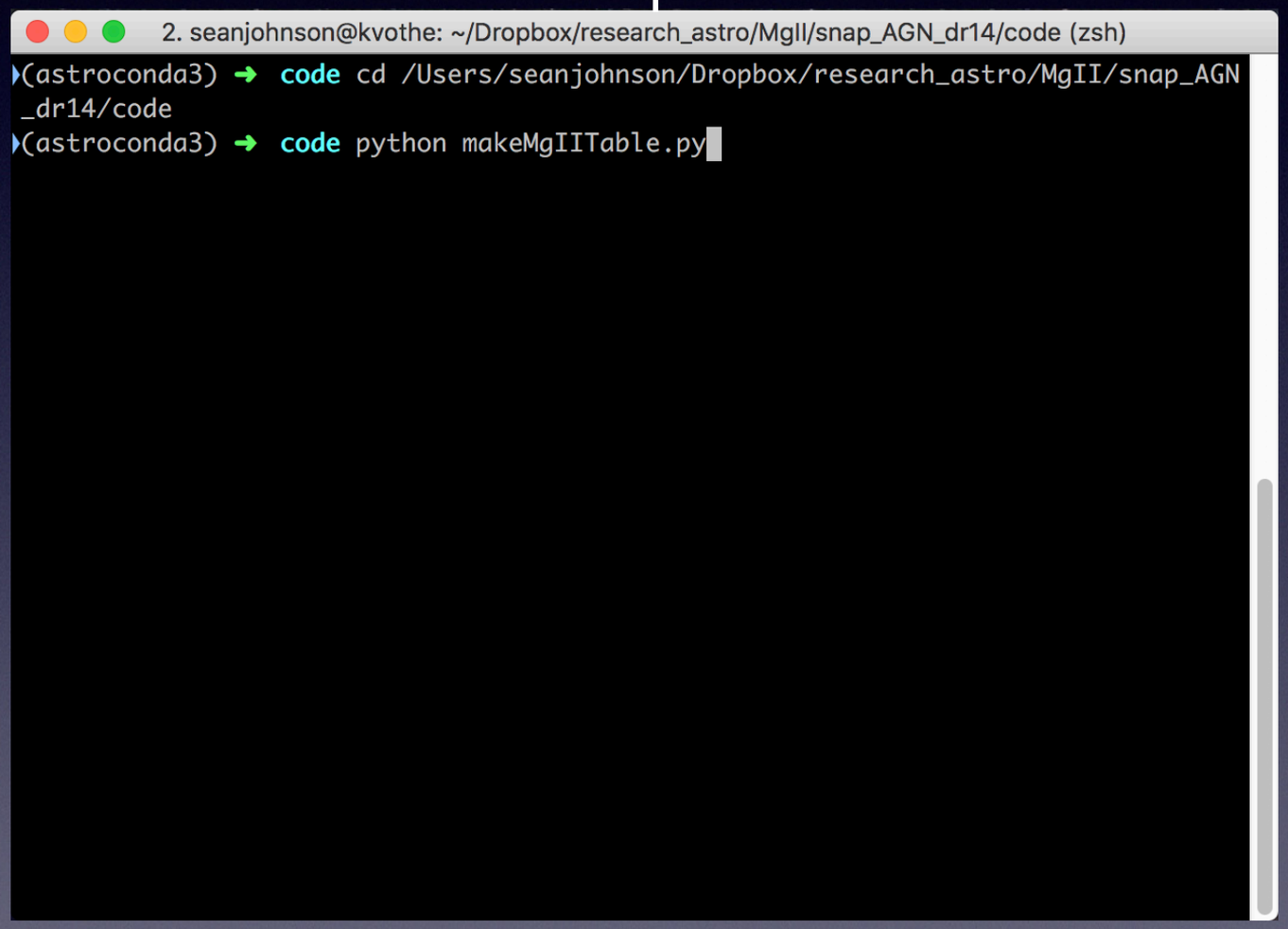
Measuring circum-galactic gas around quasars

