express Visual Inspection training

Changhoon Hahn

PRINCETON
UNIVERSITY

important links

wiki page for Visual Inspection:

https://desi.lbl.gov/trac/wiki/SurveyValidation/VisualInspection

original VI training slides:

https://docs.google.com/presentation/d/ 1XeKnG3slX46FL_Y8BACAh33J22gUyIYrfpCUZijx-A8/edit?usp=sharing

VI Round 2:

https://desi.lbl.gov/trac/wiki/SurveyValidation/ Register_of_VIs_Reinspection_Andes

VI: WORKFLOW [ACTUAL EXPERIENCE MAY VARY]

- VI leads prepare static html pages of targets for inspection. These may be indexed by night/pixel/magnitude/whatever.

- Volunteers are allocated a page or section in the index.

- Volunteers carry on the VI within a requested time-frame, download a text file with the VI results when they finish (see next), and email it or otherwise upload it somewhere for VI leads to access.

  - At the moment no NERSC access is required, though pages are password-protected (see https://desi.lbl.gov/trac/wiki/Computing/AccessNerscData for access)

- Repeat. Repeat. Repeat.

- Repeat.

CURRENT TRAINING MATERIALS

- A simulated SV set (not mini-SV).

- A set of mini-SV2 data, at full depth.

  - All sets are separated by target class (BSG, QSO, ELG, LRG, MWS), indexed by pixels or tiles.

  - For at least 1 set in each class, we provide master VI files, with our classifications, and scripts for you to compare your classifications with ours, and to truth tables.

  For current training sets, please always refer to the wiki page.

  (https://desi.lbl.gov/trac/wiki/SurveyValidation/VisualInspection)

PROSPECT - DESI'S VI TOOL
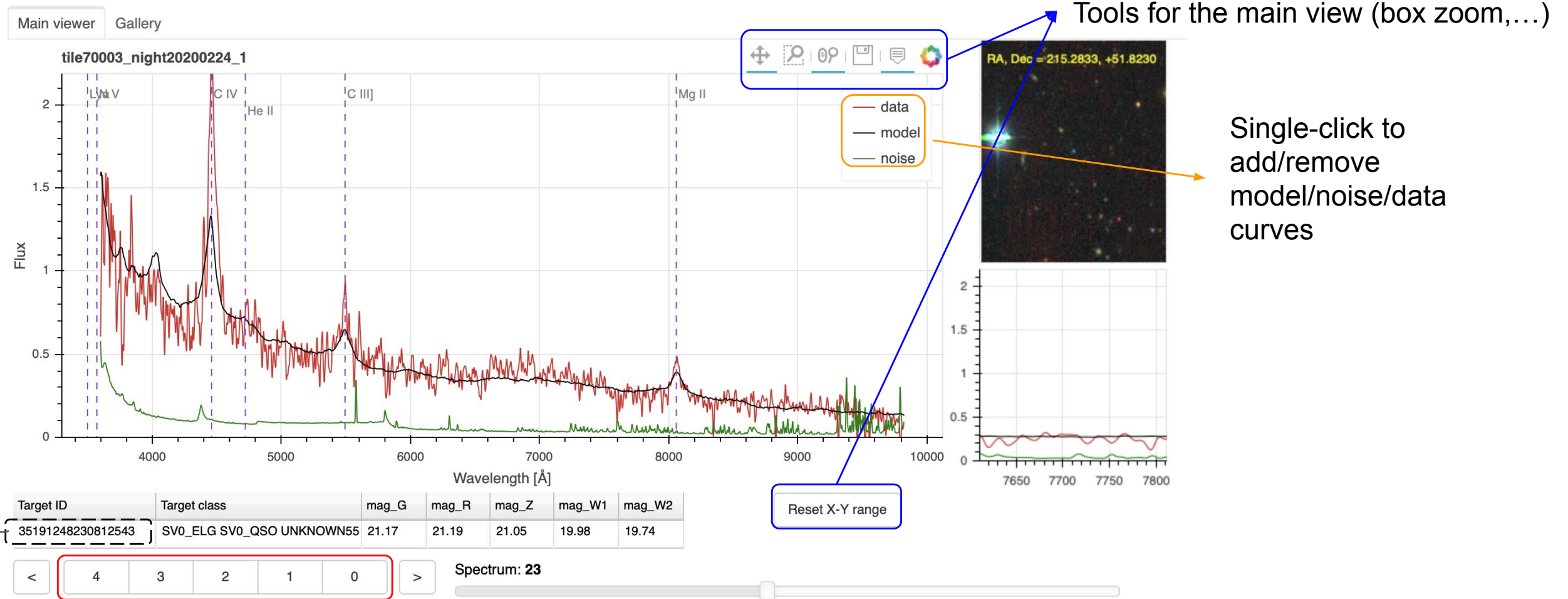
Tools for the main view (box zoom,…)

