The XDspres Package for Reducing OSIRIS XD Spectra

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Motivation

- Lack of a pipeline for OSIRIS Cross-dispersed mode

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- On-going project involving lots of data

Goals

- To develop a highly automated reduction script...

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- ...using available standard IRAF tasks...

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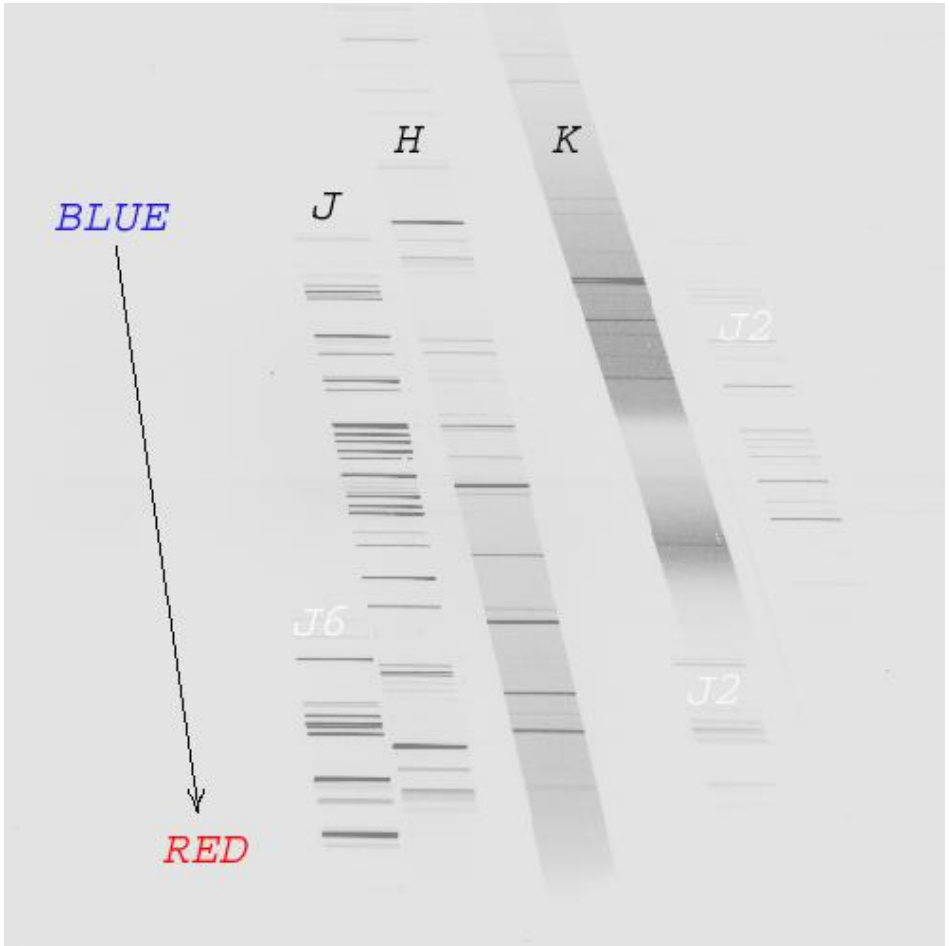
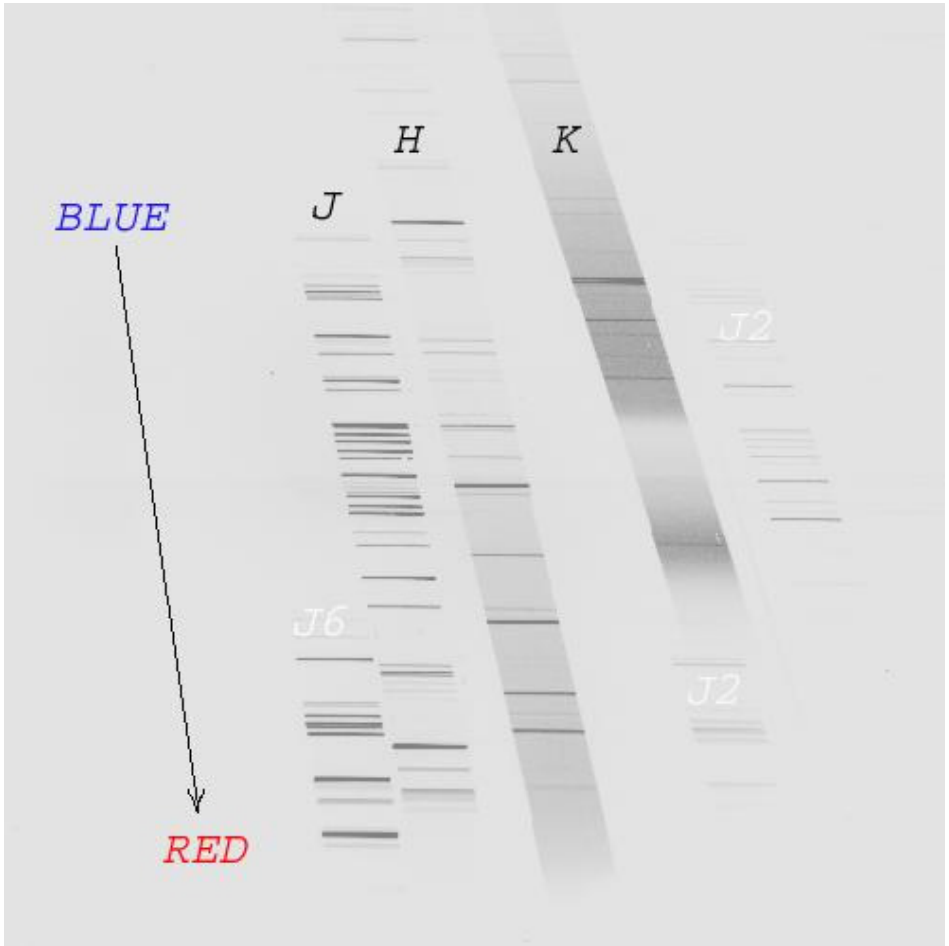
- To develop a highly automated reduction script...
- ...using available standard IRAF tasks...
- ...allowing user interaction in critical steps.

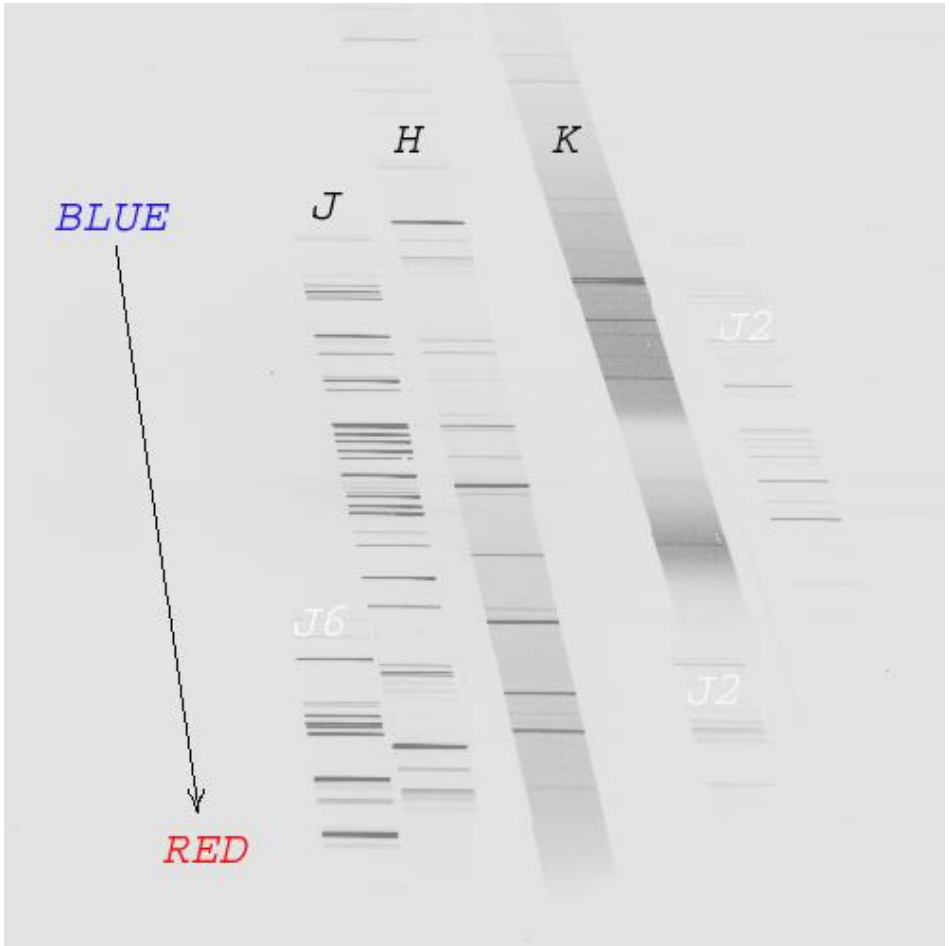
- $1.2 - 2.35\mu$m simultaneously projected on the detector



- $1.2 - 2.35\mu$m simultaneously projected on the detector
- Three separate apertures per exposure

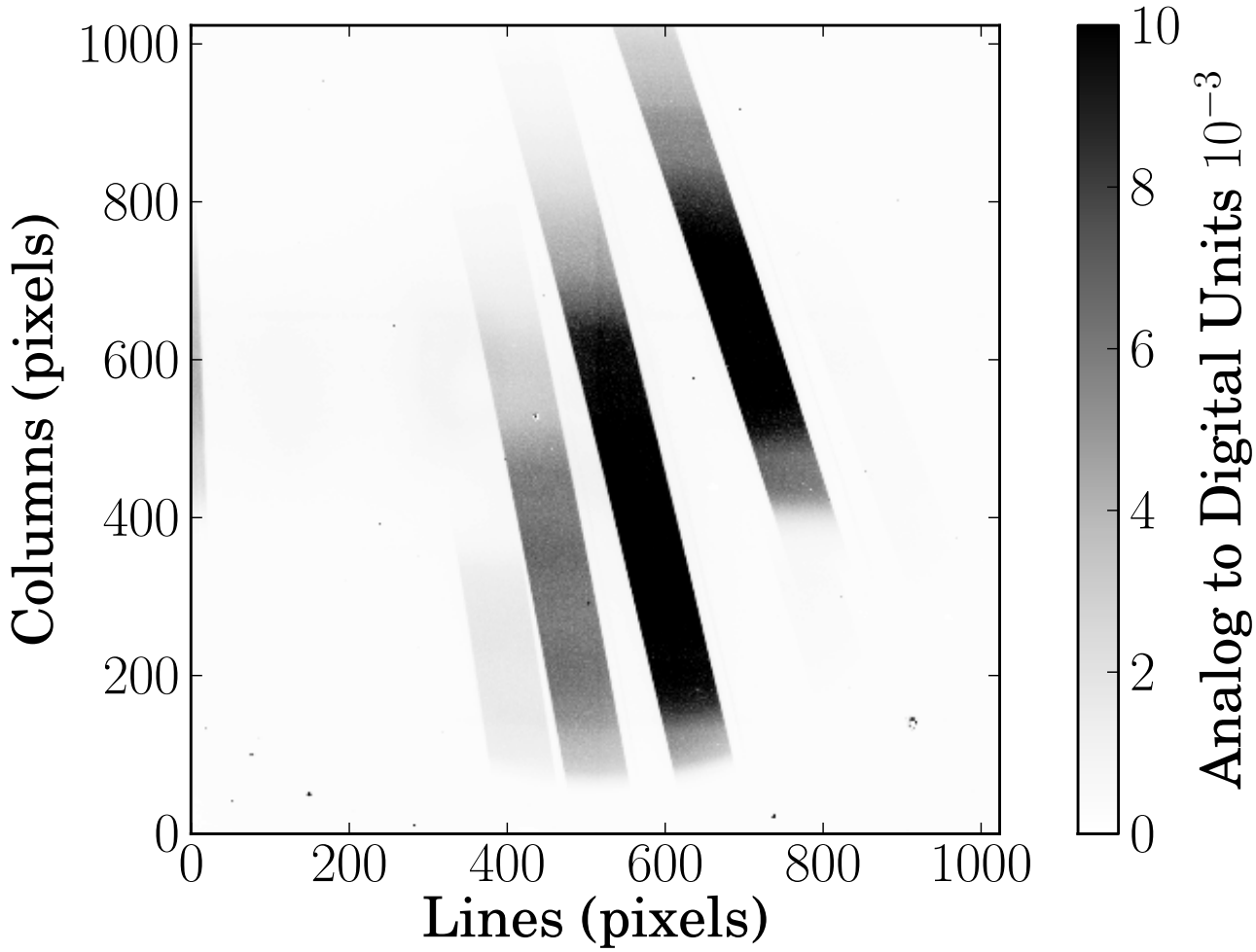


- $1.2 - 2.35\mu$m simultaneously projected on the detector
- Three separate apertures per exposure
- R $\sim$ 1200



