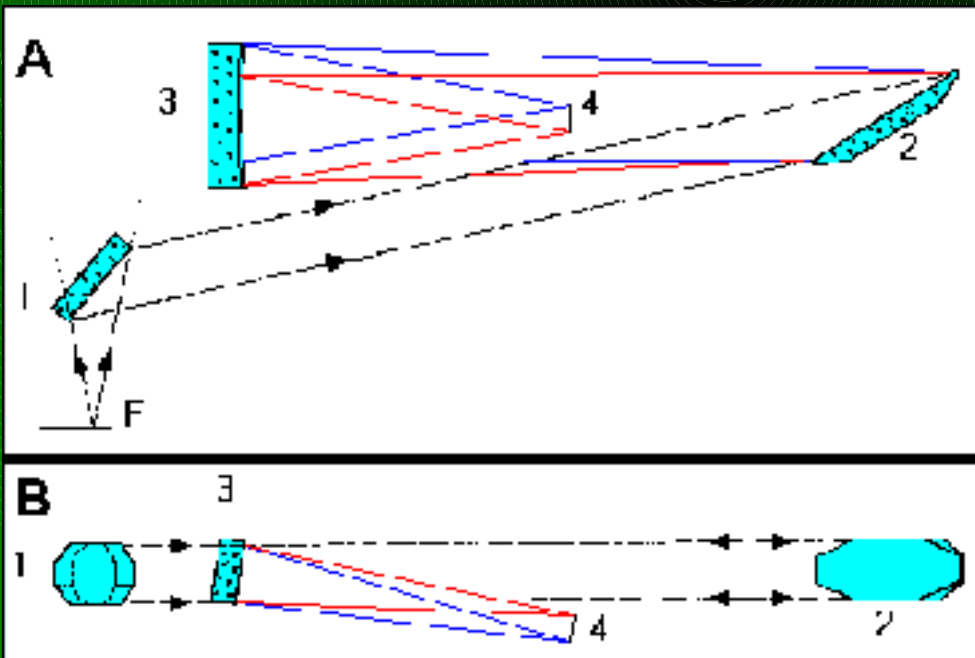


*Echelle spektrumok kiredukálása
az IRAF-ban*

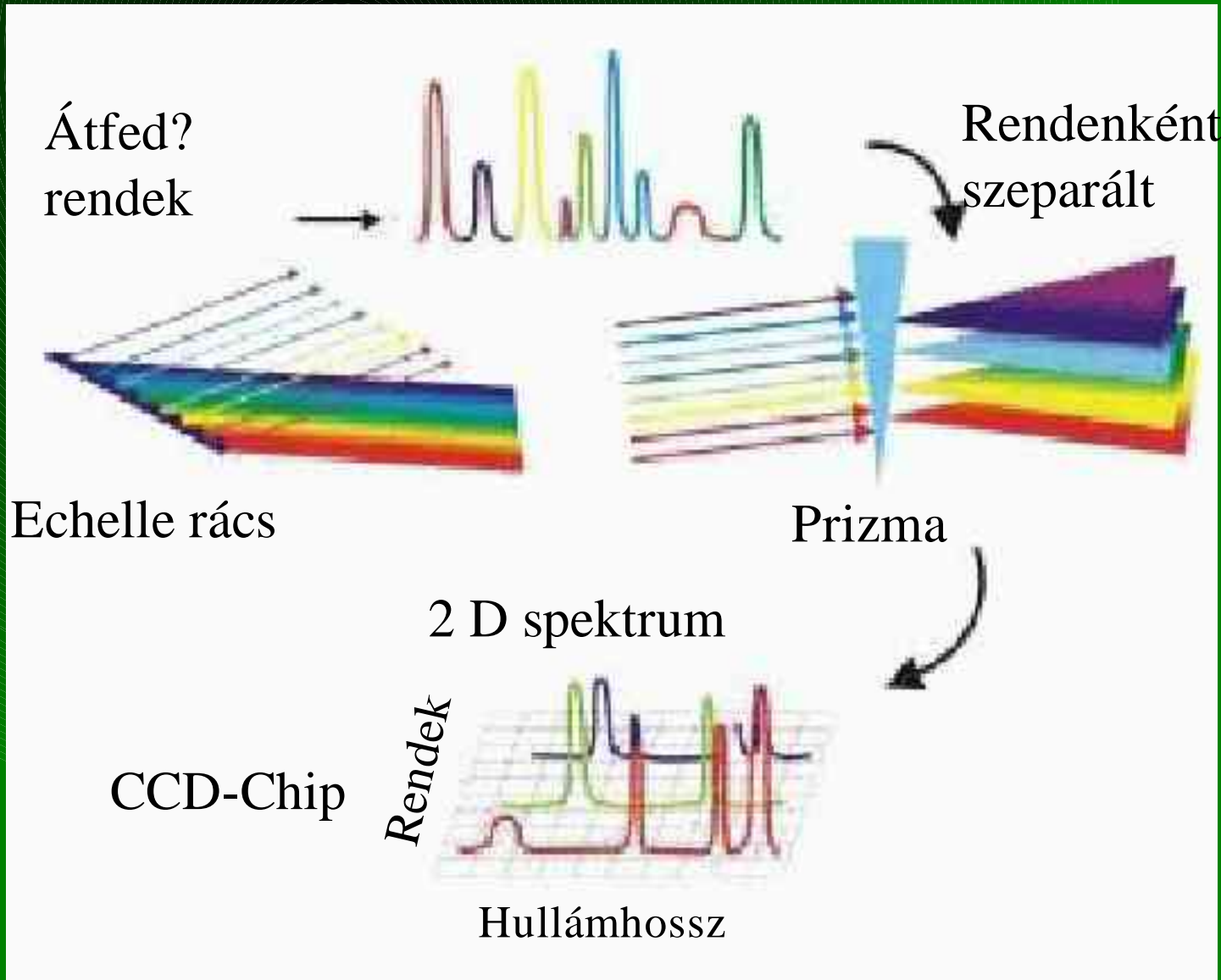
Echelle spektrográf



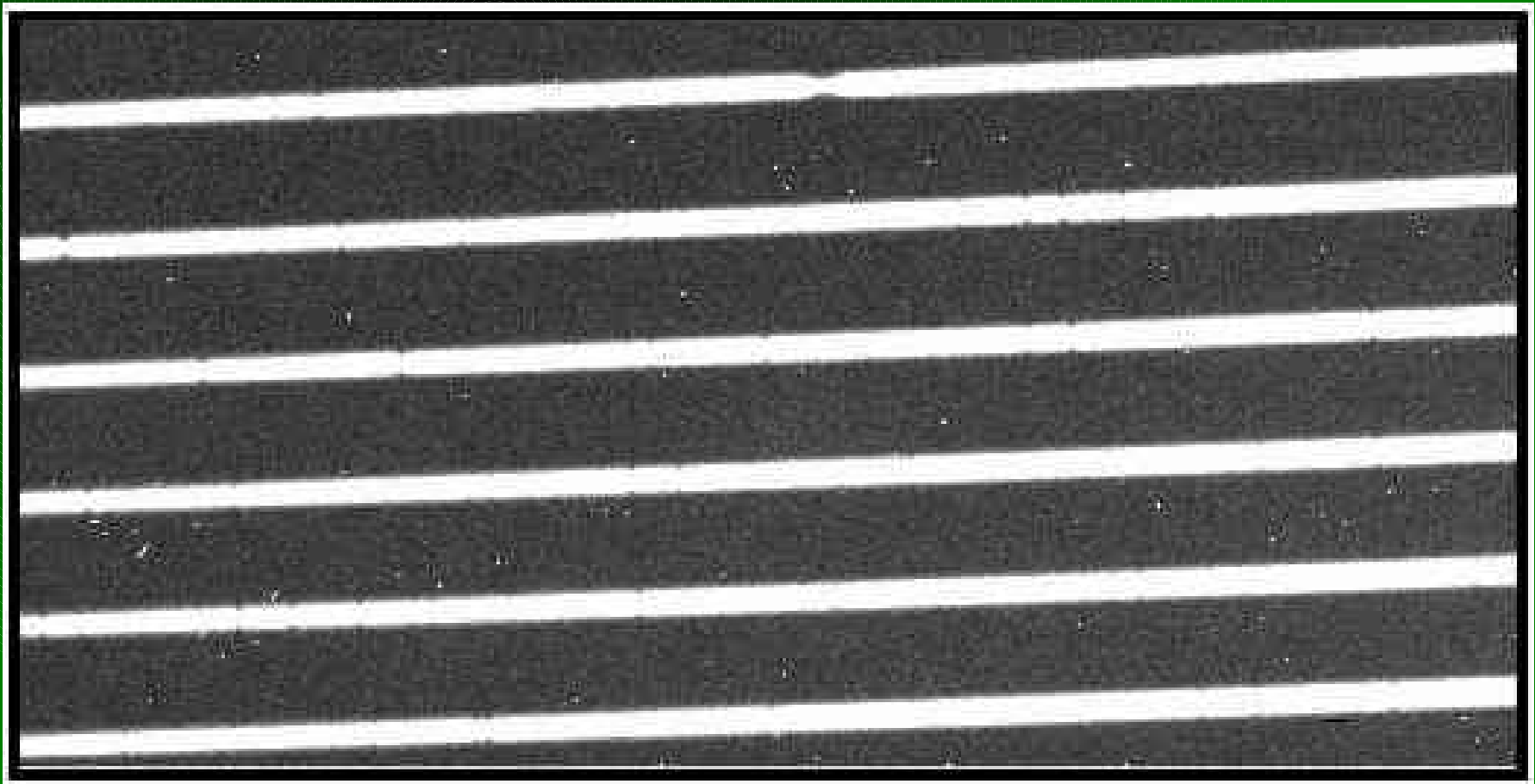
- Kollimátor
- Rács
- Kamera tükör
(kereszt-diszperziós
elem)
- Detektor
(spektrum)

