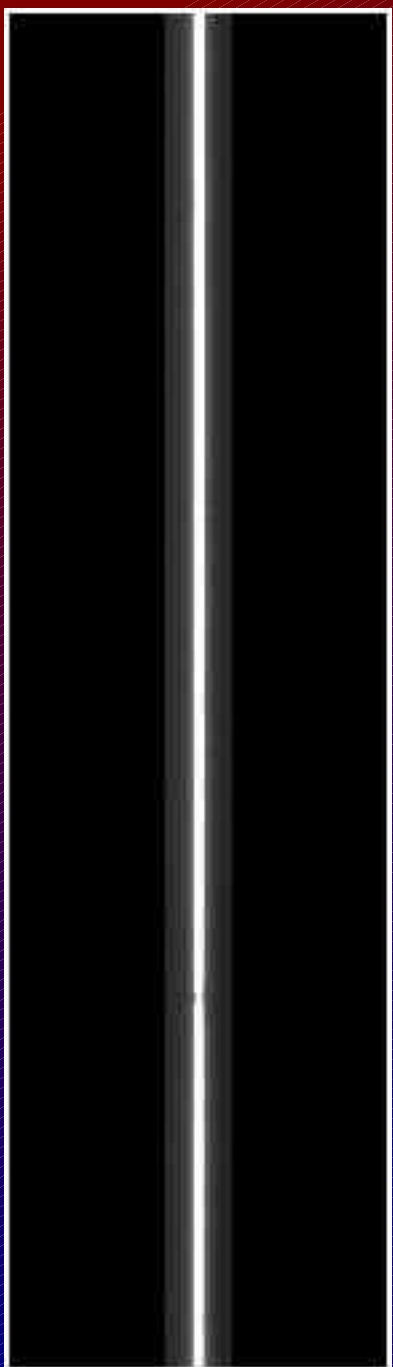


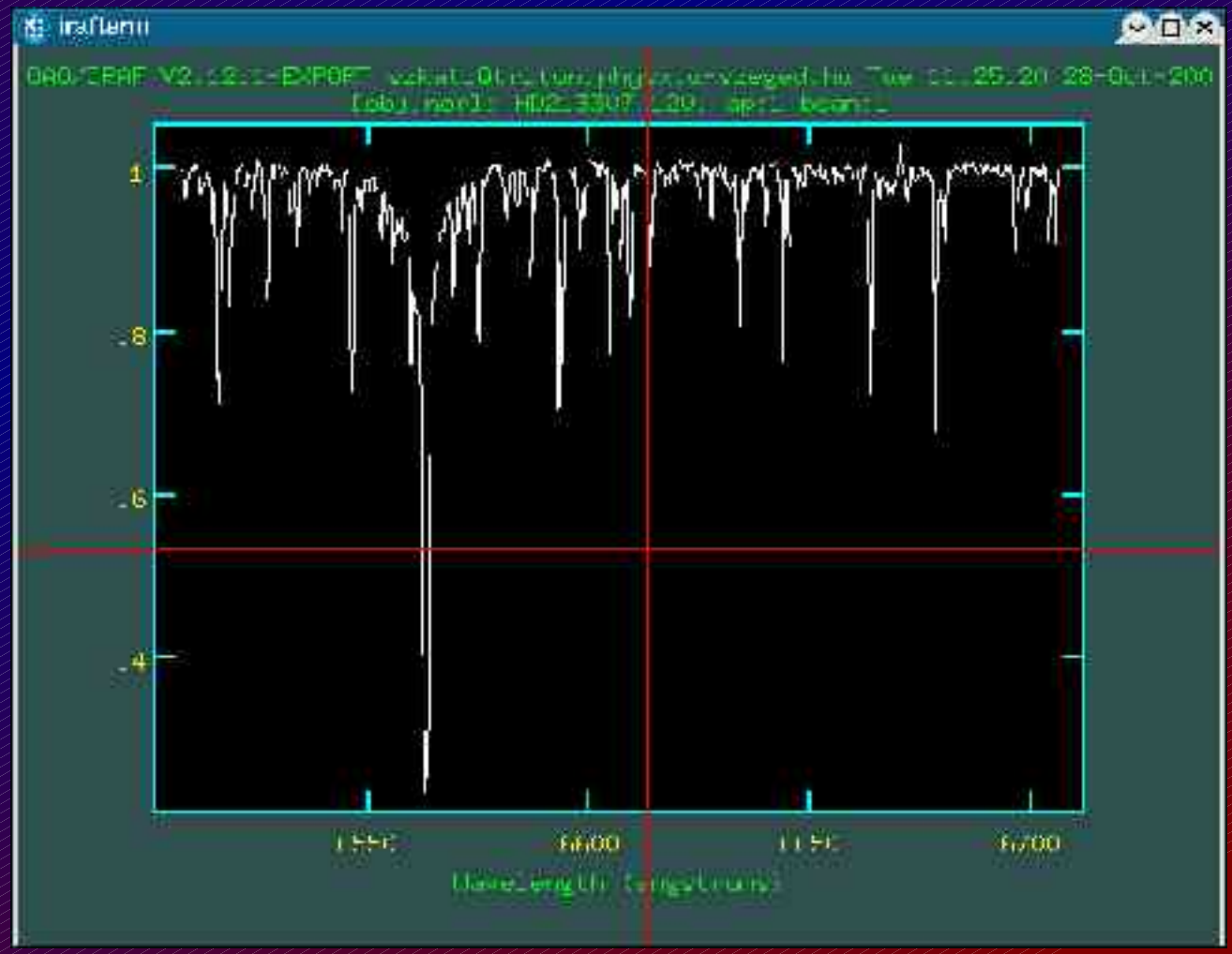
Cassegrain-spektrum feldolgozása az IRAF-ban



Nyers spektrum



Hullámhossz-kalibrált, kontinuum normált spektrum



Mire van szükség?

Korrigáláshoz:

- *Bias kép*



Noao => imred => ccdred => zerocombine

Zerocombine

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ocdred  
TASK = zerocombine  
  
input = @fits.list List of zero level images to combine  
(output = Zero) Output zero level name  
(combine= average) Type of combine operation  
(reject = minmax) Type of rejection  
(ccdtype= zero) 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 = 0) 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 = 3.) Lower sigma clipping factor  
(hsigma = 3.) Upper sigma clipping factor  
(rdnoise= 0.) ccdclip: CCD readout noise (electrons)  
More  
ESC=? for HELP
```

- => bemen? file
- => kimen? file
- => kép típusa
- => kombinált képek törlése
- => a CCD kiolvasási zaja

Zerocombine

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = zerocombine  
More  
(gain = 1.) 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)  
  
ESC=? for HELP
```

A képek bias korrekciója

Noao => imred => ccdred => ccdproc

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = ccdproc  
  
images = @fits.list List of CCD images to correct  
(output = ) List of output CCD images  
(ccdtype= flat) 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?  
(fringed= no) Apply fringe correction?  
(readcor= no) Convert zero level image to readout correction?  
(scancor= no) Convert flat field image to scan correction?  
  
More  
ESC=? for HELP
```

=> bemen? file
=> kimen? file
=> kép típusa

=> bias korrekció

A képek bias korrekciója

Noao => imred => ccdred => ccdproc

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = ccdproc  
More  
(readaxi= column) Read out axis (column/line)  
(fixfile= ) File describing the bad lines and columns  
(biassec= ) Overscan strip image section  
(trimsec= ) Trim data section  
(zero = 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= no) Fit overscan interactively?  
(functio= legendre) Fitting function  
(order = 1) Number of polynomial terms or spline pieces  
(sample = *) Sample points to fit  
More  
ESC-? for HELP
```

=> kiolvasási irány

=> biast korrigáló kép

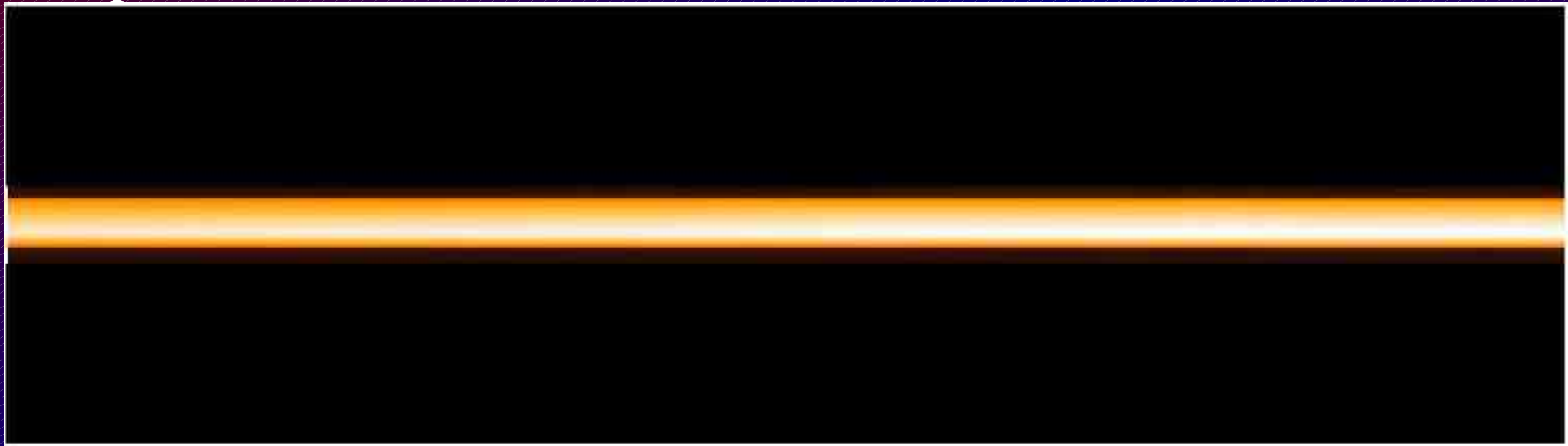
A képek bias korrekciója

Noao => imred => ccdred => ccdproc

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = ccdproc  
more  
(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)  
  
