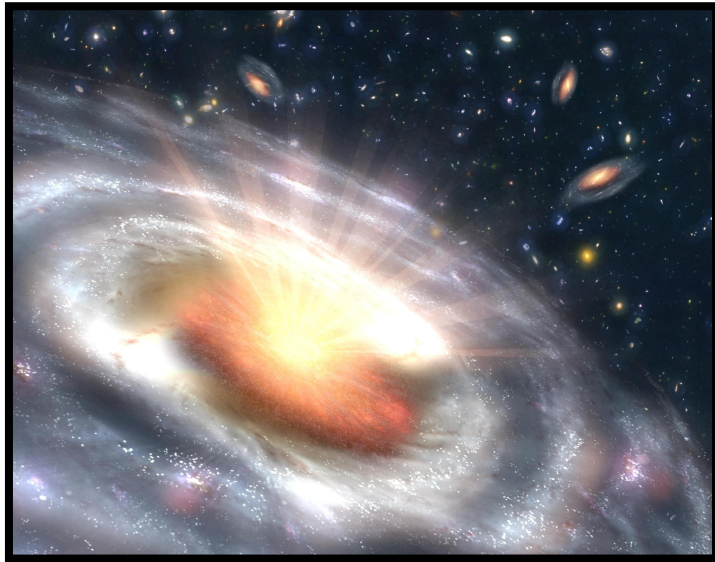


Incorporating the Narrow-Line Region into a Coherent View of the Central Engine & Host Galaxy



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Hill, Allison R., SG, Deo, R. P., Peeters, R. & Richards, G. T.
2014, MNRAS, 438, 231

Tammour, Aycha, SG, & Richards, G. T. 2014 MNRAS,
submitted *Willsfest ~ September 2014*

What do the narrow lines know about the central engine?

→ disappearing NLR

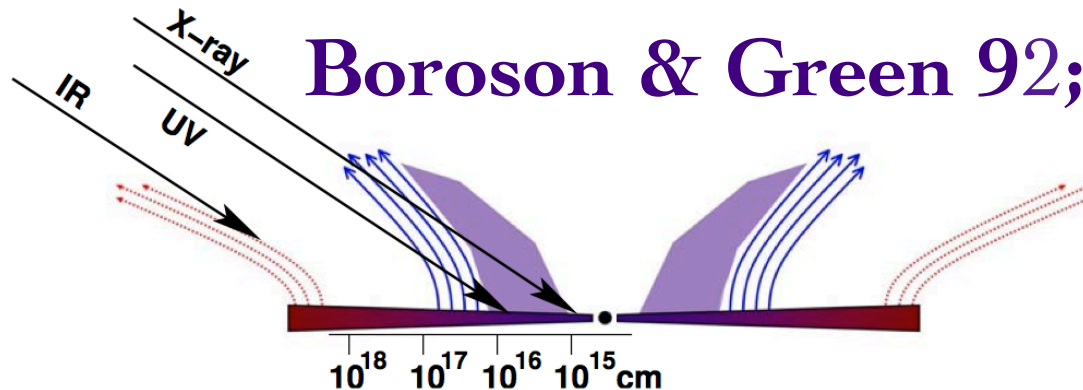
Netzer+04

→ mid-IR NLR “Baldwin Effect”

Hoenig+08; Keremedjiev+09

→ eigenvector 1 correlations

Boroson & Green 92; Wills+99



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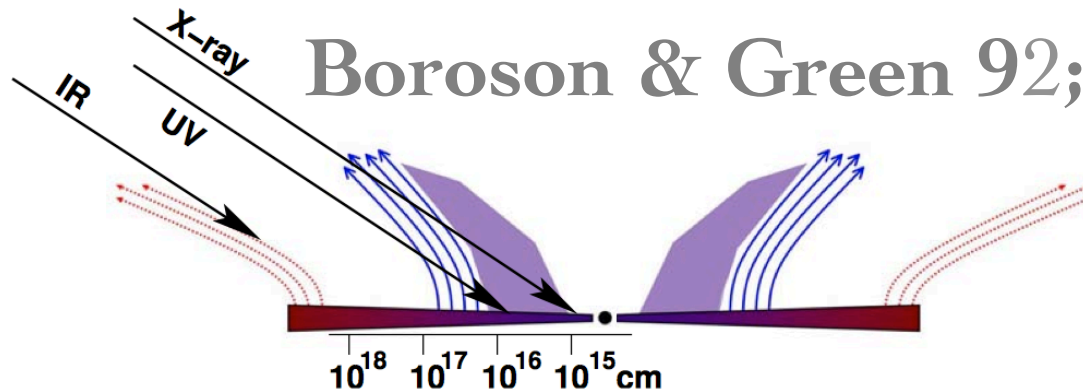
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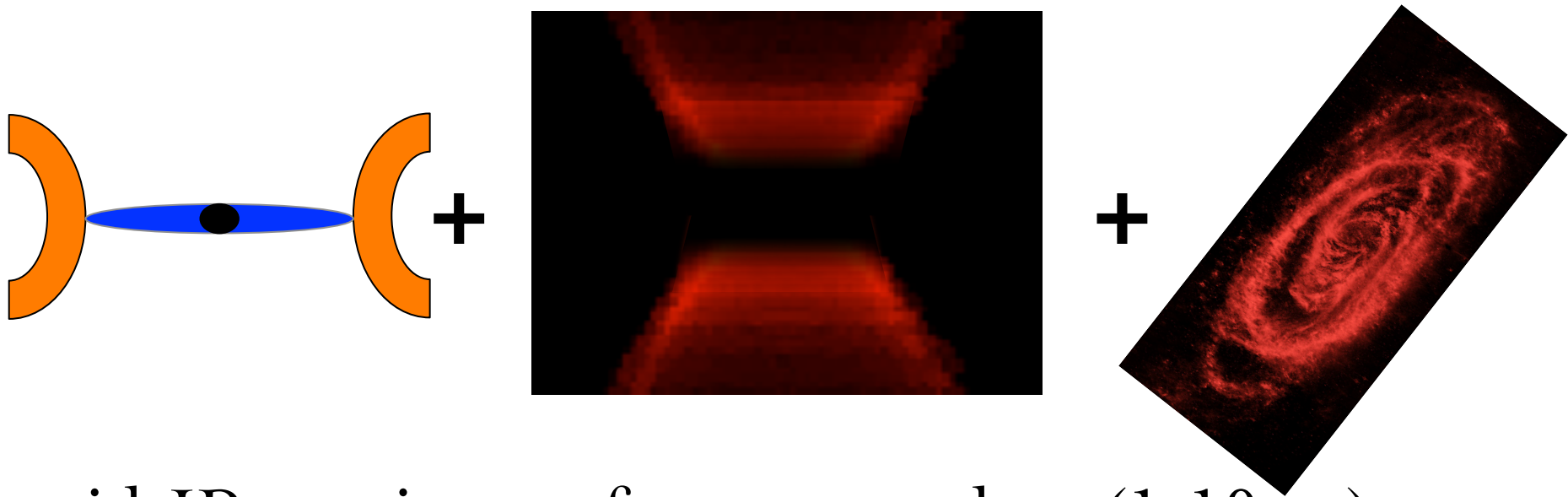
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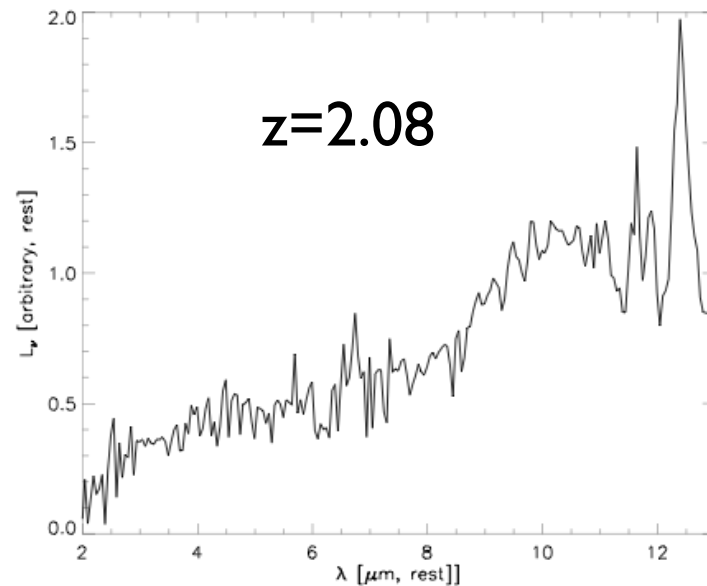
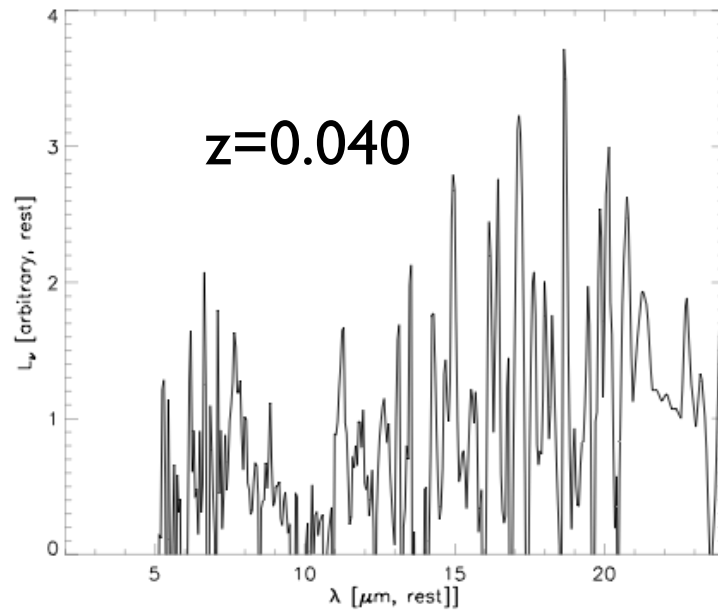
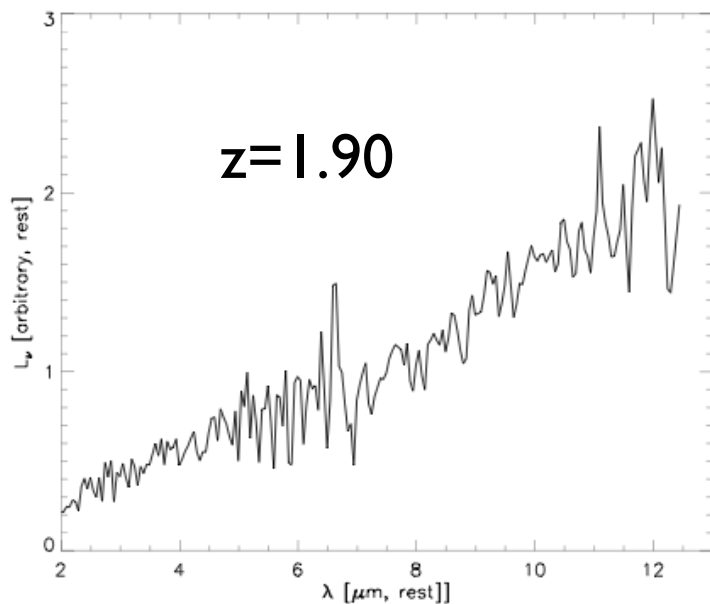
What does a typical SDSS quasar look like in mid-IR spectra?



