# Outliers in Changing-Look AGN

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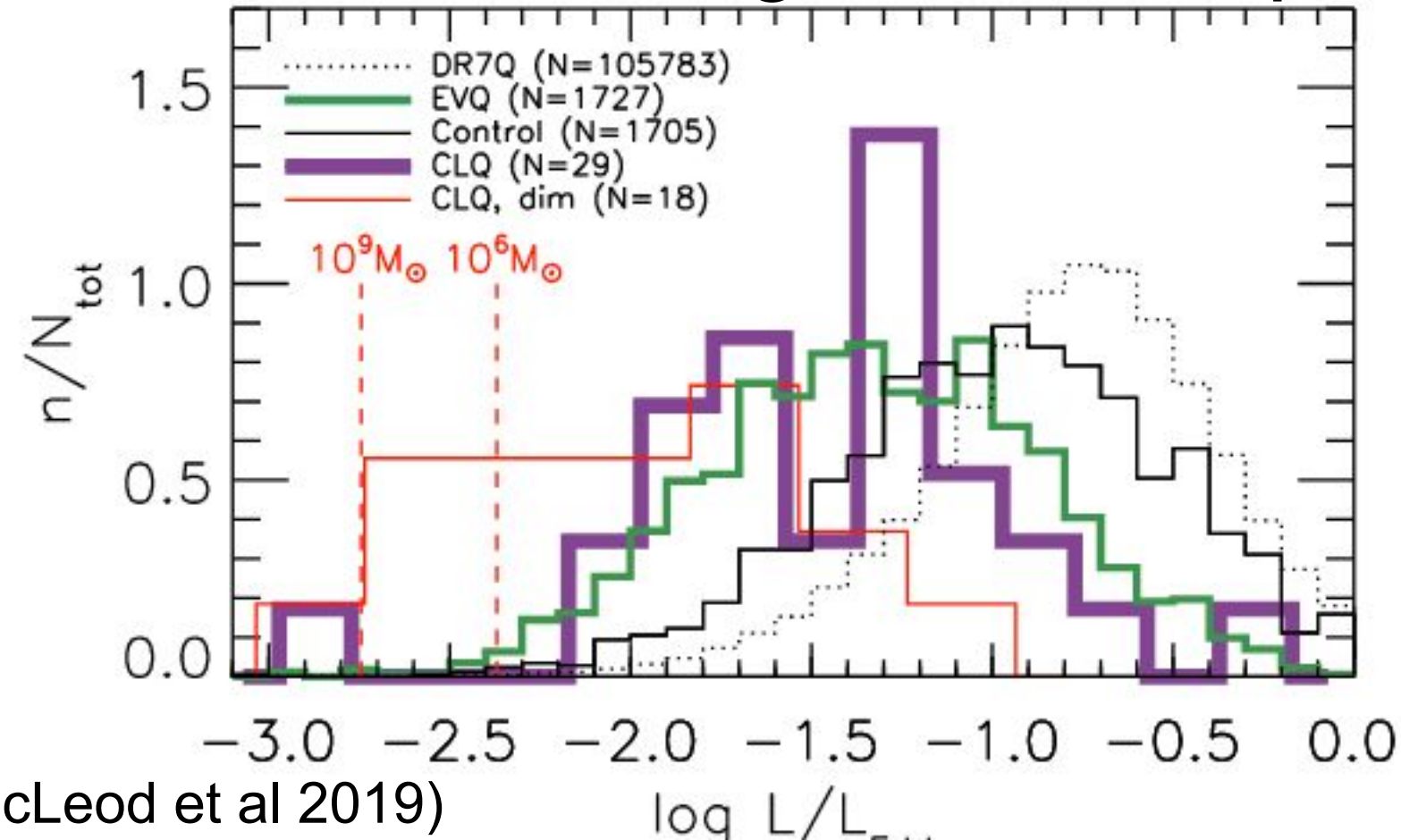
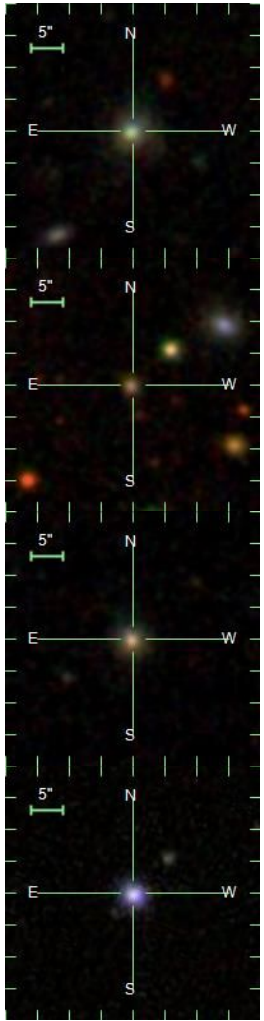
# Are CL AGN homogenous sample?




