Investigating AGN activity in recently quenched galaxies at cosmic noon

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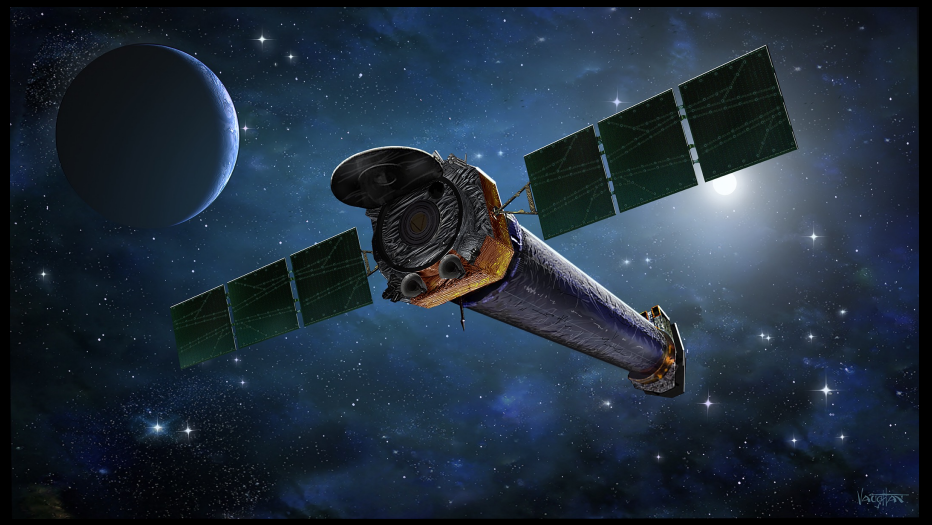
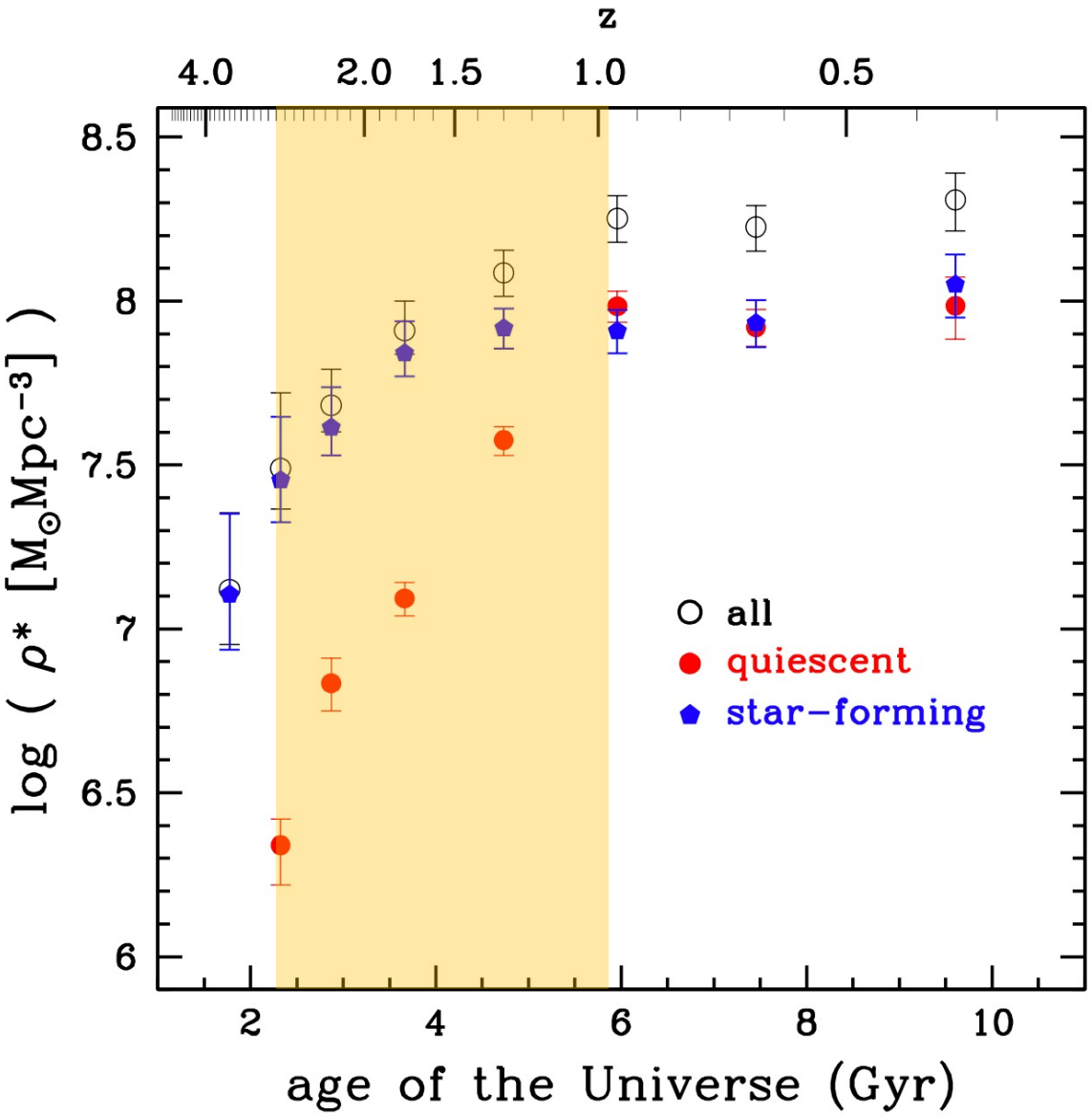