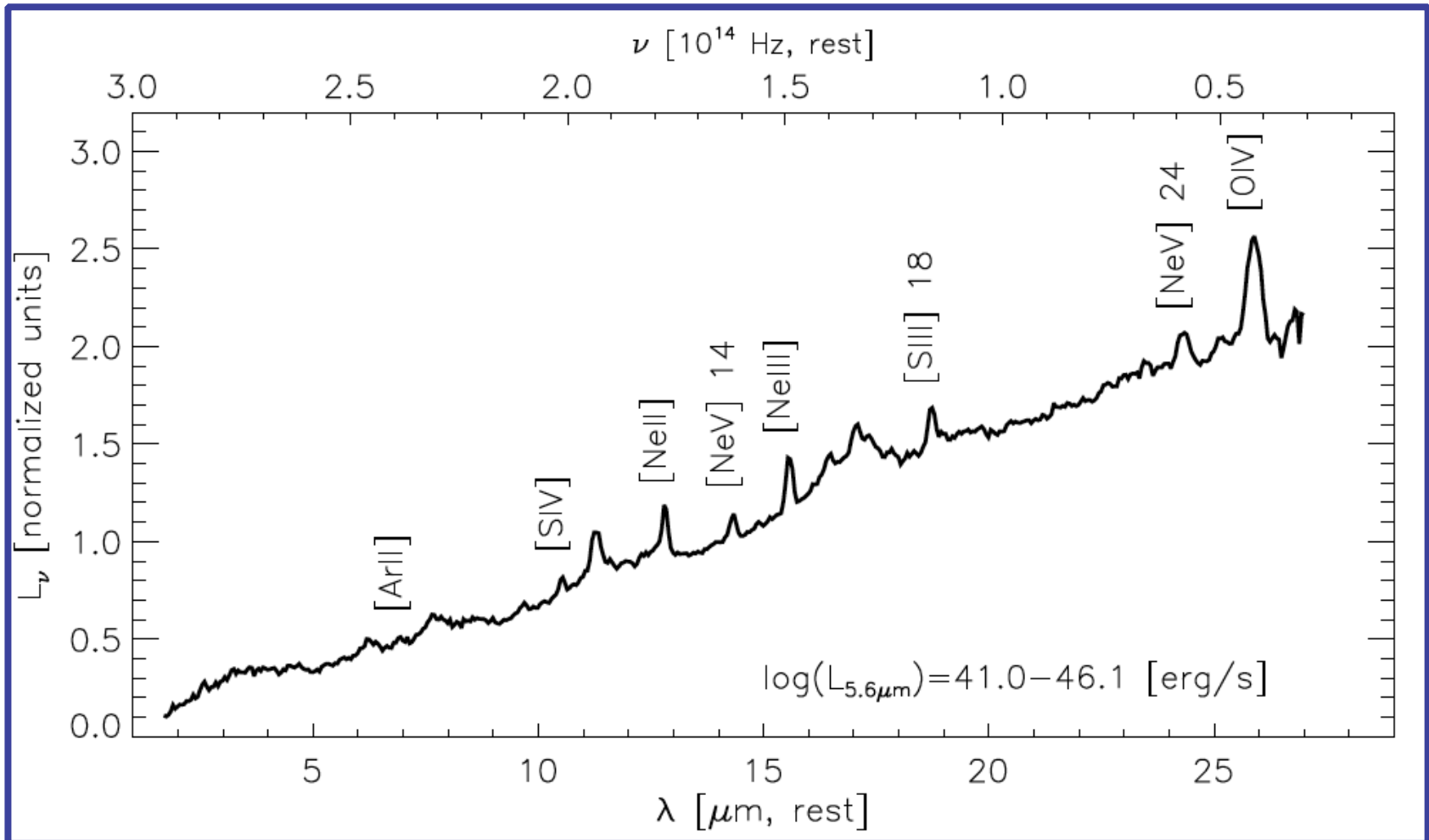
mid-IR continuum from warm dust (1-10 pc) +
narrow line region emission lines ($10-10^3$ pc) +
PAH emission from host galaxy (kpc)



