

UNIVERSITY OF
BATH

The influence of mergers on the star formation history of luminous AGN

Anastasia Efthymiadou¹, Carolin Villforth¹, Vivienne Wild², Paul Hewett³

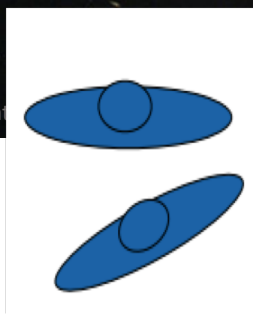
¹University of Bath, ²University of St Andrews, ³University of Cambridge

A.Efthymiadou@bath.ac.uk

SF and BH growth driven by galaxy mergers



SF and BH growth driven by galaxy mergers

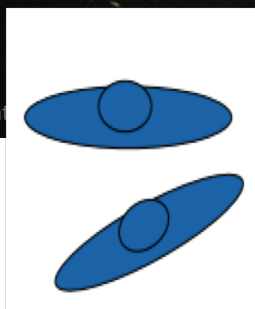


Gas-rich
galaxy(s)

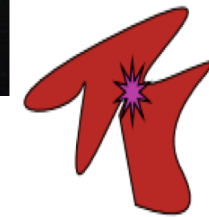
SF and BH growth driven by galaxy mergers



NASA/ESA Hubble ma



Gas-rich
galaxy(s)

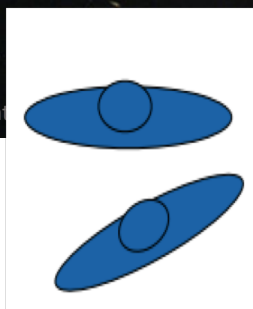


Intense SF
obscured AGN(?)

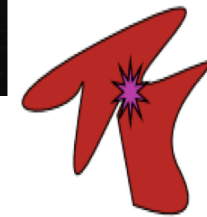
SF and BH growth driven by galaxy mergers



NASA/ESA Hubble ma



Gas-rich
galaxy(s)



Intense SF
obscured AGN(?)



unobscured AGN

Alexander & Hickox 2012

Comparison of **star formation activity** arising due to mergers in galaxies

AGN vs no AGN



Star formation – AGN activity

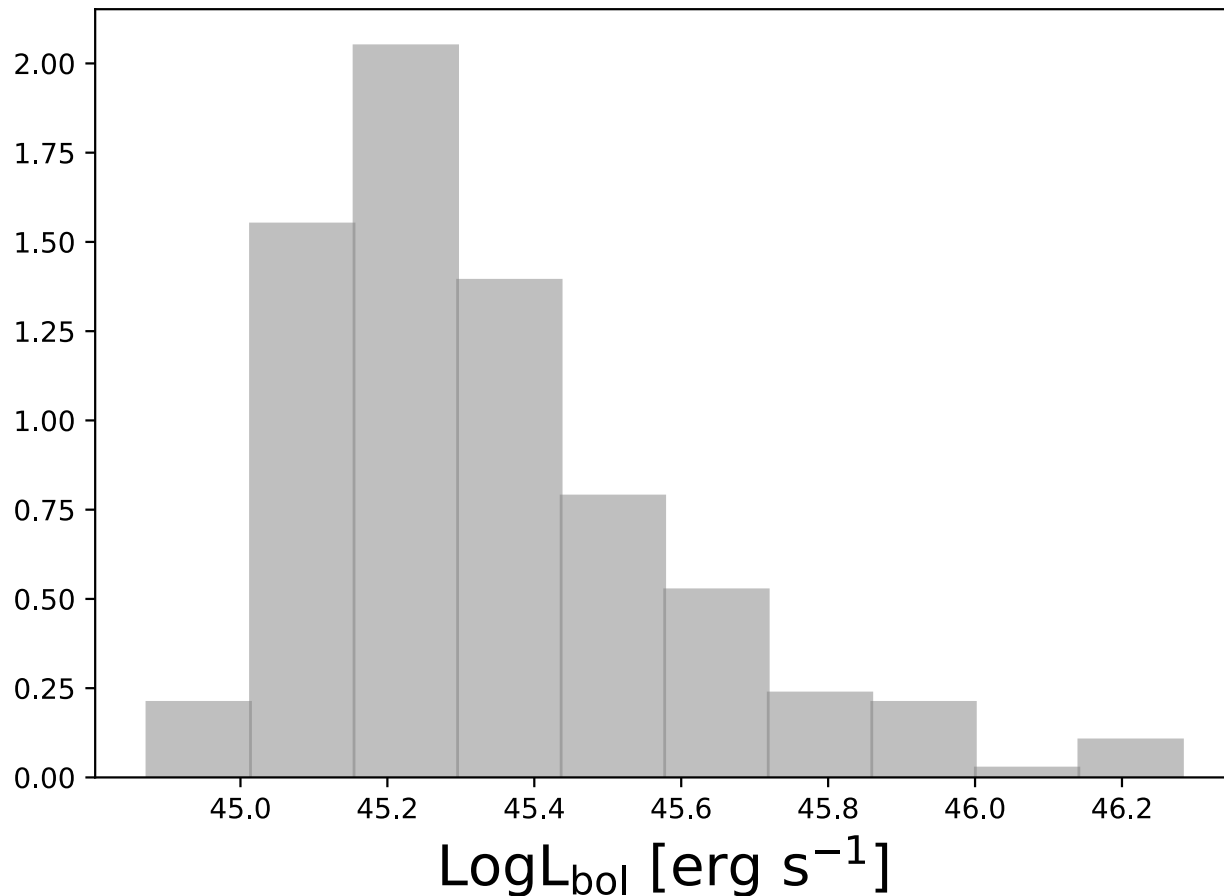
Kauffmann et al. 2007

Sabater et al. 2012, 2014

LaMassa et al. 2013

Luminous AGN with neighbouring galaxies

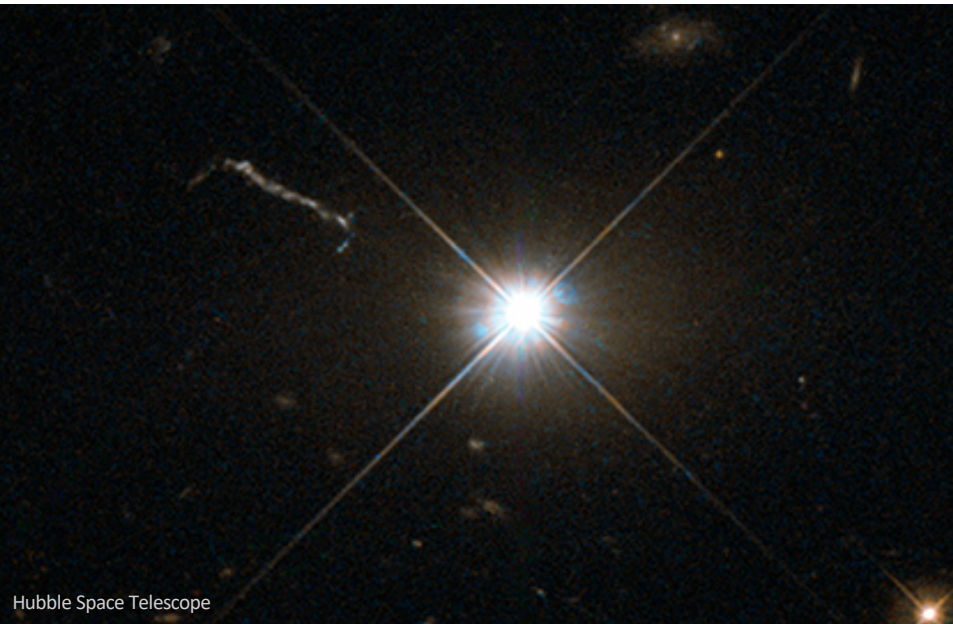
- Central AGN
 - SDSS DR7
 - $z = 0.2 - 0.4$
 - ($D \sim 19$ kpc)
- Neighbours
 - $r_p \leq 1$ Mpc
 - $\Delta v \leq 2,000$ Km/s



