Three LINERs under the Hubble Spectral Microscope

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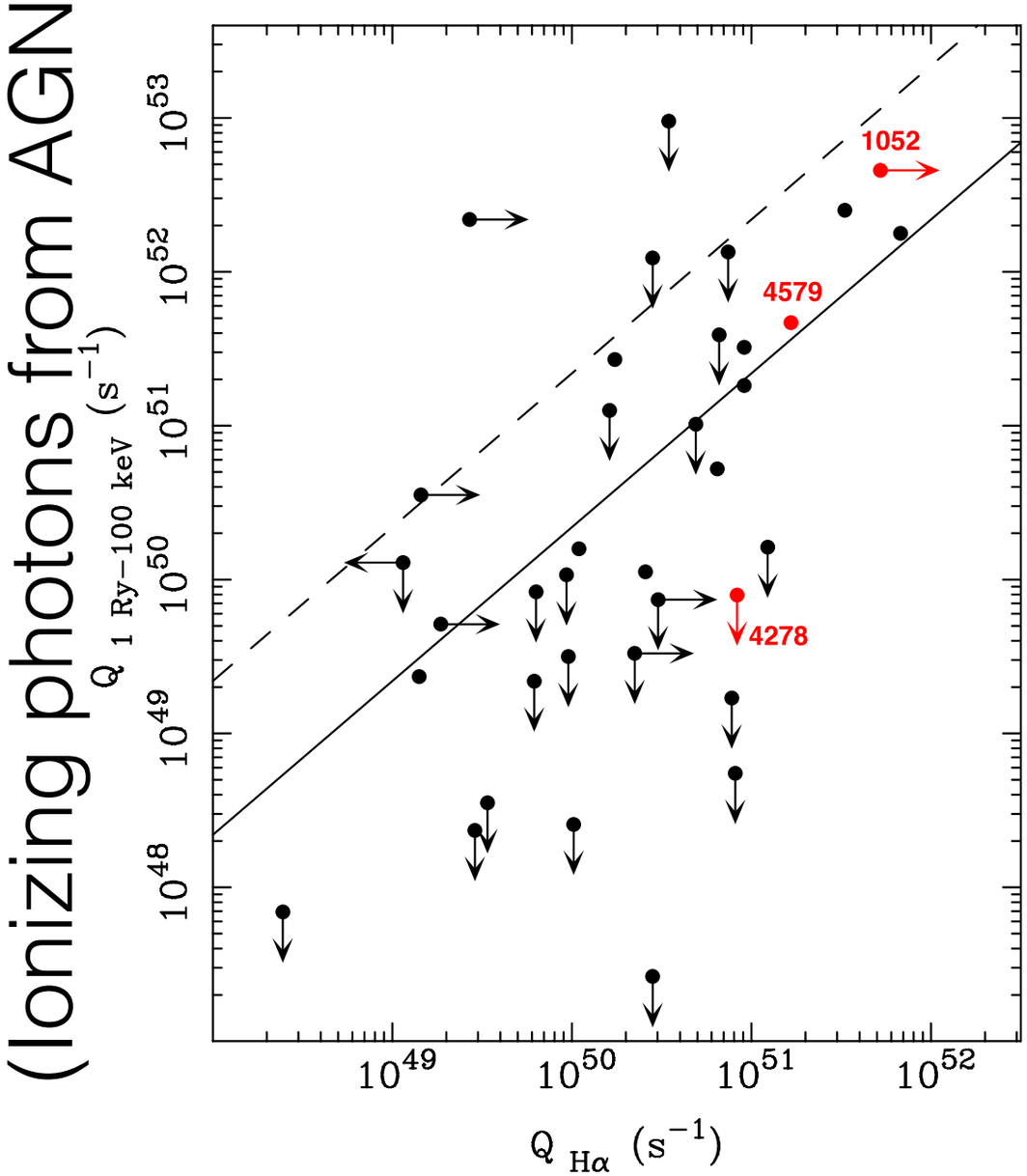
Alfred P. Sloan FOUNDATION

Energy Budget Deficit in LINERS



from Eracleous, Hwang,
and Flohic (2010)

Three Luminous Nearby Objects Chosen:

-NGC 1052

-NGC 4278

-NGC 4579

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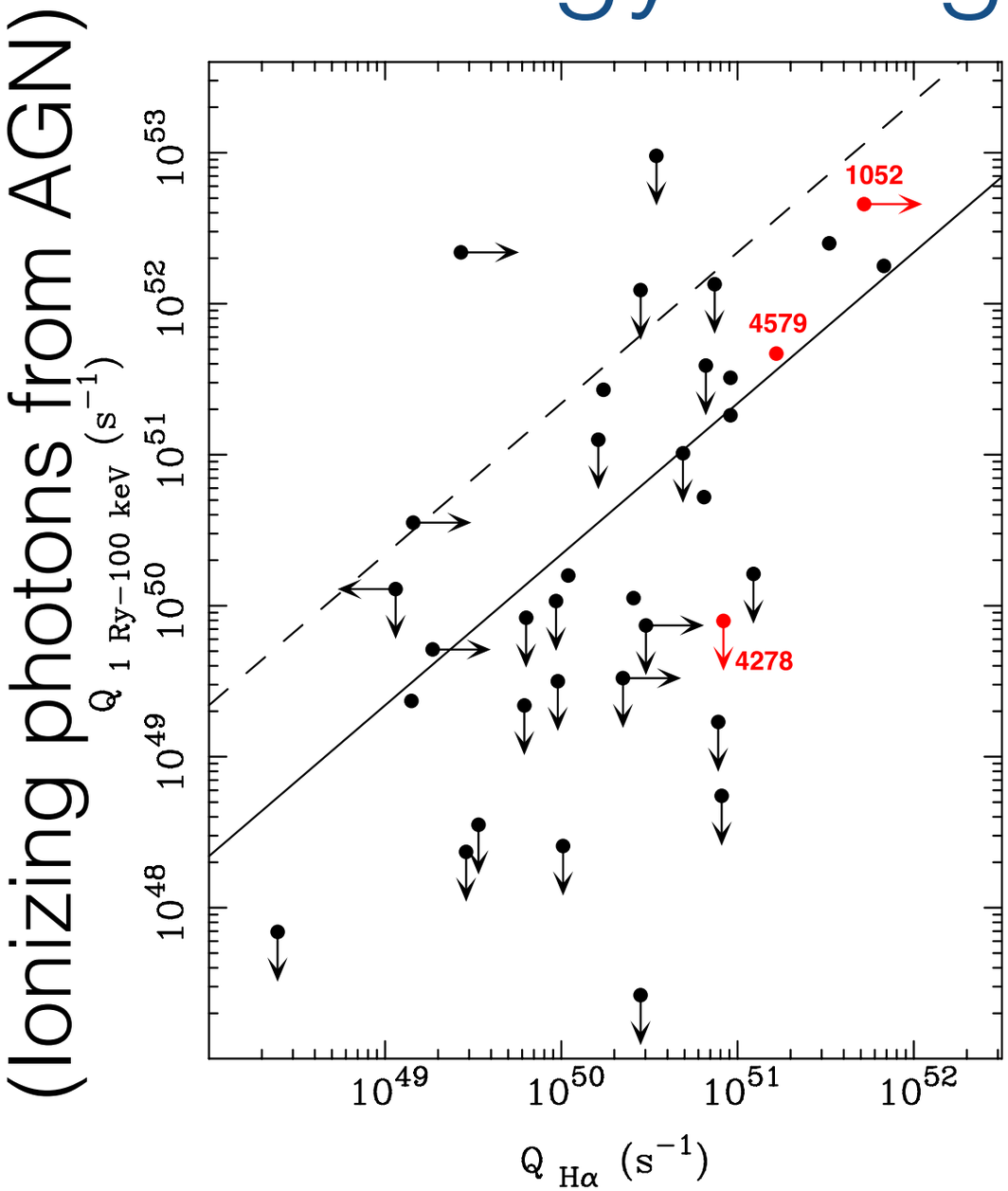

(Ha photons)

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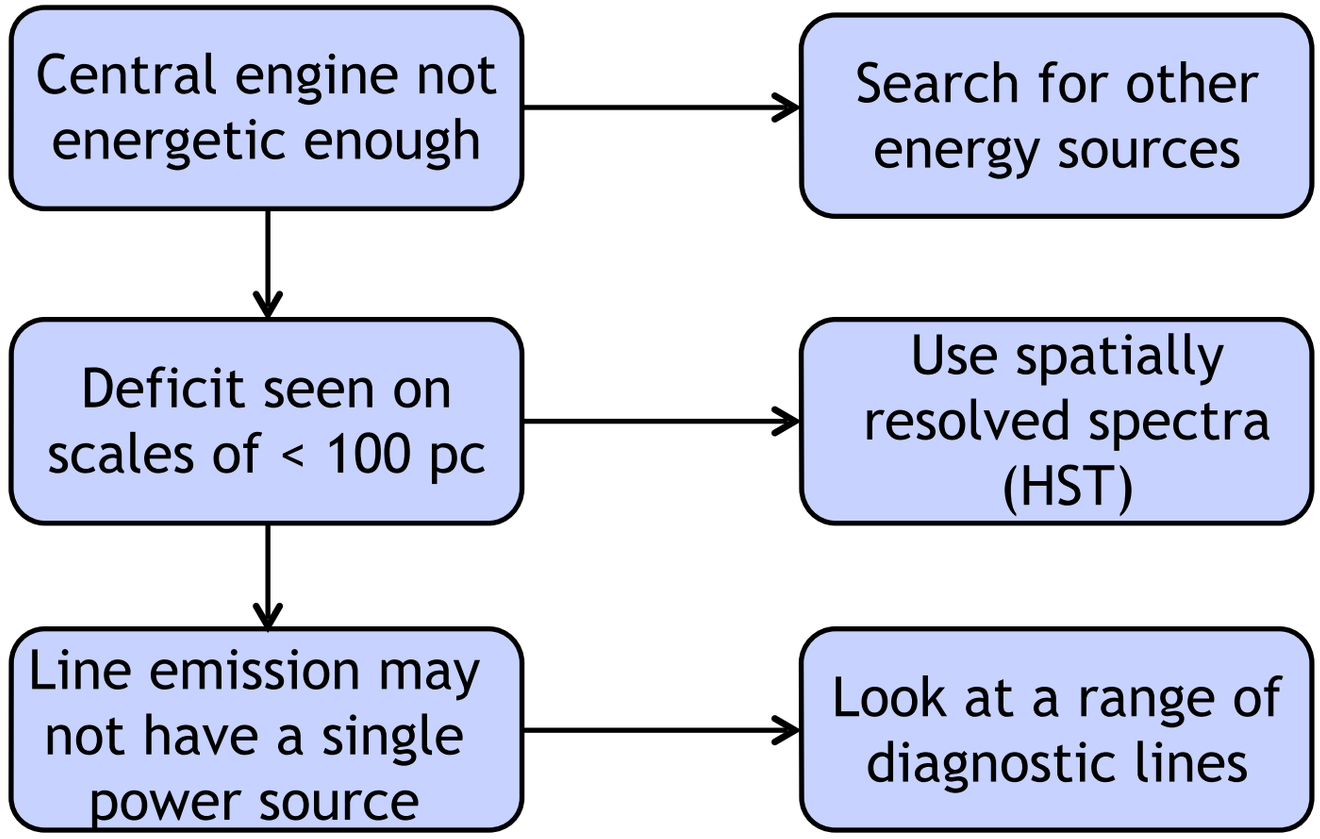

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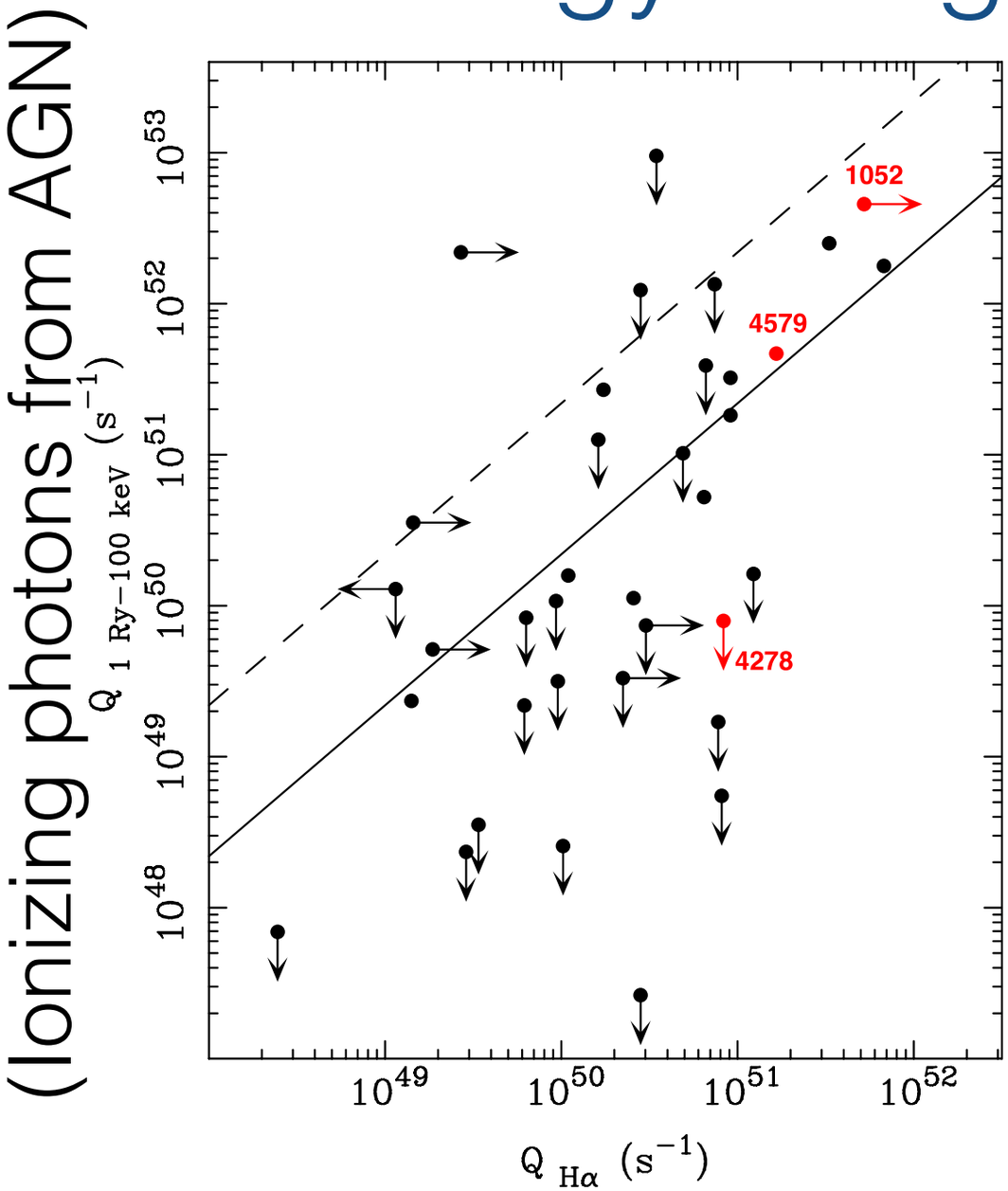

