RSS longslit data reduction

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Information

The RSS spectrograph has a large set of observational modes:

1. long-slit spectroscopy
2. multi-object spectroscopy
3. imaging in narrow–band filters
4. Fabry-Perot imaging
5. long-slit spectropolarimetry
6. high time resolution spectroscopy

Of these available modes, the most commonly used is that of long-slit spectroscopy, which is chosen for 90% of the observational time.

The spectral reduction of RSS long-slit data is a very standard procedure, but RSS has very large amount of potential configurations.

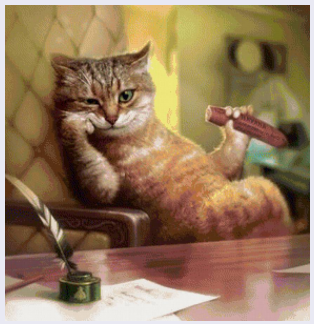
Background

- It is possible to reduce hundreds of SALT spectra in a semi-automatic way
- Some may prefer fully automatic, but semi-automatic allows for careful oversight of data quality and it is a good scientific practice
- For more details about my experience see:
  - SALT report https://www.saao.ac.za/~akniazev/pub/RSS/SALT_Long_slit.pdf
  - My paper

    https://www.saao.ac.za/~akniazev/pub/RSS/2022_ABull..77..334K_RSS_pipe.pdf
- For more details about spectra reduction with IRAF, IRAF, UNIX shell look into my collection:

  https://www.saao.ac.za/~akniazev/pub/RSS/Manuals

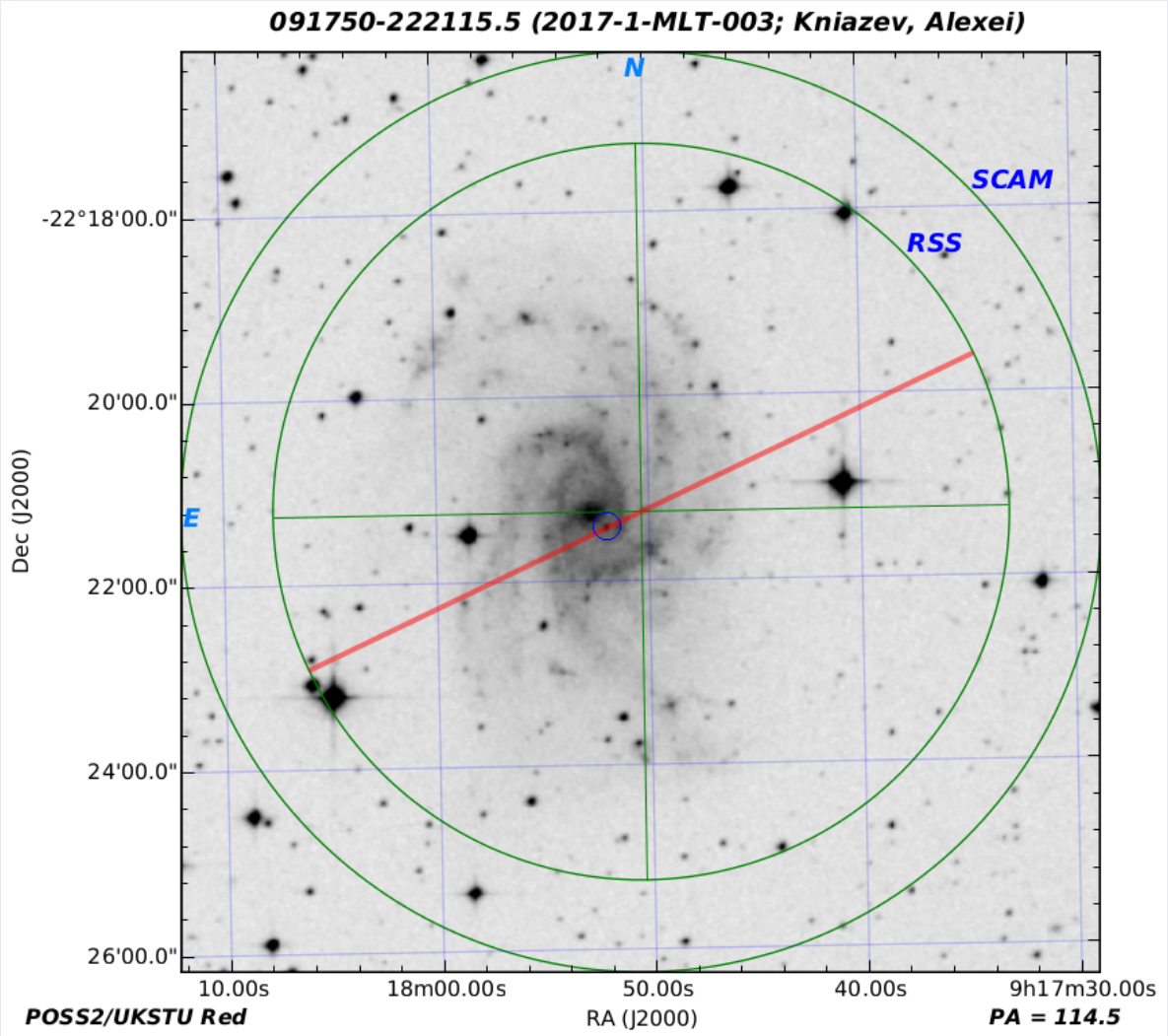
Aim of this talk



1. To give you an overview of the long-slit data reduction, where RSS is just a particular case
2. To show some steps of the RSS long-slit data reduction in the way I am doing: IRAF/pyRAF + MIDAS + UNIX shell
3. It is just my way and you can probably do it better and faster nowadays in python?!
4. In case you will try, you will need to use IRAF packages `longslit` and `apextract`, which are inside of package `twodspec`, which is inside of `noao` package.

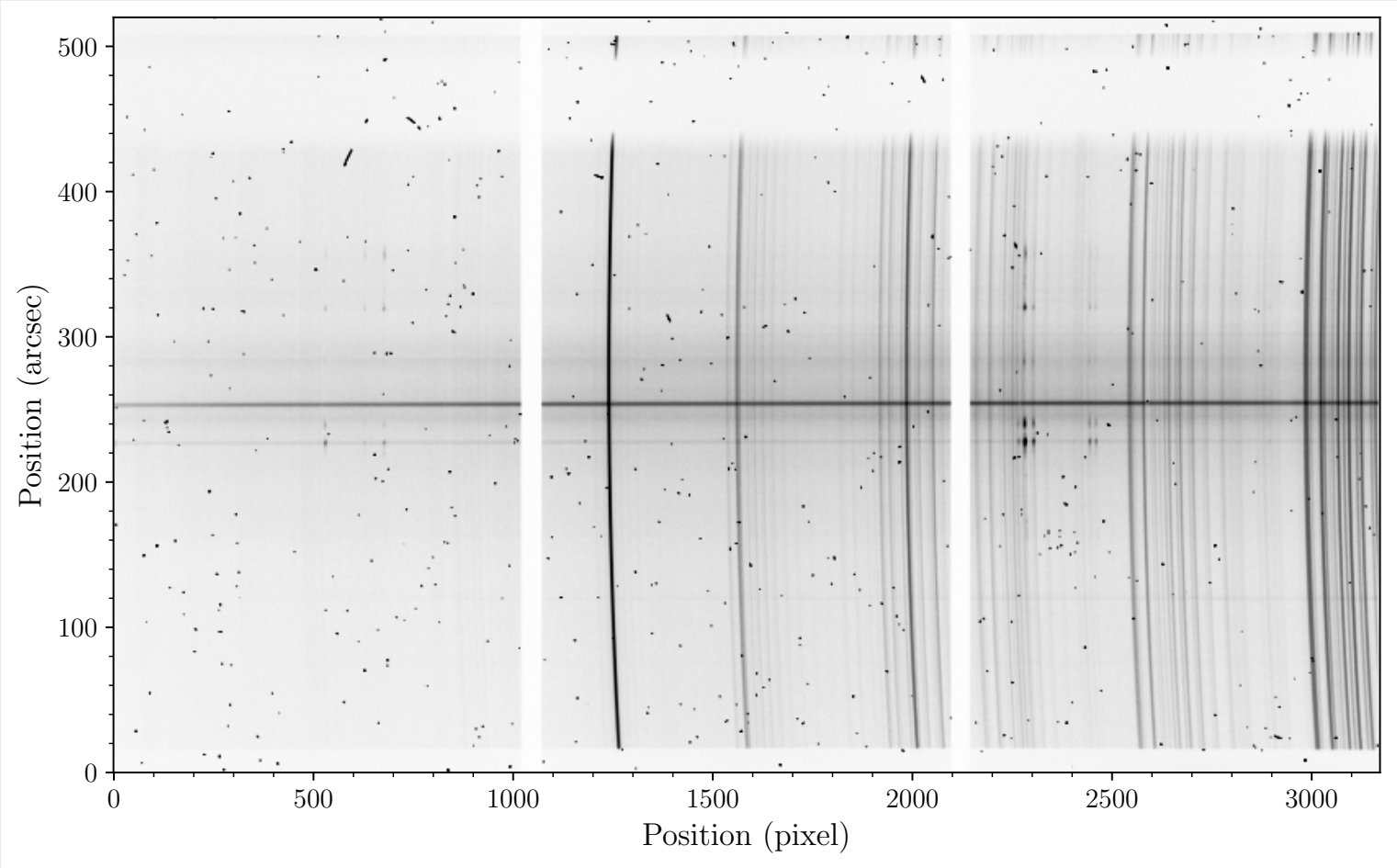
What do we want? (1)