F: A f?tükör
fókuszába helyezett

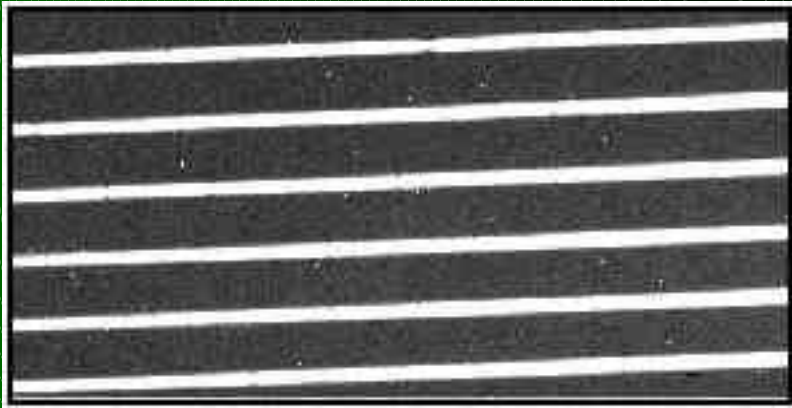
Leképezés



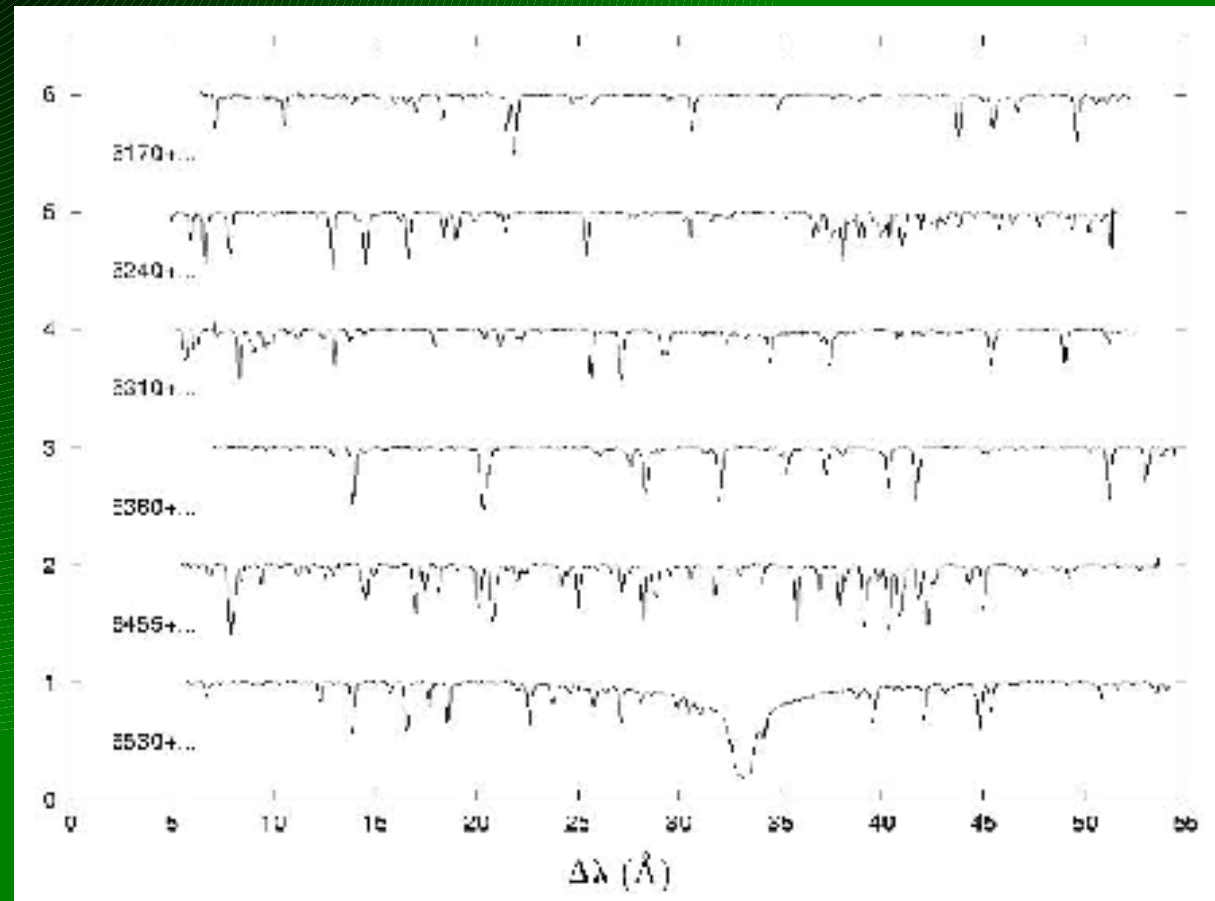
"Nyers" echelle spektrum



Honnan – hova



Redukálatlan kép

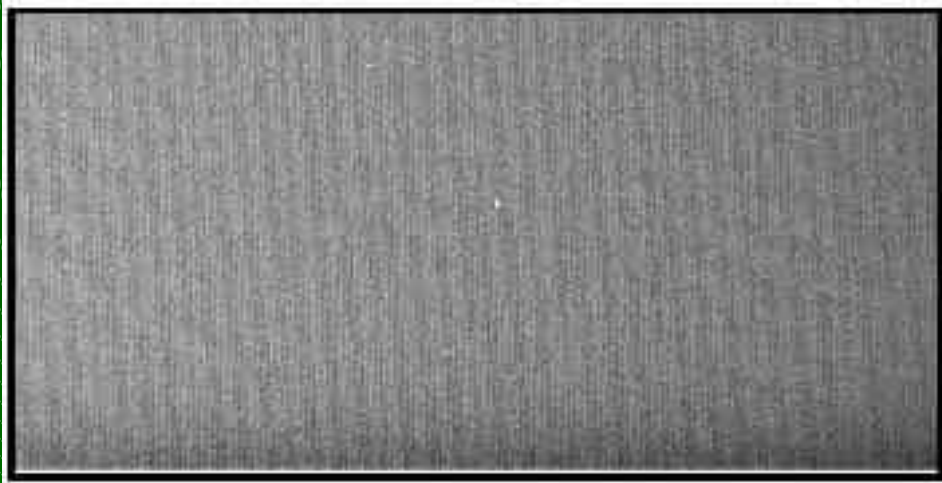


Kontinuum normált,
hullámhossz-kalibrált spektrum

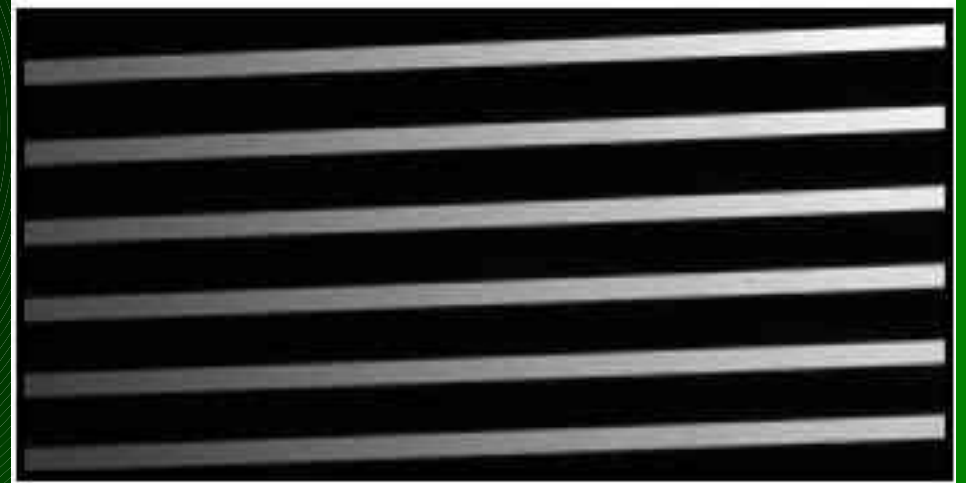
A spektrumok feldolgozása

- Szükséges felvételek:
 - *Objektum spektruma*
 - *Spektrállámpa spektruma* (Hullámhossz kalibráláshoz)
 - *Bias-kép* (0 expozíciós időnél adott pixelhez hány elektron tartozik)
 - *Flatfield-kép* (Az egyes pixelek eltérő érzékenységének figyelembe vételéhez)

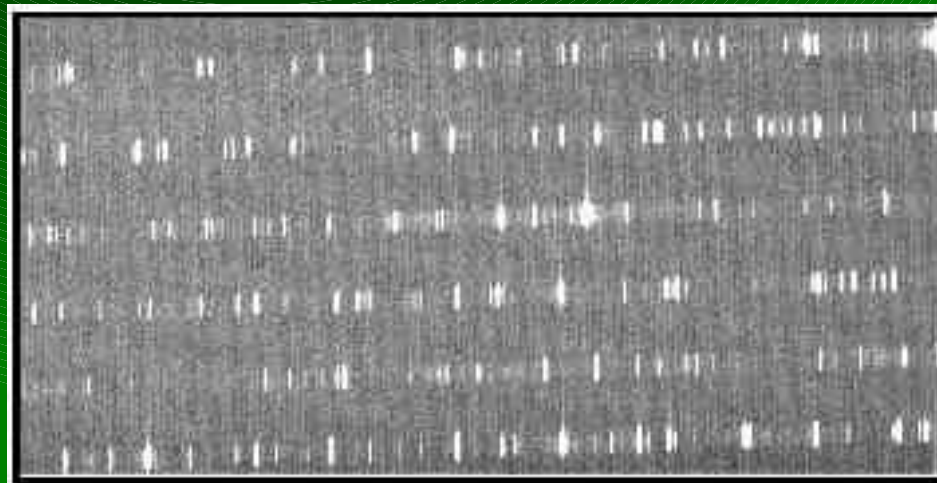
Korrigáló és kalibráló képek



Bias-kép



Flat-kép



Th-Ar spektrállámpa spektruma

Bias korrekció

Átlagolt bias-kép elkészítése:

noao => imred => ccdred => **zerocombine**

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
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  
(rlow = 0) minmax: Number of low pixels to reject  
(rhigh = 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
=> kombináció típusa

Bias korrekció

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= 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 = 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?  
(fringe= 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
```

Minden nemre (no)
van állítva, kivéve:
zerocor

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
```

Bias korrekció

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 = q1)  
  
ESC-? for HELP
```


Bias korrekció

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 = ) 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?  
(fringe= 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
```

