Studying high-redshift AGN host galaxies & co-evolution with Adaptive Optics

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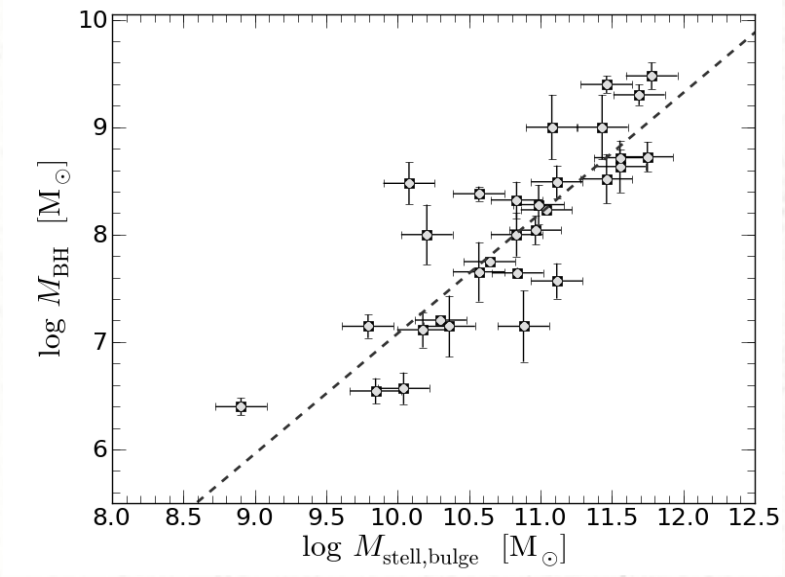
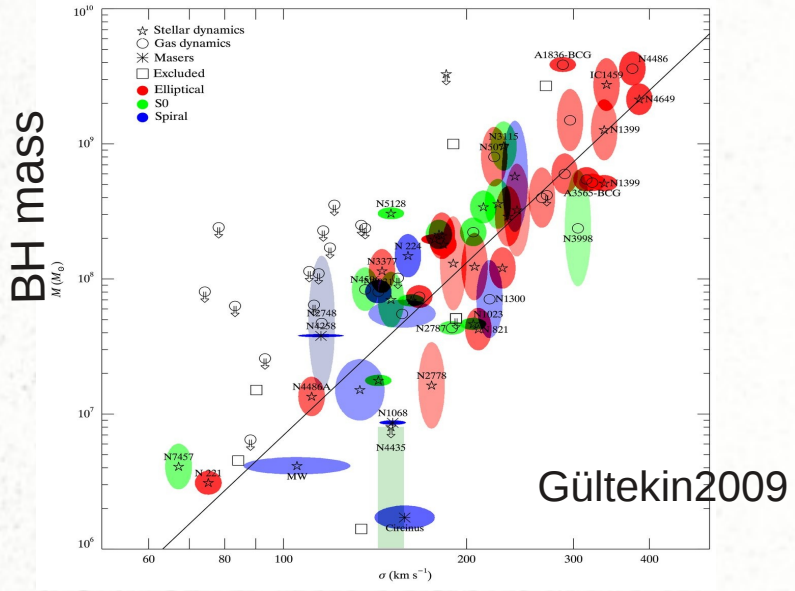
Motivation for AO to study AGN hosts