Most quenching occurs at cosmic noon

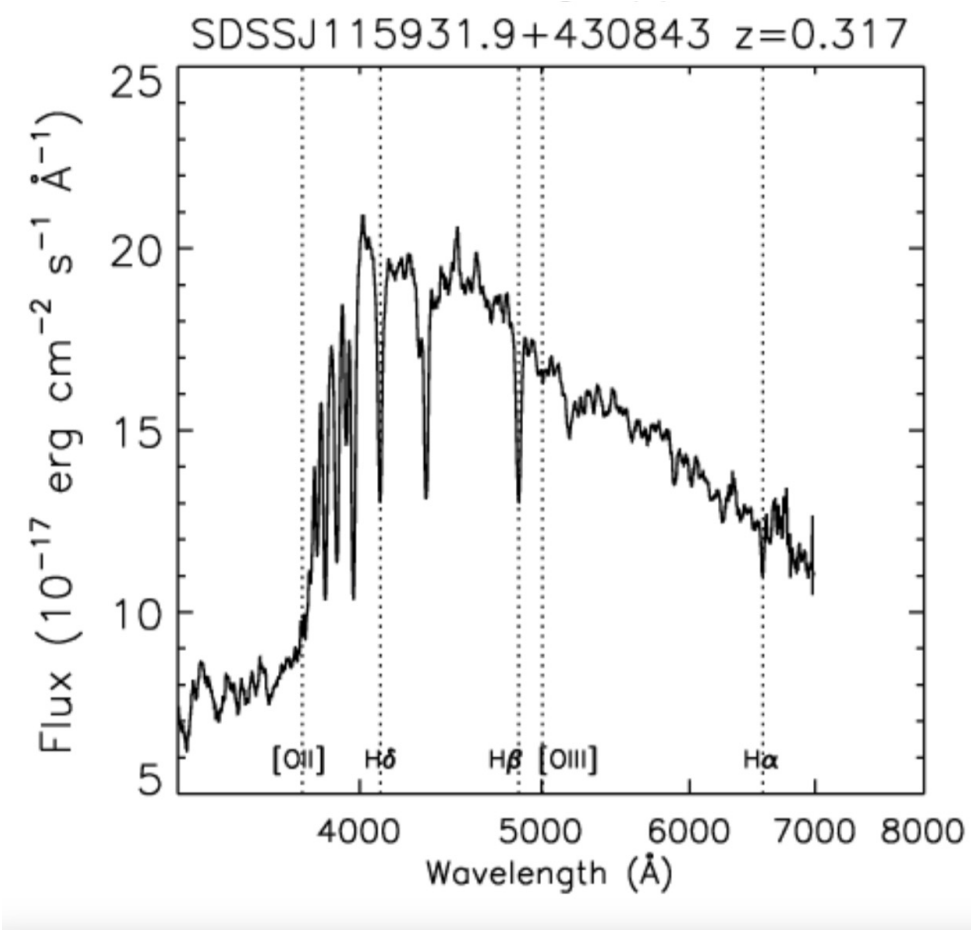


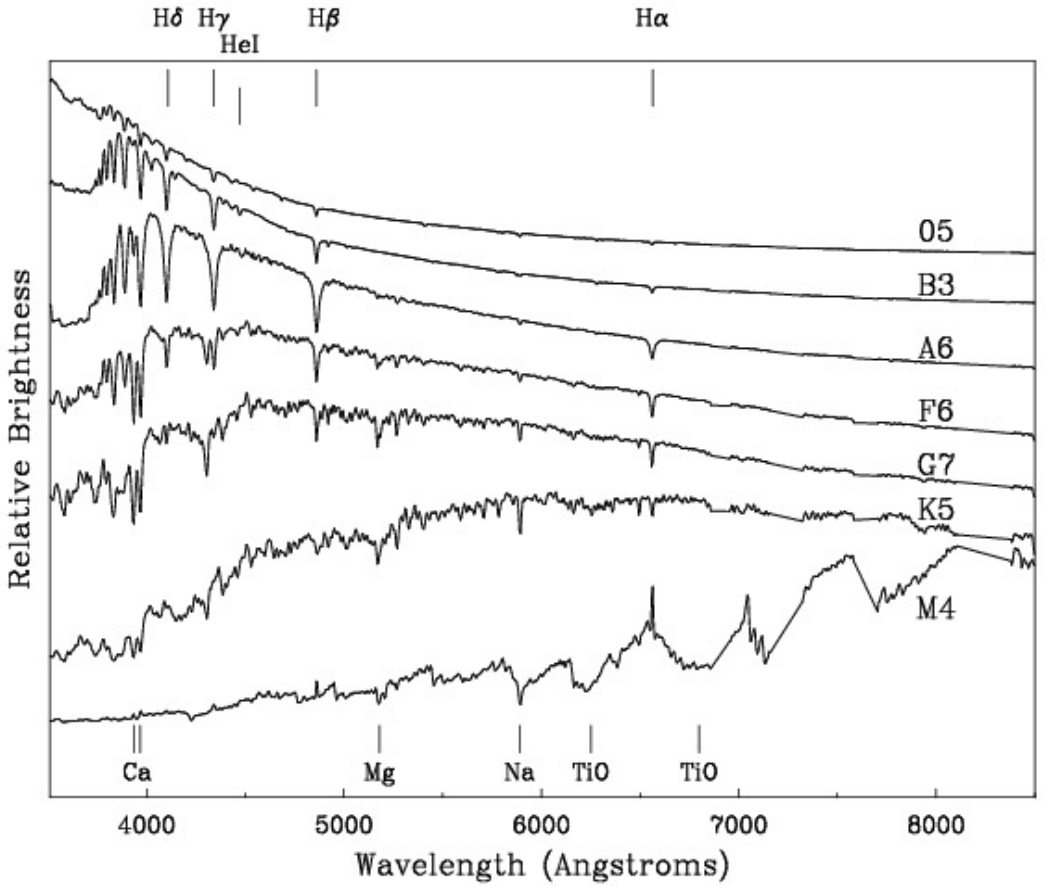
Ilbert et al. (2013)

Post-starburst galaxies (PSBs) – galaxies in transition

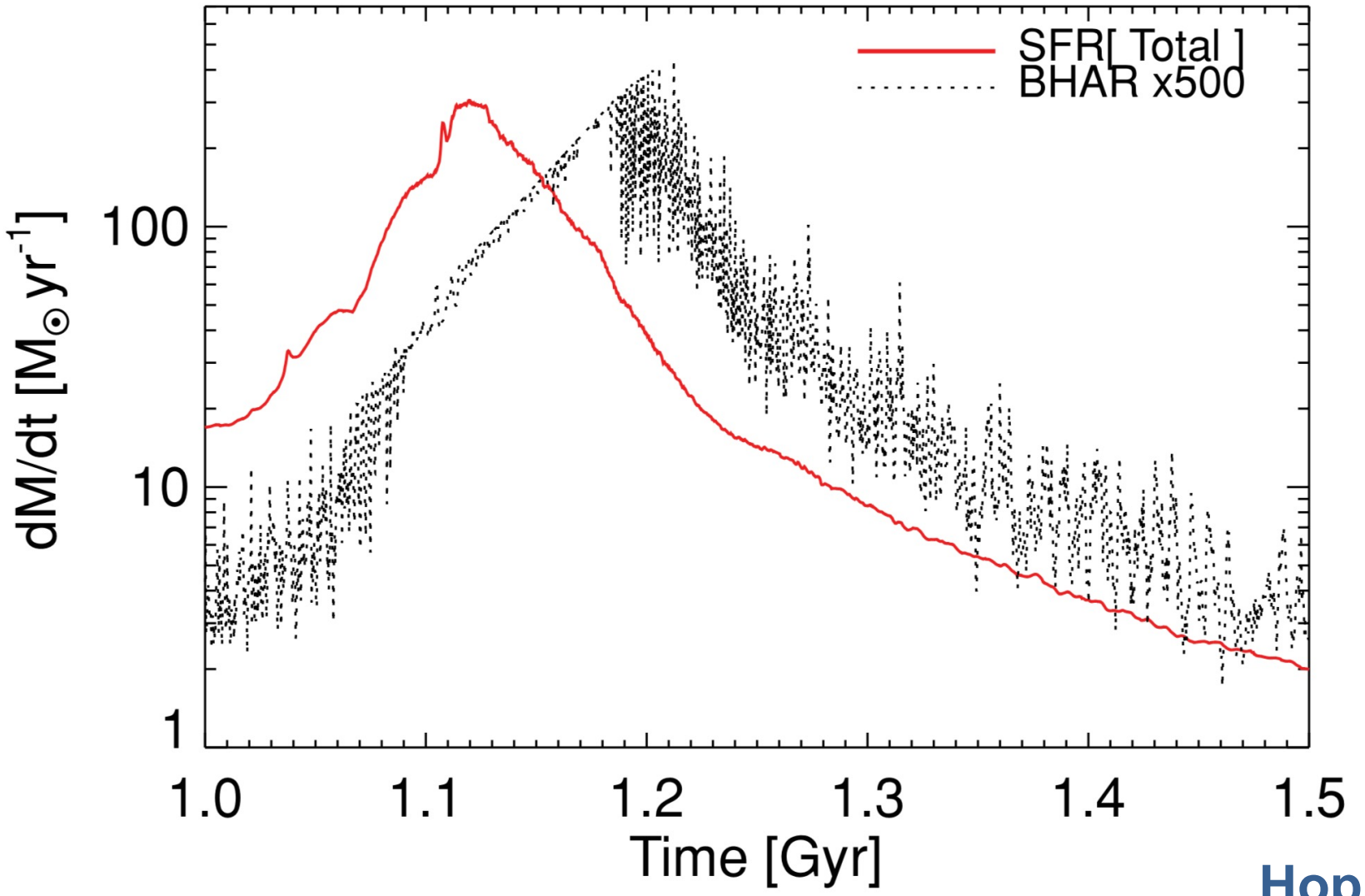
Strong Balmer absorption => A stars

Major starburst truncated **abruptly** within last ~ 1Gyr





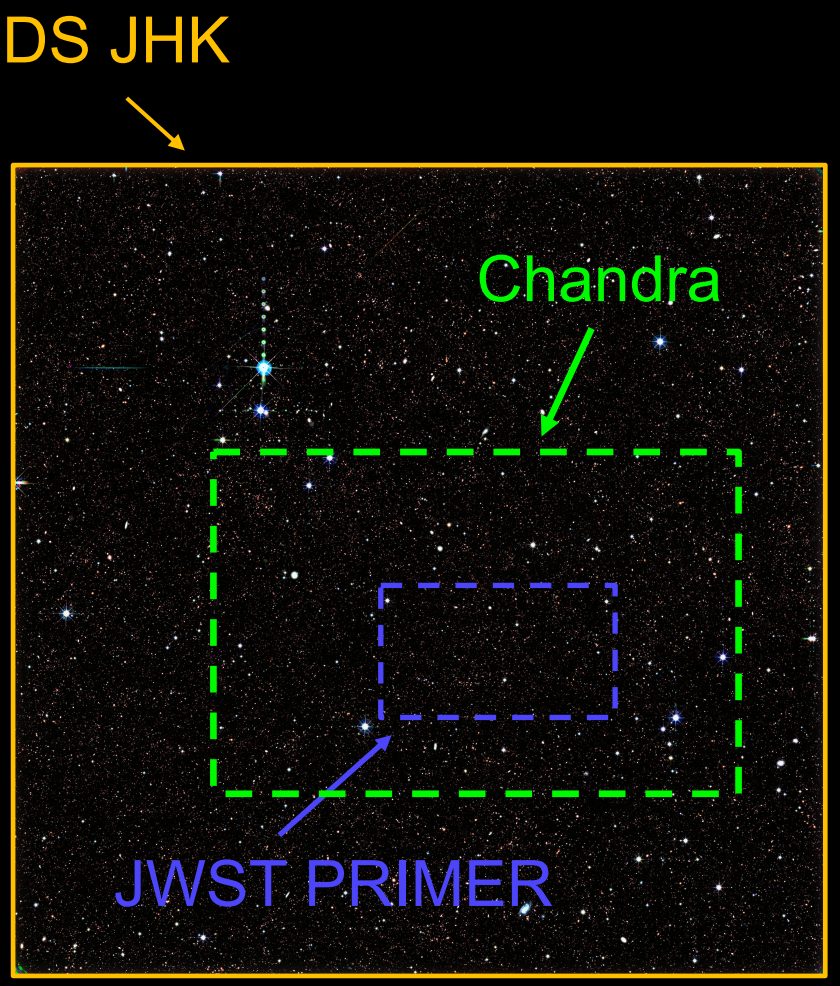
Simulations predict AGN activity peaking ~ 100 Myr after starburst



Hopkins et al. (2012)

