Variability of AGN in the context of the main sequence of quasars

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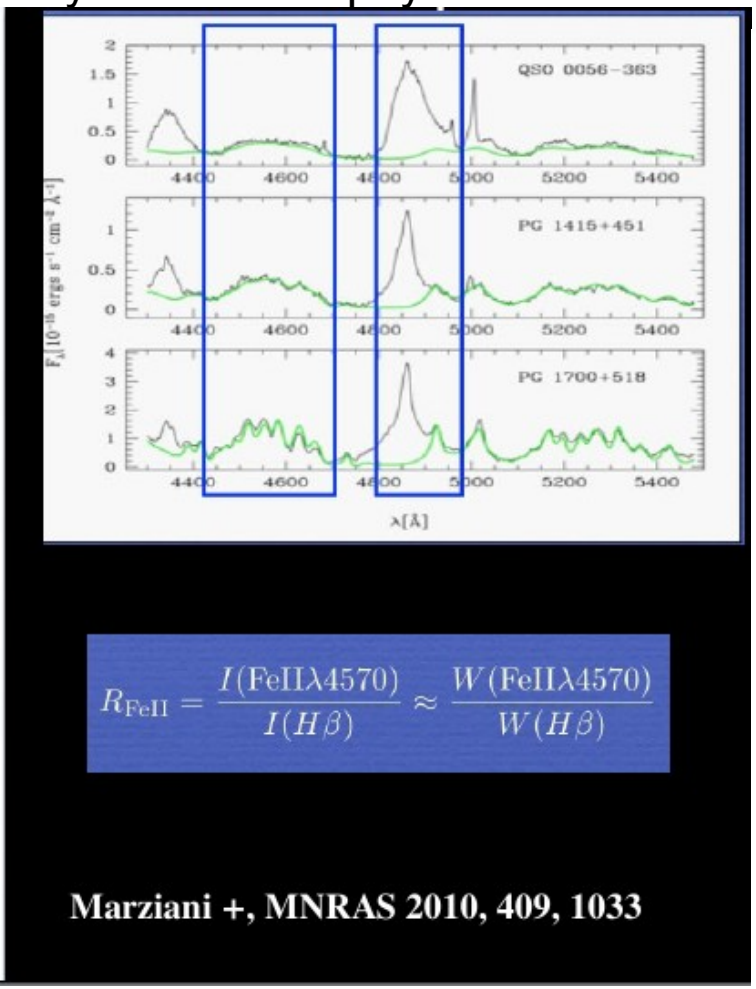
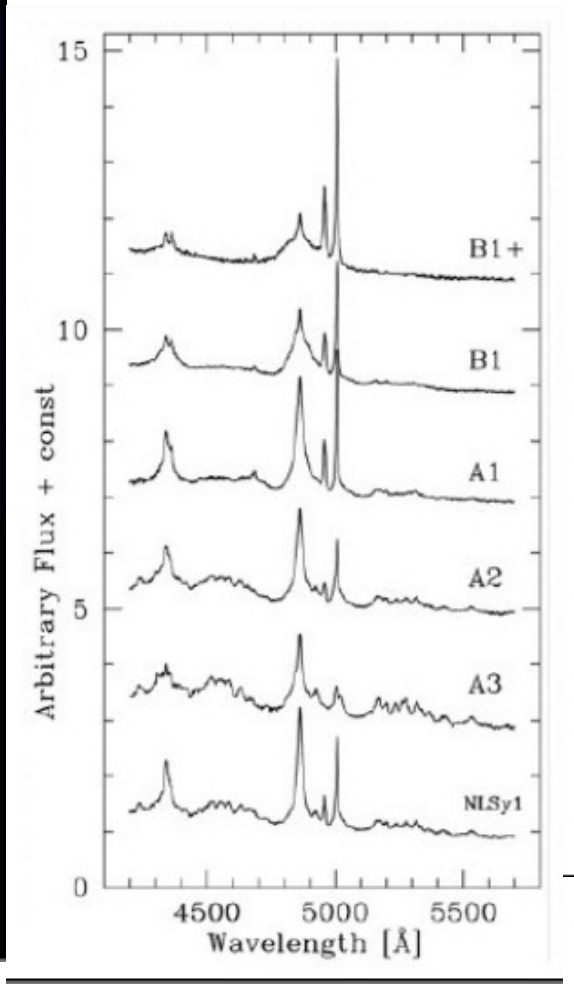
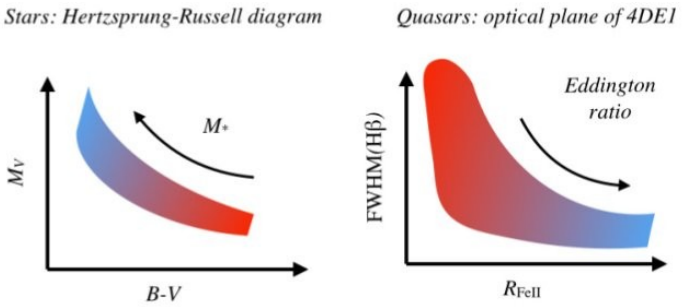
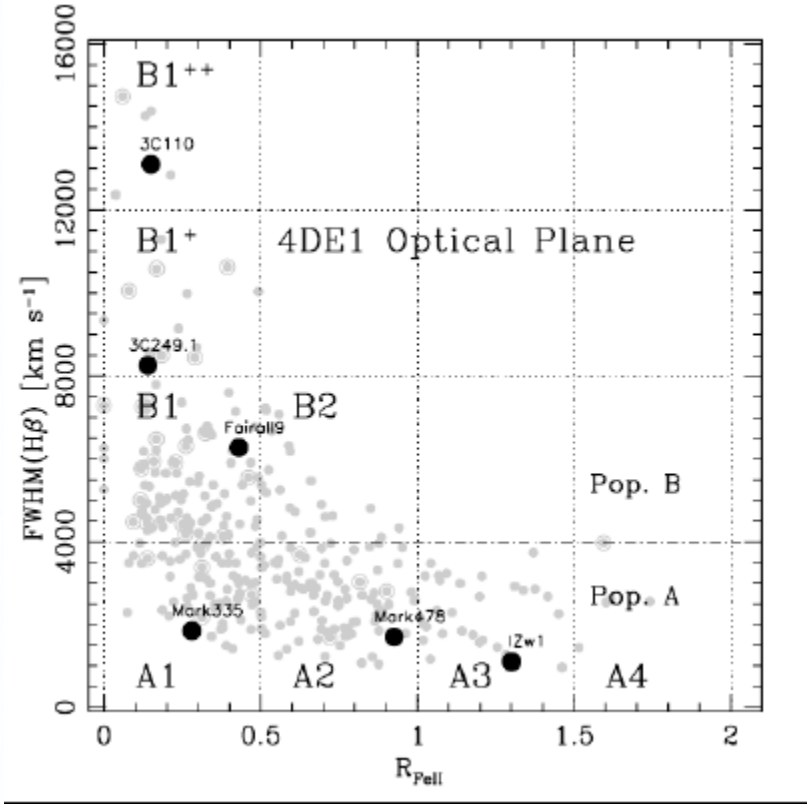
“Main Sequence of Quasars”

There were many efforts to organize Type 1 AGNs into the “main sequence” of quasars, that allows to set observational constraints on dynamics and physical conditions within BLR.