- Redshift evolution of the scaling relations

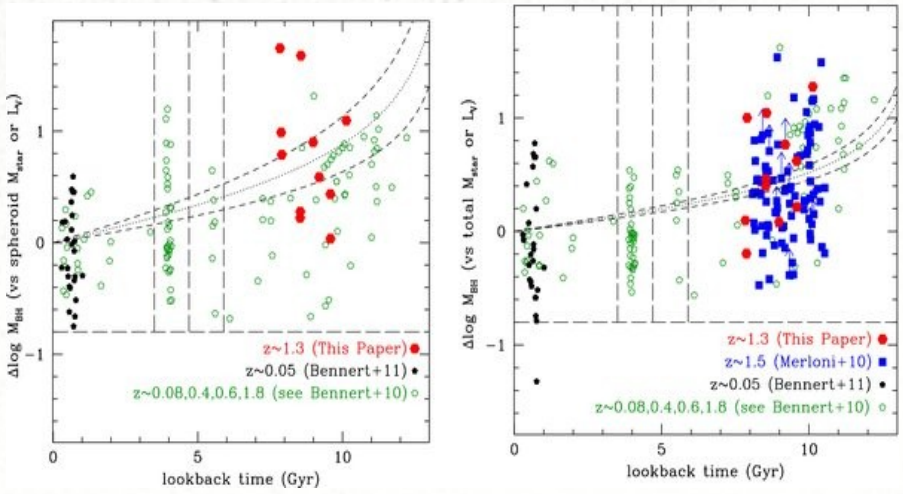


Häring&Rix2004



Gültekin2009

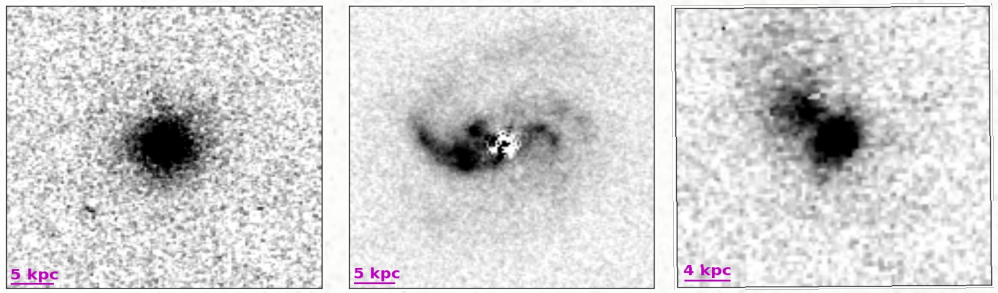
bulge velocity dispersion



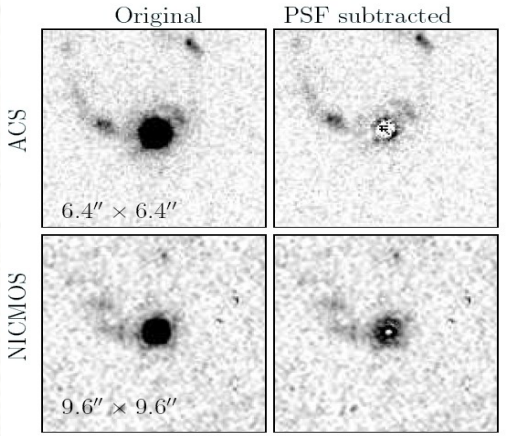
High resolution imaging mainly with HST

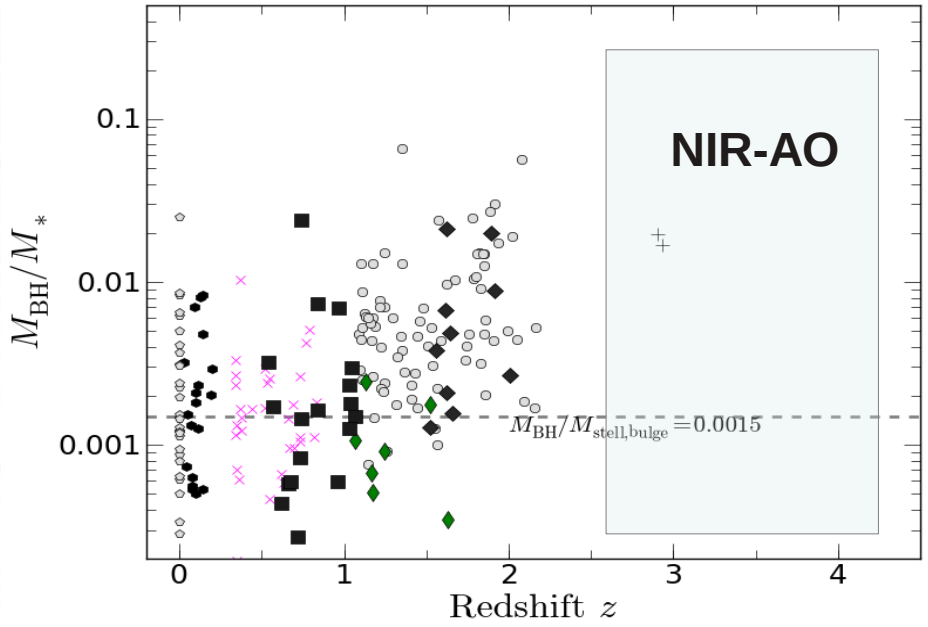
HST suited for z<2.5 to probe rest-frame optical

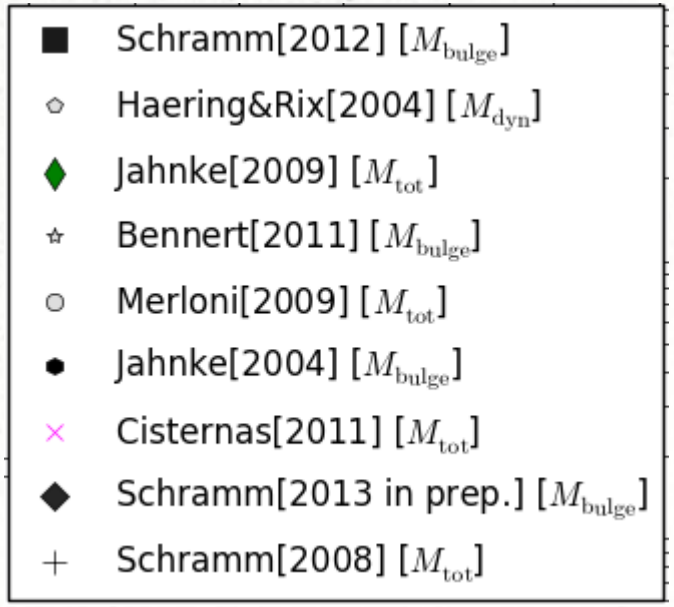
z<1 AGN host galaxies with ACS



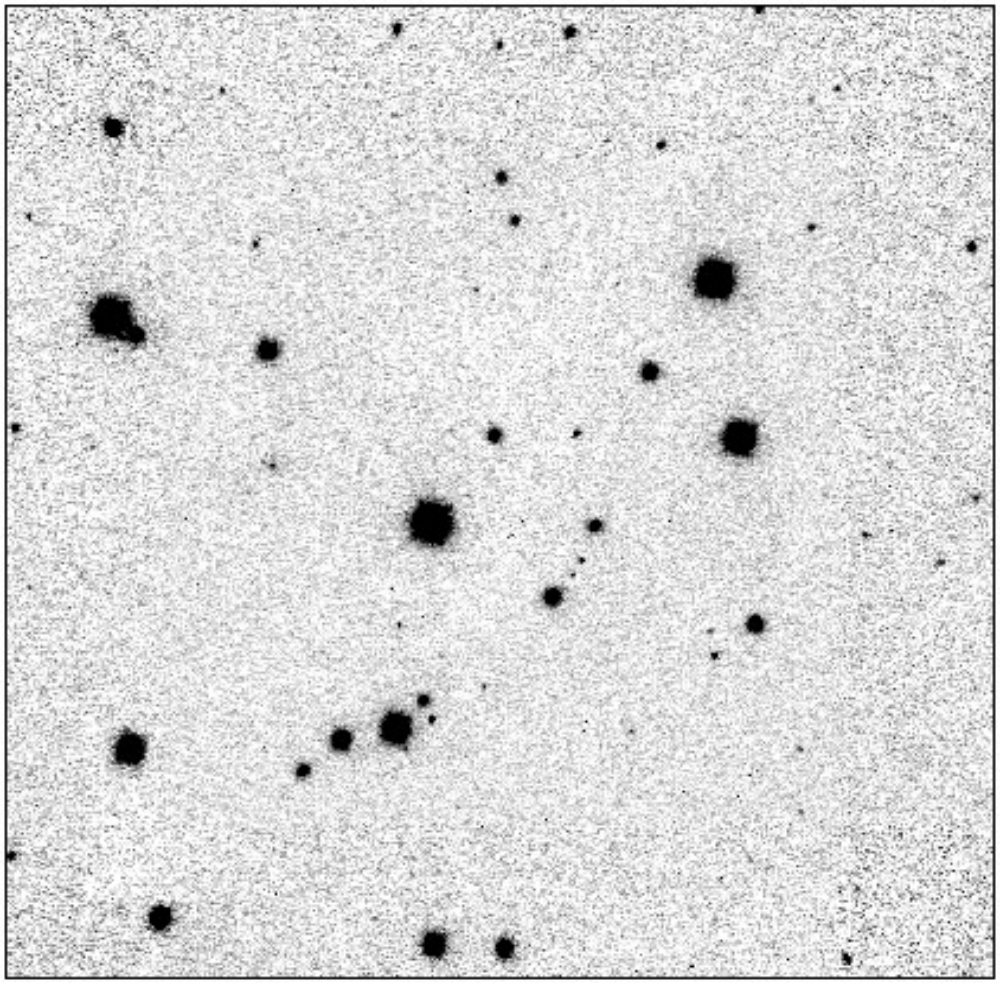
z=1.5-2







Essential for the analysis: the PSF



Necessary Information:

(1) PSF at QSO position
→ usually not known

(2) PSF from nearby stars

(3) PSF variability

PSF variability from open cluster observations M35

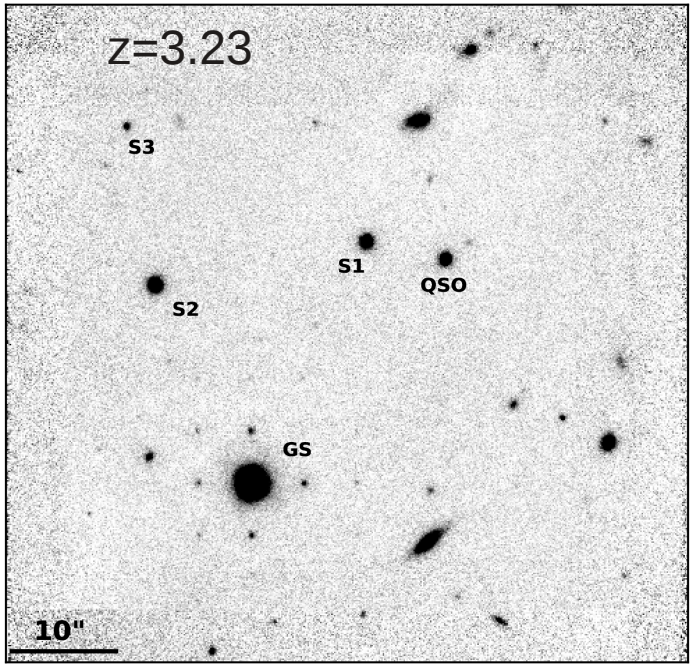
Fit each star with analytic profiles

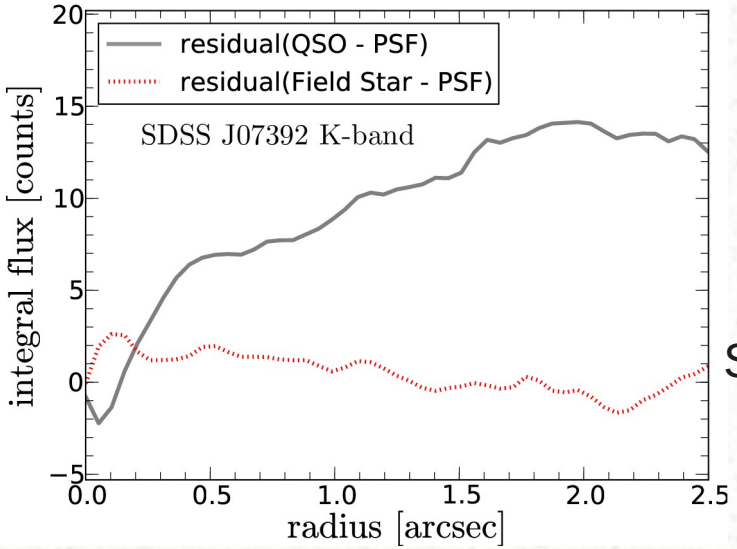
Two Possibilities

- Many stars in the FoV to model PSF variability
- Strong constraints on the PSF position (close to target and at same distance from GS)

Important: PSF at least critically sampled

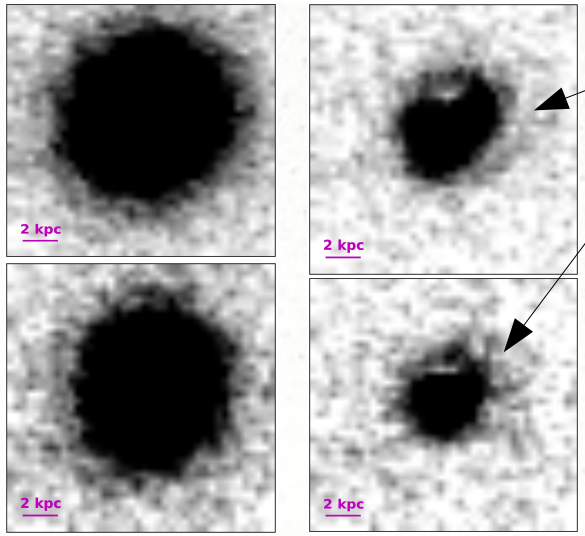
Successfully resolved AGN hosts with current IRCS+AO188





QSO-PSF(S1)

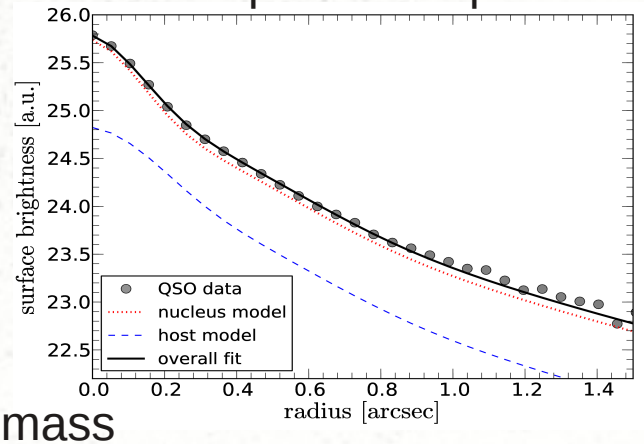
S2-PSF(S1)