ESC=? for HELP
```

Mire van szükség?

- *Flat
kép*



Noao => imred => ccdred => flatcombine

Flatcombine

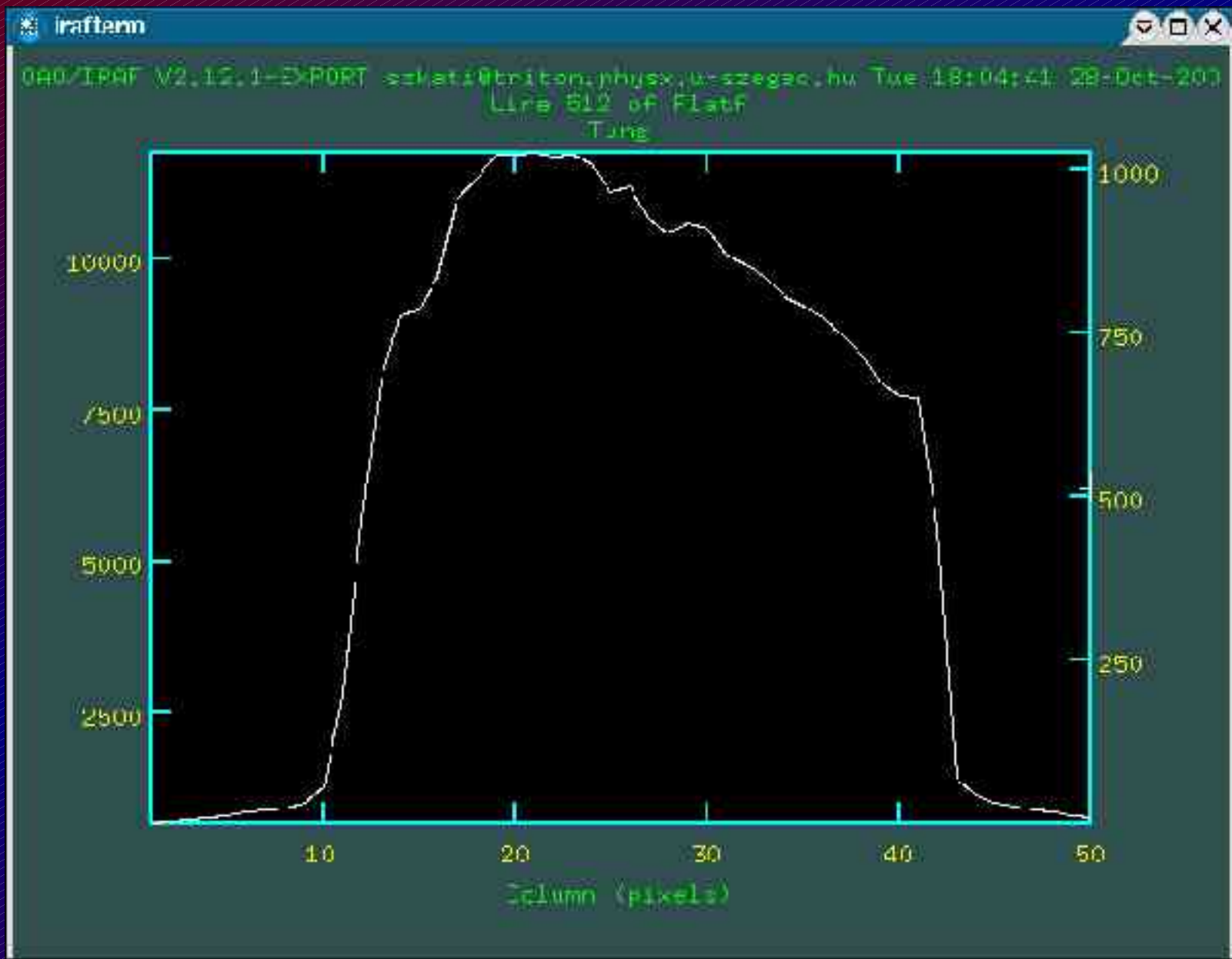
```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = flatcombine  
  
input = | @fits.list List of flat field images to combine  
(output = Flat) Output flat field root name  
(combine= median) Type of combine operation  
(reject = avsigclip) Type of rejection  
(ccdtype= flat) 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 = mean) 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 = 3.) Lower sigma clipping factor  
(hsigma = 3.) Upper sigma clipping factor  
More  
  
ESC-? for HELP
```

- => bemen? file
- => kimen? file
- => átlagolás típusa
- => kép típusa

Flatcombine

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = flatcombine  
More  
(rdnoise= 0.) ccdclip: CCD readout noise (electrons)  
(gain = 1.) 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)  
  
ESC=? for HELP
```

Hasznos tartomány kiválasztása



Korrekciók elvégzése - flat

Noao => imred => ccdred => ccdproc

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = ccdproc  
  
images = @fits.list List of CCD images to correct  
(output = ) List of output CCD images  
(ccdtype= object) 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 = yes) Trim the image?  
(zerocor= no) Apply zero level correction?  
(darkcor= no) Apply dark count correction?  
(flatcor= yes) Apply flat field correction?  
(illumco= no) Apply illumination correction?  
(fringed= no) Apply fringe correction?  
(readcor= no) Convert zero level image to readout correction?  
(scancor= no) Convert flat field image to scan correction?  
  
More  
ESC=? for HELP
```

=> kép
=> kimenet kép neve
=> neve
=> kép típusa

=> vágás

=> darkkorrekció

=> flatkorrekció

Korrekciók elvégzése - flat

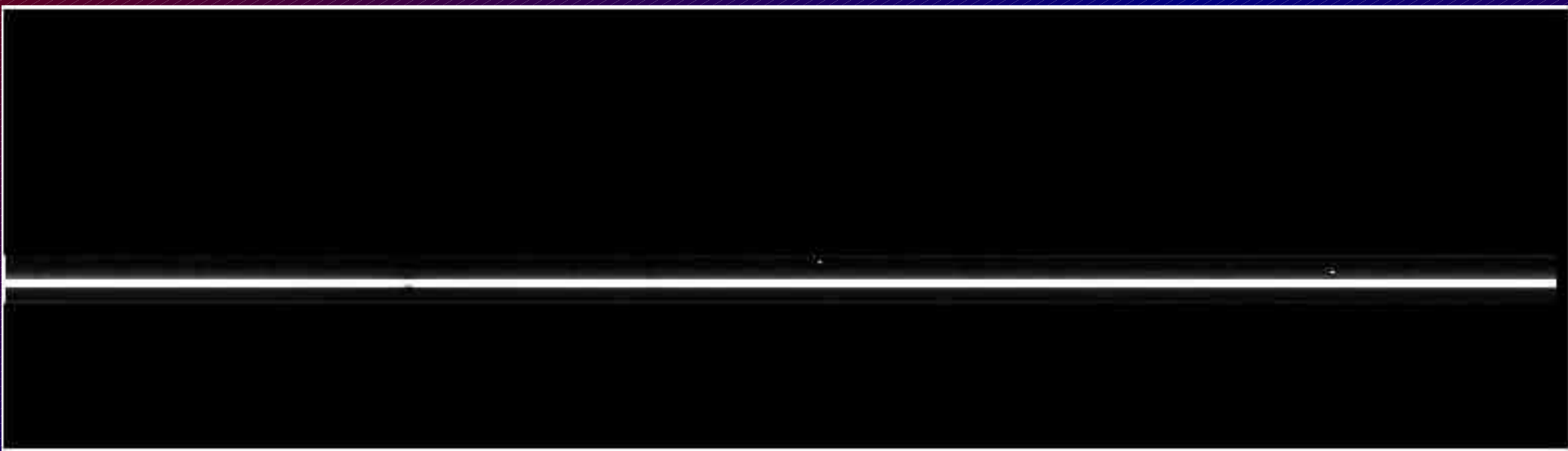
Noao => imred => ccdred => ccdproc

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = ccdproc  
More  
(readaxi= column) Read out axis (column/line)  
(fixfile= ) File describing the bad lines and columns  
(biassec= ) Overscan strip image section  
(trimsec= [12:42,2:1024]) Trim data section  
(zero = ) Zero level calibration image  
(dark = ) Dark count calibration image  
(flat = 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= no) Fit overscan interactively?  
(functio= legendre) Fitting function  
(order = 1) Number of polynomial terms or spline pieces  
(sample = *) Sample points to fit  
More  
ESC-? for HELP
```

=> kivágandó régió

=> flat korrigáló kép

Korrigált kép



Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

Fontos! Először az objektum spektrumára kell lefutatni.

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
  
input =  obj List of input images  
(output = obj,ap) List of output spectra  
(apertur= 1) Apertures  
(format = onedspec) 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= yes) Extract spectra?  
(extras = no) Extract sky, sigma, etc.?  
  