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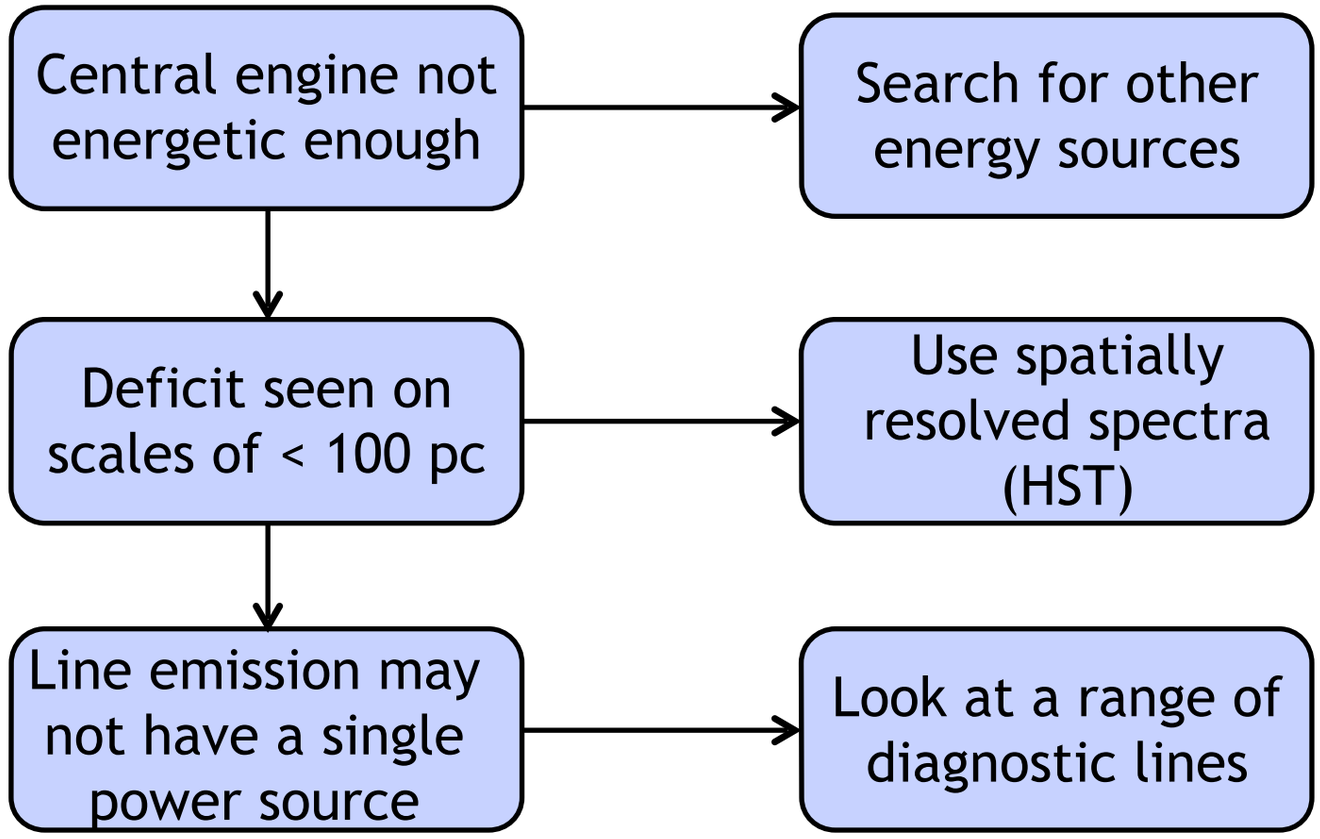
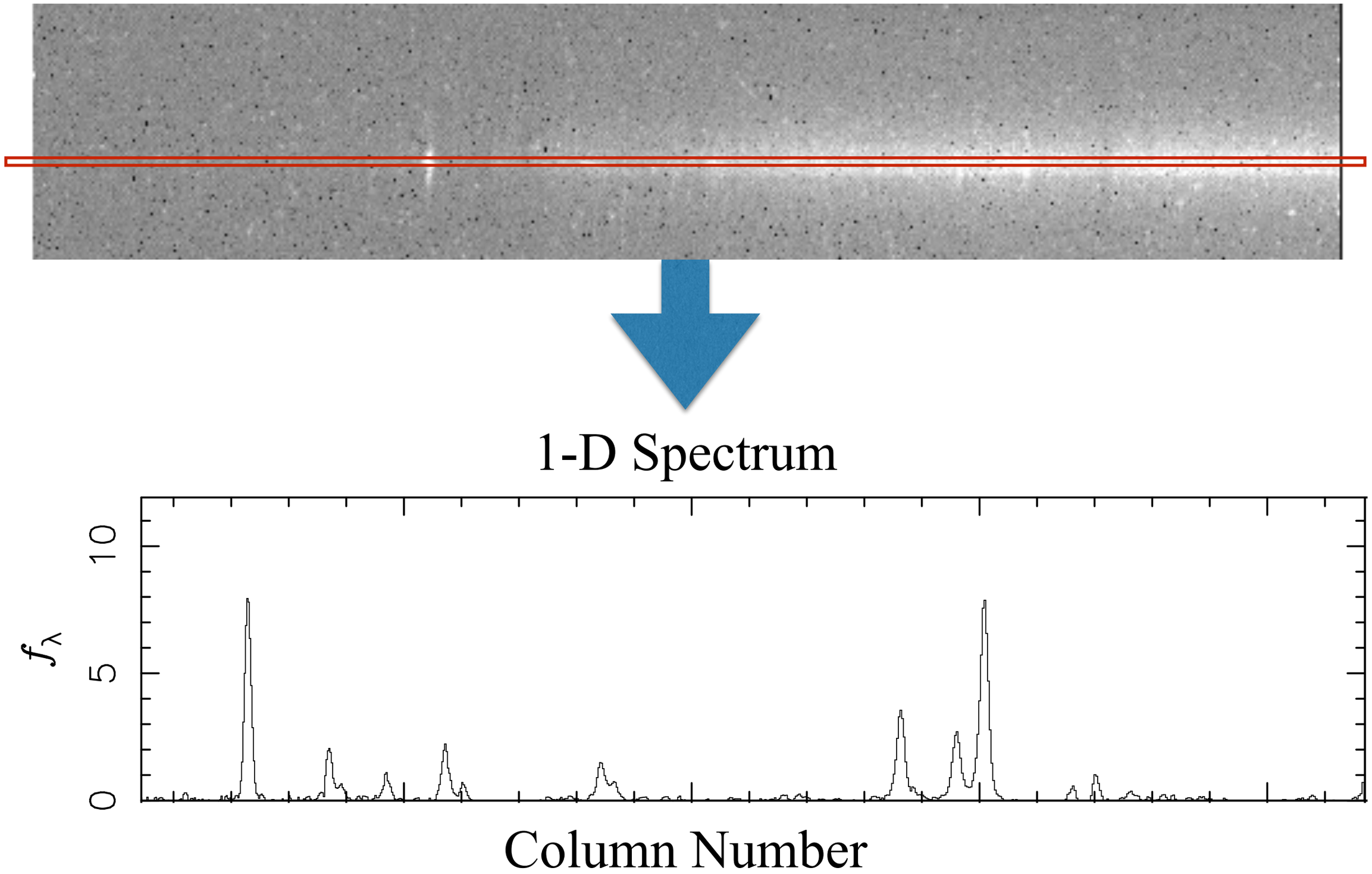
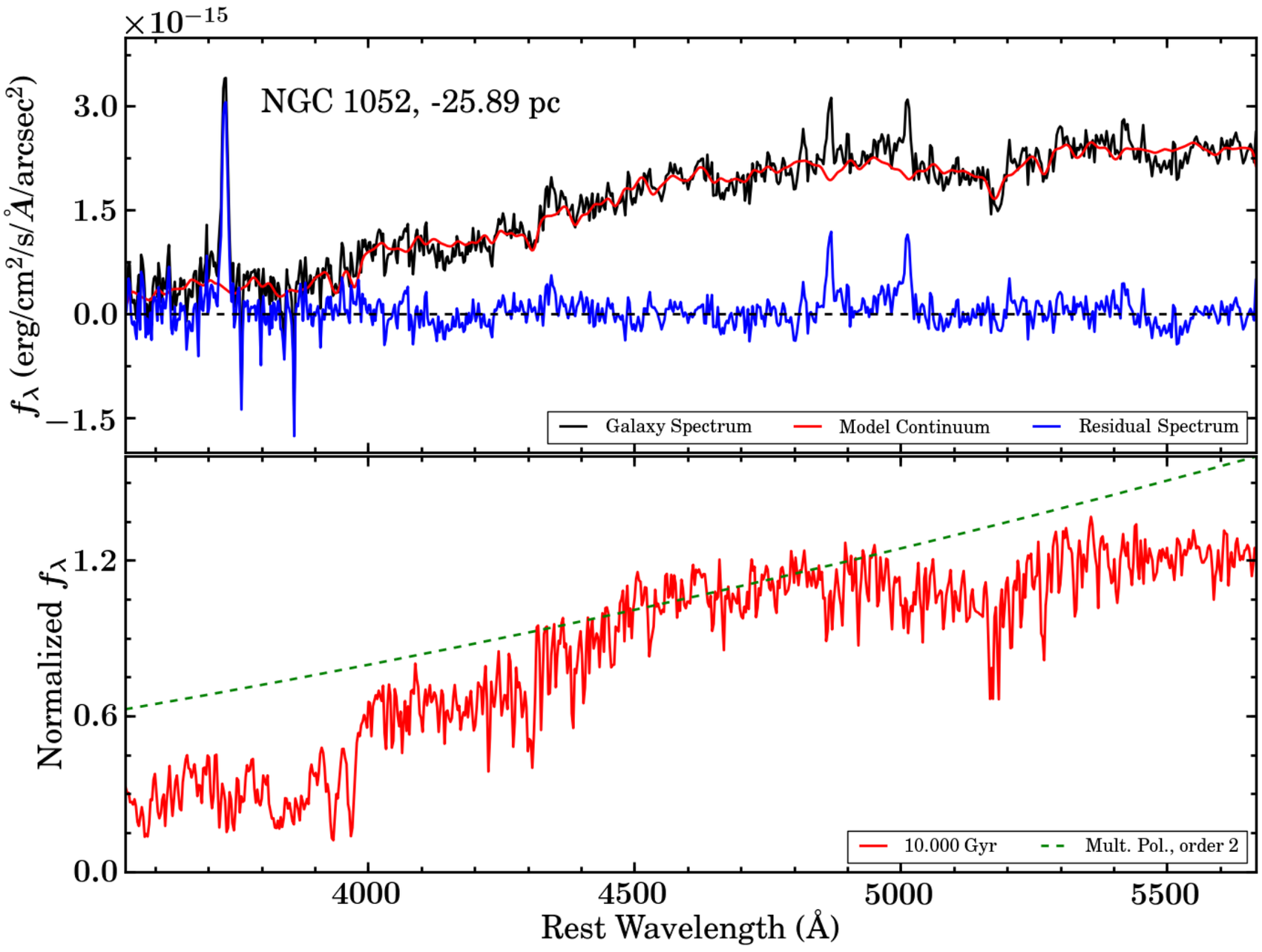