well resolved host galaxy

Even asymmetries in the host are visible

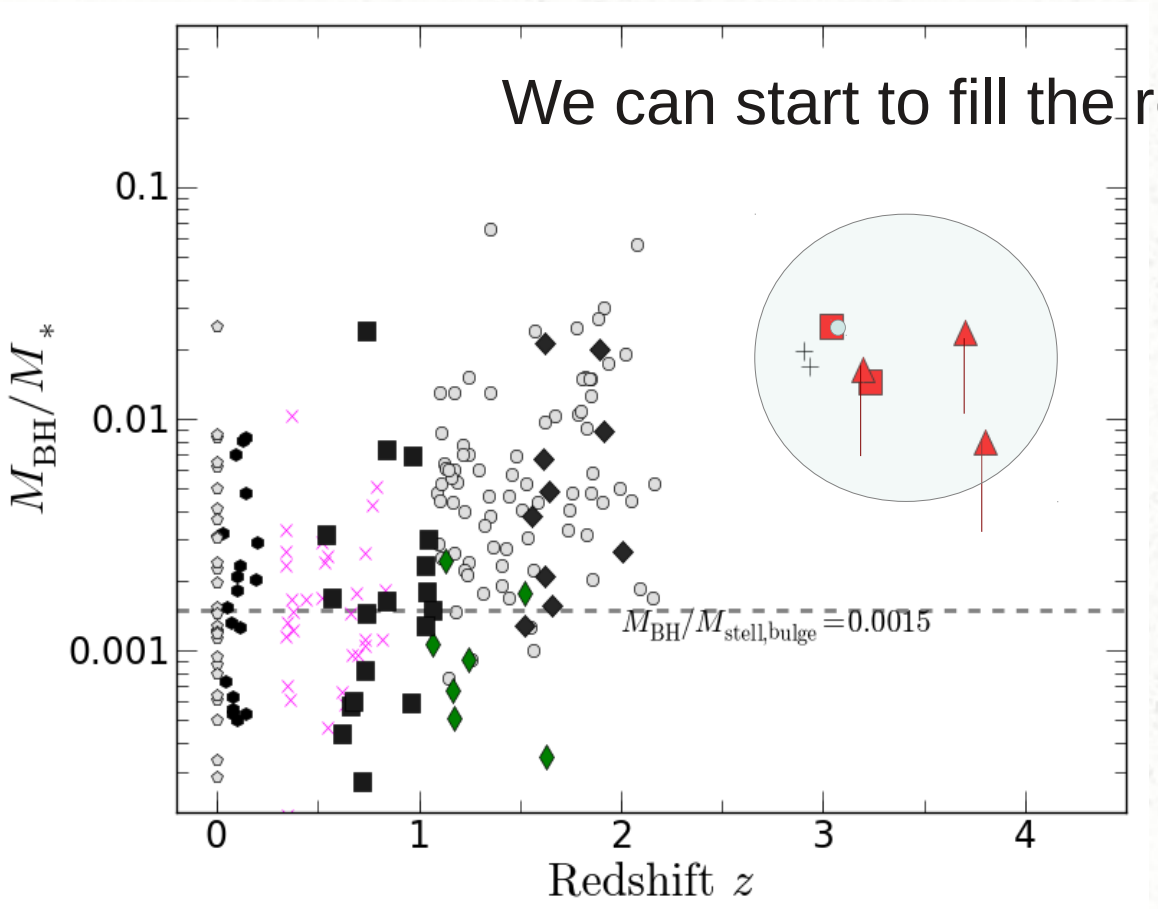
Decomposed SB profile



We can estimate stellar mass
LogM*=11.2

MBH-MBulge Relation at z~3-4

We can start to fill the region at z>2.5



BUT: We need many nights (Minowa-san can confirm)

Reminder: GLAO as a survey instrument

ECDFS
1100 armin²

Why do we need a wide FoV GLAO?

Selection of high-z Quasars suitable for AO

SDSS DR7: ~7000 total at 3<z<4

~3% suitable for current AO/NGS

<5% suitable for current AO/LGS

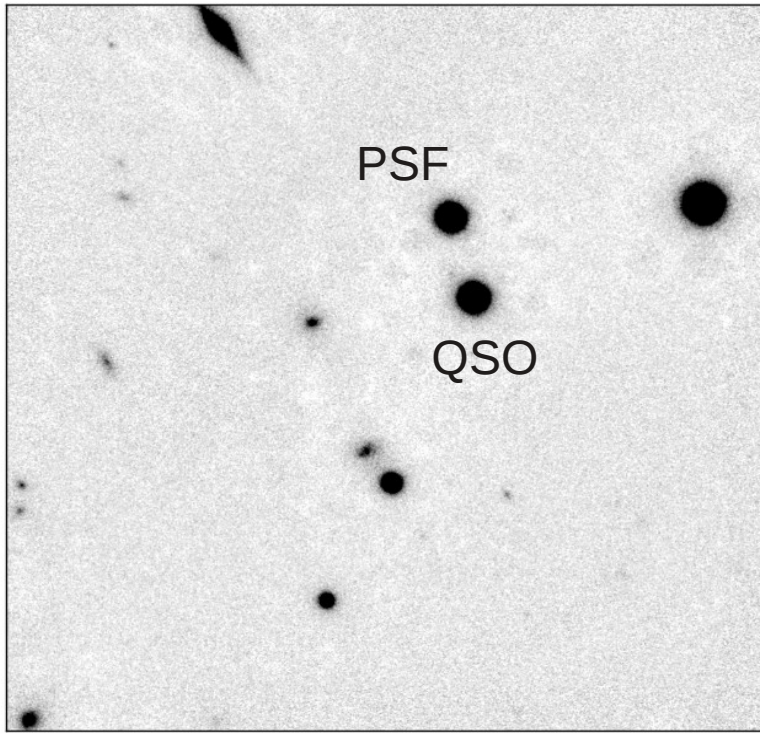
Criteria for a NGS:

- PSF star at r<10" **[strong constraint]**
- bright guide star at r<25"
- spectrum to estimate M_{BH}
- more stars in FOV for PSF
-(distance PSF-GS = QSO-GS) **[strong constraint]**