More  
  
ESC=? for HELP
```

=> bemen? kép
=> kimen? kép
=> apertúrák száma

Minden kérdésre a
válasz: **yes**
Kivéve: extras

Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
more  
(review =  yes) 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_func= chebyshev) Background function  
(b_order= 1) Background function order  
(b_sampl= [2:9,19:30]) Background sample regions  
(b_naver= -3) Background average or median  
more  
ESC-? for HELP
```

=> háttér régió

Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
more  
(b_niter=          0.) Background rejection iterations  
(b_low_r=         3.) Background lower rejection sigma  
(b_high_r=        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 =           1 Number of apertures to be found automatically  
(minsep =         5.) Minimum separation between spectra  
(maxsep =       1000.) Maximum separation between spectra  
  
more  
ESC-? for HELP
```

Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
more  
(order =          increasing) Order of apertures  
  
# RECENTERING PARAMETERS  
  
(aprecen=          ) Apertures for recentering calculation  
(npeaks =         INDEF) Select brightest peaks  
(shift =          yes) Use average shift instead of recentering?  
  
# RESIZING PARAMETERS  
  
(llimit =         INDEF) Lower aperture limit relative to center  
(ulimit =         INDEF) Upper aperture limit relative to center  
(ylevel =         0.1) Fraction of peak or intensity for automatic width  
(peak =          yes) Is ylevel a fraction of the peak?  
(bkg =           yes) Subtract background in automatic width?  
(r_grow =         0.) Grow limits by this factor  
  
more  
  
ESC-? for HELP
```

Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
more  
(avglimi= █ no) Average limits over all apertures?  
  
# TRACING PARAMETERS  
  
(t_nsum = 10) Number of dispersion lines to sum  
(t_step = 10) Tracing step  
(t_nlost= 3) Number of consecutive times profile is lost befo  
(t_funct= spline3) Trace fitting function  
(t_order= 1) Trace fitting function order  
(t_sampl= *) Trace sample regions  
(t_naver= 1) Trace average or median  
(t_niter= 0) Trace rejection iterations  
(t_low_r= 3.) Trace lower rejection sigma  
(t_high_= 3.) Trace upper rejection sigma  
  