(MacLeod et al 2019)

# Case studies

- ★ J123359.12+084211.5 (MacLeod+ 2019)
- ★ PS16dtm (Blanchard+ 2017)
- ★ PS1-10adi (Kankare+ 2017)
- ★ CSS100217 (Drake+ 2011)




All of them in **NLS1 galaxies**.

In the optical part:

- ★ FWHM<2000 km/s
- ★ Strong Fe II emission (optical/UV)
- ★ F([O III]) / F(Hβ) < 3
- ★ Stronger [OIII] line asymmetries

Moreover:

- ★ Lower-luminosity AGN,
- ★ High Eddington ratio
- ★ Small black hole masses
- ★ NLSy 1 galaxies generally show stronger X–ray variability than BLSy 1s

# Case study

J123359.12+084211.5

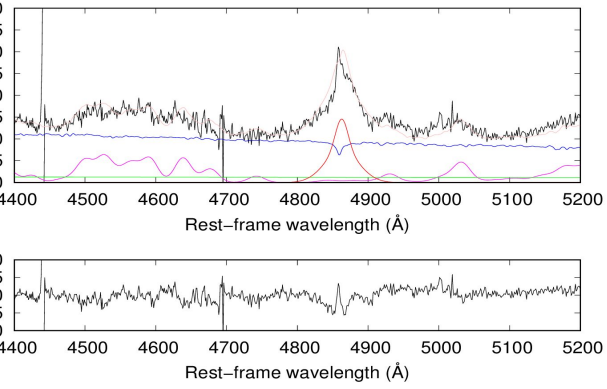
Spectral decomposition:
- FeII continuum
- power law
- starlight
- emission lines

- shows change in FeII emission
- small changes in continuum
- Eddington ratio is large