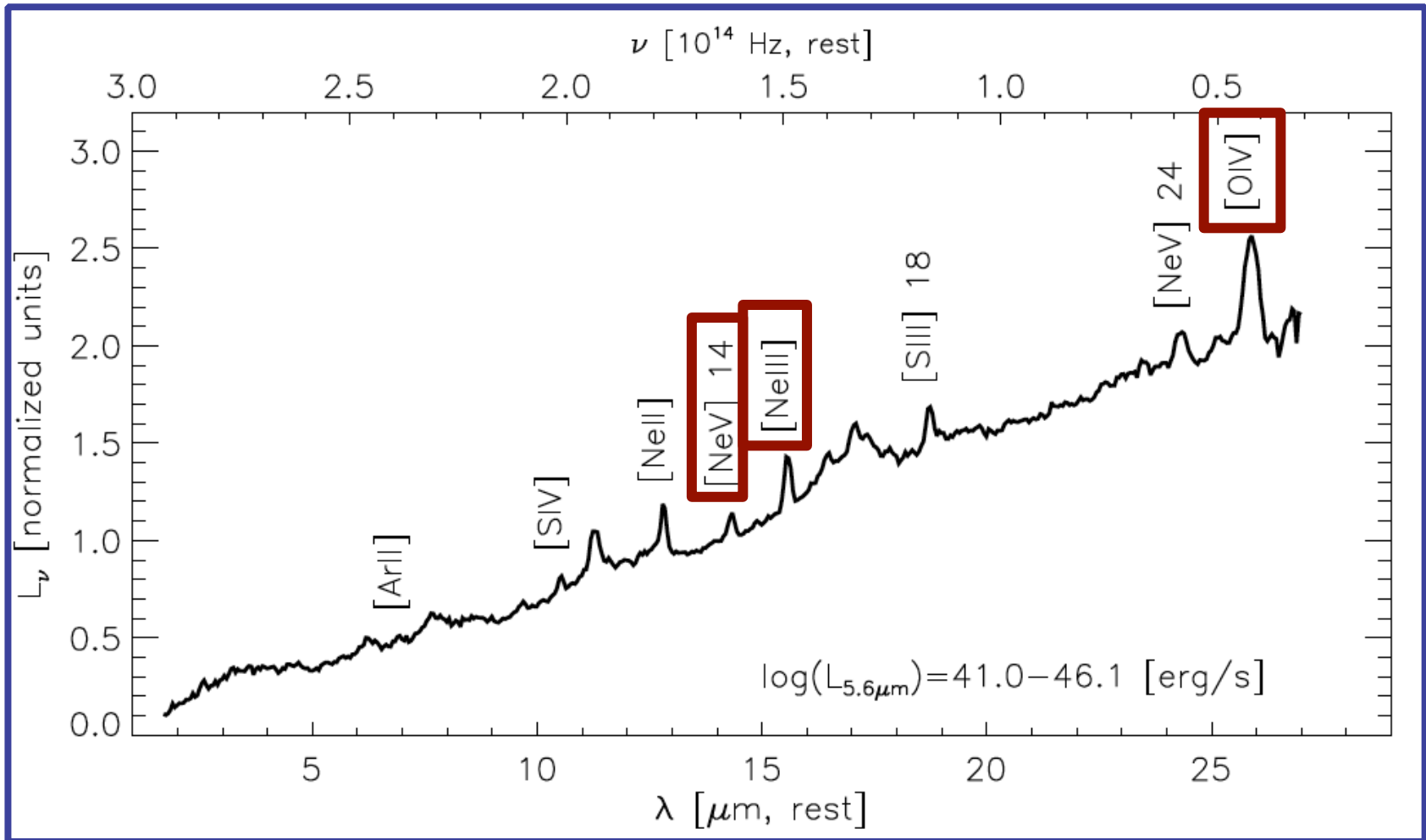
Typical *Spitzer* spectra of SDSS quasars