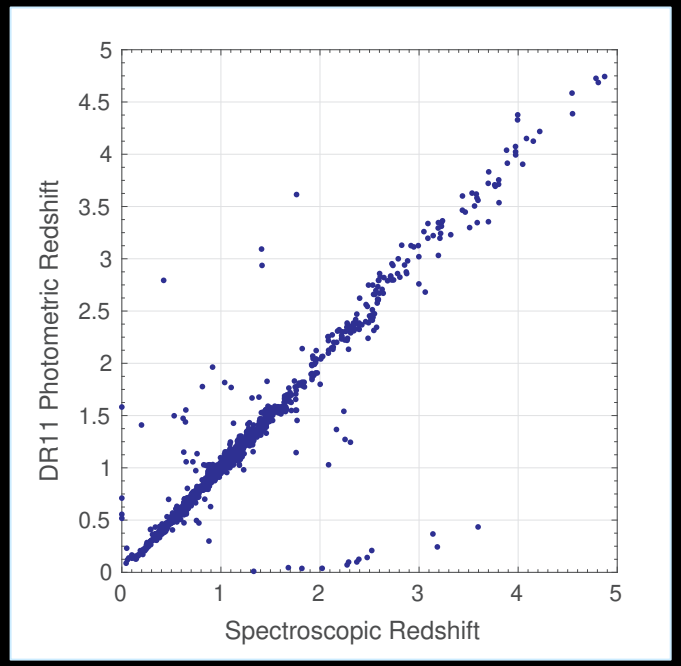
The UKIDSS Ultra-Deep Survey

Deepest K-band survey over ~1 sq deg



Deep photometry in 13+ bands

Photo-zs : $\delta z/(1+z) \sim 0.019$

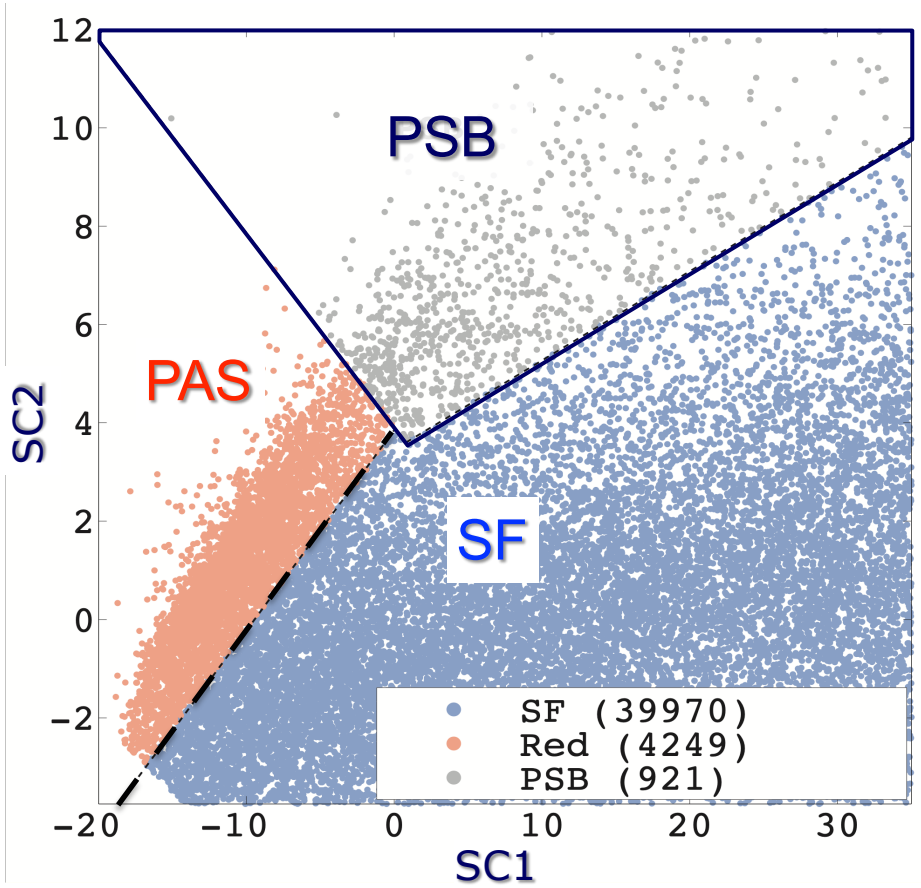


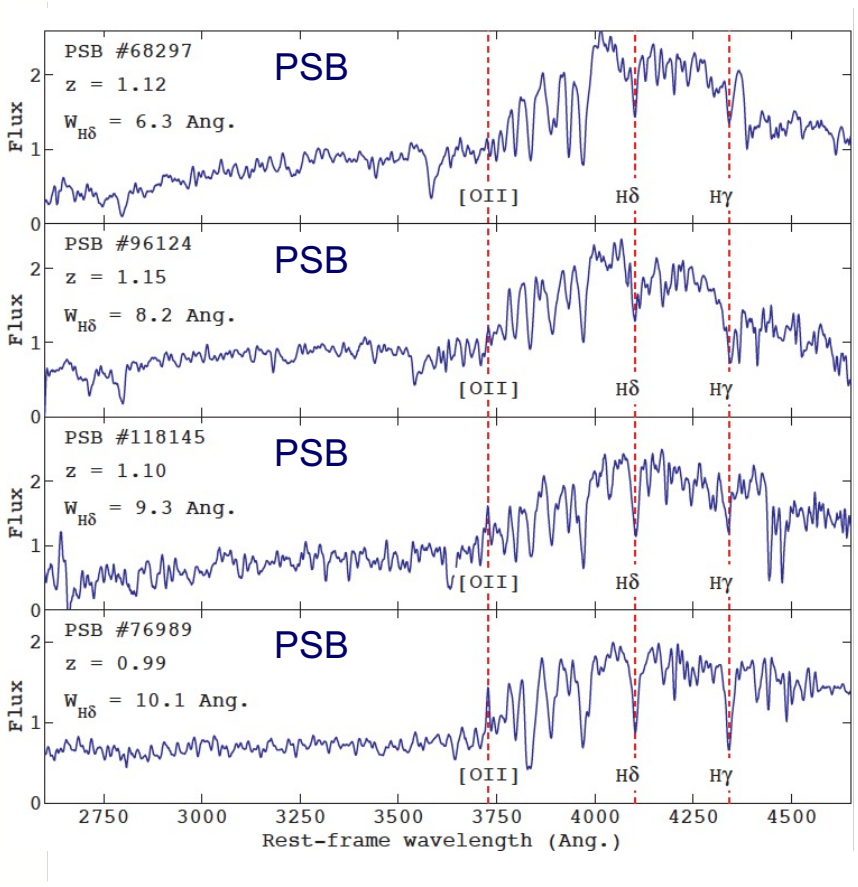
1.3Ms Chandra mosaic (~0.3 deg^2)

Lx ~10^{43} erg s^{-1} to z~3

Photometric PCA method to identify PSBs

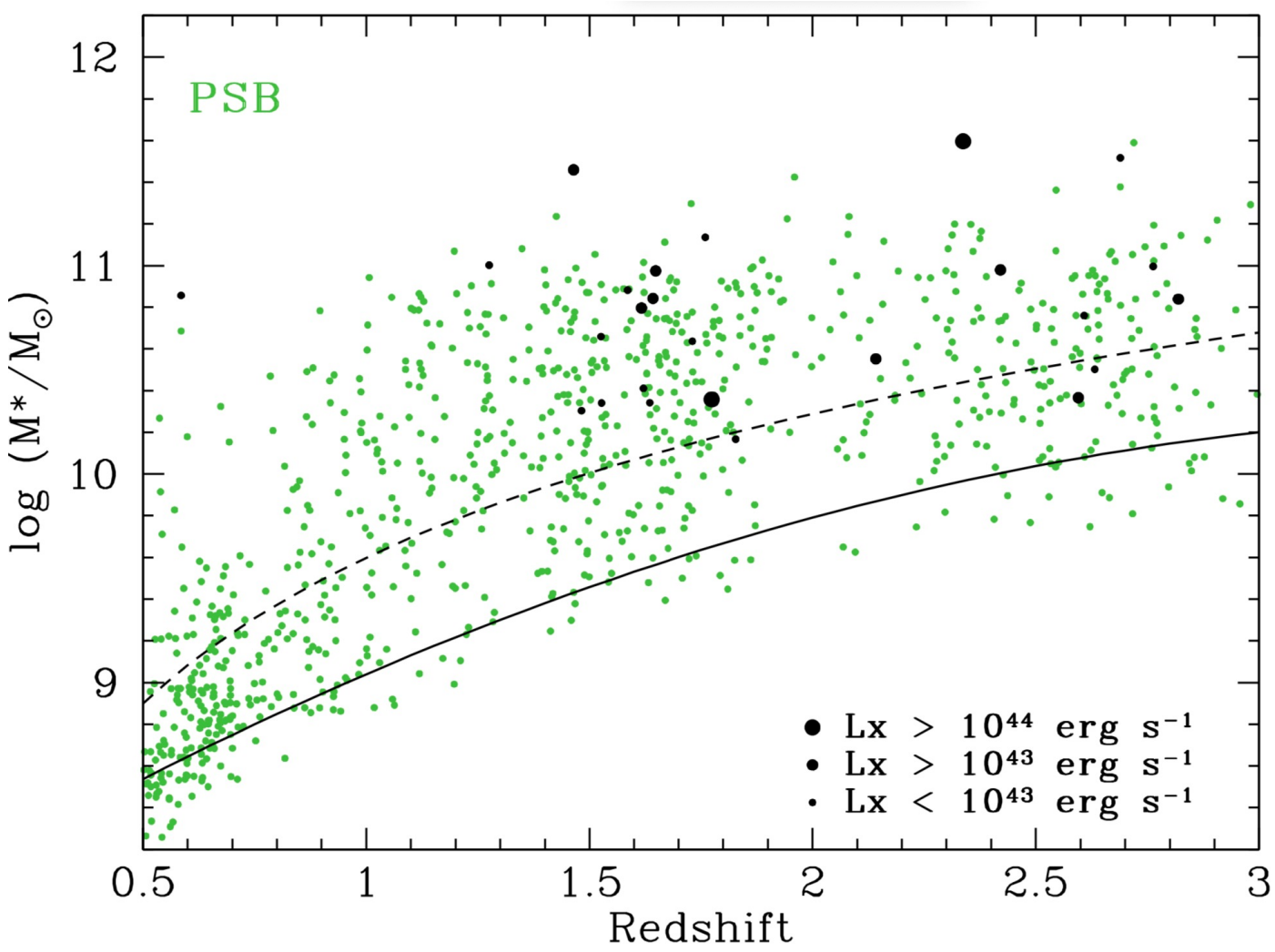
Spectroscopically confirmed
Good agreement with UVJ classification