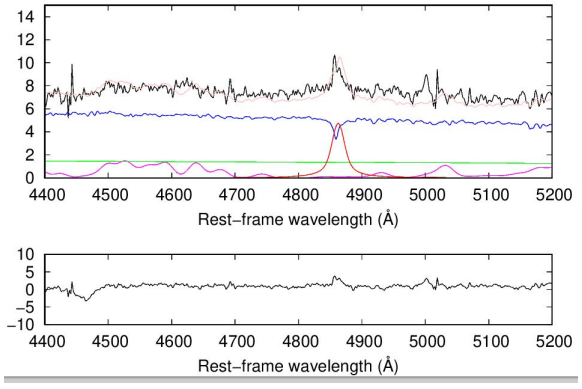
→ In SDSS & LAMOST the same continuum

- Hb asymmetry

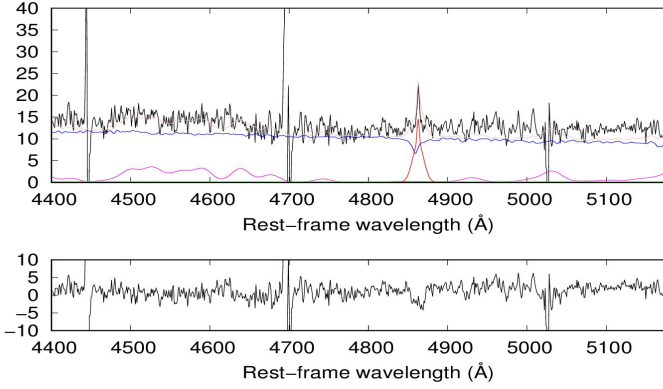
04/01/2003 SDSS




31/05/2016 WHT



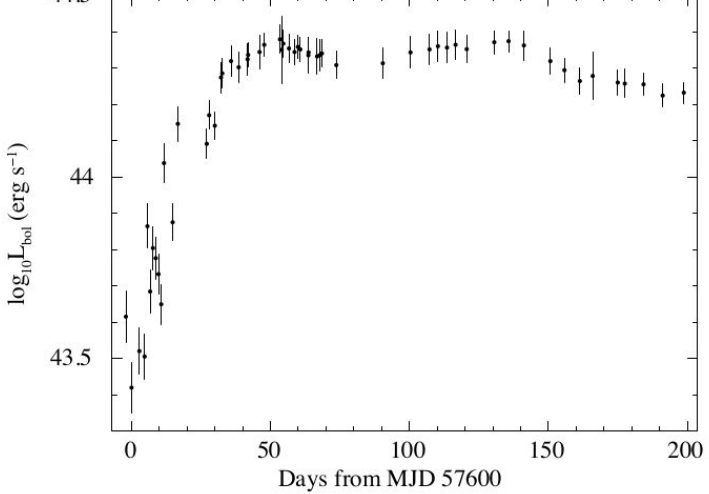

22/12/2017 LAMOST



# Case study

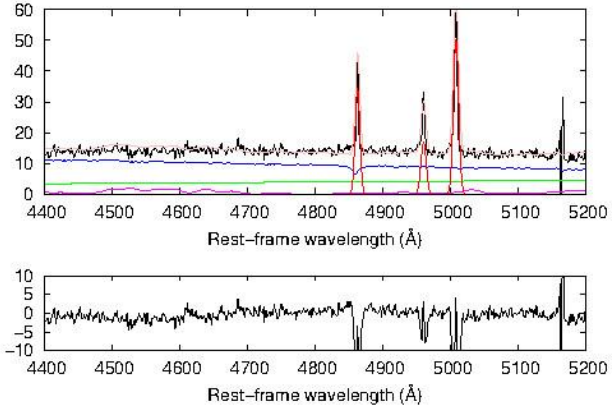
PS16dtm

- classified as a TDE (Blanchard+ 2017)
- SN IIn scenario (Dong+ 2016)
- double-"humped" accretion flare (Mainetti, D.)
- small (no?) changes in continuum
- the dramatic decrease in the X-ray luminosity during the transient
- changes in OIII] emission

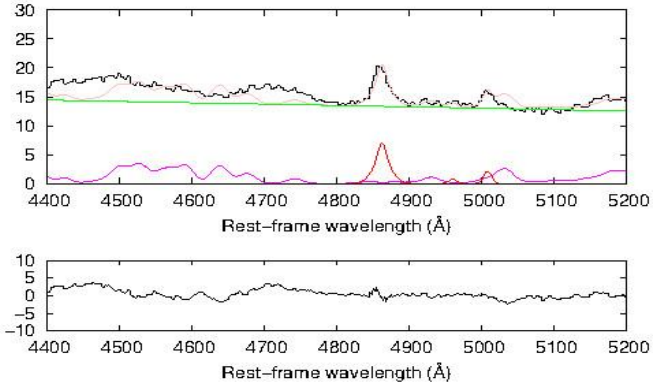



(Blanchard+ 2017)