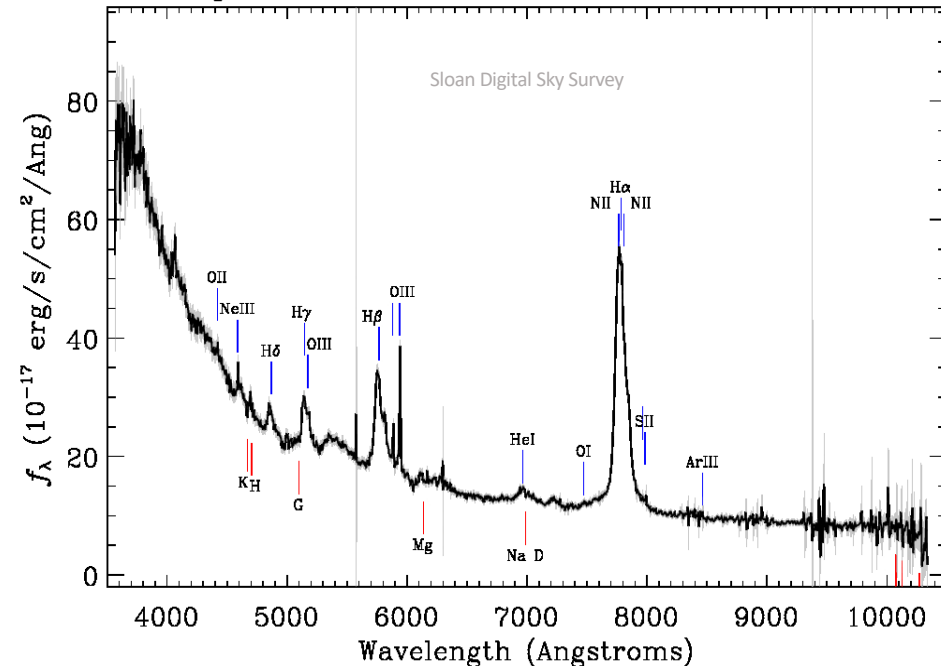
477 pairs of central AGN – neighbour

AGN dominance on the host galaxy

Comparison of **star formation history** between host galaxies of luminous AGN and that of their non active neighbouring galaxies



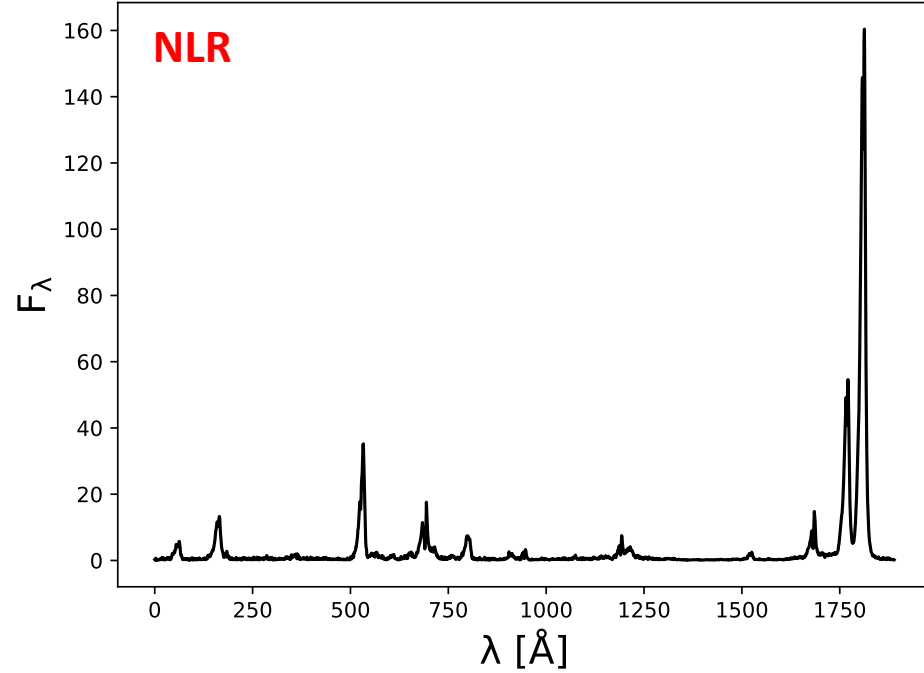
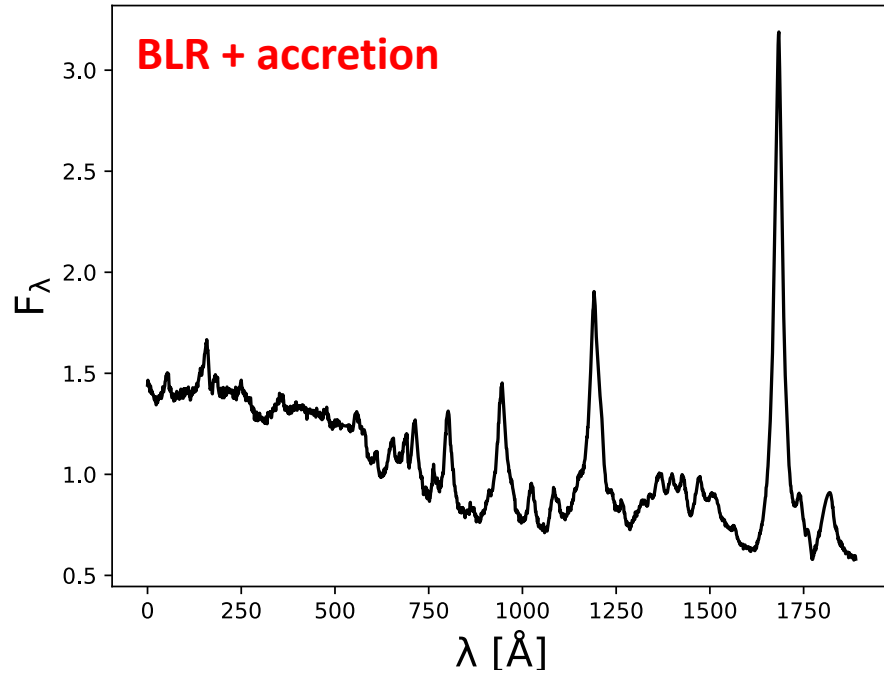
Survey: *boss* Program: *sequels* Target:
RA=132.15936, Dec=47.88870, Plate=7512, Fiber=321, MJD=56777
 $z=0.18561 \pm 0.00005$ Class=QSO BROADLINE
No warnings.



...using optical **Spectroscopy***!