more  
ESC=? for HELP
```

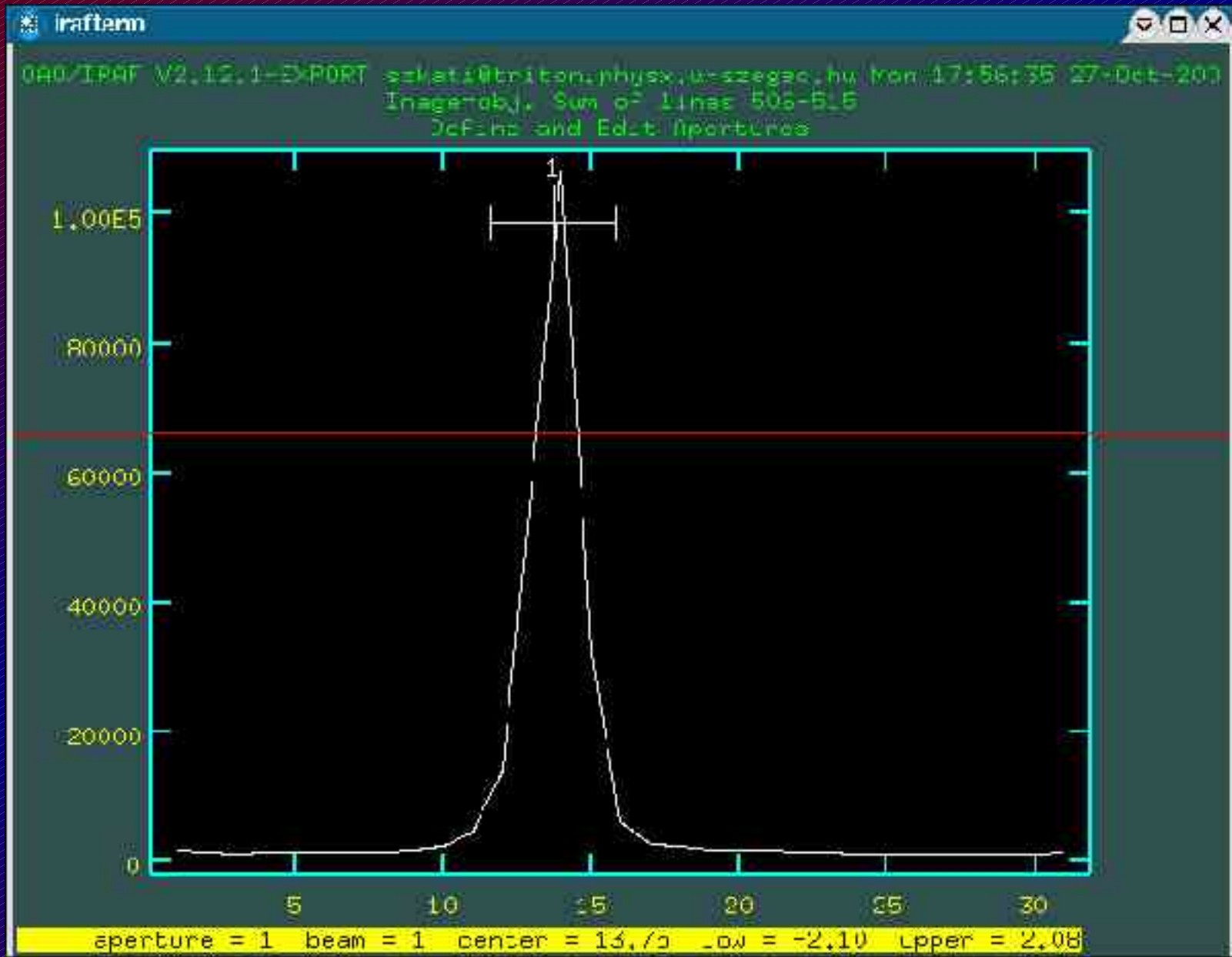
Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

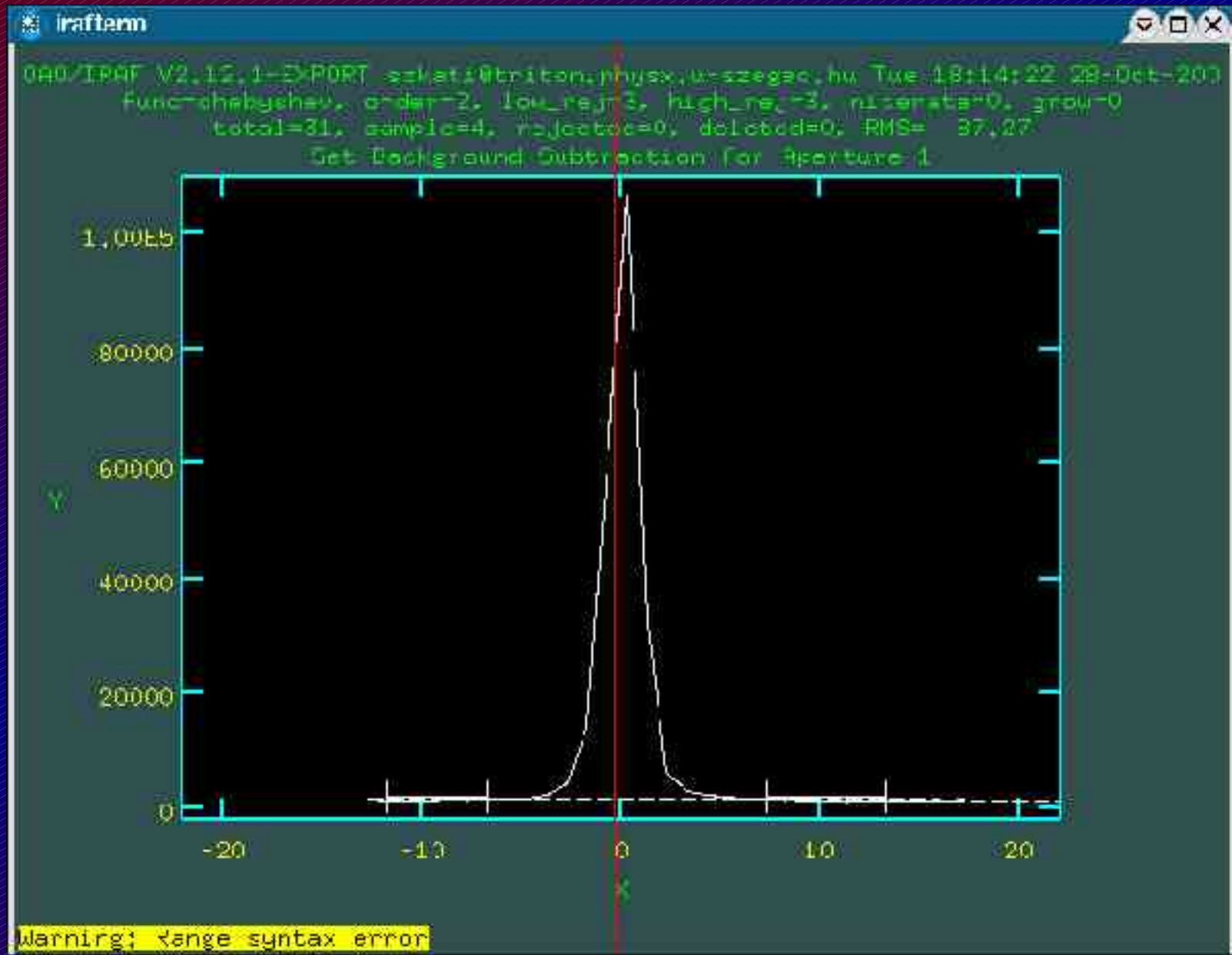
```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
more  
(t_grow = █ 0.) Trace rejection growing radius  
# EXTRACTION PARAMETERS  
(backgro= fit) Background to subtract  
(skybox = 1) Box car smoothing length for sky  
(weights= none) Extraction weights (none|variance)  
(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  
(nsubaps= 1) Number of subapertures per aperture  
(mode = ql)  
ESC=? for HELP
```

=> háttér illesztése

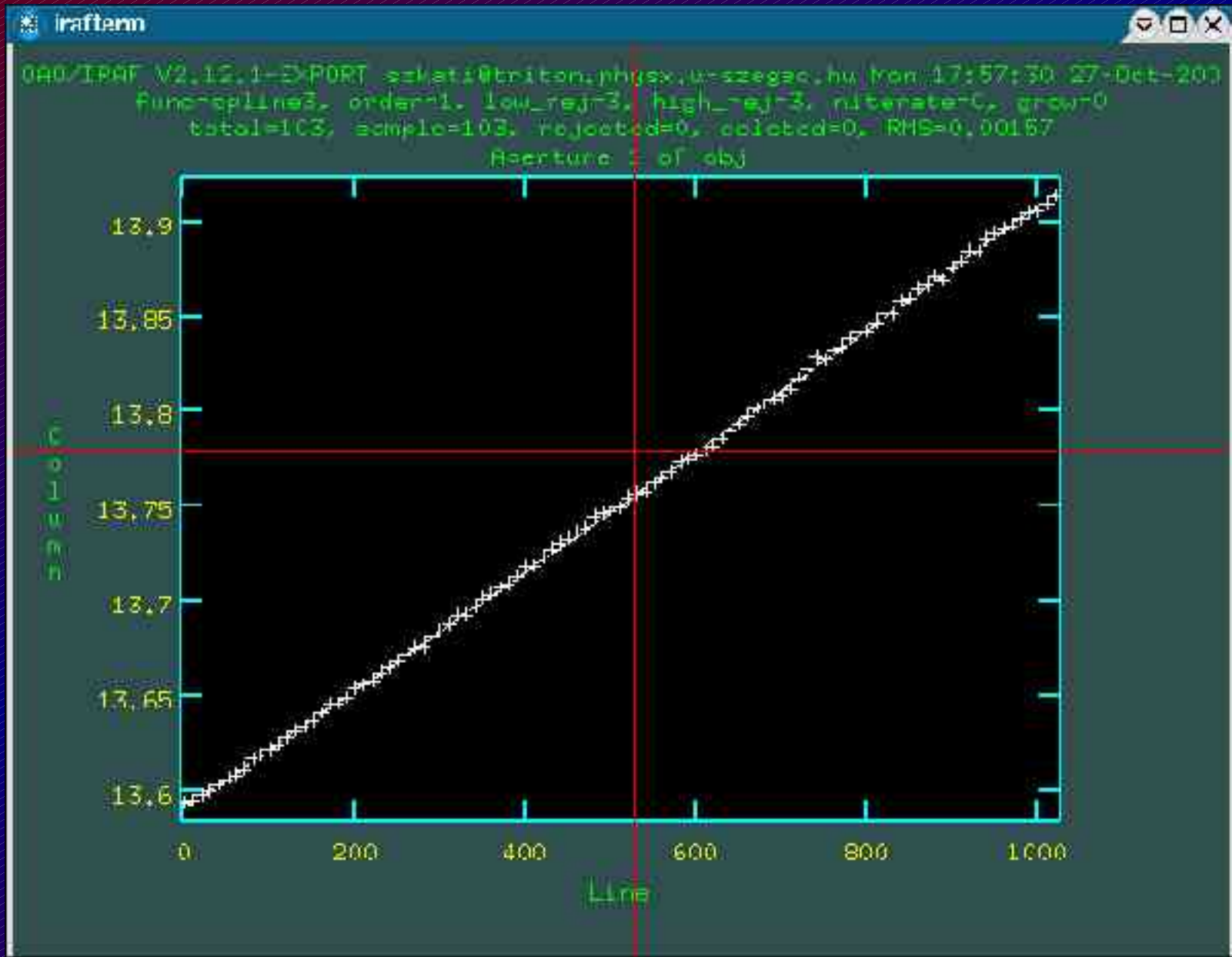
Redukálás - apertúra megkeresése



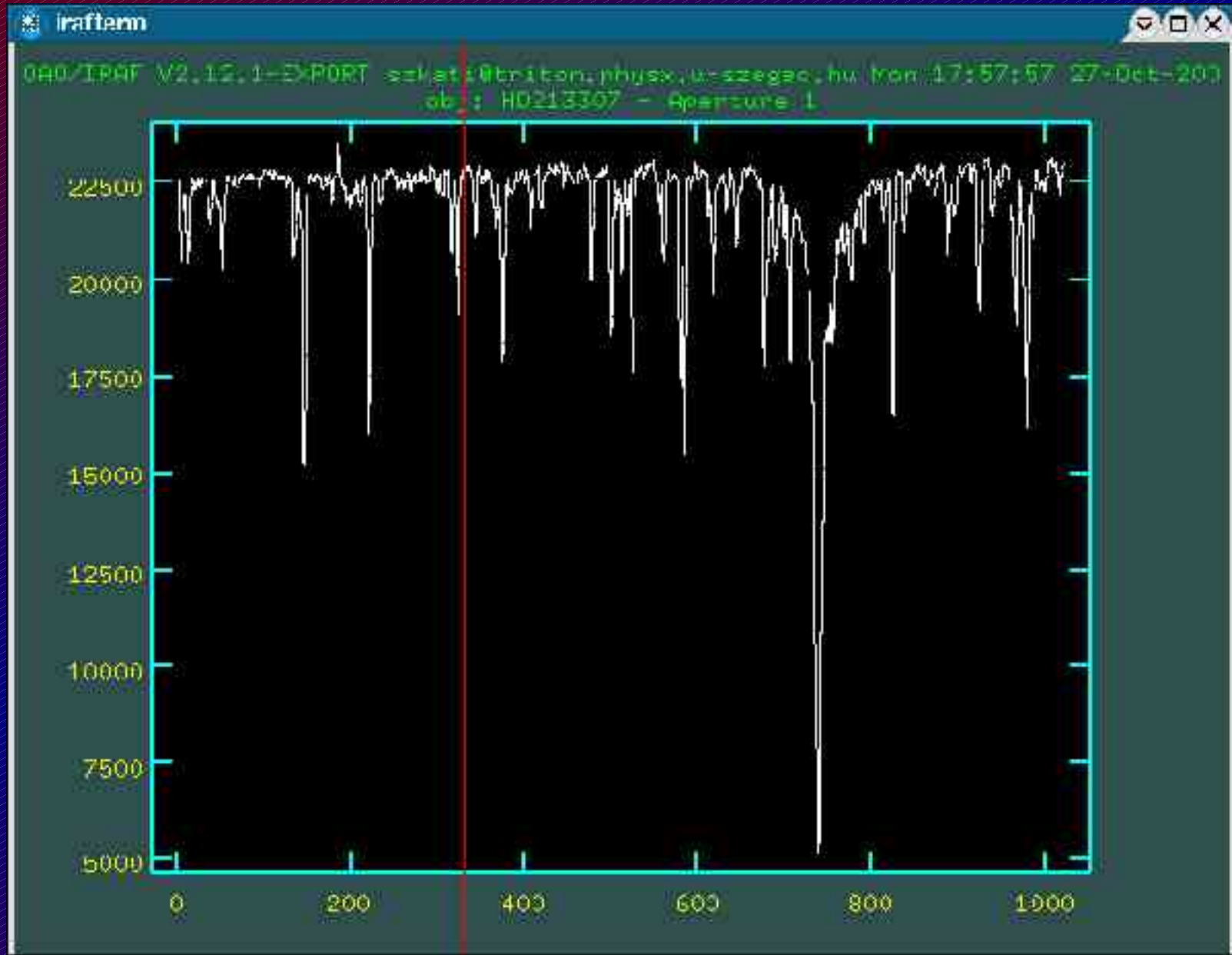
Redukálás - háttér meghatározása



Redukálás - apertúra megkeresése



Redukálás - apertúra megkeresése



Redukálás - apertúra megkeresése

Noao => twodspec => apextract => apall

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = apextract  
TASK = apall  
  
input =  fear1,fear2 List of input images  
(output = fear1.ap,fear2.ap) List of output spectra  
(apertur= 1) Apertures  
(format = onedspec) Extracted spectra format  
(referen= obj) 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 = no) Resize apertures?  
(edit = no) Edit apertures?  
(trace = no) Trace apertures?  
(fittrac= no) Fit the traced points interactively?  
(extract= yes) Extract spectra?  
(extras = no) Extract sky, sigma, etc.?  
  
More  
ESC-? for HELP
```