Single-click to add/remove model/noise/data curves

Reset X-Y range

VI flags (see later)

Can copy-paste (if you accidentally edit, no worry: no impact on VI)

QUALITY FLAGS AND SPEC CLASSIFICATION

- You will need to assign a classification flag to each spectrum (compulsory), and you may need to assign an optional indicator to some spectra.

Classification flags :

[**4**] Confident classification, two or more secure features

[**3**] Probable classification, at least one secure feature + continuum; or many weak features

[**2**] Possible classification, one strong emission feature, but not sure what it is

[**1**] Unlikely classification, one or some unidentified features

[**0**] Nothing there - no signal.

Optional indications :

[**Bad redshift fit   (R)**] Misestimation of redshift by pipeline fitter

[**Bad spectype fit   (C)**] Misidentification of spectral category by pipeline fitter, eg. star vs QSO...

[**Bad spectrum   (S)**] Bad spectrum, eg. cosmic / skyline subtraction residuals...

These might end up in the truth table

< | 4 | 3 | 2 | 1 | 0 | >

These will end up in the truth table

These will not.

☐ Bad redshift fit
☐ Bad spectype fit
☐ Bad spectrum

VI redshift :

VI spectype :

VI comment (100 char max.) :

PROSPECT - DESI'S VI TOOL

VI optional indications :

☐ Bad redshift fit
☐ Bad spectype fit
☐ Bad spectrum

VI redshift :

VI spectype :

VI comment (100 char max.) :

Your name :

VI file name :

desi-vi_tile70003_night20200224_1_unknown

Download VI

Pipeline fit :

SPECTYPE	Z	ZERR	ZWARN	DeltaChi2
QSO	1.8783	0.0002	0	384.9

< Redshift rough tuning: **1.87** > Redshift value: 1.8783

Redshift fine-tuning: **0.0083**   Reset redshift   Copy z to VI

Gaussian Sigma Smooth: **27**

Obs | Rest

Emission | Absorption
☐ Show only major lines

→ Redrock output

→ Redshift widgets (rescales x-axis in viewer)
Reset: back to RR value
Copy to VI: for VI recording

→ Smoothing ~ 15 generally a good choice
Smoothing = 0 to see doublet

→ Show lines in main window

Entering VI information
main « VI flag » = ranking 4 - 0 (see guidelines)
- optional flags : bad spectrum, bad z, bad classification ;
- if VI flag == 4, not necessary to enter a VI redshift/spectype (agreement with pipeline fit results)
Saving VI information
- Enter your name once (eg 3-letter identifier) ; VI filename should be automatically assigned
- « Download VI » once you're done with a given html page. A csv file is downloaded on your machine => send to VI leads.
- If you forgot to download, or go back to a previously-inspected set of spectra and wish to restore previous VI infos you entered : use « recover auto-saved VI » (VI info is stored in your browser through localStorage)

YOUR WORKFLOW

- **Does the spectrum look bad?** I.e., big gaps, big jumps, anything that looks unphysical or unusual?

  - If yes, tick "Bad spectrum", and give details on the VI comment. If the issues are bad enough that you can't assess the redshift, mark flag=0 and move to the next spectrum.

  - Else, carry on to spectral classification.

- **Is the spectral classification by the pipeline correct?**

  - If no, tick "Bad spectype fit", and select the correct spectype from the dropdown menu. Carry on to redshift inspection.

  - Else, carry on to redshift inspection.

- **Redshift inspection.**

  - Does the redshift look correct?

    - If yes, provide a confidence flag. Move on to the next spectrum.

    - If no:

      - Can you determine the correct redshift by inspection?