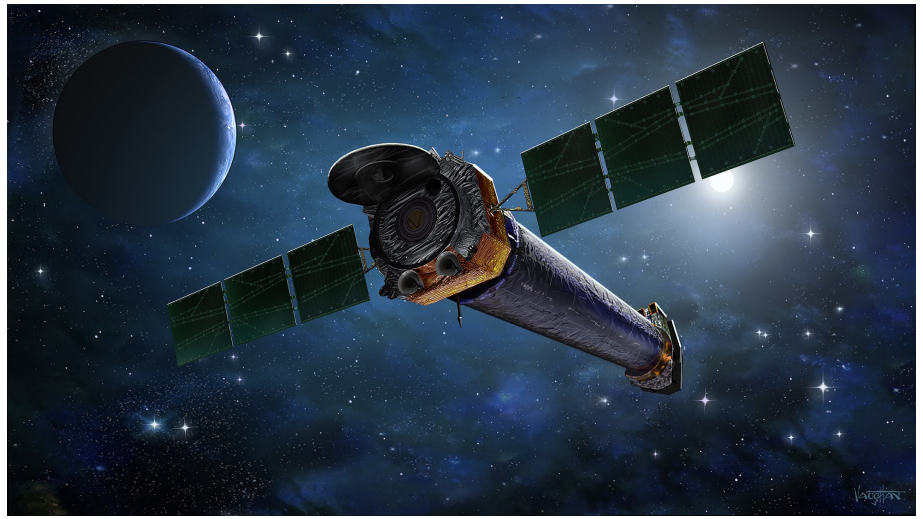




Wild et al. (2016), Almaini et al. (2017), Maltby et al. (2019), Wilkinson et al. (2021)

X-ray AGN activity is rare in recently quenched massive galaxies



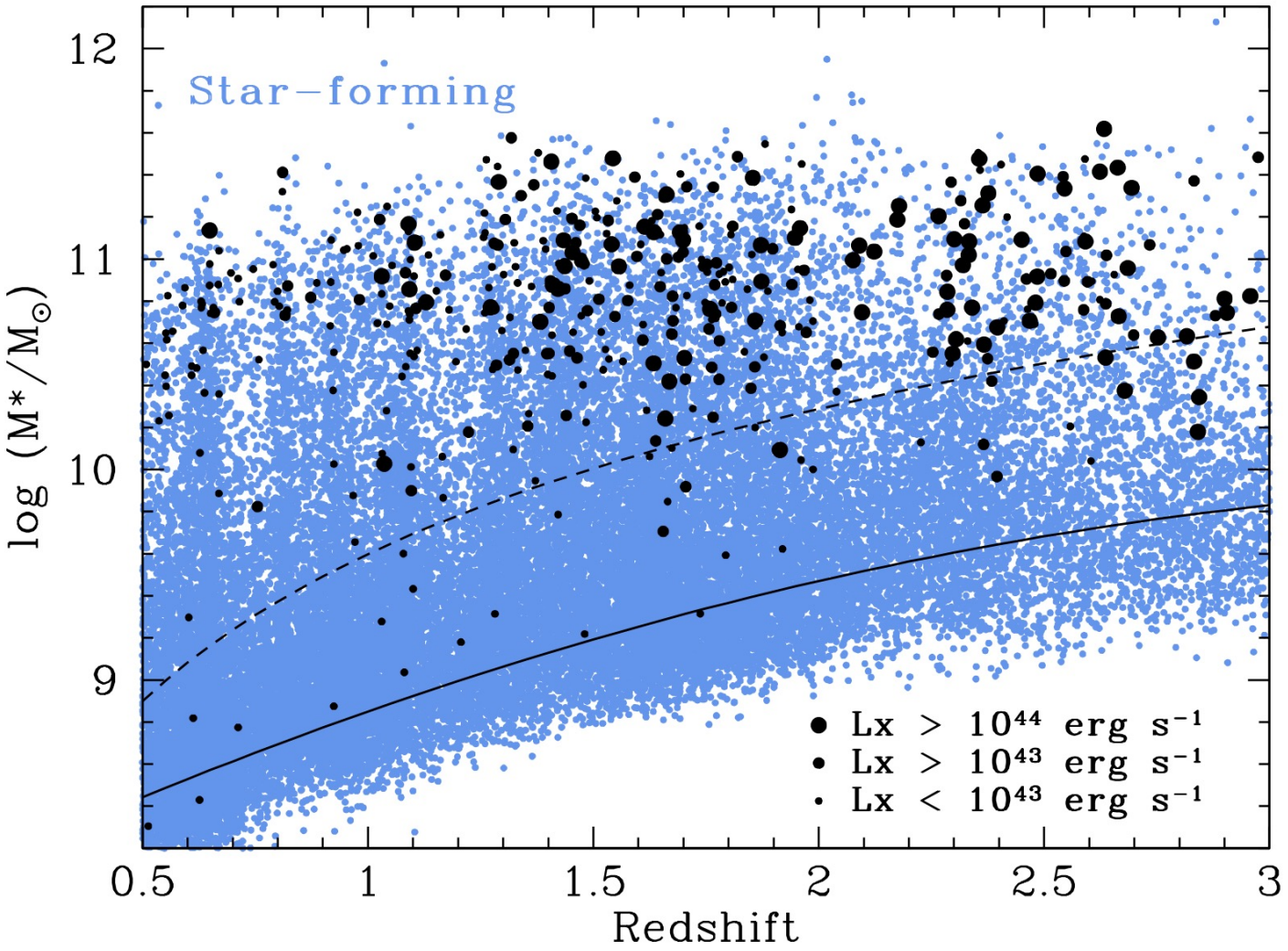


Chandra X-UDS (200-600 ks)

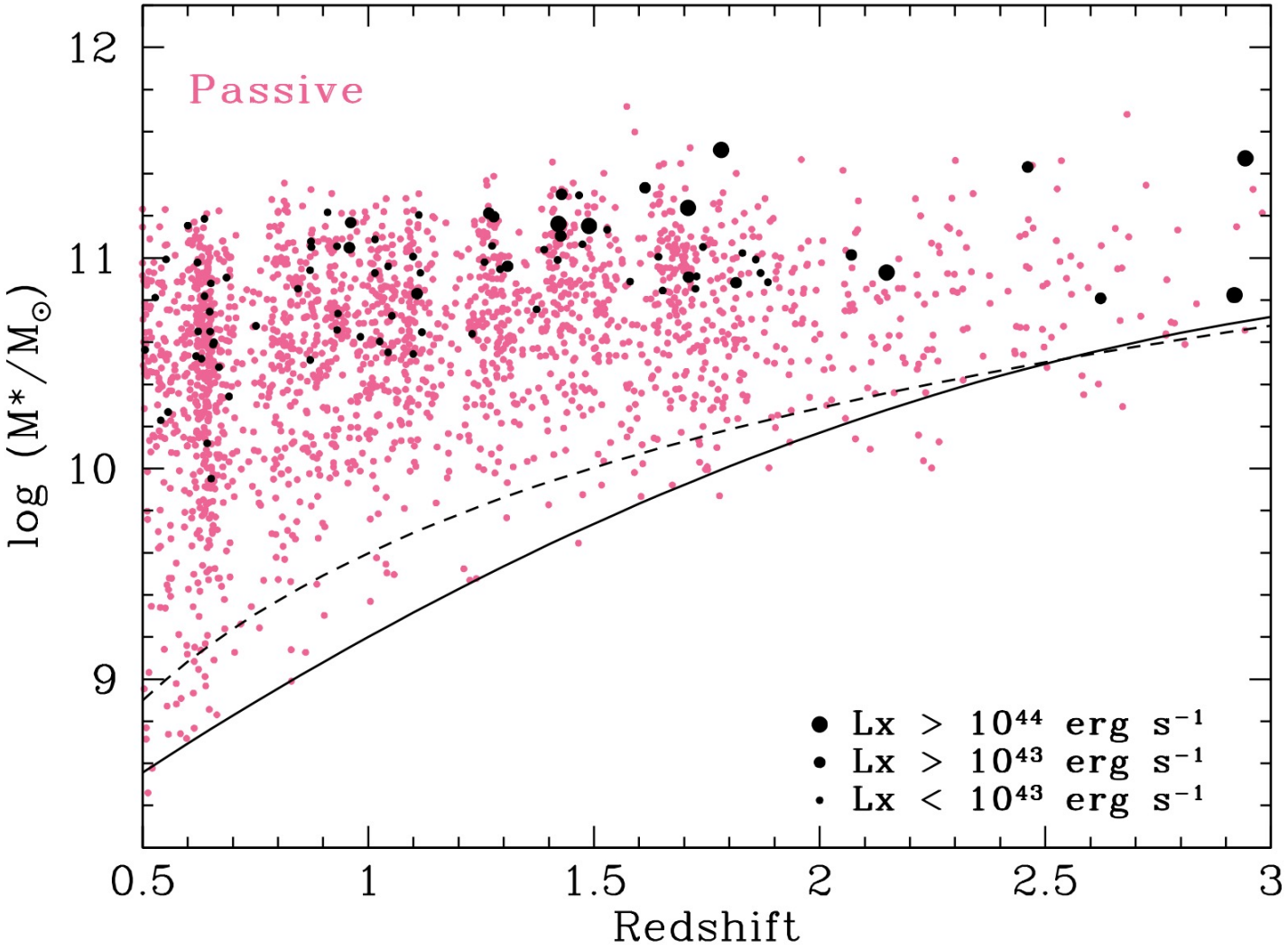
Only 6% of PSBs detected ($M^* > 10^{10.5}\ M_\odot$)

Almaini et al. (in prep)