=> spektrállámpa spektrum

=> kimen? kép

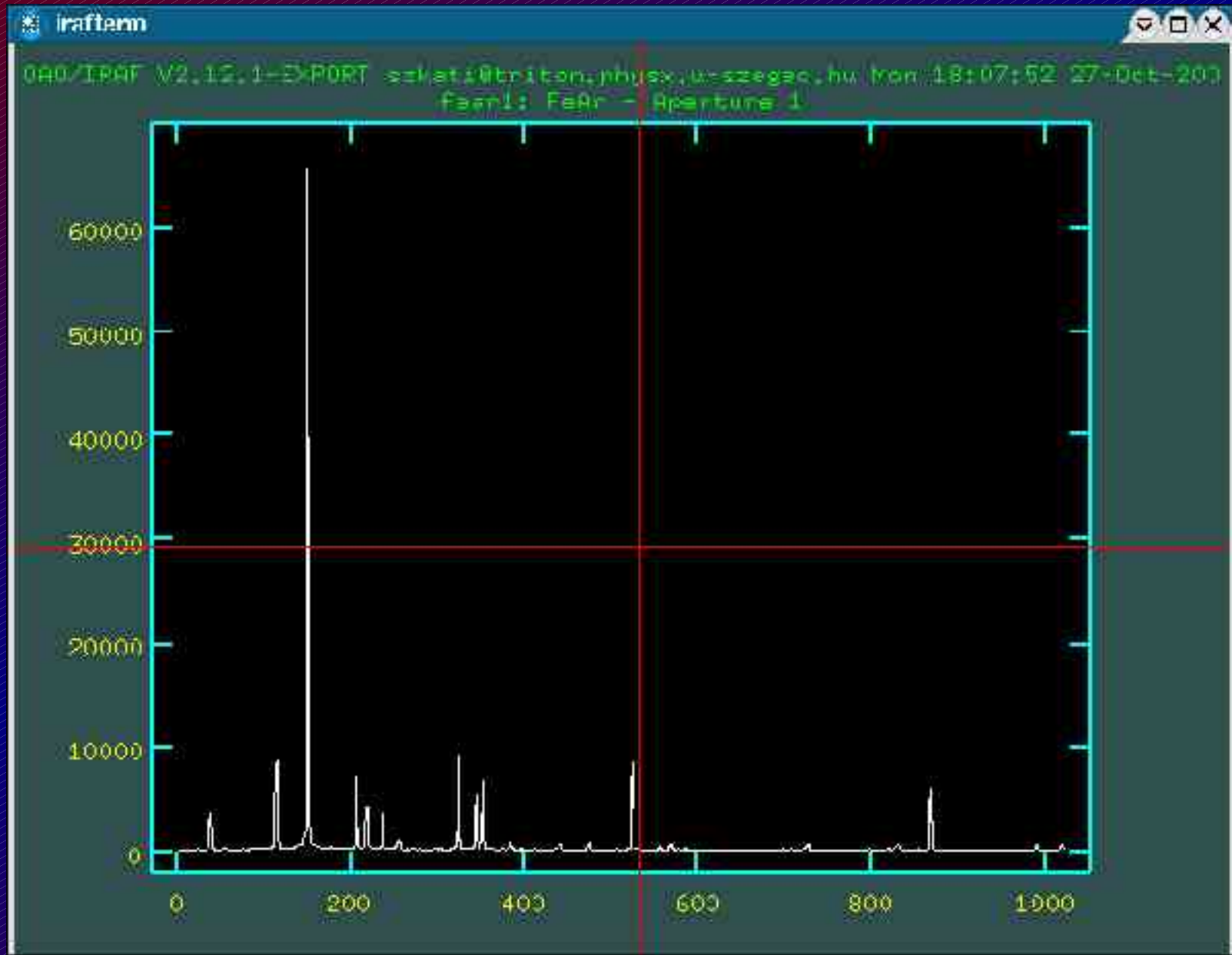
=> objektum spektruma

Minden kérdésre a
válasz: no

Kivéve: extras,
interac

Background: none

Redukálás - apertúra megkeresése



Hullámhossz kalibráció - spektrállámpa

Noao => onedspec => identify

Fontos! Csak egy spektrumra kell elvégezni.

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = identify  
  
images = ■      fear1.ap.0001  Images containing features to be identified  
(section=      middle line) Section to apply to two dimensional images  
(databas=      database) Database in which to record feature data  
(coordli=      linelists$fear.dat) User coordinate list  
(units =      ) Coordinate units  
(nsum =      10) Number of lines/columns/bands to sum in 2D image  
(match =      -3.) Coordinate list matching limit  
(maxfeat=      50) Maximum number of features for automatic identif  
(zwidth =      100.) Zoom graph width in user units  
(ftype =      emission) Feature type  
(fwidth =      4.) Feature width in pixels  
(cradius=      5.) Centering radius in pixels  
(thresho=      0.) Feature threshold for centering  
(minsep =      2.) Minimum pixel separation  
(functio=      legendre) Coordinate function  
(order =      3) Order of coordinate function  
(sample =      *) Coordinate sample regions  
More  
ESC-? for HELP
```

=>spektrállámpa spektrum

=> vonallista

=> vonalak típusa

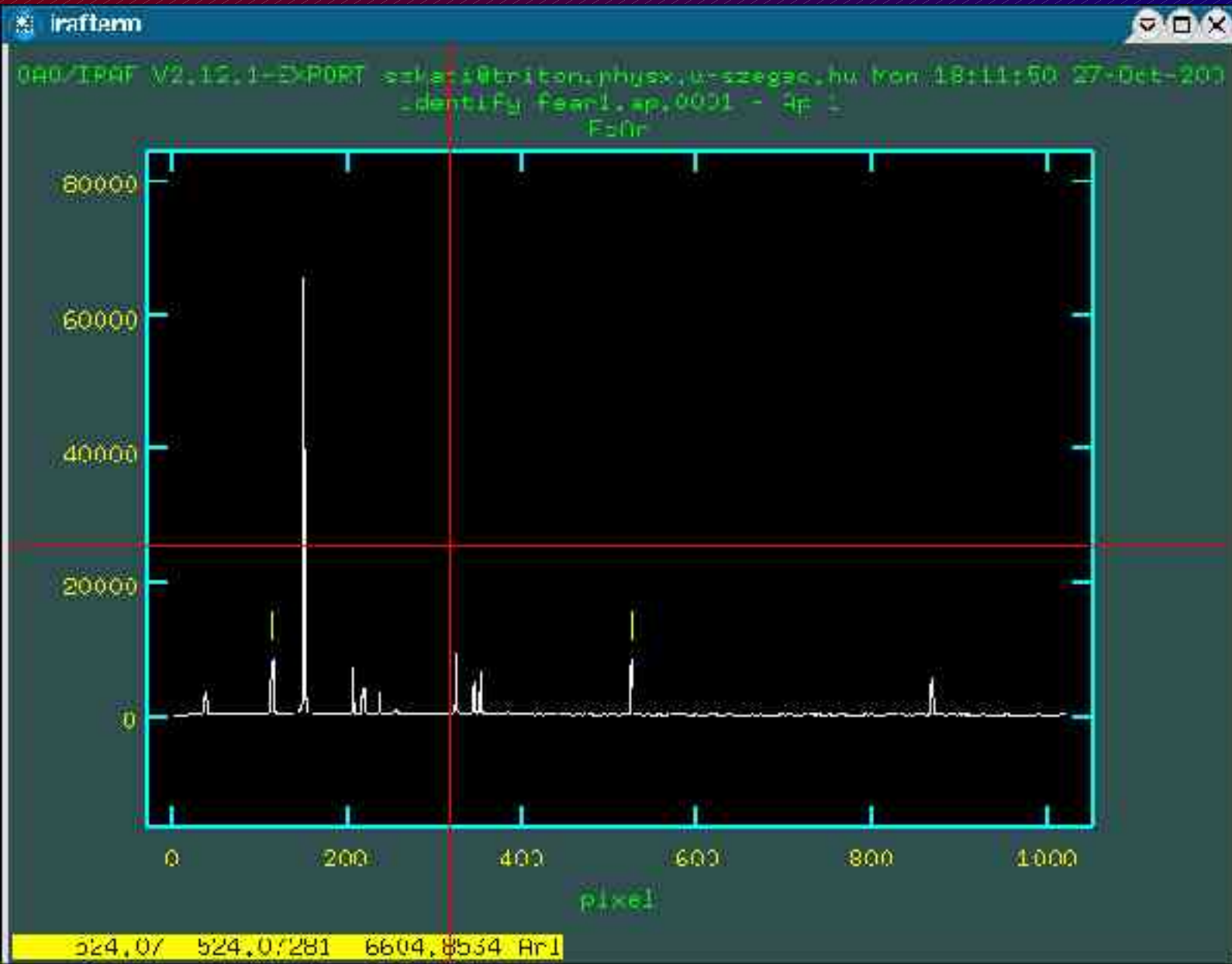
Hullámhossz kalibráció - spektrállámpa

Noao => onedspec => identify

Kalibrálás: <http://www.noao.edu/kpno/specatlas/fear/fear.html>

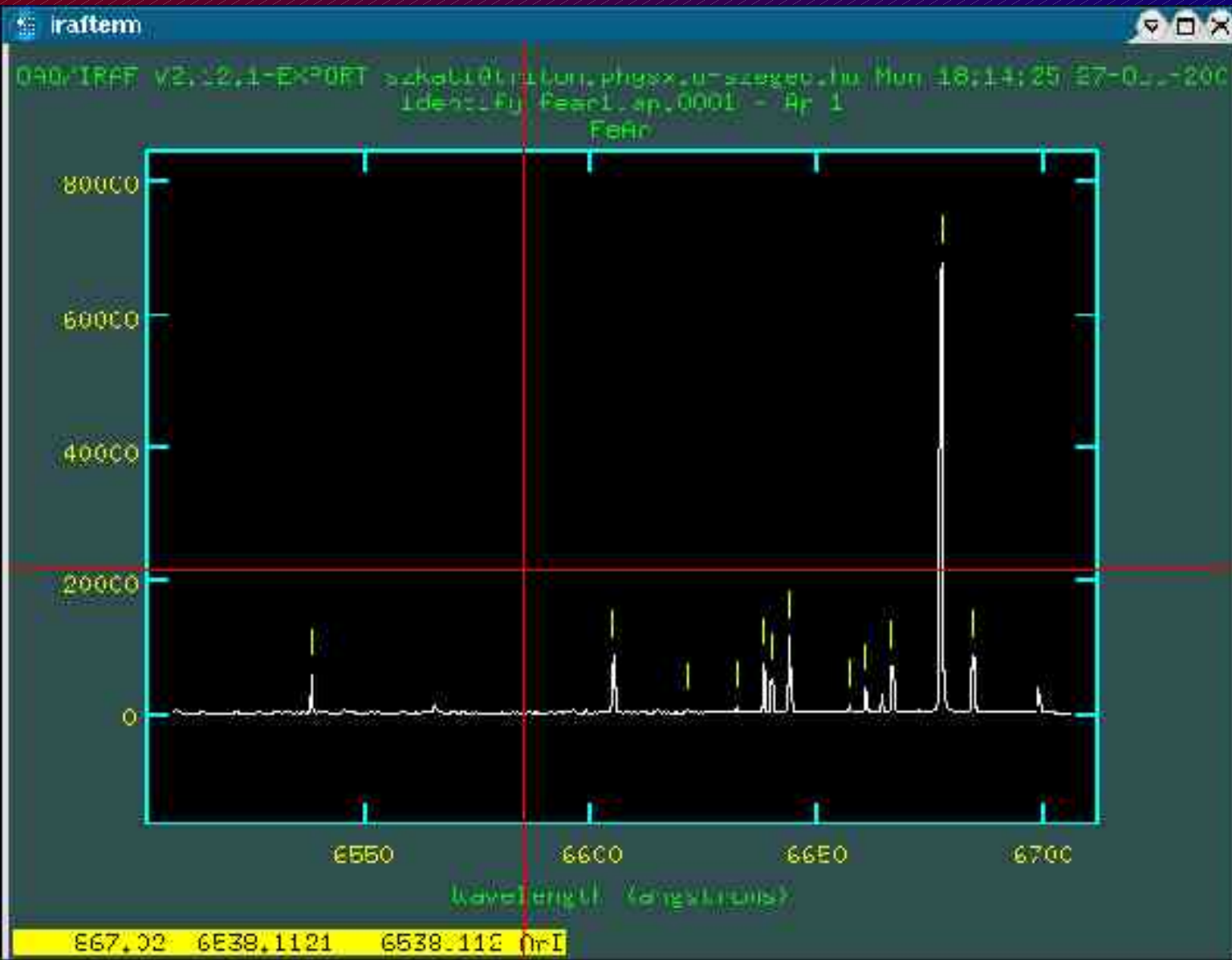
```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = identify  
more  
(niterat= 0) Rejection iterations  
(low_rej= 3.) Lower rejection sigma  
(high_rej= 3.) Upper rejection sigma  
(grow = 0.) Rejection growing radius  
(autowri= no) Automatically write to database  
(graphic= stdgraph) Graphics output device  
(cursor = ) Graphics cursor input  
crval = Approximate coordinate (at reference pixel)  
cdelt = Approximate dispersion  
(aidpars= ) Automatic identification algorithm parameters  
(mode = q1)  
  