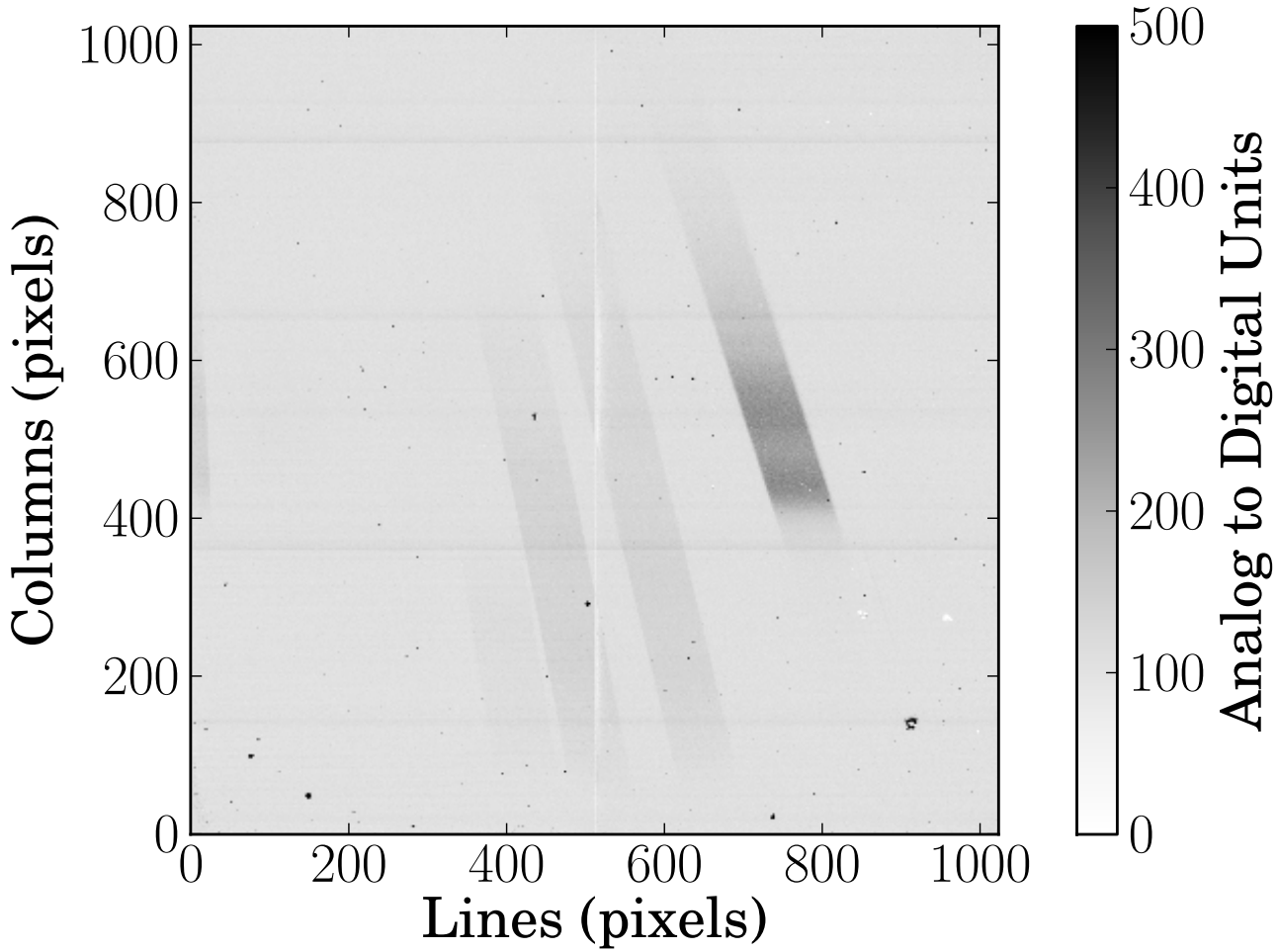
xdflat

- Flat on



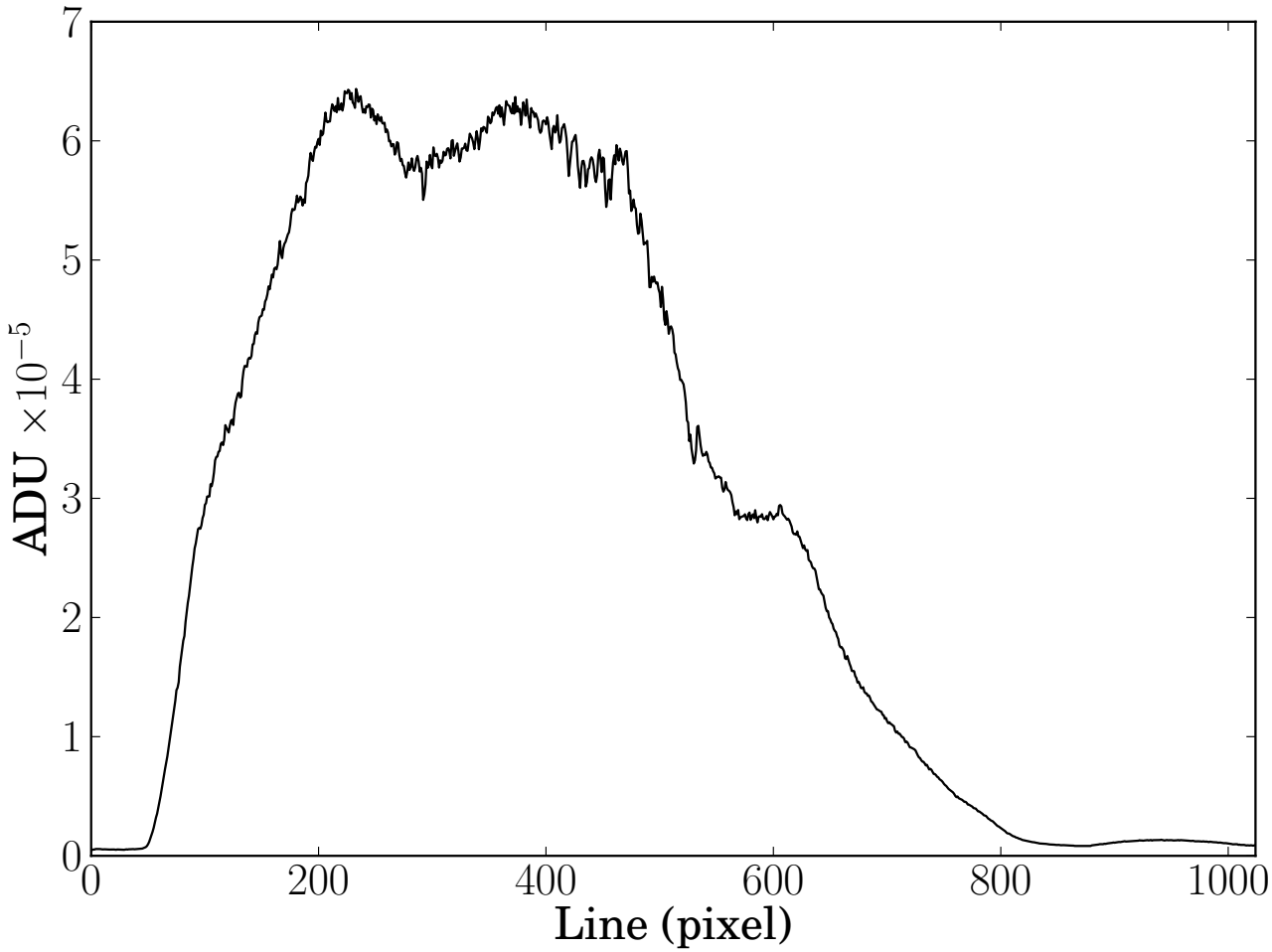
xdflat

- Flat on
- Flat off



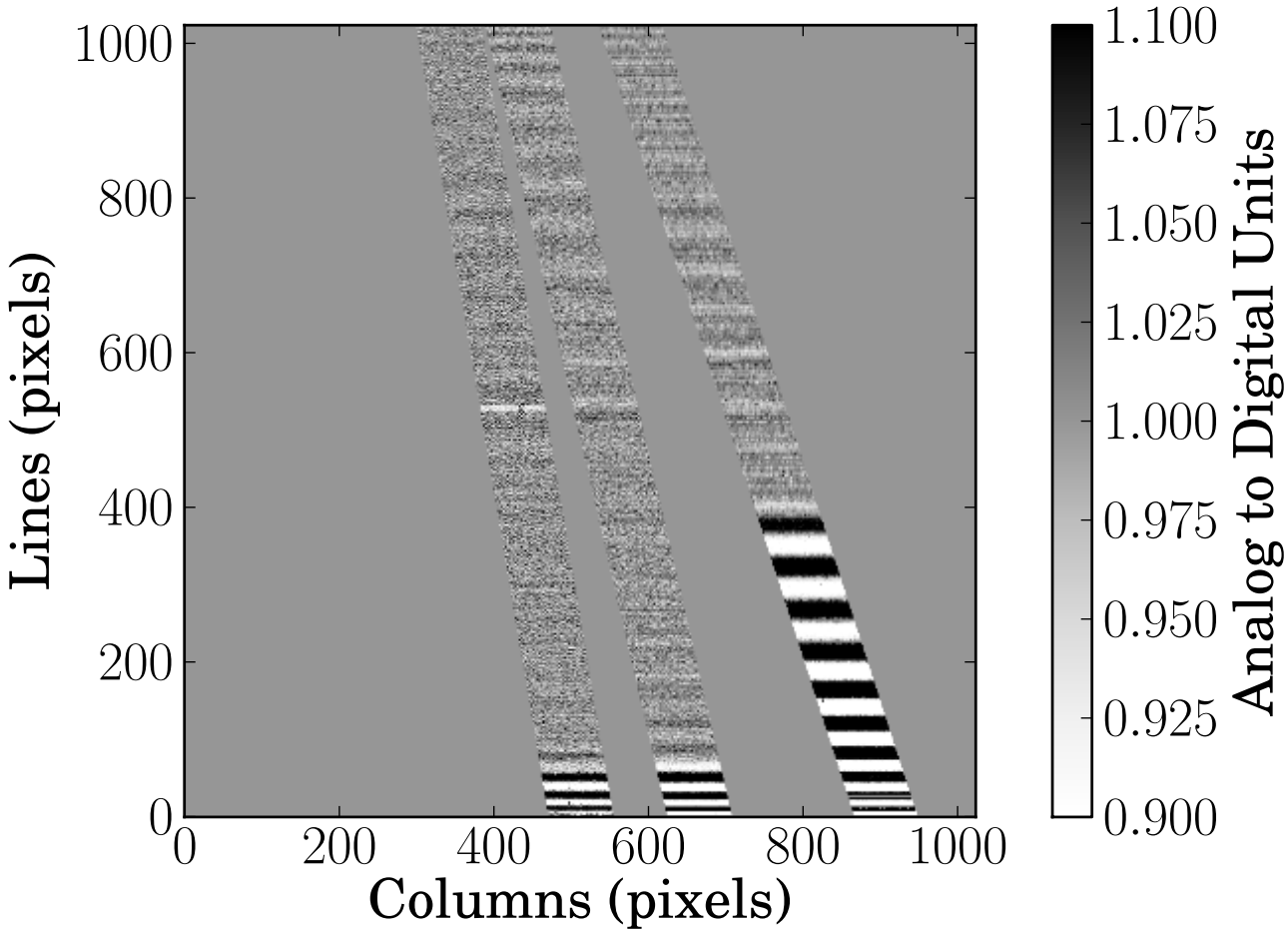
xdflat

- Flat on
- Flat off
- Normalize flat



xdflat

- Flat on
- Flat off
- Normalize flat
- Output

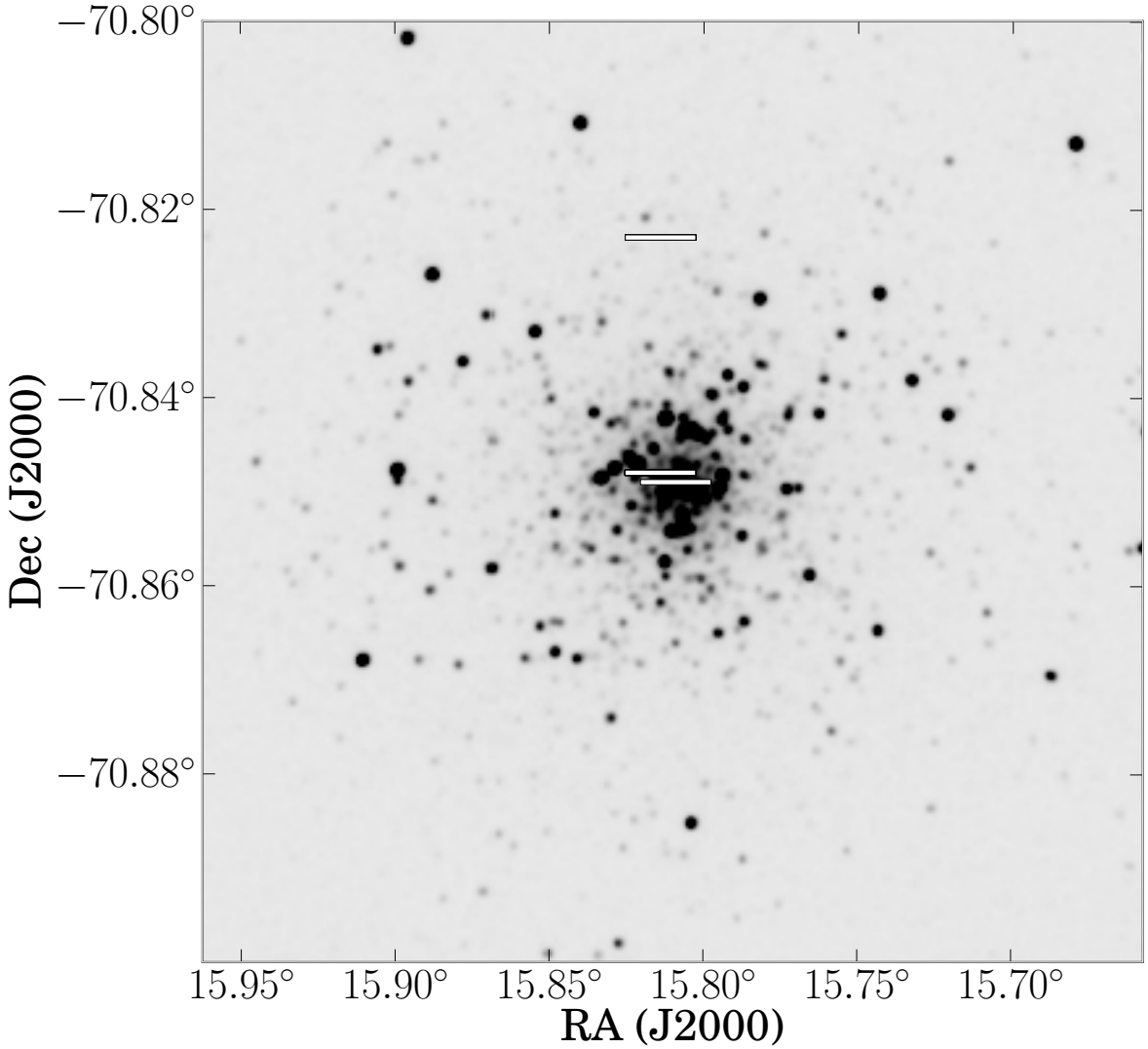


doosiris

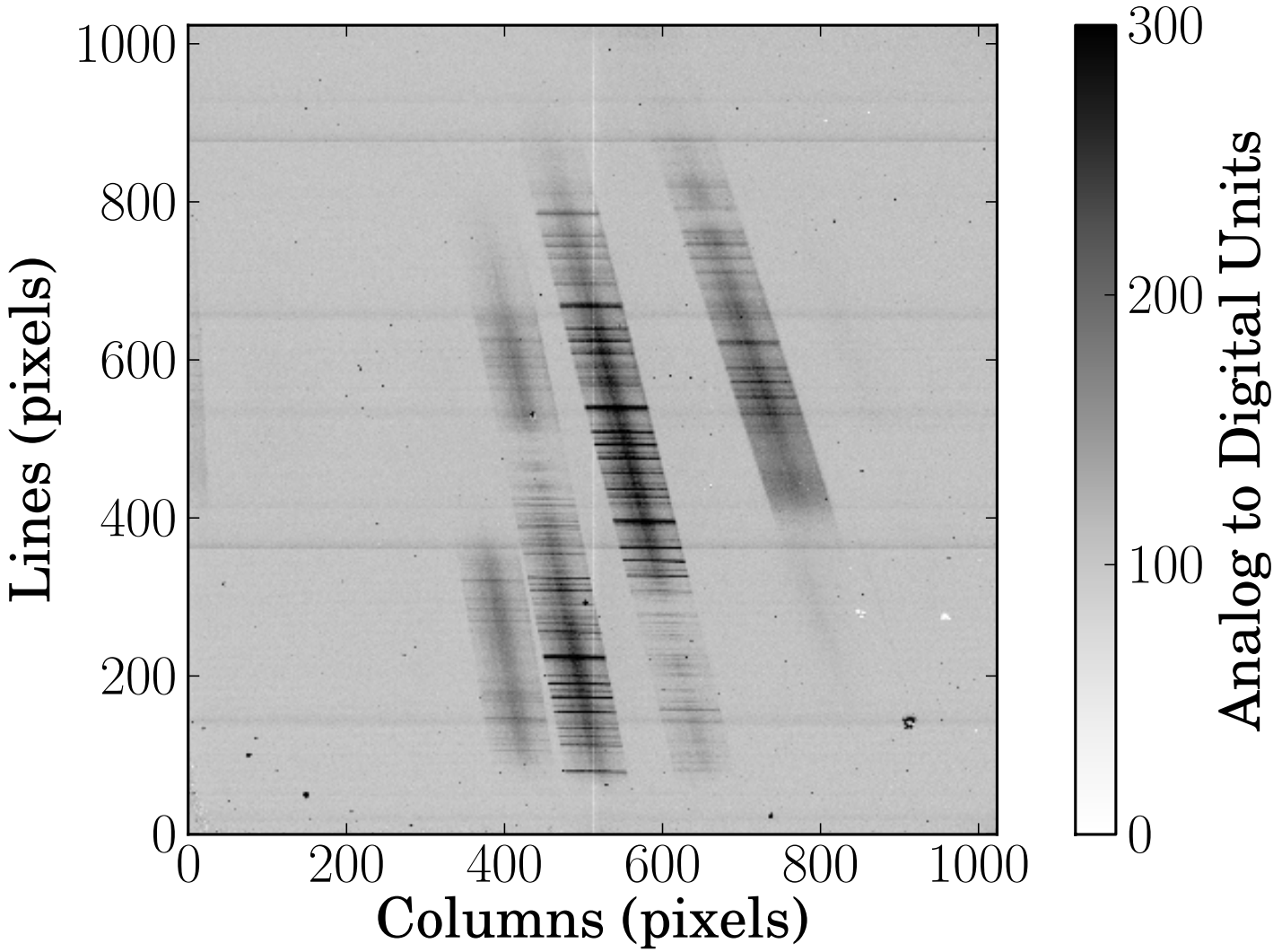
```
PACKAGE = xdspres
   TASK = doosiris

prefix  =    ./raw/s06b07_0930.  Image name prefix
(outpre =              ngc362_)  Output image name prefix
(lsc    =                  yes)  Linearize, subtract and combine
                                  science exposures?
(inter  =                   no)  Perform extraction interactively?
(num1   =                   57)  First image number
(num2   =                   86)  Last image number
(objseq =         ngc362_.seq)  File containing the sequence of
                                  object/sky images
(apid   =     xdspres$xdap.tab)  Aperture identification table