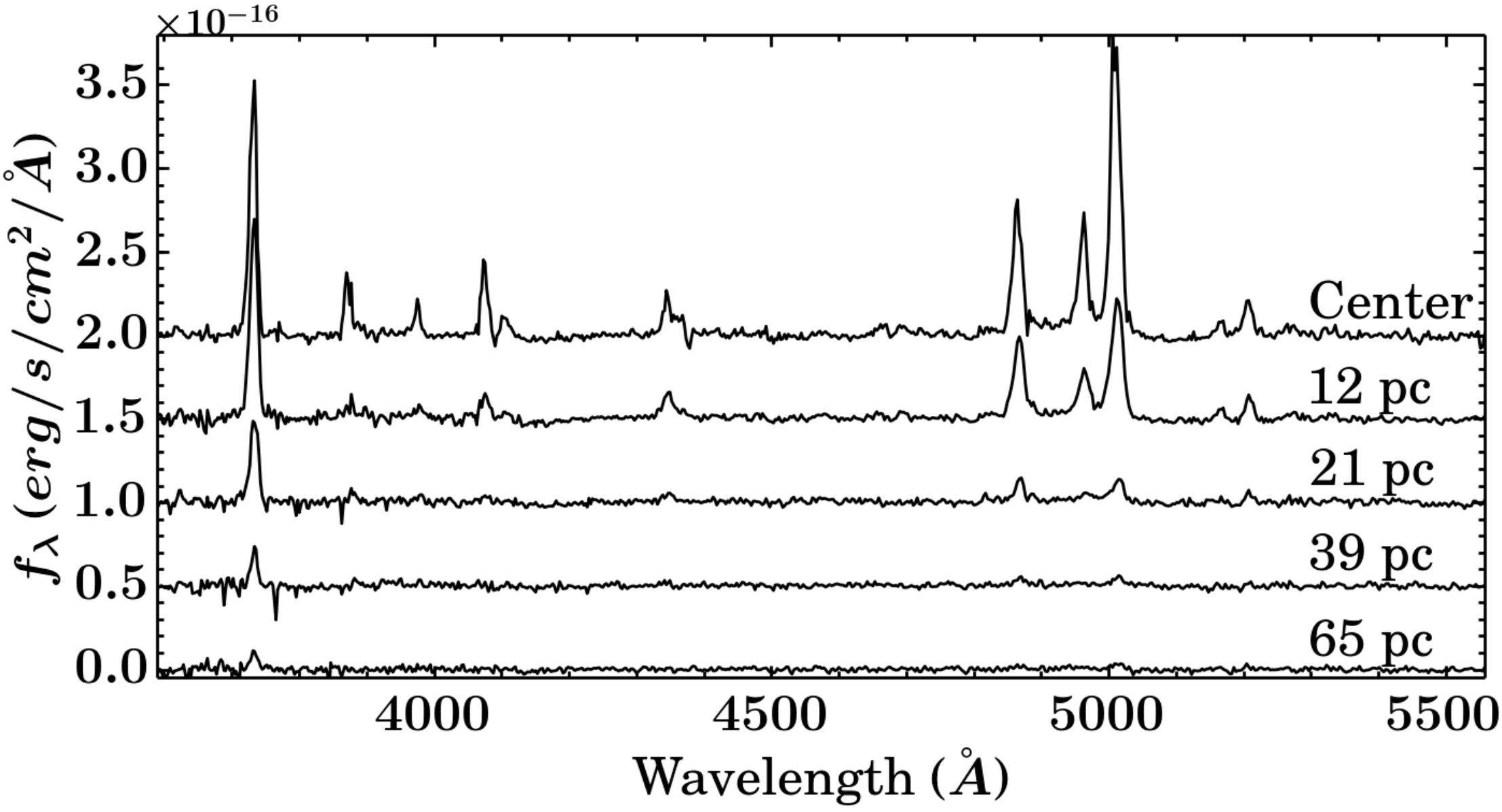
“Spectral Direction” in a 2-D Spectrum



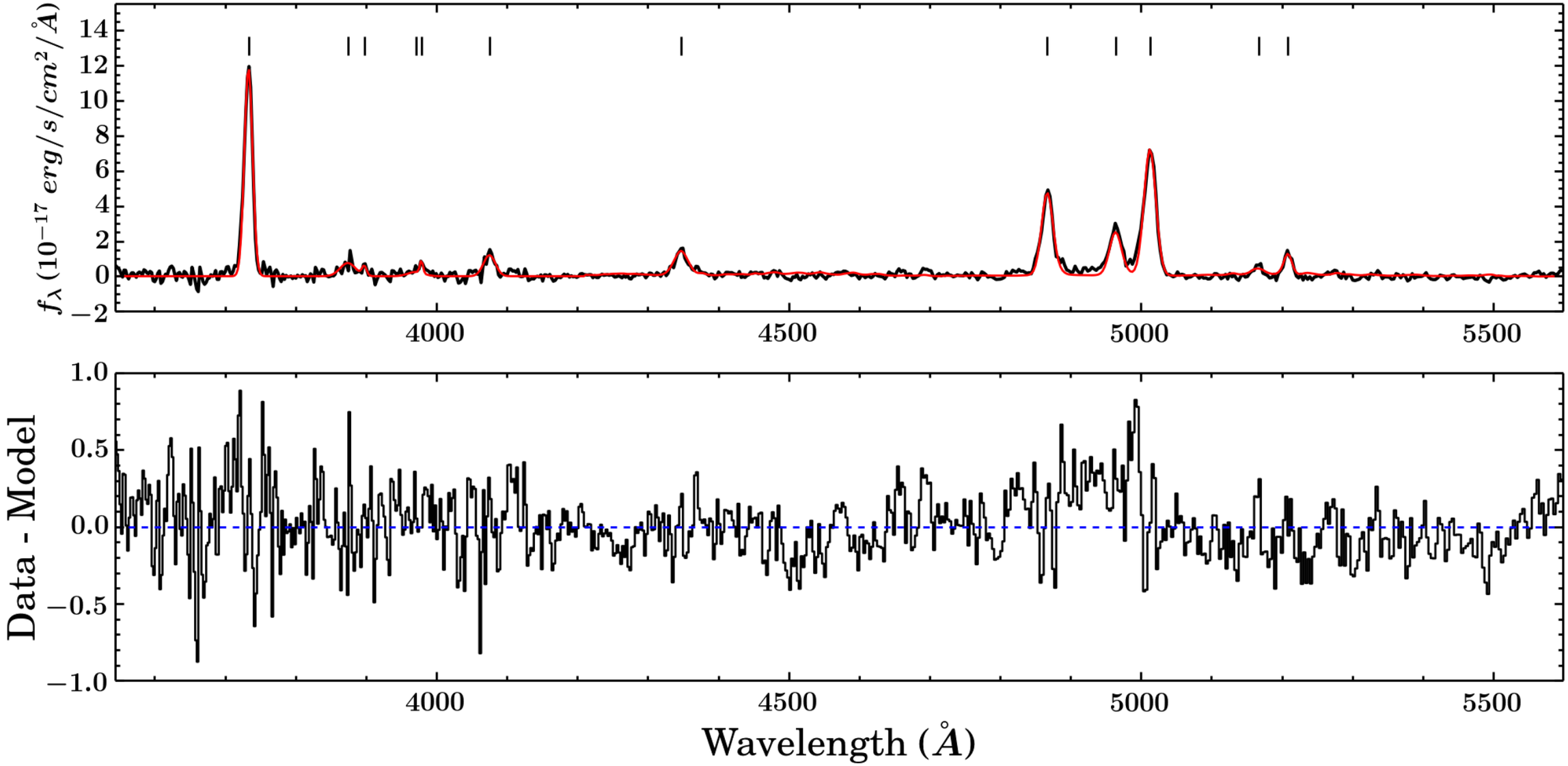
Starlight Fit Example



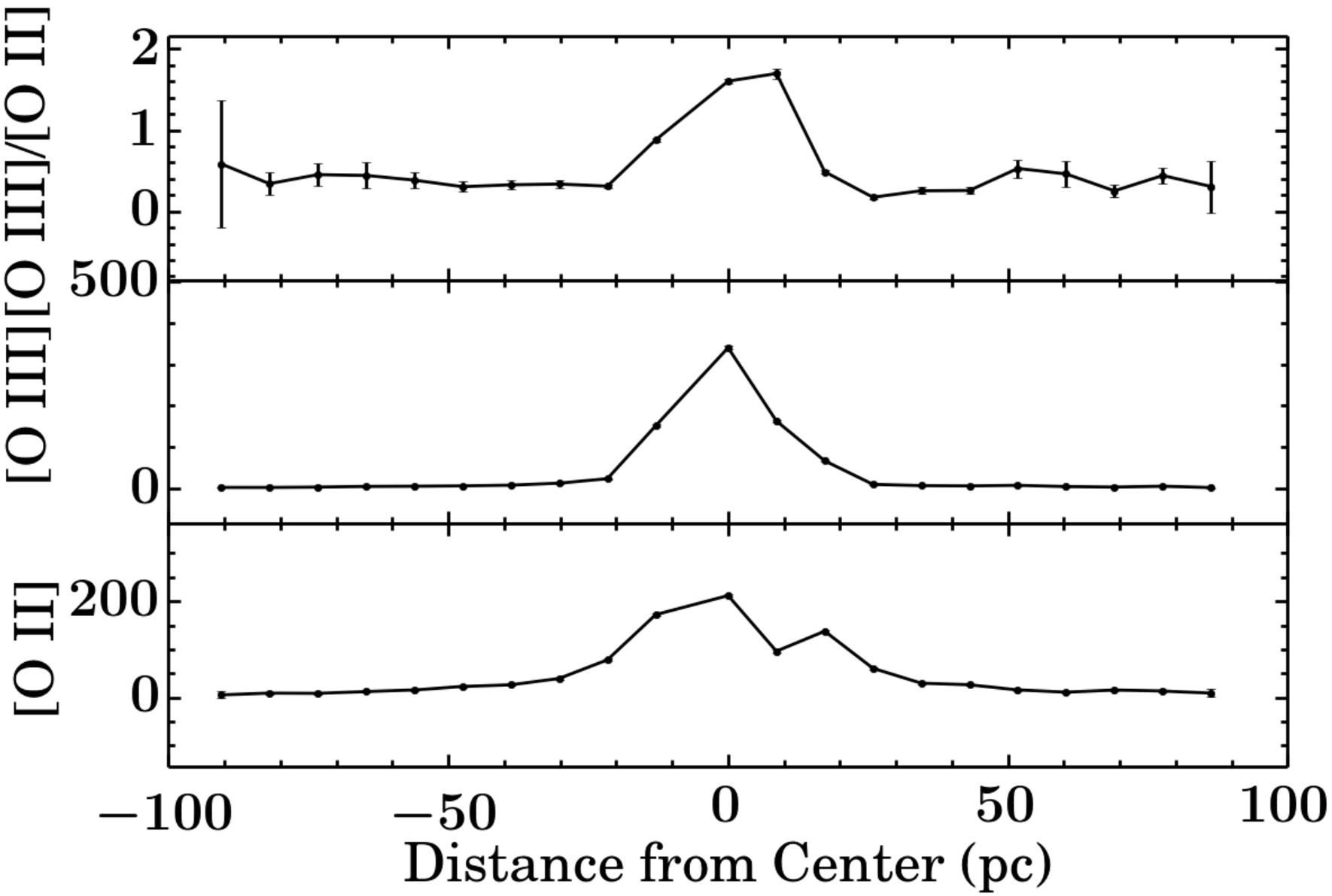
Final Spectra for NGC 1052



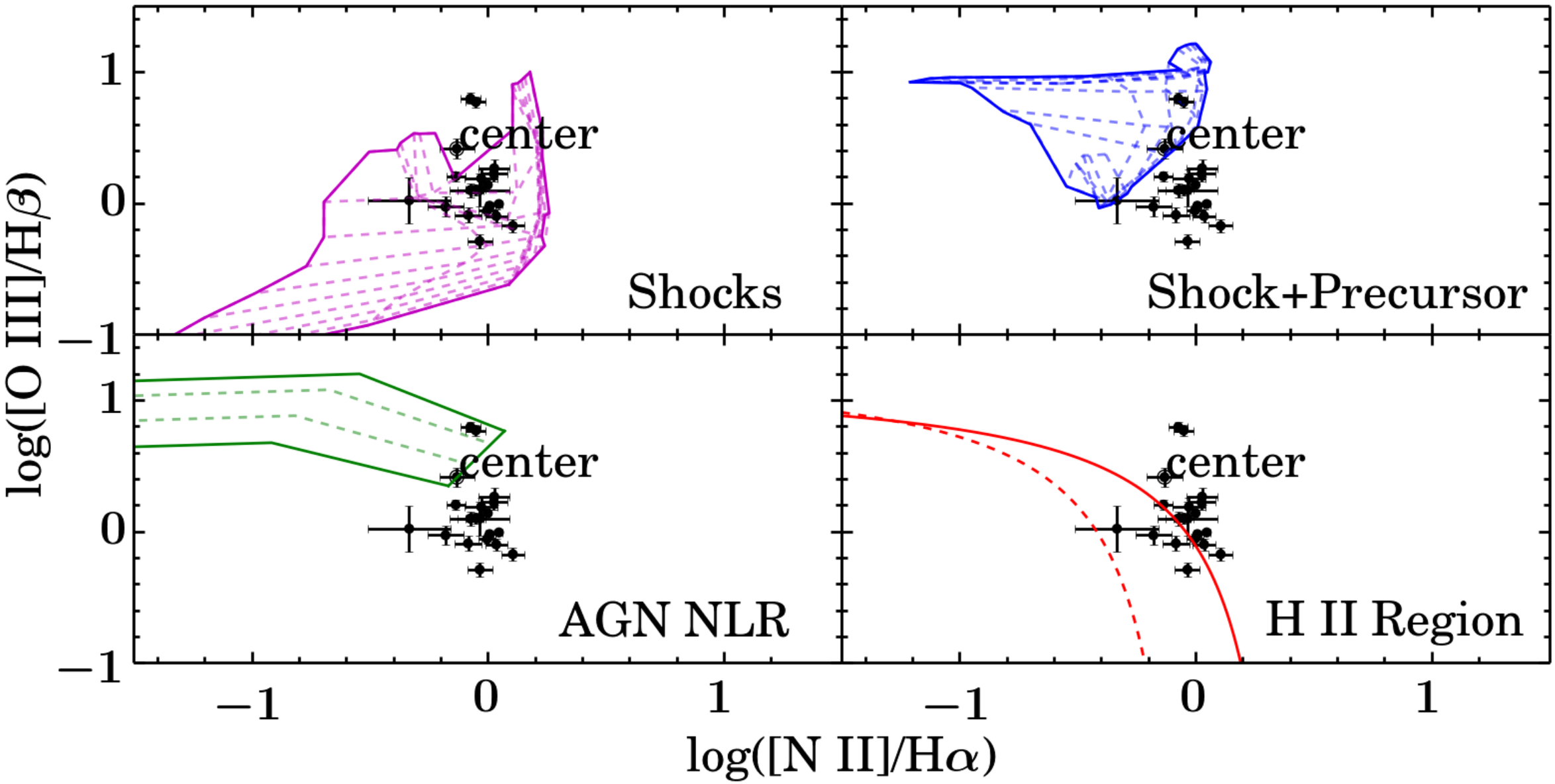
Example of fit to NGC 1052 spectrum



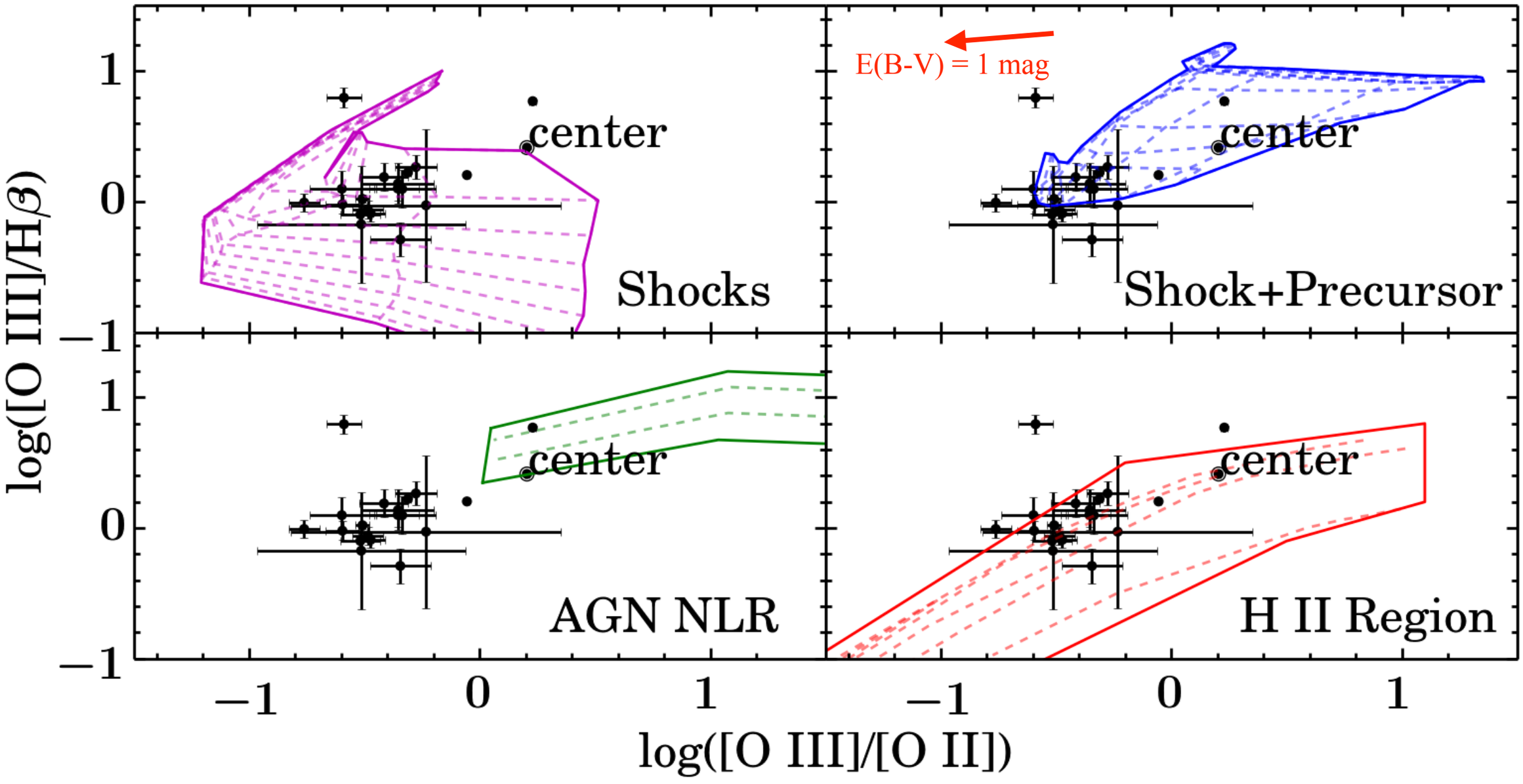
Line ratios *DO* change with distance



BPT Diagram shows change in energy source for NGC 1052



NGC 1052: Different diagnostic lines, consistent results



LINERs do not have a “one size fits all” model

Characteristic LINER emission is not from a *single* excitation mechanism, but is a combination of multiple mechanisms that varies with radius and from object to object:

- We looked at three prototypical LINERs to identify the unknown energy sources
- See clear transition in **dominant** energy source for NGC 4579 and NGC 1052:
  - *Beyond ~20 pc it could be hot stars, shocks, or both, but NOT photoionization by an AGN (but stay tuned for future results)*
- NGC 4278 seems to be shock dominated, which is plausible due to mini-radio jets of size 10 milli-arcsec that fall entirely within our slit

LINERs are not identified because of their weak AGN, but because of the strength of the combination of multiple energy sources

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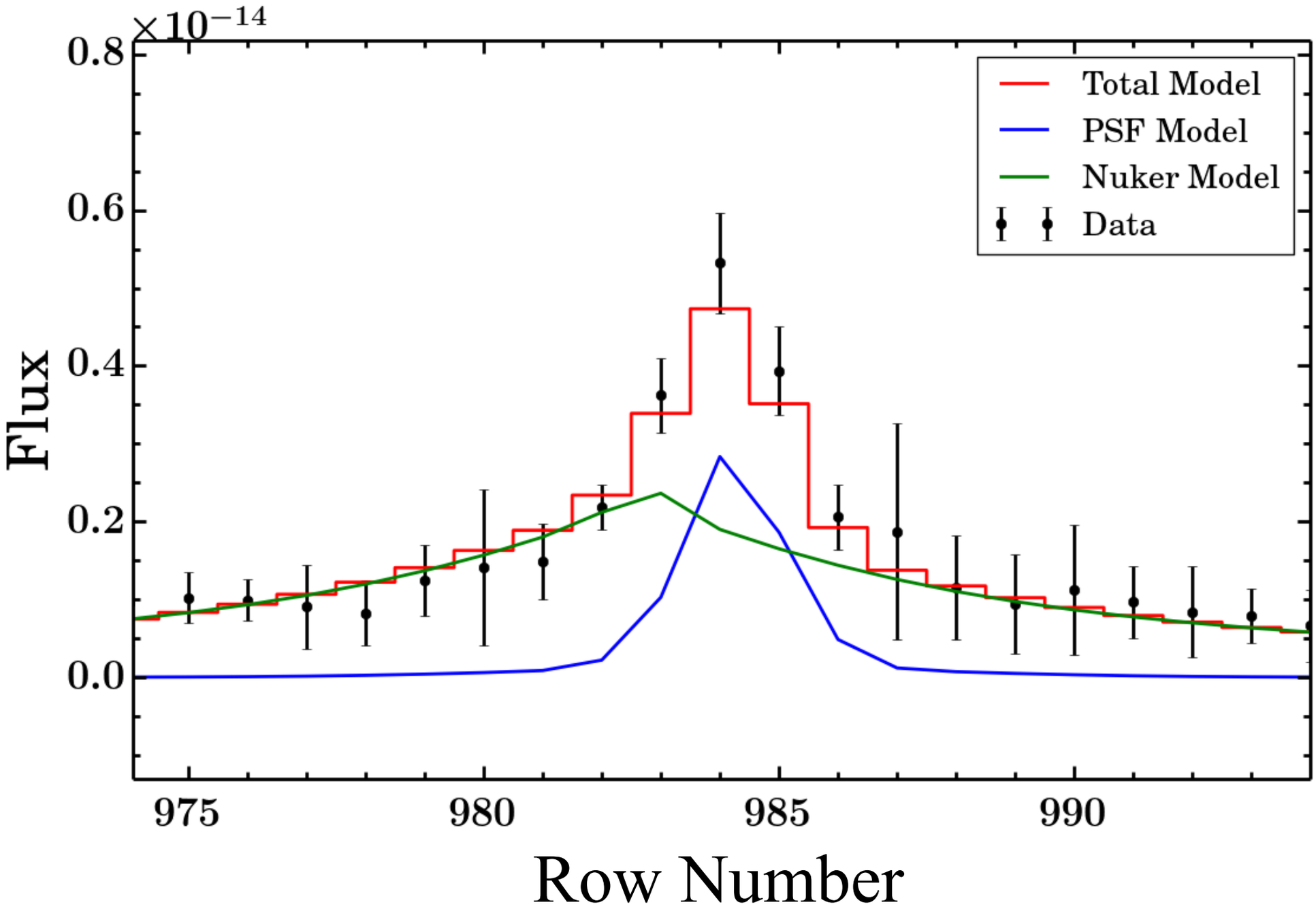
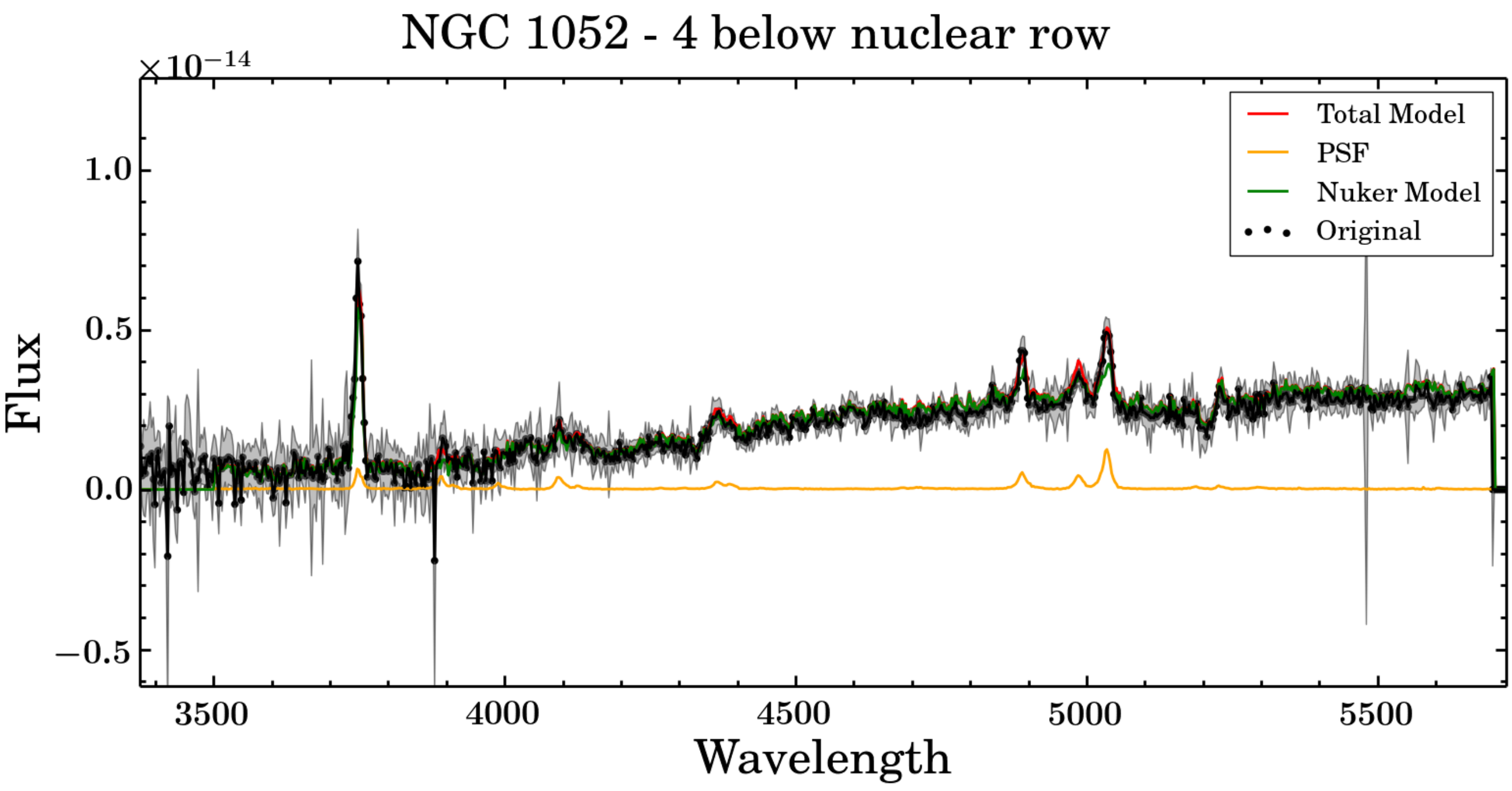
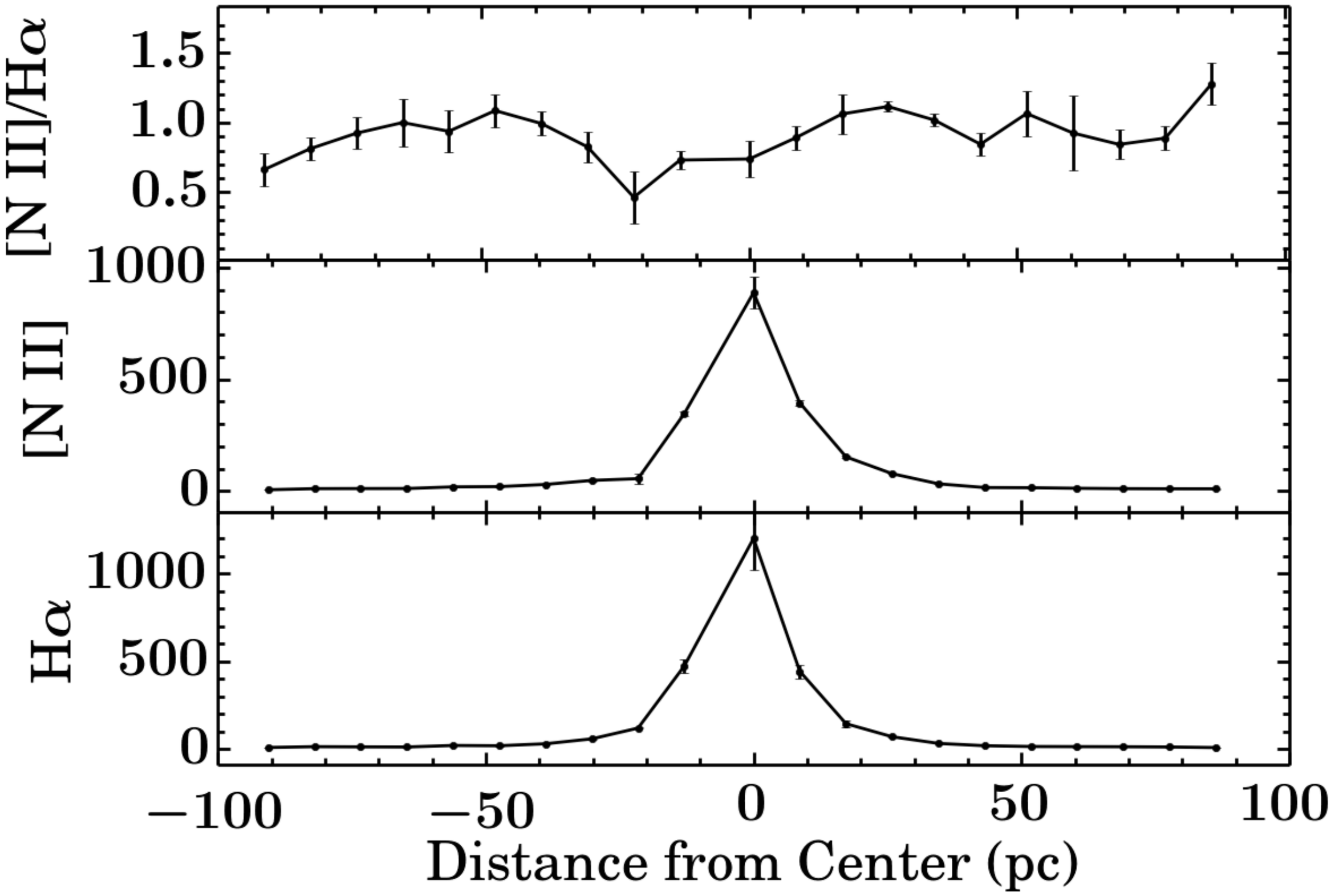
Isolating RESOLVED component of emission lines



Example of Final fit



Line ratios *DO* change with distance



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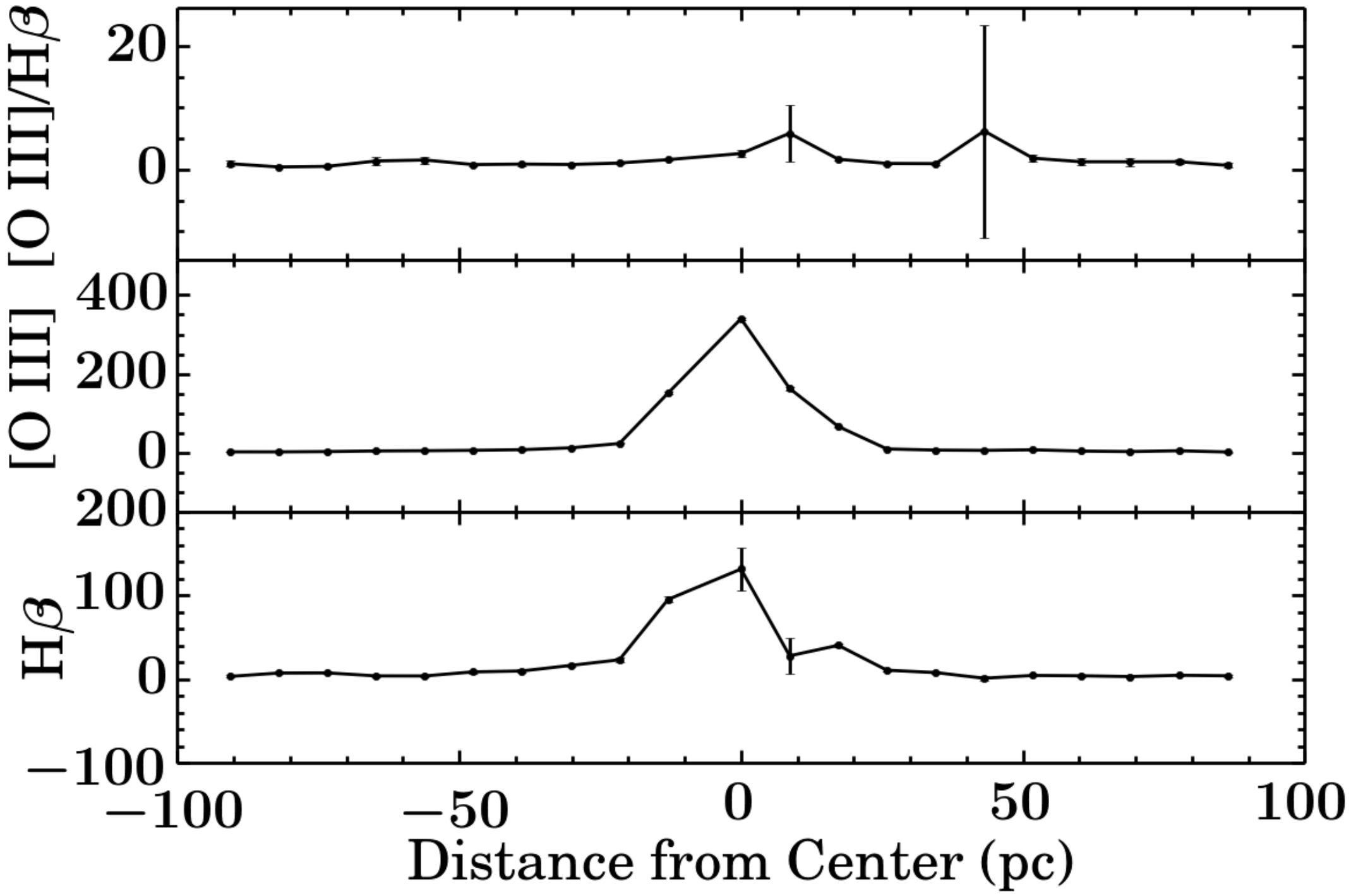