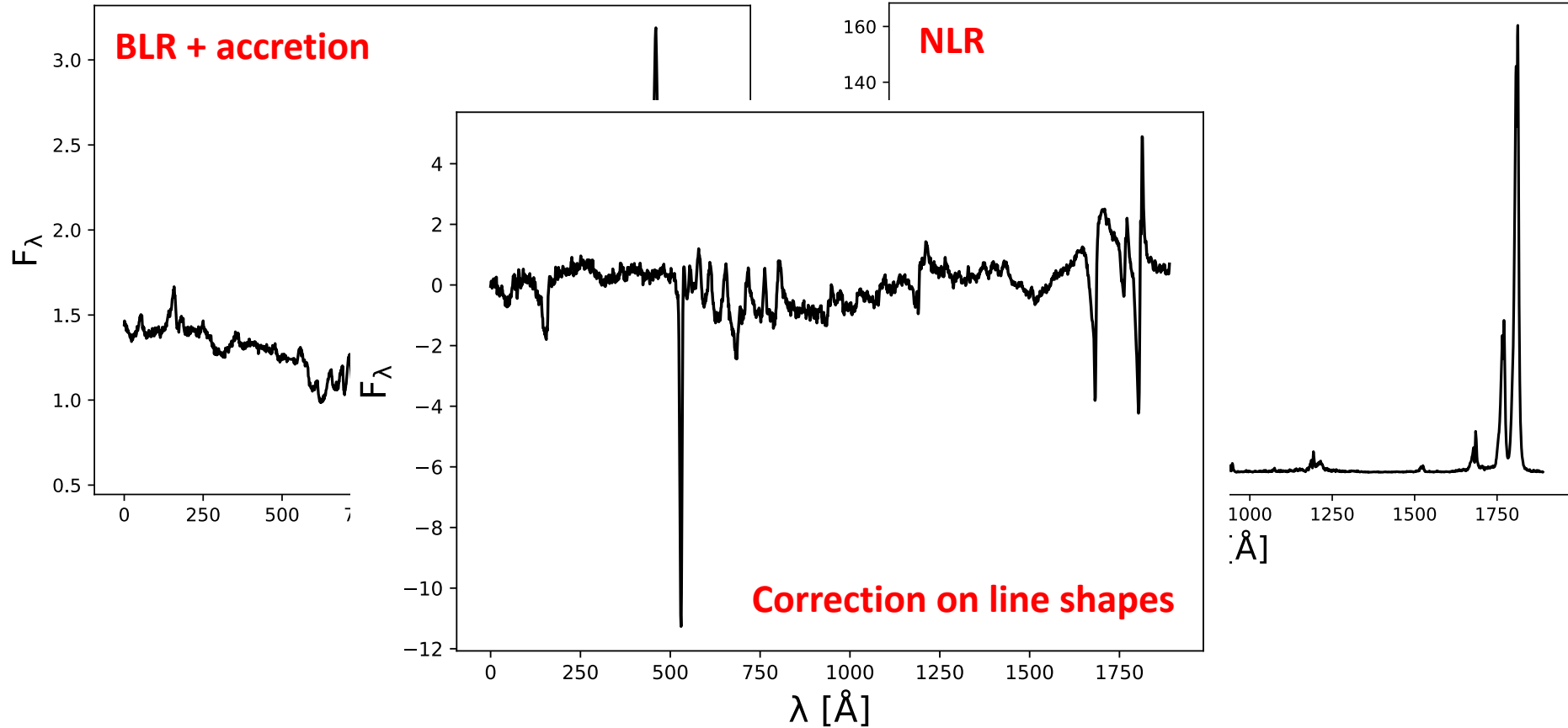
19 Spectral components for the decomposition

12 AGN



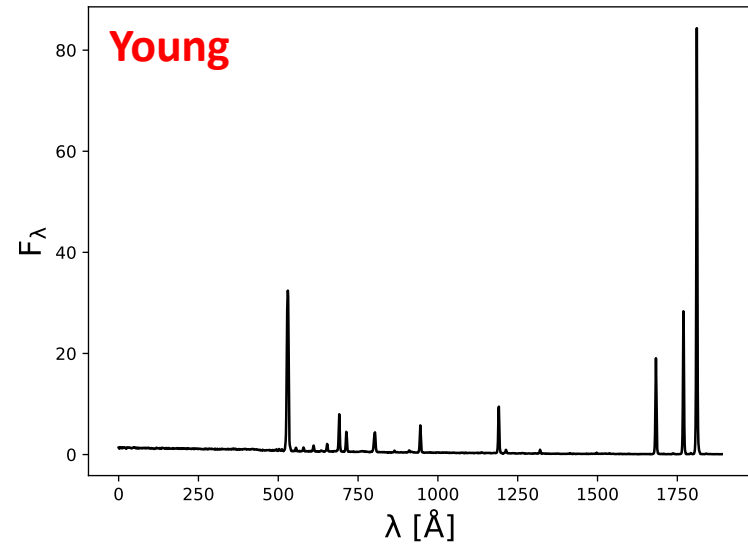
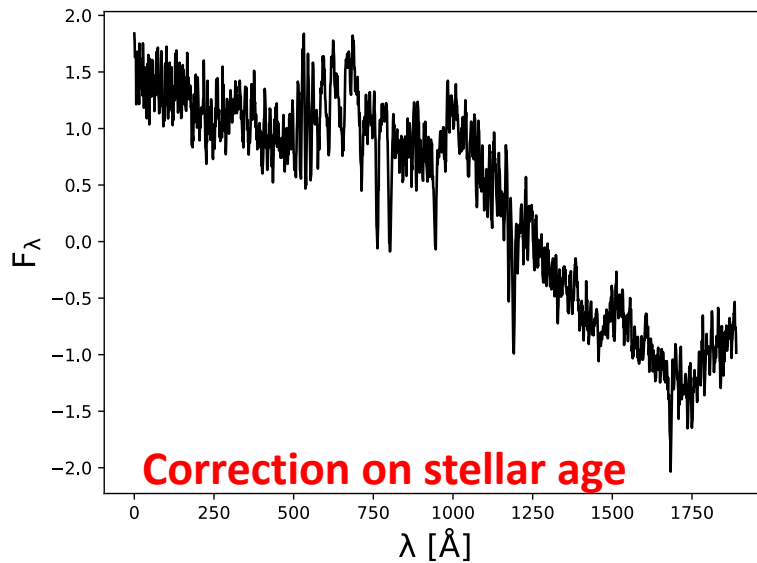
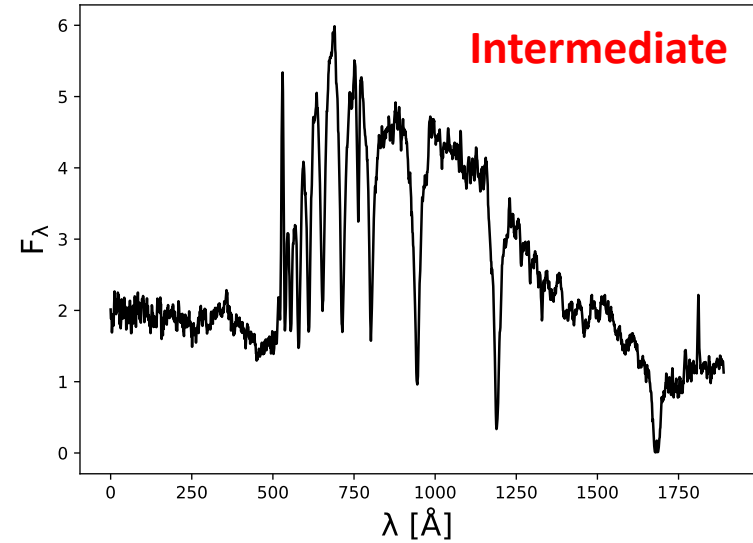
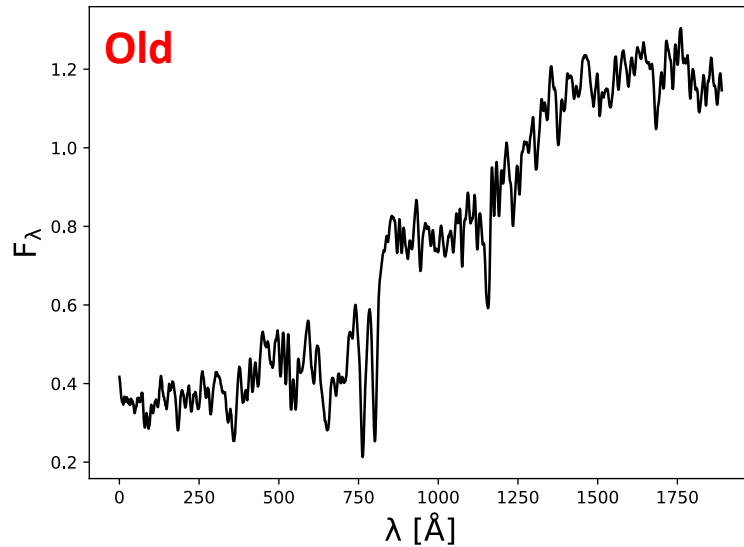
19 Spectral components for the decomposition