(nflat  =          ./flat/Flat)  Normalized flat image
(skyim  =              sky362_)  Output name for sky image
(id     =                   no)  Identify OH lines interactively?
```

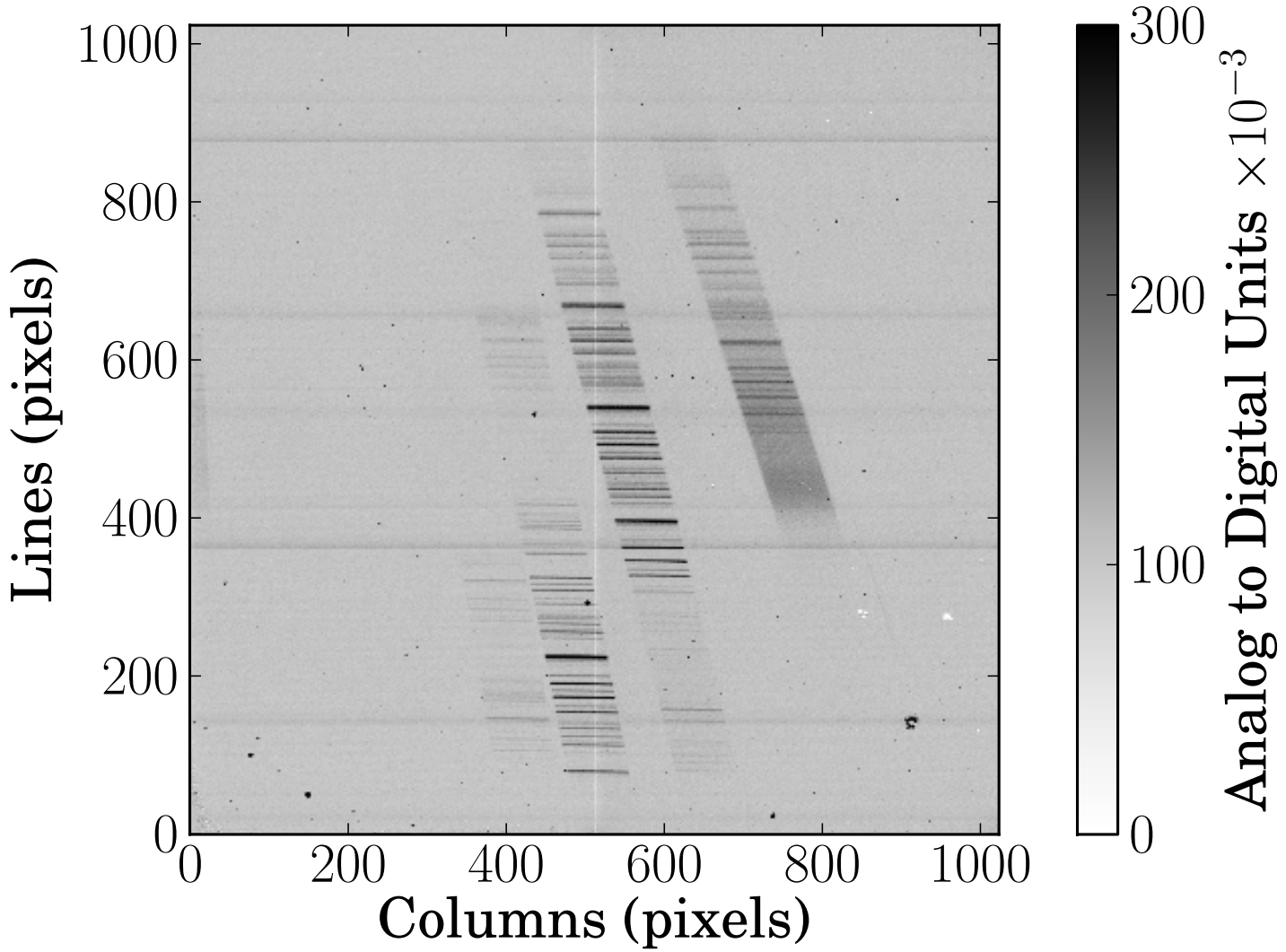
Sky chopping



Sky chopping



Sky chopping



Sky chopping

- Two ways for identifying exposures

Sky chopping

- Two ways for identifying exposures
  - Visual, on the fly

Sky chopping

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  - Visual, on the fly
  - Previously written file

Sky chopping

- Two ways for identifying exposures
  - Visual, on the fly
  - Previously written file
- After identification

Sky chopping

- Two ways for identifying exposures
  - Visual, on the fly
  - Previously written file
- After identification
  - Linearity correction

Sky chopping

- Two ways for identifying exposures
  - Visual, on the fly
  - Previously written file
- After identification
  - Linearity correction
  - Flat correction