First create a catalog

Step 1



This creates a file in the catalog directory called pairs_MgII.fits

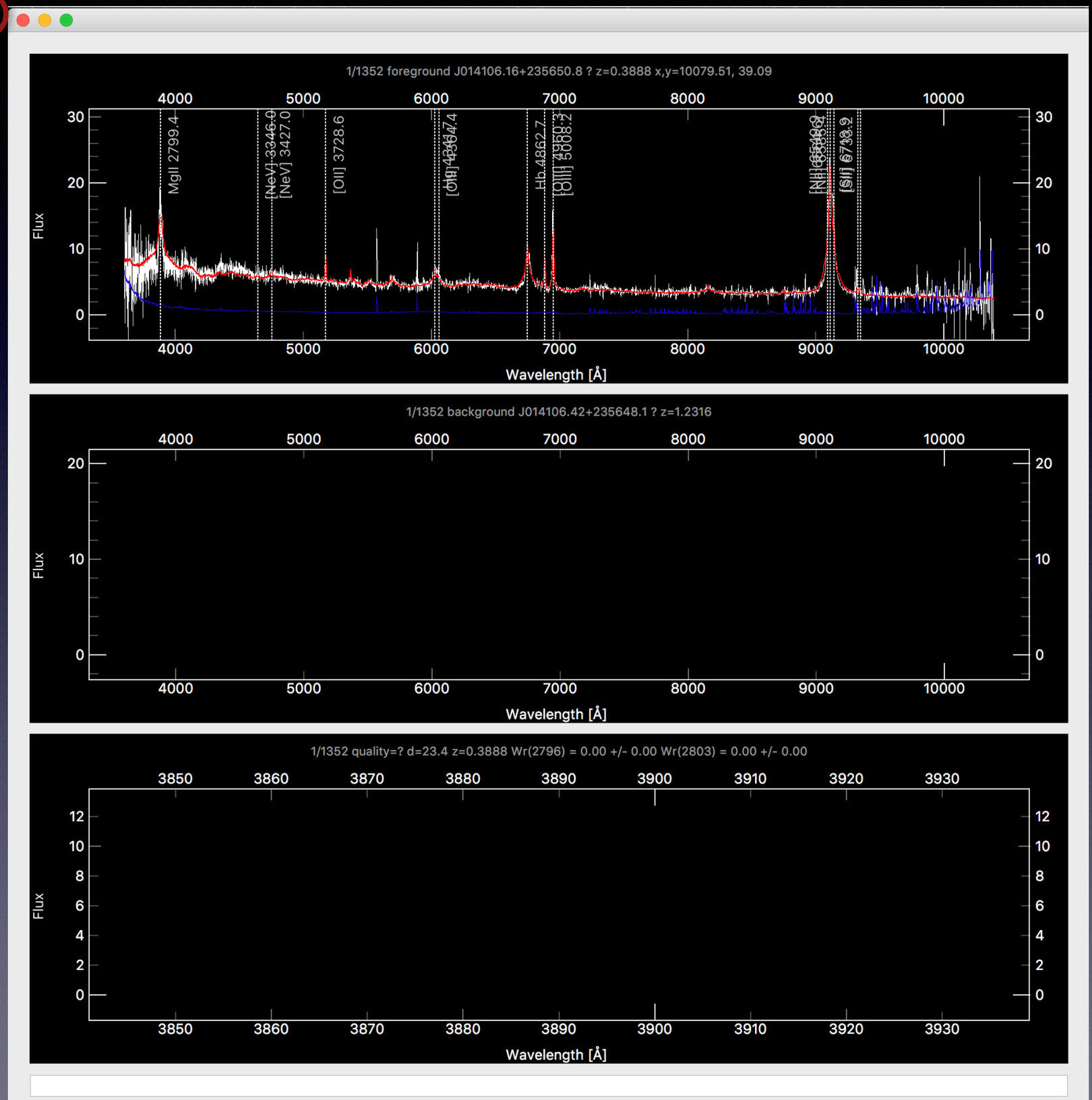
Step 2

Change the file name replacing _MgII.fits with _MgII_username.fits

I used my initials as my user name, so pairs_MgII_sdj.fits

Step 3: foreground quasar verification

```
(astroconda3) ➜  code python measureQuasarHalos.py -u sdj
Starting app
Reading pair table
Create bg quasar plot region
Create fg quasar plot region
Create absorption plot region
Layout
Reading in first spectra
```



Top: foreground quasar spectrum

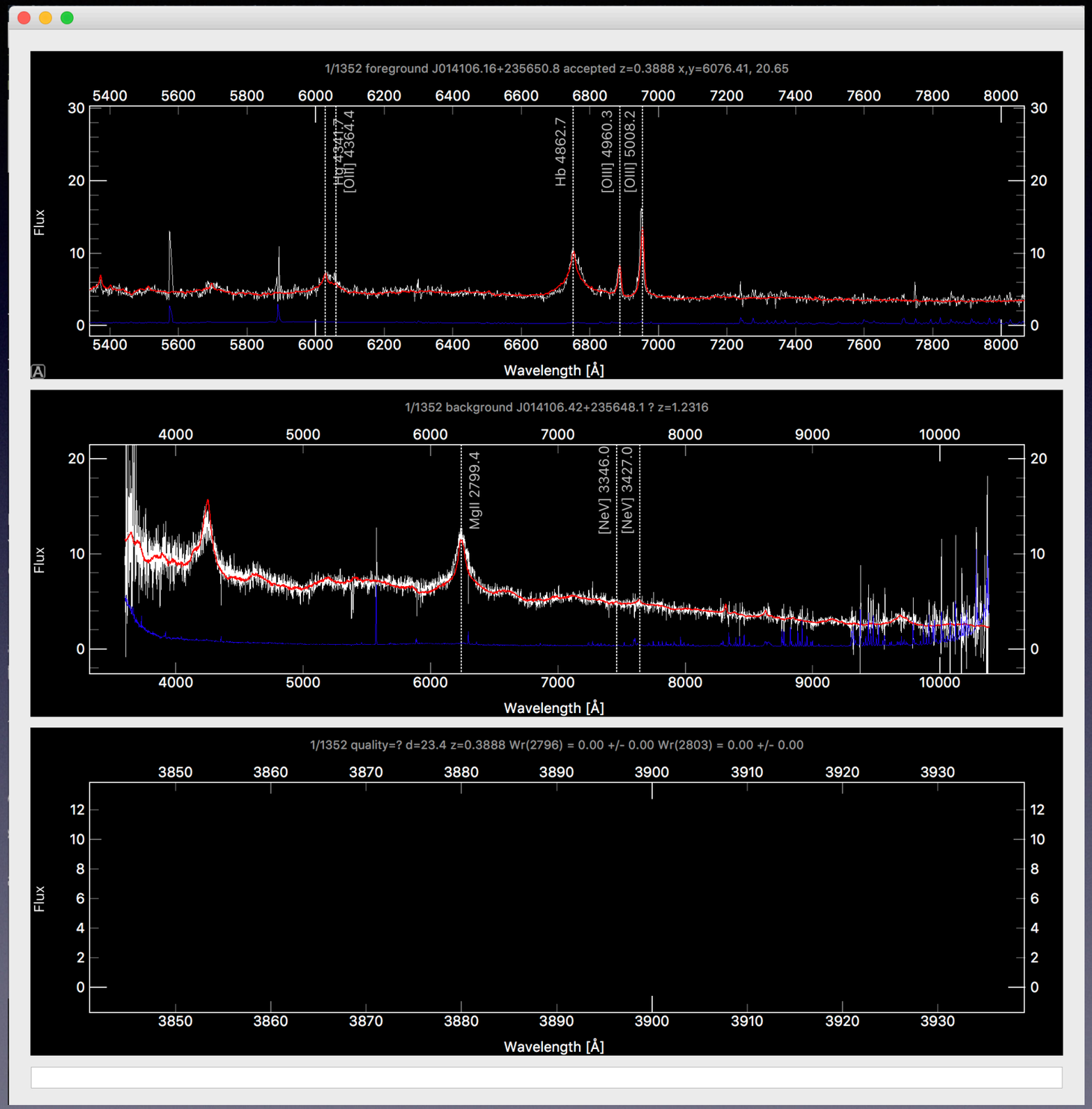
- white = data
- blue = error
- red = best-fit model
- vertical labelled lines = emission lines at the quasar redshift
- A good quasar classification means the emission lines in the spectrum should match the model and vertical lines: at least two emission lines needed.
- If the spectrum is noisy, smooth is with “=” (unsmooth is “-“ keystroke) with cursor in the top panel
- Zoom in and out with right-click and drag
- Pan with left click and drag
- After evaluating: classify as good/ accepted by hitting “t” or reject by hitting “r”.
- If you accept, the background quasar will be shown for evaluation in the middle panel. If rejected hit “n” to move on.