Kozmikus sugár korrekció

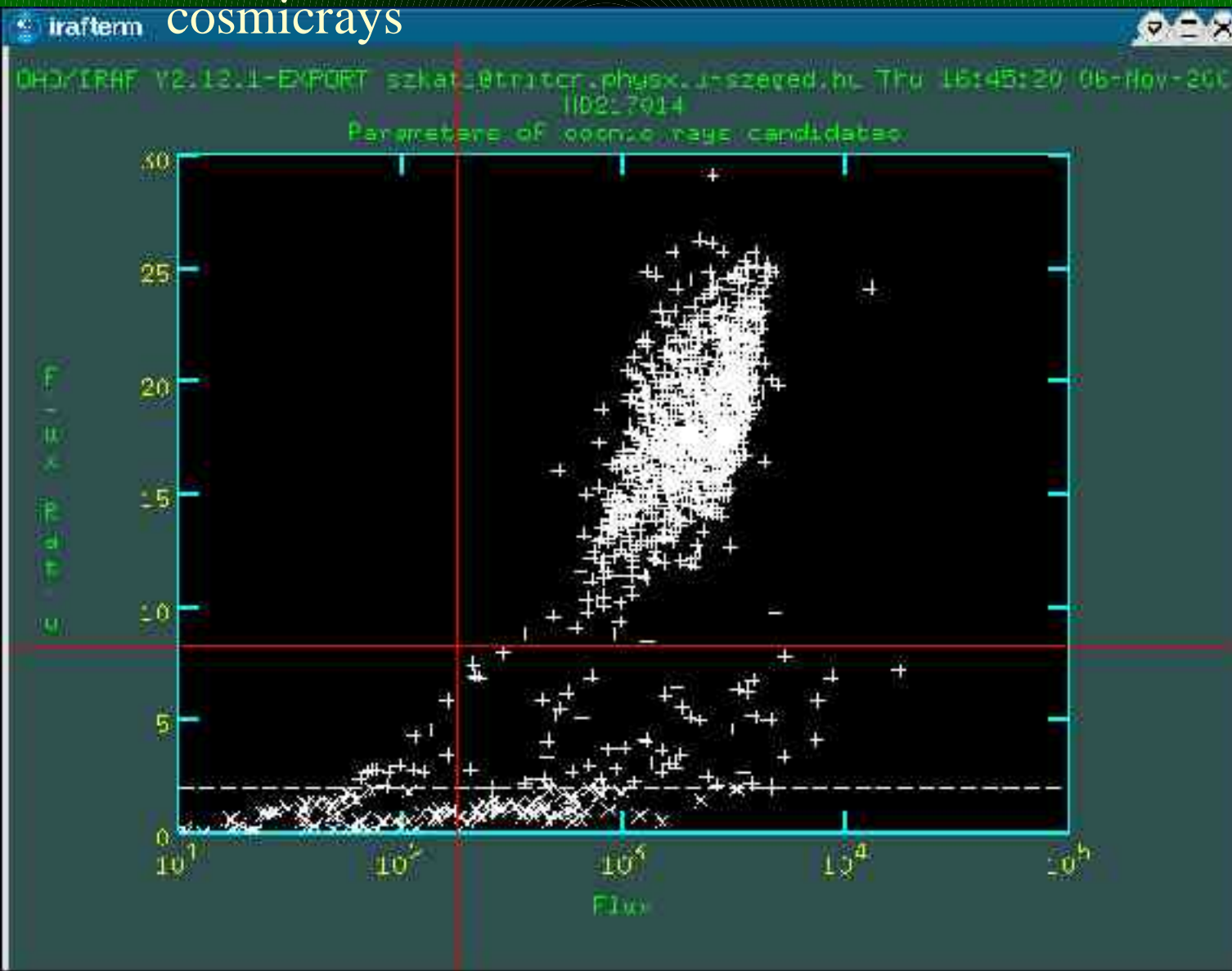
A kozmikus sugár korrekciója:

noao => imred => crutil => cosmicrays

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = crutil  
TASK = cosmicrays  
  
input = 51Peg List of images in which to detect cosmic rays  
output = 51Peg_korr List of cosmic ray replaced output images (optio  
(crmask= ) List of bad pixel masks (optional)  
  
(thresho= 25.) Detection threshold above mean  
(fluxrat= 2.) Flux ratio threshold (in percent)  
(npasses= 5) Number of detection passes  
(window = 5) Size of detection window  
  