Sky chopping

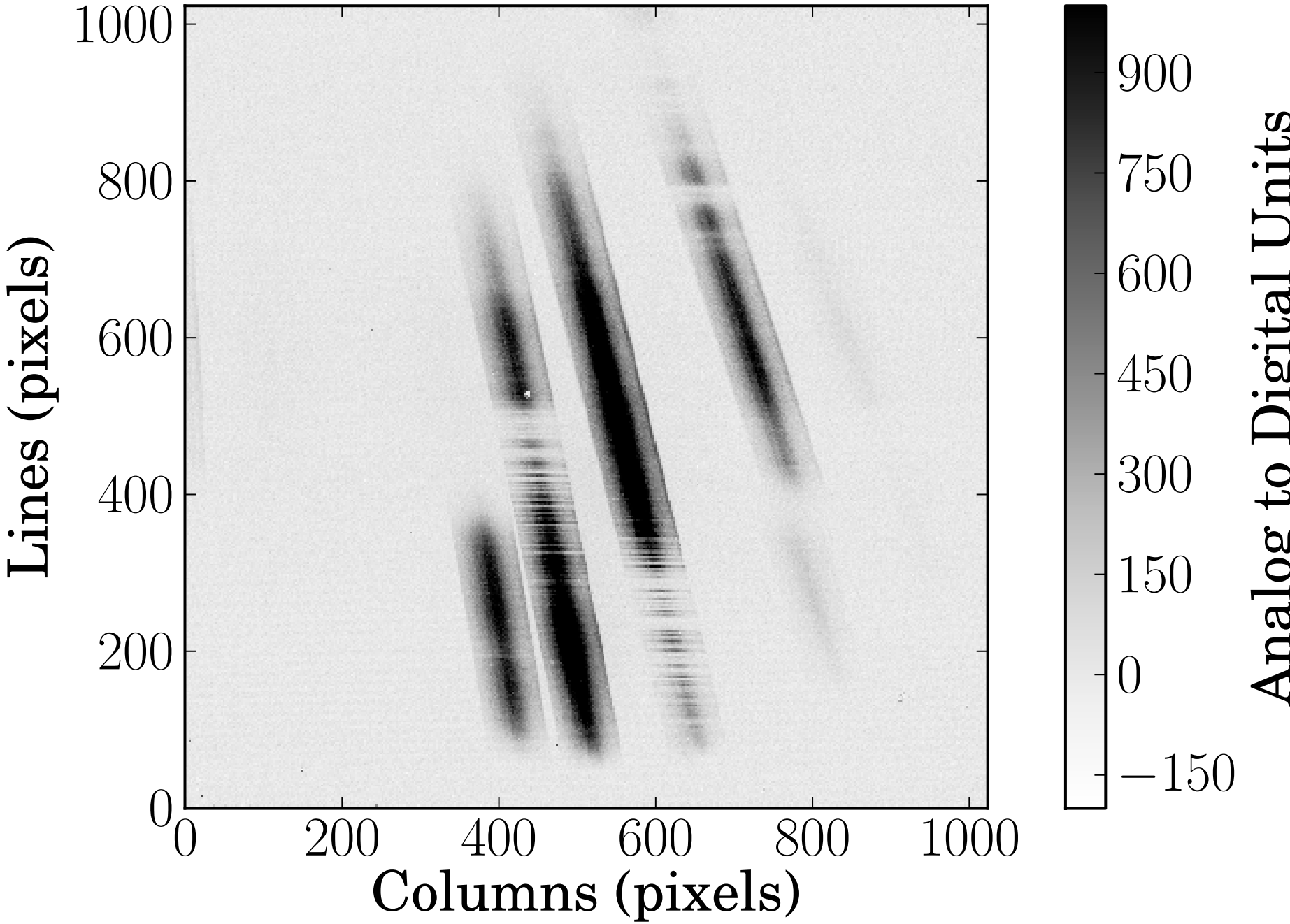
- Two ways for identifying exposures
  - Visual, on the fly
  - Previously written file
- After identification
  - Linearity correction
  - Flat correction
  - Cosmic ray removal

Sky chopping

- Two ways for identifying exposures
  - Visual, on the fly
  - Previously written file
- After identification
  - Linearity correction
  - Flat correction
  - Cosmic ray removal
  - Reads necessary info from header

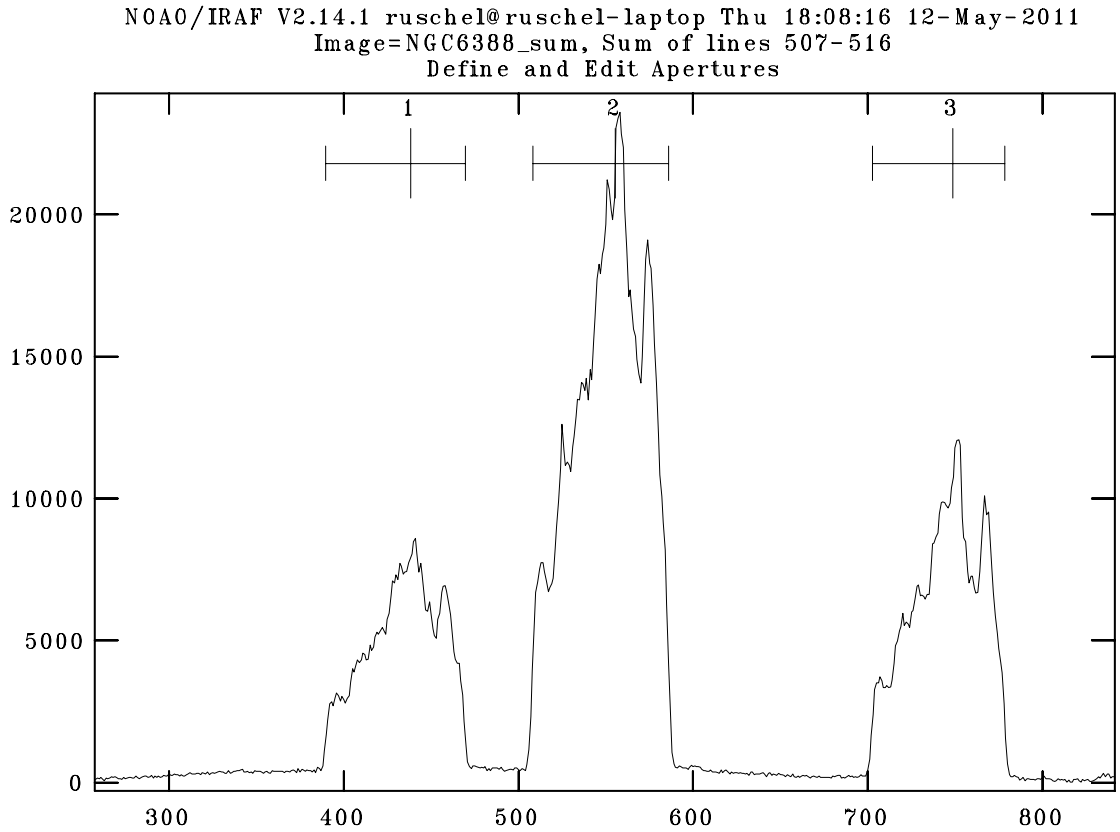
Sky chopping

- Two ways for identifying exposures
  - Visual, on the fly
  - Previously written file
- After identification
  - Linearity correction
  - Flat correction
  - Cosmic ray removal
  - Reads necessary info from header
  - Subtracts adjacent sky


Lines (pixels)
0
200
400
600
800
1000
Columns (pixels)
0
200
400
600
800
1000
Analog to Digital Units
900
750
600
450
300
150
0
−150