Step 4: background quasar verification

Same as 3 but in middle panel

Middle: background quasar spectrum

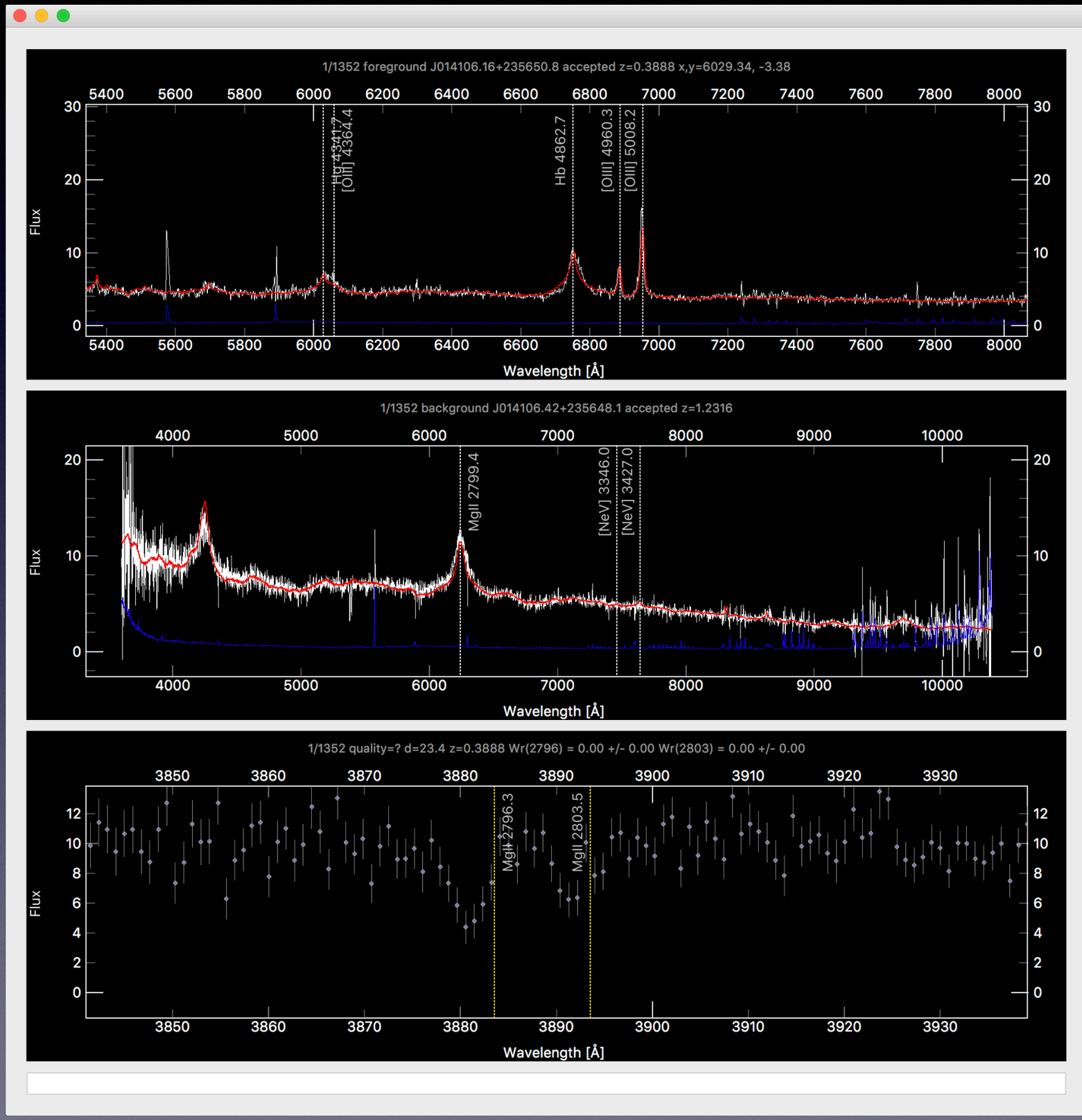
- white = data
- blue = error
- red = best-fit model
- vertical labelled lines = emission lines at the quasar redshift
- A good quasar classification means the emission lines in the spectrum should match the model and vertical lines: at least two emission lines needed.
- If the spectrum is noisy, smooth is with "=" (unsmooth is "-" keystroke) with cursor in the top panel
- Zoom in/out with right-click and drag
- Pan with left click and drag
- After evaluating: classify as good/ accepted by hitting "t" or reject by hitting "r".
- If you accept, the background quasar will be shown for evaluation in the middle panel. If rejected hit "n" to move on to the next quasar pair.