We are probing the most massive systems

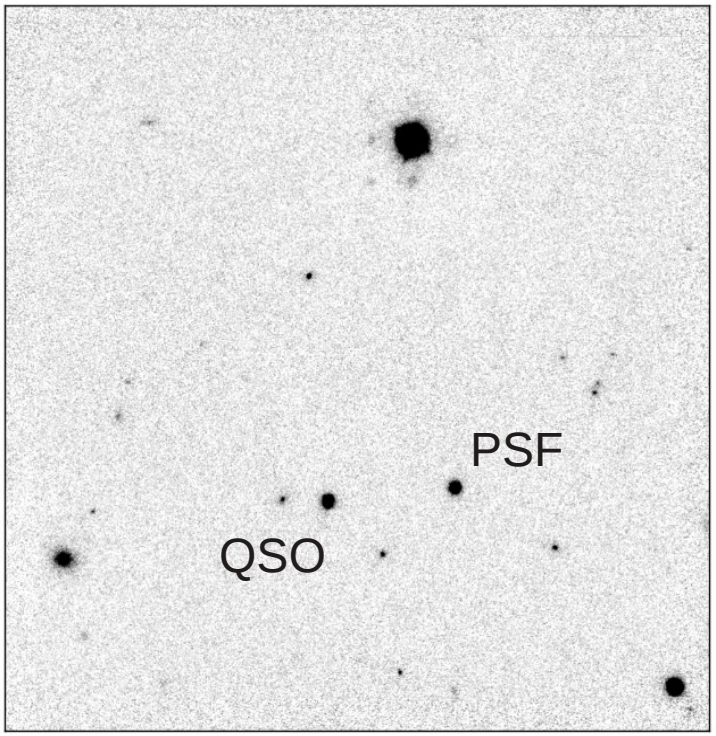
What is a good target for current AO

K-band – LGS



z=3.80

K-band LGS



z=3.24

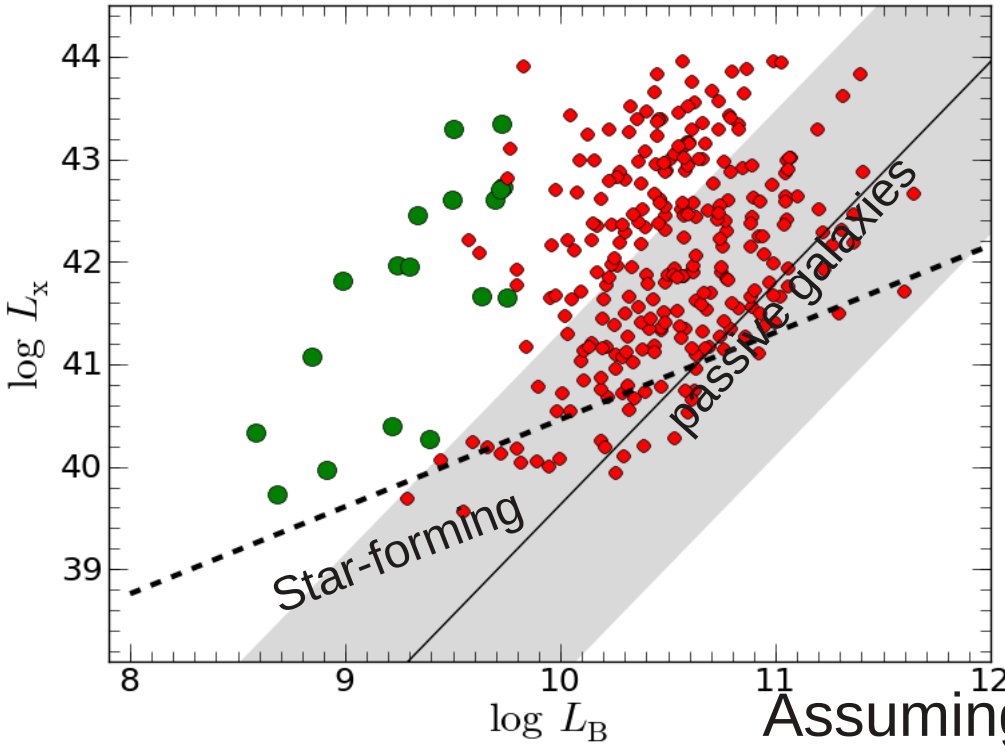
Advantage of GLAO

- Basically no limitations on the targets due to wide FoV (field stars for PSF modeling & sufficient GS candidates)
- Low luminosity targets possible (FoV needed)
- Large selection bias free samples possible (SUBARU GLAO as a survey instrument)