(interac= yes) Examine parameters interactively?  
(train = no) Use training objects?  
(objects= ) Cursor list of training objects  
(savefil= ) File to save train objects  
(plotfil= ) Plot file  
(graphic= stdgraph) Interactive graphics output device  
(cursor = ) Graphics cursor input  
answer = yes Review parameters for a particular image?  
More  
ESC-? for HELP
```

Kozmikus sugár korrekció

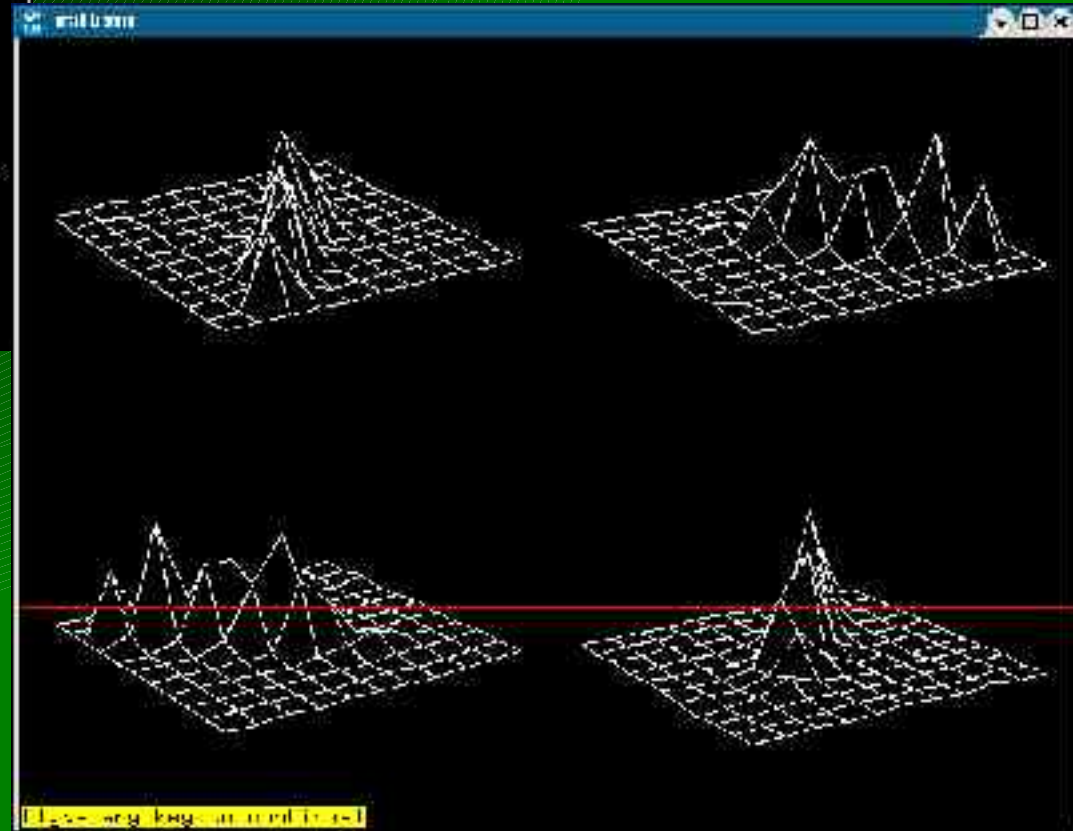
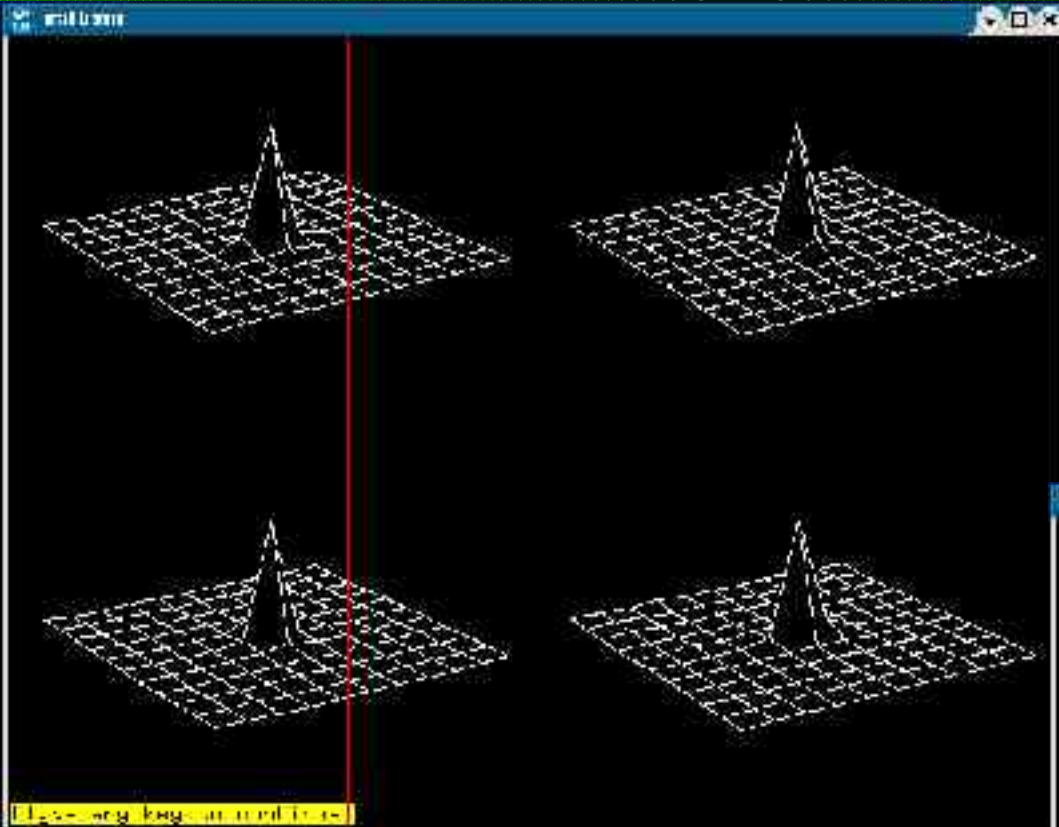
noao => imred => crutil =>
cosmicrays



t: szint megemelése
d: pont törlése
s: profil megnézése

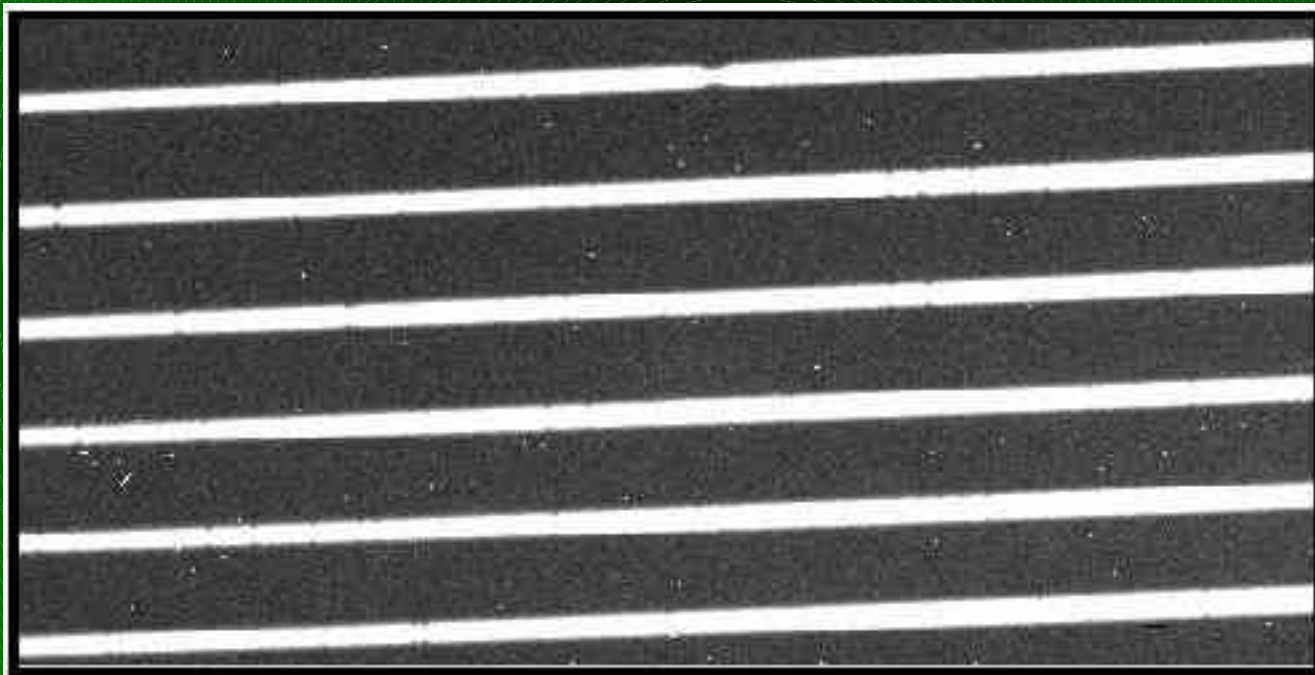
Kozmikus sugár korrekció

Kozmikus sugár

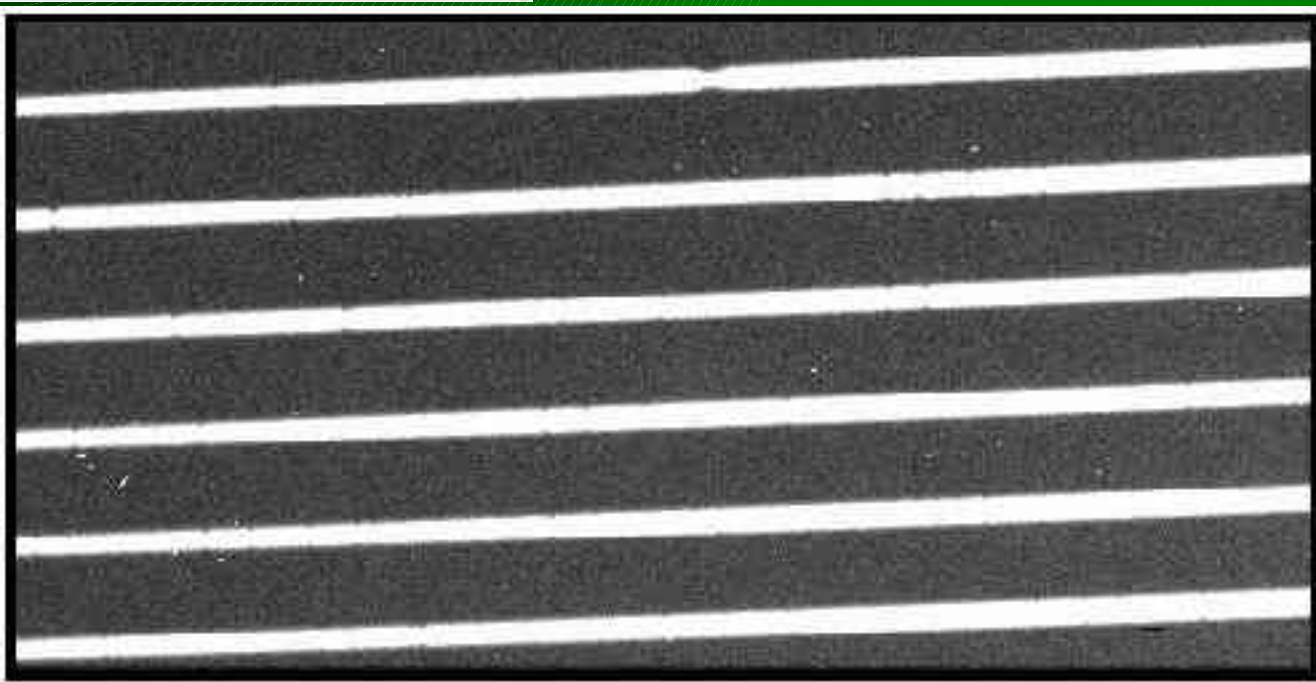


Oldalról bees? kozmikus sugár

Kozmikus sugár korrekció



"Nyers" kép



Kozmikus sugármentes kép

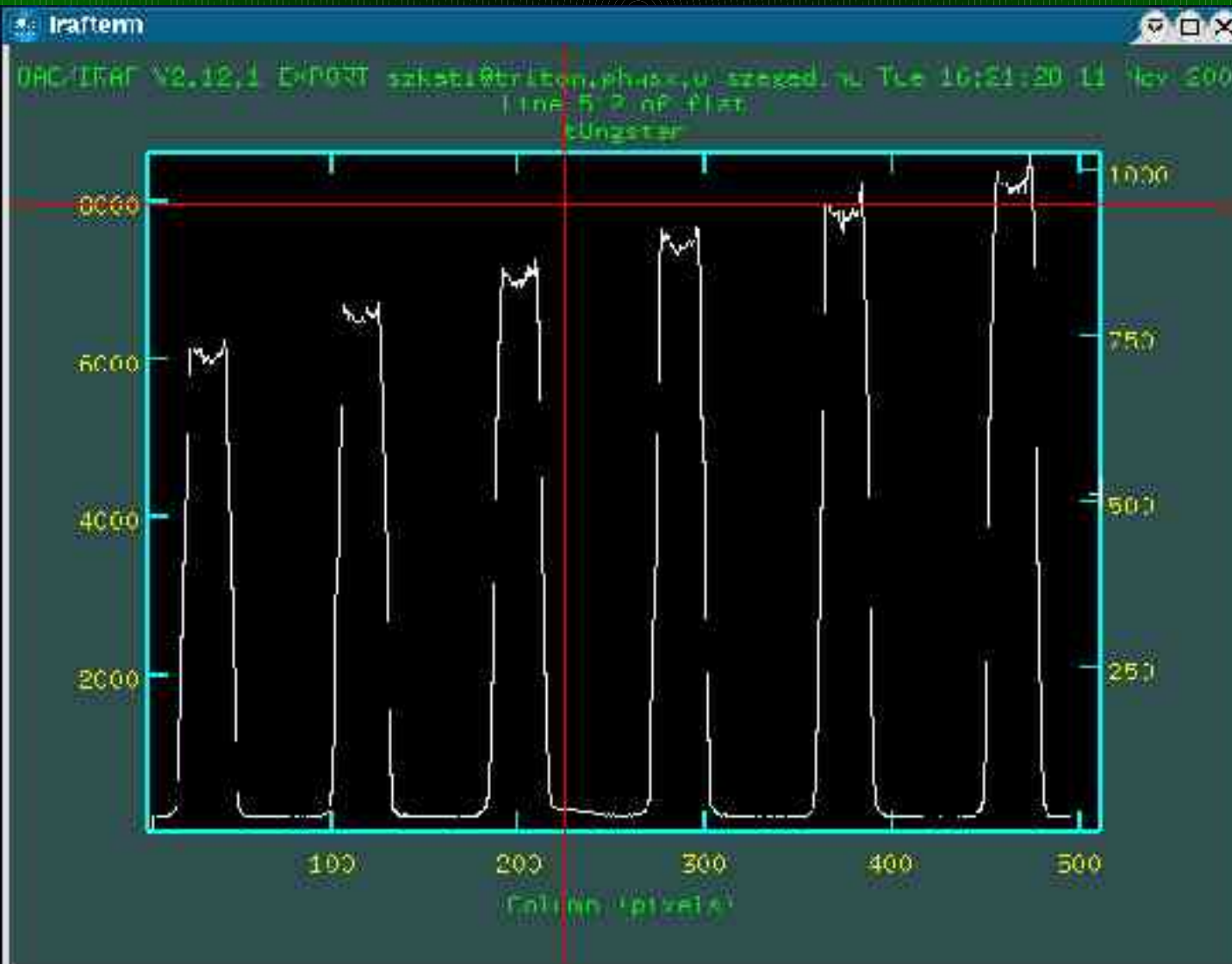
Flatfield-kép

- Átlagolt flat kép elkészítése:
noao => imred => ccdred => 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 = ccdclip) 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
```


Flatfield-kép

Implot flat:



Apetúra szélessége:
`apedit.width=<érték>`
Apertúrák szeparációja:
`apfind.minsep=<érték>`
`apresize.ylevel=0.5`
`apresize.bkg=no`

Flatfield-kép

noao => imred => echelle => apflatten

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = echelle  
TASK = apflatten  
  
input = flat List of images to flatten  
output = Flat List of output flatten images  
(apertur= ) Apertures  
(referen= ) List of 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 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  
More  
  