11/11/2001 SDSS




26/08/2017 ASIAGO



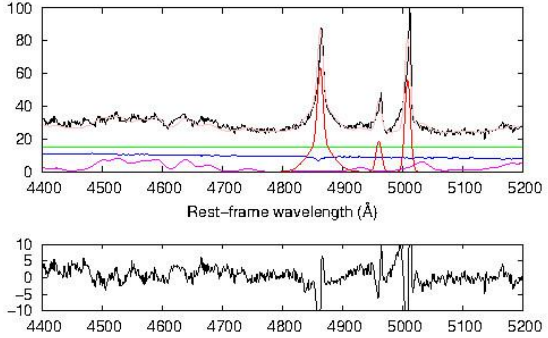
# Case study

**I used the same model for 2003 and 2012!**

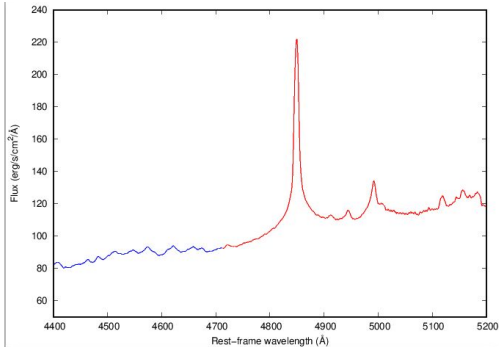
CSS100217

- clear evolution in its continuum
- detected in the centre of its host galaxy
- light curve and temperature resembled of SN
- strong variable narrow Balmer features (typical for SN)