Studying BH growth with GLAO

Look at the smallest BHs in galaxies

- X-ray selected low-mass BHs z<1



Look for X-ray excess in low-mass galaxies

3 promising cases at z<0.3

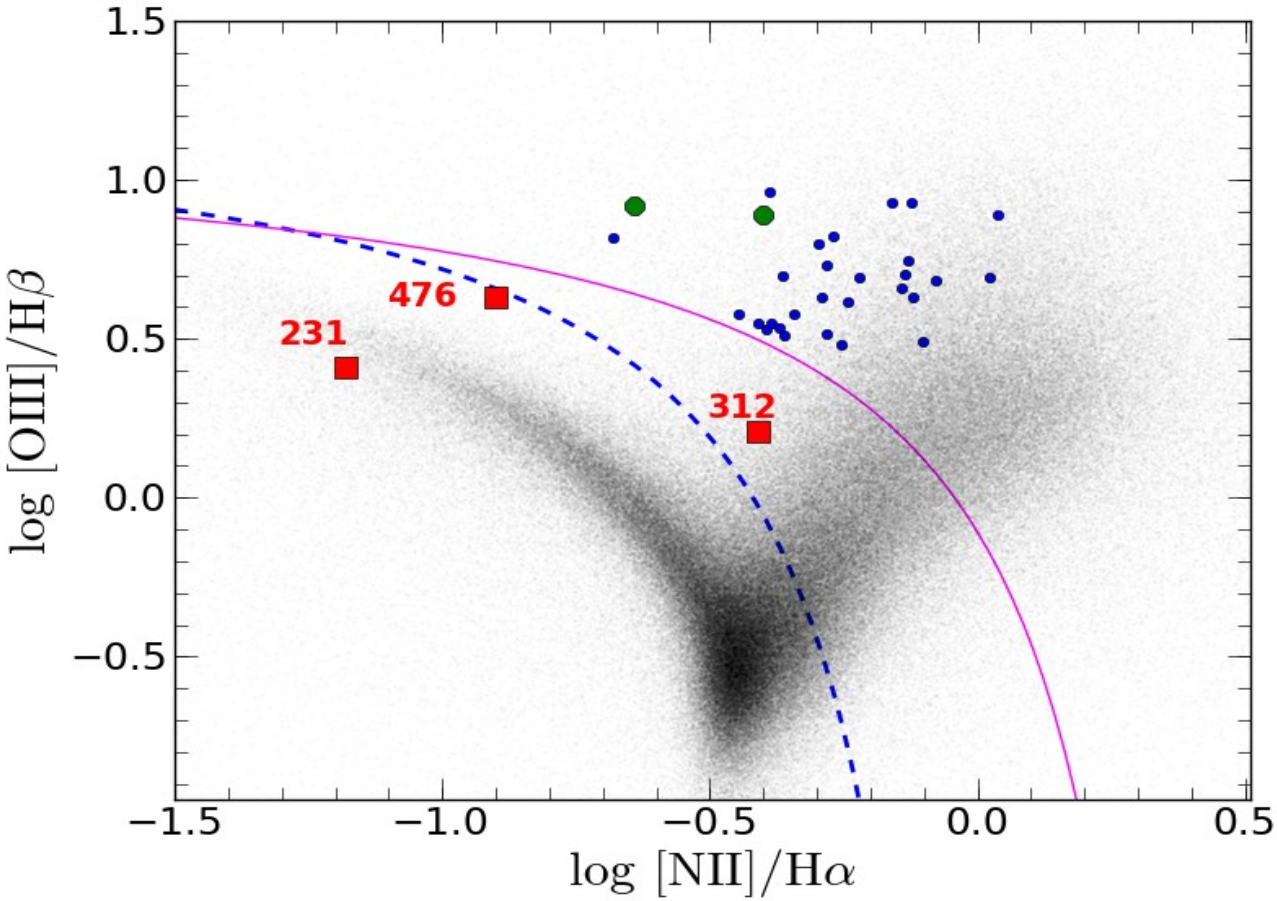
So far: ~30 candidates z<1 in ECDFS

Assuming the local scaling relations

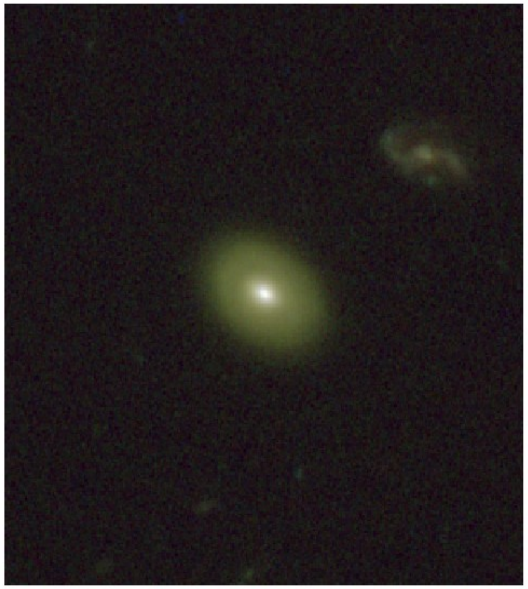
Schramm et al 2013b

log M_{BH}= 5.2-6.2 M_{sol}

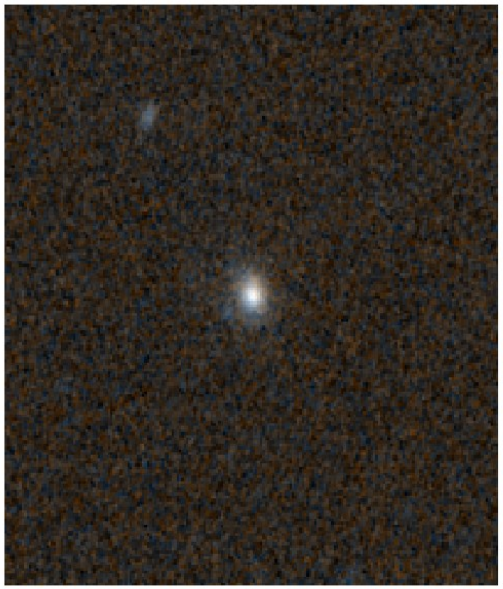
We can study the occupation fractions of low-mass BHs and their hosts