NGC 2835 - Finding Chart



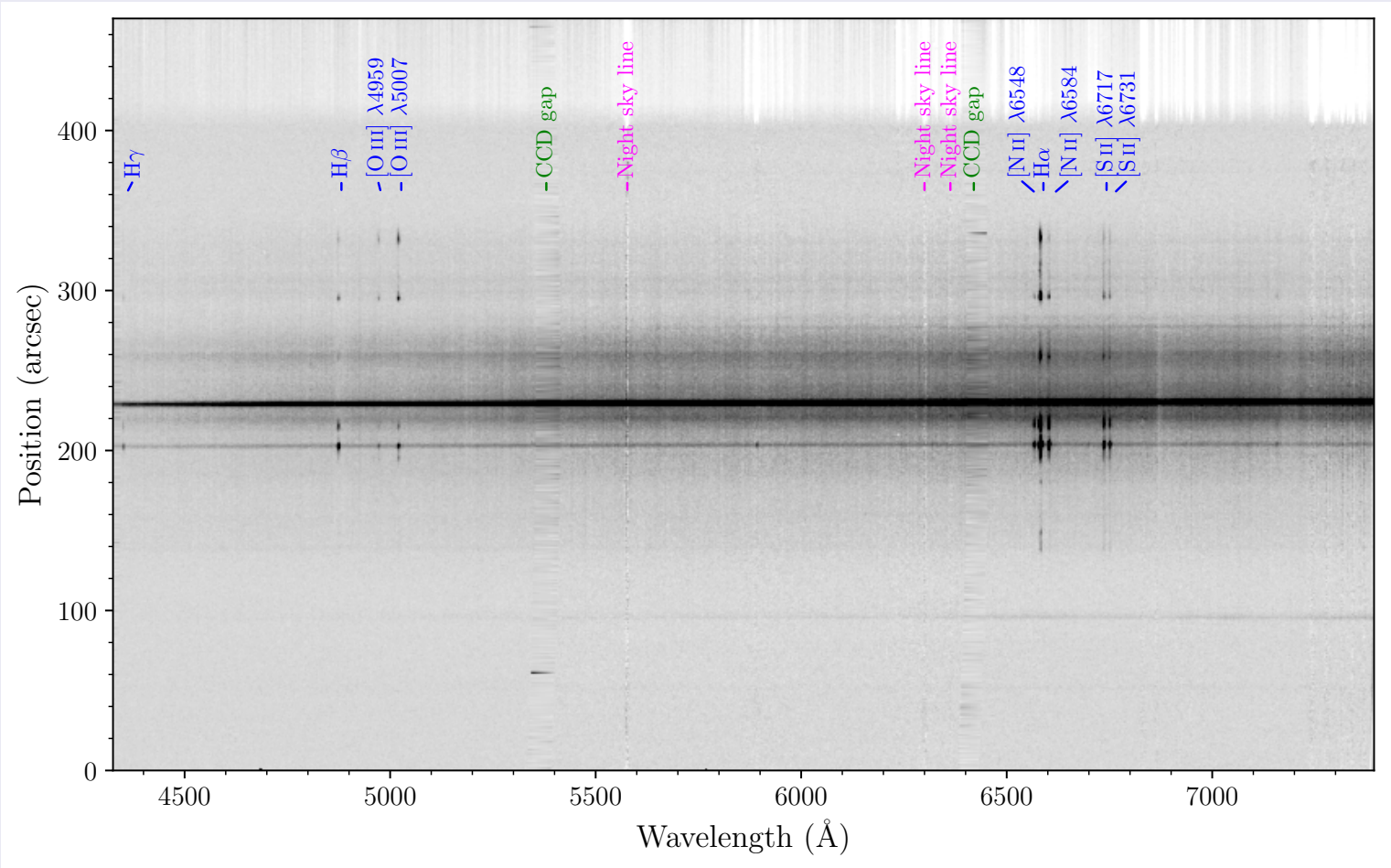
What do we want? (2)

NGC 2835 - Long-slit raw spectrum



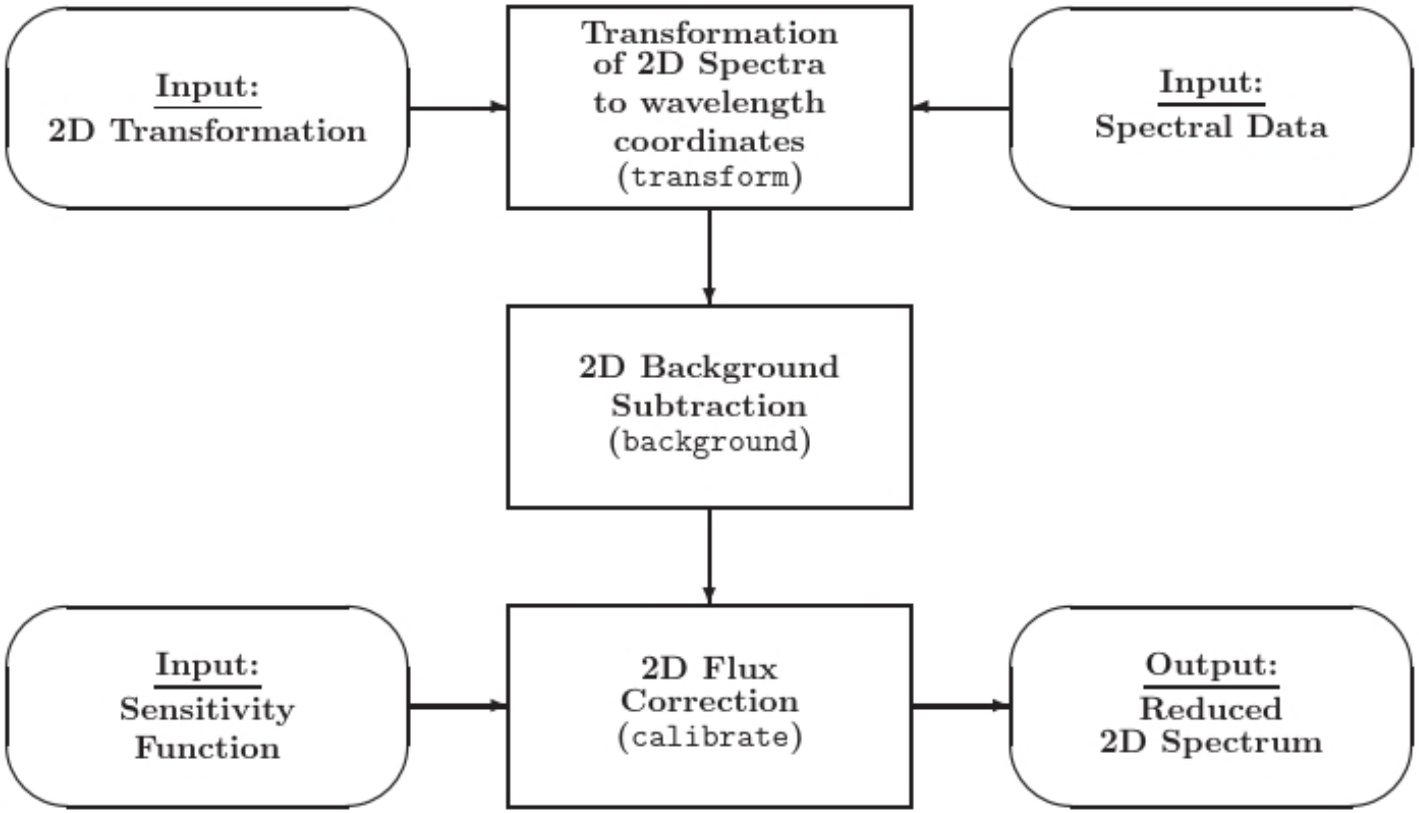
What do we want? (3)

NGC 2835 - Long-slit reduced spectrum



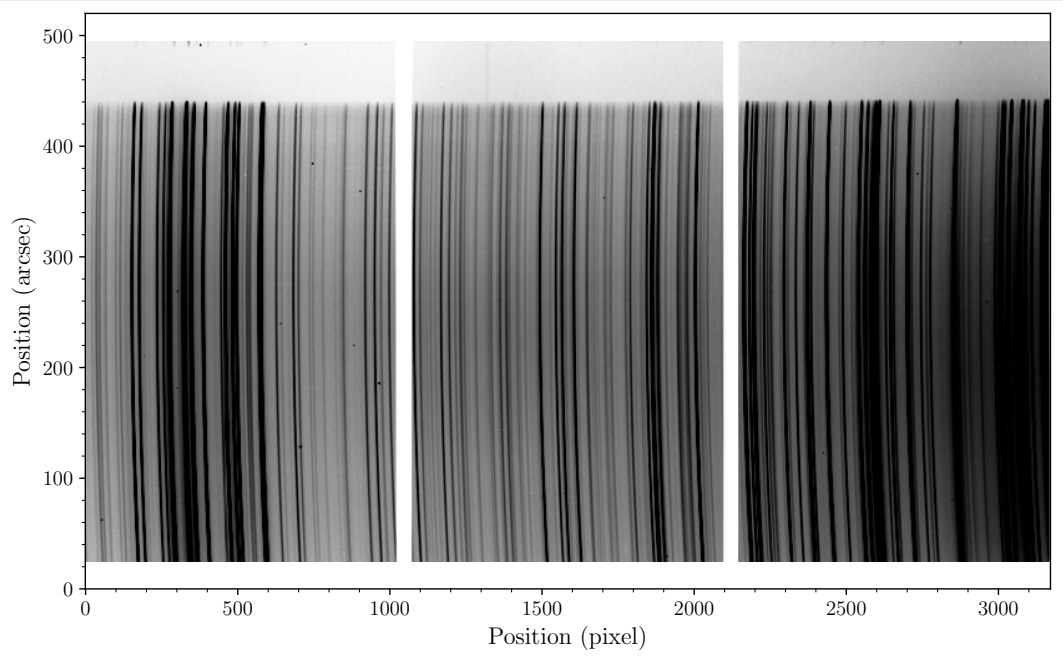
How to reduce 2D spectrum of object?