ESC=? for HELP
```

Hullámhossz kalibráció - spektrállámpa



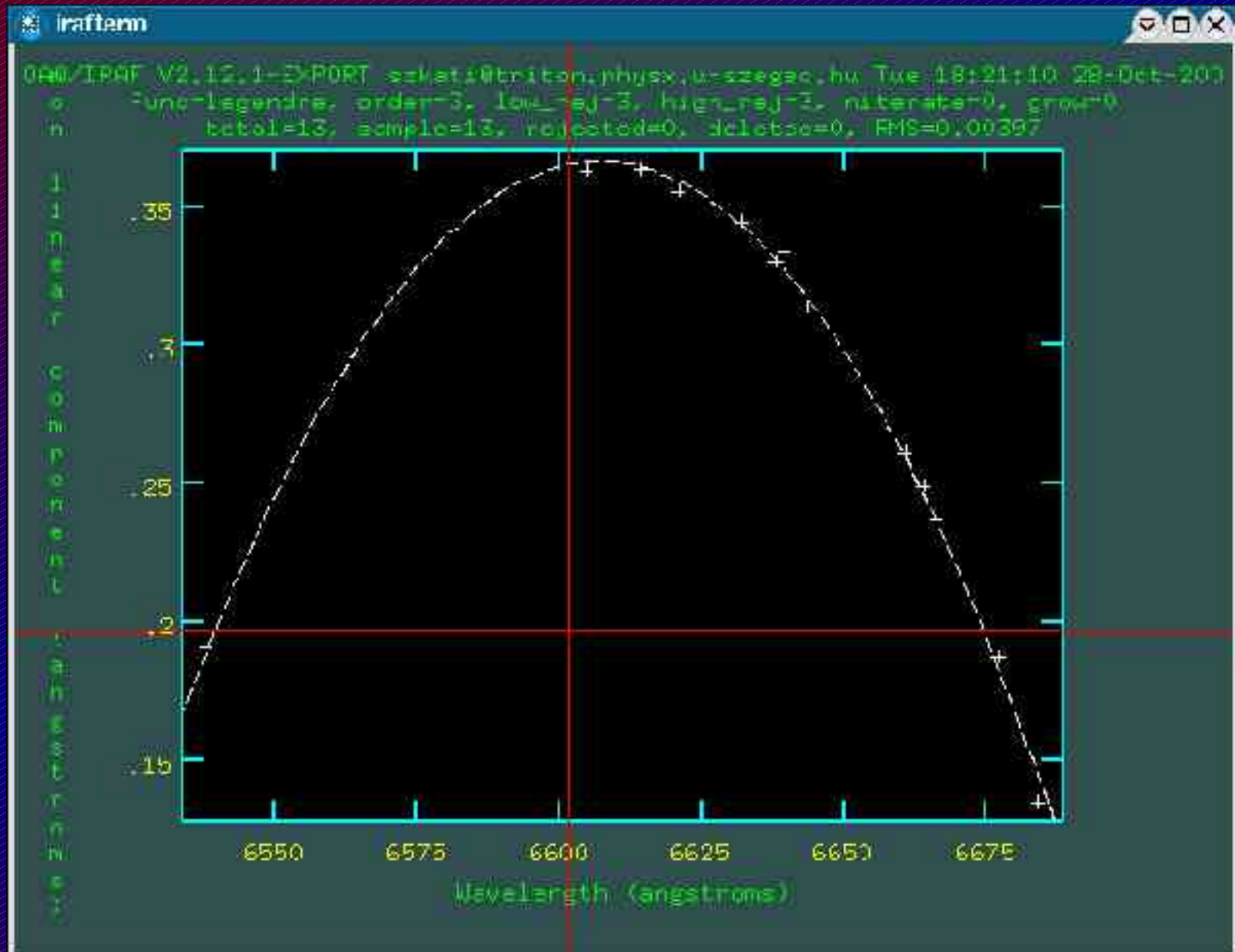
m => azonosítás
d => rontott törlése

Hullámhossz kalibráció - spektrállámpa

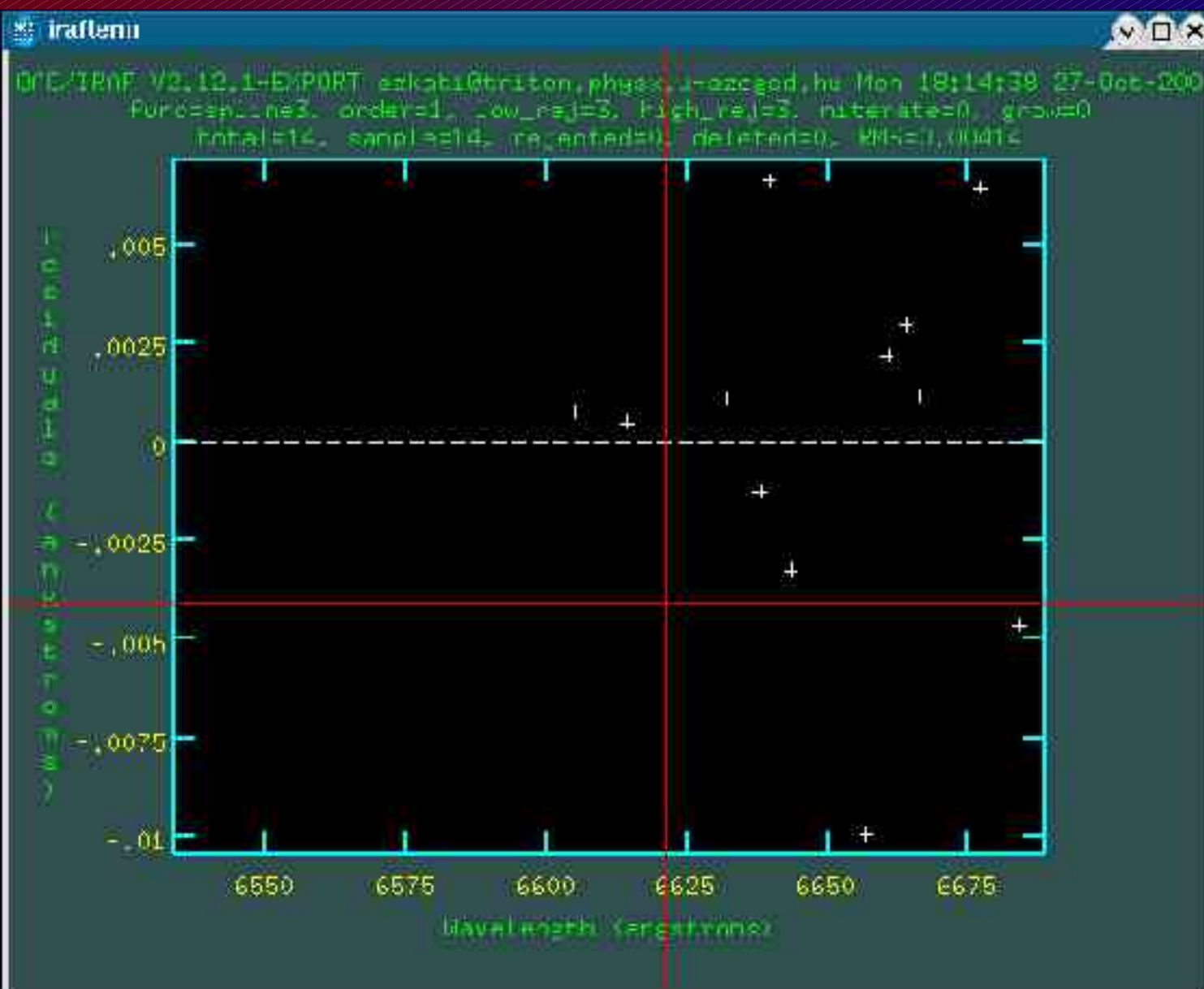


l => sok pont azonosítás
f => diszp.görbe illesztés

Hullámhossz kalibráció - spektrállámpa



Hullámhossz kalibráció - spektrállámpa



d => törli a pontot

f => új diszp. görbe illesztés

Hullámhossz kalibráció - spektrállámpa

Noao => onedspec => reidentify

A kalibrált spektrum alapján bekalibrálja a többi spektrállámpa spektrumot.

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = reidentify  
  
referenc=      fear1.ap.0001 Reference image  
images =      fear2.ap.0001 Images to be reidentified  
(interac=      yes) Interactive fitting?  
(section=      middle line) Section to apply to two dimensional images  
(newaps =      yes) Reidentify apertures in images not in reference?  
(overrid=      no) Override previous solutions?  
(refit =       yes) Refit coordinate function?  
  
(trace =       no) Trace reference image?  
(step =        10) Step in lines/columns/bands for tracing an image  
(nsum =        10) Number of lines/columns/bands to sum  
(shift =       0.) Shift to add to reference features (INDEF to sea  
(search =      0.) Search radius  
(nlost =       0) Maximum number of features which may be lost  
  
(radius=      5.) Centering radius  
(thresho=     0.) Feature threshold for centering  
More  
  
ESC=? for HELP
```