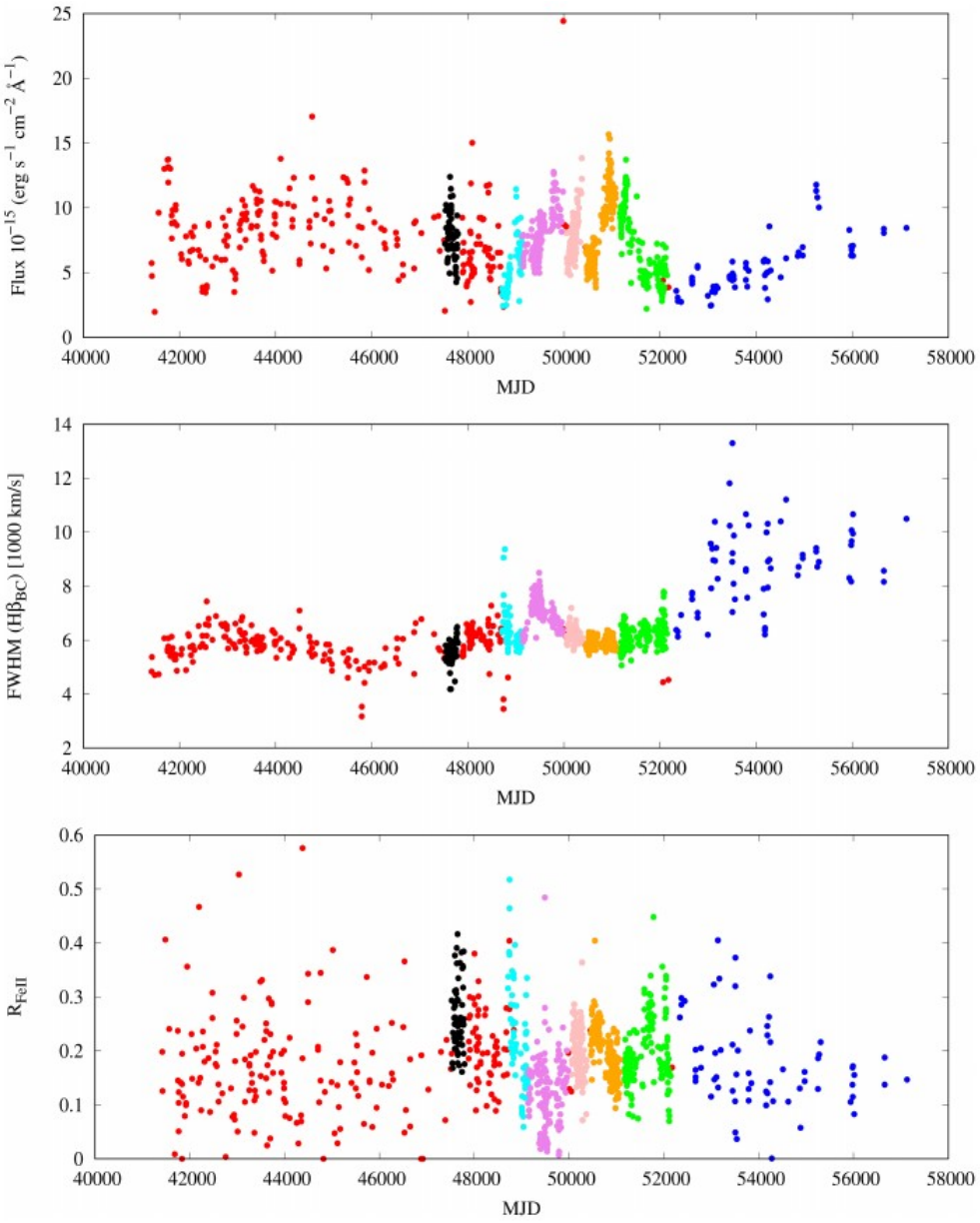








NGC 5548 variability



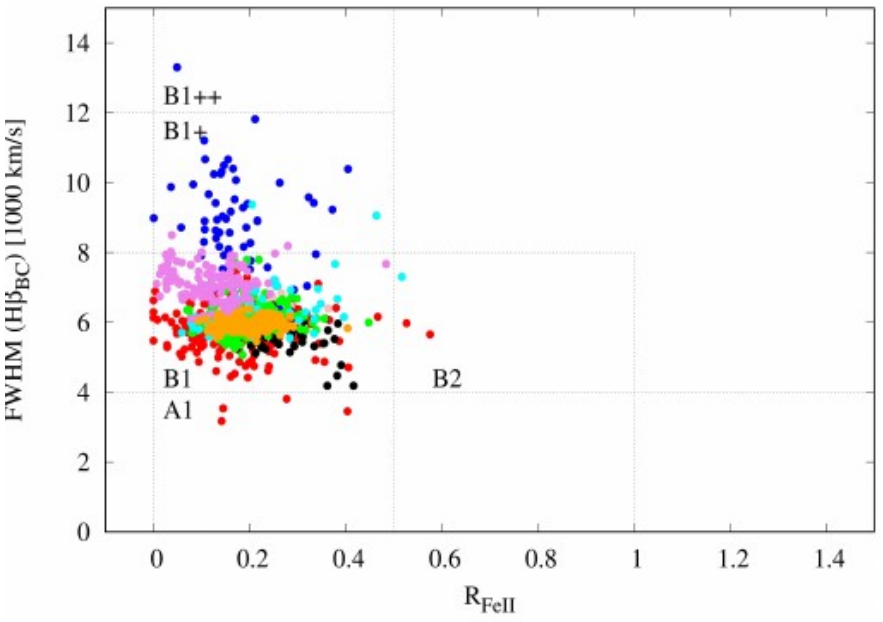


FIGURE 2 | The EV1 diagram of NGC 5548 spectral properties during 43 years of monitoring campaigns. Colors correspond to those in the **Figure 1**.

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Frontiers in Astronomy and Space Sciences, Volume 5, id.3

Data analysis and sample collection

- We used available spectra from monitoring campaigns:
  - AGN watch,
  - Kaspi 2000,
  - and some that we gathered and compiled from different campaigns like for NGC 4151, NGC5548, Ark120…
- We fitted spectra using the method based on UlySS code that we developed and applied to several monitoring campaigns

  (see, Bon E. et al. 2016, Bon N. et al. 2018., Li et al 2019., Sniegowska et al. 2020.)
- We extended our measurements with published results of:

  Hu et al. 2015 &

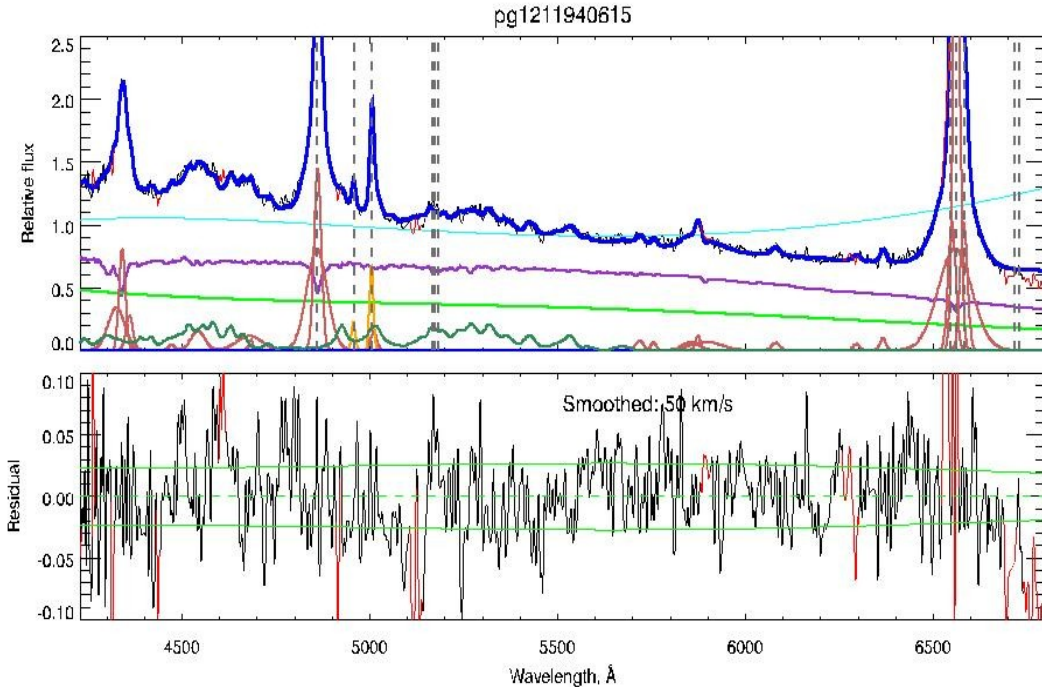
  Barth et al. 2012

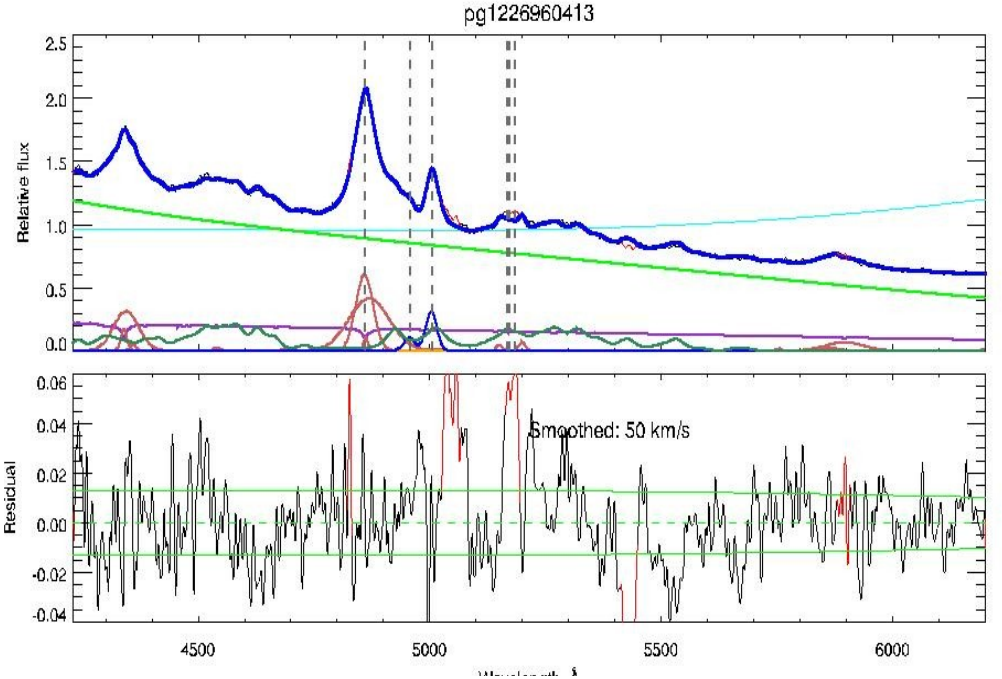
Fitting of the spectra

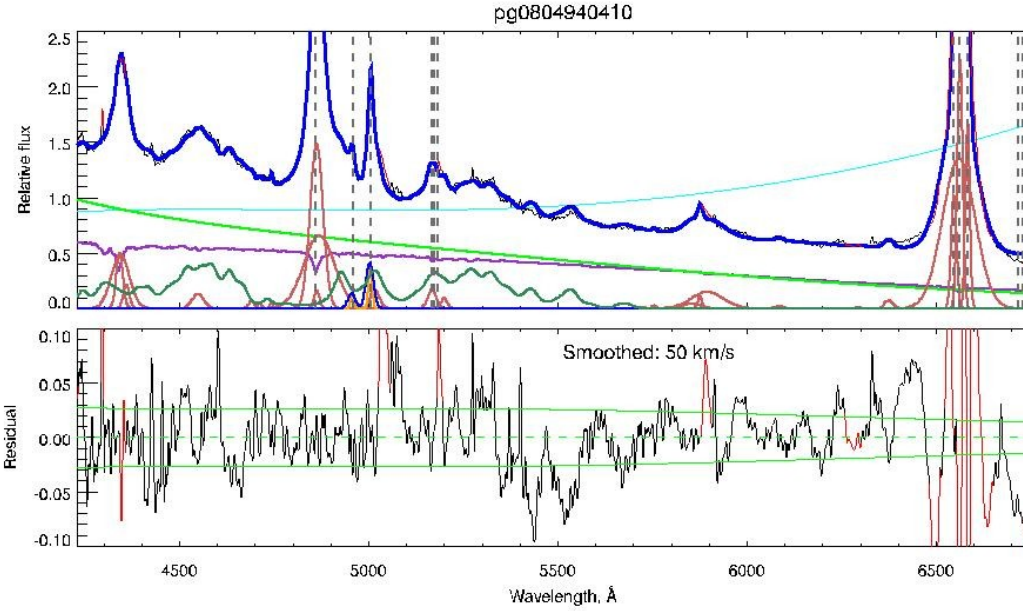
We use UlySS code (Koleva 2009) **a full spectrum fitting package –** analysis of all components of integrated light in AGN spectrum, that **we adjusted for simultaneous fit of AGN Type1 spectra** with model that consists of following components:

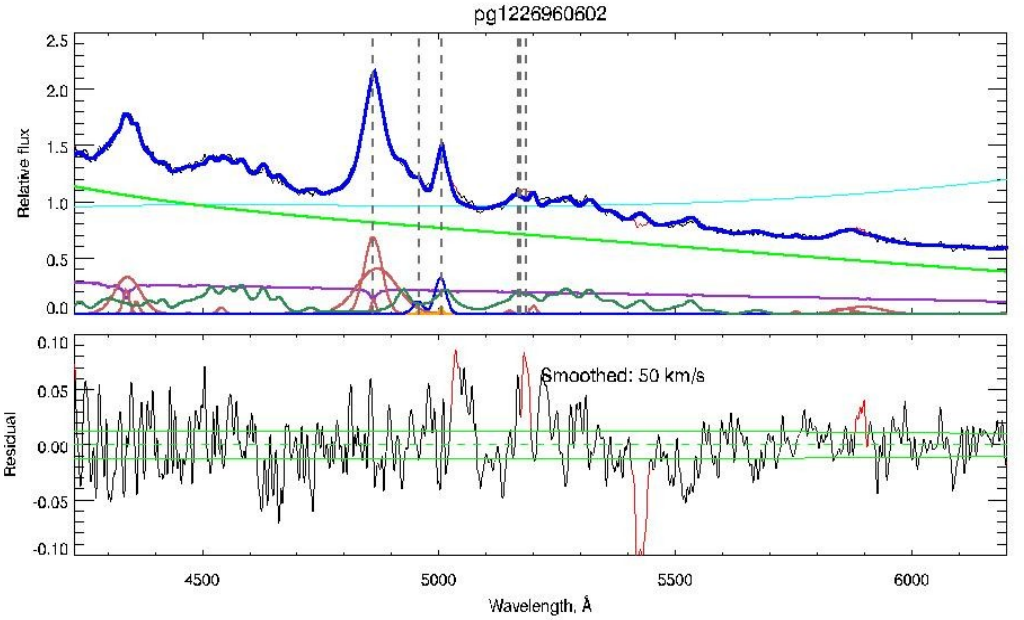
- AGN continuum (power low)**,**
- galactic host continuum, stellar population model (PEGASE.HR)
- Various emission lines:
  - Multiple broad and narrow emission line components and
  - FeII emission line quasi-continuum using template of Marziani et al. 2009.

