun 23:44:34 19-Apr-2015
func=legendre, order=9, low_rej=1, high_rej=2, niterate=10, grow=1
total=996, sample=149, rejected=129, deleted=0, RMS= 33.9
OAC_0_20050703_204218rotbfslam.ec.fit, [4,1]
Coordinates
25000
20000
15000
10000
5000
6125
6150
6175
6200
6225
6250
wavelength
ewa@alrisha:~/praco...
ewa@alrisha:~/iraf
irafterm



UWAGA:

Najlepsze funkcje do normowania do legendre i chebyshev; staramy się utrzymać niskie rzędy (około 3-4) jeśli to możliwe, szczególnie w tych rzędach, w których są silne linie. Jeśli będzie to konieczne użyj funkcji spline3 i wysokich rzędów, ale uważaj, żeby funkcja nie wchodziła w silne linie. Normowanie jest bardzo trudne i wymaga uwagi i czasu.