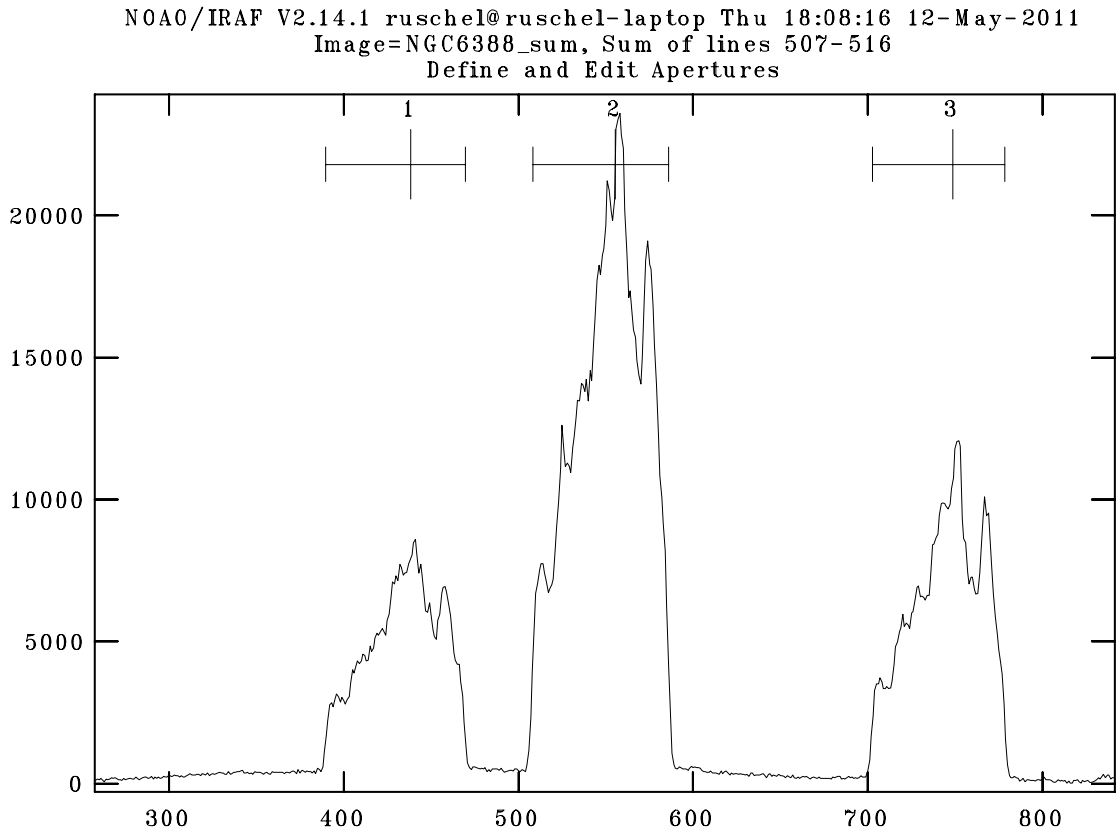
Extraction

- Automatic aperture finding, based on relative flux on the middle of the chip



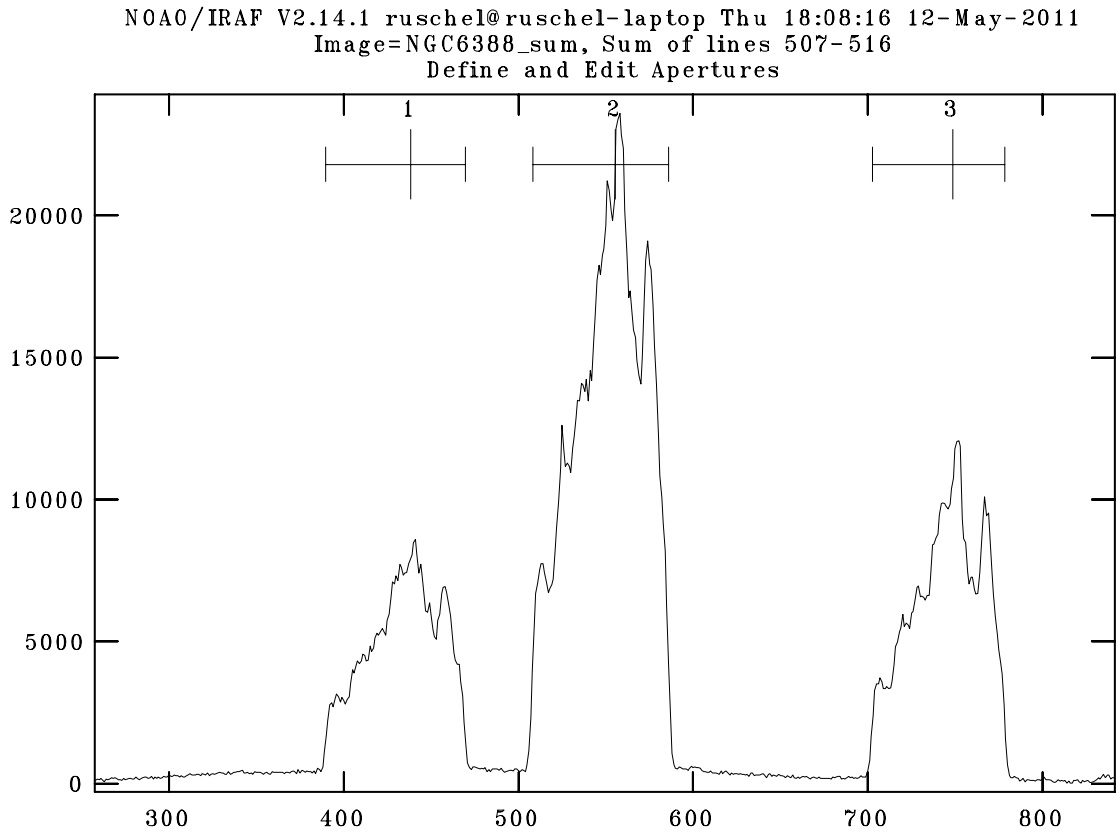
Extraction

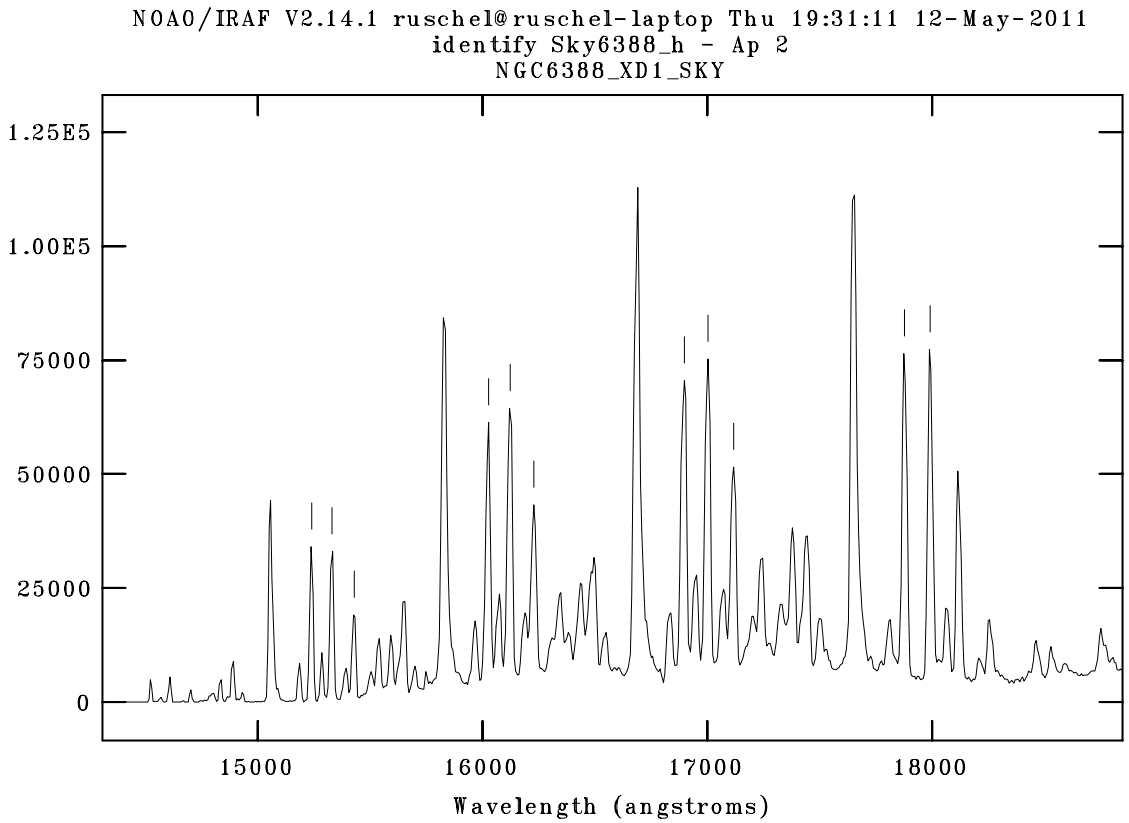
- Automatic aperture finding, based on relative flux on the middle of the chip
- Aperture editing can also be done interactively



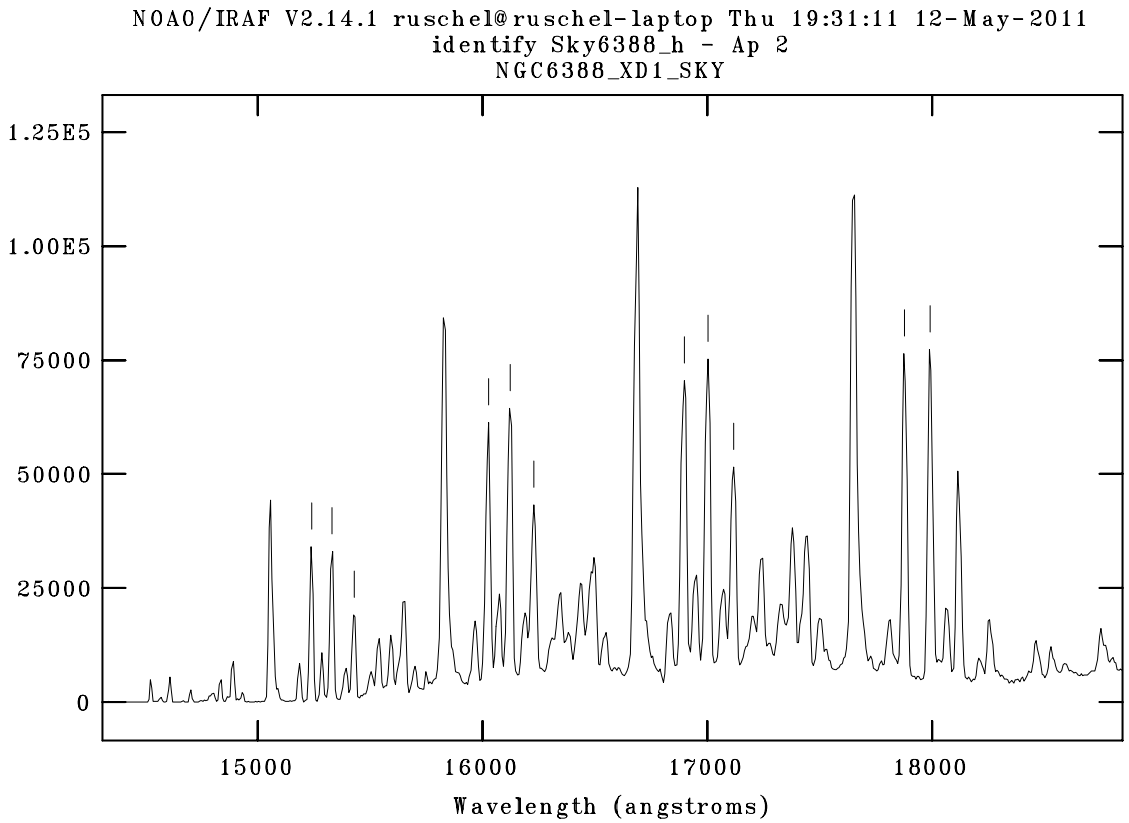
Extraction

- Automatic aperture finding, based on relative flux on the middle of the chip
- Aperture editing can also be done interactively
- Extraction assumes vertical dispersion, which is a good aproximation

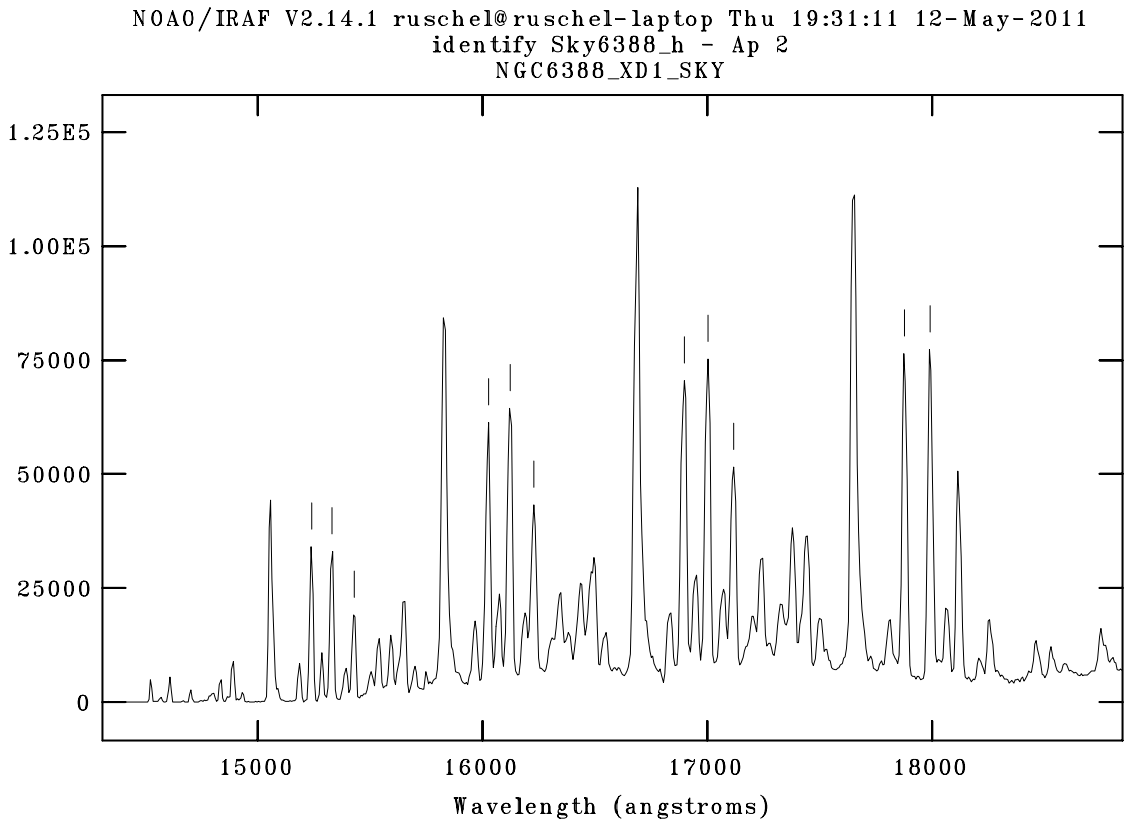




- Based on OH lines in the sky exposures, extracted with identical aperture definitions

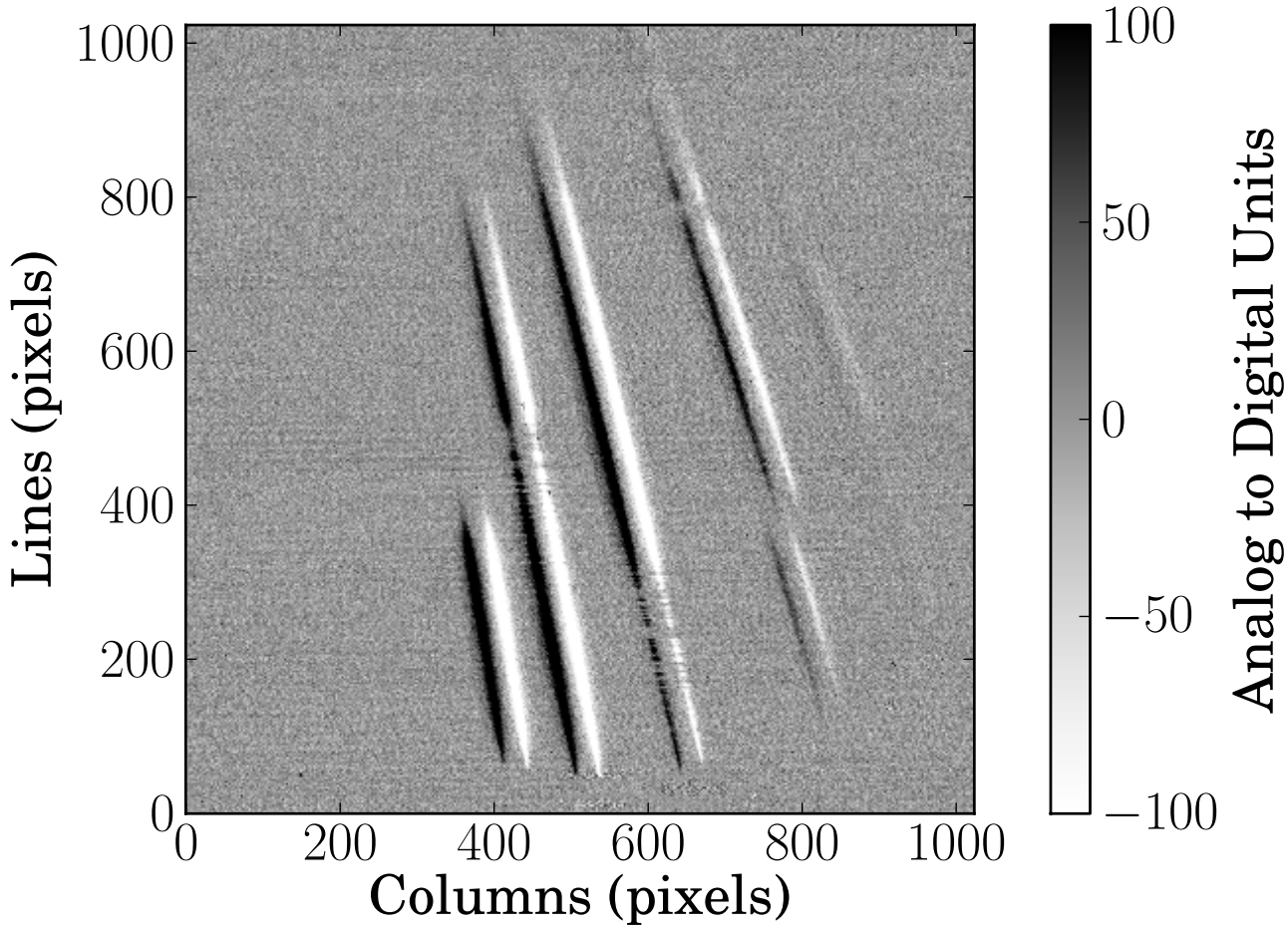


- Based on OH lines in the sky exposures, extracted with identical aperture definitions
- Can be performed interactively