Some examples of fitted spectra

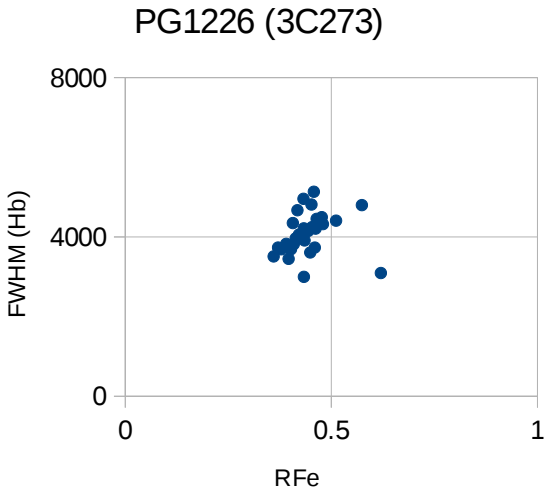


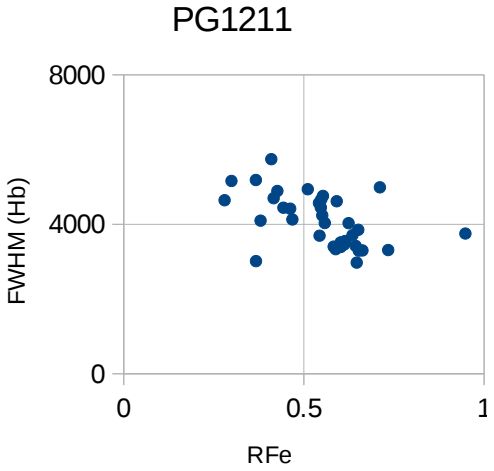


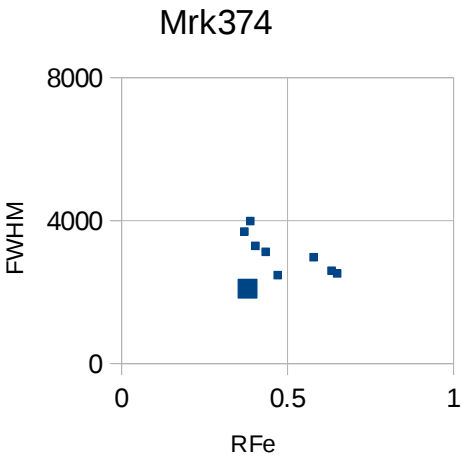


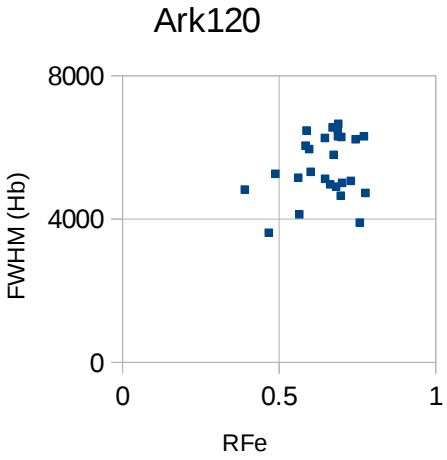


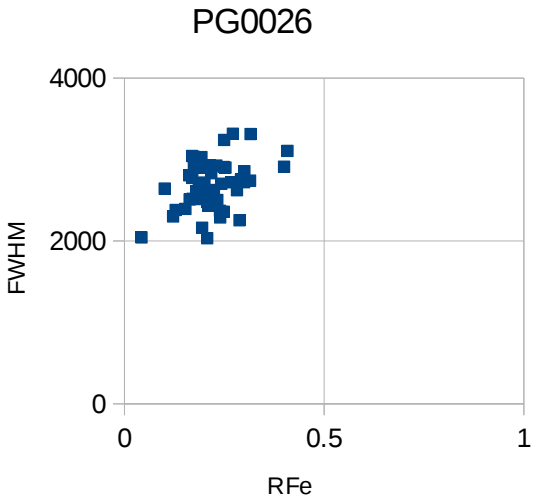
Results (in EV1 context)