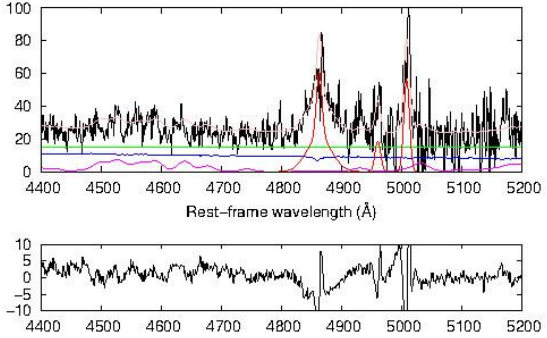
23/12/2003 SDSS




18/05/2010 KECK



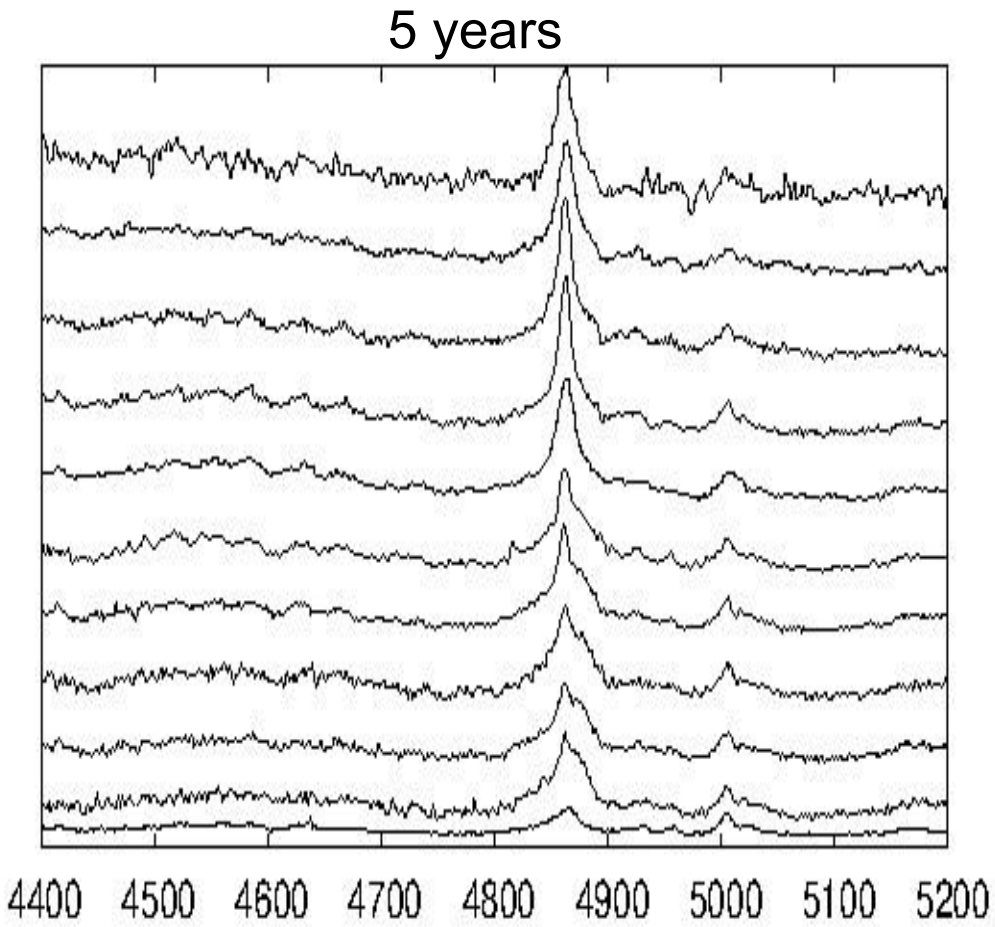

13/03/2012 LAMOST



# Case study

PS1-10adi

- is interpreted as a likely peculiar kind of supernova
- Total radiated energy $2.3\times10^{52}$erg (SNe power output ~$10^{51}$ ergs)
- “Powering by shock interaction between expanding material and large quantities of surrounding dense matter”




**(Kankare+ 2017)**

# Evolution of OIII] emission lines

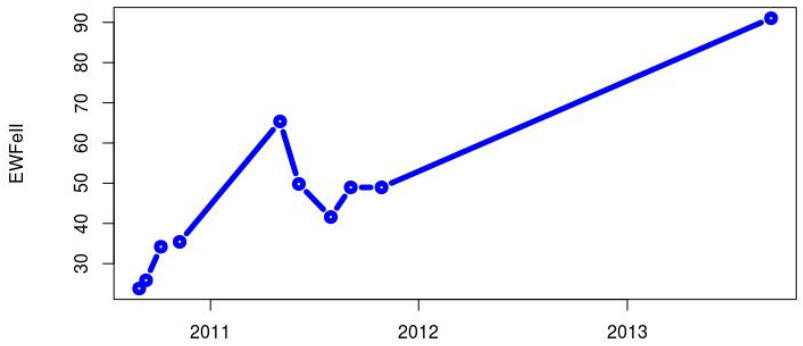
**Using:**

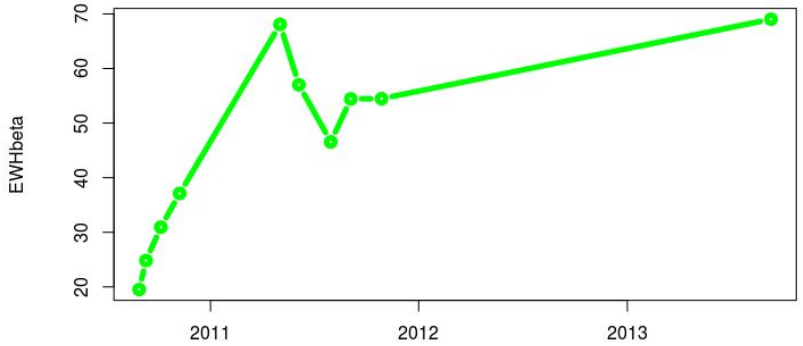
$\log M = 5.04 \log \sigma^*_{200} + 8.34$ (Woo+ 2015)