ESC-? for HELP
```

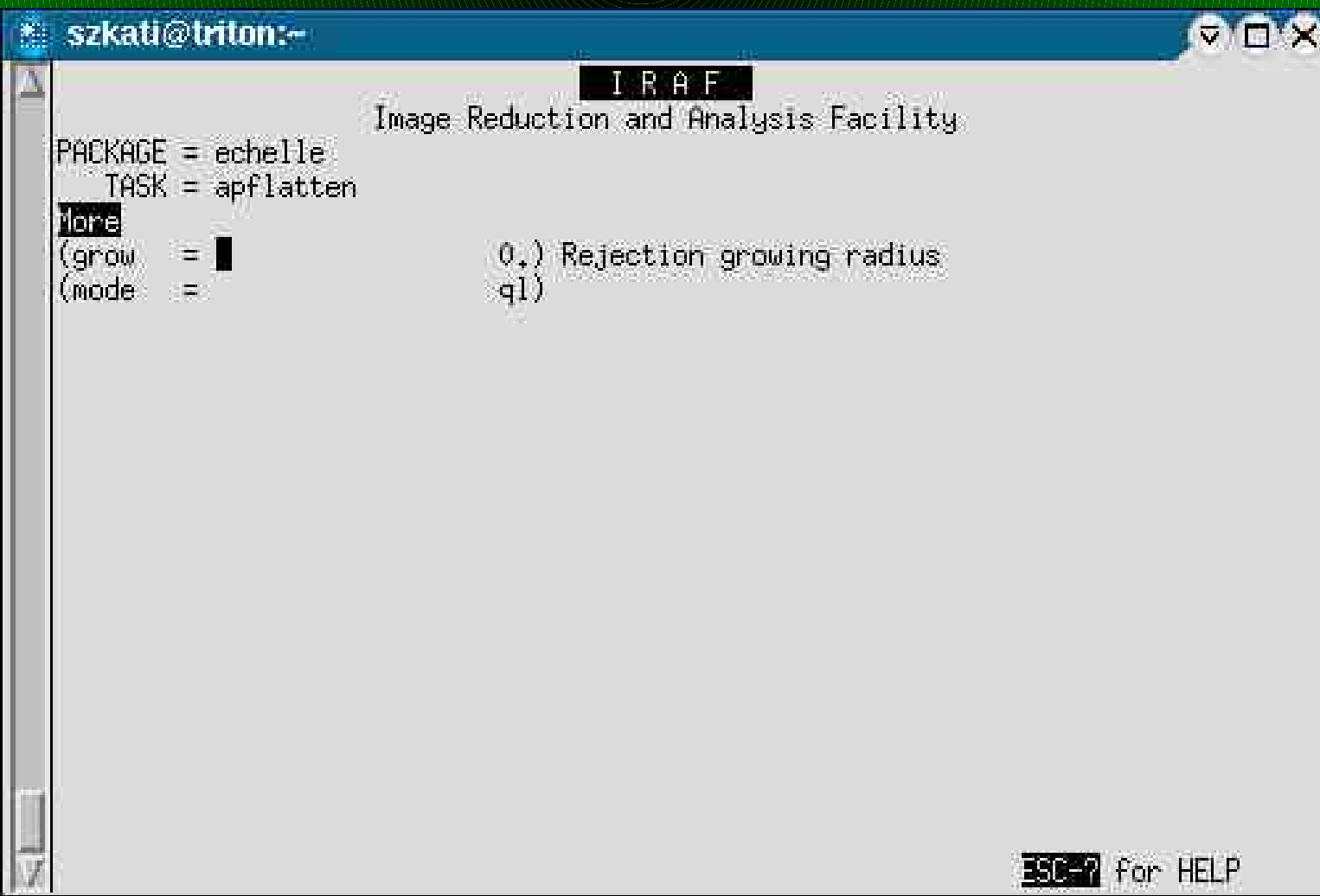
Flatfield-kép

noao => imred => echelle =>
apflatten

```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = echelle  
TASK = apflatten  
more  
(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= legendre) Fitting function for normalization spectra  
(order = 5) Fitting function order  
(sample = *) Sample regions  
(naverag= 1) Average or median  
(niterat= 10) Number of rejection iterations  
(low_rej= 3.) Lower rejection sigma  
(high_re= 3.) High upper rejection sigma  
more  
ESC-? for HELP
```

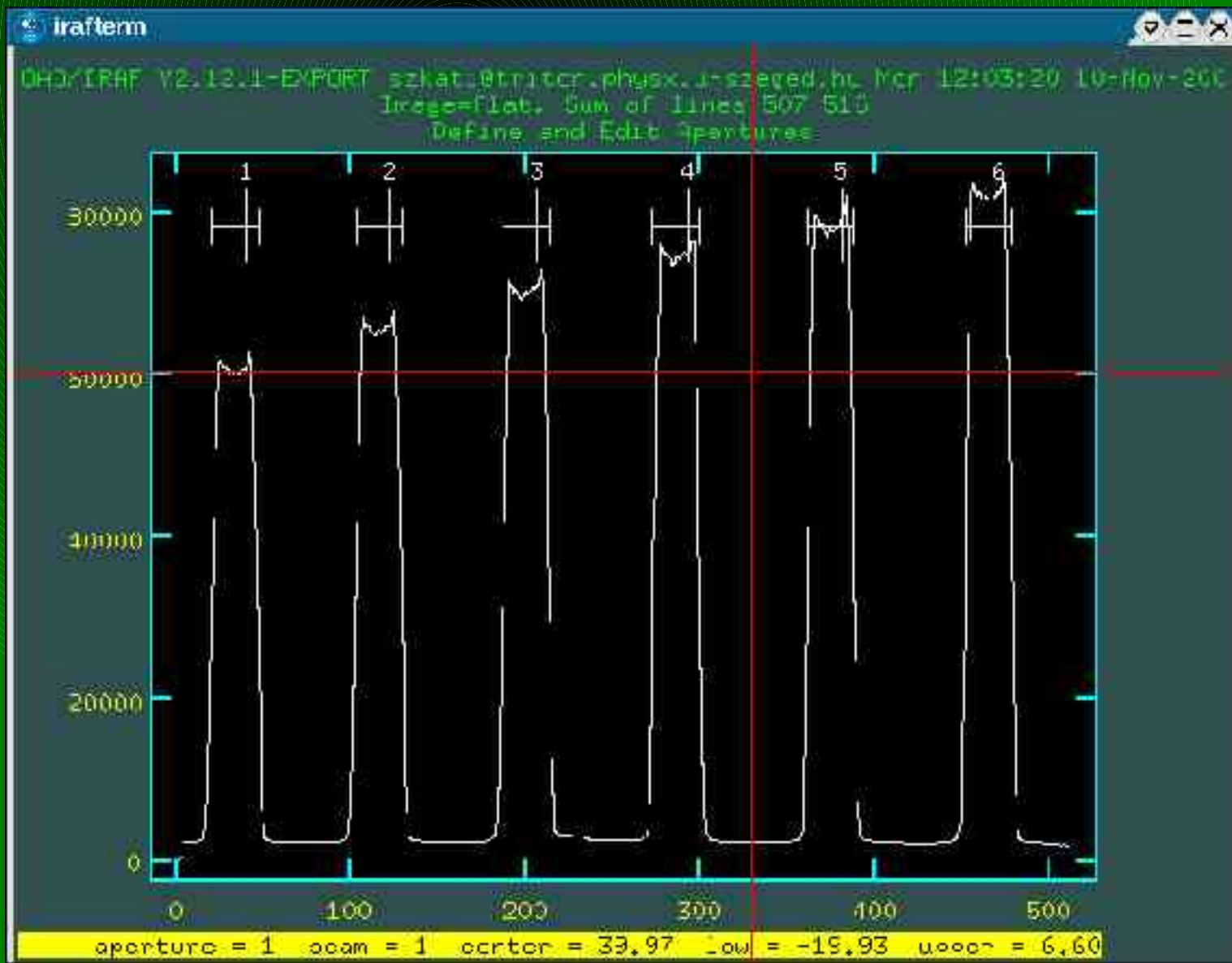

Flatfield-kép

noao => imred => echelle =>
apflatten

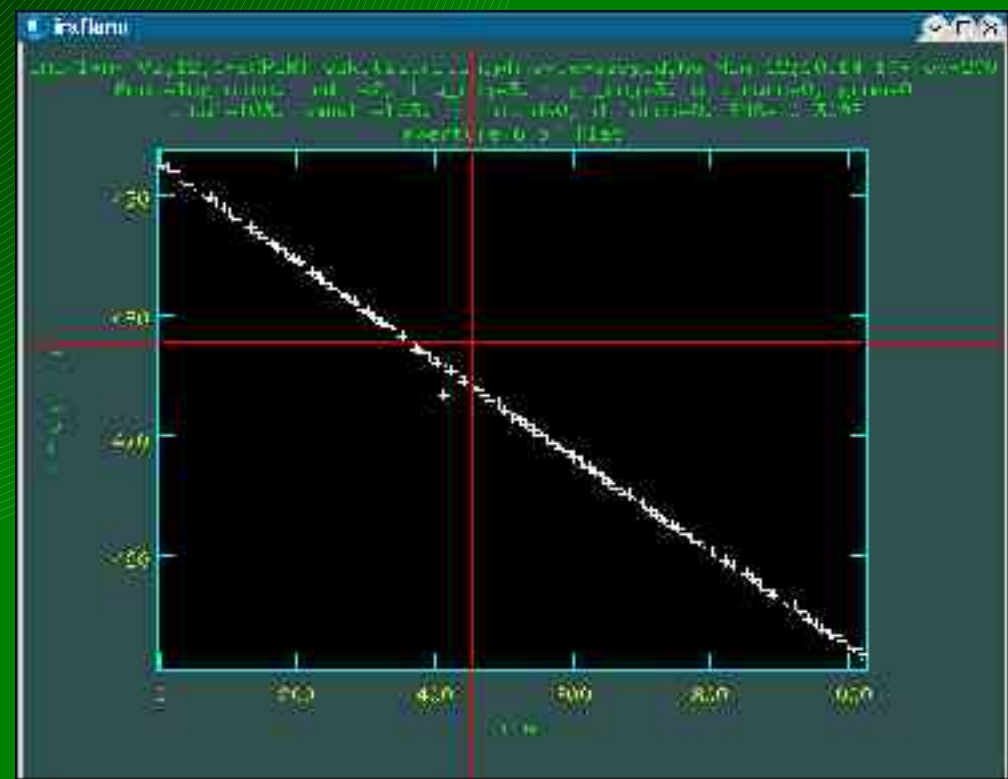
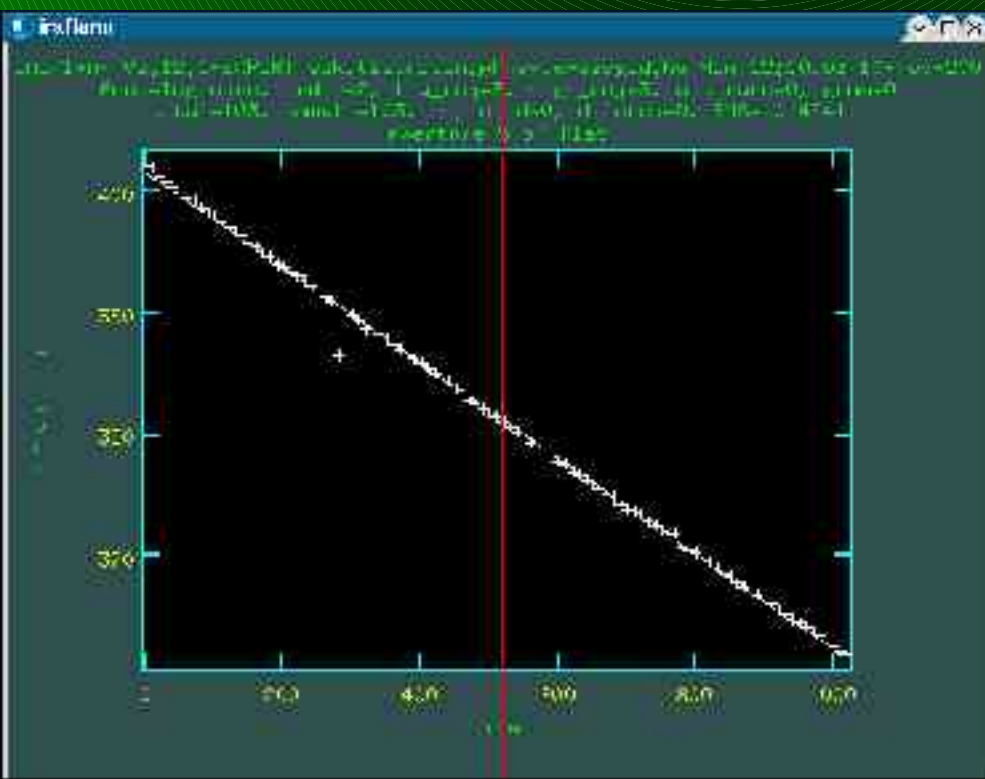
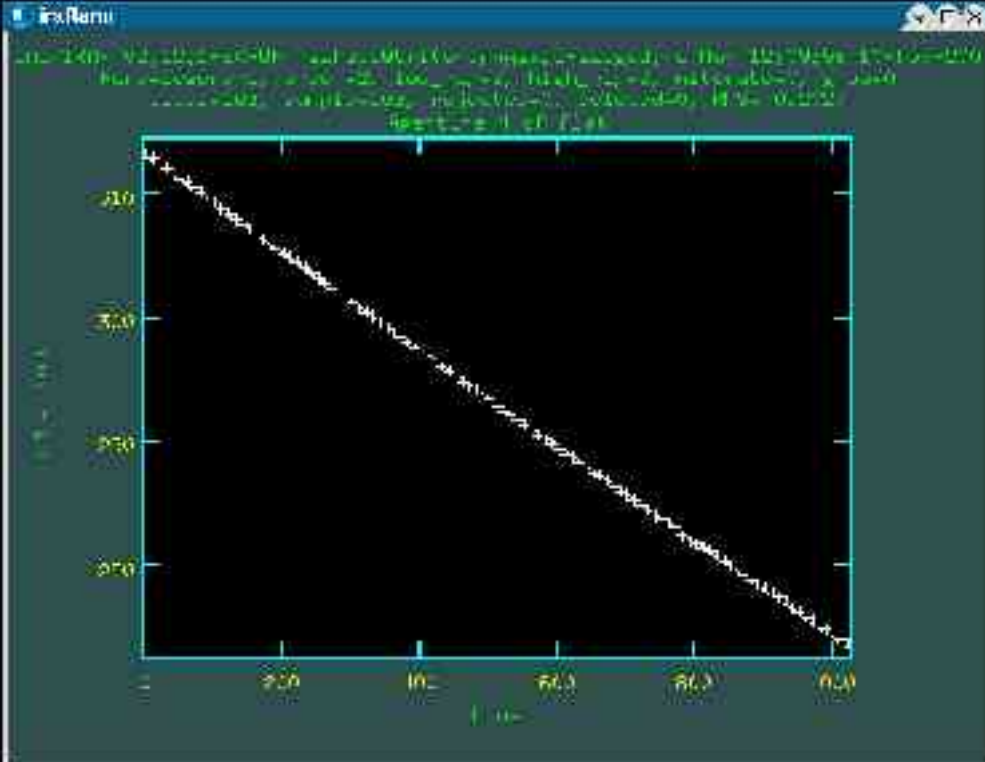