        - If yes, tick "Bad redshift fit", and provide your VI estimate in "VI redshift". Provide a confidence flag. Move on to the next spectrum.

        - If no, give flag 0. Move on to next spectrum.

OPTICAL SPECTRA

A correct redshift will usually be evident by the fact that strong, identifiable features appear in the correct place, in the rest-frame of the target. Sometimes, you'll have to rely on many, but weaker features.

The next slides offer a quick introduction to those unfamiliar with optical spectra, and gives examples of features that you should expect to identify in DESI spectra, as well as general tips and hints.

When looking at spectra, especially if it's not full Mini-SV2 depth, **some (or many) of these features will only be apparent once you've smoothed the spectra** (the key exception is the [OII] doublet!).

Remember that the templates aren't meant to be perfect - if the shape of a feature doesn't match the data well (say, line strength, or line width), that's OK, provided it's in the right place.

Some strong optical spectral features
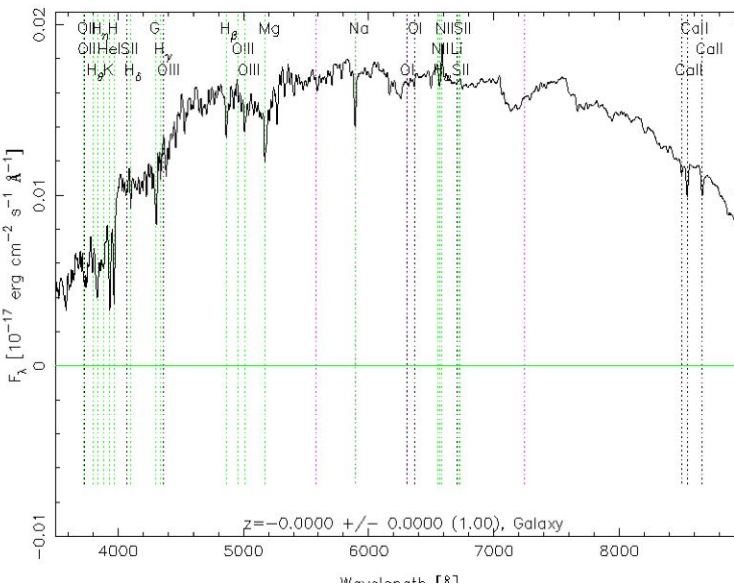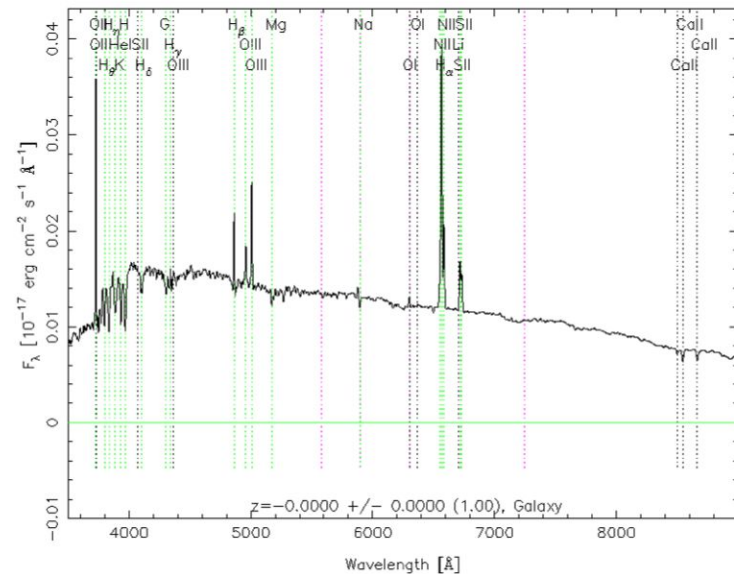
- Emission
  - O[II] = 3727.1,3729.9A
  - Hδ = 4102.9A
  - Hγ = 4341.7A
  - Hβ = 4862.7A
  - O[III] = 4960.3A
  - O[III] = 5008.2A
  - N[II] = 6549.8,6585.3A
  - Hα = 6564.6A
  - S[II] = 6718.3,6732.7A

- Absorption
  - Ca(K) = 3934.8A
  - Ca(H) = 3969.6A
  - G-band = 4305.6A
  - Mg = 5176.7A
  - Na = 5895.6 A
  - CaT = 8498,8542,8662 A
  - Also Balmer series (see →)

Some typical, and frequent, absorption and emission features in optical spectra of galaxies.