Step 5: look for absorption and “doublet”

Bottom: search for MgII absorption doublet

- white = data
- blue = error
- vertical labelled lines = absorption lines at the quasar redshift
- If you see absorption like in this case, hit “m” at the lowest point of the MgII 2796.3 (lower wavelength, left) absorption feature. The second line, MgII 2803.5 should then line up with the other vertical line.



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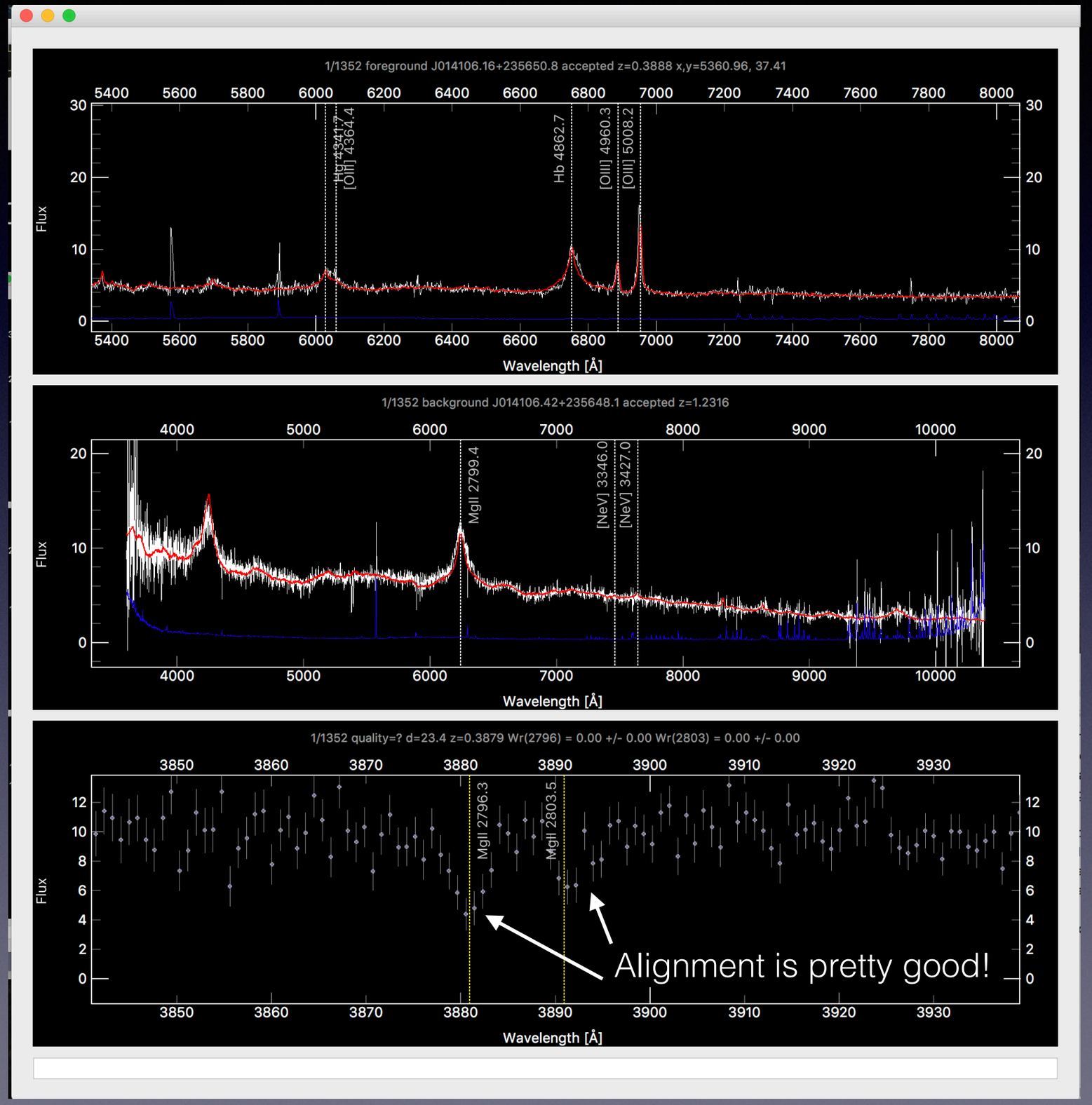
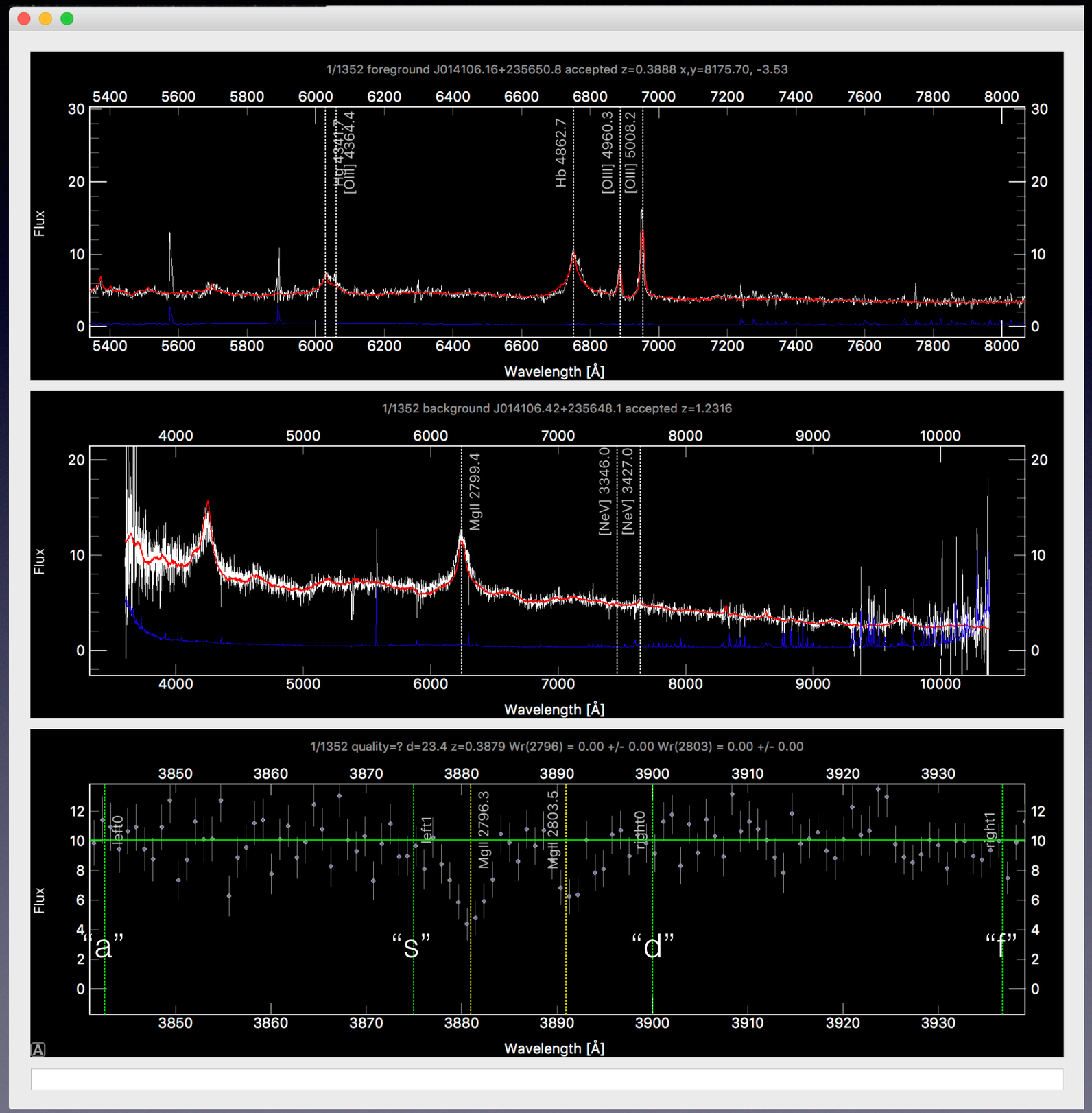