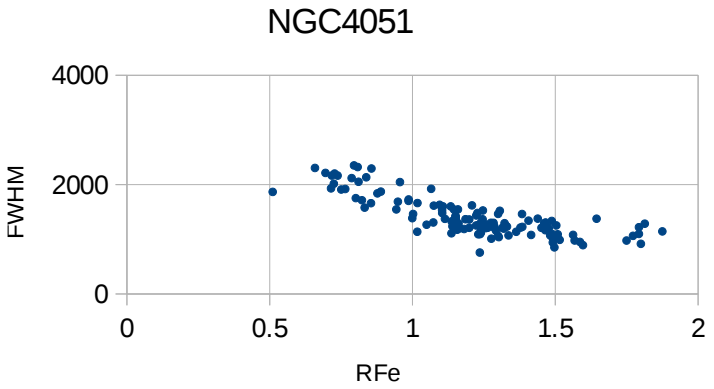


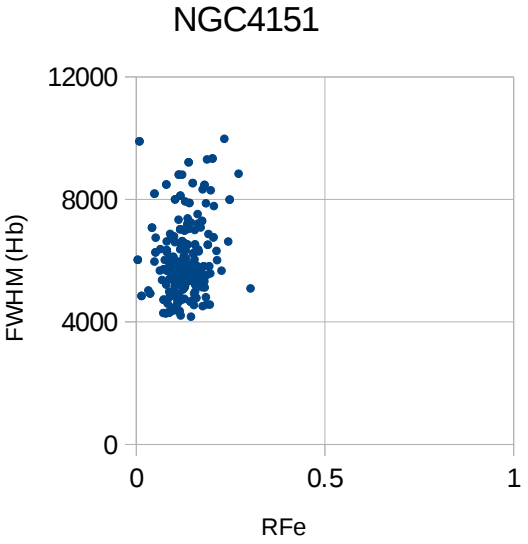




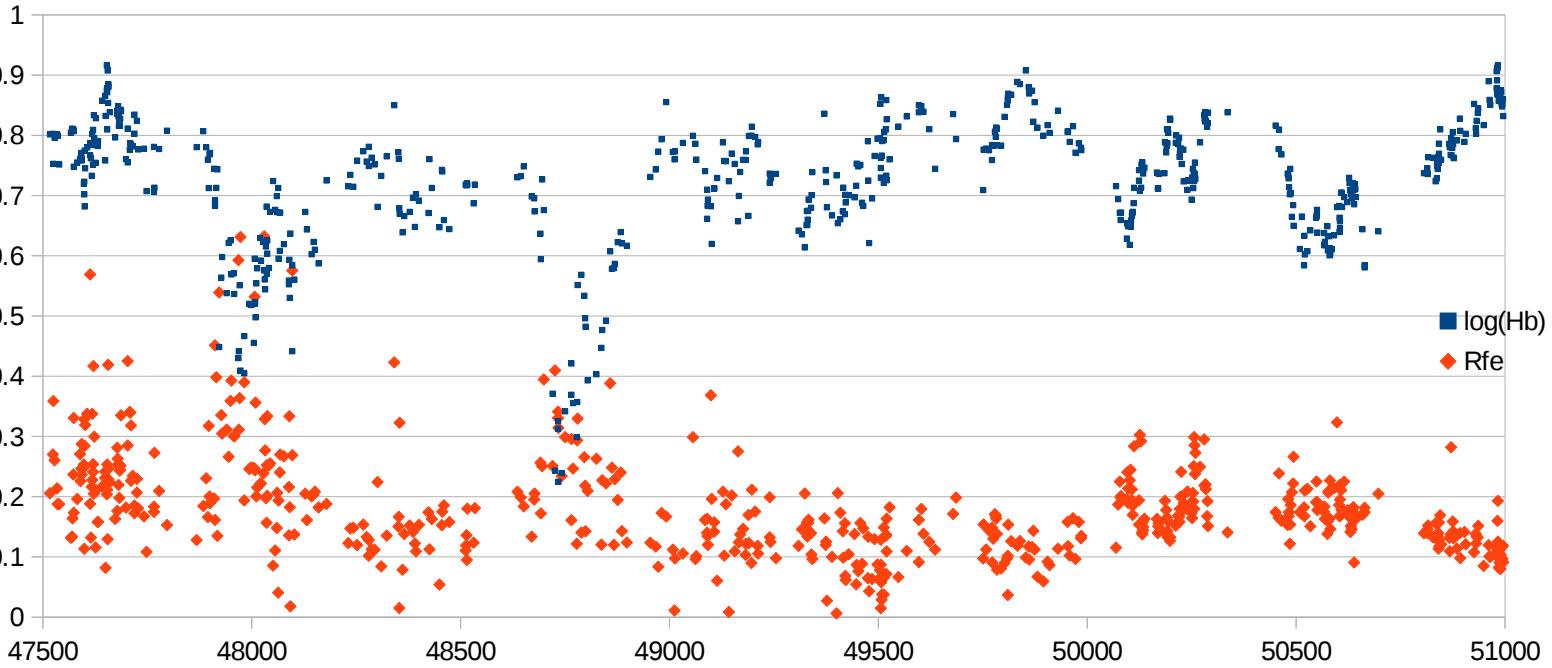


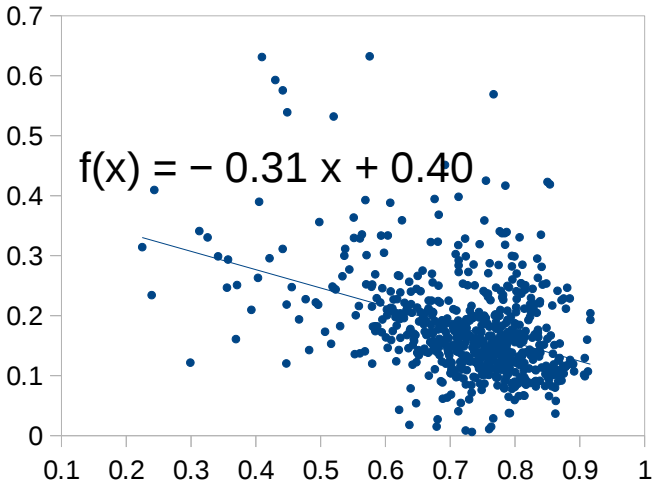




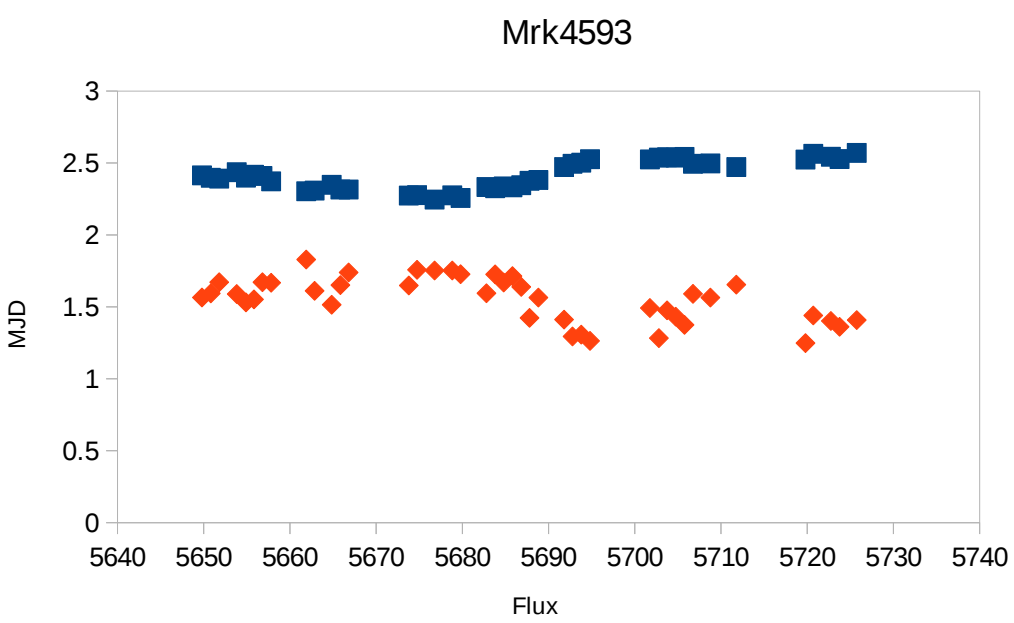


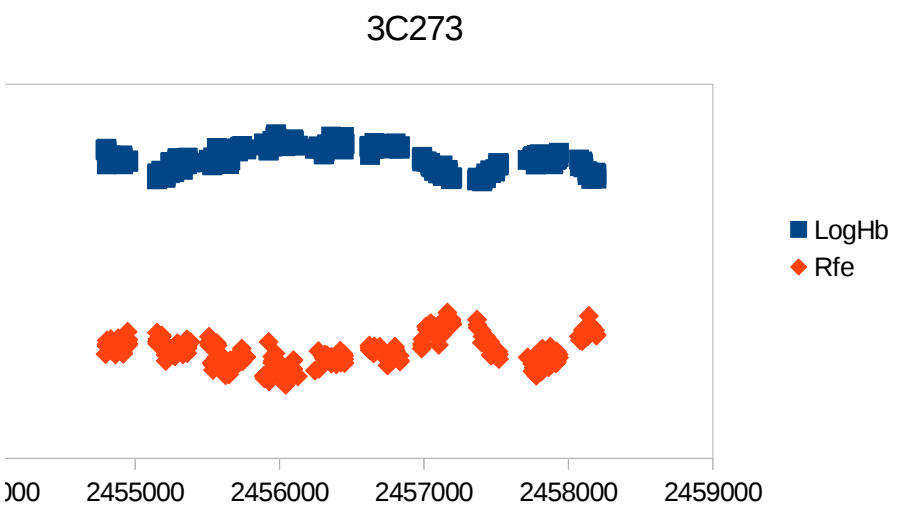
NGC5548 AGN watch epochs

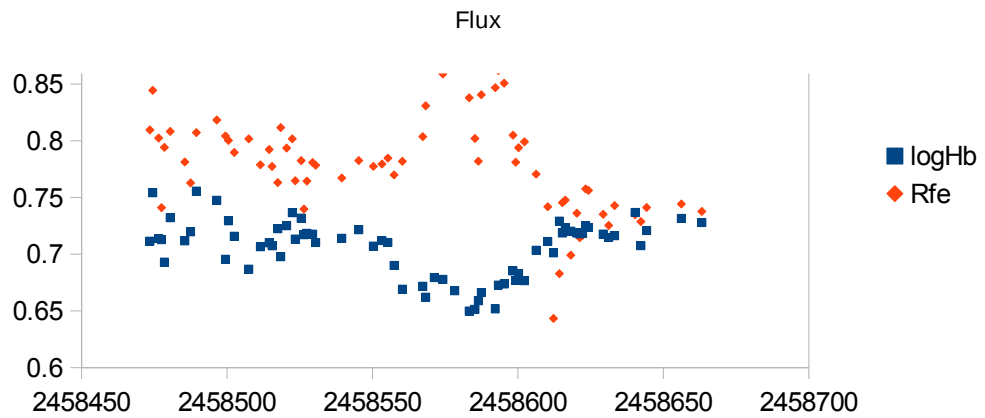


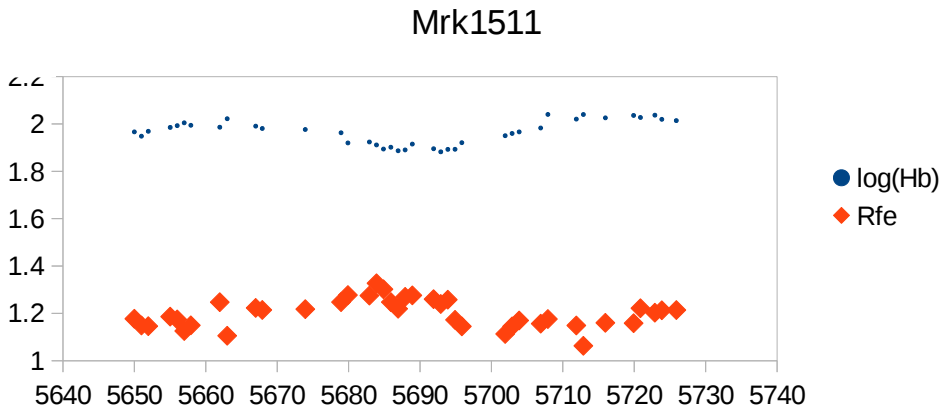


Hβ and Rfe light curves are anti-correlated

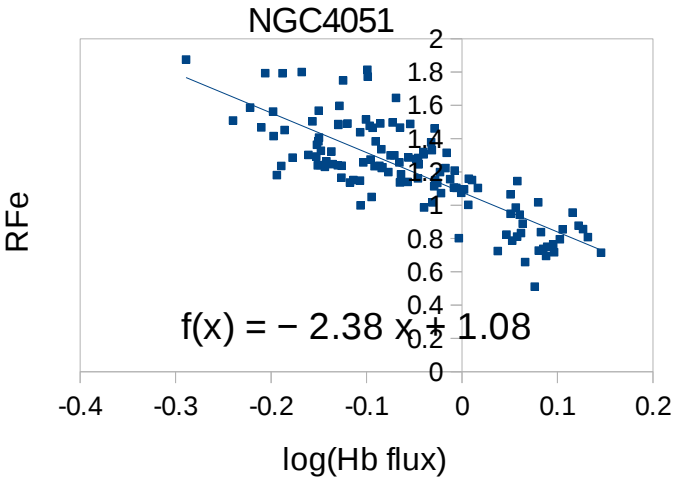


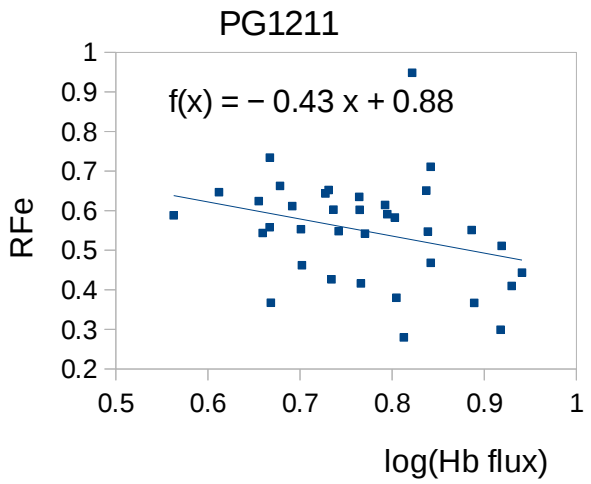


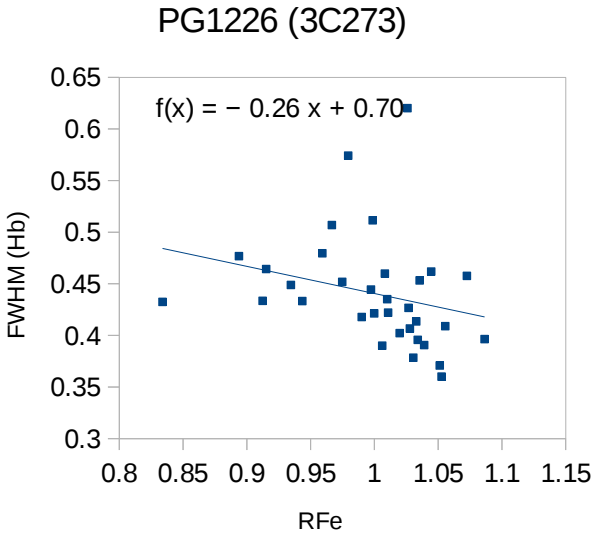