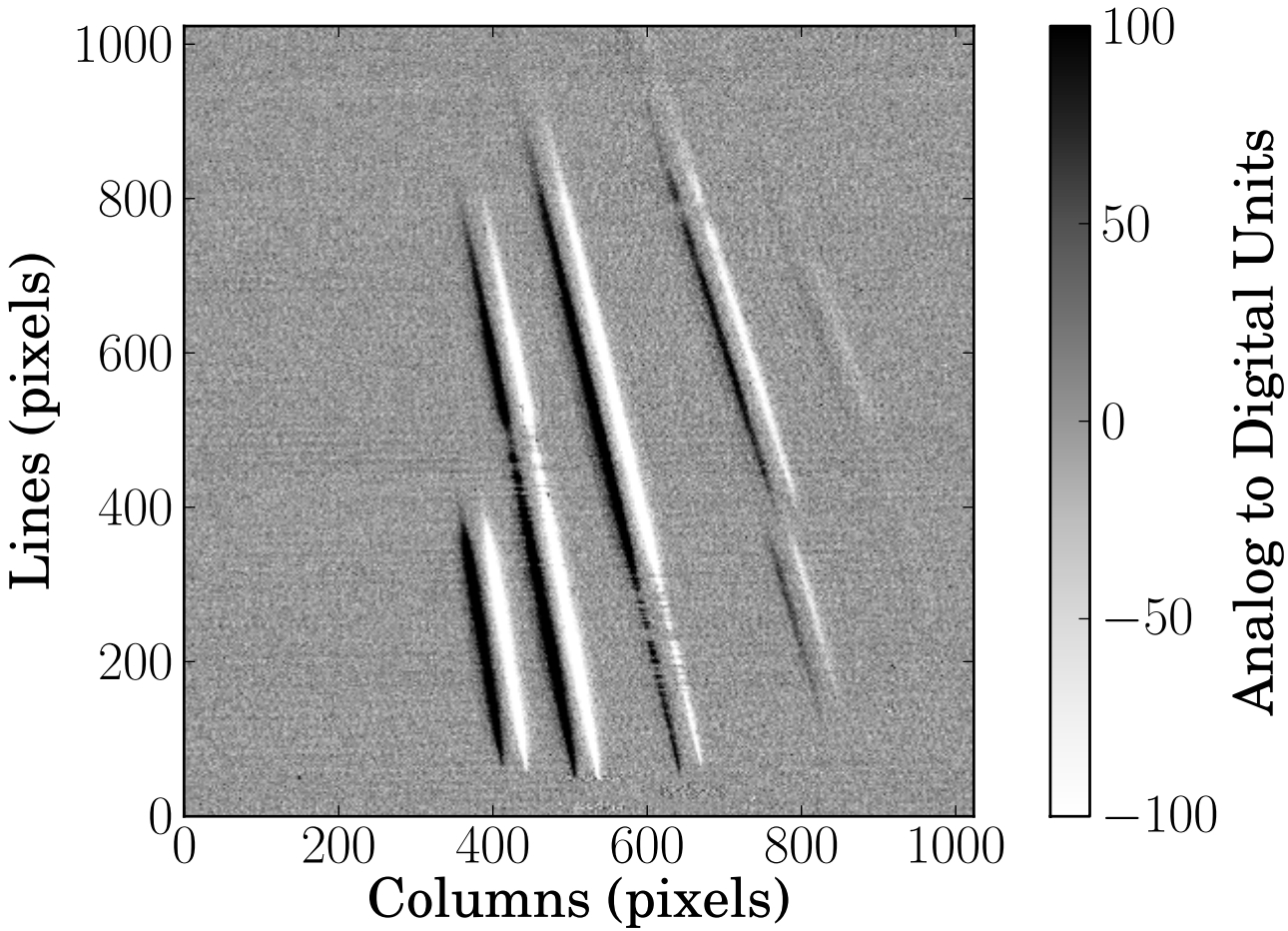


- Based on OH lines in the sky exposures, extracted with identical aperture definitions
- Can be performed interactively
- Can receive previously identified spectra as input

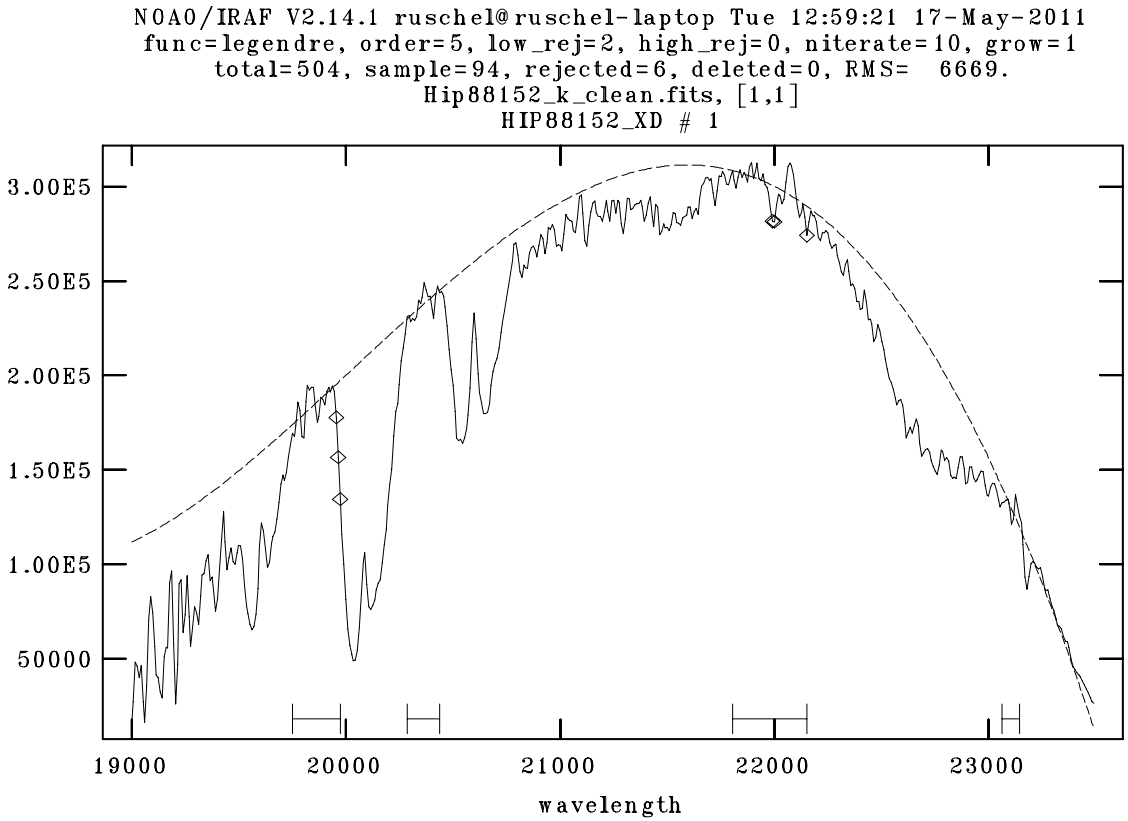
- Subtract standard star exposures



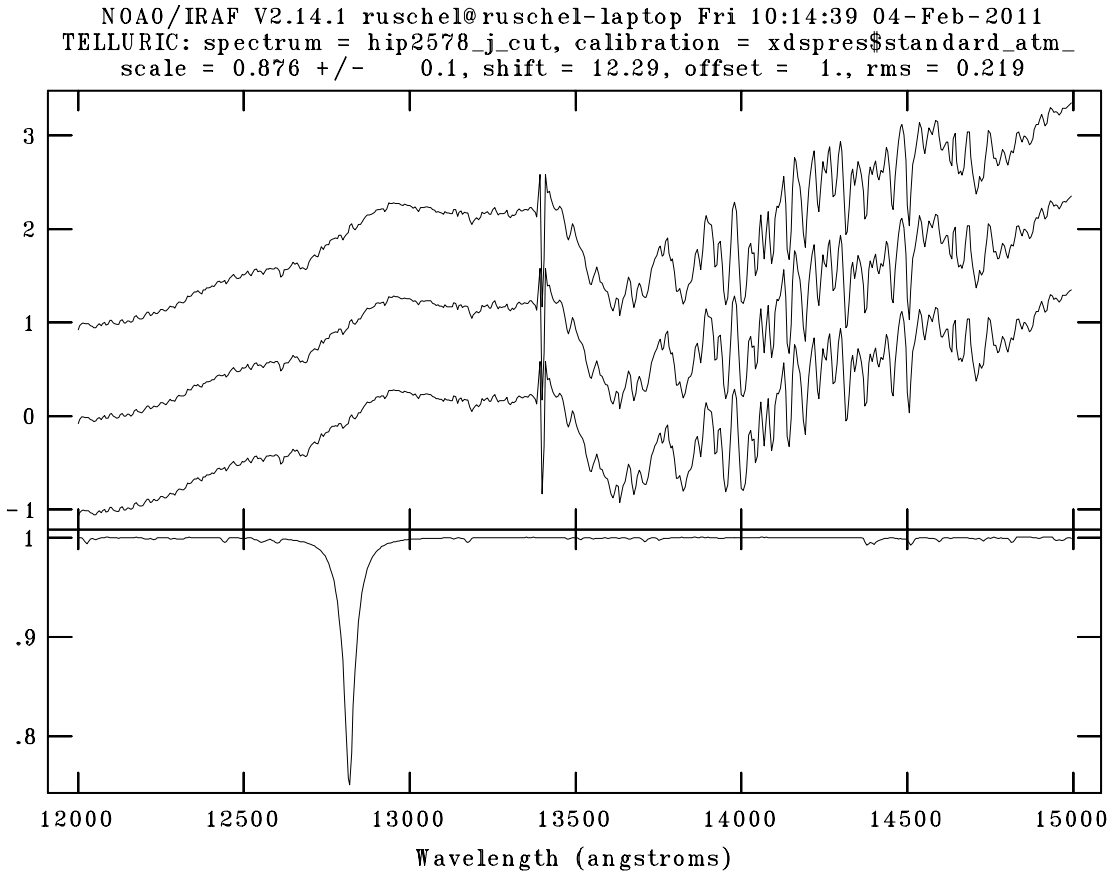
- Subtract standard star exposures
- Extract the spectra



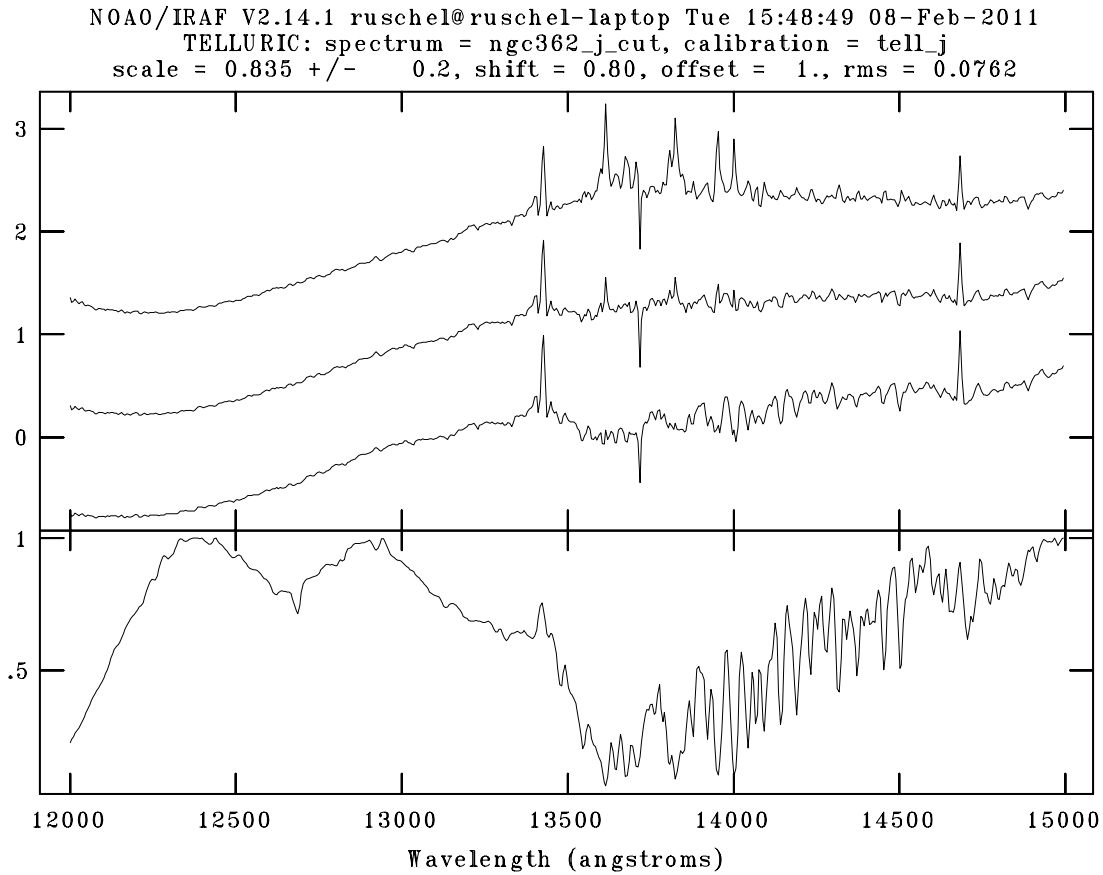
- Subtract standard star exposures
- Extract the spectra
- Fit “continuum”