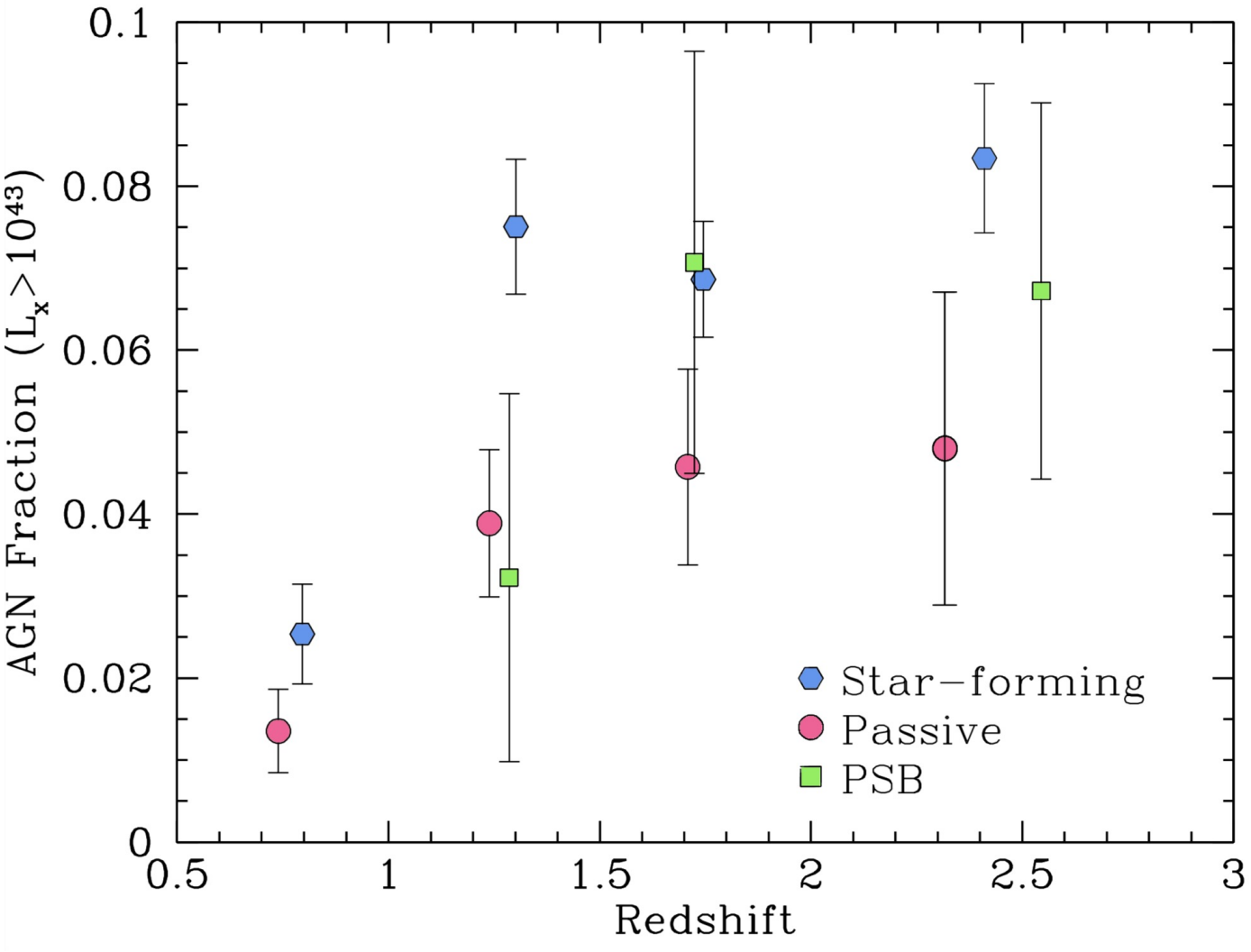
~8% of massive SF galaxies detected by Chandra ($M^* > 10^{10.5}\ M_\odot$)



~5% of massive passive galaxies detected by Chandra ($M^* > 10^{10.5}\ M_\odot$)

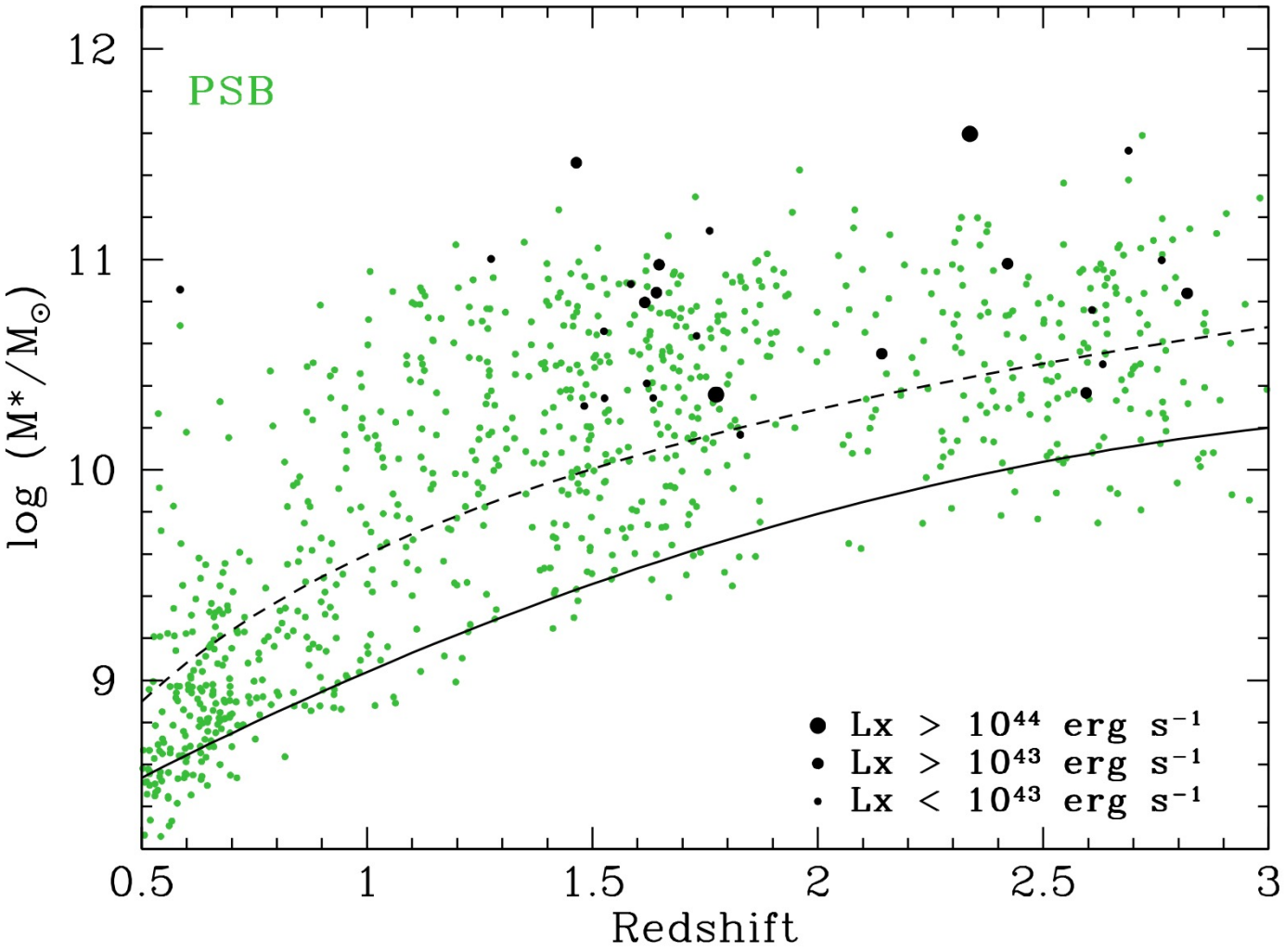


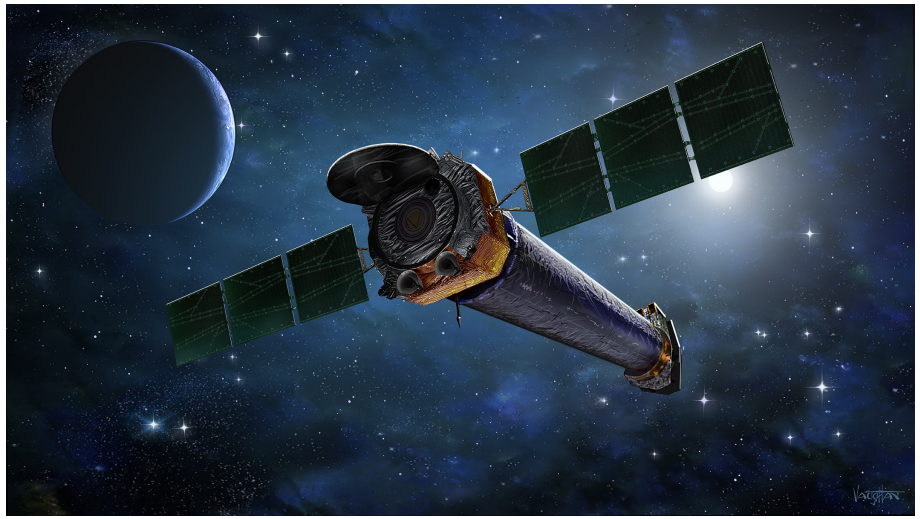
No evidence for excess AGN activity in high-mass PSBs (Chandra detections, $L_X > 10^{43}$ erg s^{-1})



Almaini et al. (in prep)

Could we be missing a large population of fading AGN?