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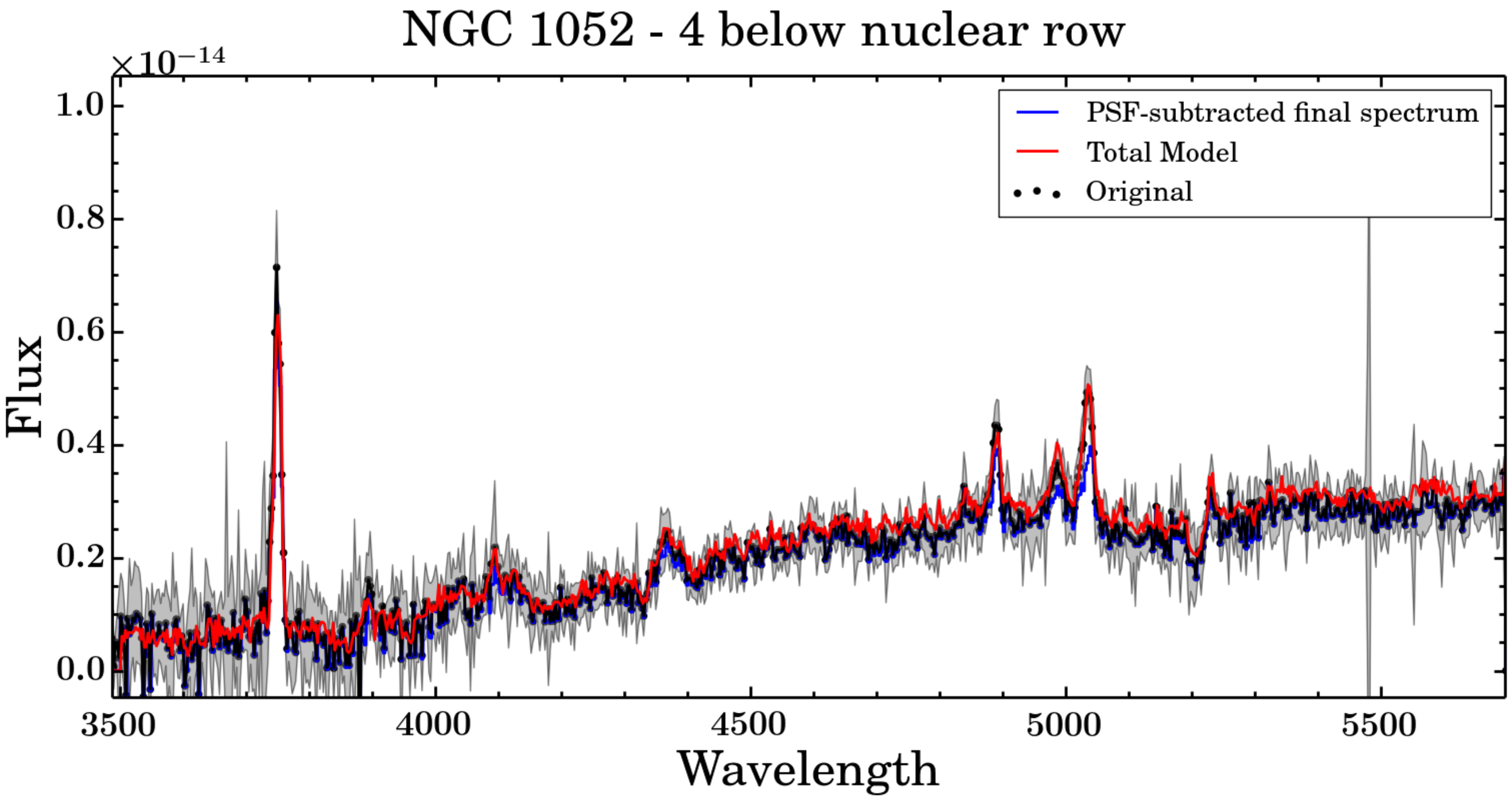
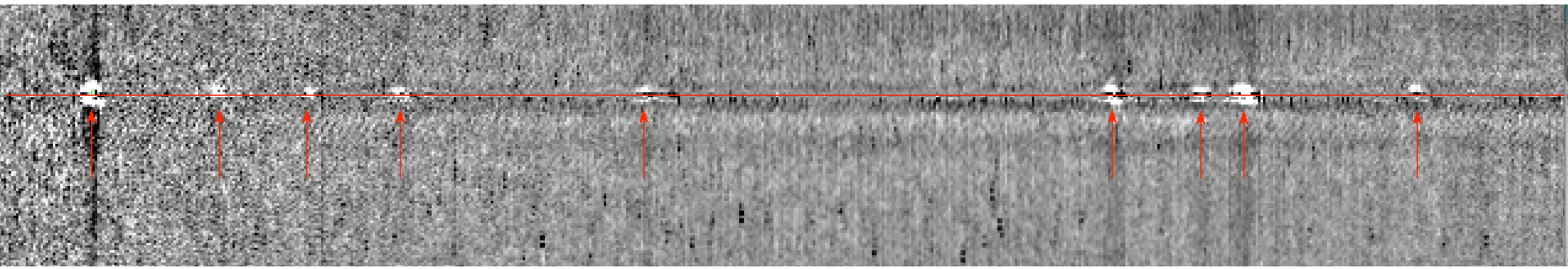
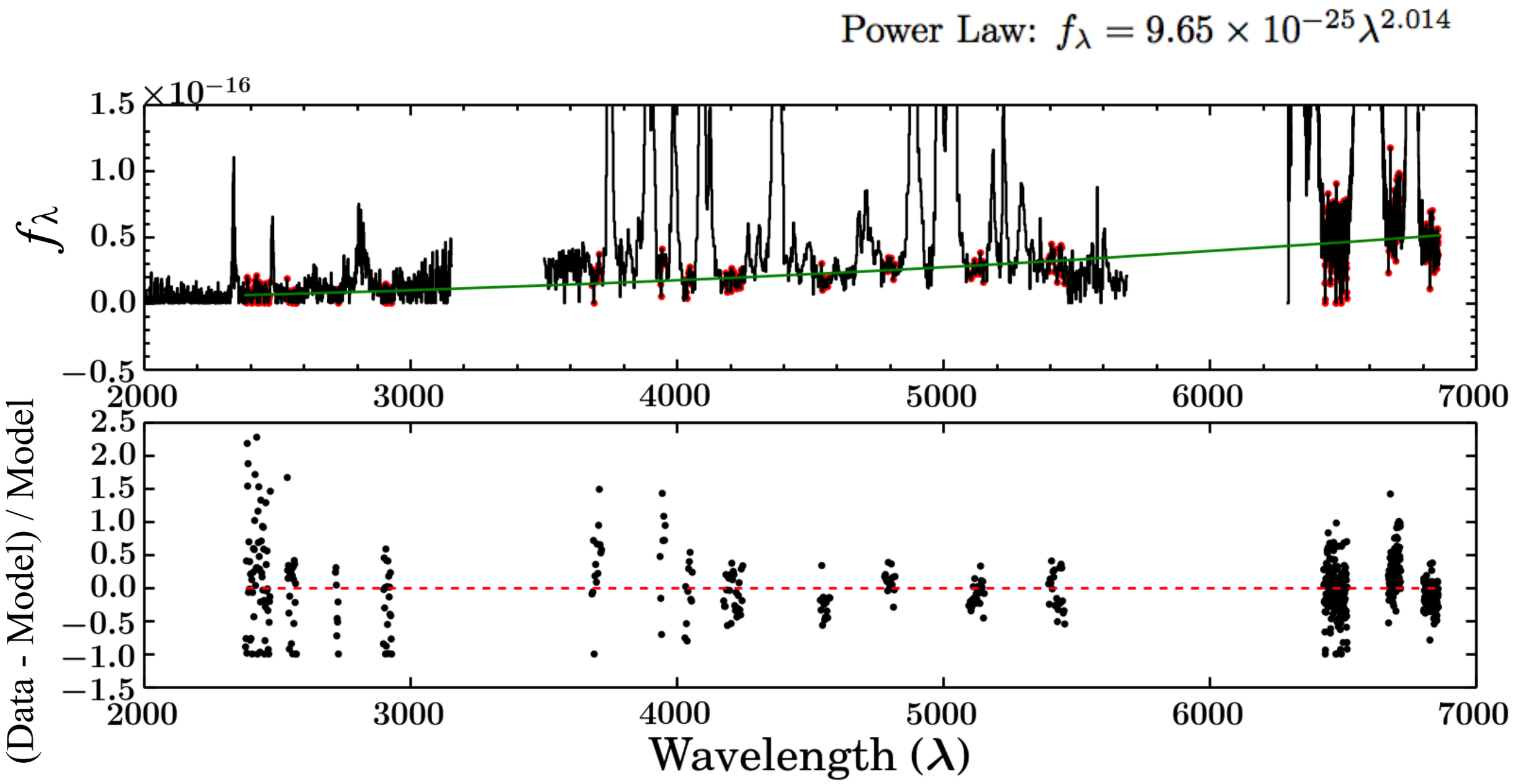


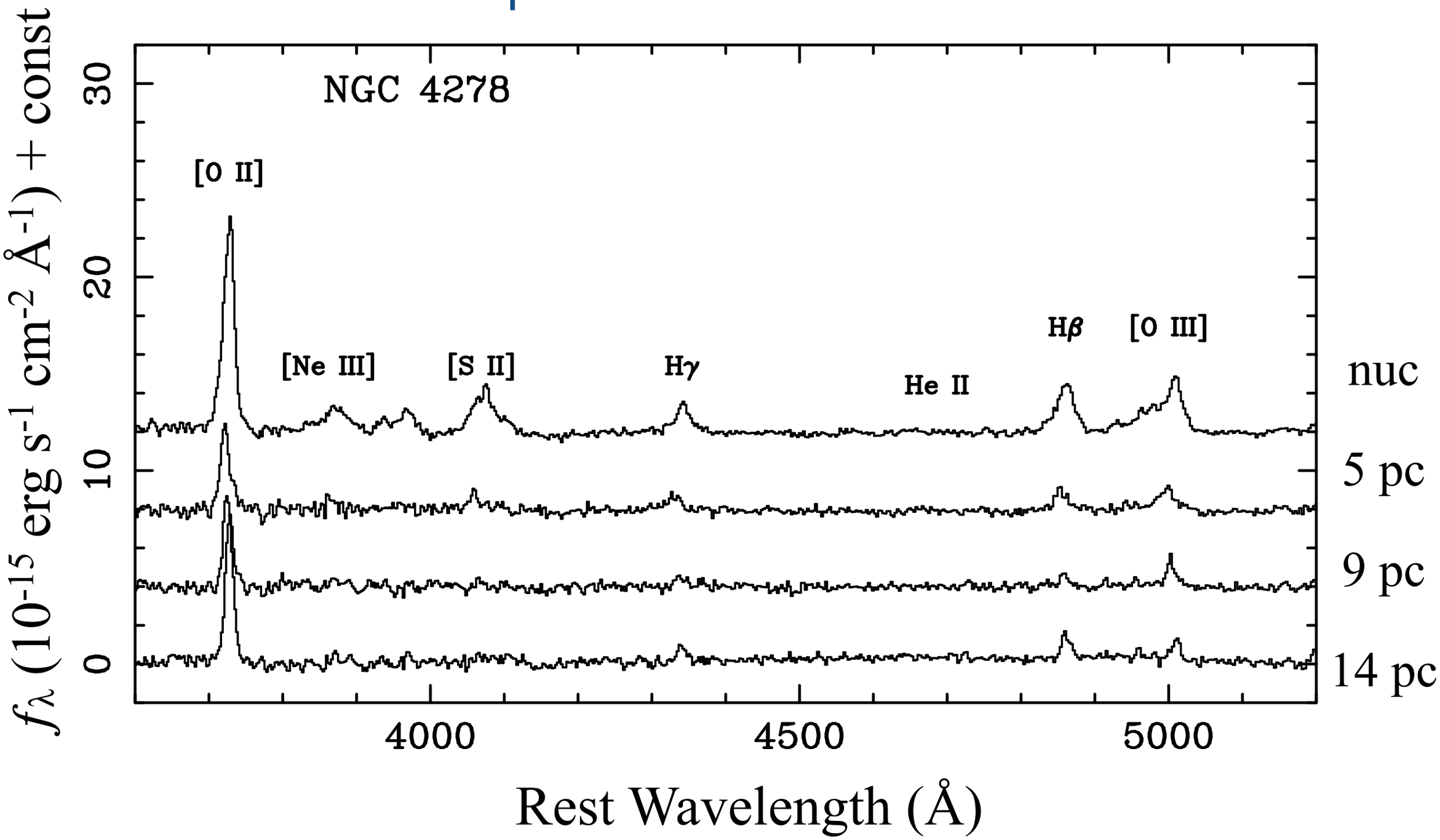
Resolved light that doesn't follow starlight