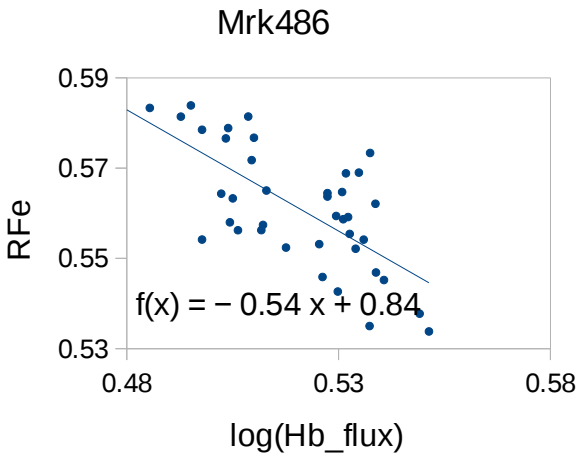


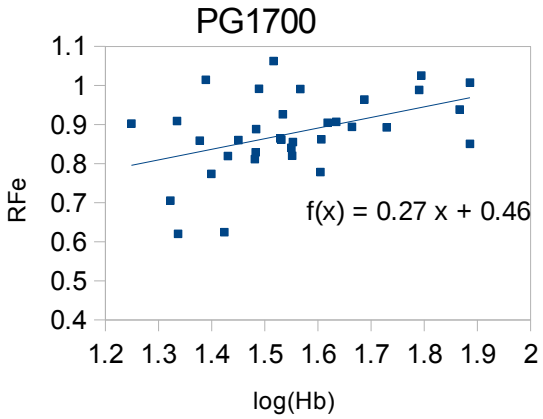
RFe vs. Hβ

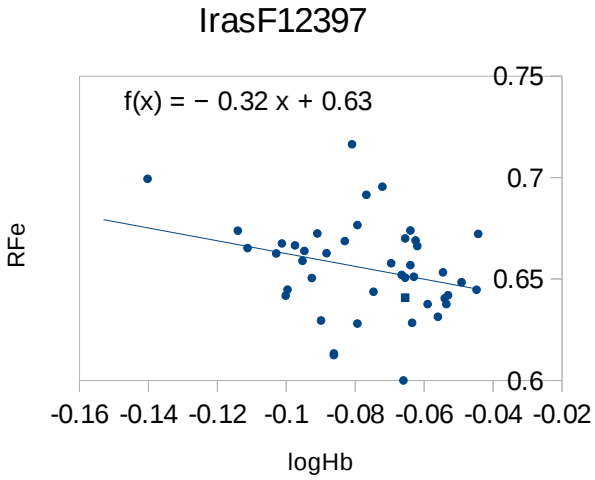

NGC4051
f(x) = − 2.38 x + 1.08
RFe
log(Hb flux)

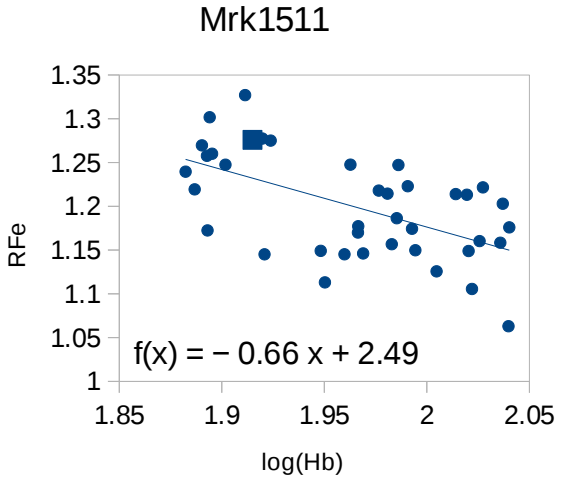

PG1211
f(x) = − 0.43 x + 0.88
RFe
log(Hb flux)

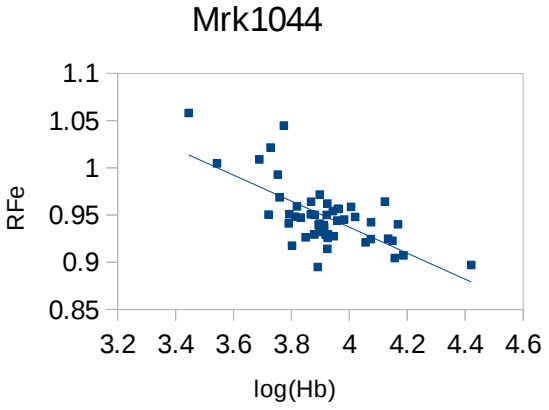

PG1226 (3C273)
f(x) = − 0.26 x + 0.70
FWHM (Hb)
RFe

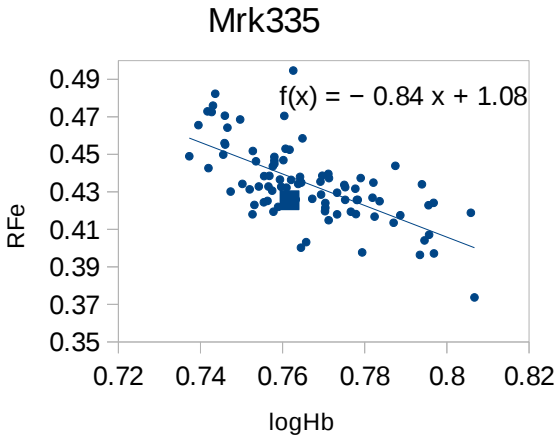

Mrk486
f(x) = − 0.54 x + 0.84
RFe
log(Hb_flux)


PG1700
f(x) = 0.27 x + 0.46
RFe
log(Hb)