```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = echelle  
TASK = apflatten  
more  
(grow = 0.) Rejection growing radius  
(mode = ql)  
  
ESC-? for HELP
```

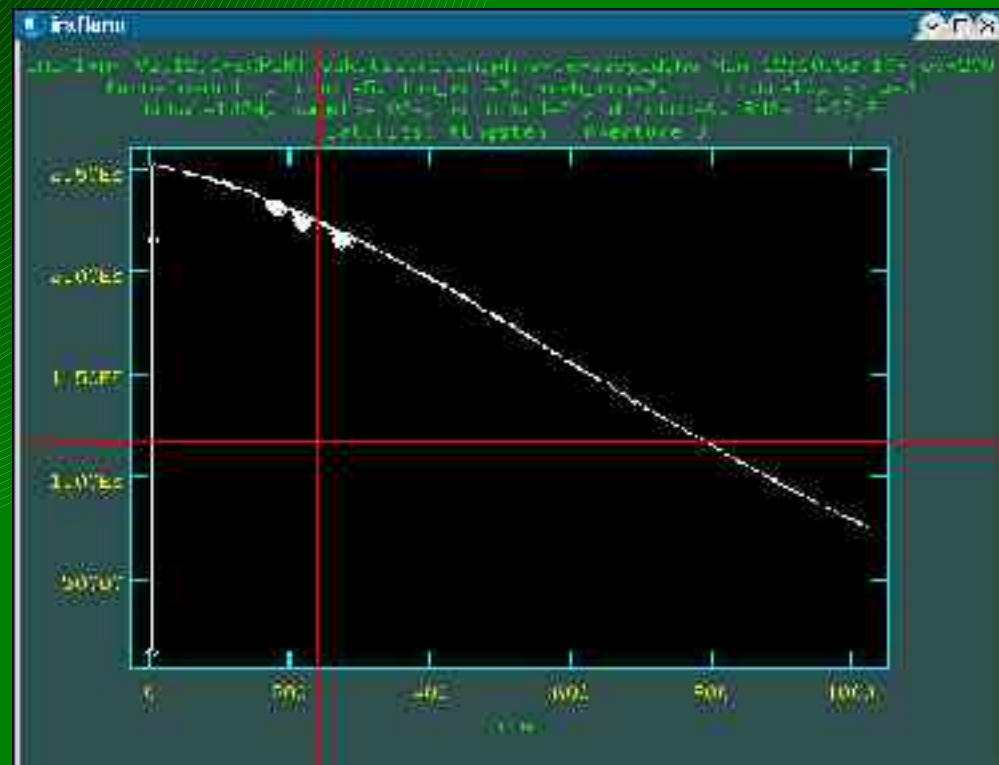
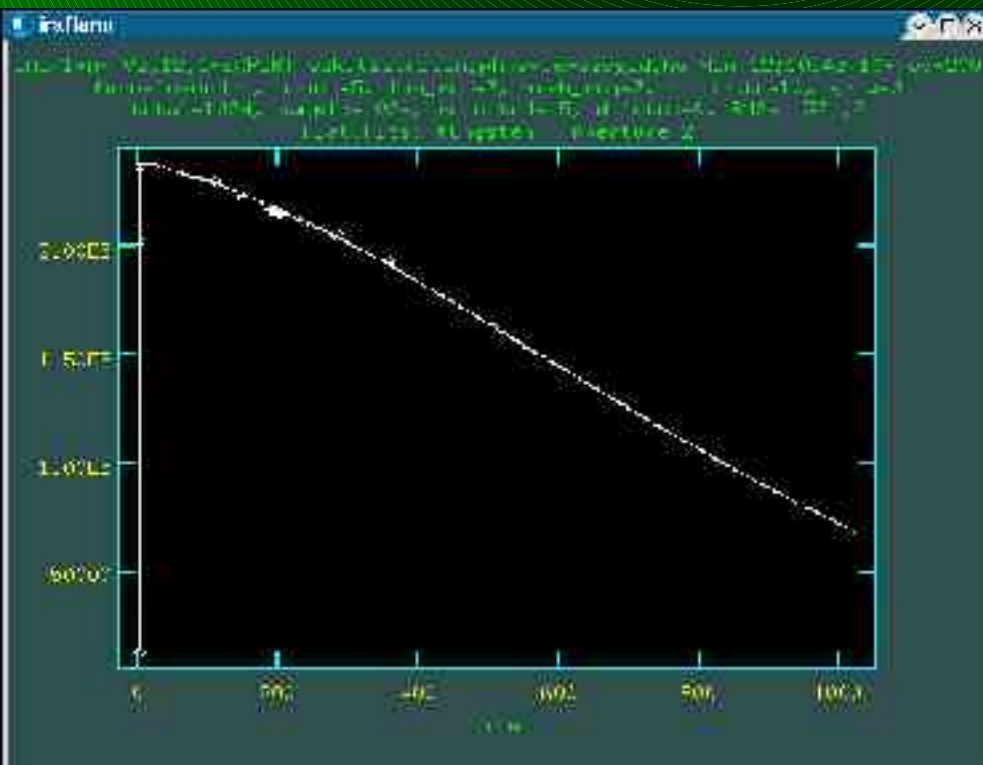
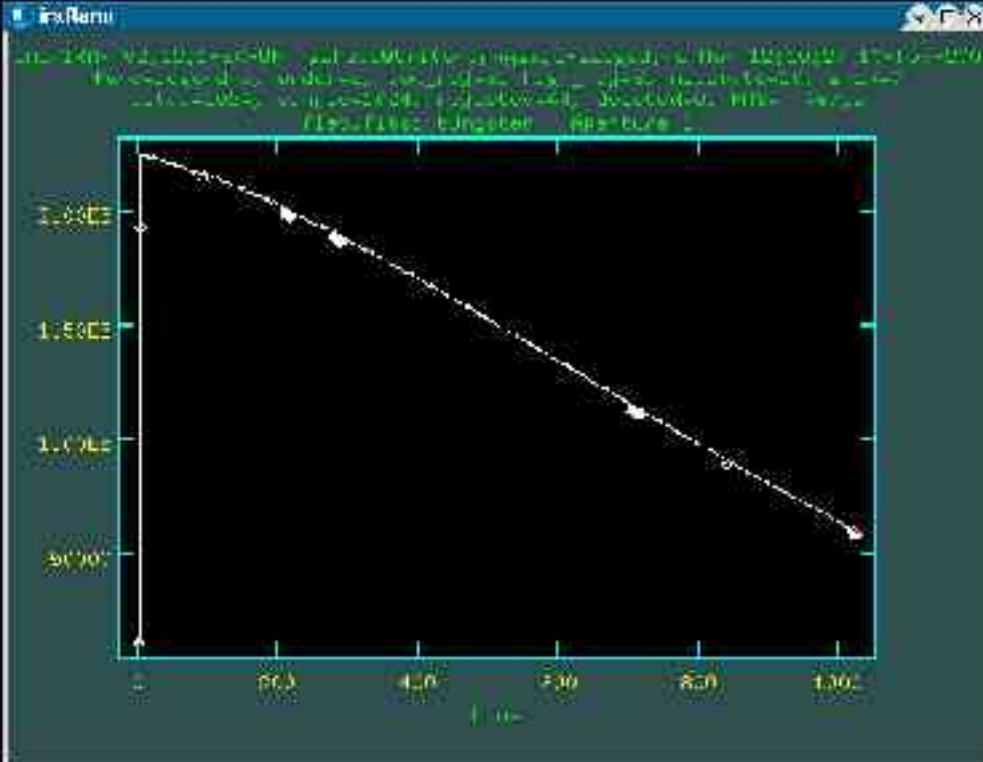
Flatfield-kép => apertúrák

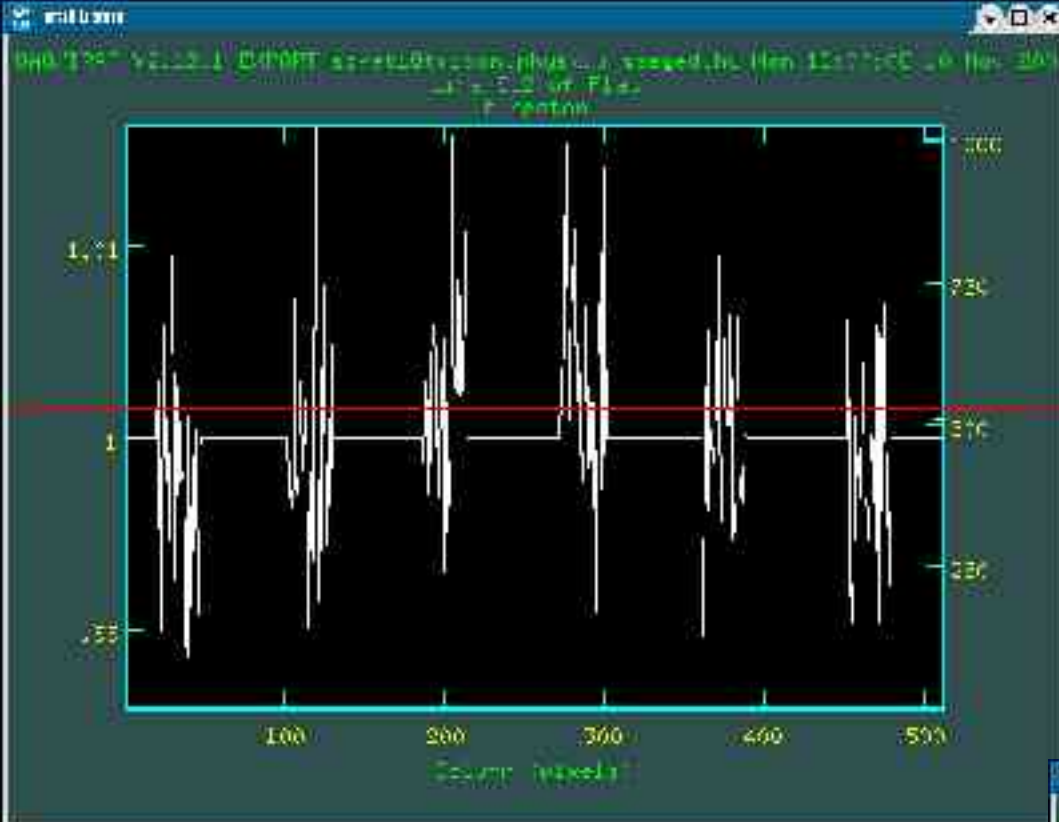


Apertúrák



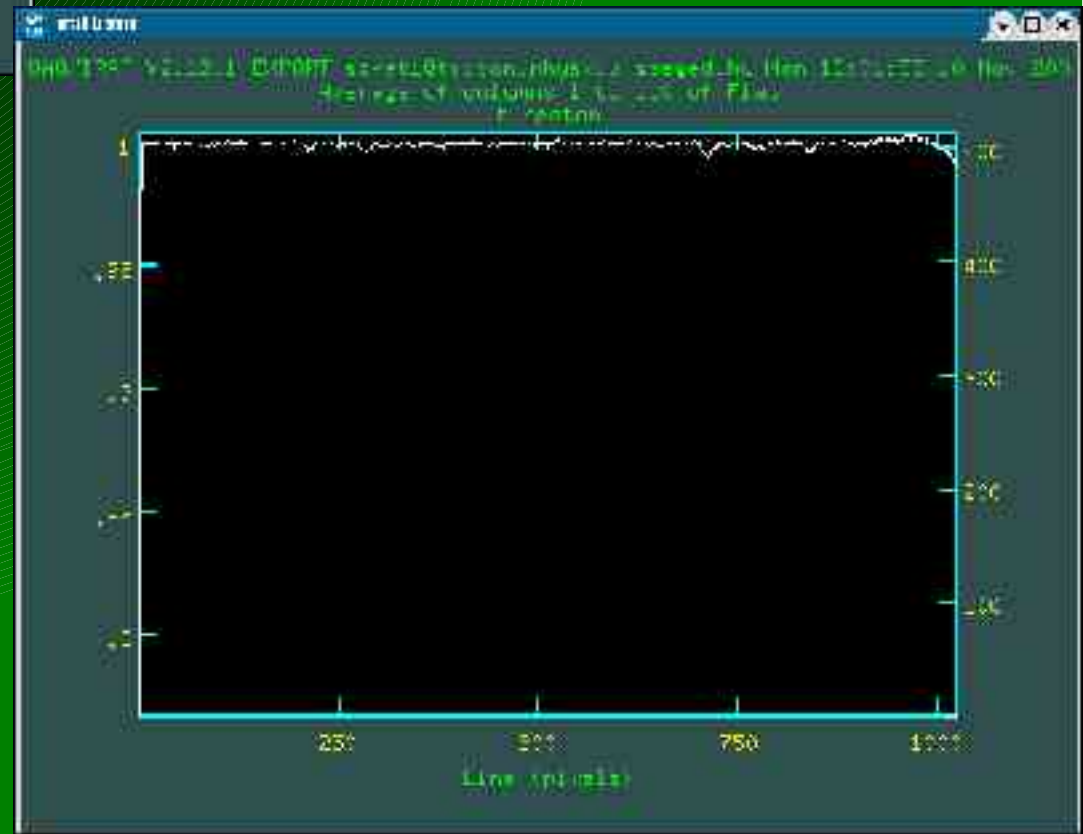