12 AGN



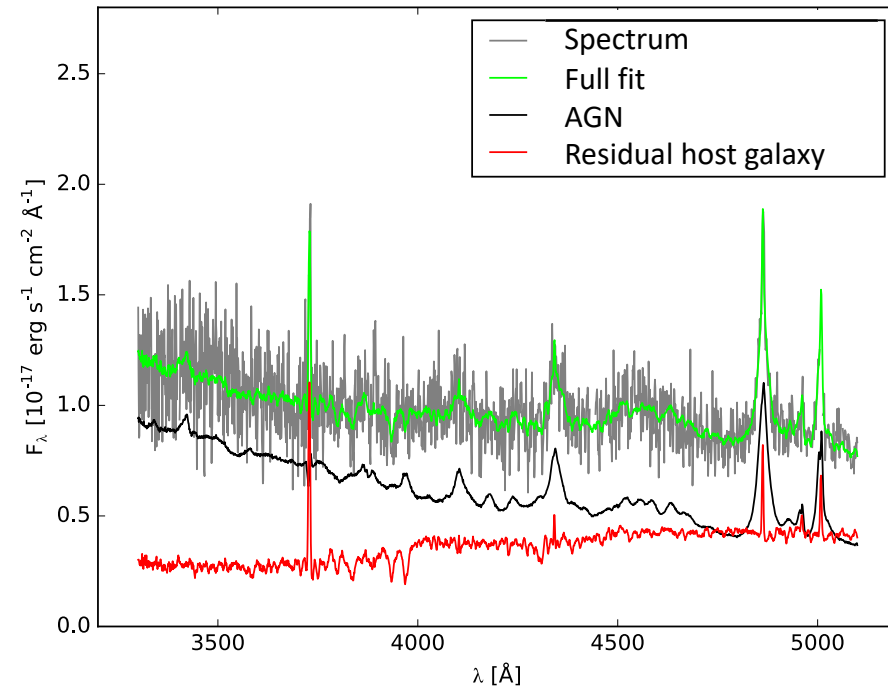
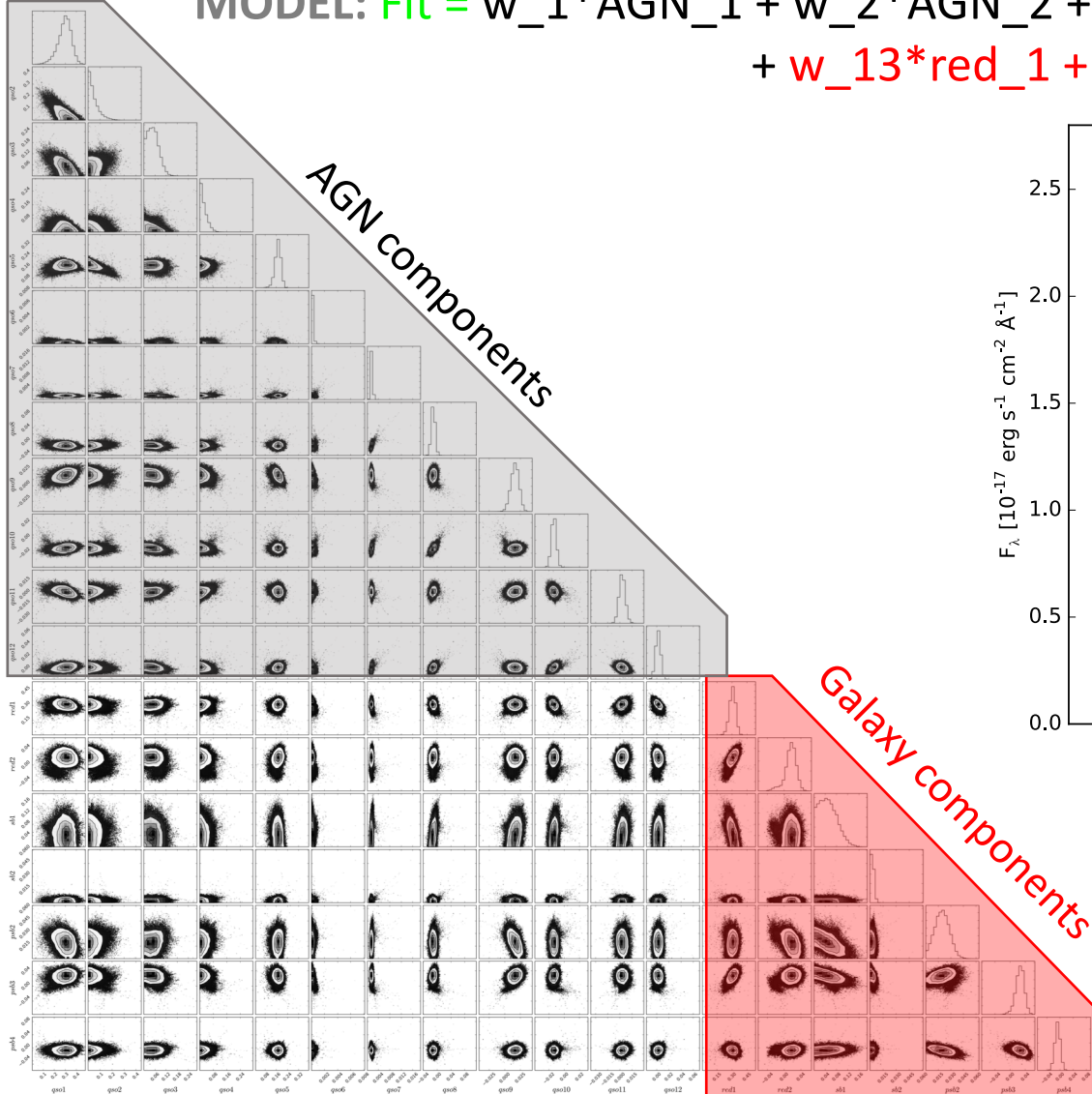
19 Spectral components for the decomposition