Step 6: fit the “continuum”

Bottom: search for MgII absorption doublet

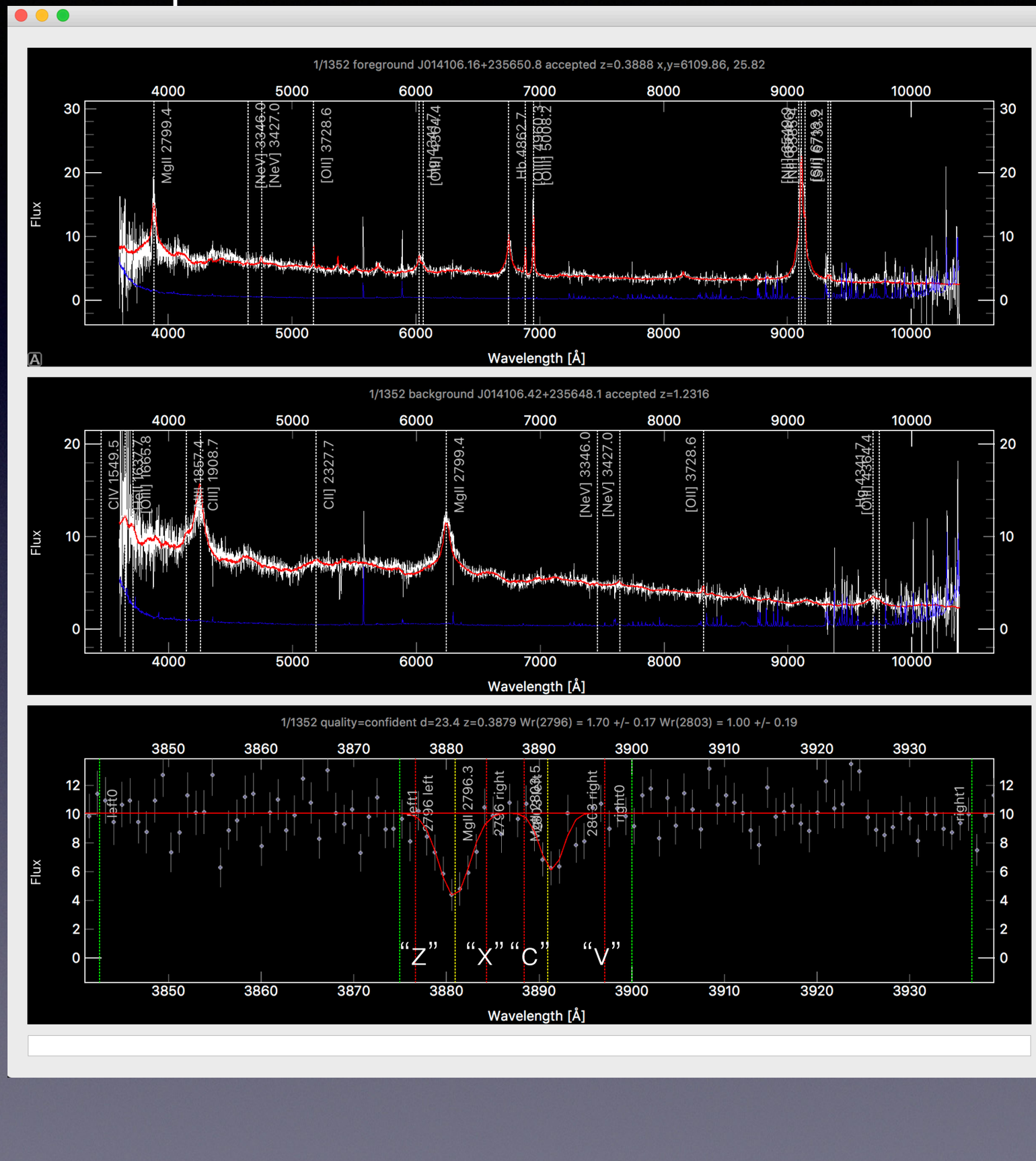
- white = data
- blue = error
- vertical labelled lines = absorption lines at the quasar redshift
- Mark two regions on the left and right of the absorption that are free of features with keystrokes “a”, “s”, “d”, “f”
- Green vertical lines show the fitting regions
- Green horizontal line shows the fit
- Change the order the polynomial fit by hitting “0”, “1”, “2”, “3” if the fit isn’t good.