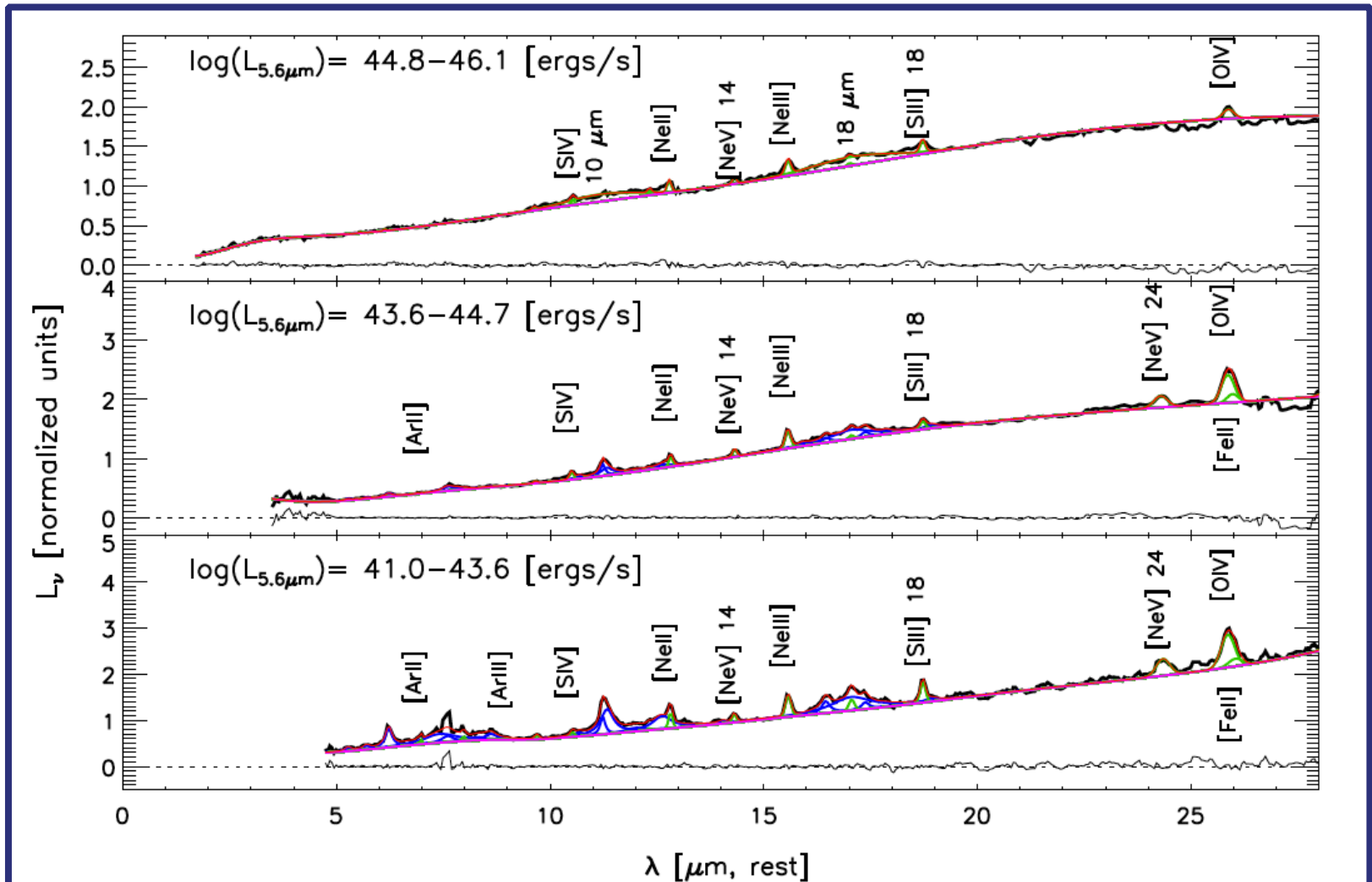
Mid-IR composite of 184 Type 1 quasars



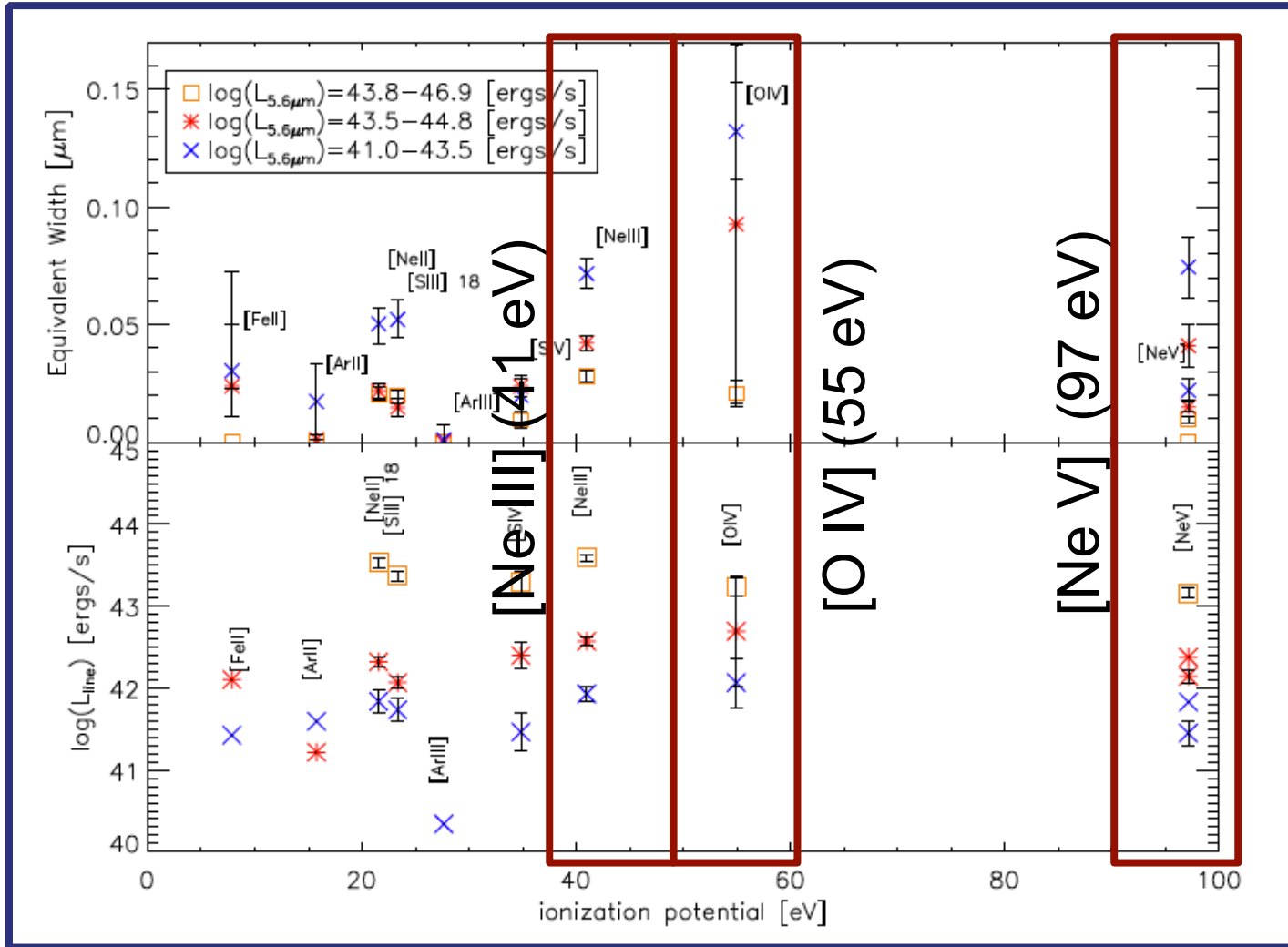
Mid-IR composite of 184 Type 1 quasars



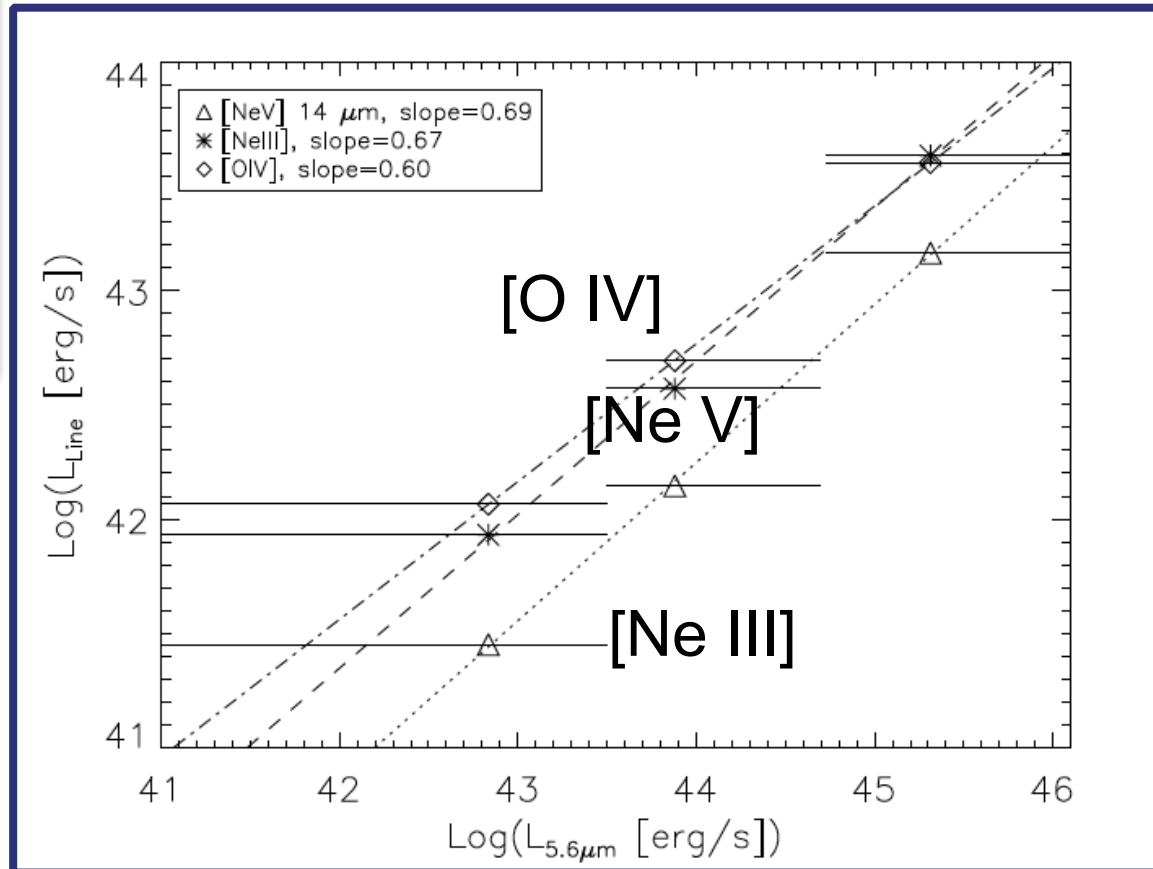
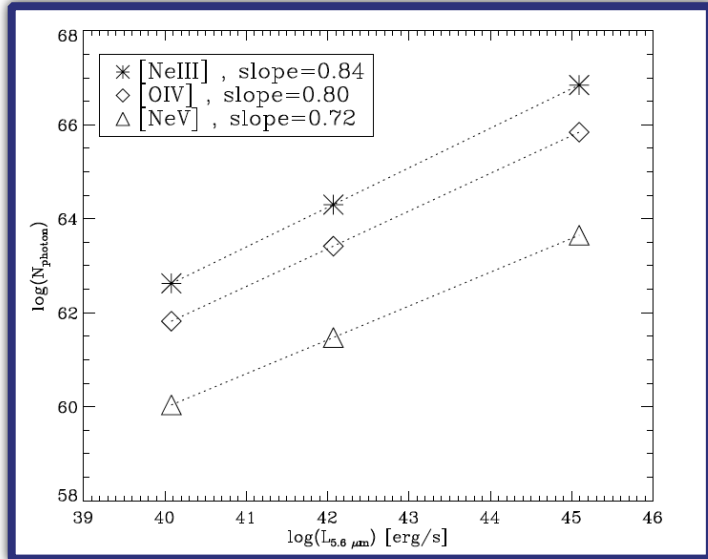
PAHfit results of luminosity composites