Apertúra



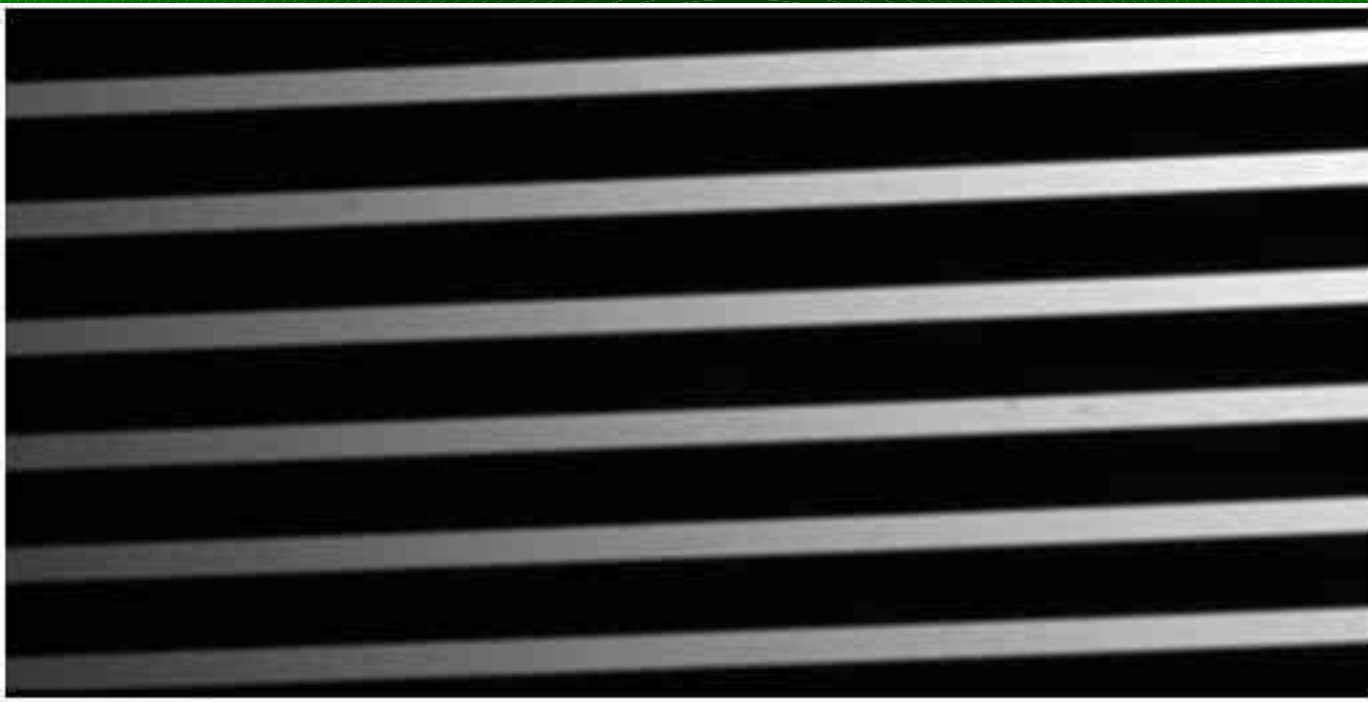


Flatfield-kép

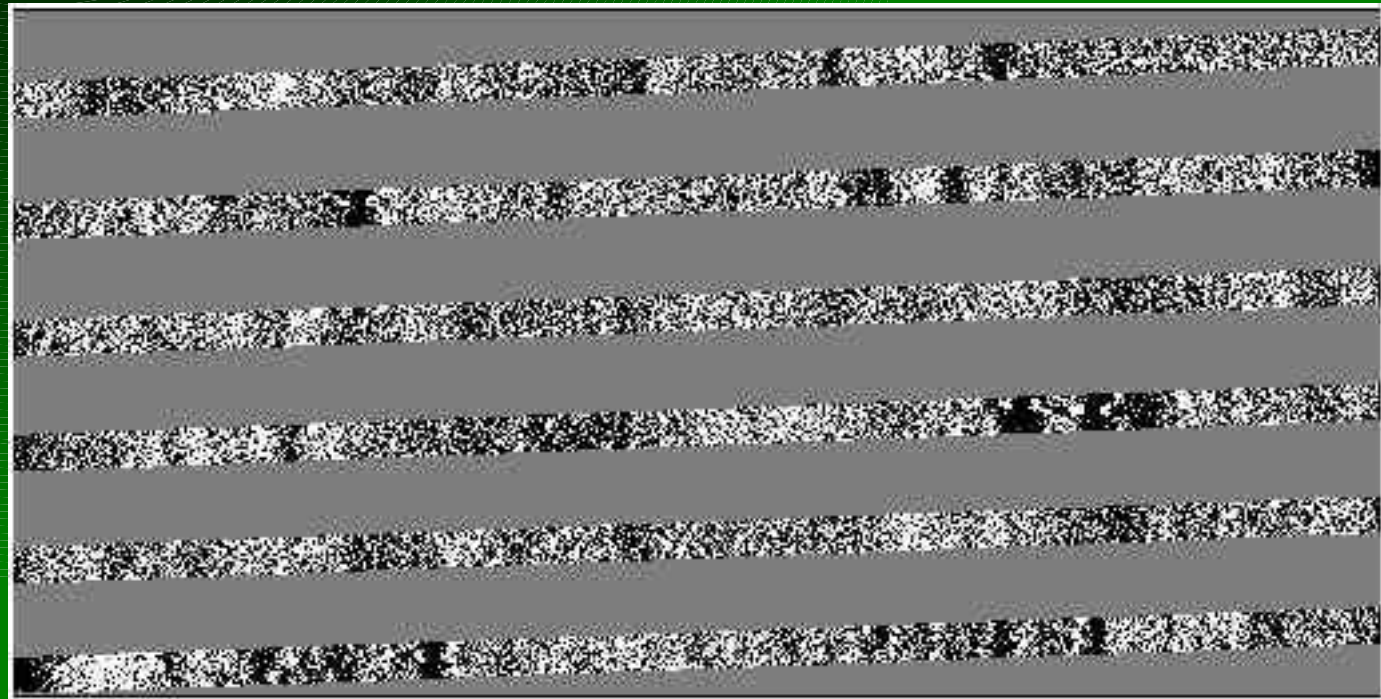
Implot Flat;
:c oszlop



Flatfield-kép



Eredeti átlagolt flat-kép



Flat korrekcióhoz
elkészített flat-kép

Flatfield-korrekcio

Noao => imred => ccdred => ccdproc

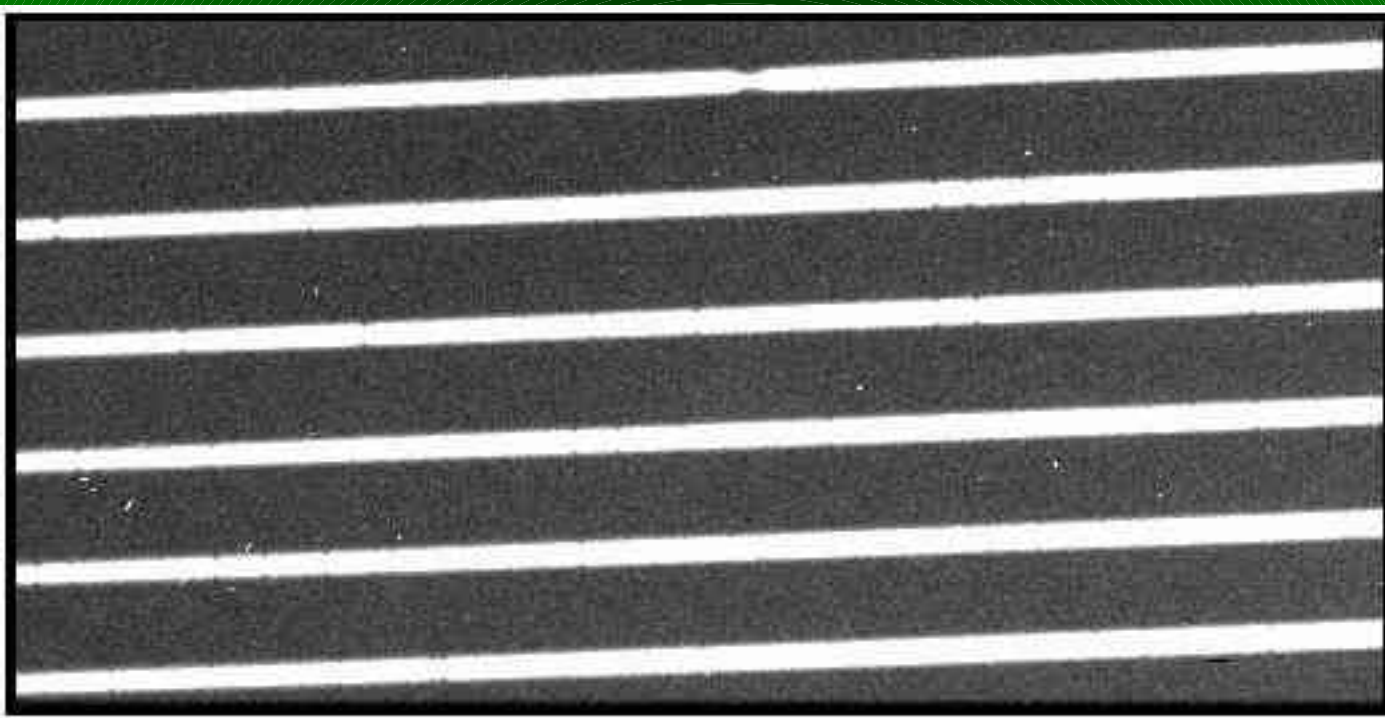
```
szkati@triton:~  
IRAF  
Image Reduction and Analysis Facility  
PACKAGE = ccdred  
TASK = ccdproc  
  