Chandra X-UDS (200-600 ks)

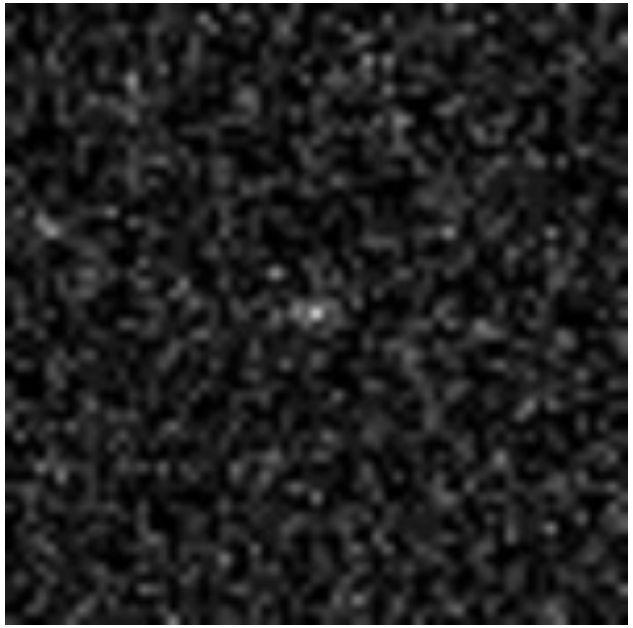
Only 6% of PSBs detected ($M^* > 10^{10.5}\ M_\odot$)

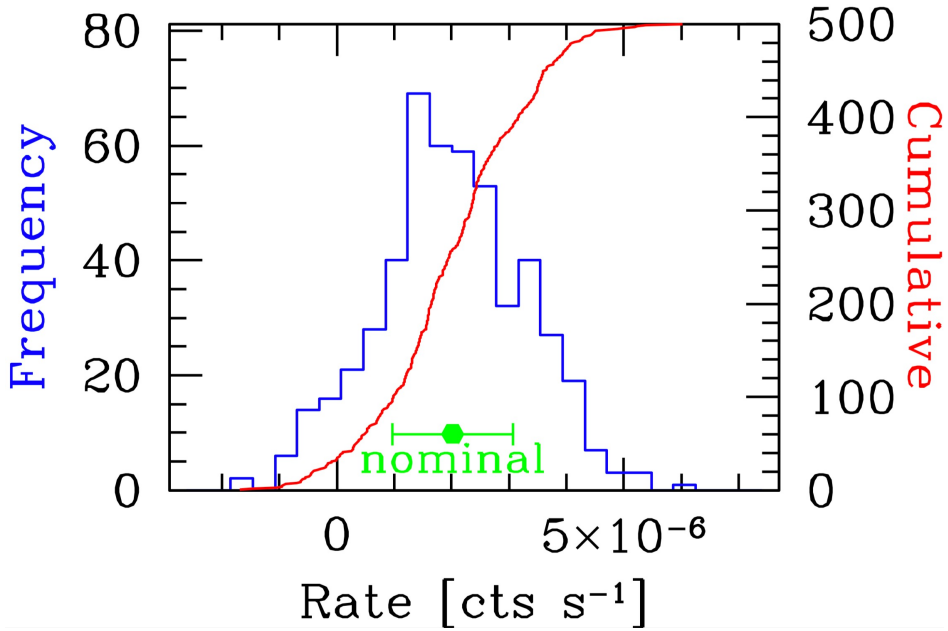
Almaini et al. (in prep)

Chandra stacking with CSTACK

119 PSBs

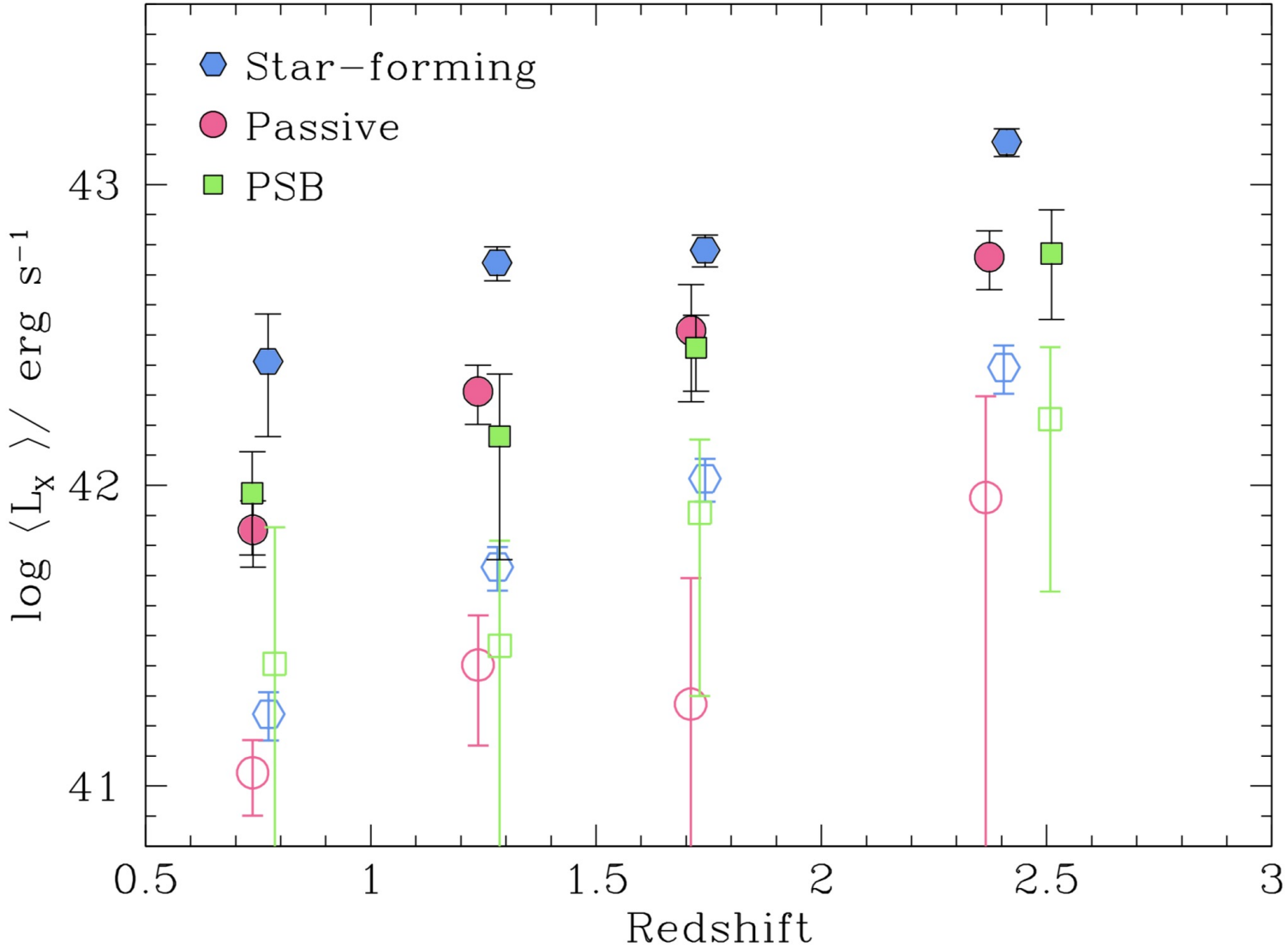
$2<z<3 \quad M^* > 10^{10.5}\ M_\odot$





$\langle Lx \rangle_{0.5\text{-}8keV} = 2.4 \pm 1.3 \times 10^{42}$ erg s^{-1}

Chandra stacking reveals low-level AGN activity … but no enhancement among PSBs

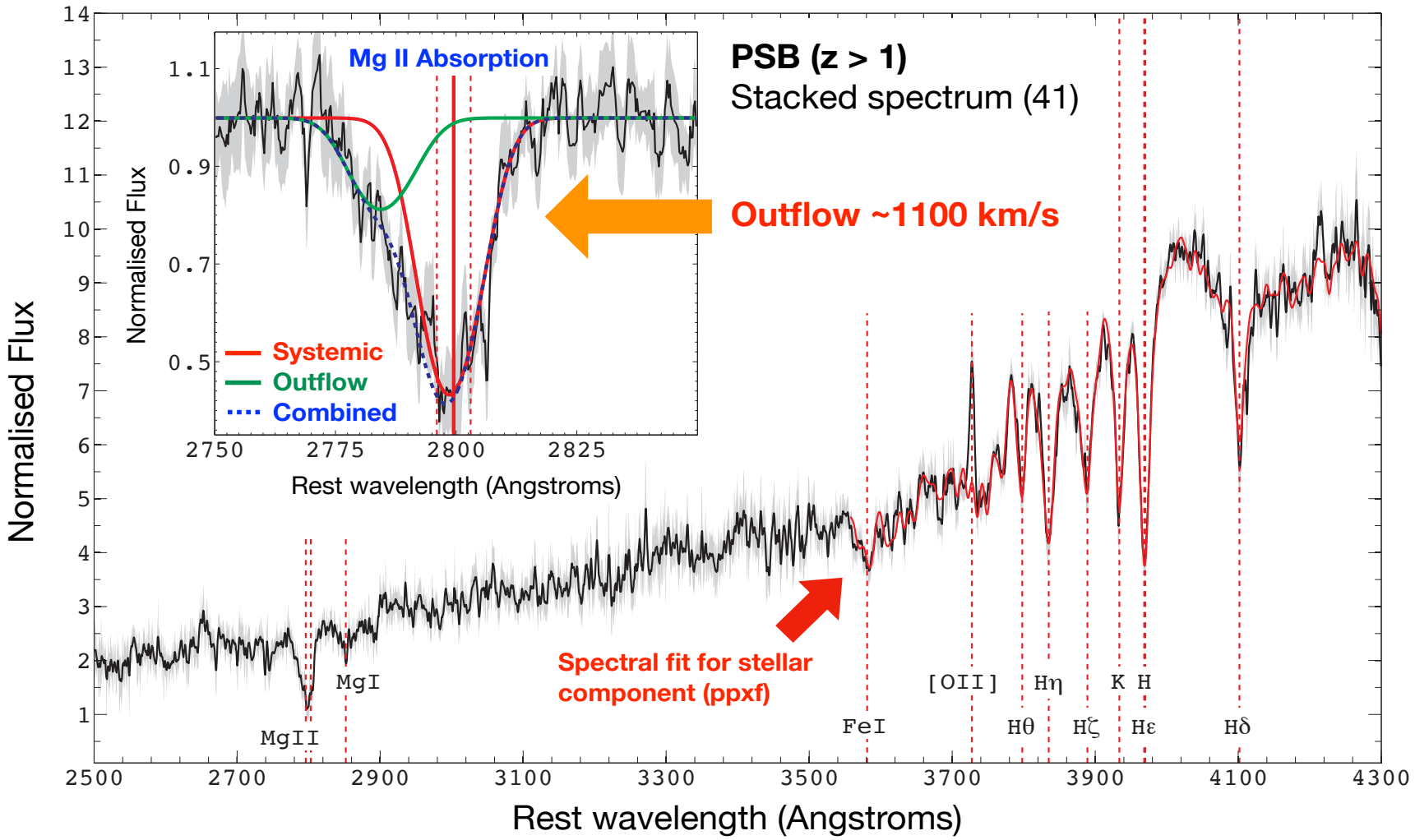


$M^* > 10^{10.5}\ M_\odot$

Almaini et al. (in prep)