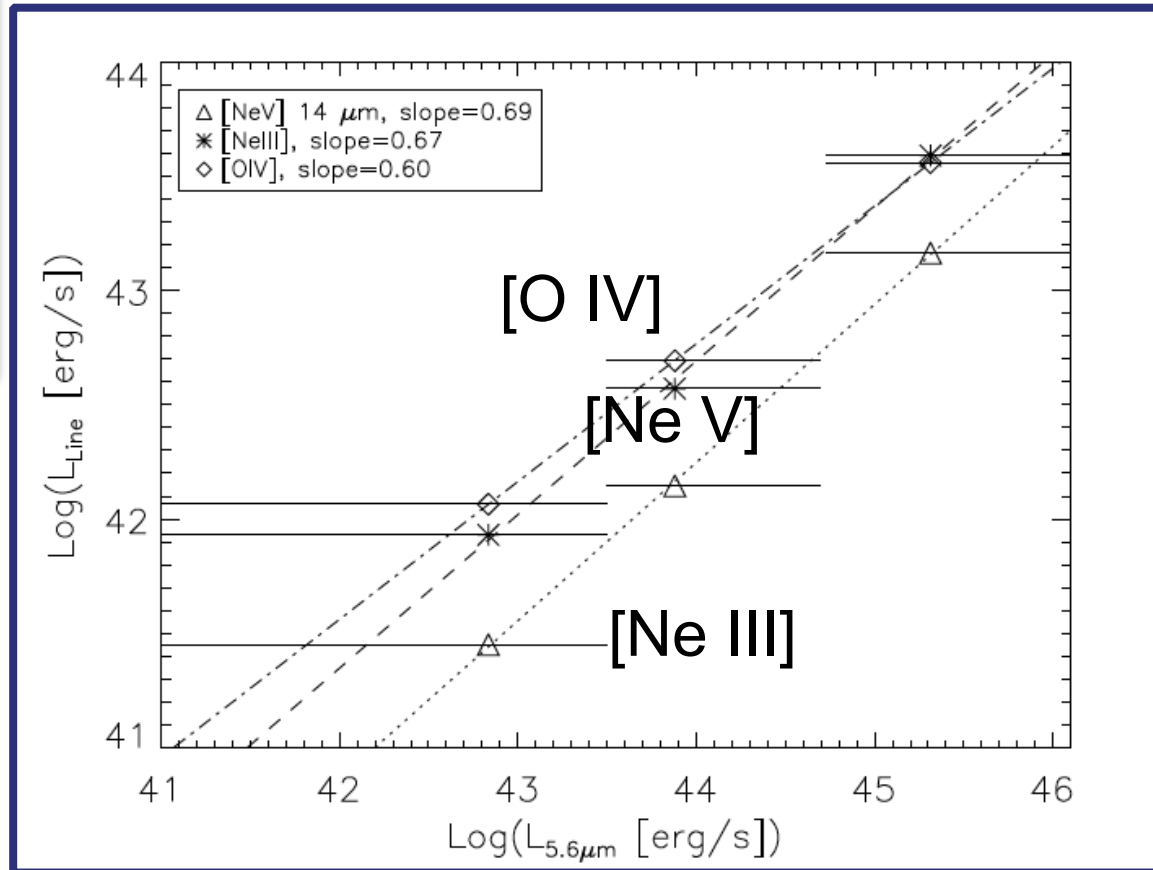
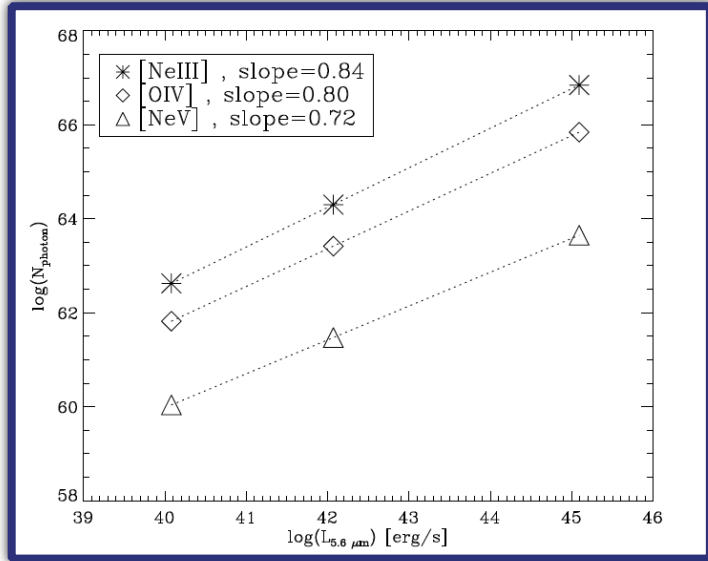
Narrow line luminosities



Number of ionizing photons vs. line luminosity



Number of ionizing photons vs. line luminosity



predicted +
observed slopes for
[Ne V] match well



Two points from mid-IR NLR spectral analysis

- The EW is not a meaningful metric for high ionization lines in the mid-IR (a mid-IR Baldwin Effect isn't meaningful).
- In composite spectra, the NLR is getting stronger with increasing continuum luminosity (with non-linear scaling) as expected.



What do the narrow lines know about the central engine?