7 galactic with different **stellar populations**



Successful retrieval of AGN host galaxy spectrum

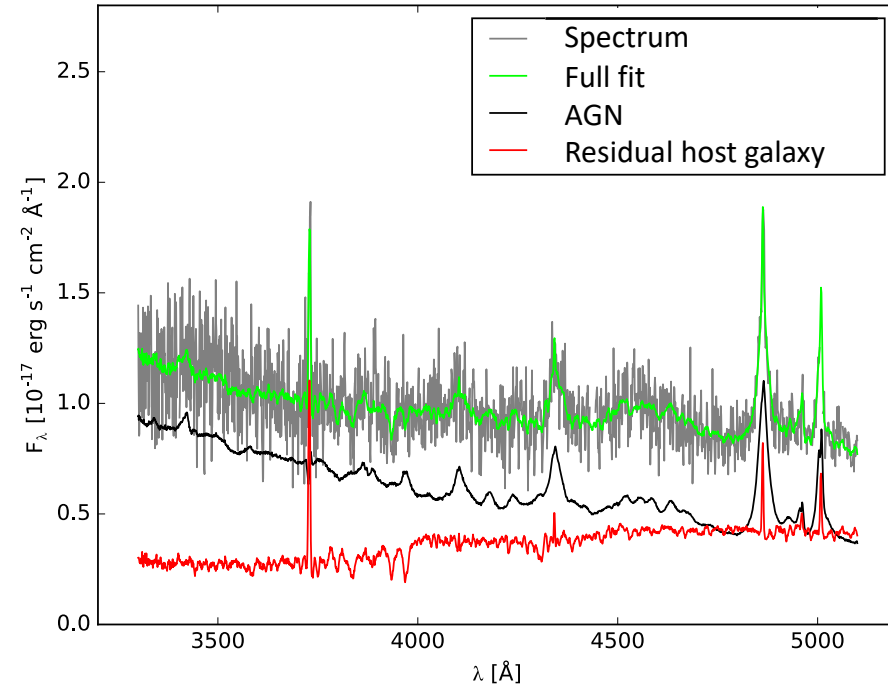
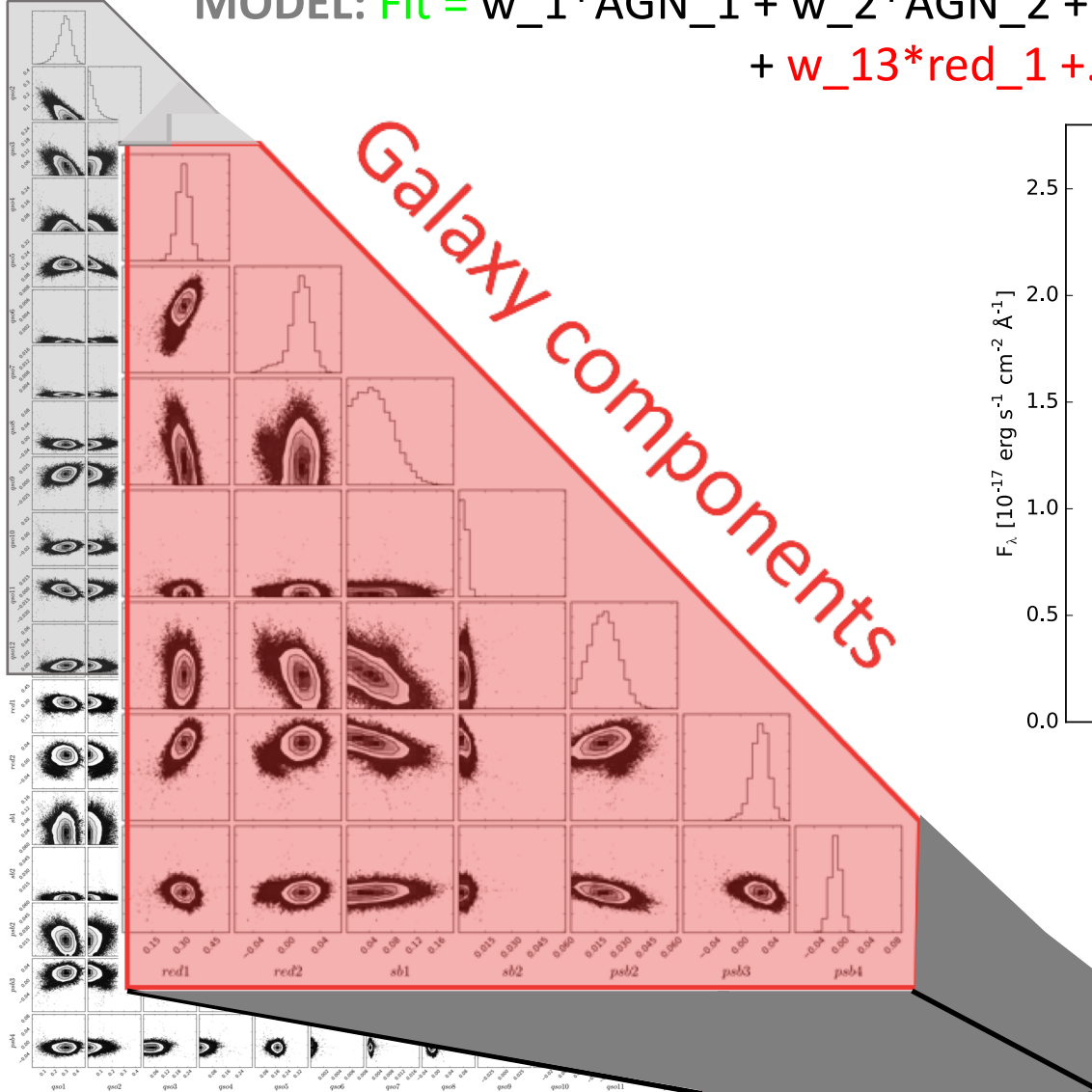
$$\text{MODEL: Fit} = w_1 \cdot \text{AGN}_1 + w_2 \cdot \text{AGN}_2 + \dots + w_{12} \cdot \text{AGN}_{12} \\ + w_{13} \cdot \text{red}_1 + \dots + w_{14} \cdot \text{sb}_1 + \dots + w_{19} \cdot \text{psb}_3$$



Efthymiadou et al. (in prep.)

Successful retrieval of AGN host galaxy spectrum

$$\text{MODEL: Fit} = w_1 \cdot \text{AGN}_1 + w_2 \cdot \text{AGN}_2 + \dots + w_{12} \cdot \text{AGN}_{12} \\ + w_{13} \cdot \text{red}_1 + \dots + w_{14} \cdot \text{sb}_1 + \dots + w_{19} \cdot \text{psb}_3$$