=> bekalibrált spektrum
=> összes spektrállámpa
spektrum

Hullámhossz kalibráció - spektrállámpa

Noao => onedspec => reidentify

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = reidentify  
More  
(addfeat=          no) Add features from a line list?  
(coordli=  linelists$fear.dat) User coordinate list  
(match =          -3.) Coordinate list matching limit  
(maxfeat=          50) Maximum number of features for automatic identif  
(minsep =          2.) Minimum pixel separation  
  
(databas=          database) Database  
(logfile=          logfile) List of log files  
(plotfil=          ) Plot file for residuals  
(verbose=          no) Verbose output?  
(graphic=          stdgraph) Graphics output device  
(cursor =          ) Graphics cursor input  
  
answer =          yes  Fit dispersion function interactively?  
crval   =          Approximate coordinate (at reference pixel)  
cdelt   =          Approximate dispersion  
(aidpars=          ) Automatic identification algorithm parameters  
More  
ESC-? for HELP
```

Futatas közben:
q =>kilépés;

Fejléc szerkesztés

Noao => onedspec => refspectra

Fejlécbe beírja, hogy mely spektrumok tartoznak össze.

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = refspectra  
  
input =  obj.ap.0001 List of input spectra  
(referen= fear1.ap.0001,fear2.ap.0001) List of reference spectra  
(apertur= ) Input aperture selection list  
(refaps = ) Reference aperture selection list  
(ignorea= yes) Ignore input and reference apertures?  
(select = average) Selection method for reference spectra  
(sort = ) Sort key  
(group = ) Group key  
(time = no) Is sort key a time?  
(timewra= 17.) Time wrap point for time sorting  
(overrid= no) Override previous assignments?  
(confirm= yes) Confirm reference spectrum assignments?  
(assign = yes) Assign the reference spectra to the input spectra  
(logfile= STDOUT,logfile) List of logfiles  
(verbose= no) Verbose log output?  
answer = Accept assignment?  
(mode = ql)  
  
? for HELP
```

=> csillag spektruma
=> a spektrumhoz tartozó
spektrállámpa spektrumok

Hullámhossz kalibráció - objektum

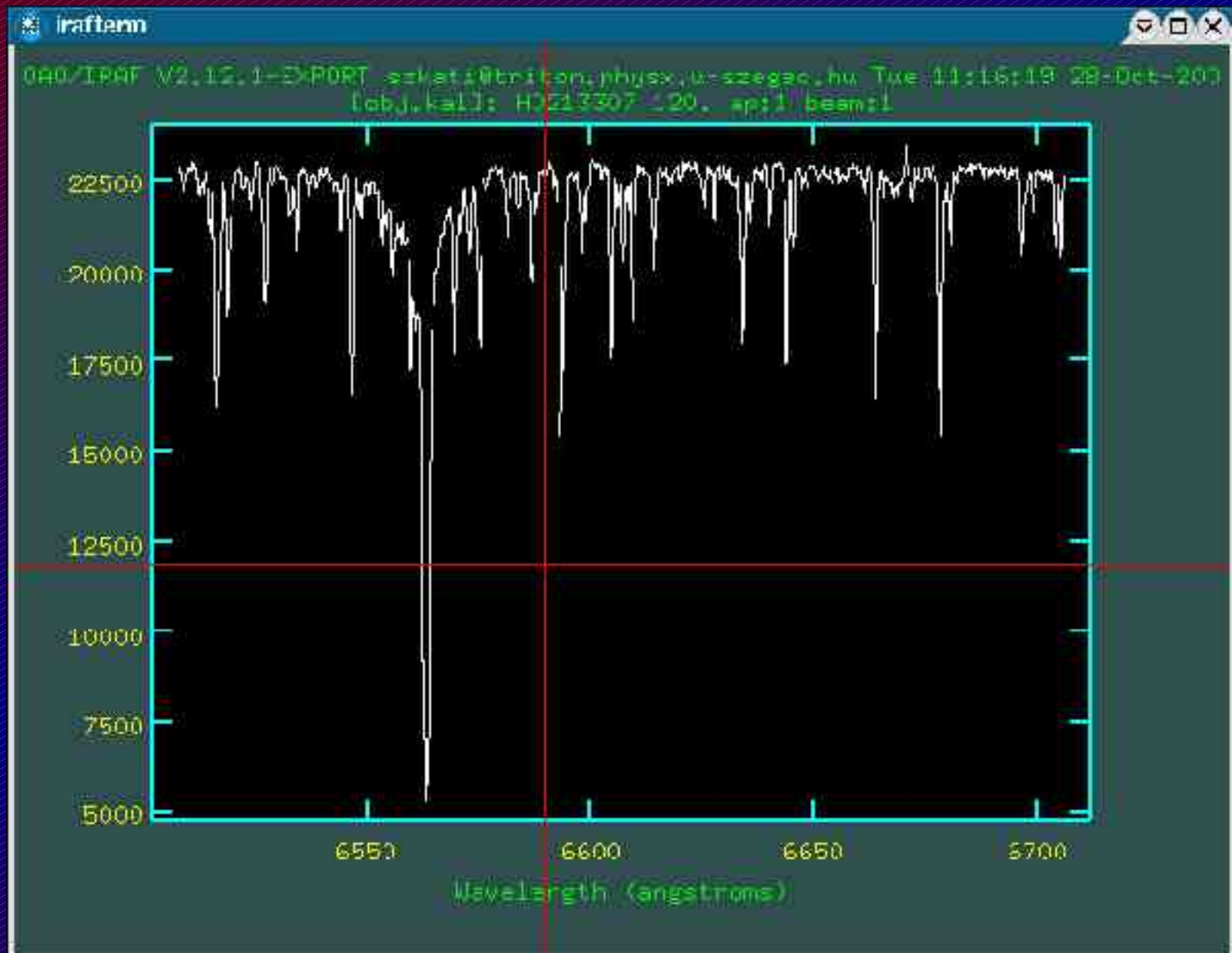
Noao => onedspec => dispcor

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = dispcor  
  
input = obj.ap,0001 List of input spectra  
output = obj.kal List of output spectra  
(linear= yes) Linearize (interpolate) spectra?  
(database= 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 = ) Conserve flux?  
(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?  
More  
ESC=? for HELP
```

=> bemen? file
=> kimen? file

Hullámhossz kalibráció - objektum

Megnézni: Noao => onedspec => splot



Kontinuum normálás

Noao => onedspec => continuum

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = continuum  
  
input = obj.kal Input images  
output = obj.nor Output images  
(lines = *) Image lines to be fit  
(bands = 1) 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= spline3) Fitting function  
(order = 1) Order of fitting function  
(low_rej= 2.) Low rejection in sigma of fit  
More  
  
ESC-? for HELP
```