→ eigenvector 1 correlations

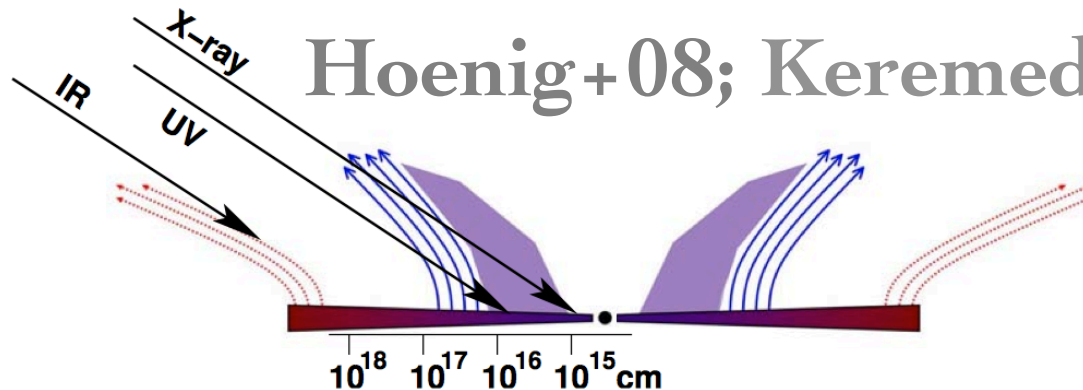
Boroson & Green 92; Wills+99

→ disappearing NLR

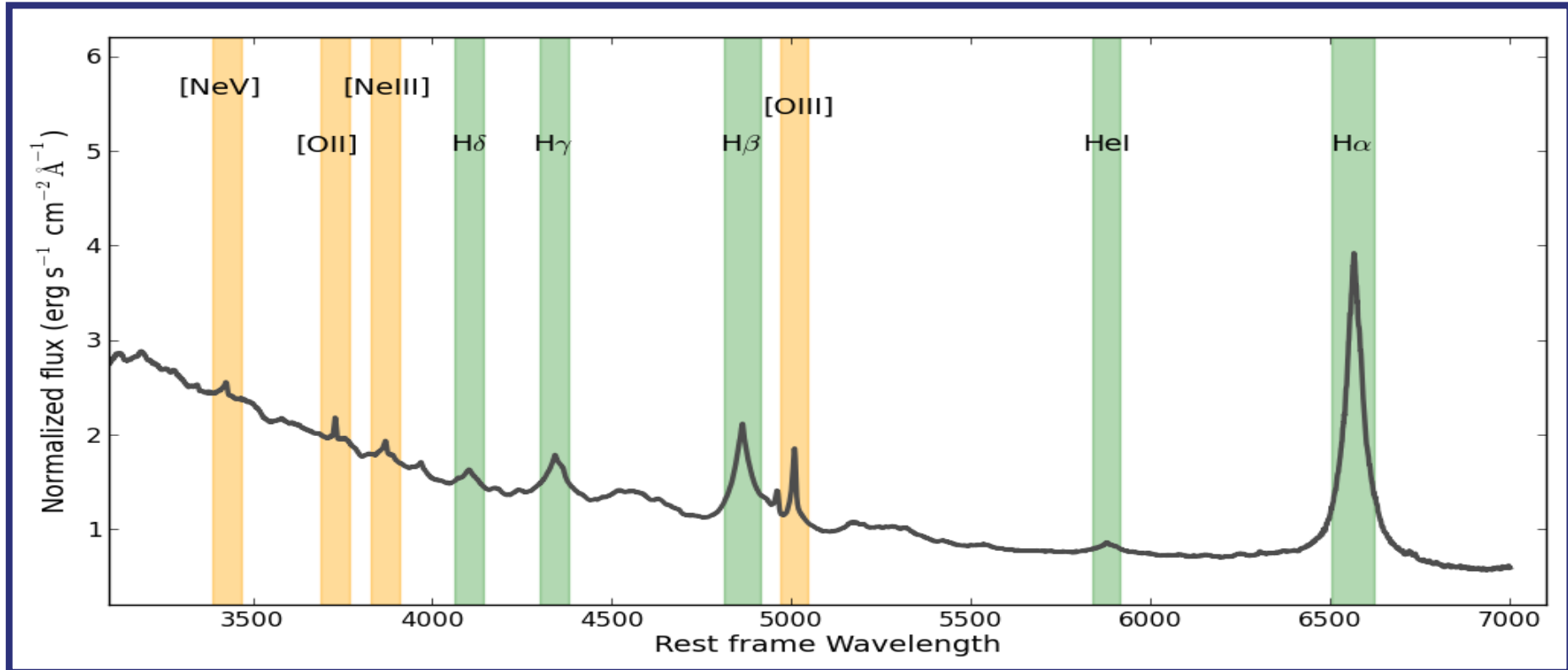
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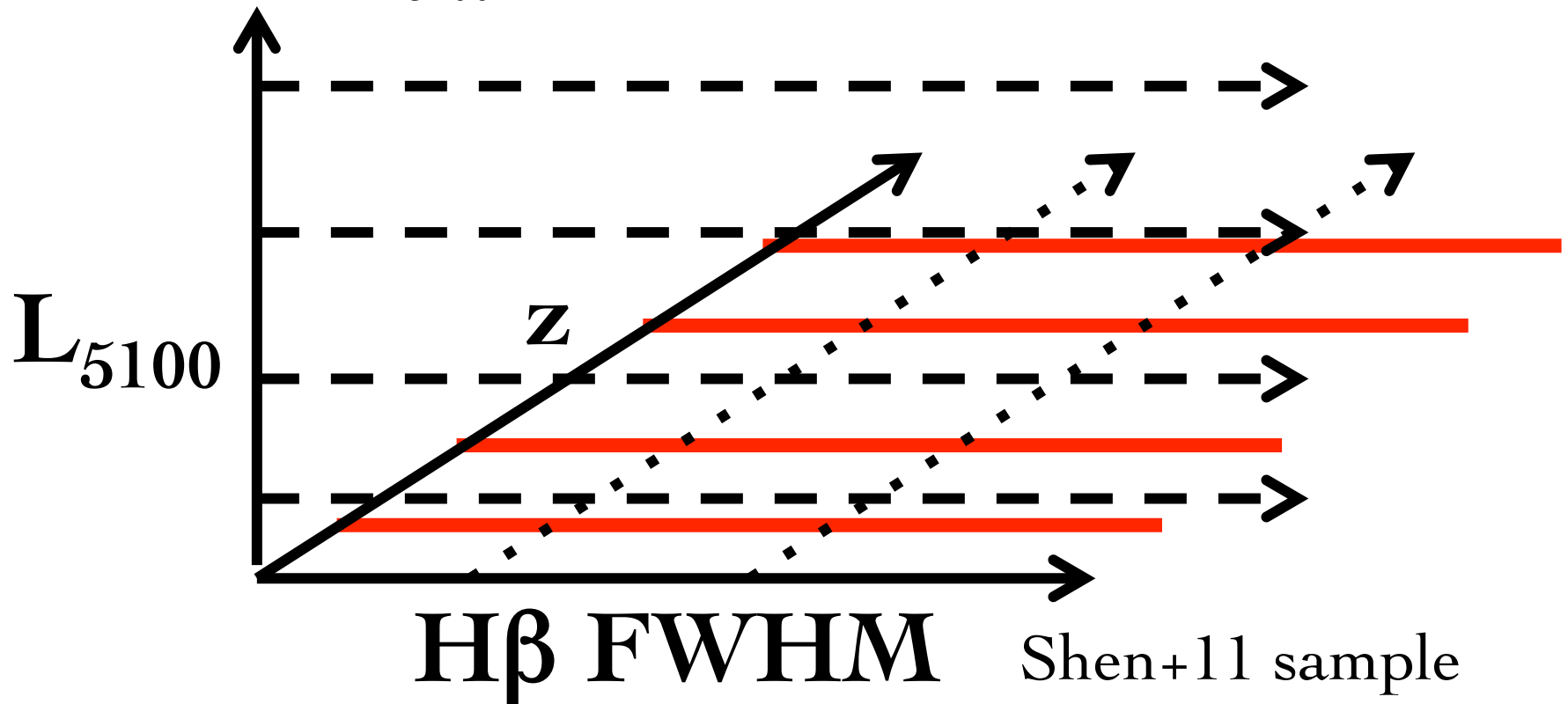


Optical narrow lines with high S/N (composites)