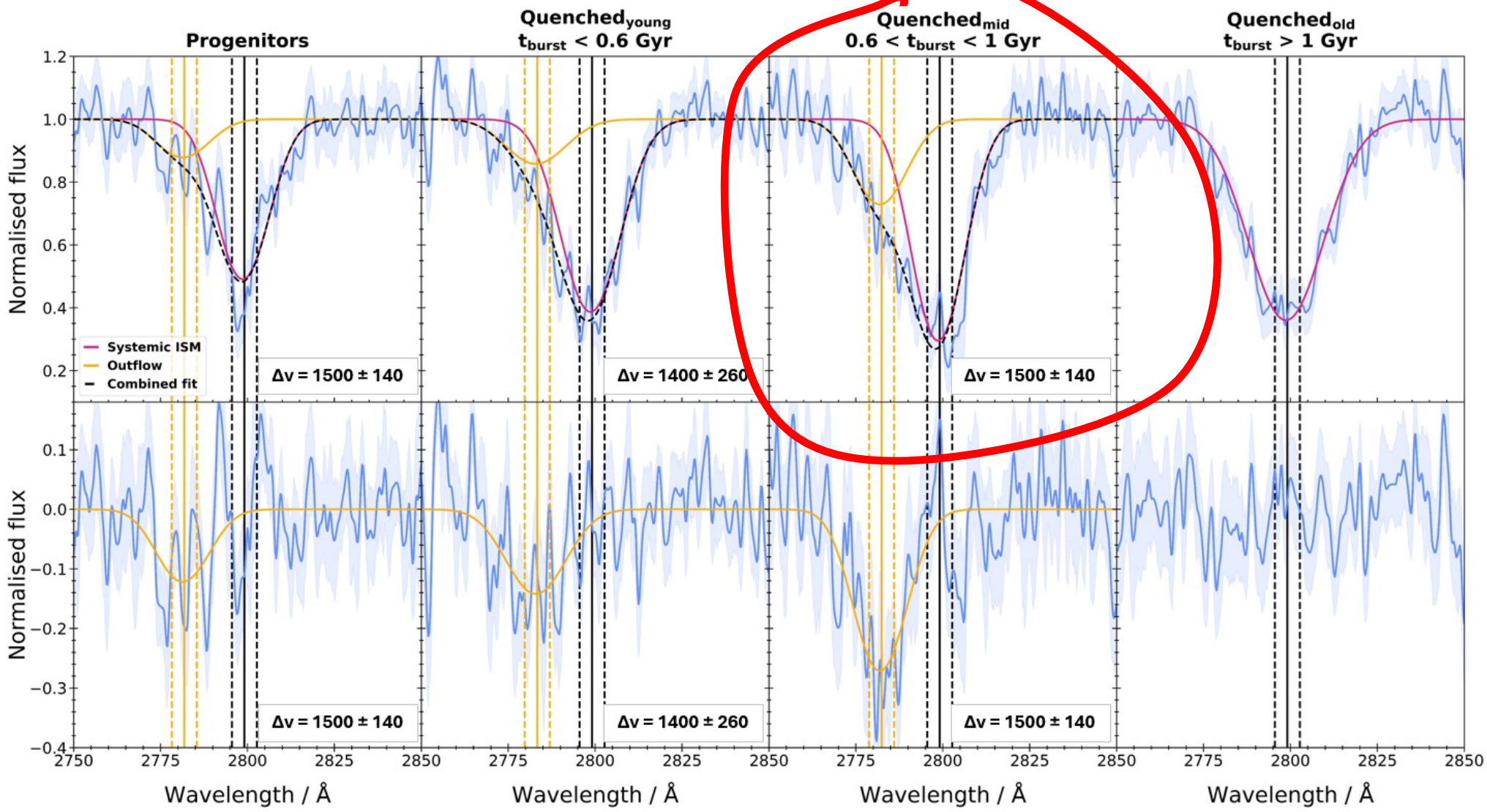
Are AGN just along for the ride?

How do we explain outflows in high-z PSBs?



Maltby et al. (2019); see also Tremonti et al. 2007, D'Eugenio et al. (2024), etc

High velocity outflows in older quenched galaxies



Taylor et al. (submitted)

Can observed AGN activity explain outflows?

Kinetic power
(~10 $M_\odot$ yr^{-1}, 1000 km/s)

$P_{outflow} \sim 3 \times 10^{42}$ $ergs^{-1}$

PSB AGN power
(when "on")

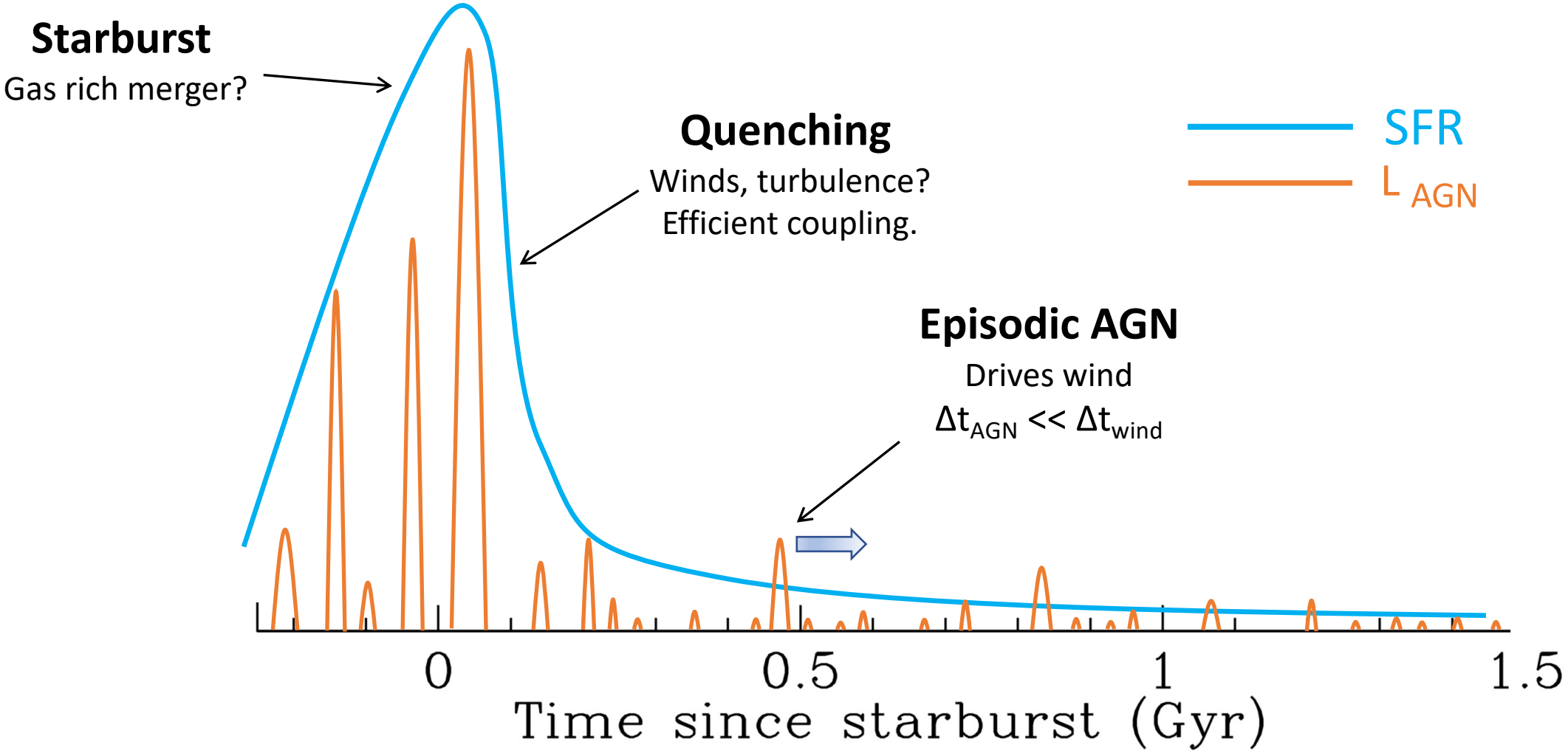
$L_X \sim 5 \times 10^{43}$ erg s^{-1}
$L_{bol} \sim 5 \times 10^{44}$ erg s^{-1}