$\sigma^* = \mathrm{FWHM(OIII)} / 2.35$ (Gaskell+ 2009)

| | Predicted FWHM [km/s] | 1st spectrum | 2nd spectrum | 3rd spectrum |
|---|---|---|---|---|
| J123359 | 350 | 1200 | 540 | 540 |
| PS16dtm | 200 | 230 | 330 | lack of spectrum |
| CSS100217 | 350 | 280 | 340 | 280 |
| PS1-10adi | 230 | 400 | 330 | 350 |

# Evolution of FeII emission lines



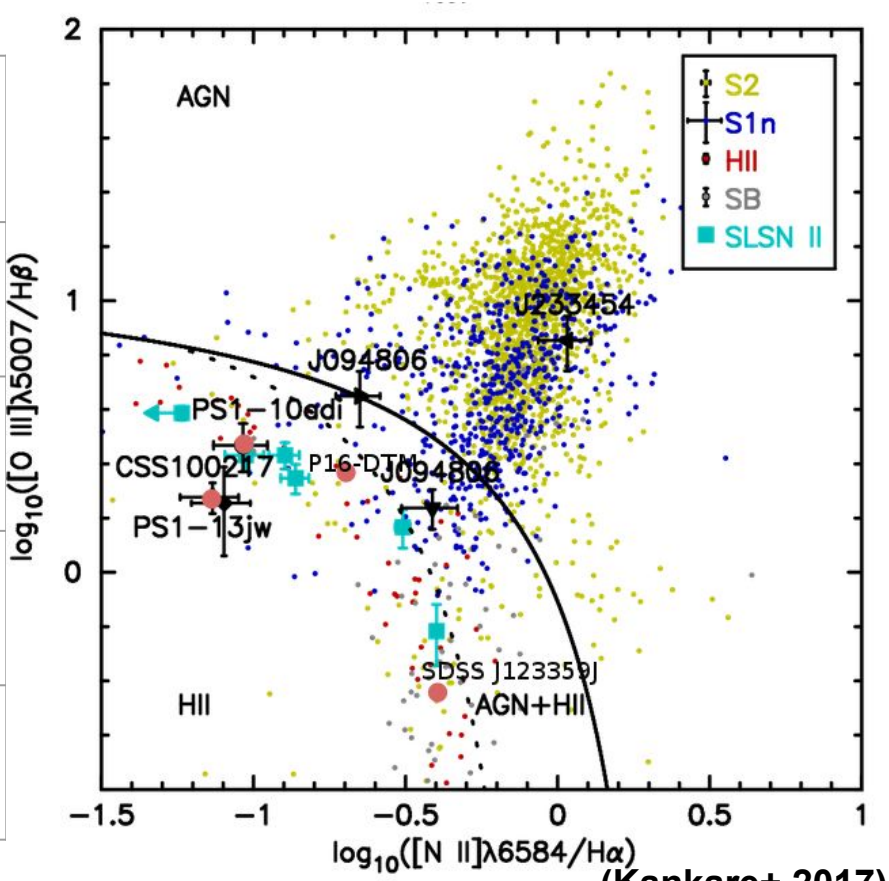

| | Particle density [$cm^{-3}$] | Ionisation parameter [$cm^{-2}$] | Turbulent velocity [km/s] |
|---|---|---|---|
| J123359 | 11 | 50 | 20.5 |
| PS16dtm<br>CSS100217<br>PS1-10adi | 11 | 10 | 20.5 |

Theoretical templates of Bruhweiler & Verner (2008).