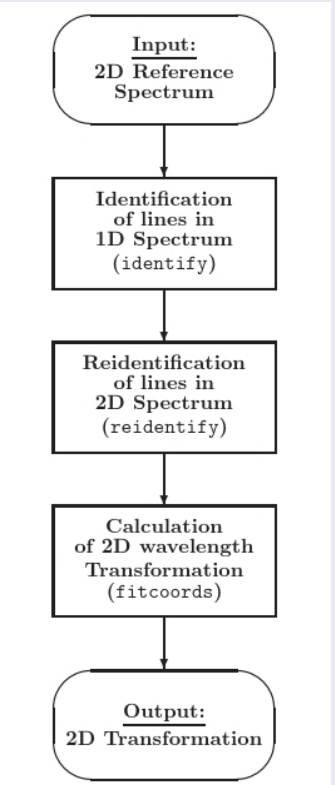
Flow chart for object reduction



How to reduce 2D spectrum of Arc (Reference spectrum)?

2D long-slit spectrum of Arc





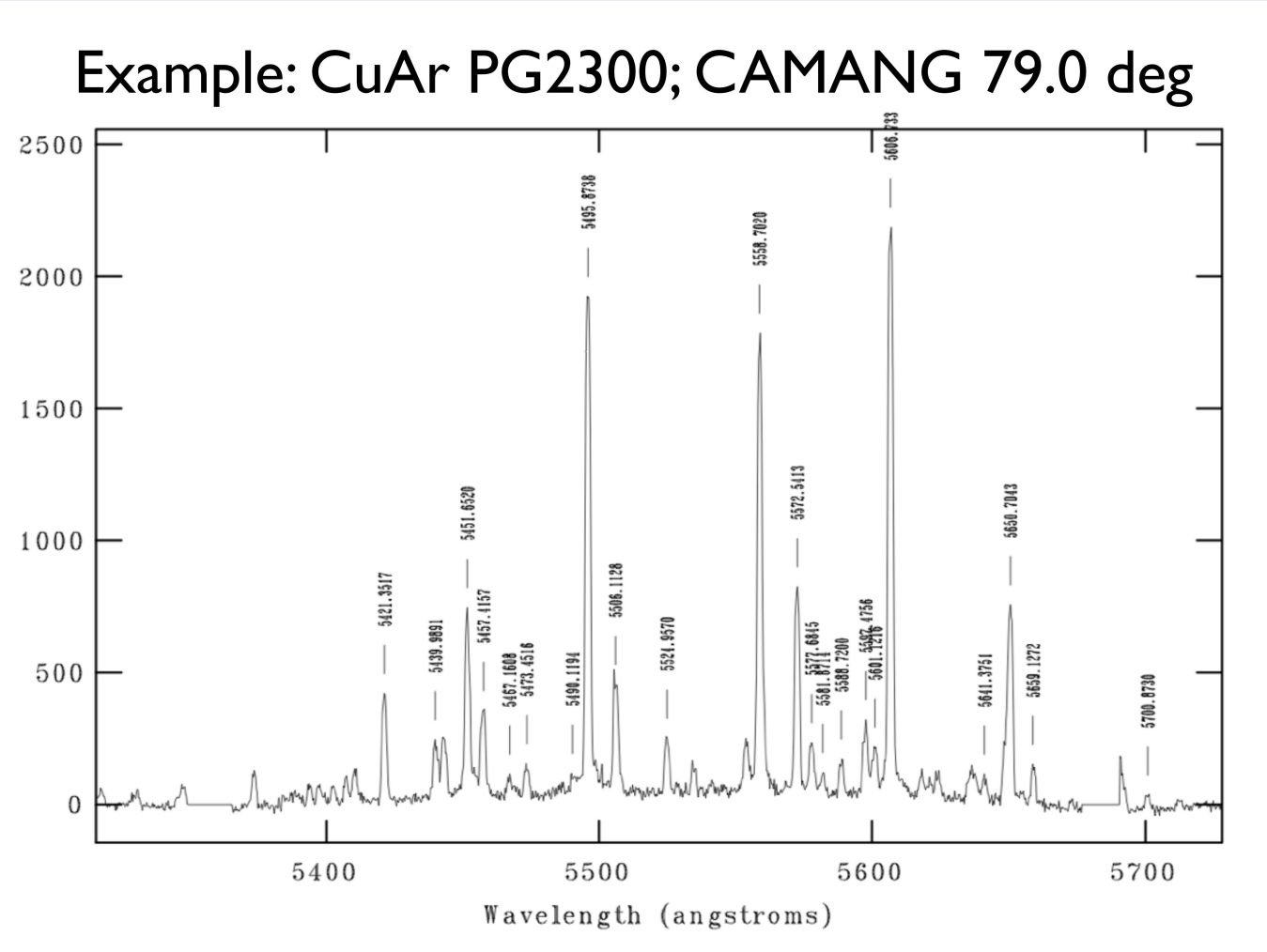
How to reduce 2D spectrum of Arc

Before you start:

- Find Arc linelist and Arc line identification atlas for the lamp used with your data (see LAMPID header)
- Look for that at `http://pysalt.salt.ac.za/lineatlas/lineatlas.html`

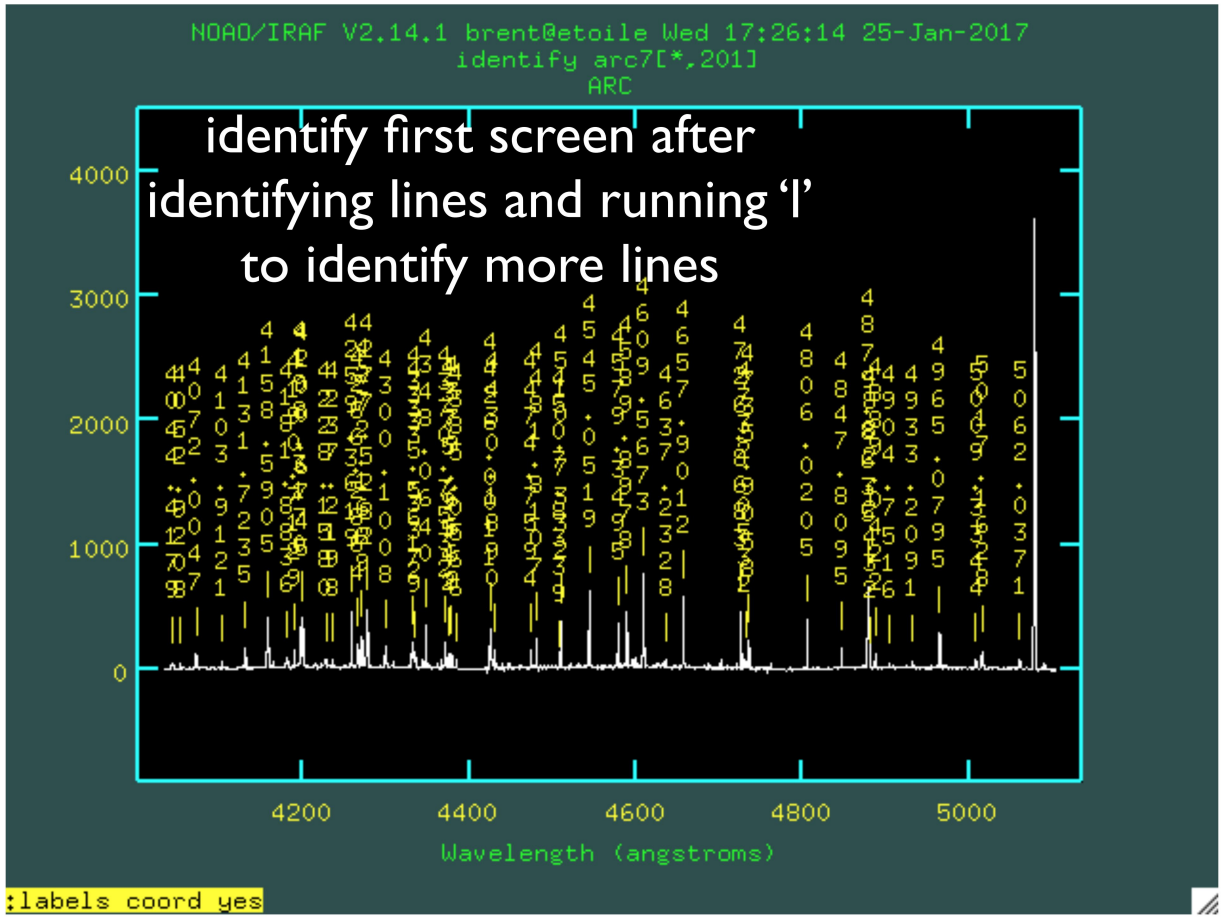
How to reduce 2D spectrum of Arc

Just an example:



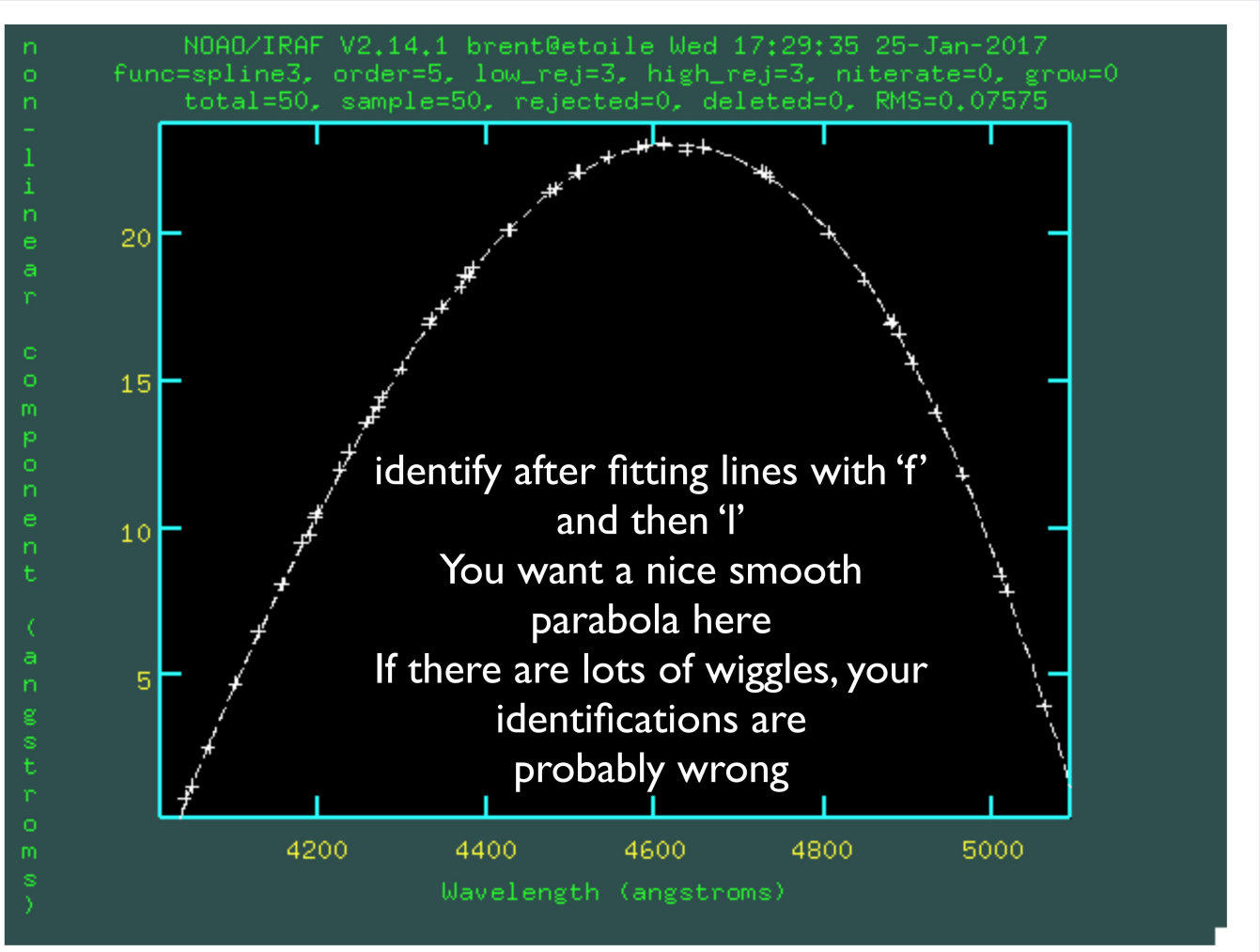
How to reduce 2D spectrum of Arc

IRAF task identify:



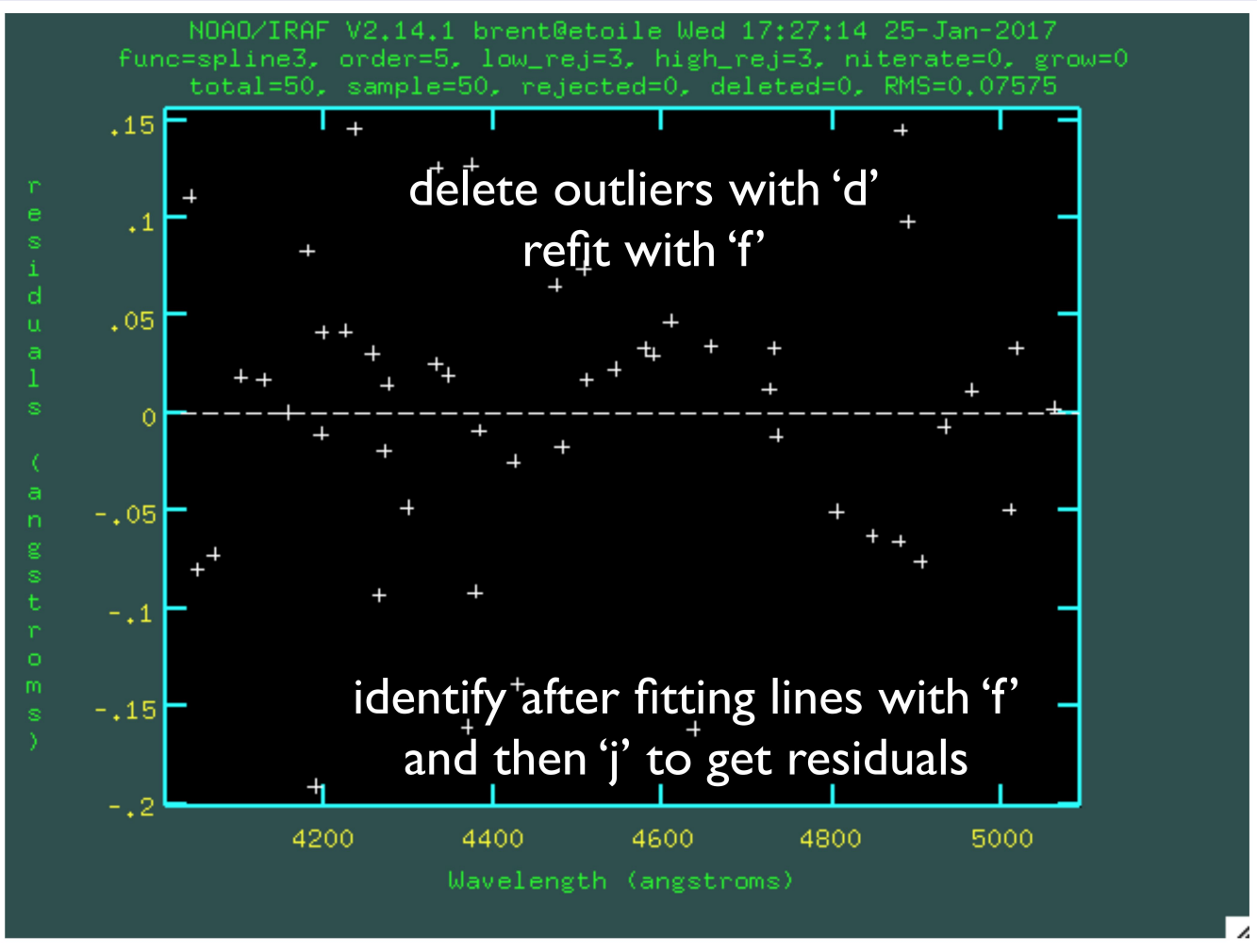
How to reduce 2D spectrum of Arc

IRAF task identify:



How to reduce 2D spectrum of Arc

IRAF task identify:



How to reduce 2D spectrum of Arc

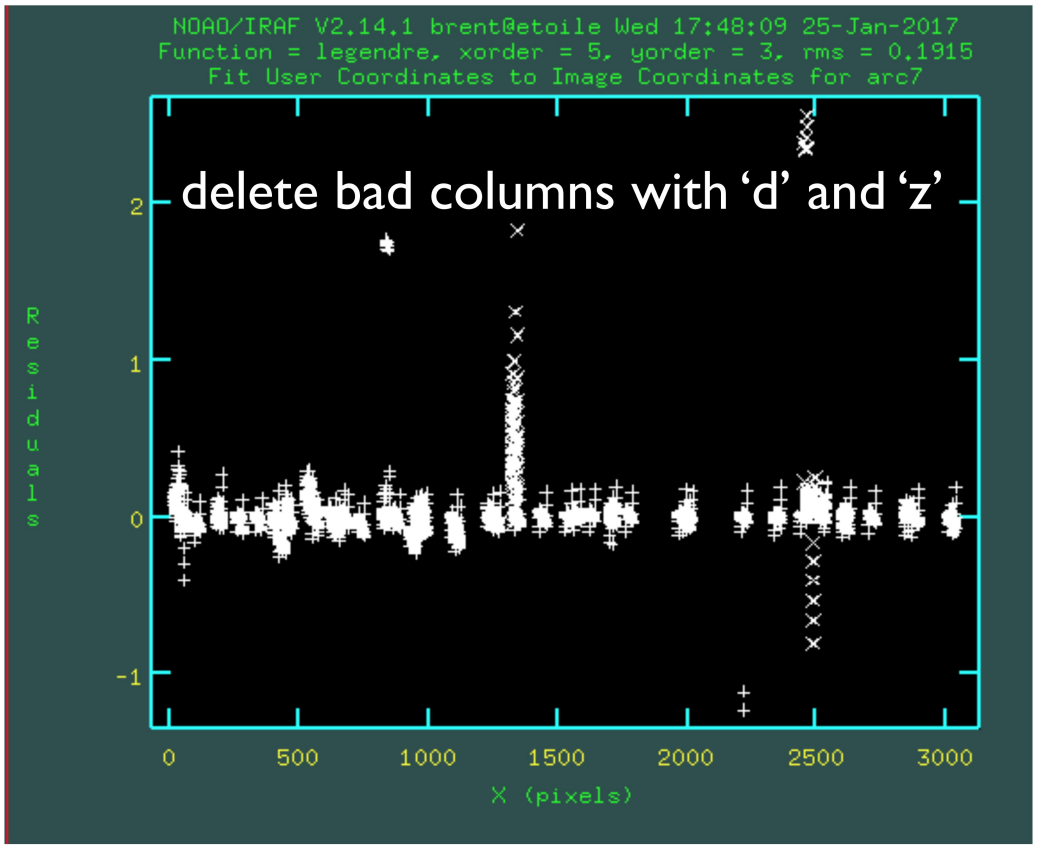
IRAF task `reidentify`:

To reidentify all selected lines along the columns of 2D spectrum:
cl> reidentify reference=refspec.fits images=refspec.fits interactive=no newaps=yes override=no refit=yes nlost=20 coordlist=cuar.dat verbose=yes

How to reduce 2D spectrum of Arc

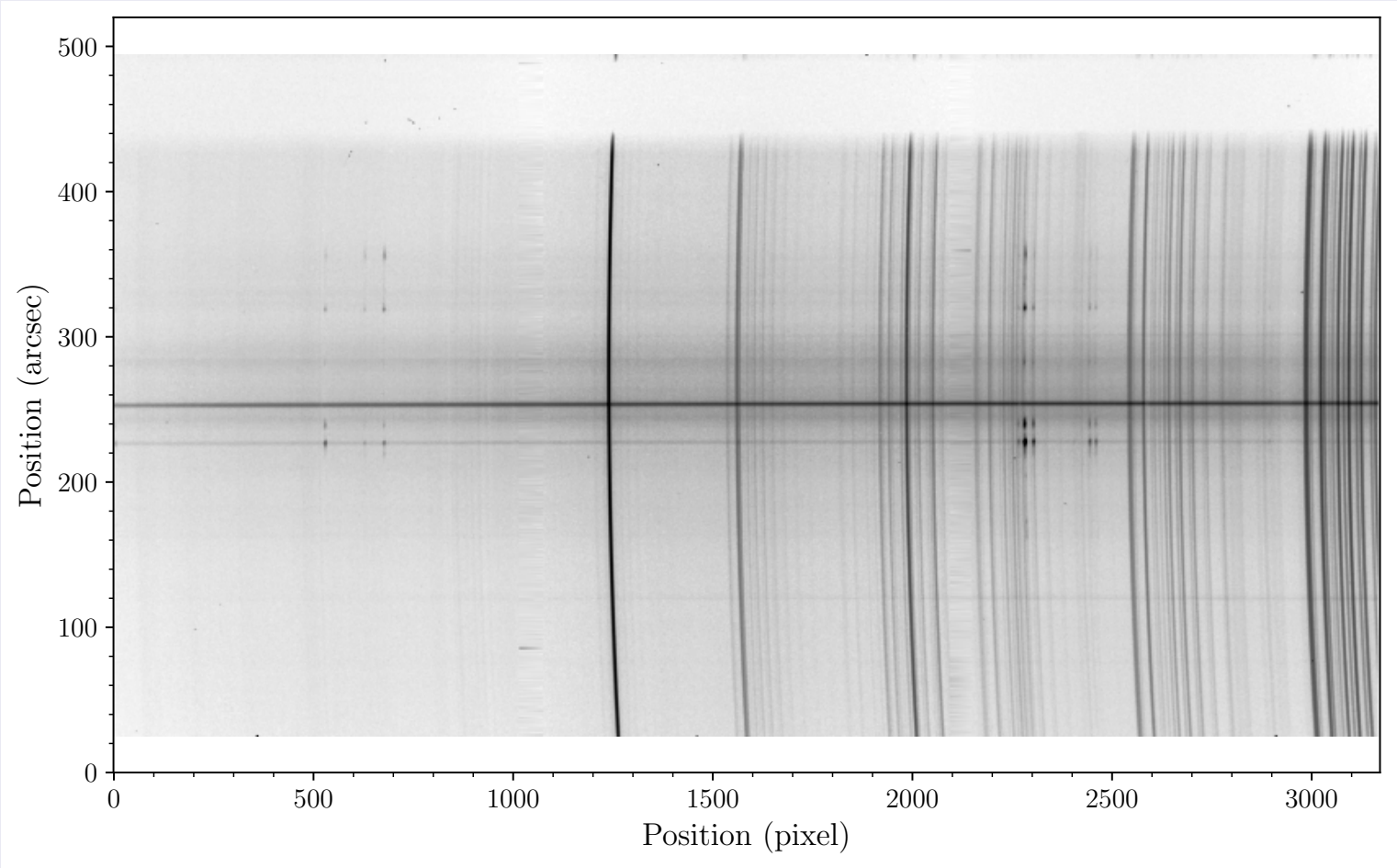
IRAF task `fitcoords`:

CuAr arc from earlier



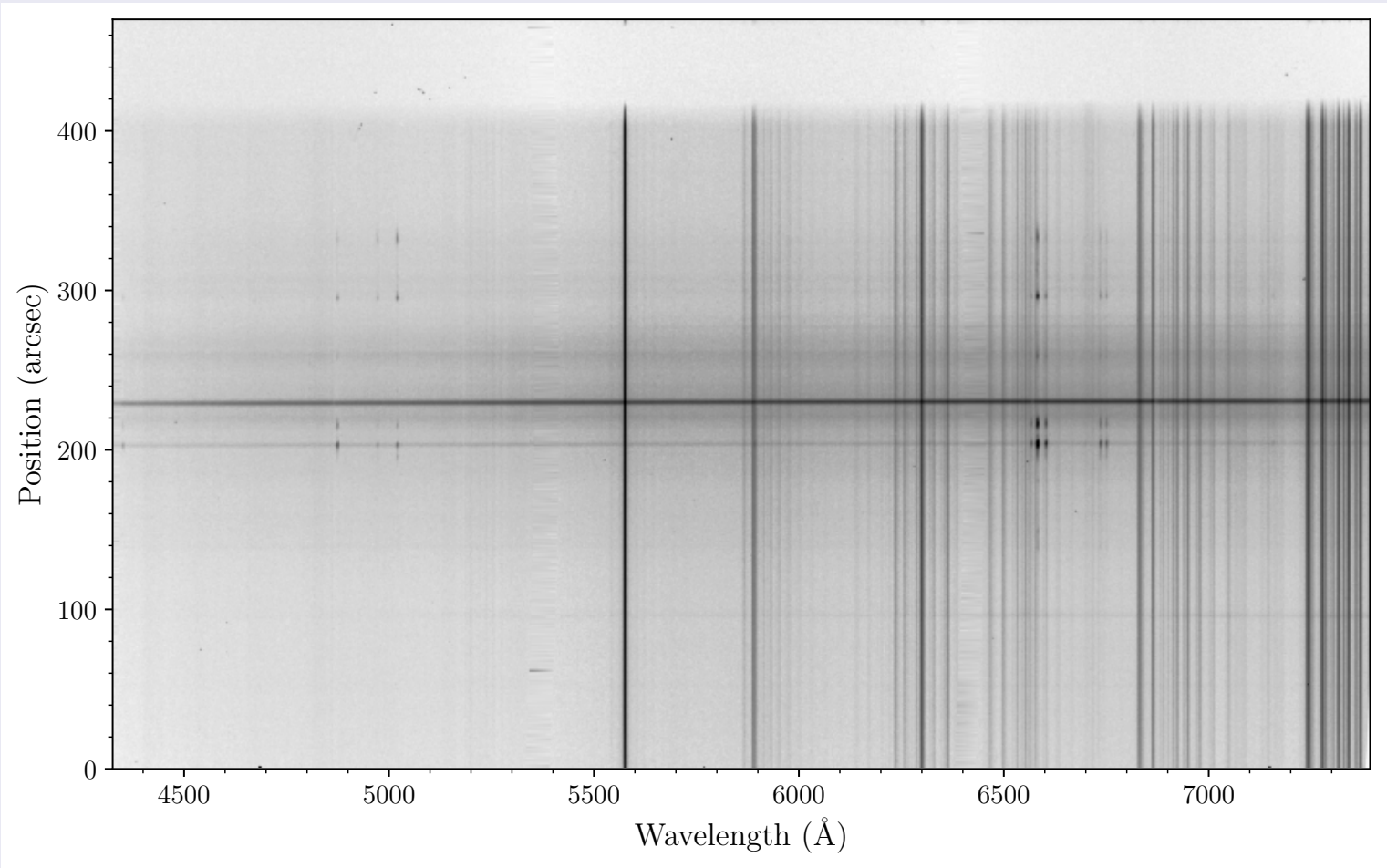
Wavelength transformation of 2D spectrum (1)

Reduced 2D spectrum BEFORE transformation:



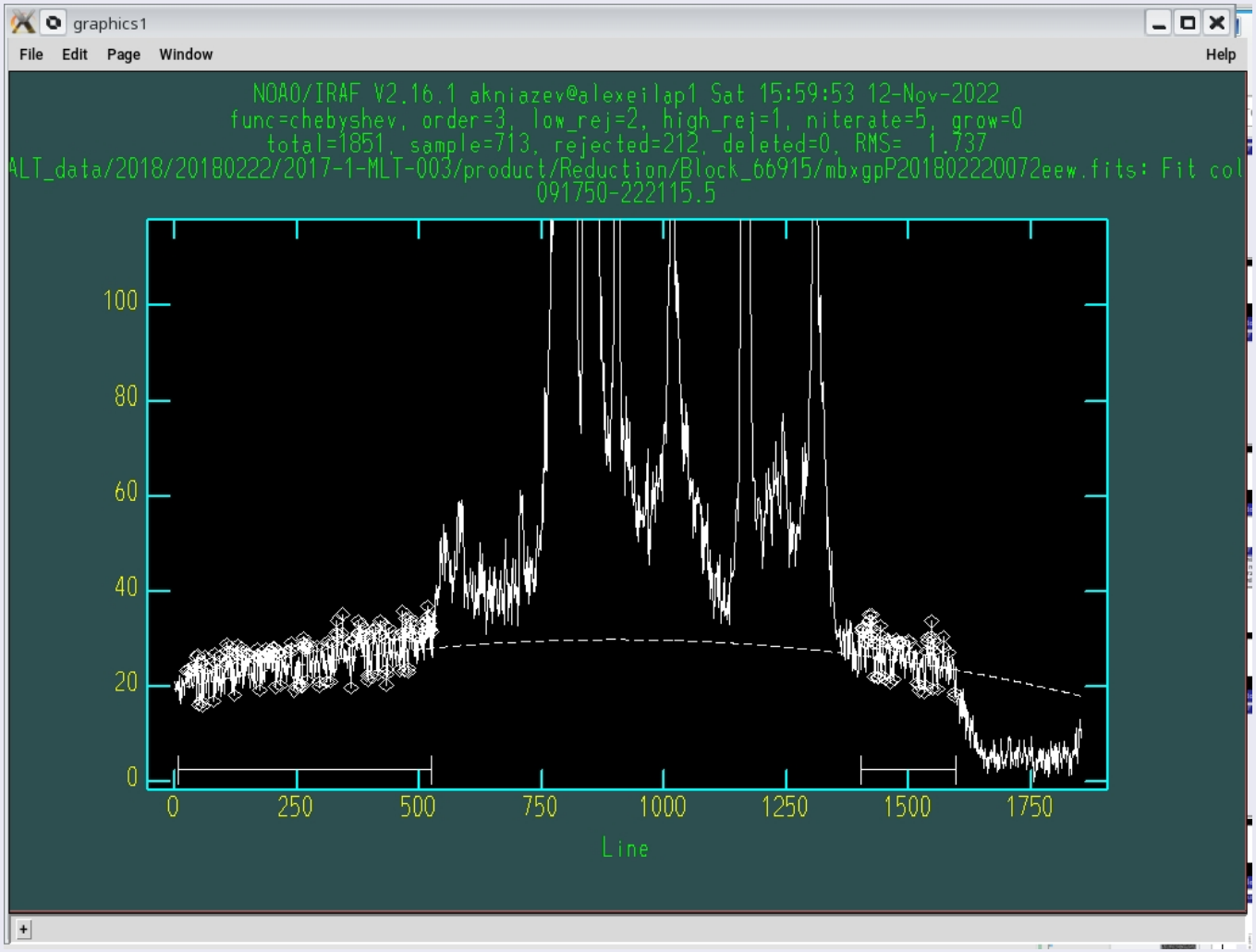
Wavelength transformation of 2D spectrum (2)

IRAF task `fitcoords`:



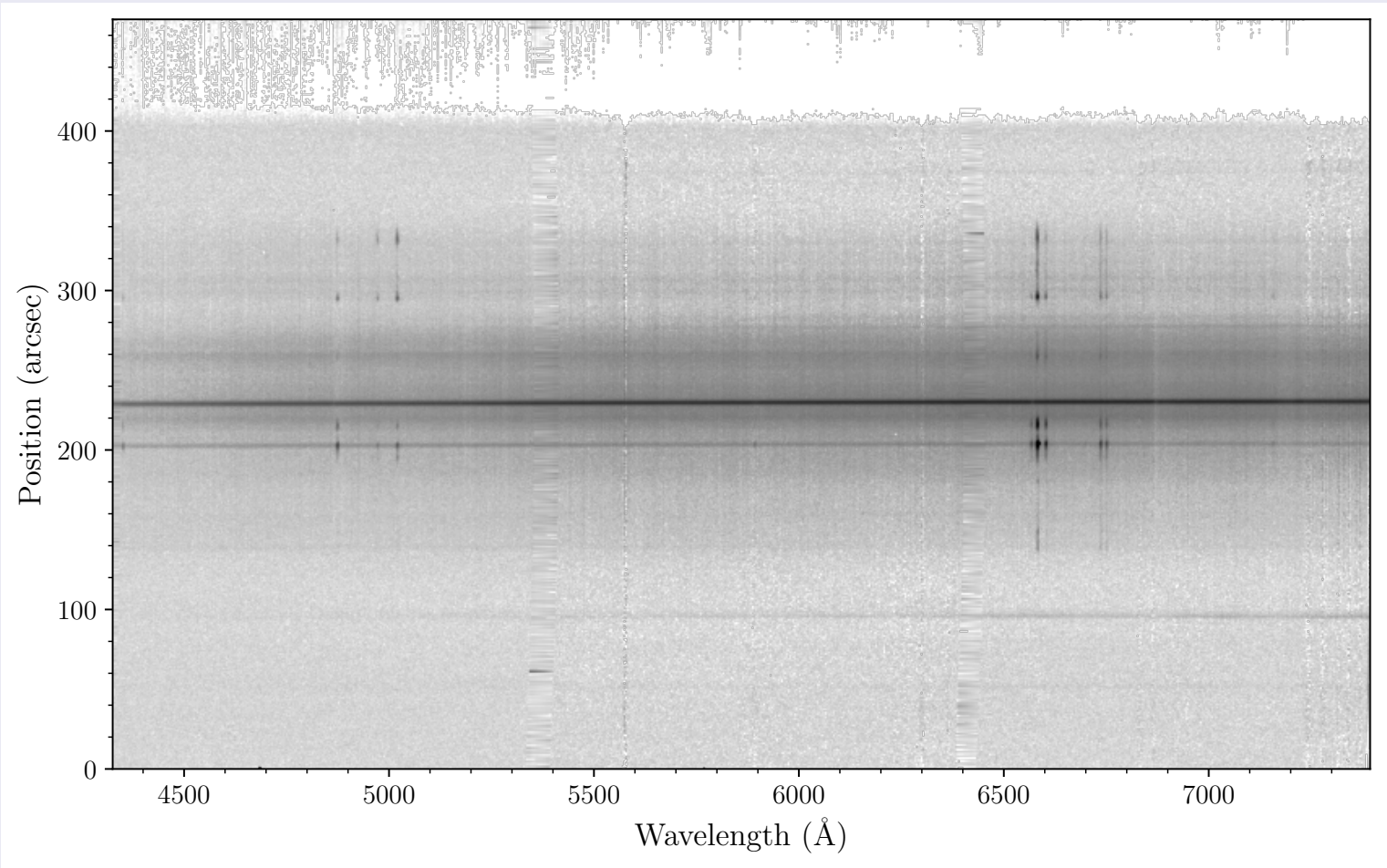
Background subtraction in 2D spectrum

IRAF task background:



Background subtraction in 2D spectrum

IRAF task `background`:



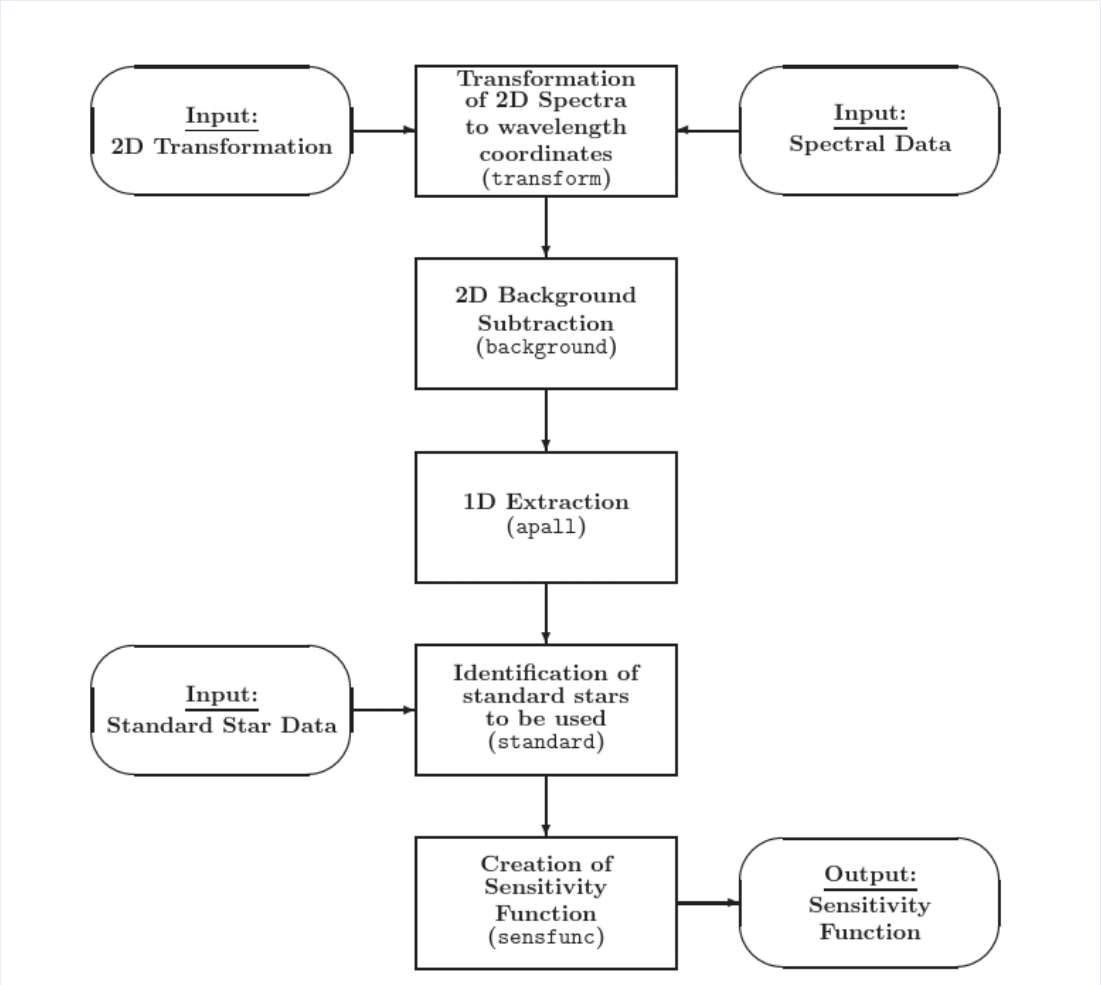
How to reduce spectrophotometric standard (SPST)?