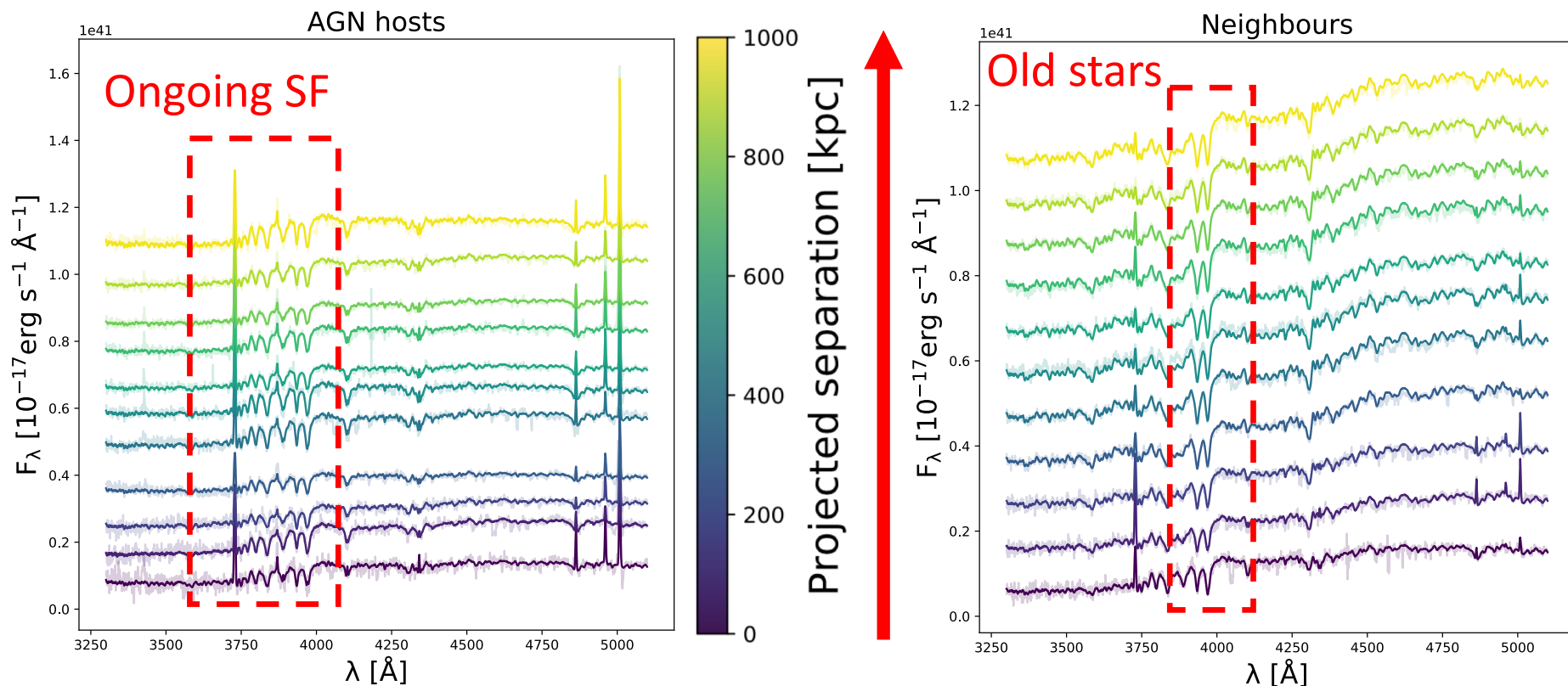


Efthymiadou et al. (in prep.)

Star formation with separation

Arrange pairs as a function of separation \rightarrow Merger stages

Efthymiadou et al. (in prep.)