Step 7: mark absorption boundaries and fit

Bottom: search for MgII absorption doublet

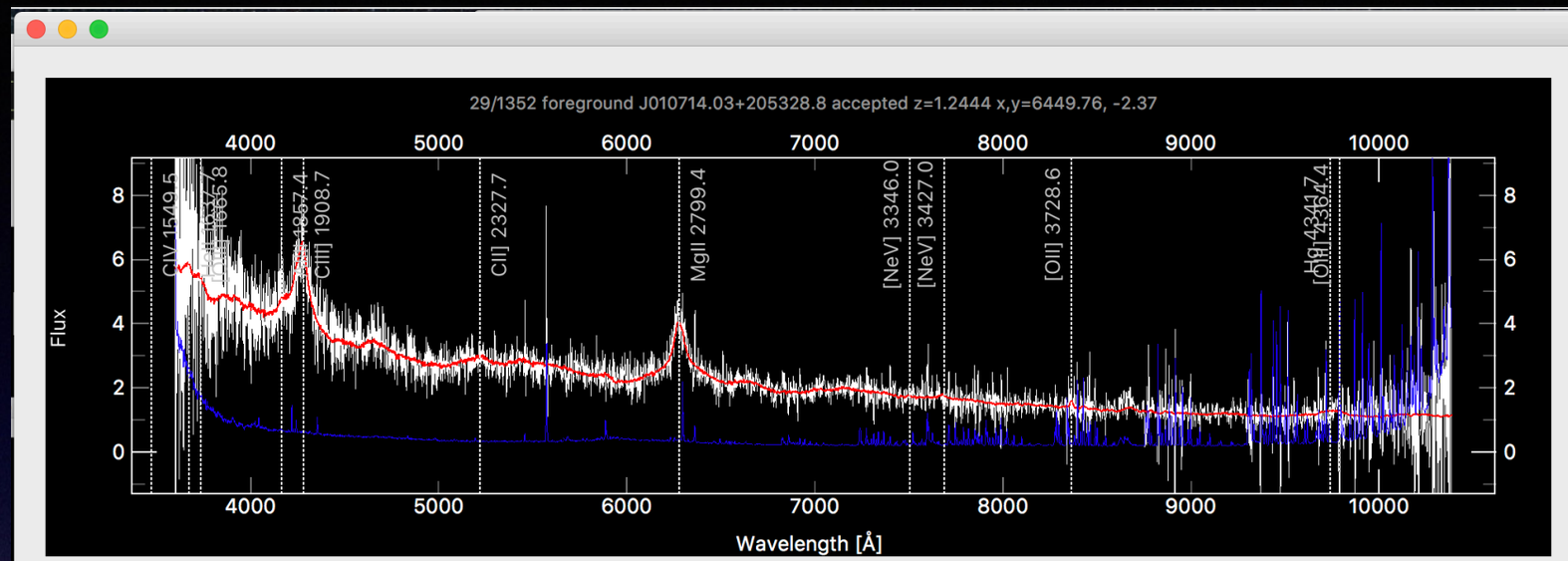
- white = data
- blue = error
- vertical labelled lines = absorption lines at the quasar redshift
- Mark the left and right boundaries of MgII 2796 with “z”, “x” respectively
- Mark the left and right boundaries of MgII 2803 with “c”, “v” respectively
- The code will fit a gaussian model shown in red
- If the fit is good, hit “t” to classify as confident
- Hit “n” to move on to the next object