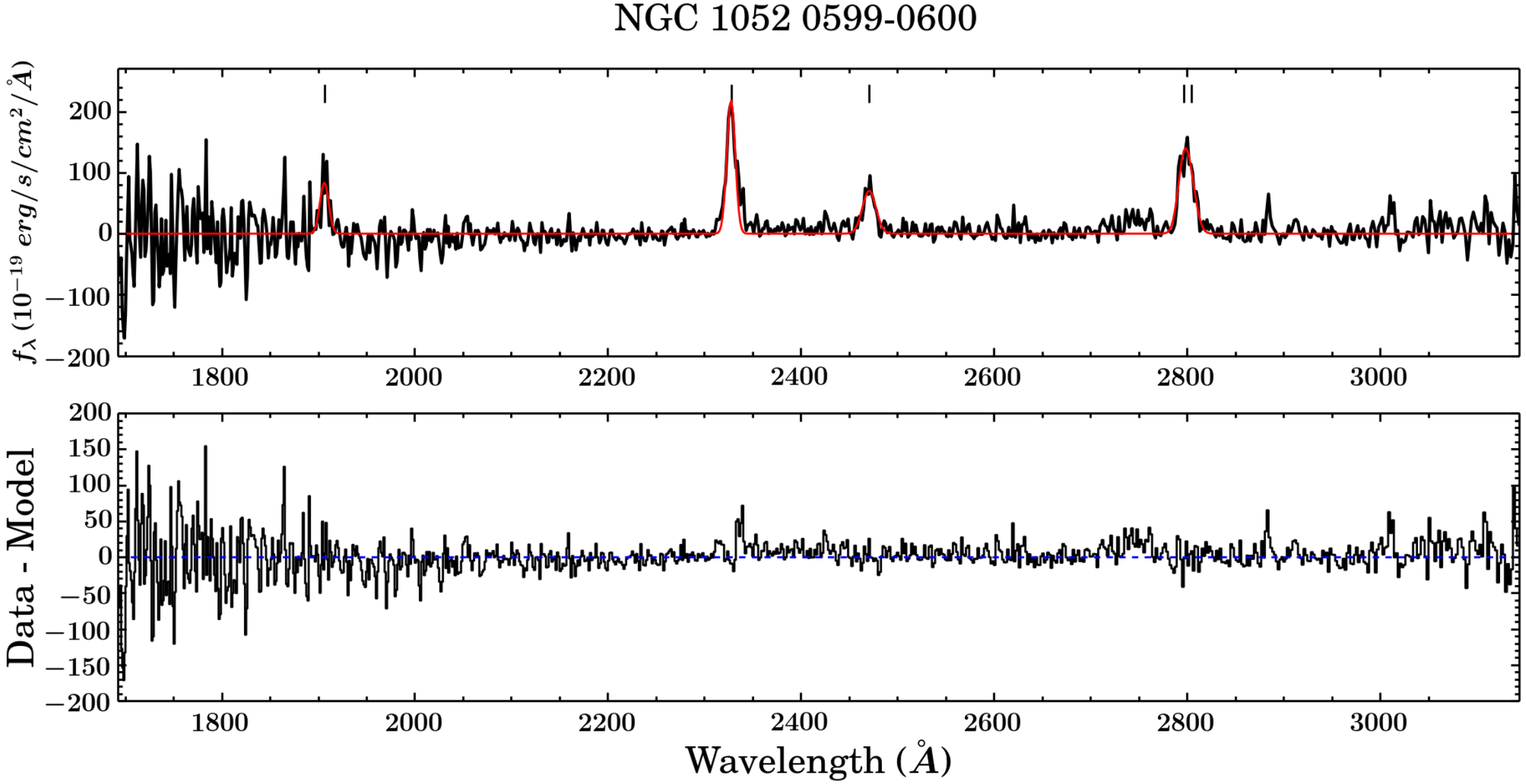
Continuum of unresolved light can be described by power law



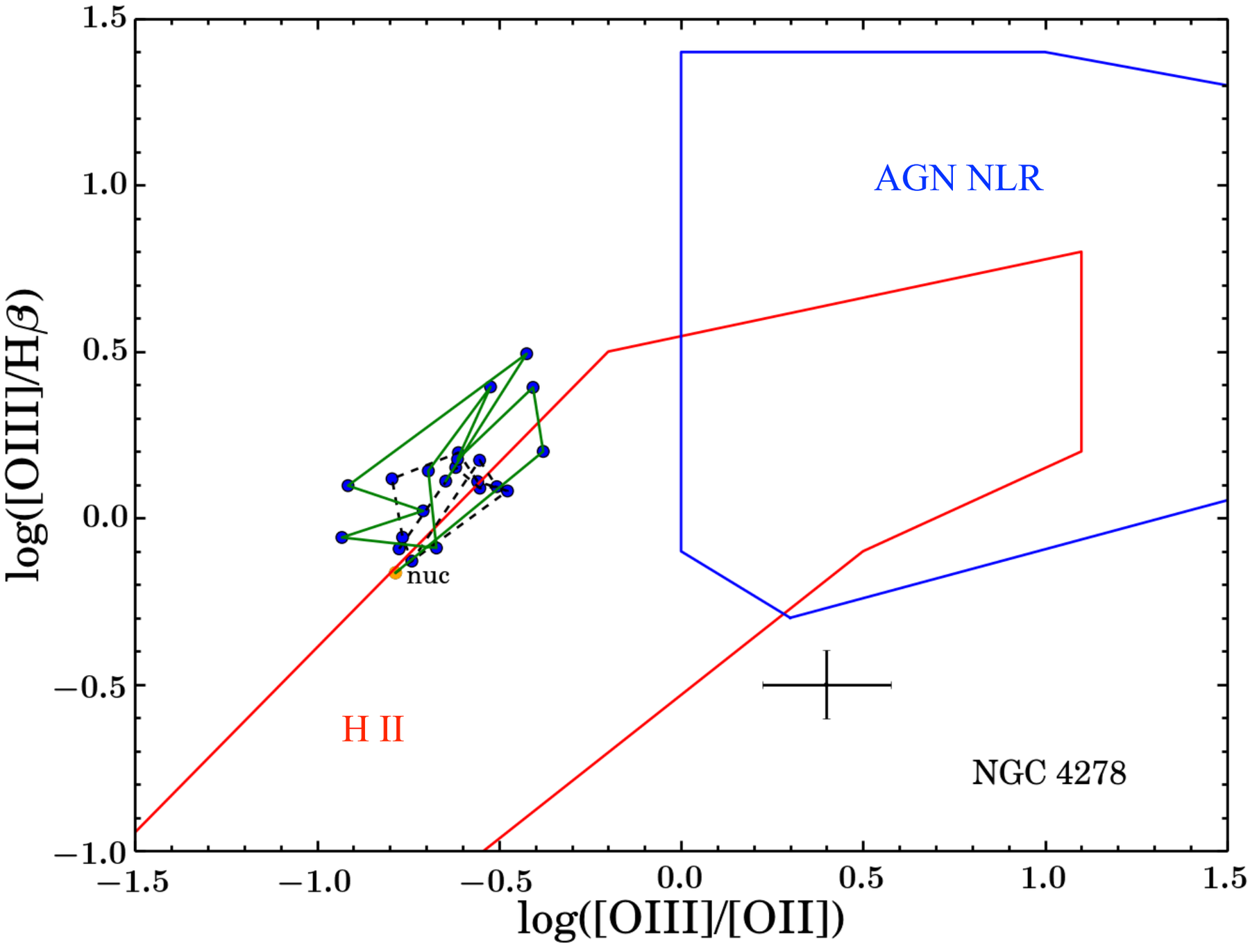
Final Spectra for NGC 4278



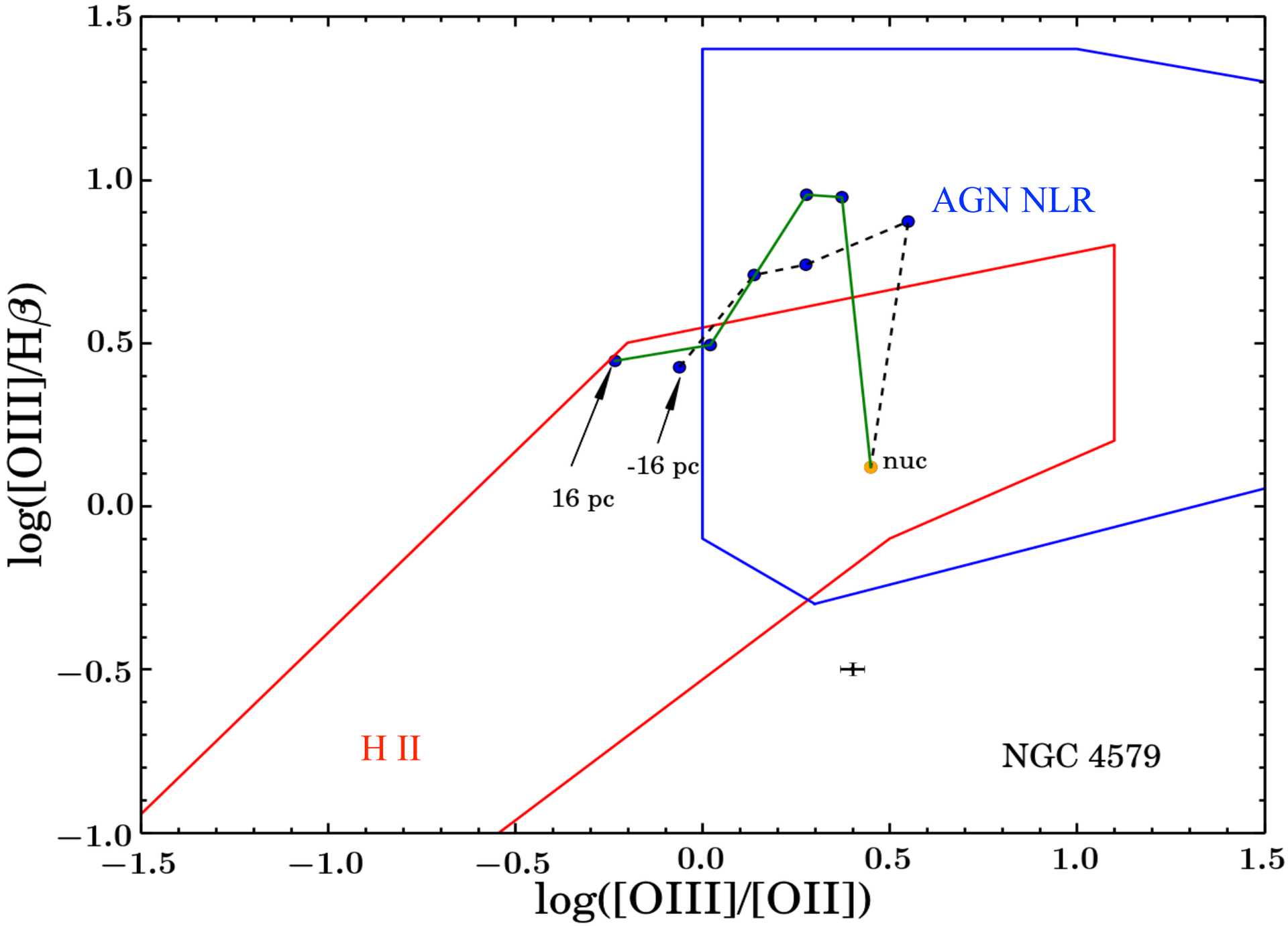
Line Fit for central row for UV spectrum