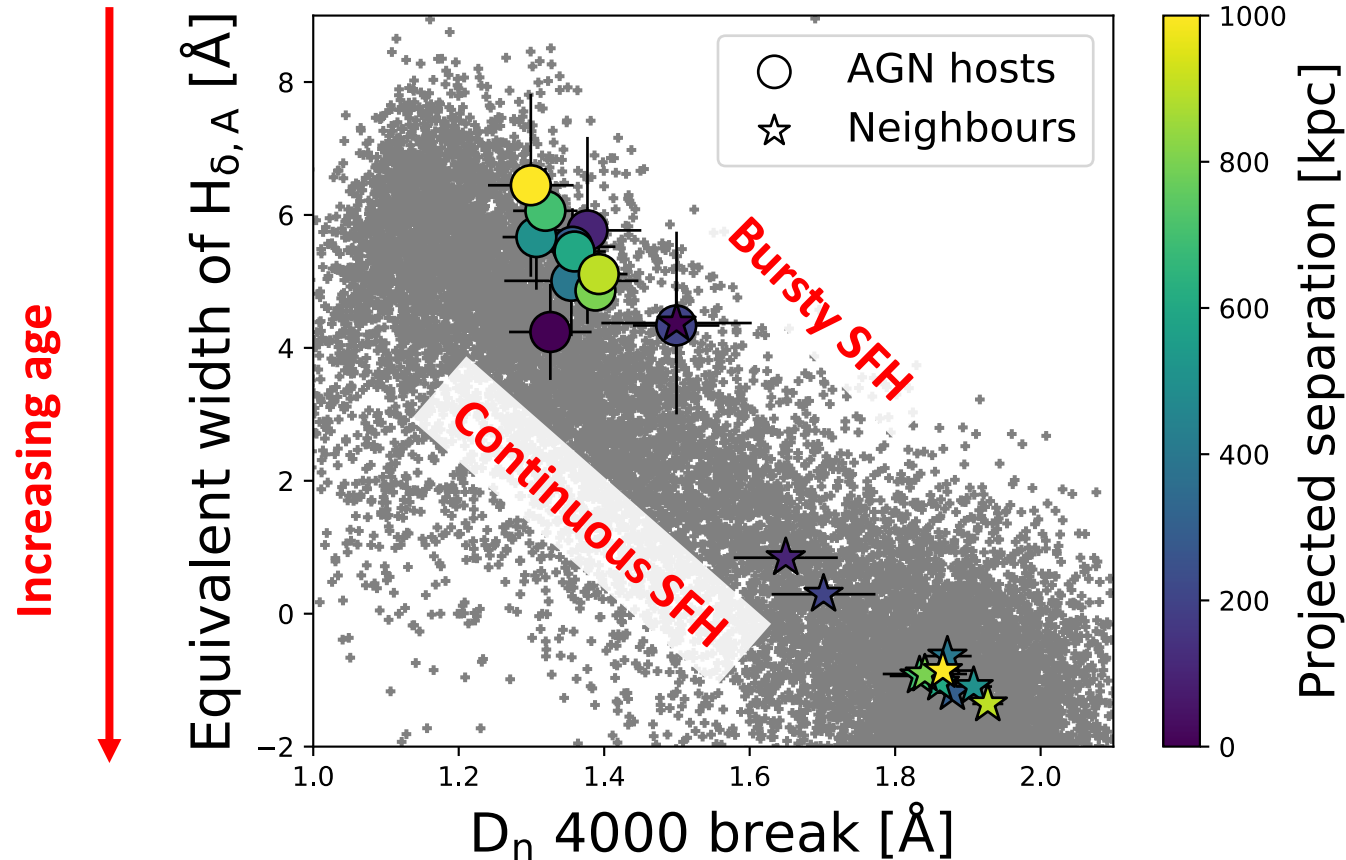


- AGN hosts: Star forming;
No evolution with separation

- Neighbours: SF enhancement
with decreasing separation

$H_{\delta,A}$ and D_n 4000 as stellar age indicators

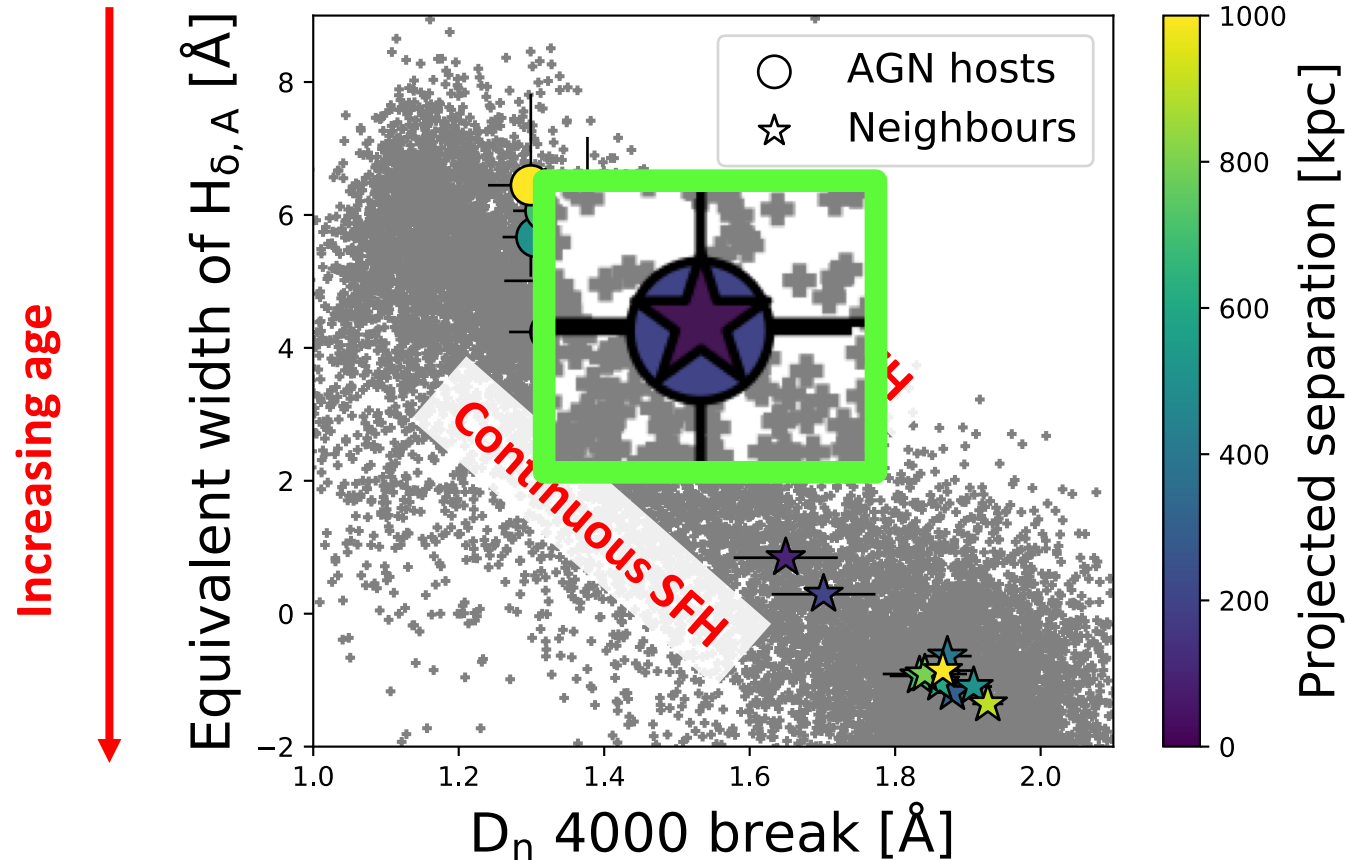
Following Kauffmann et al. 2003; background from JHUMPA



- Neighbours : older stellar populations
- Extend of star formation enhancement: $r_p \sim 150$ kpc (Patton et al. 2013)
- AGN hosts : Bursty star formation history that has started to shut down

$H_{\delta,A}$ and D_n 4000 as stellar age indicators

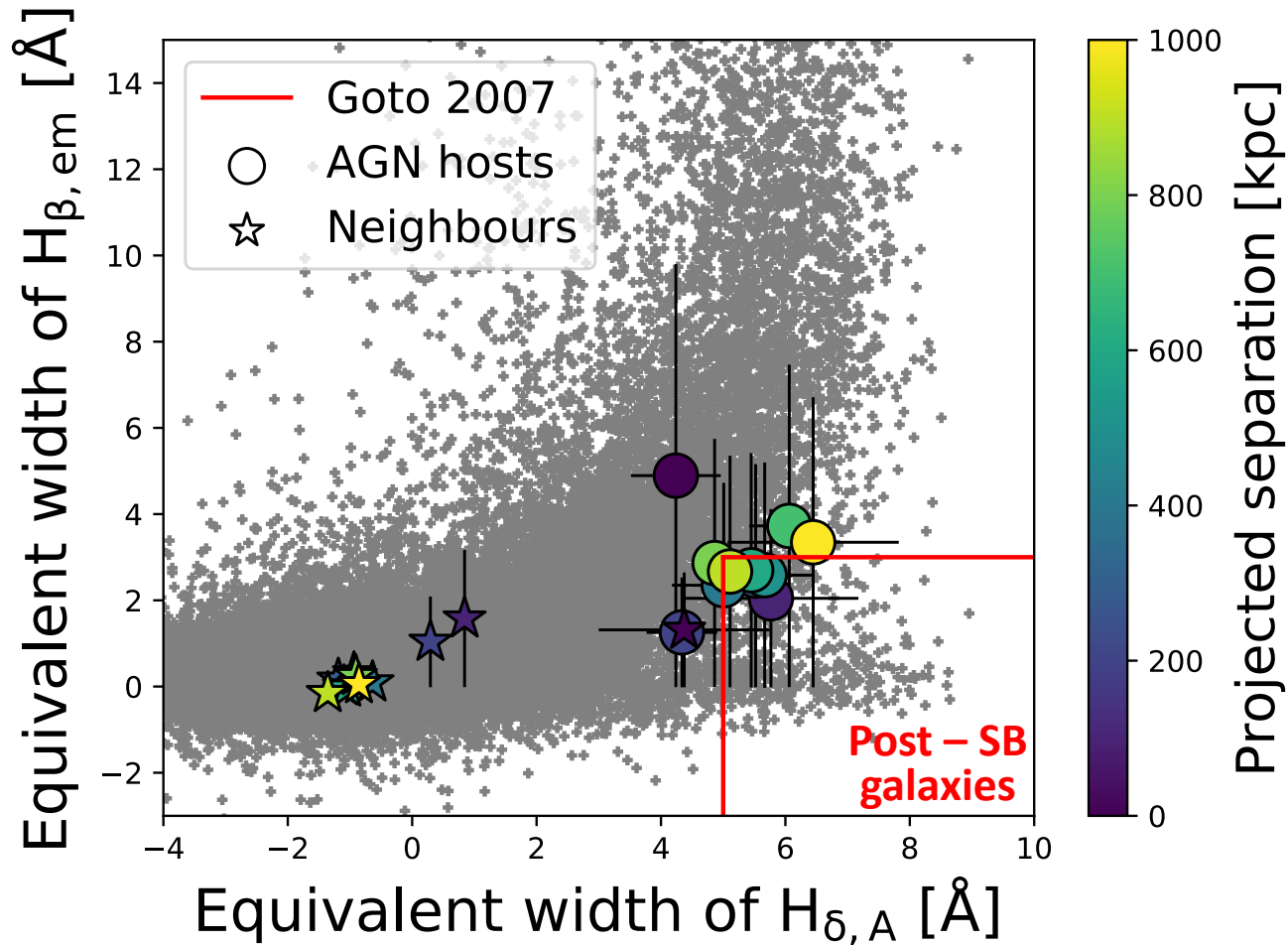
Following Kauffmann et al. 2003; background from JHUMPA



- Neighbours : older stellar populations
- AGN hosts : Bursty star formation history that has started to shut down
- Extend of star formation enhancement:
 $r_p \sim 150$ kpc (Patton et al. 2013)