Many BGS and almost all ELG targets will show strong emission lines, and often strong Balmer lines in absorption as well as emission. At nominal depth, you will rarely see a continuum for ELGs.

Very few LRGs will show strong emission lines, but they have a strong break in the continuum at 4000A and often sharp H&K lines in absorption.

INSPECTING GALAXIES: EXAMPLES
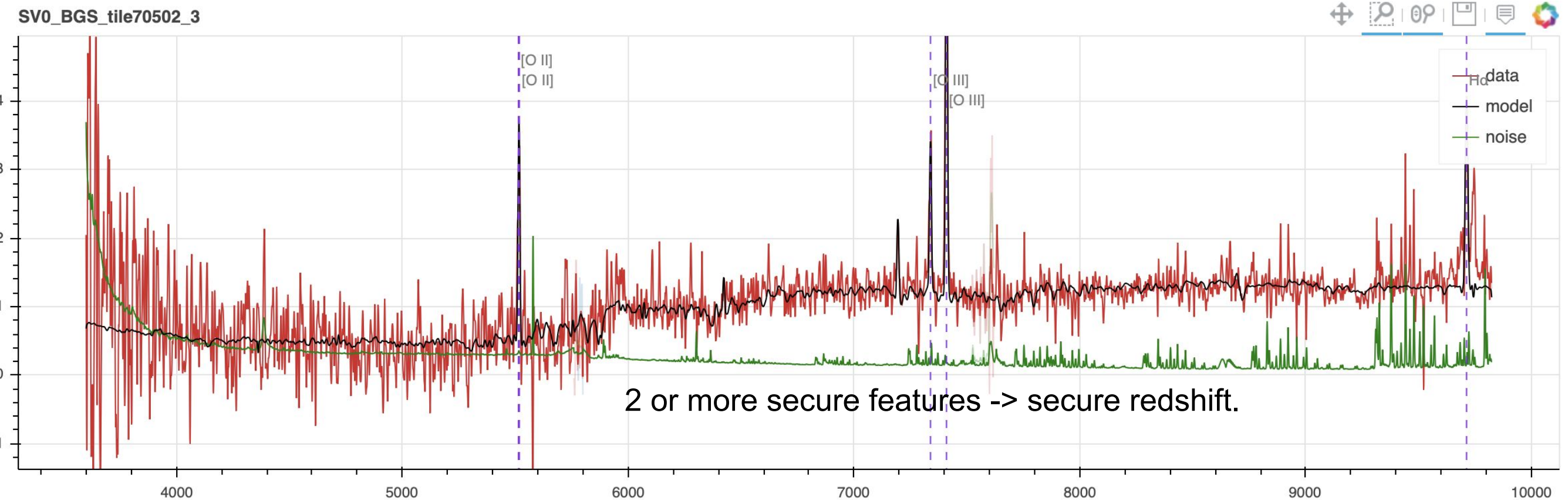
- ## Secure redshifts (star-forming galaxies)

  ### After smoothing

Emission lines?
Look for: [OII] (doublet, sometimes resolved), Ha, Hb, [OIII] (two lines)
Balmer lines redwards of [OII] in absorption
Change in continuum amplitude to either side of [OII]

2 or more secure features -> secure redshift.