Low-mass BHs in low-mass galaxies



z=0.131

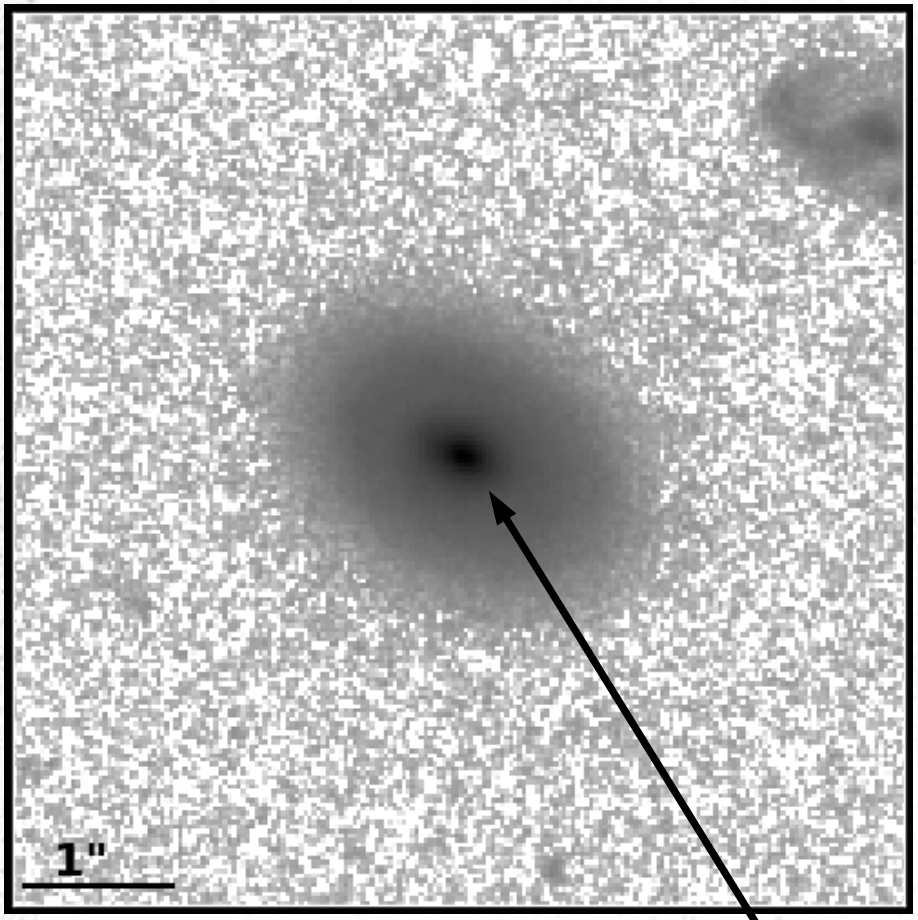


z=0.285

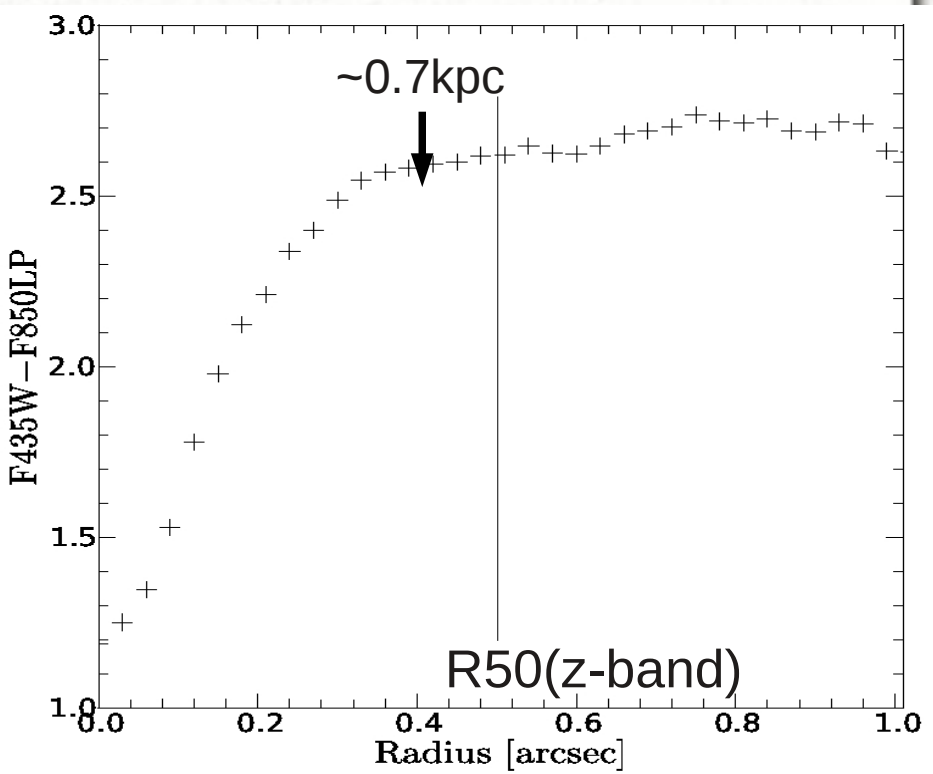
z=0.128

Three galaxies: three different morphologies

Looking at Hα with IFU or NB

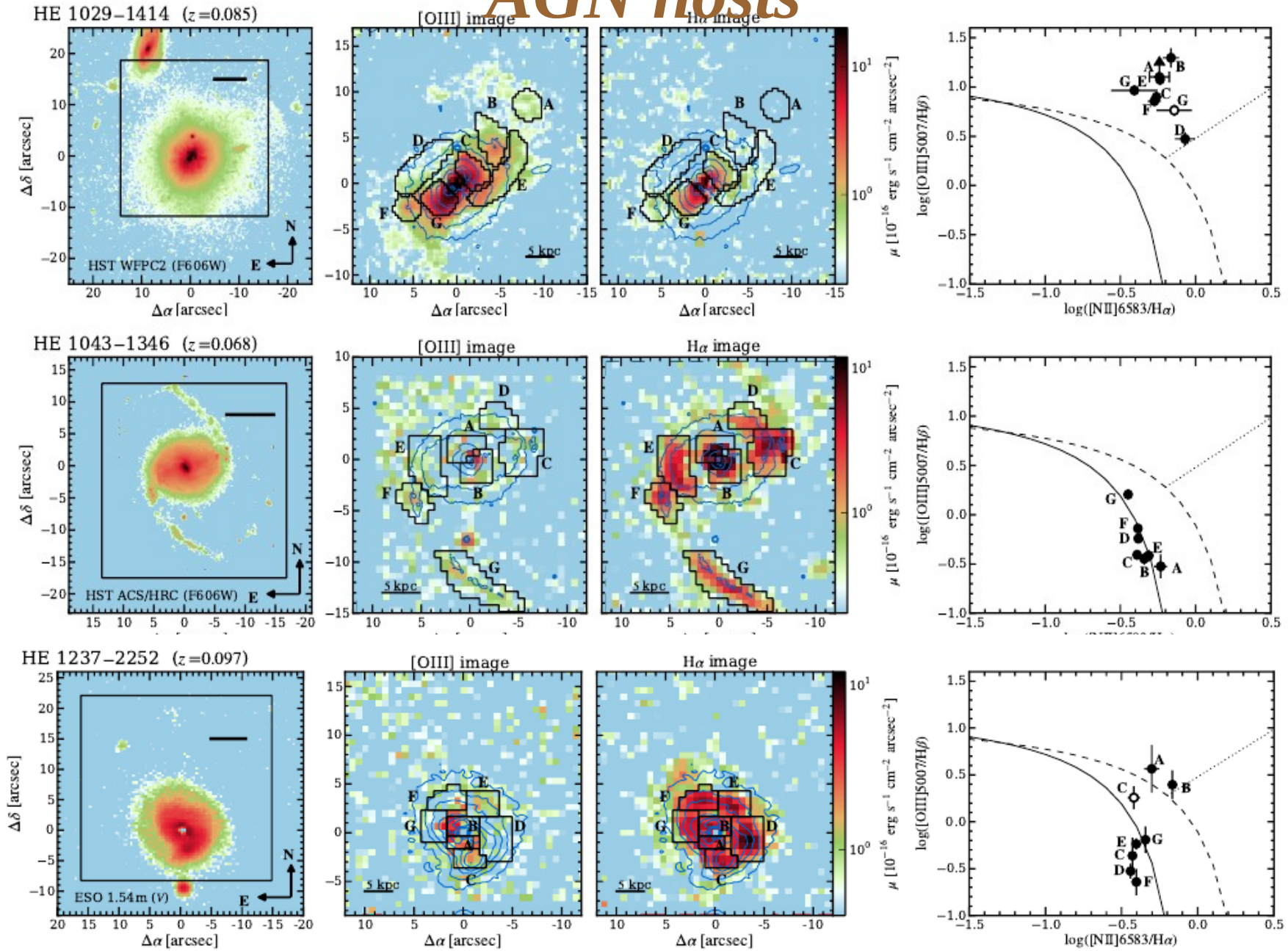


Radial color profile



Final application: ENLR size – luminosity relation, star formation and resolved gas phase metalicites of AGN host galaxies