Step 7: non-detections

Bottom: search for MgII absorption doublet

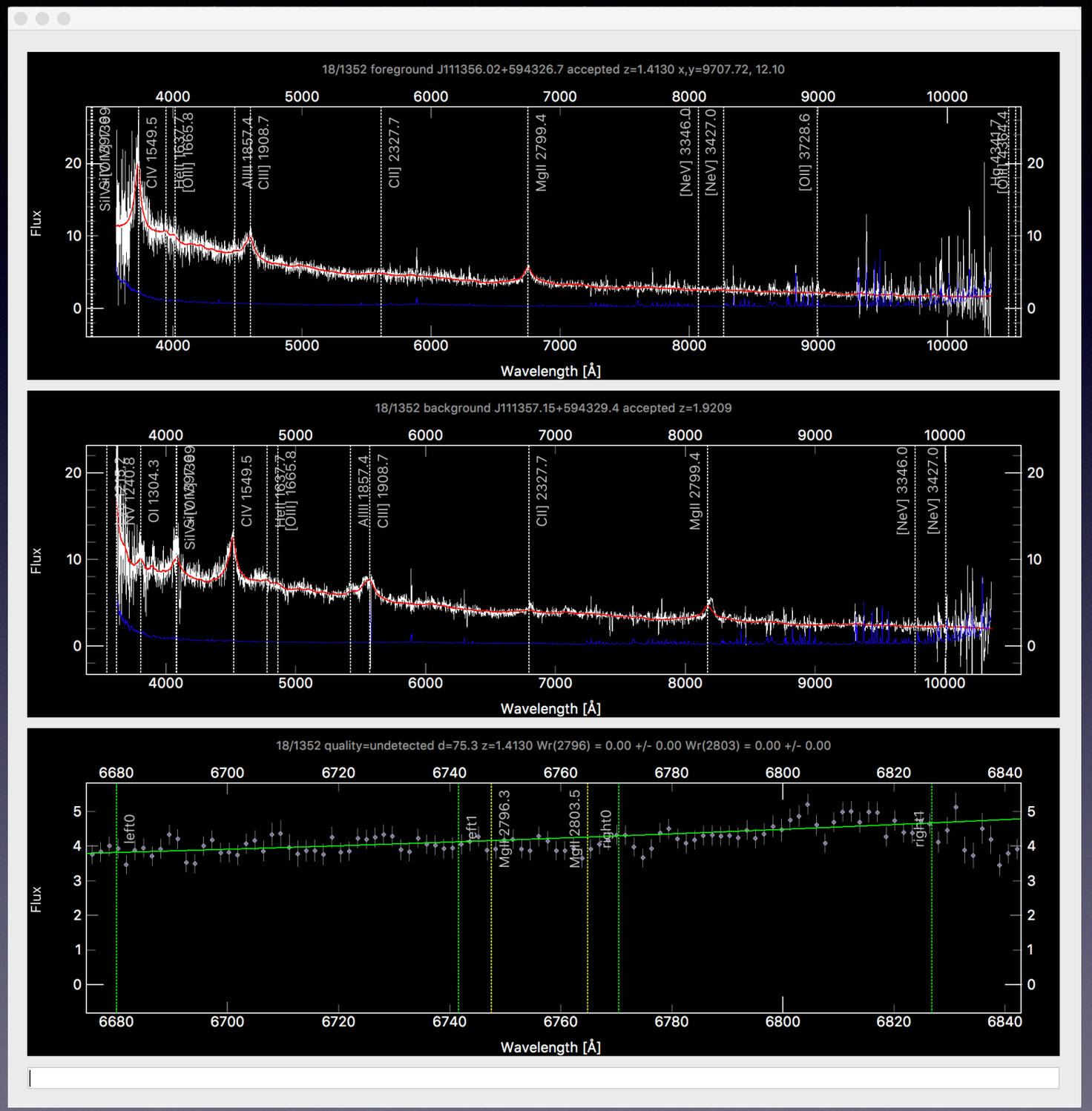
- white = data
- blue = error
- vertical labelled lines = absorption lines at the quasar redshift
- Mark the left and right boundaries of MgII 2796 with “z”, “x” respectively
- The code will fit a gaussian model shown in red
- If you only see one absorption line, hit “y” to classify as single-line
- Hit “n” to move on to the next object



Step 7: non-detections

Bottom: search for MgII absorption doublet

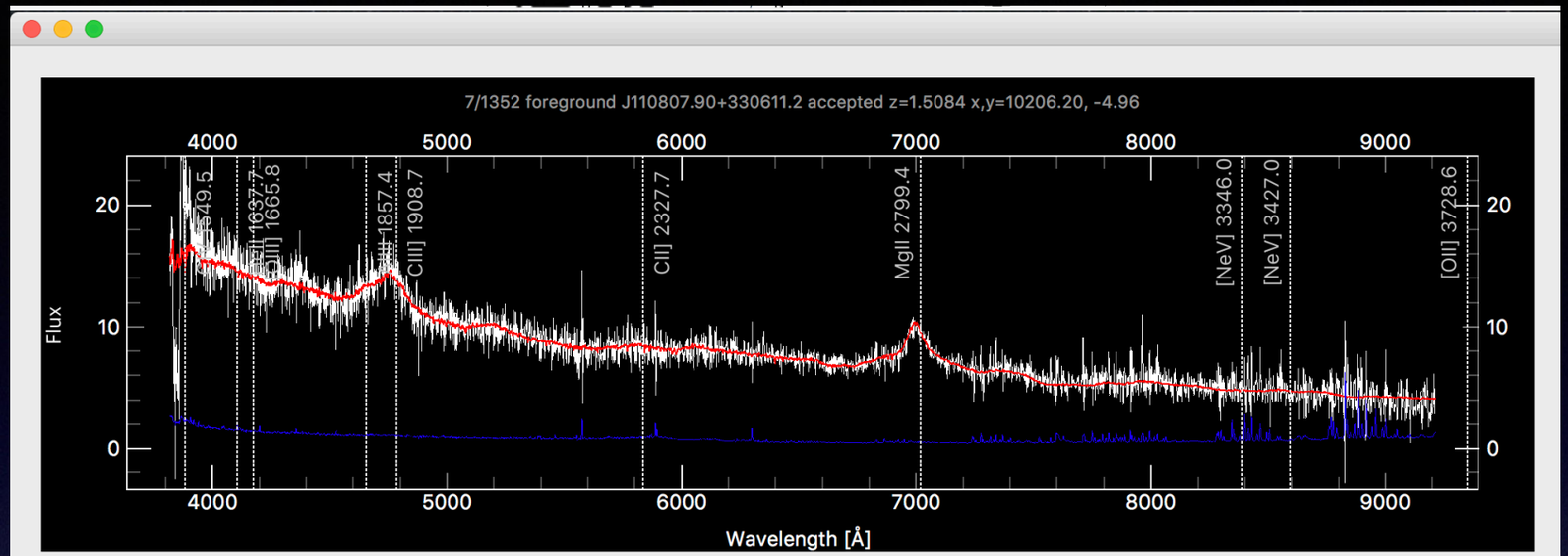
- white = data
- blue = error
- vertical labelled lines = absorption lines at the quasar redshift
- The code will fit a gaussian model shown in red
- If you only see one absorption line, hit “u” to classify as undetected absorption
- Hit “n” to move on to the next object