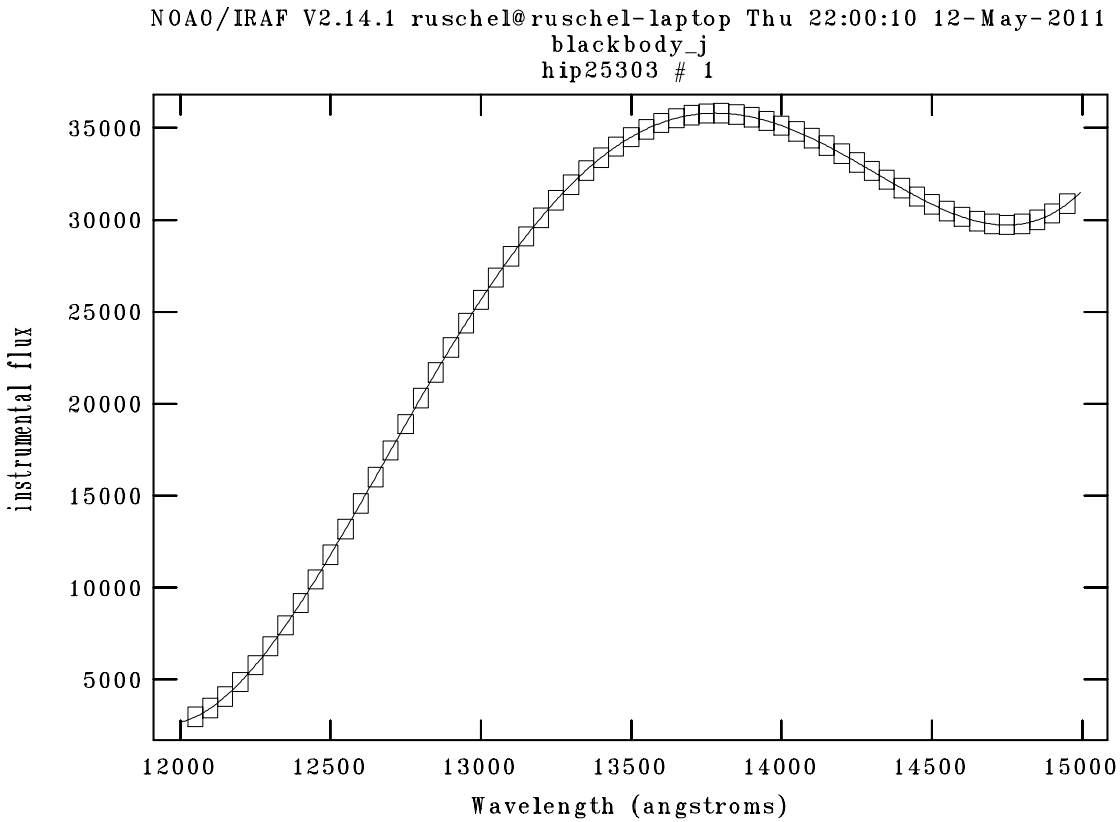


- Subtract standard star exposures
- Extract the spectra
- Fit “continuum”
- Remove star’s atmospheric lines

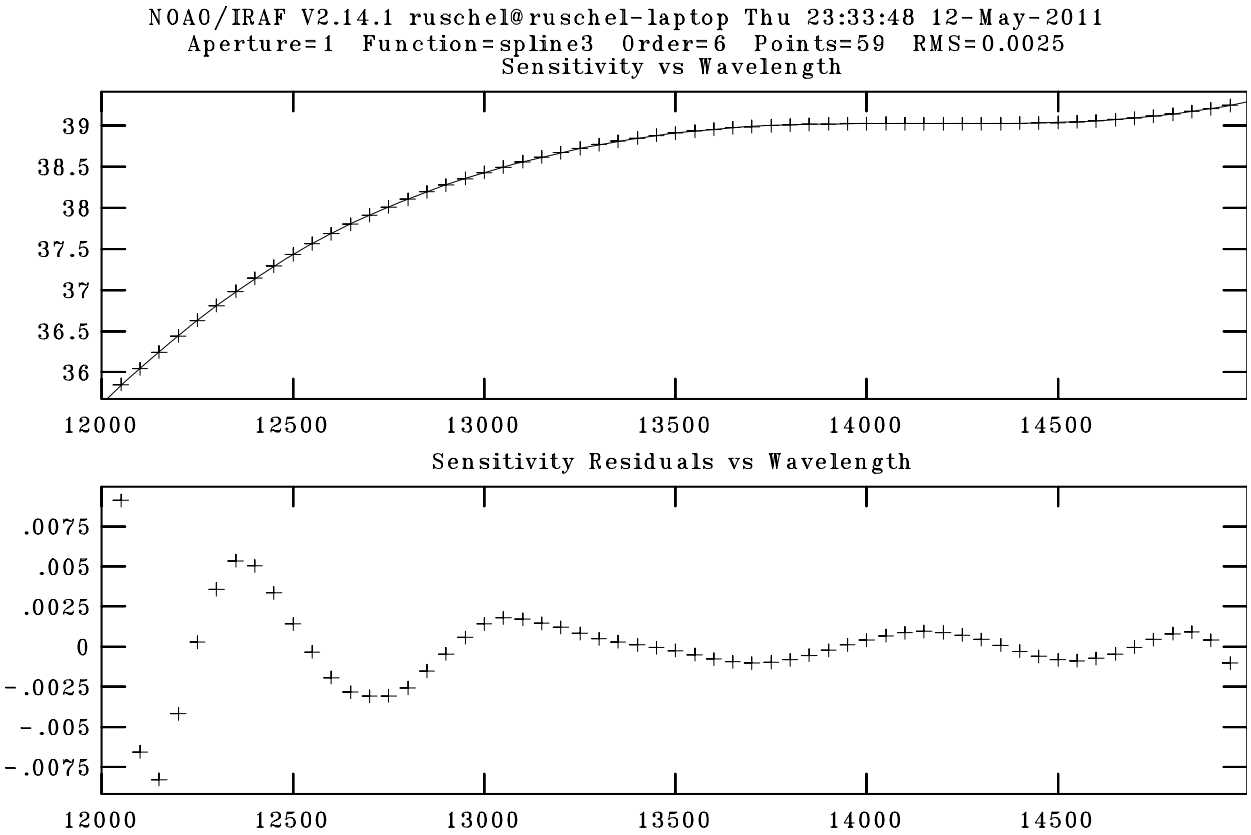


- Subtract standard star exposures
- Extract the spectra
- Fit “continuum”
- Remove star’s atmospheric lines
- Remove telluric lines

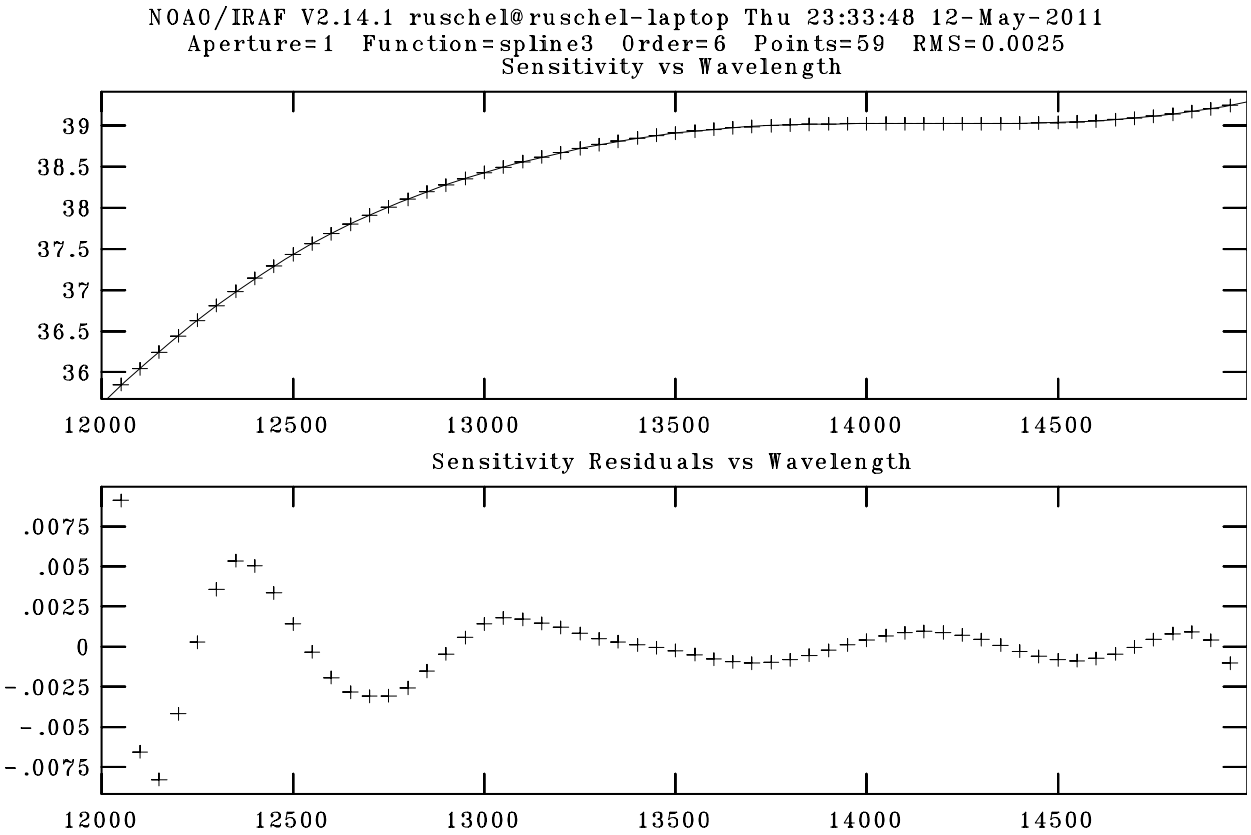




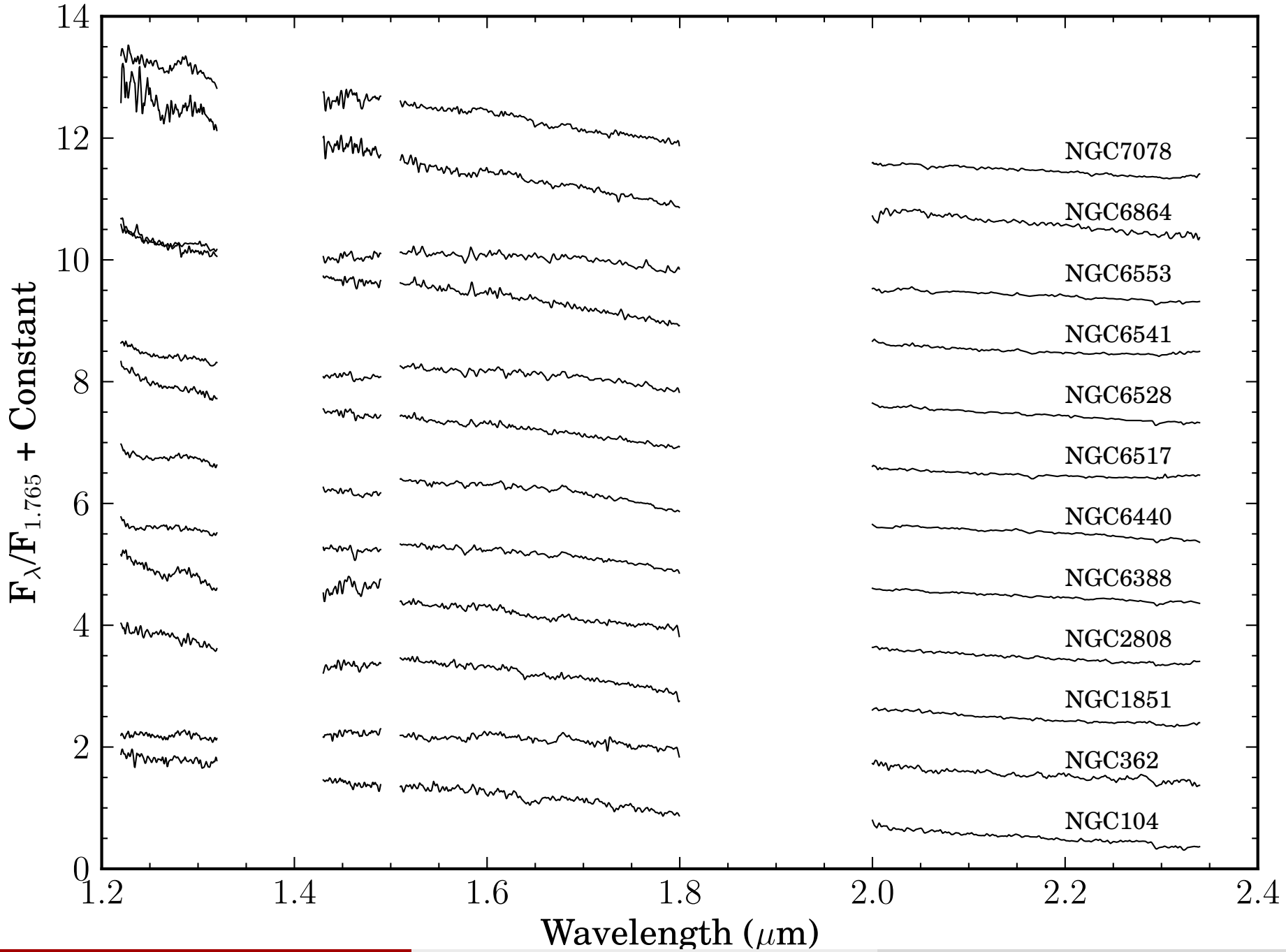
- Star's pseudo continuum serves for comparison with a black body of similar temperature