# Starlight contamination

Fernandes+ (2005,2009)

| | stellar age [Gyr] | starlight [%] |
|---|---|---|
| J123359 | 0.3 | 13 |
| PS16dtm | 13 | 1 |
| CSS100217 | 0.001 | 2 |
| PS1-10adi | 0.001 | 8 |

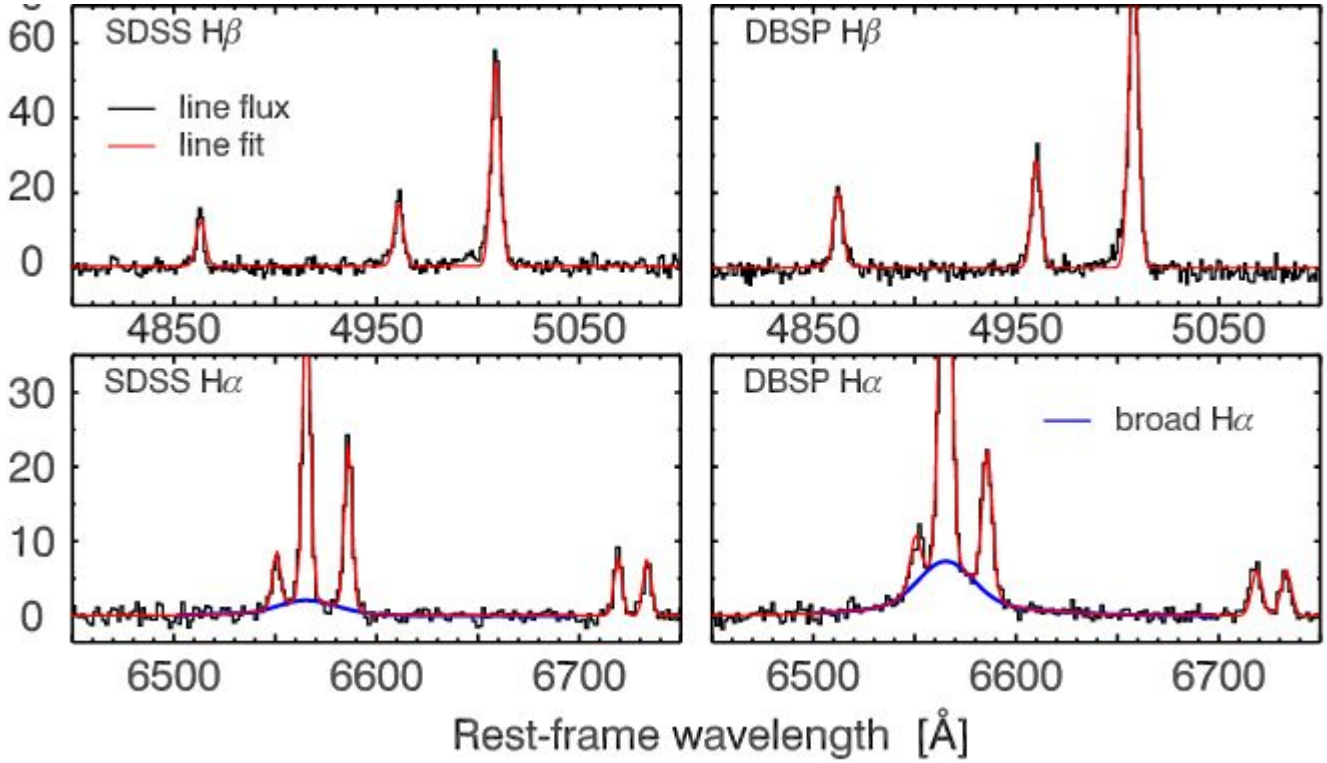



(Kankare+ 2017)

# Summary and main conclusions

- ★ We focus on 4 unusual phenomena in NLS1 galaxies
- ★ Strong Fe II emission complexes evolving in time
- ★ OIII] emission evolving in time
- ★ Host galaxies display AGN characteristics
- ★ Line ratios suggest ongoing star formation
- ★ What drives changes is not yet understood
- ★ **Multiwavelength follow-up is crucial**

# One more interesting object! (on arxiv 31 Jul 2019)




thank you ☺

Yang et al. 2019