For what we need spectrophotometric standard (SPST)?

1. SPST is a star for which its absolute flux distribution is known with very good accuracy
2. After our reduction the spectral distribution of studied object reflects not his physics, but it is skewed by the spectral sensitivity of the Atmosphere+Telescope+Spectrograph+CCD
3. To correct for that effect we need to find the function of this distortion which astronomers call "sensitivity function".
4. Remember, that only relative calibration is correct with SALT

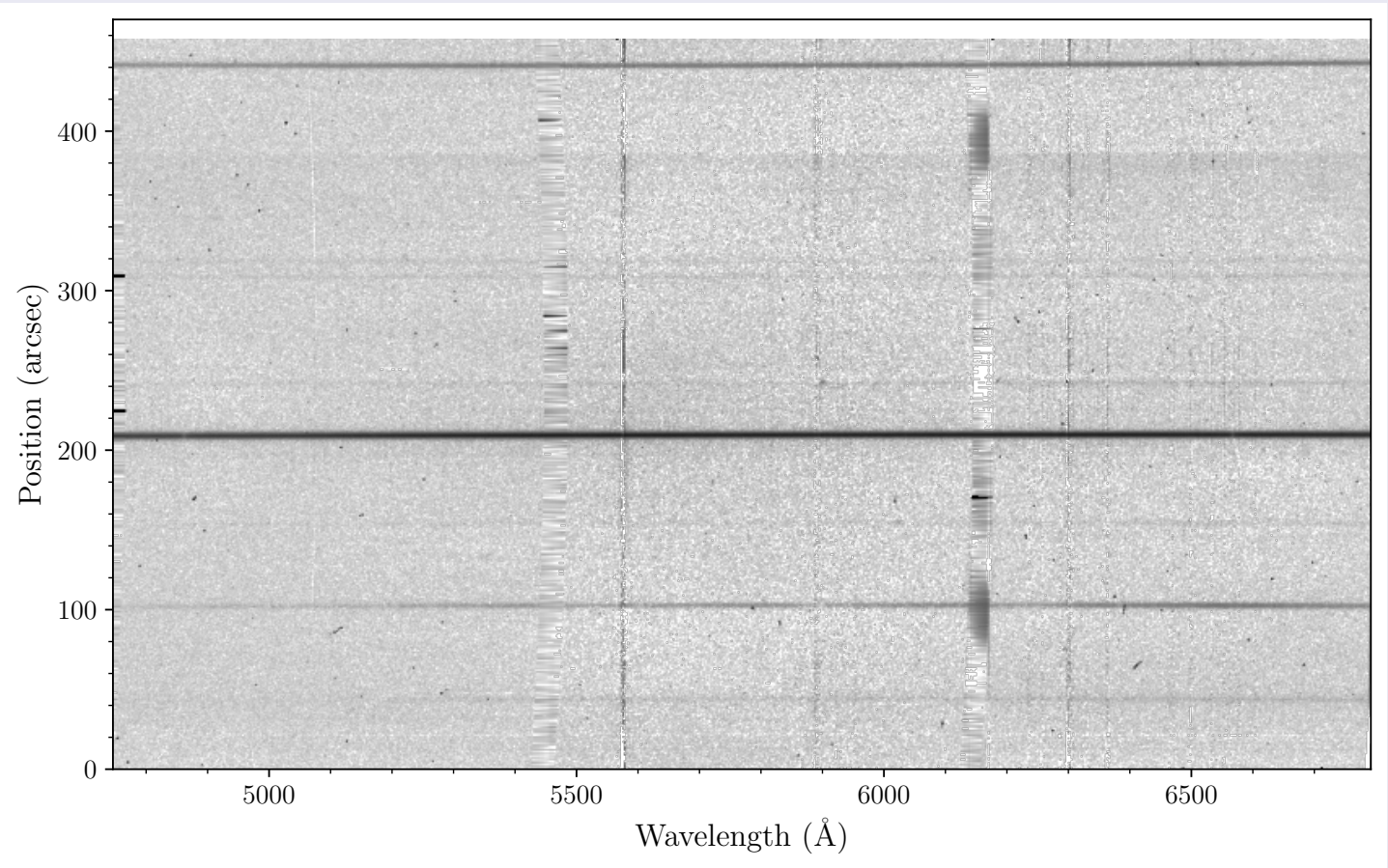
How to reduce spectrophotometric standard (SPST)?

Flow chart for SPST reduction



How to reduce spectrophotometric standard

2D spectrum of SPST after wavelength transformation and background subtraction:



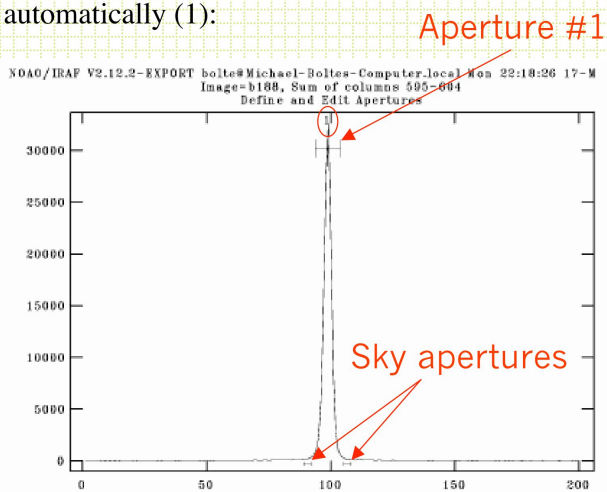
How to reduce spectrophotometric standard

IRAF task apall in the package apextract:

Example Extraction

```
cl>apall b188 output=b188.ms
Find apertures for b188?  (yes):
Number of apertures to be found automatically (1):
Edit apertures for b188?  (yes):
```

Commonly used options:
- ? -- help
- l -- set lower ap limit
- u -- set upper ap limit
- b -- to tweak sky aperture
- w -- window the plot
  - ? -- window help
  - e -- expand plot
- q -- happy, continue



How to reduce spectrophotometric standard

IRAF task apall in the package apextract:

`b' option:

Commonly-used commands:

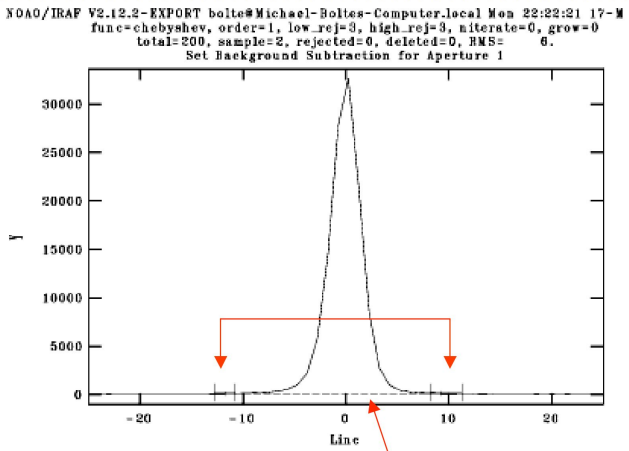
z -- deletes nearest aperture

s -- define new aperture

f -- redo fit

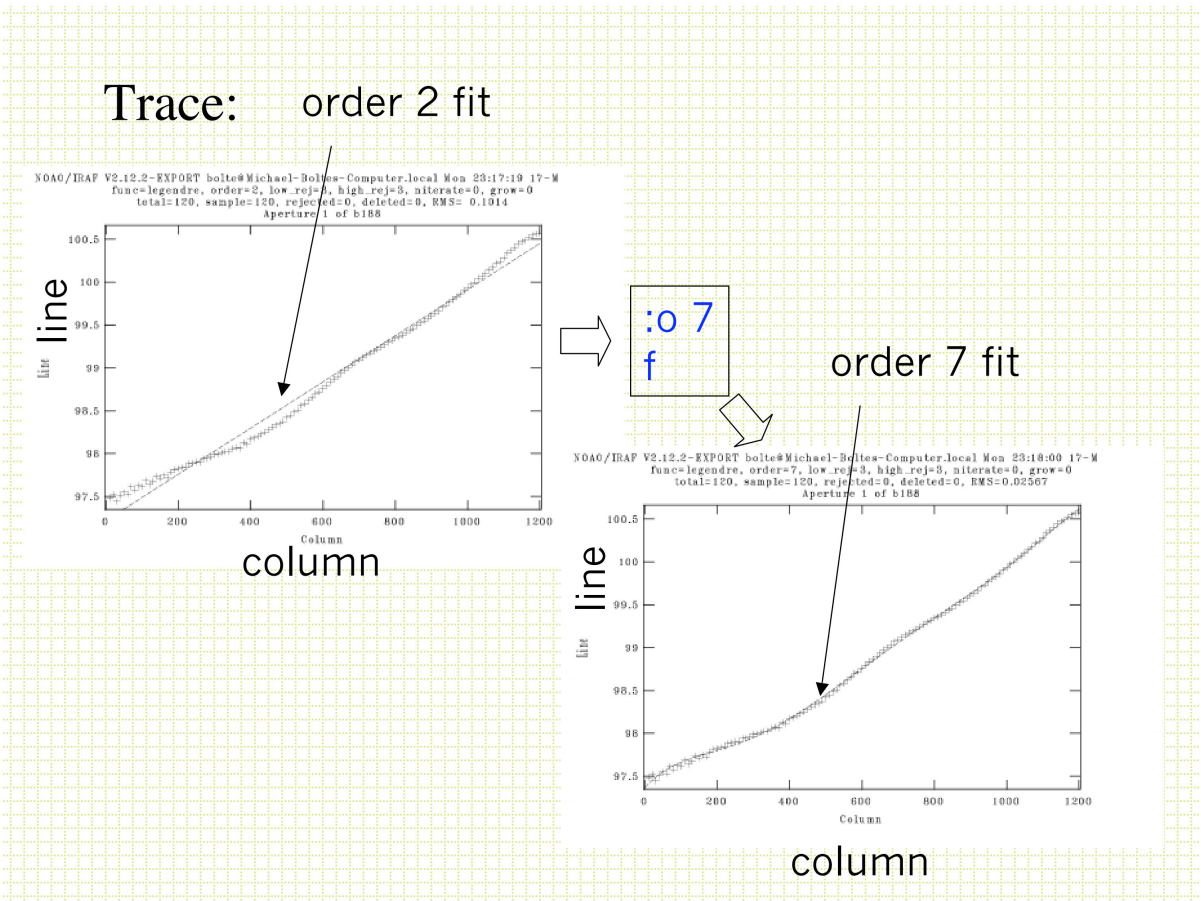
:order n -- set order of fit

q -- accept fit and go to previous panel



How to reduce spectrophotometric standard

IRAF task apall in the package apextract:



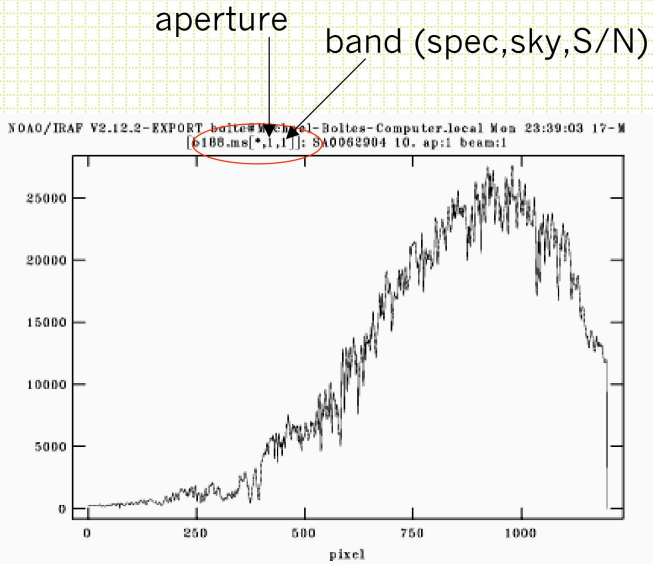
How to reduce spectrophotometric standard

IRAF task `splot`:

Splot:

cl>splot b188.ms

Common splot options:
? -- lists all the options
%-- select new band
m-- gives statistics
e-- eq. width, line centers
s-- smooth
t-- fit continuum
w--window plot



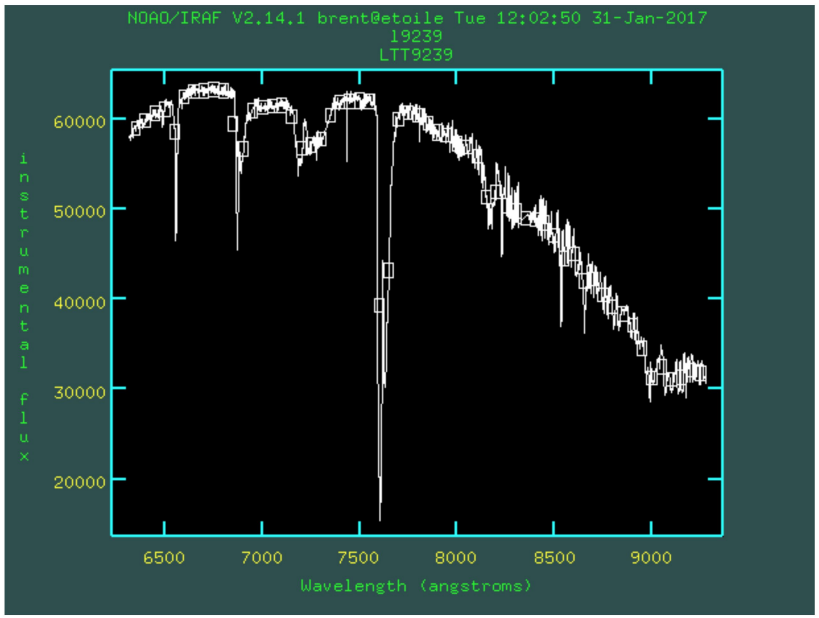
Extracted spectrum in pixel space

How to reduce spectrophotometric standard

IRAF task `standard`:

Example: LTT9239 PG900; CAMANG 41.5

standard



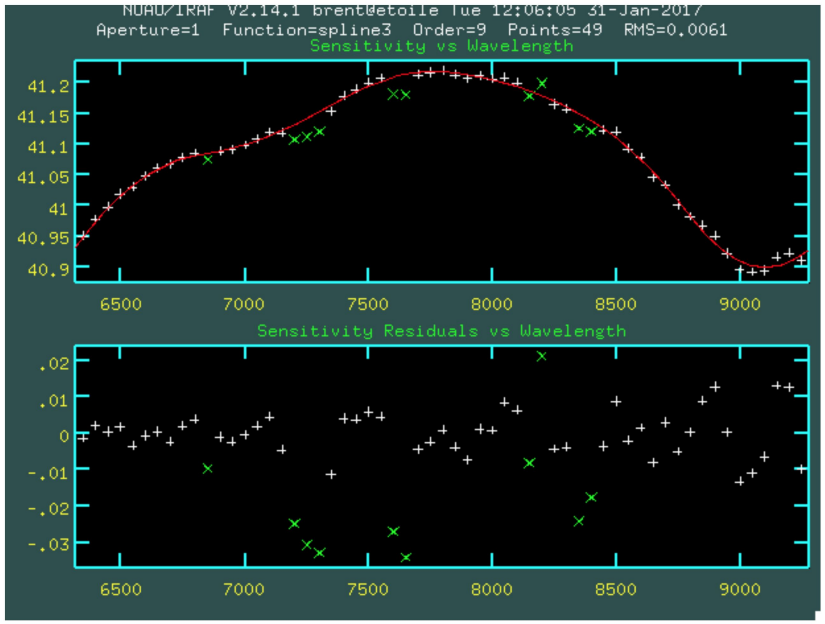
How to reduce spectrophotometric standard

IRAF task `sensfunc`:

Example: LTT9239 PG900; CAMANG 41.5

sensfunc

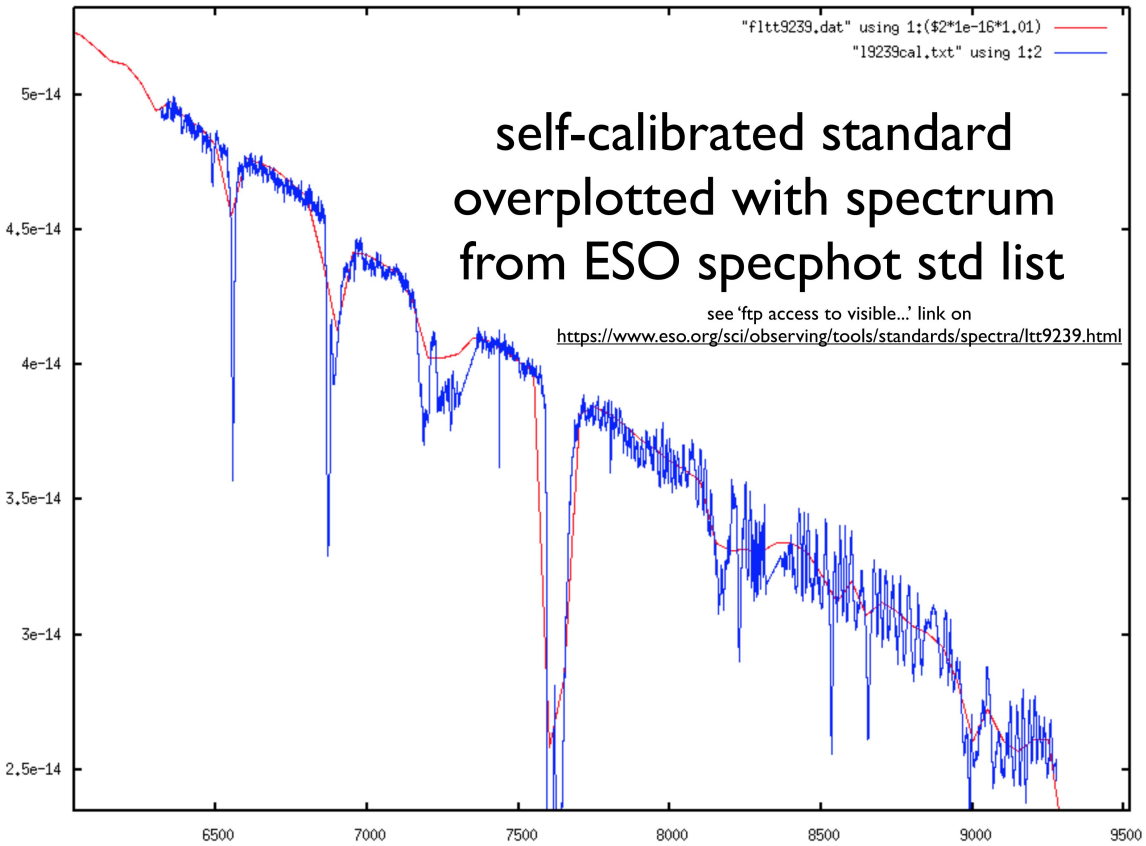
green points deleted (telluric)



Object reduction: Correction for the sensitivity function

IRAF task `calibrate`:

self calibration check



self-calibrated standard overplotted with spectrum from ESO specphot std list

see 'ftp access to visible...' link on
https://www.eso.org/sci/observing/tools/standards/spectra/ltt9239.html

The end of story

Me

You