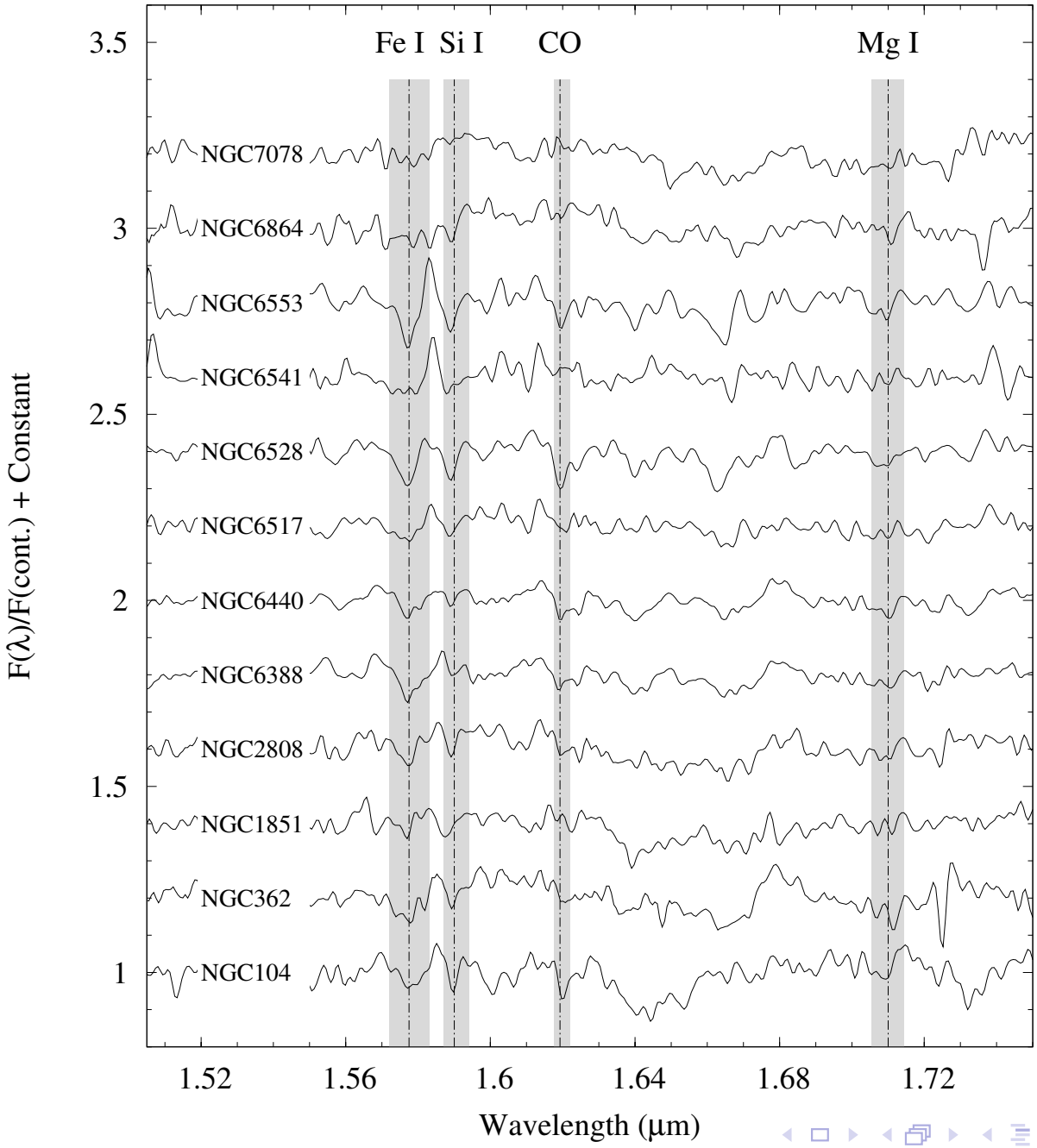


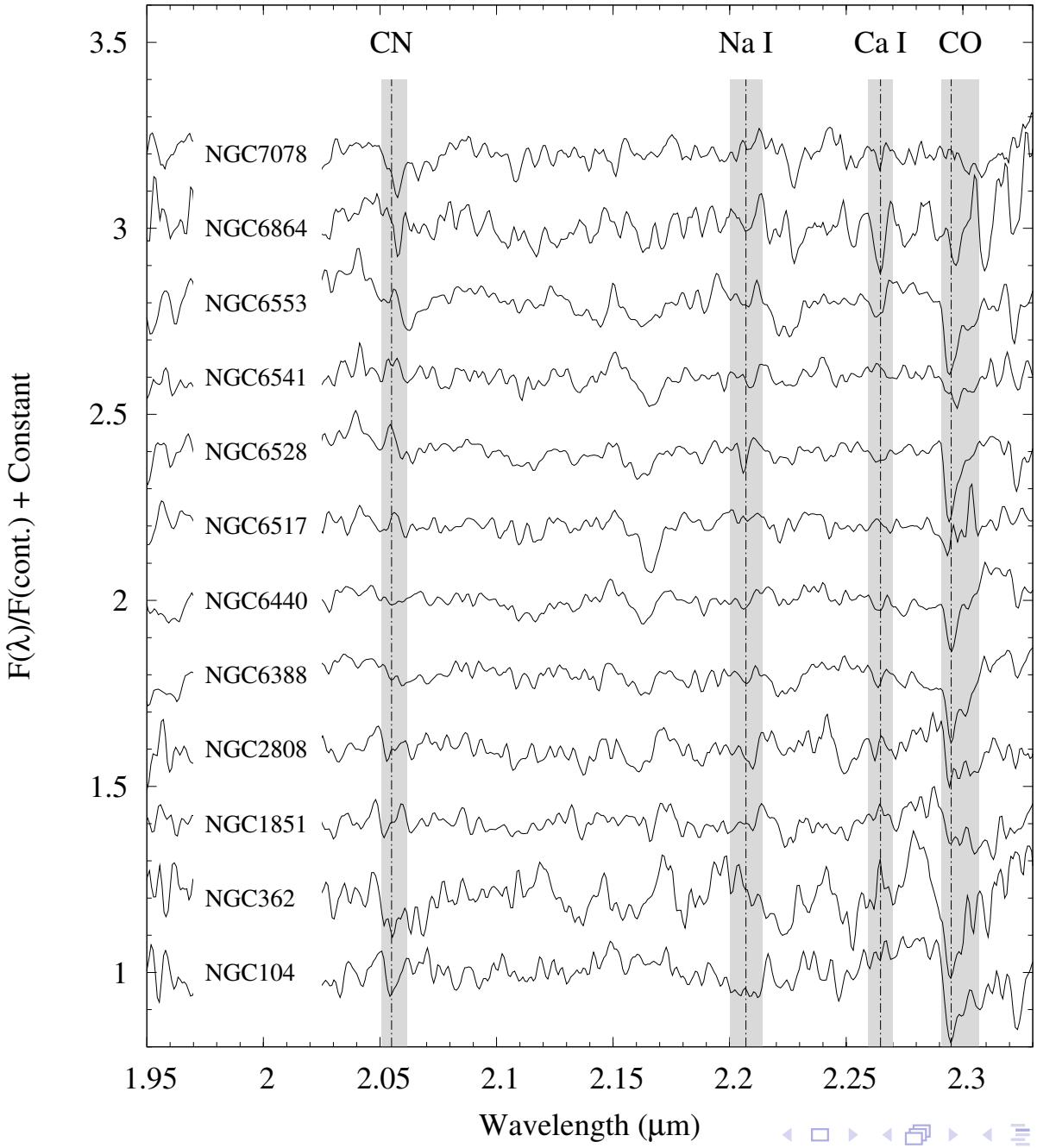
- Star's pseudo continuum serves for comparison with a black body of similar temperature
- Adjust sensitivity function

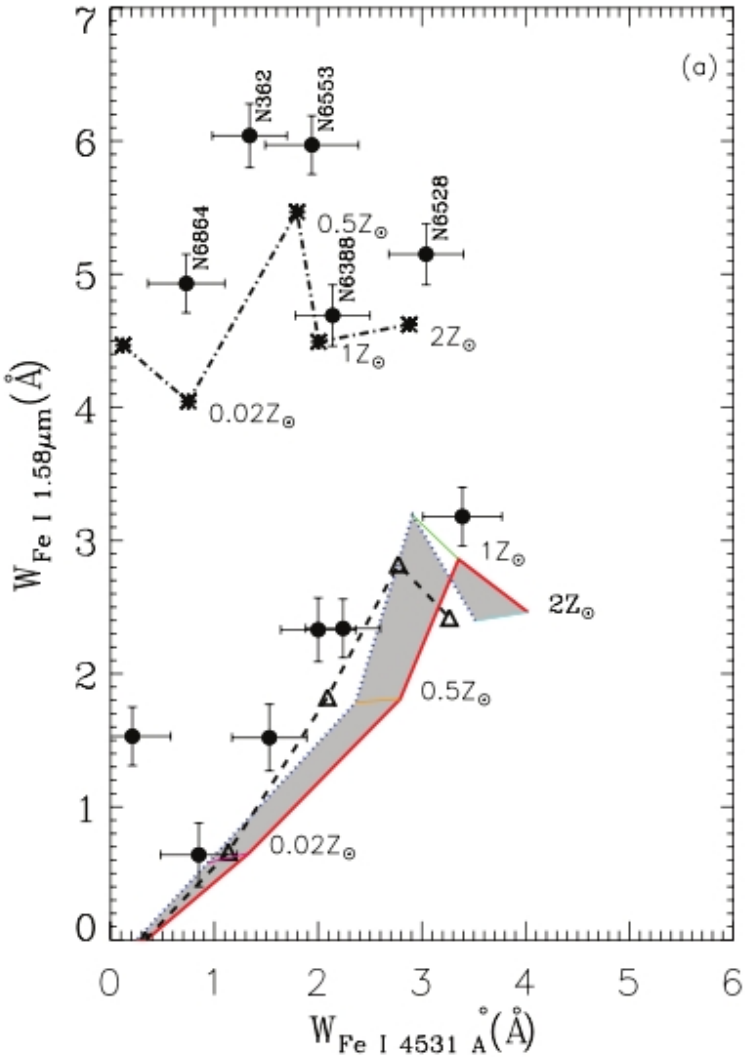


- Star's pseudo continuum serves for comparison with a black body of similar temperature
- Adjust sensitivity function
- Apply the sensitivity function


NGC7078
NGC6864
NGC6553
NGC6541
NGC6528
NGC6517
NGC6440
NGC6388
NGC2808
NGC1851
NGC362
NGC104
$F_\lambda/F_{1.765}$ + Constant
Wavelength (μm)
0
2
4
6
8
10
12
14
1.2
1.4
1.6
1.8
2.0
2.2
2.4


Fe I
Si I
CO
Mg I
NGC7078
NGC6864
NGC6553
NGC6541
NGC6528
NGC6517
NGC6440
NGC6388
NGC2808
NGC1851
NGC362
NGC104
3.5
3
2.5
2
1.5
1
1.52
1.56
1.6
1.64
1.68
1.72
F(λ)/F(cont.) + Constant
Wavelength (μm)


CN
Na I
Ca I
CO
NGC7078
NGC6864
NGC6553
NGC6541
NGC6528
NGC6517
NGC6440
NGC6388
NGC2808
NGC1851
NGC362
NGC104
3.5
3
2.5
2
1.5
1
1.95
2
2.05
2.1
2.15
2.2
2.25
2.3
F(λ)/F(cont.) + Constant
Wavelength (μm)


(a)
N362
N6553
N6528
N6864
N6388
0.5Z⊙
2Z⊙
1Z⊙
0.02Z⊙
1Z⊙
2Z⊙
0.5Z⊙
0.02Z⊙
W Fe I 1.58μm (Å)
W Fe I 4531 Å (Å)
0
1
2
3
4
5
6
7

Discussion

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- It is available on-line at www.if.ufrgs.br/∼ruschel
- Data reduced with XDspres can be found in Riffel; Ruschel-Dutra et al. 2011
- A paper describing XDspres has already been submitted