Isolate narrow lines from central engine

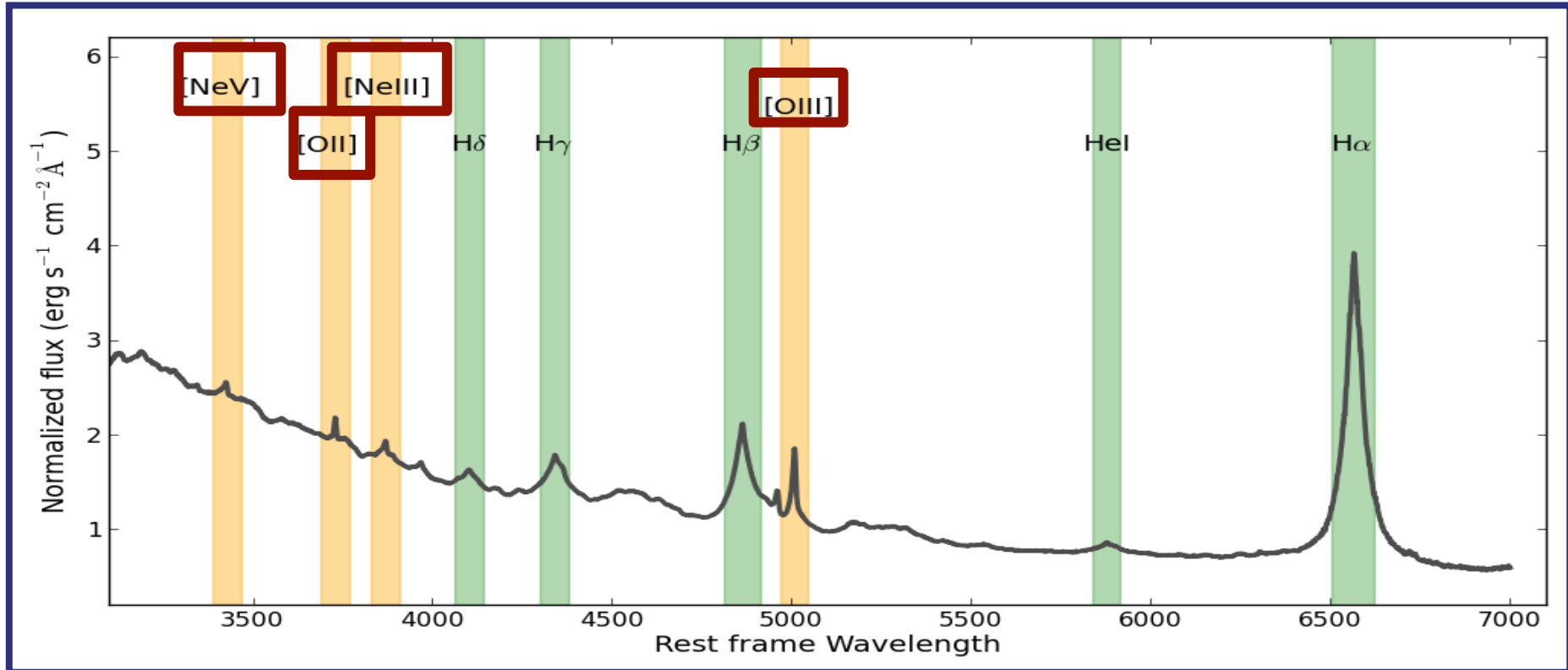
$$4 L_{5100} \times 3 \text{ HB FWHM} \times 7z = 84 \text{ bins}$$



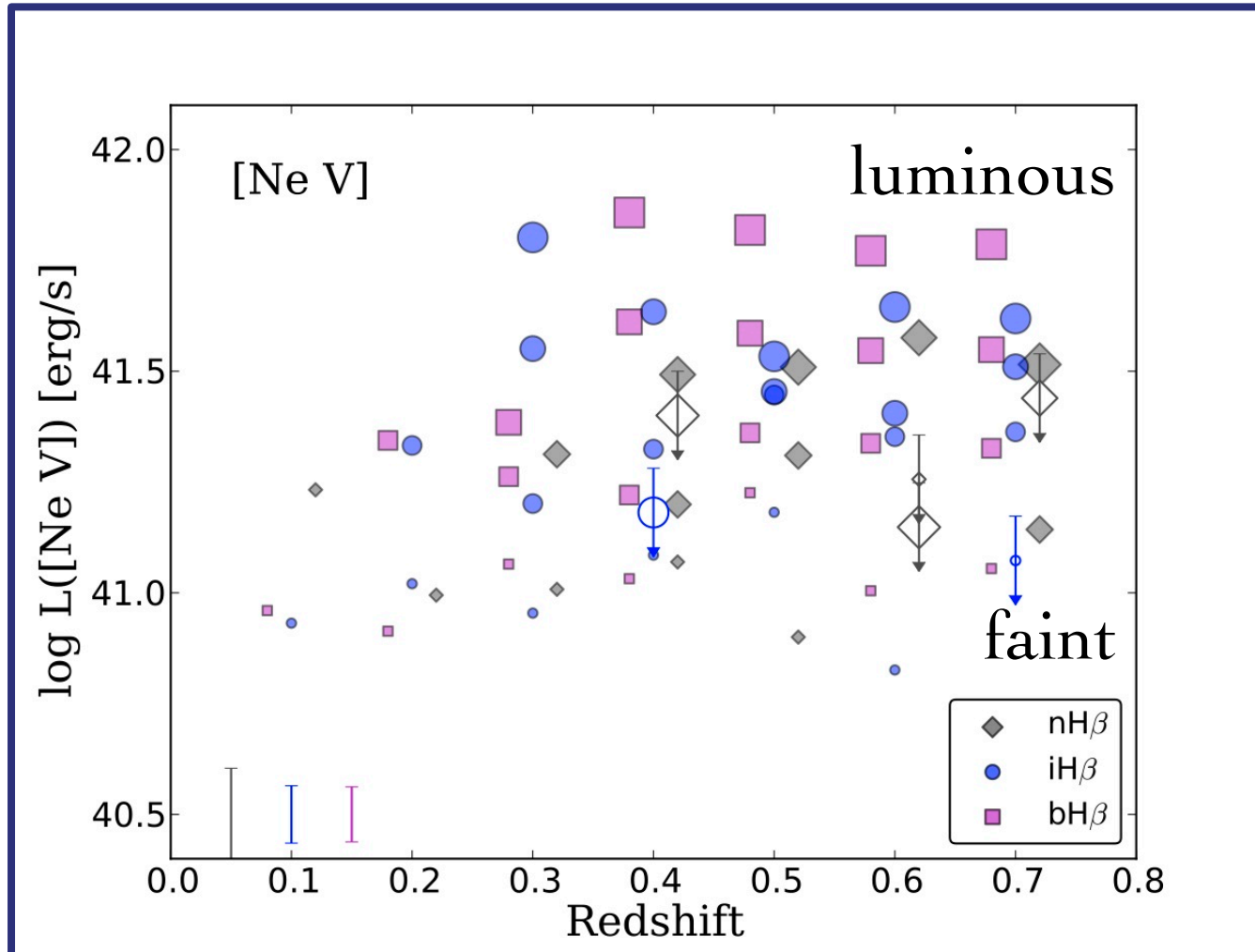
empirical proxies for M_{BH} and L/L_{Edd}