Post-starburst galaxies: H_{β} emission line indicator

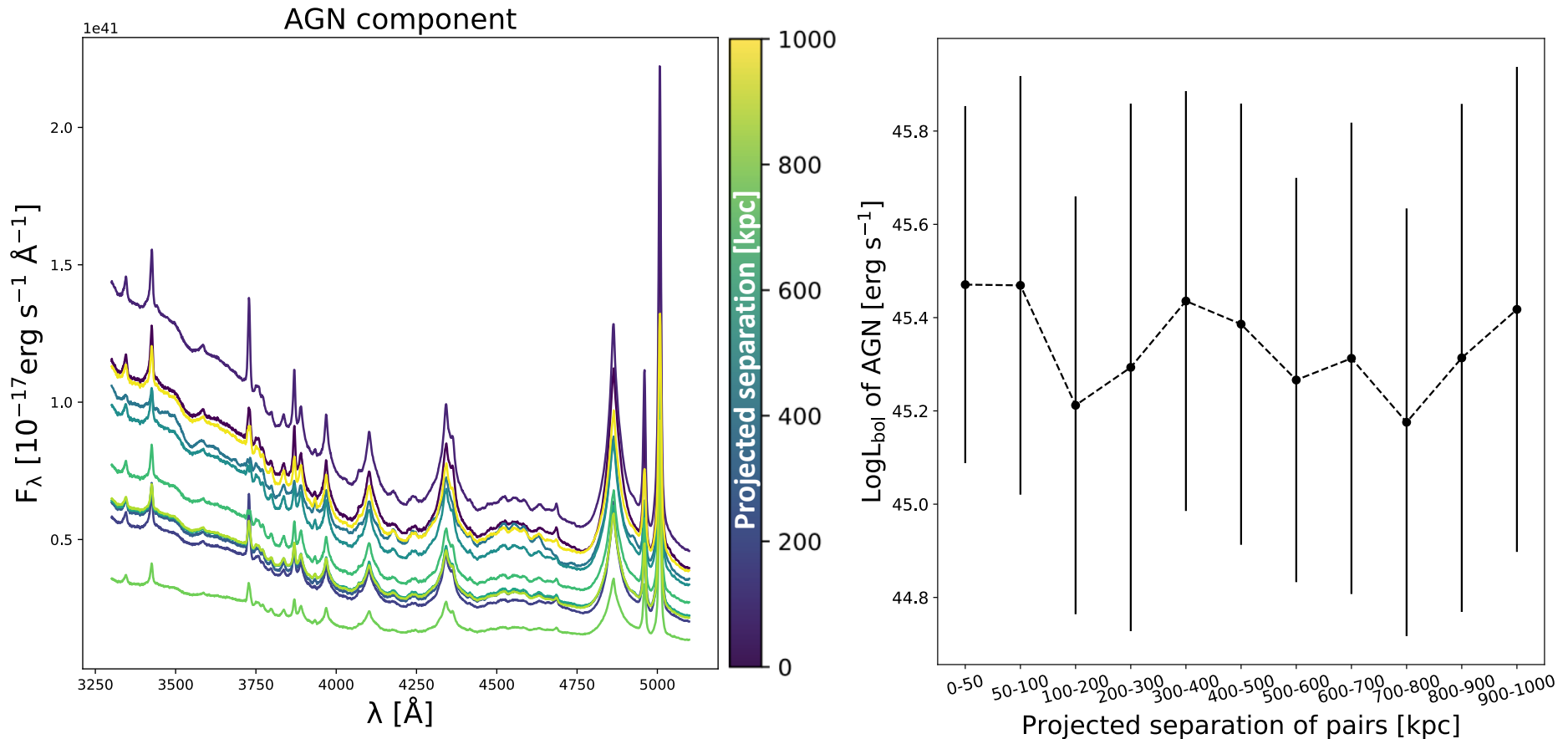
Efthymiadou et al. (in prep.)



- Recent burst of star formation in AGN hosts

No evolution of AGN with merger stage

Efthymiadou et al. (in prep.)



From Shen et al. 2011

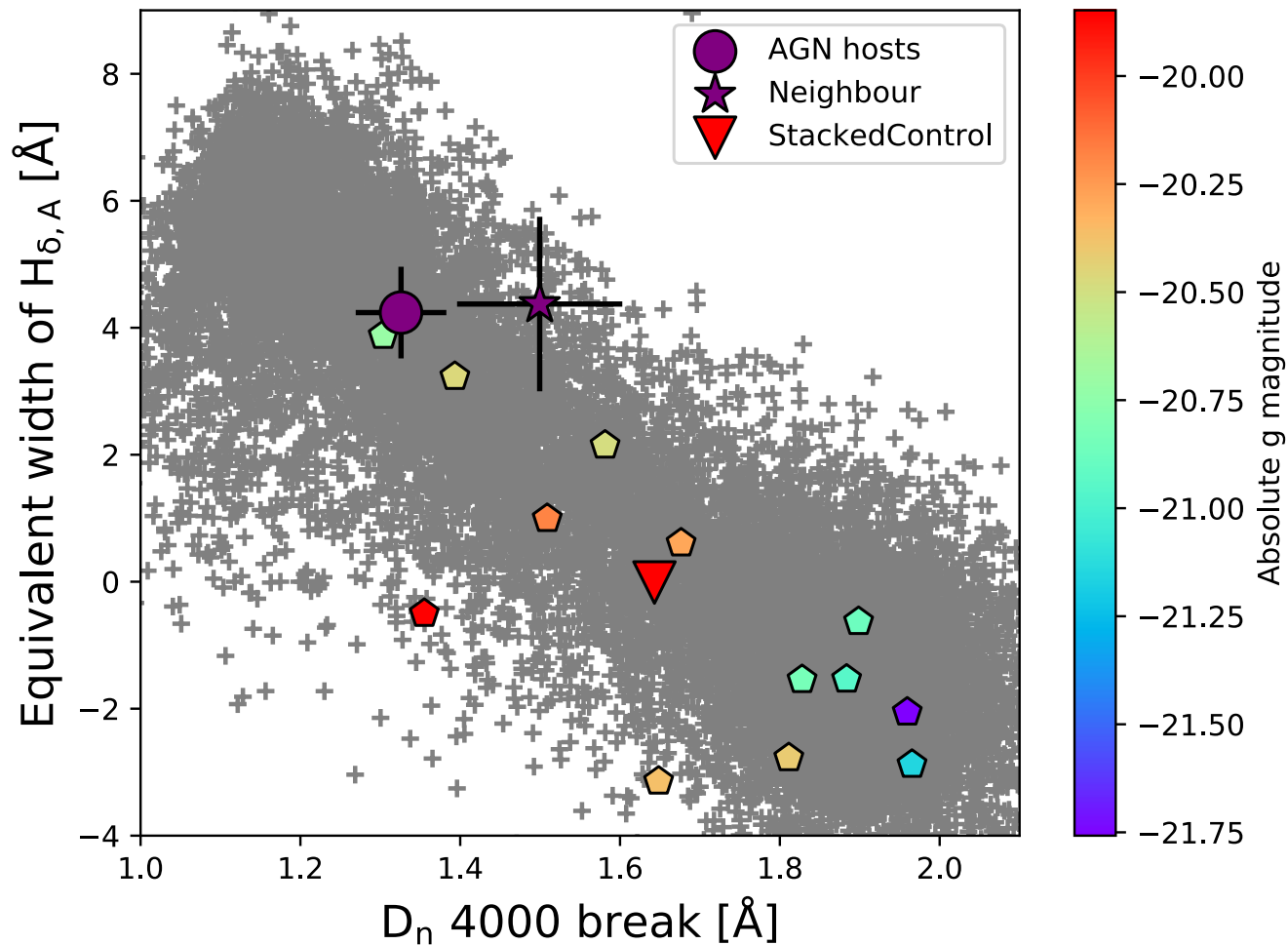
Conclusions

- Successful **decomposition** of full AGN spectrum and retrieval of host galaxy
- Confirmation of **merger – star formation** connection
(extend of enhancement: **150 kpc**)
- Confirmation of **star formation – AGN activity** connection
- **Bursty** star formation history in AGN hosts
- **No evolution** of AGN with merger stage



Neighbours at closest separation

❖ Neighbours of inactive galaxies
 matched to AGN hosts



Neighbours at closest separation

❖ Neighbours of inactive galaxies
 matched to AGN hosts