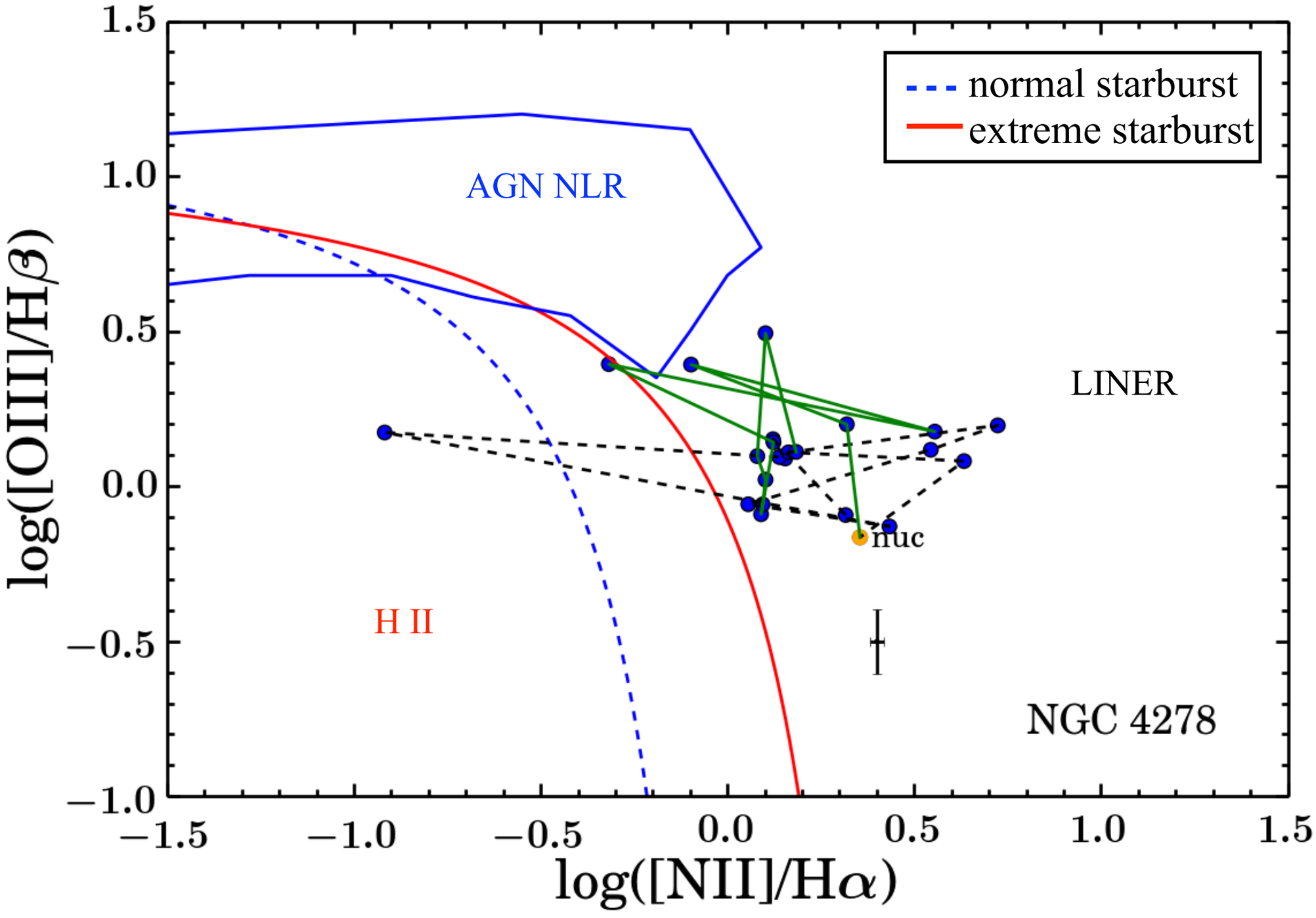
NGC 4278 Optical Lines Diagram



NGC 4579 Optical Lines Diagram



NGC 4278 Hα BPT Diagram



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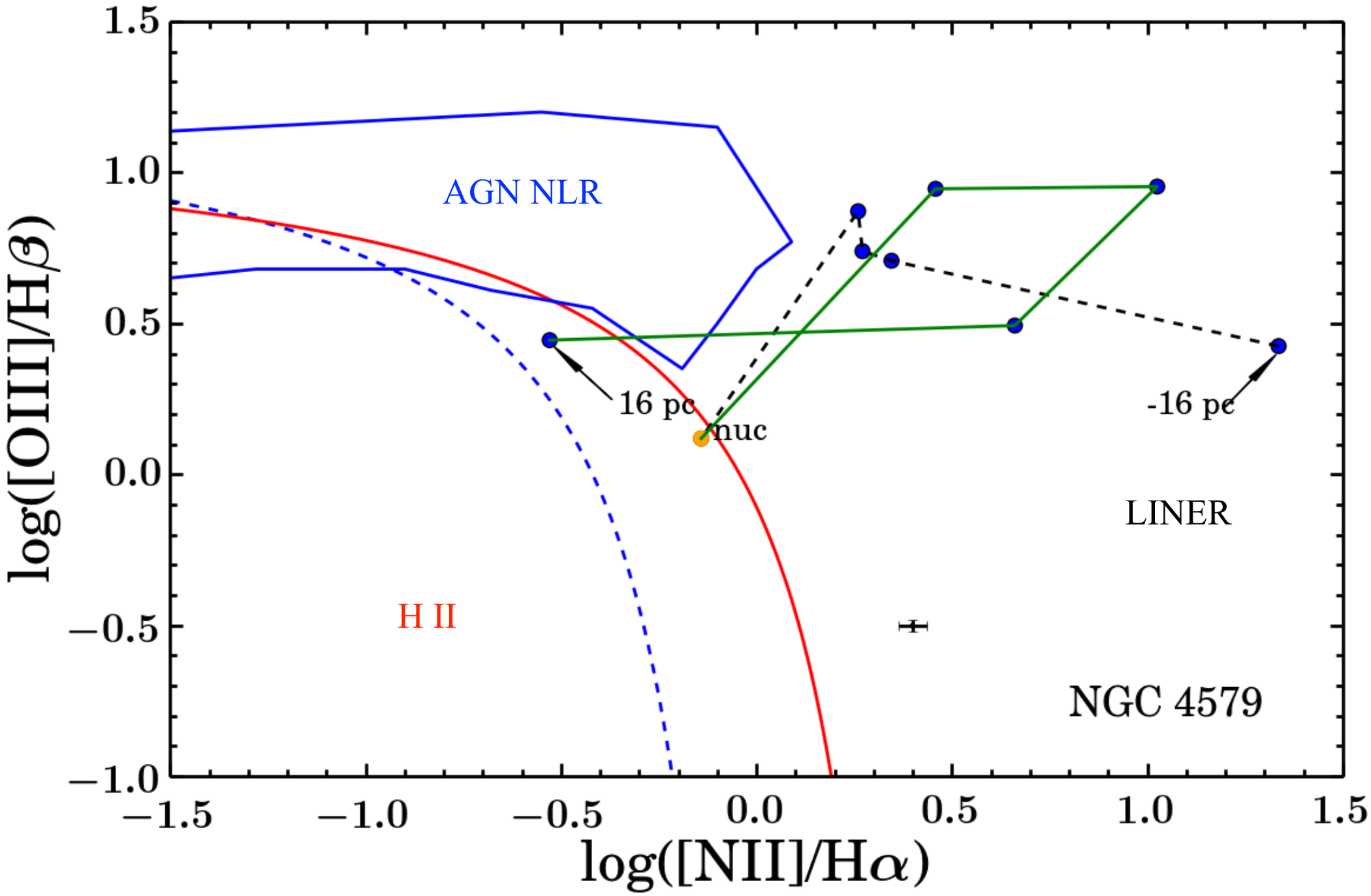
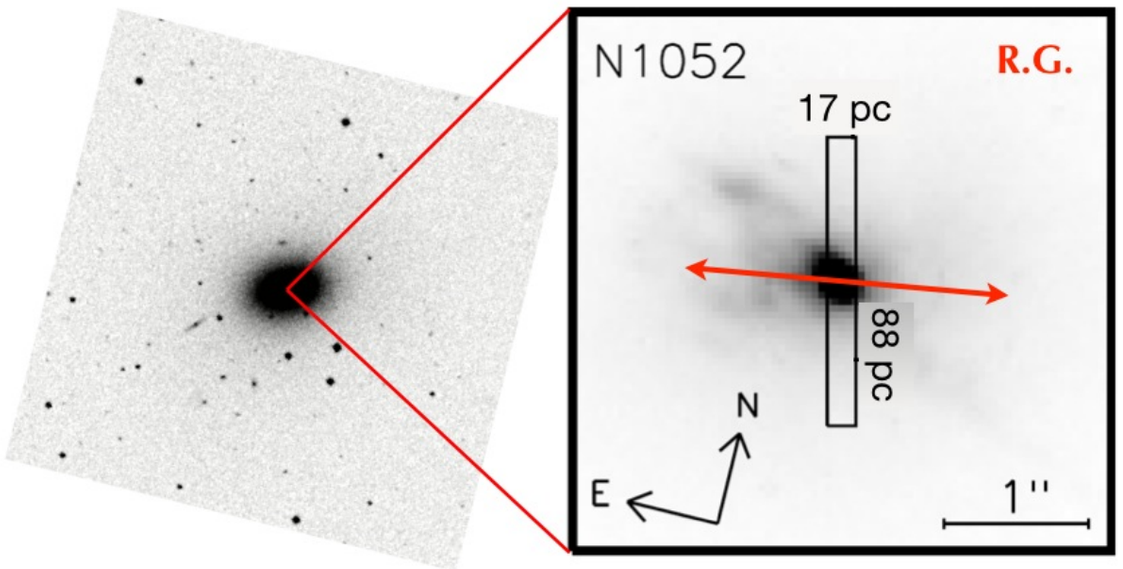
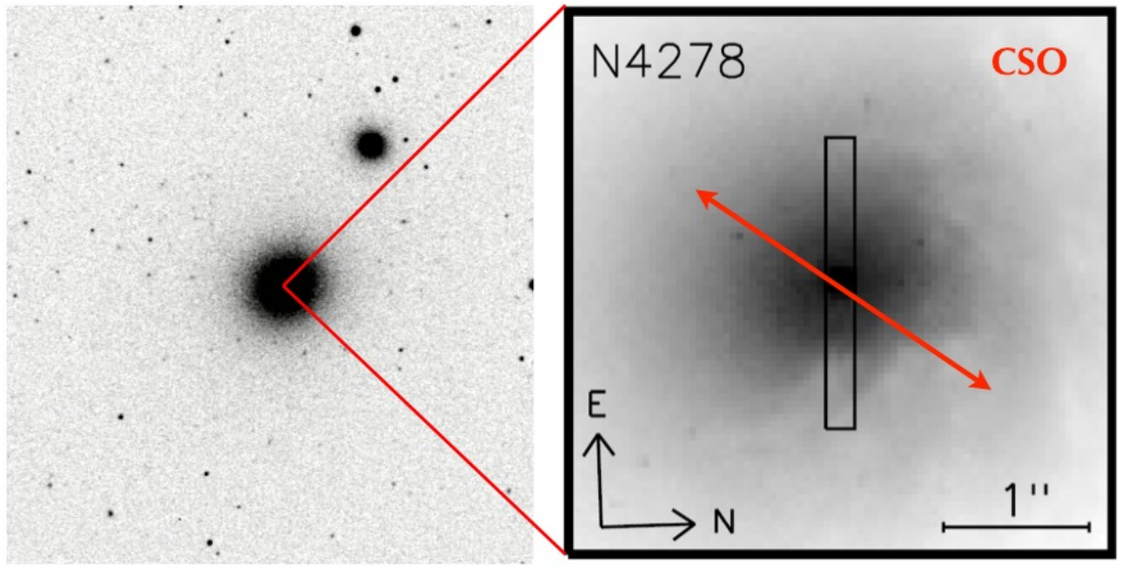




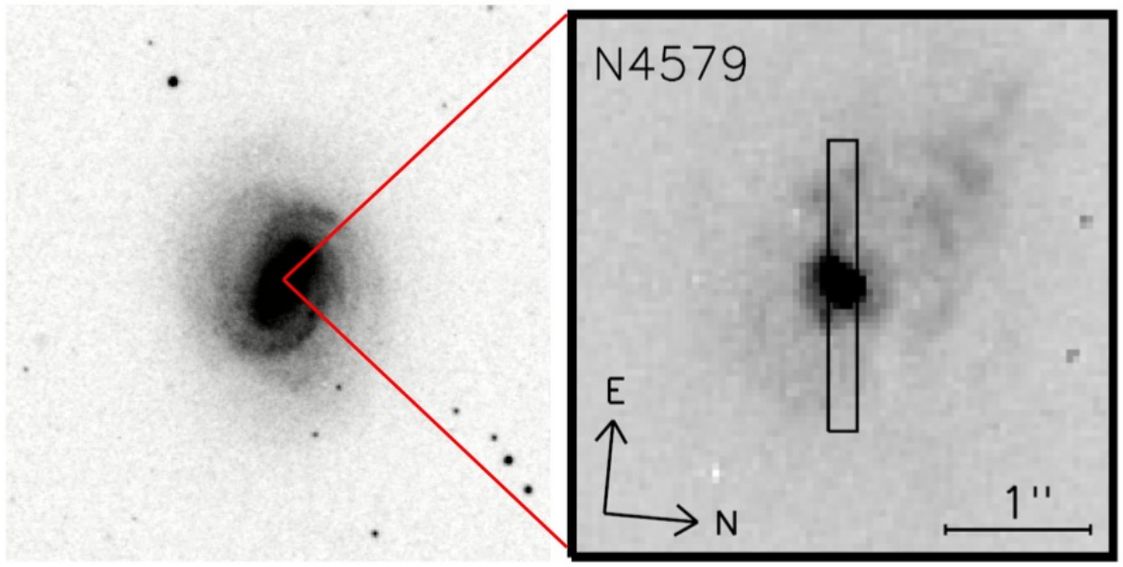
Left: From UK Schmidt Telescope, 9x9 arcmin