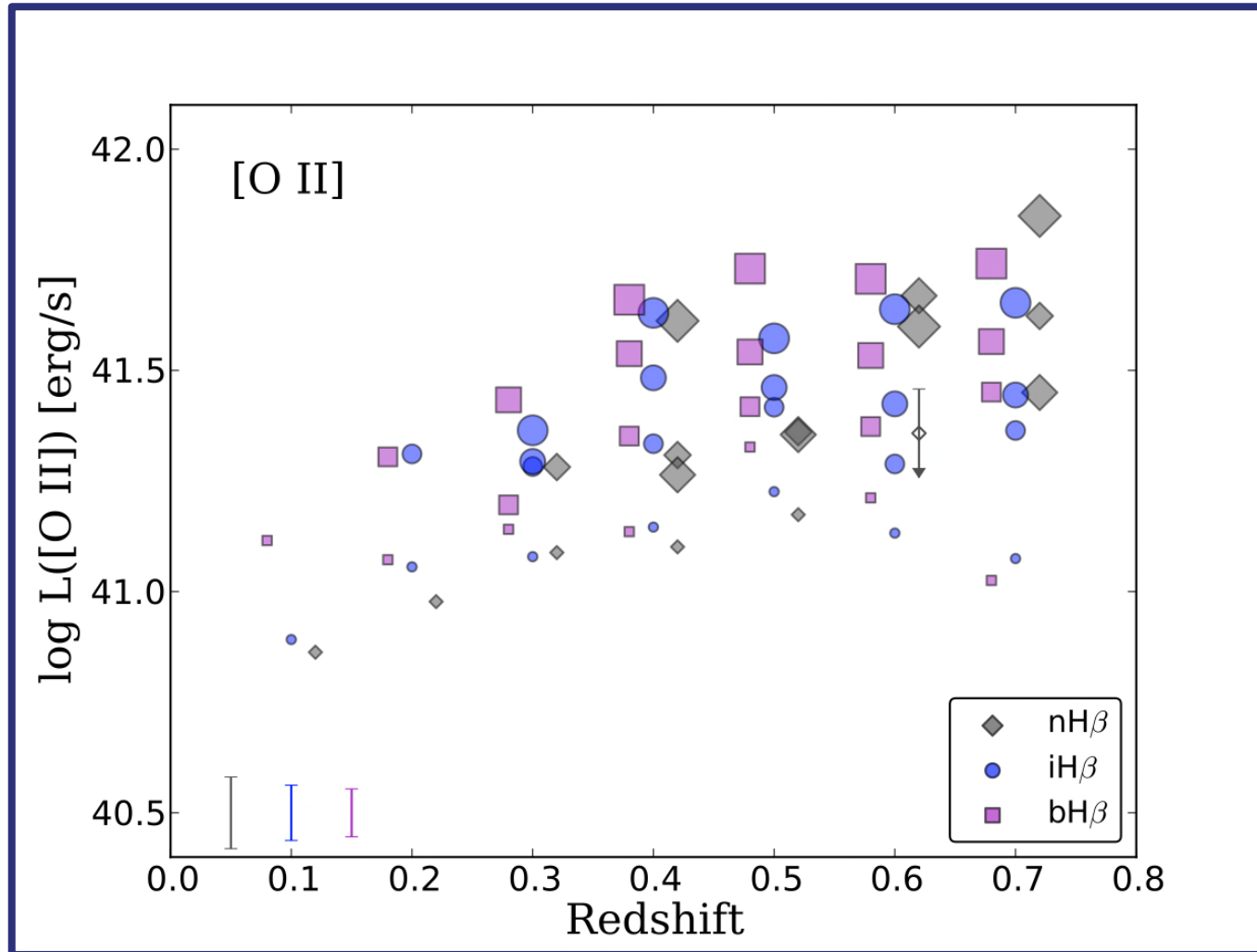
Optical narrow lines with high S/N (composites)



Evolution of quasar NLR: [Ne V] vs. redshift

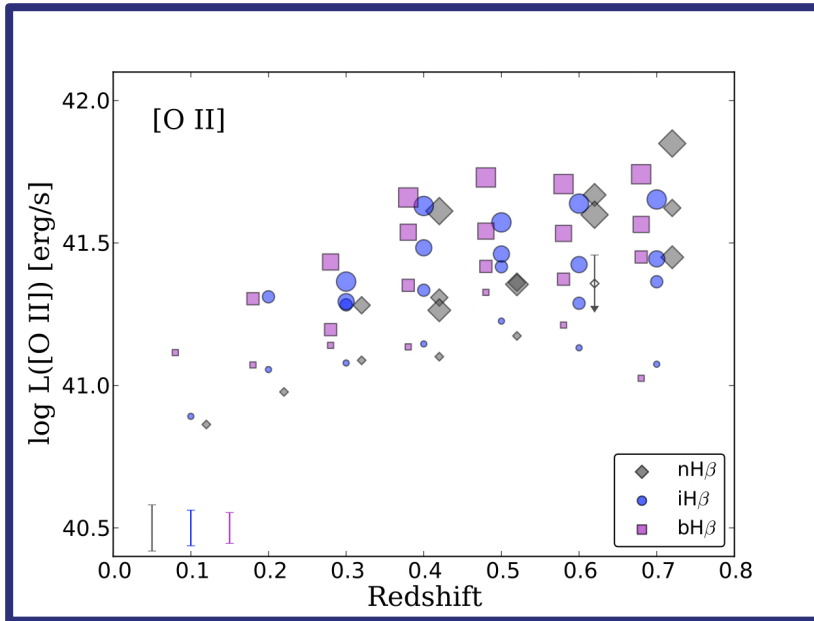


Evolution of host galaxy: [O II] vs. redshift

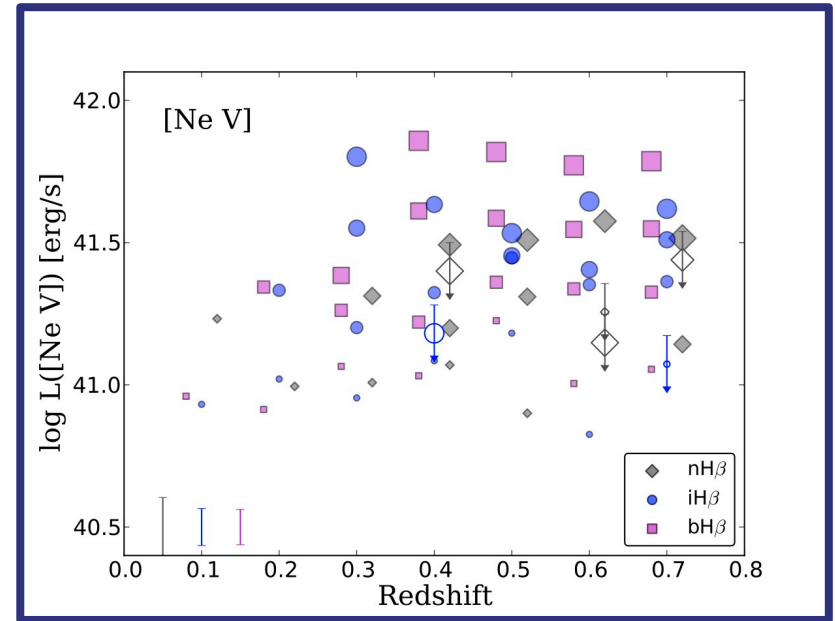


Compare [OII] & [NeV]

increasing with z



flat with z

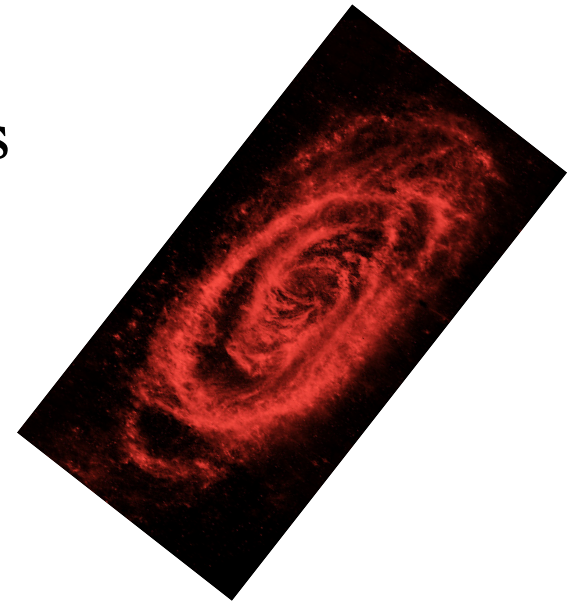
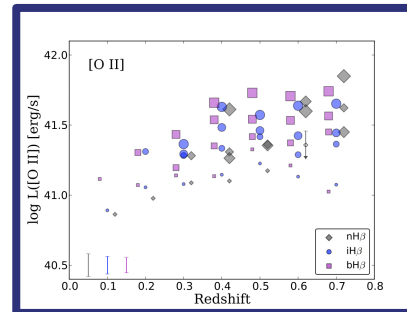


interpretation:
reflects SF in
host galaxy



Conclusions

→ don't forget your quasar lives
in a galaxy



→ high ionization narrow lines are
powerful probes
of the NLR