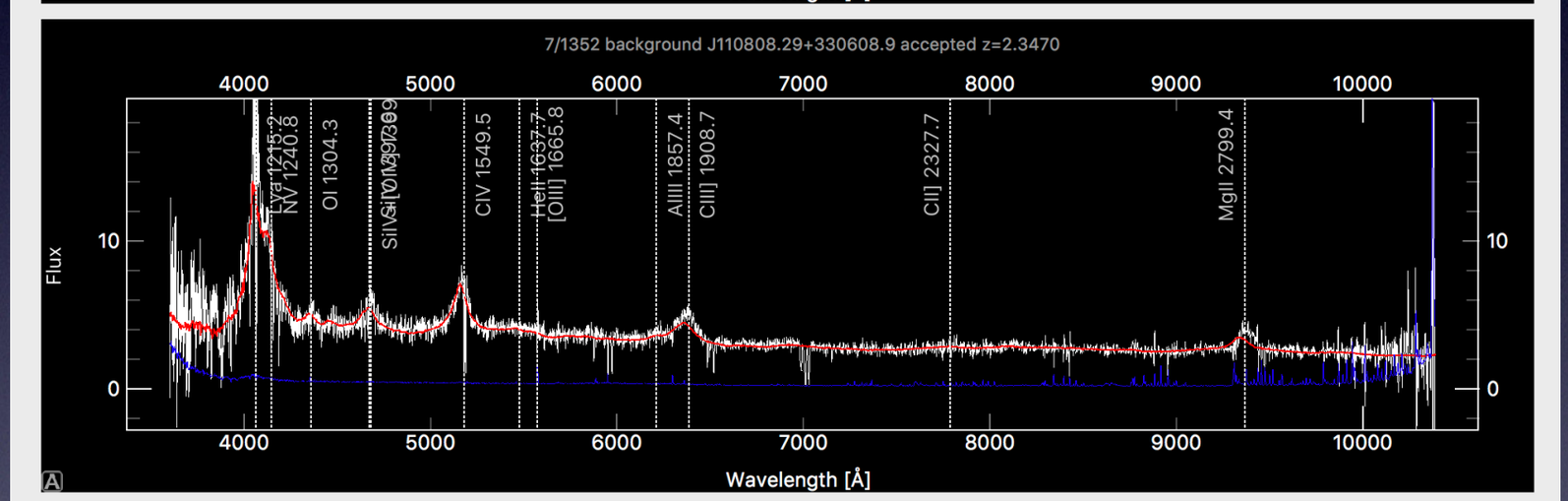


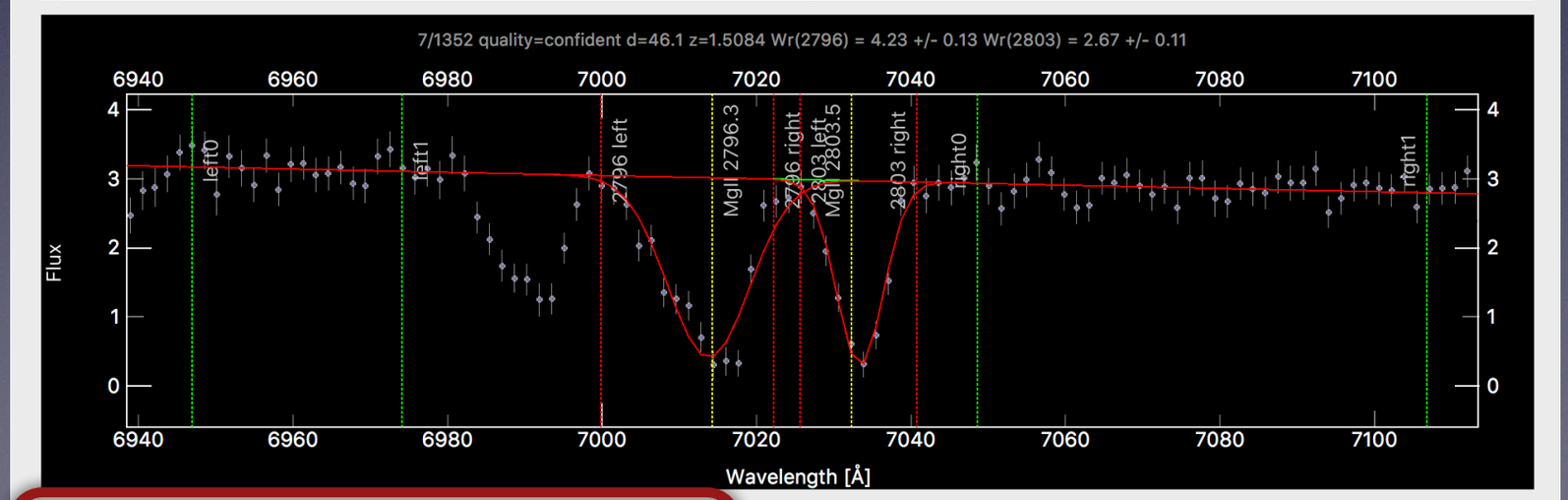
Step 7: contaminated

Bottom: search for MgII absorption doublet

- white = data
- blue = error
- vertical labelled lines = absorption lines at the quasar redshift
- Mark the left and right boundaries of MgII 2796 with “z”, “x” respectively
- Mark the left and right boundaries of MgII 2803 with “z”, “x” respectively
- The code will fit a gaussian model shown in red
- If you see some aligned doublet absorption but also more, accept with “t” but then also comment on it
- Hit “n” to move on to the next object







Comment → multiple complicated lines!