=> bemen? file
=> kimen? file

=> függvény
=> illesztés rendje

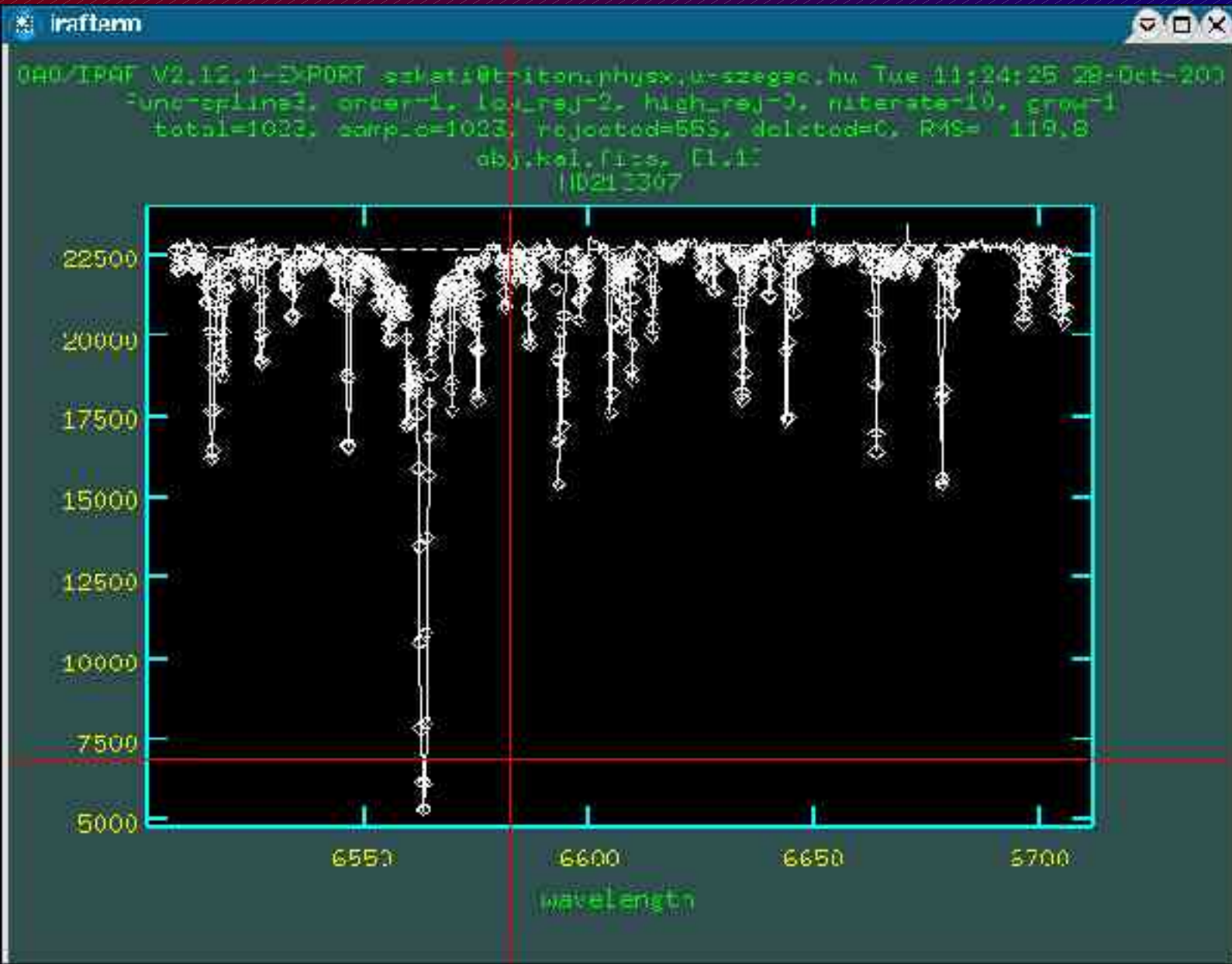
Kontinuum normálás

Noao => onedspec => continuum

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = onedspec  
TASK = continuum  
more  
(high_re= 0.) High rejection in sigma of fit  
(niterat= 10) Number of rejection iterations  
(grow = 1.) Rejection growing radius in pixels  
(markrej= yes) Mark rejected points?  
(graphic= stdgraph) Graphics output device  
(cursor = ) Graphics cursor input  
ask = yes  
(mode = ql)  
  
ESC=? for HELP
```

Kontinuum normálás

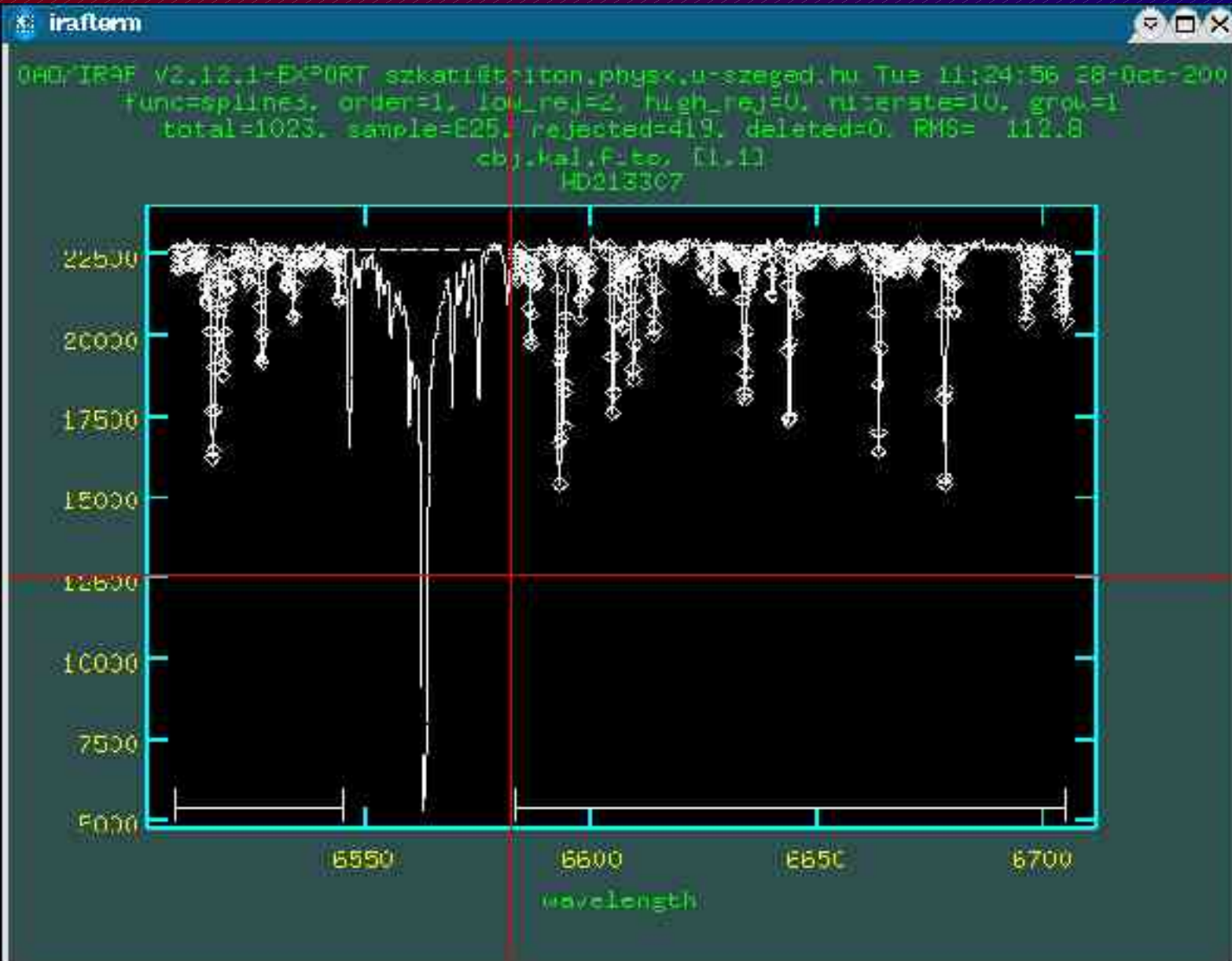
Noao => onedspec => continuum



A pontosság miatt a szélesebb vonalakat ki lehet hagyni.

Kontinuum normálás

Noao => onedspec => continuum



2xs => határok kijelölés
f => új illesztés

Kilépés => q

Kiredukált spektrum