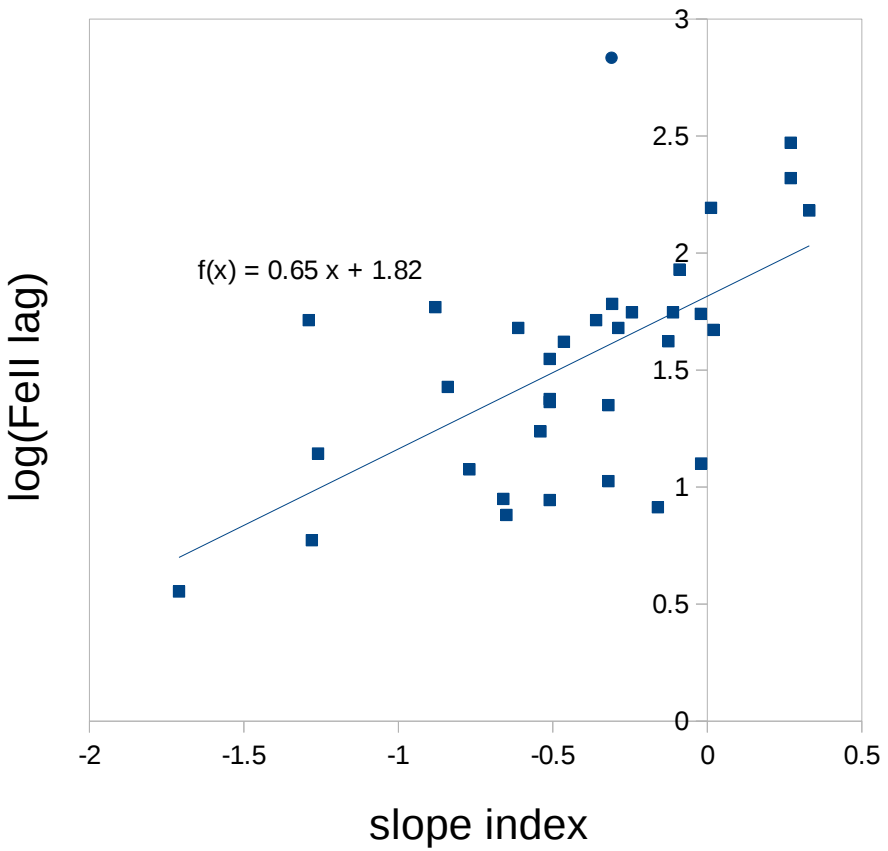

IrasF12397
f(x) = − 0.32 x + 0.63
RFe
logHb

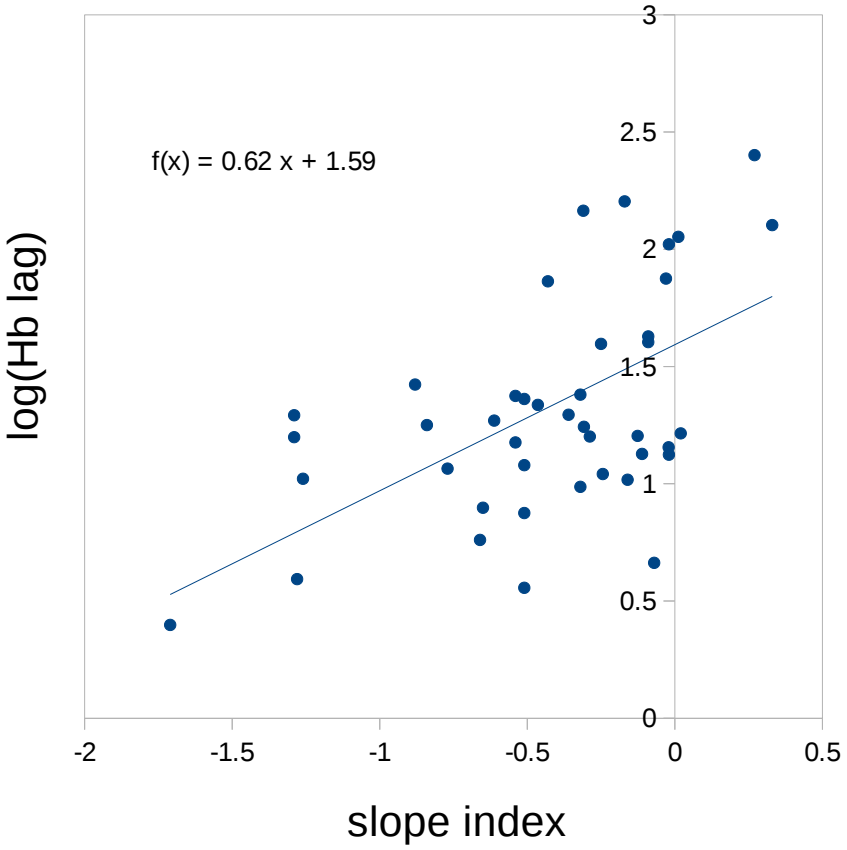

Mrk1511
f(x) = − 0.66 x + 2.49
RFe
log(Hb)


Mrk1044
RFe
log(Hb)