Distance: 17.8 Mpc



Left: From Palomar Survey, 12x12 arcmin

Distance: 9.7 Mpc

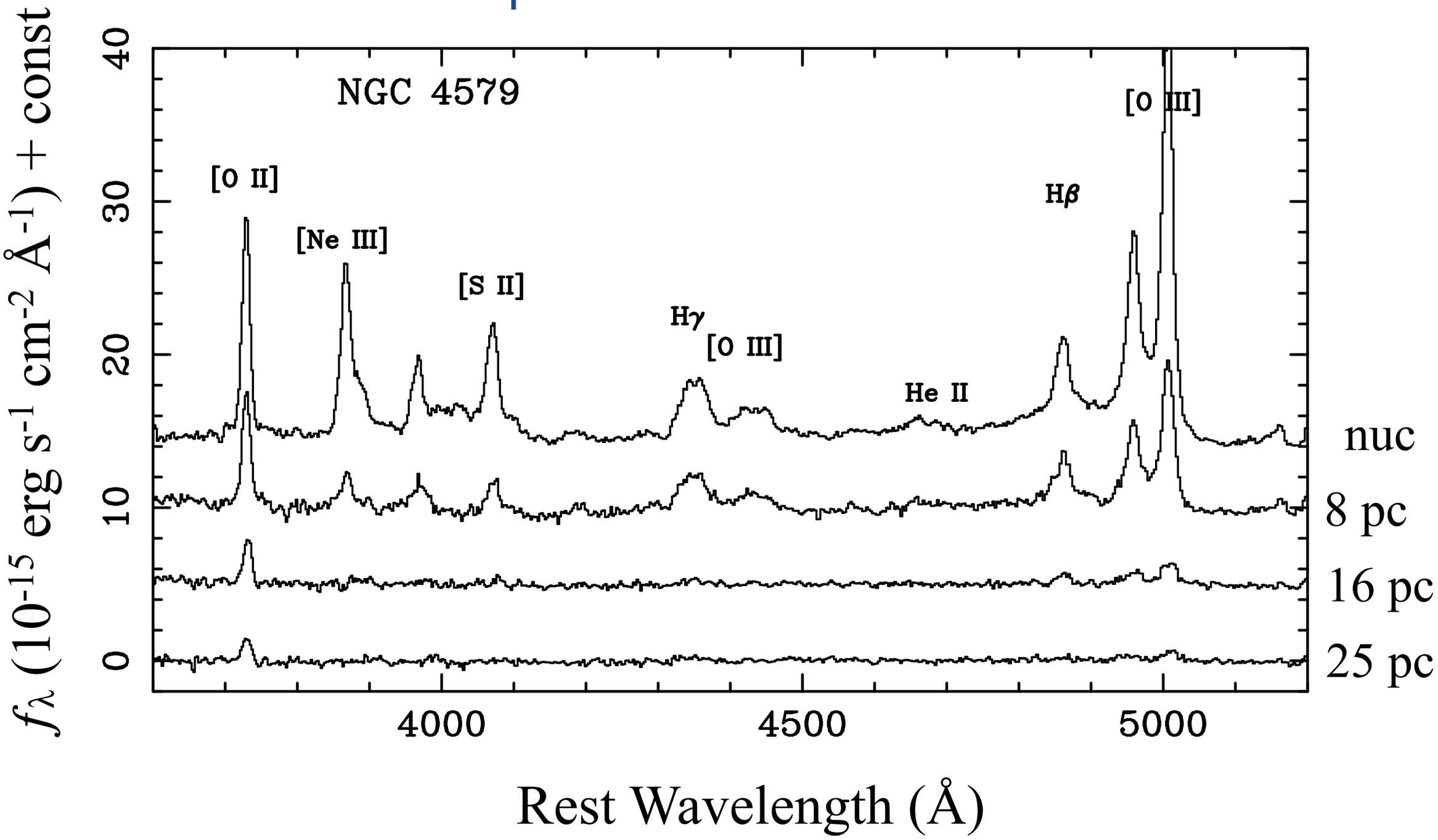


Left: From Palomar Survey, 9x9 arcmin

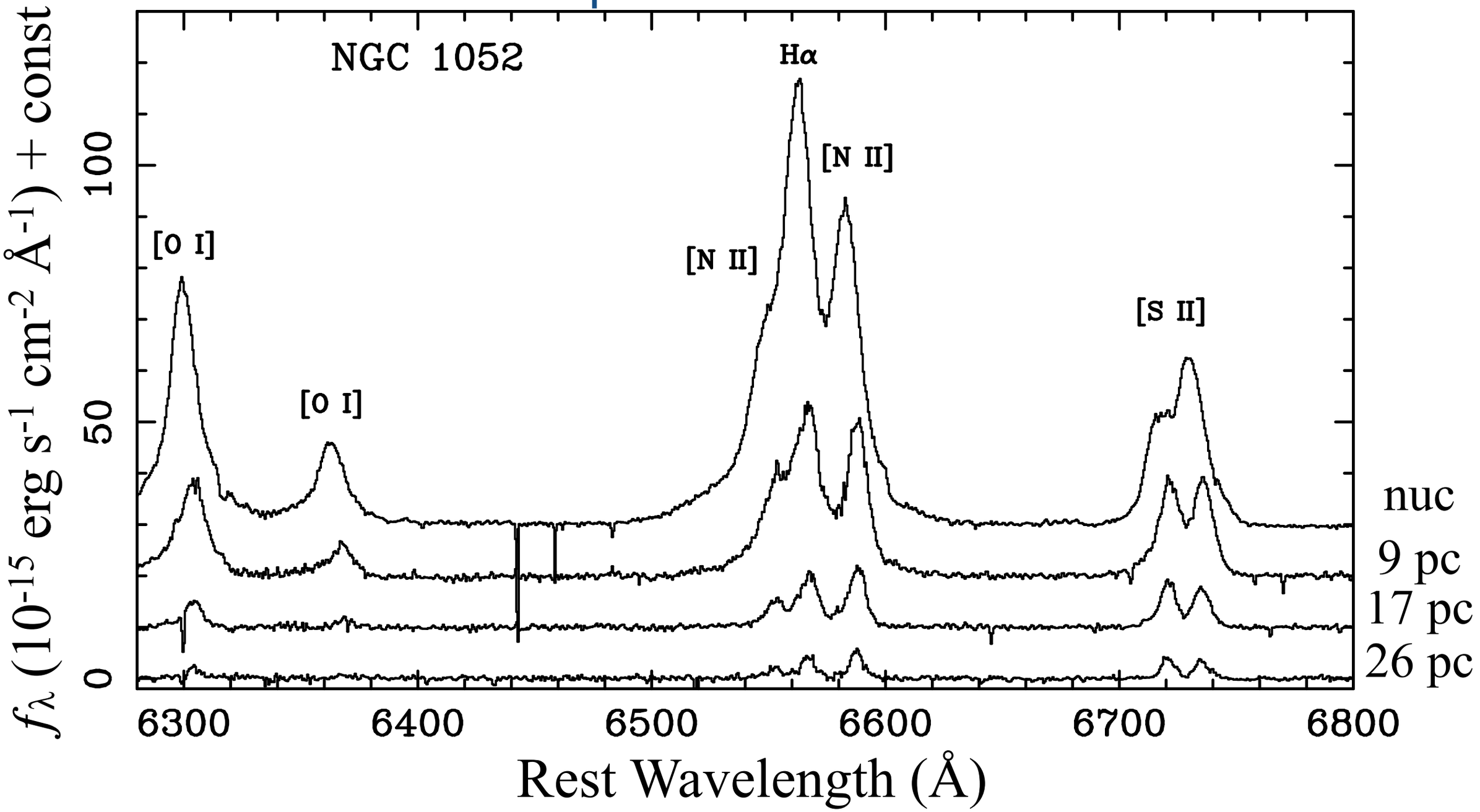
Distance: 16.8 Mpc

Figure 1 – *Top Left:* Image and slit placement for the radio galaxy (R.G.) NGC 1052, with radio jet orientation shown in red (not to scale). The radius of the radio jet for NGC 1052 is ~10″. *Top Right:* Same for the compact symmetric object candidate (CSO) NGC 4278. The radio jet radius is ~0.001″. *Bottom Left:* Same for NGC 4579. *Bottom Right:* Basic Properties of the three LINERs in this project.

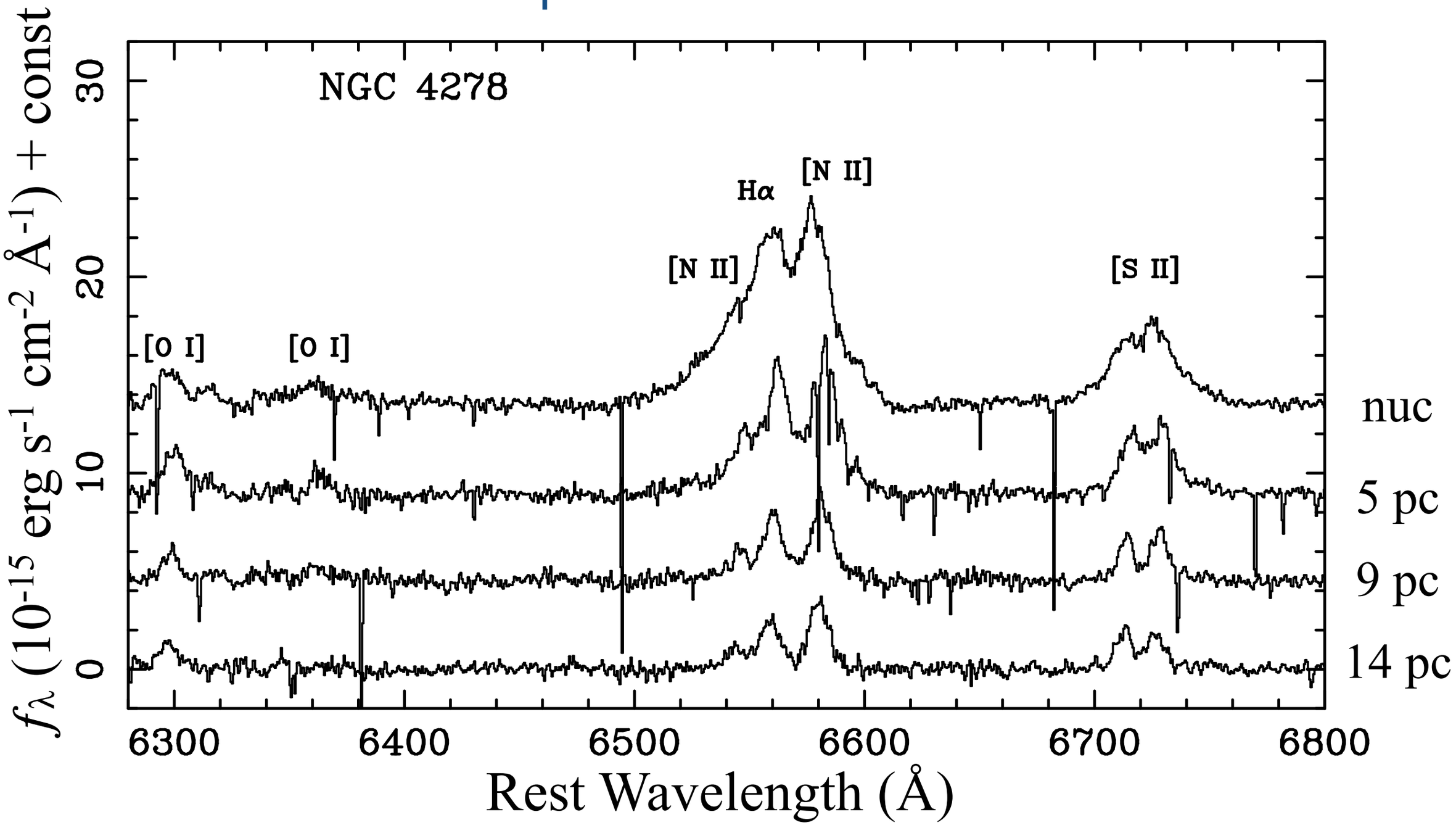
Final Spectra for NGC 4579



Final Hα Spectra for NGC 1052



Final Hα Spectra for NGC 4278



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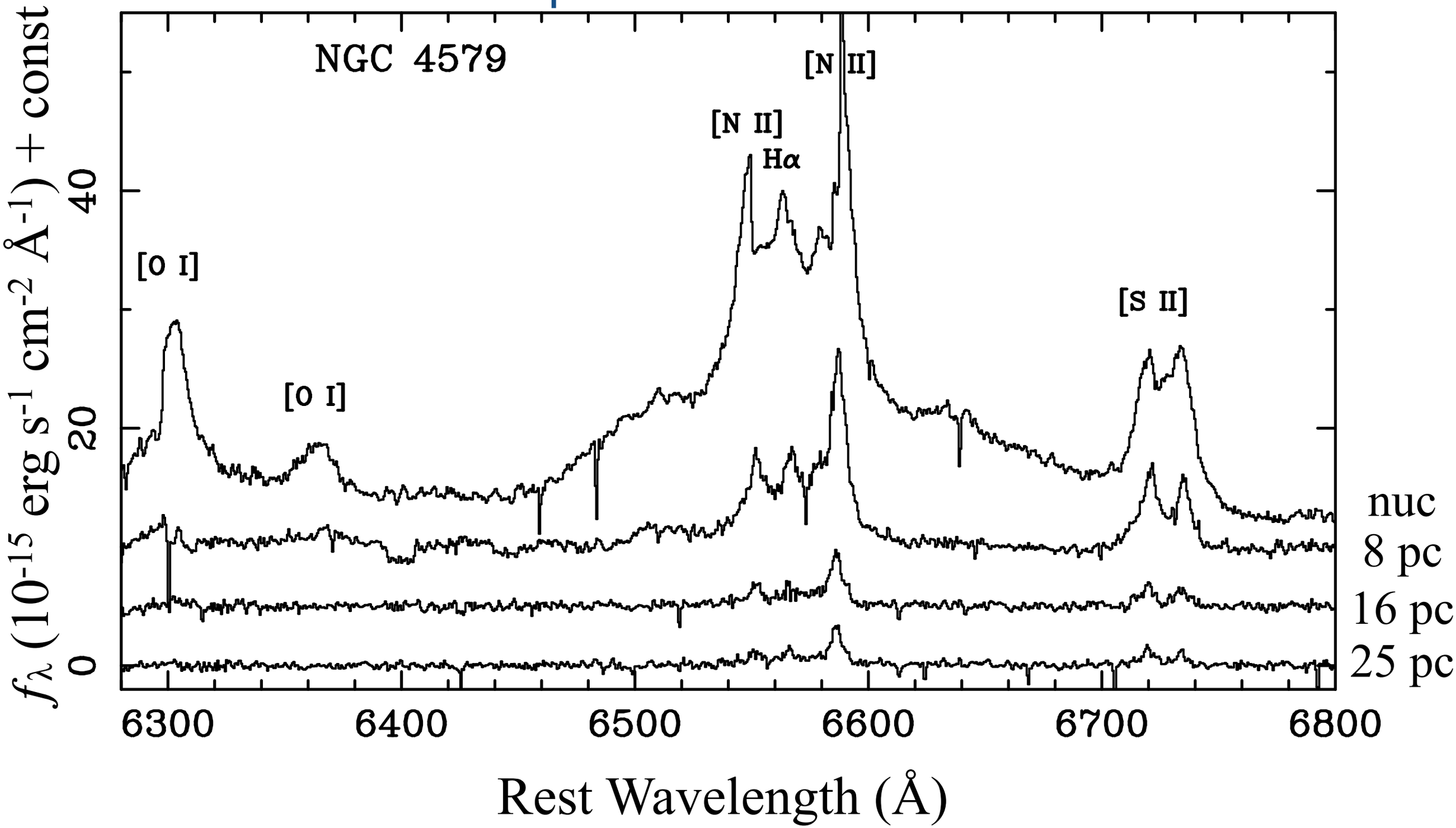
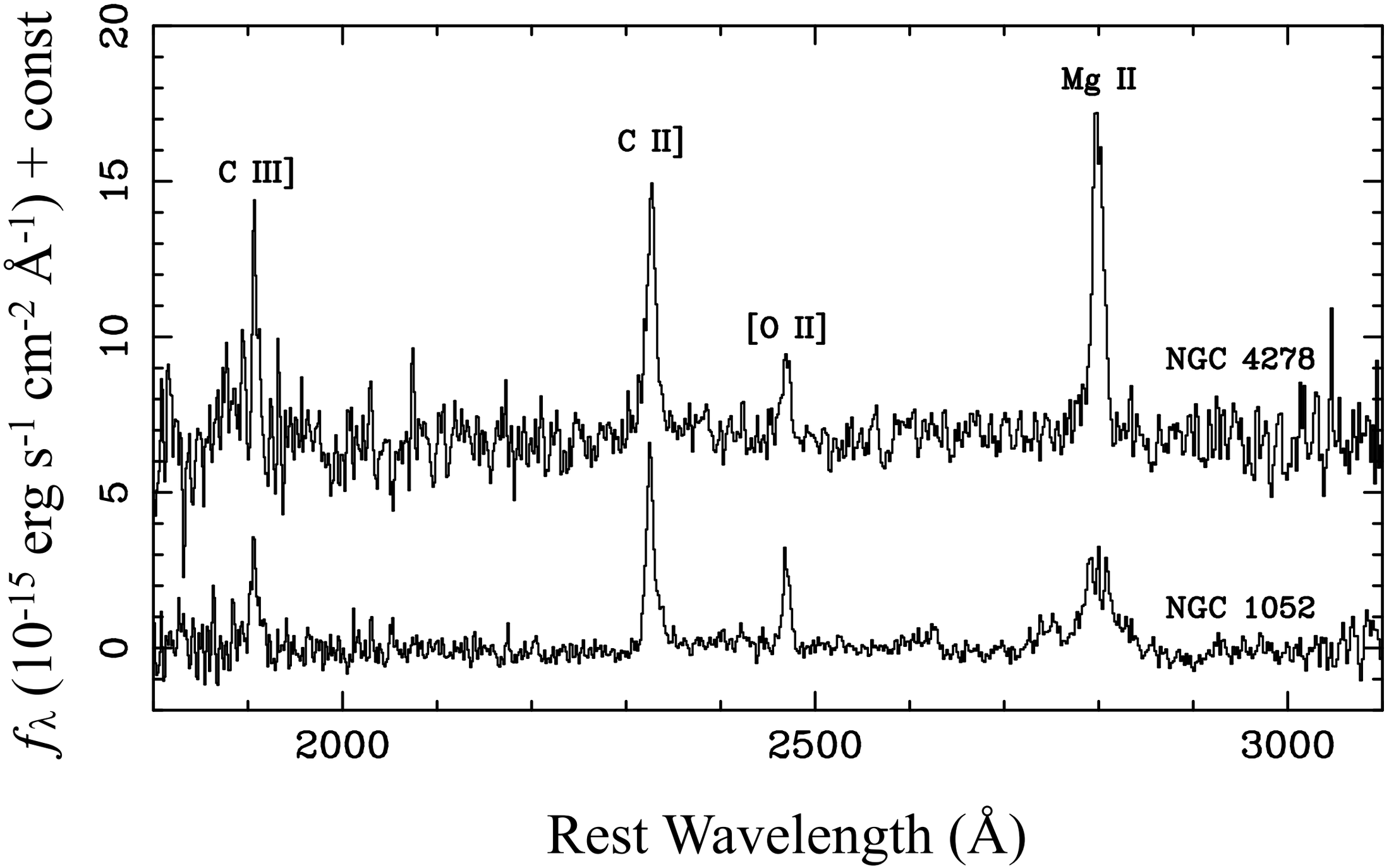
UV Spectra for NGC 1052 and NGC 4278