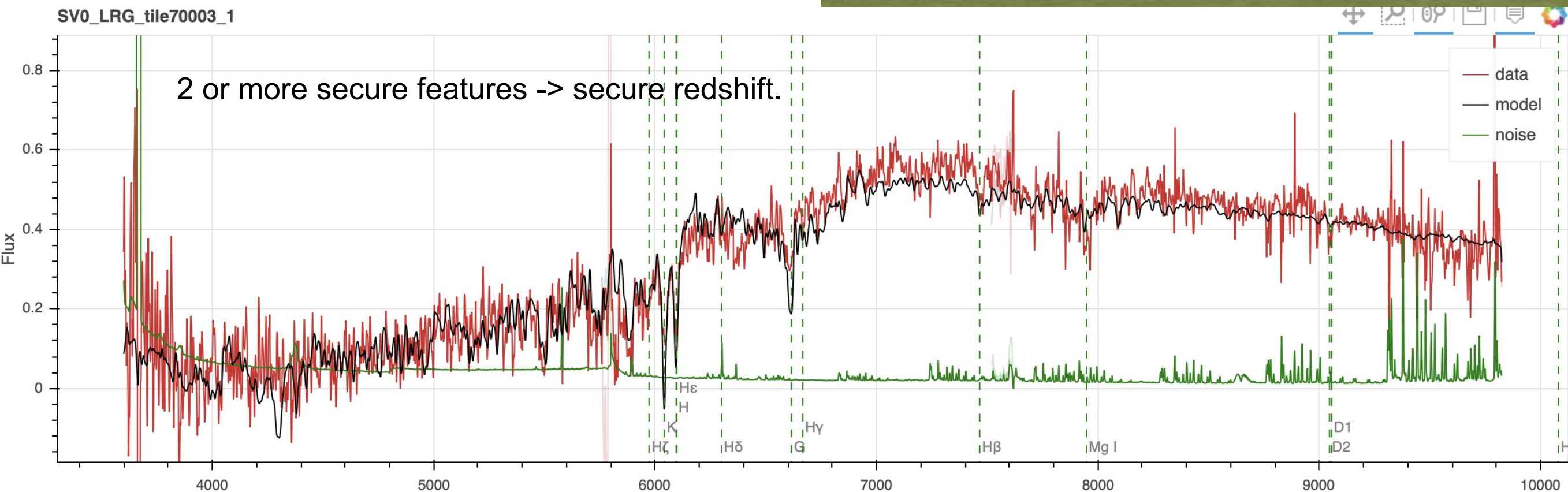# INSPECTING GALAXIES: EXAMPLES

- ## Secure redshifts (passive)

After smoothing

Look for: H&K lines and continuum break.
Broad features around MgI, G-band.
Strong Hb, NaI absorption.
Watch out for a Balmer break sometimes looking like a 4000AA break.

2 or more secure features -> secure redshift.