e.g., AGN on for ~1Myr ➔ Drive outflow for ~1kpc

AGN "off" for ~10 Myr, relic outflow visible

➔ Short duty cycle: $\Delta t_{AGN} << \Delta t_{wind}$

Plausible evolutionary scenario



Summary and conclusions

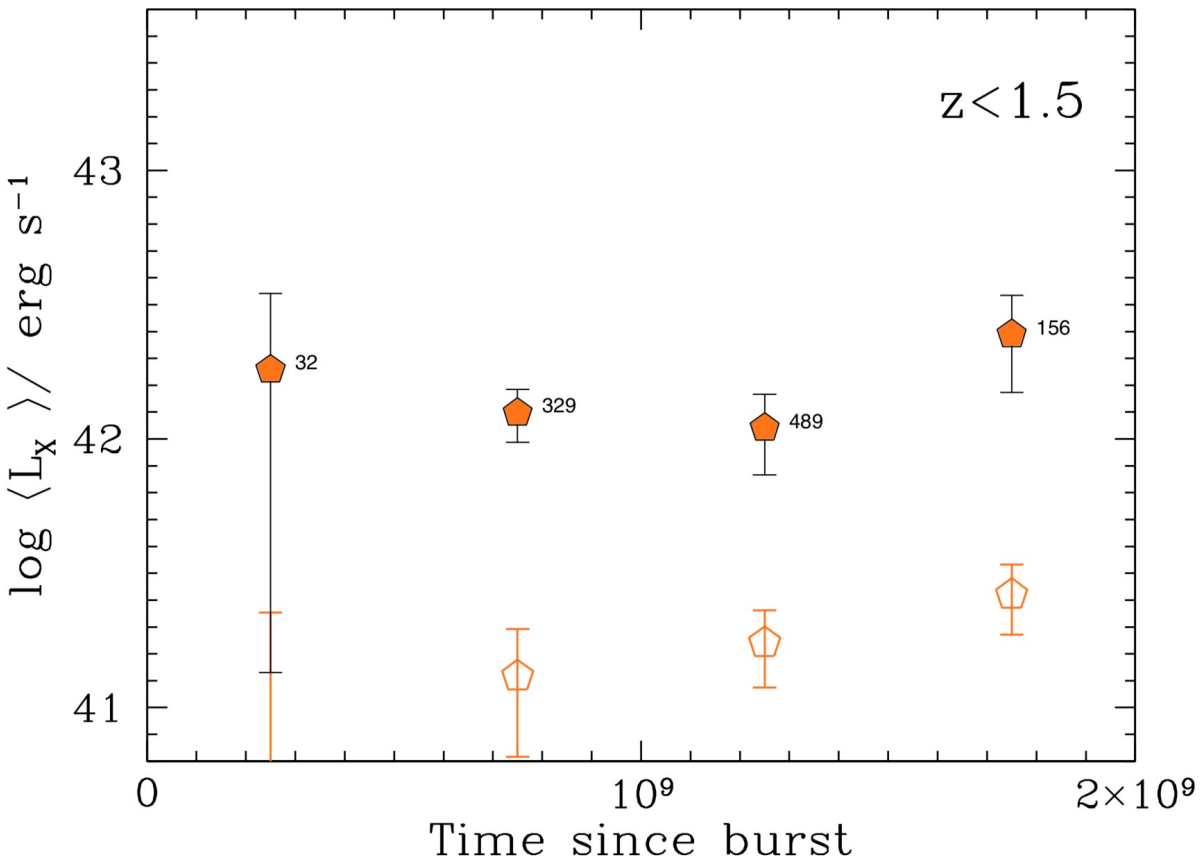
- No evidence for excess X-ray AGN in high-mass PSBs at z~2
- Bright AGN in PSBs ~5% of the time → Sufficient to drive outflows
- Possible interpretations:
  - AGN “along for the ride”?
  - AGN more efficiently coupled to the gas in this phase?
  - Analogues of the X-ray quiet high-z systems?

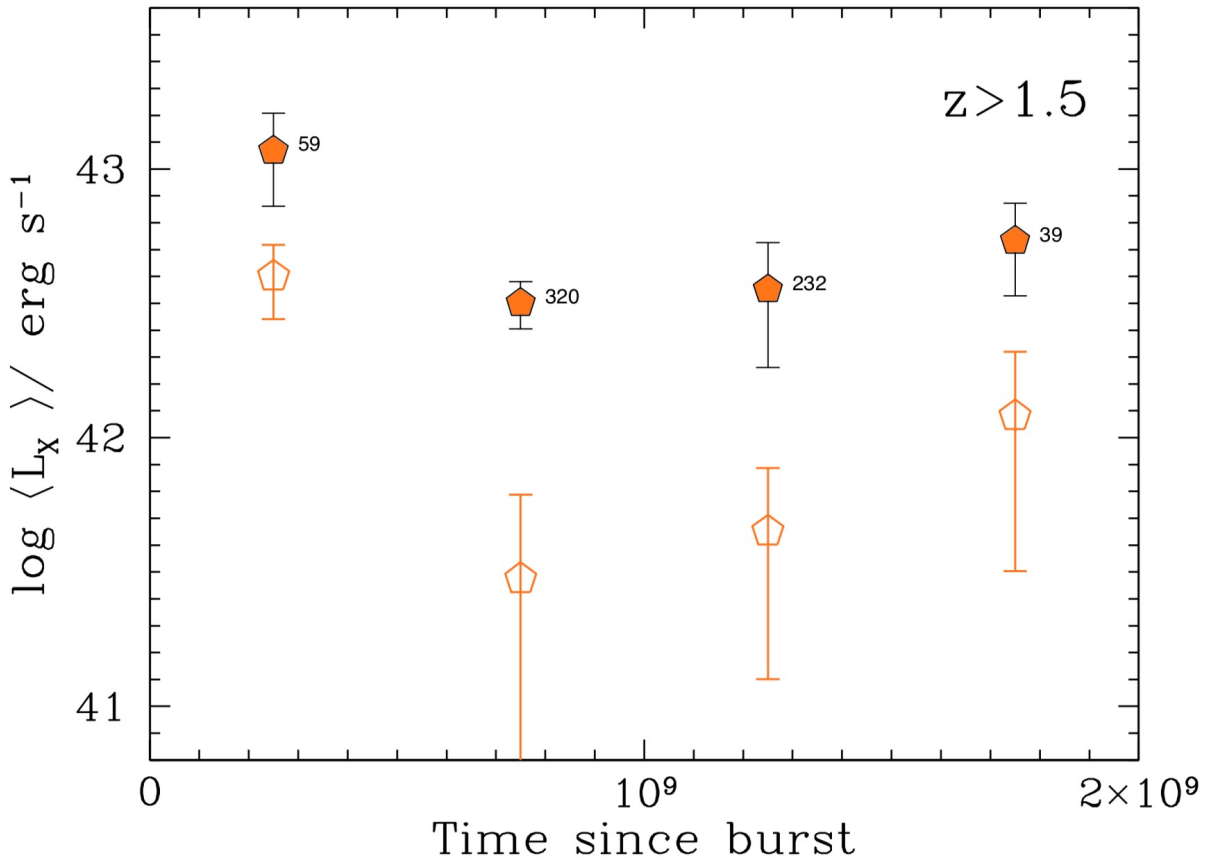
- Caveats: Missing Compton-thick AGN

  Missing unobscured luminous quasars

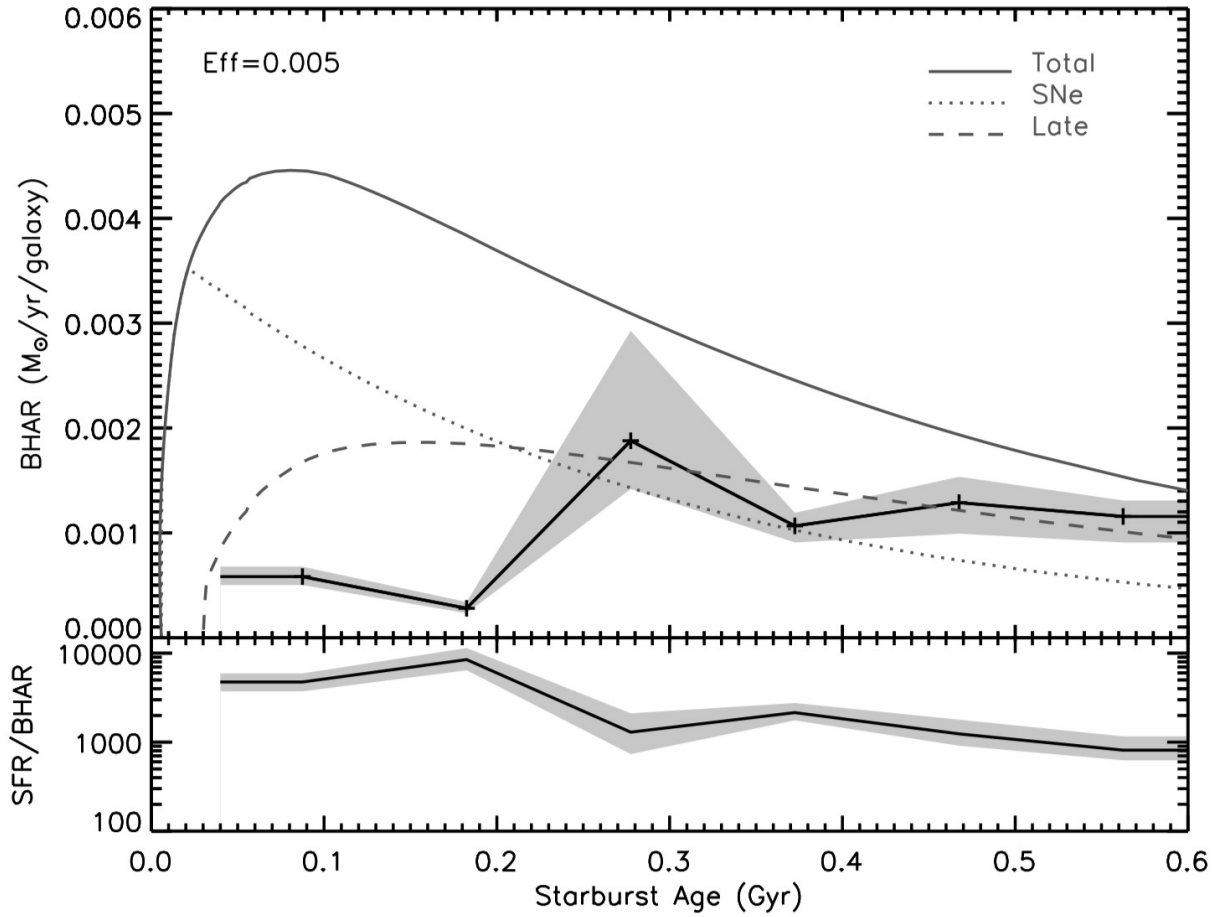
Extra Slides

Young and old quenched galaxies show similar low-level AGN activity





Local AGN activity peaks ~250 Myr after the starburst



Wild et al. (2010)
Davies et al. (2007)