images = 51Peg_korr List of CCD images to correct  
(output = ) List of output CCD images  
(ccdtype= object) CCD image type to correct  
(max_cac= 0) Maximum image caching memory (in Mbytes)  
(noproc = no) List processing steps only?  
  
(fixpix = no) Fix bad CCD lines and columns?  
(oversca= no) Apply overscan strip correction?  
(trim = no) 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?  
(fringe= 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
```


Flatfield-korrekcio

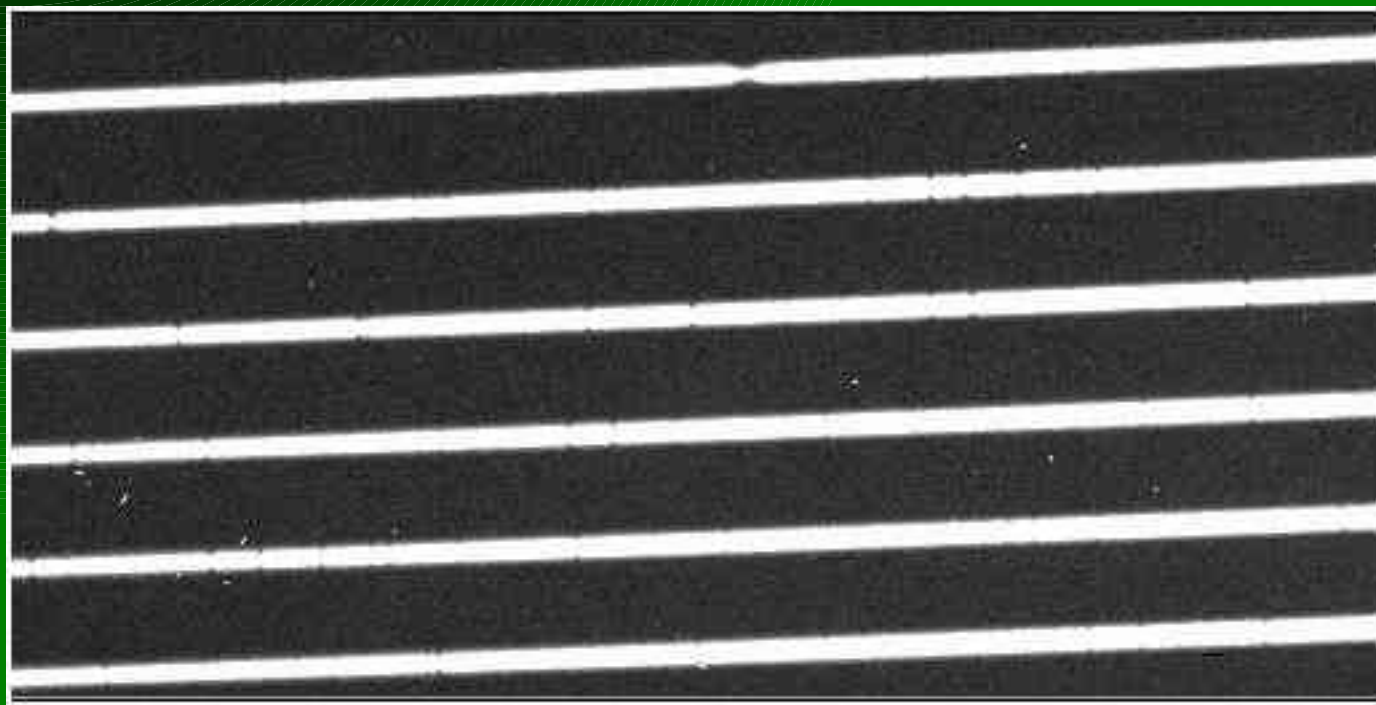
Noao => imred => ccdred =>
ccdproc

```
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 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
```

Flatfield- korrekció



Korrigálatlan kép



Korrigált kép