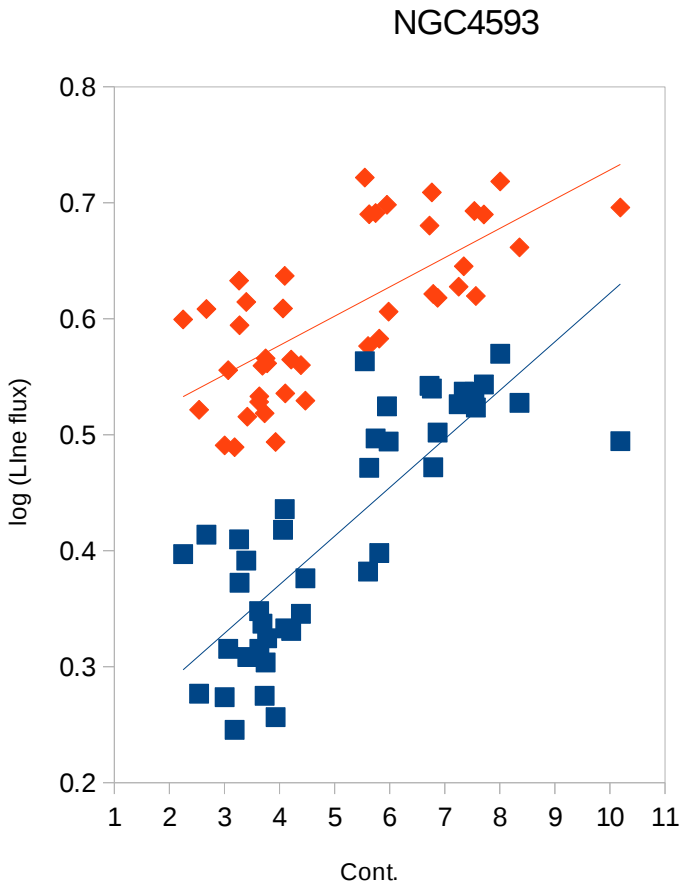

Mrk335
f(x) = − 0.84 x + 1.08
RFe
logHb

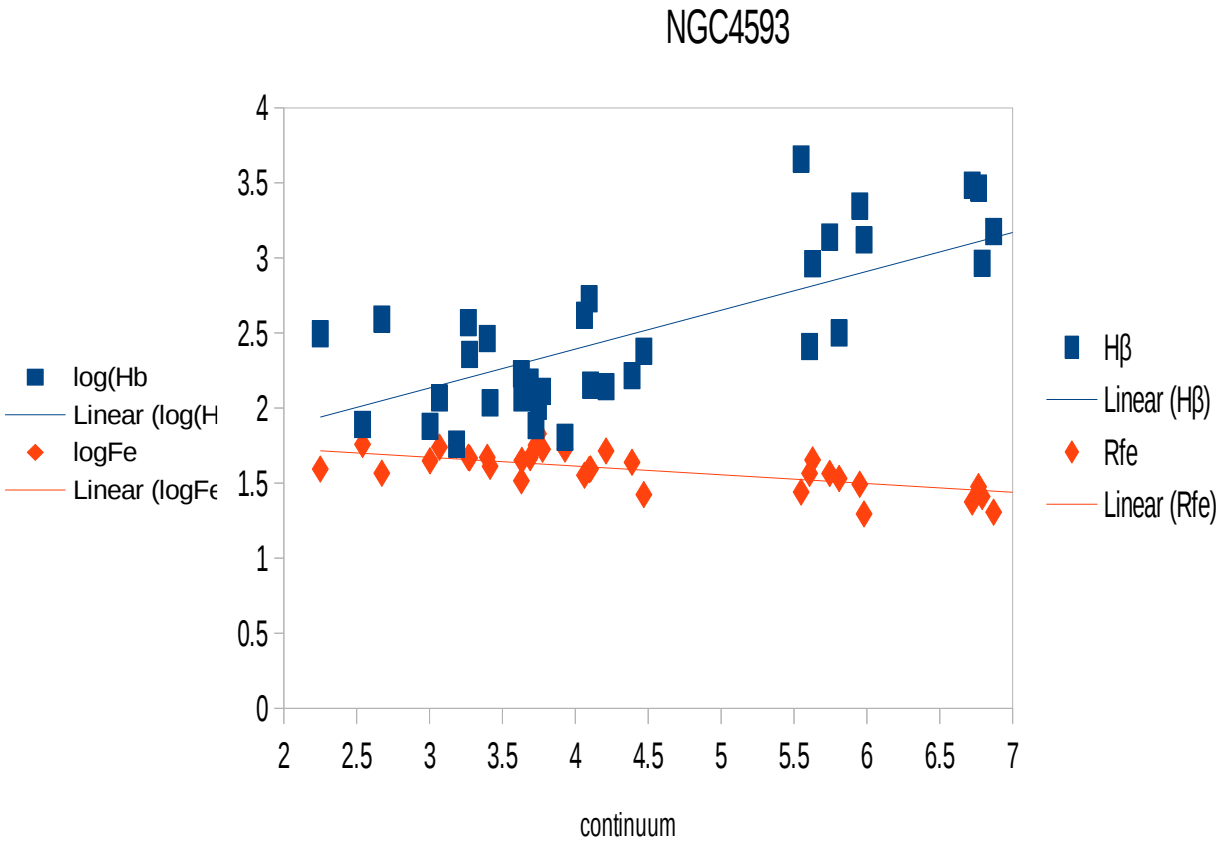
The slope depends on the size of the BLR



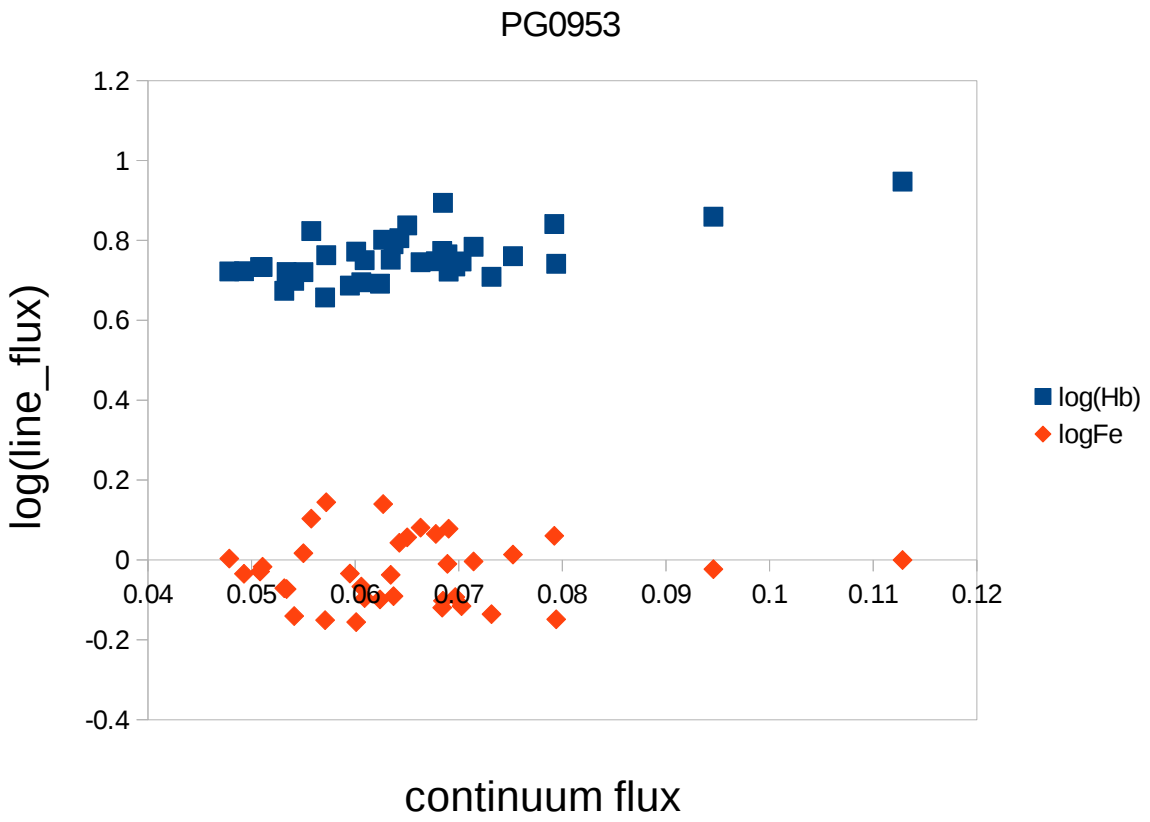


- Hβ grows stronger with continuum than the FeII in small BLR



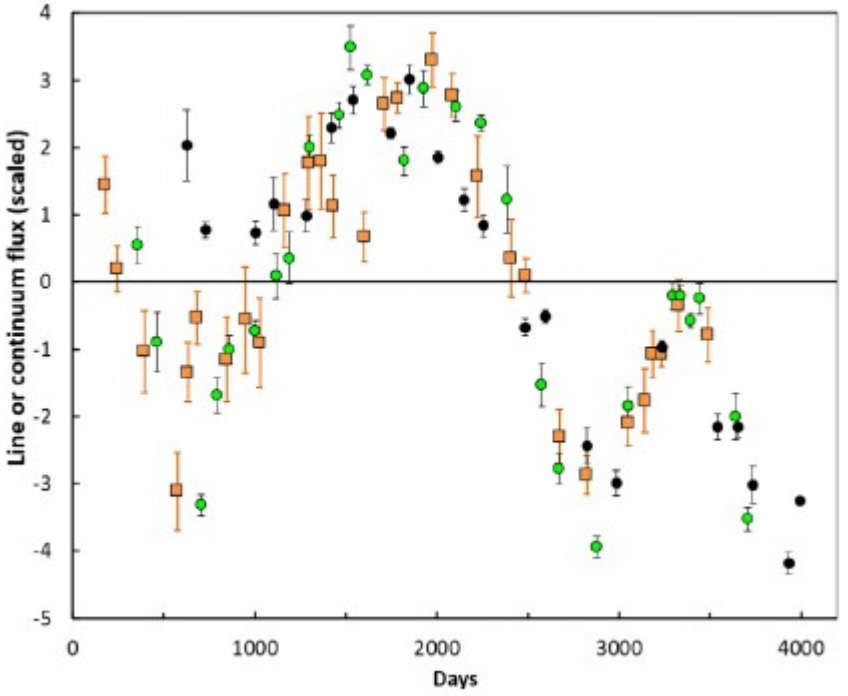


- Large BLR have slower shallower response of line flux to cont



The effect of different lags of the line light curves

- Lag of FeII lines are about 2x Hβ lag so the **response of FeII will be delayed more than the response of the Hβ** to cont.



F I G . Comparison of light curves for the optical continuum (black circles), HÎ² (green circles), and Fe II (brown squares) from 11 years of monitoring of 3C 273 from 2008 to 2018. (Gaskell et al. DOI: 10.1002/asna.20210112)

Thank you for attention