VISUALLY INSPECTING GALAXIES

Contaminants in the form of quasars and stars are common. In an ideal world, redrock will correctly identify the spectral type, but sometimes it doesn't.
Identify low mass stars by the large, molecular bands in absorption. Other stars will be easily spotted by being at z=0!
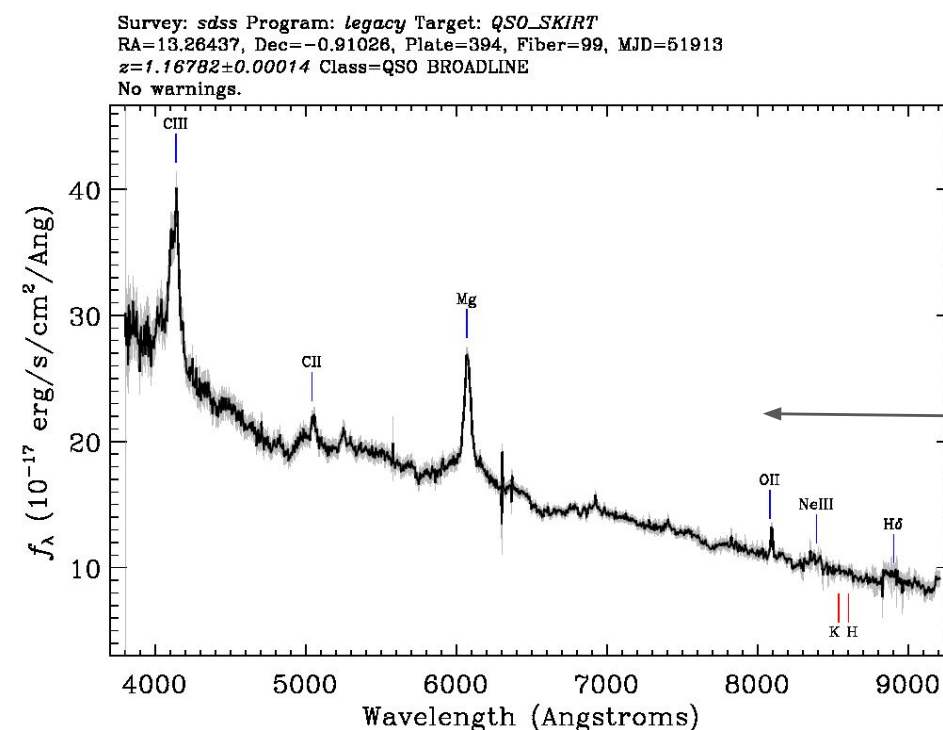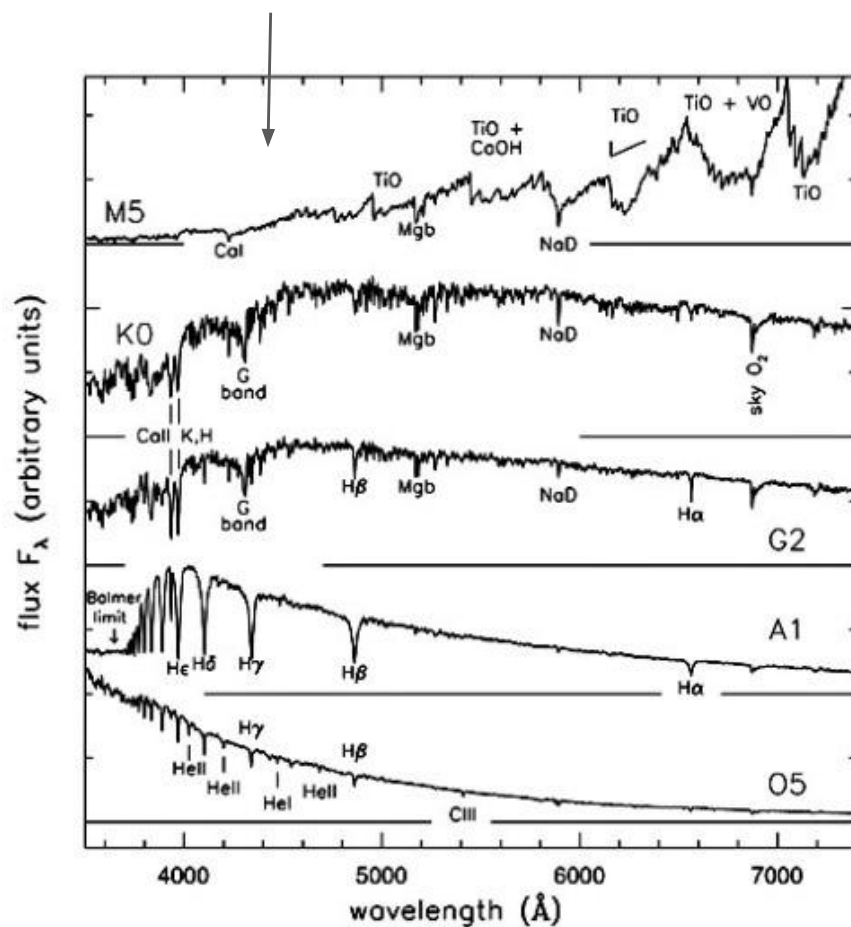
Identify quasars by broad lines in emission (or absorption), or high-excitation narrow lines.

If you're confident about a QSO redshift, still flag it as 4, even it it was targeted as a galaxy. If you're not confident, flag it as 1.

YOUR WORKFLOW

- **Does the spectrum look bad?** I.e., big gaps, big jumps, anything that looks unphysical or unusual?

  - If yes, tick "Bad spectrum", and give details on the VI comment. If the issues are bad enough that you can't assess the redshift, mark flag=0 and move to the next spectrum.

  - Else, carry on to spectral classification.

- **Is the spectral classification by the pipeline correct?**

  - If no, tick "Bad spectype fit", and select the correct spectype from the dropdown menu. Carry on to redshift inspection.

  - Else, carry on to redshift inspection.

- **Redshift inspection.**

  - Does the redshift look correct?

    - If yes, provide a confidence flag. Move on to the next spectrum.

    - If no:

      - Can you determine the correct redshift by inspection?

        - If yes, tick "Bad redshift fit", and provide your VI estimate in "VI redshift". Provide a confidence flag. Move on to the next spectrum.

        - If no, give flag 0. Move on to next spectrum.