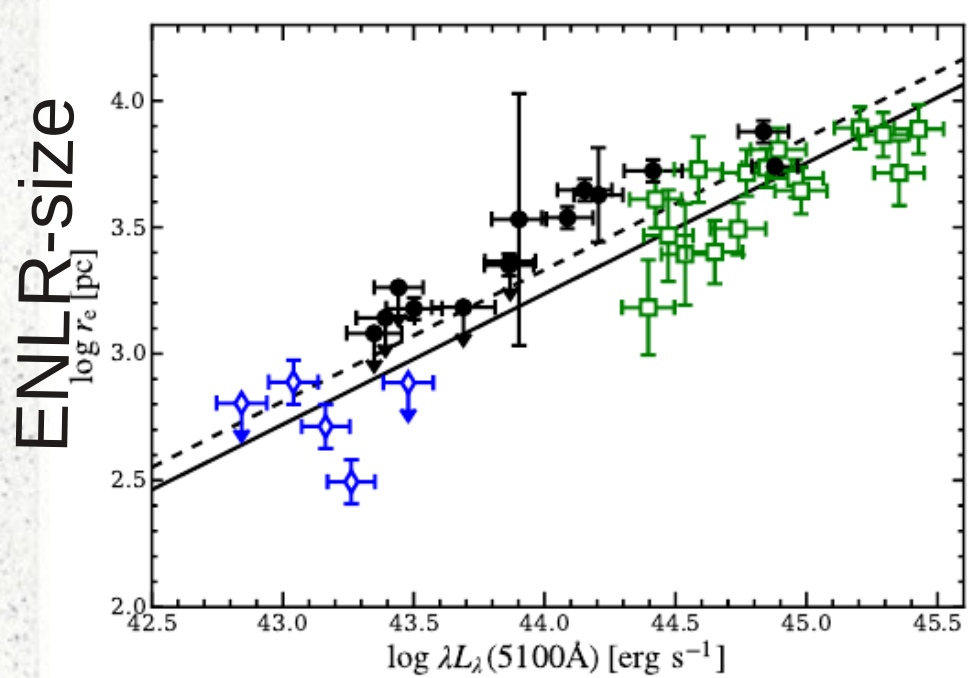
Origin of the ionized gas: IFU studies of AGN hosts



[OIII] Hα

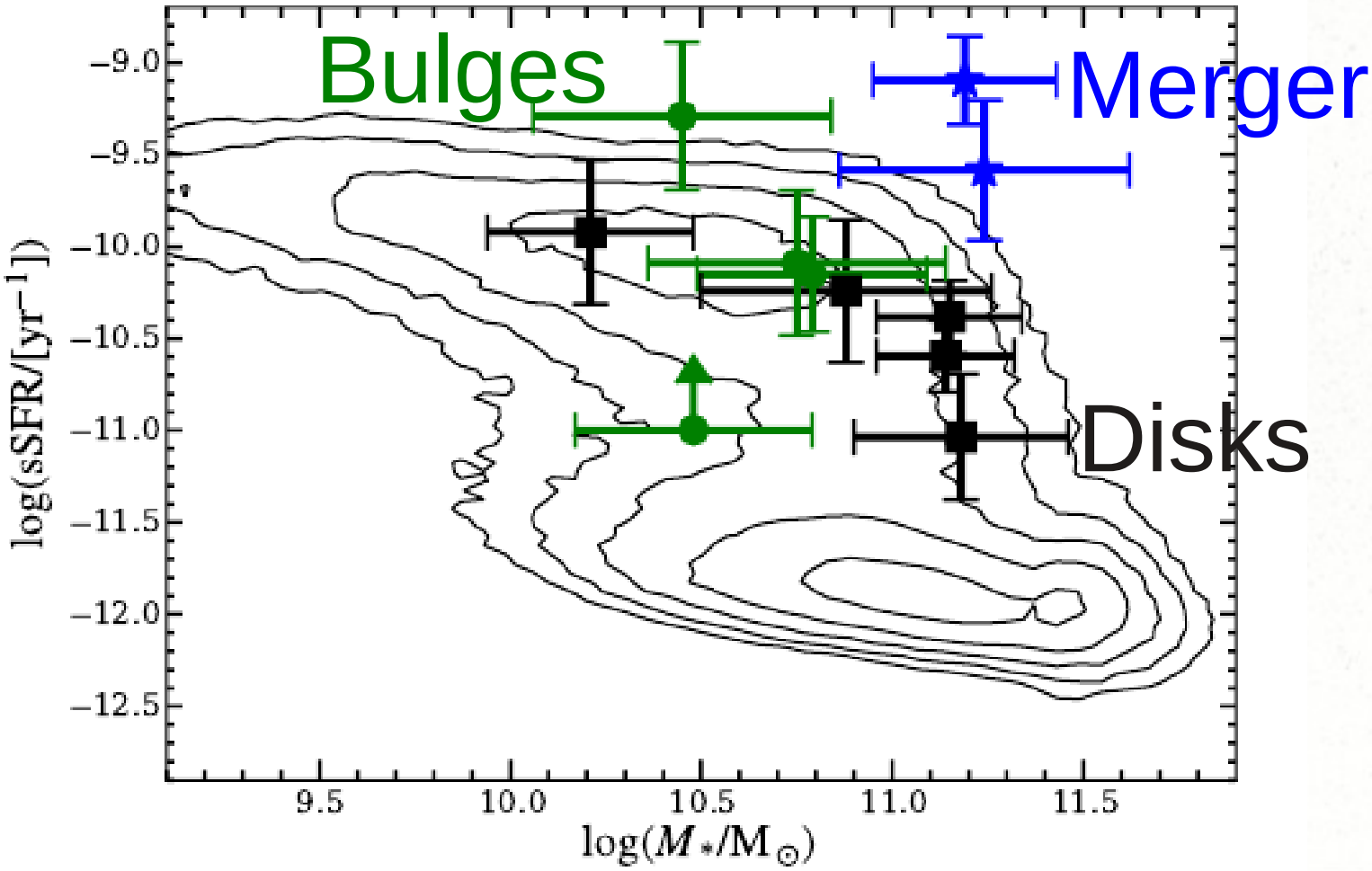
Husemann et al. in prep

Local sample: 19 AGN hosts with VIMOS

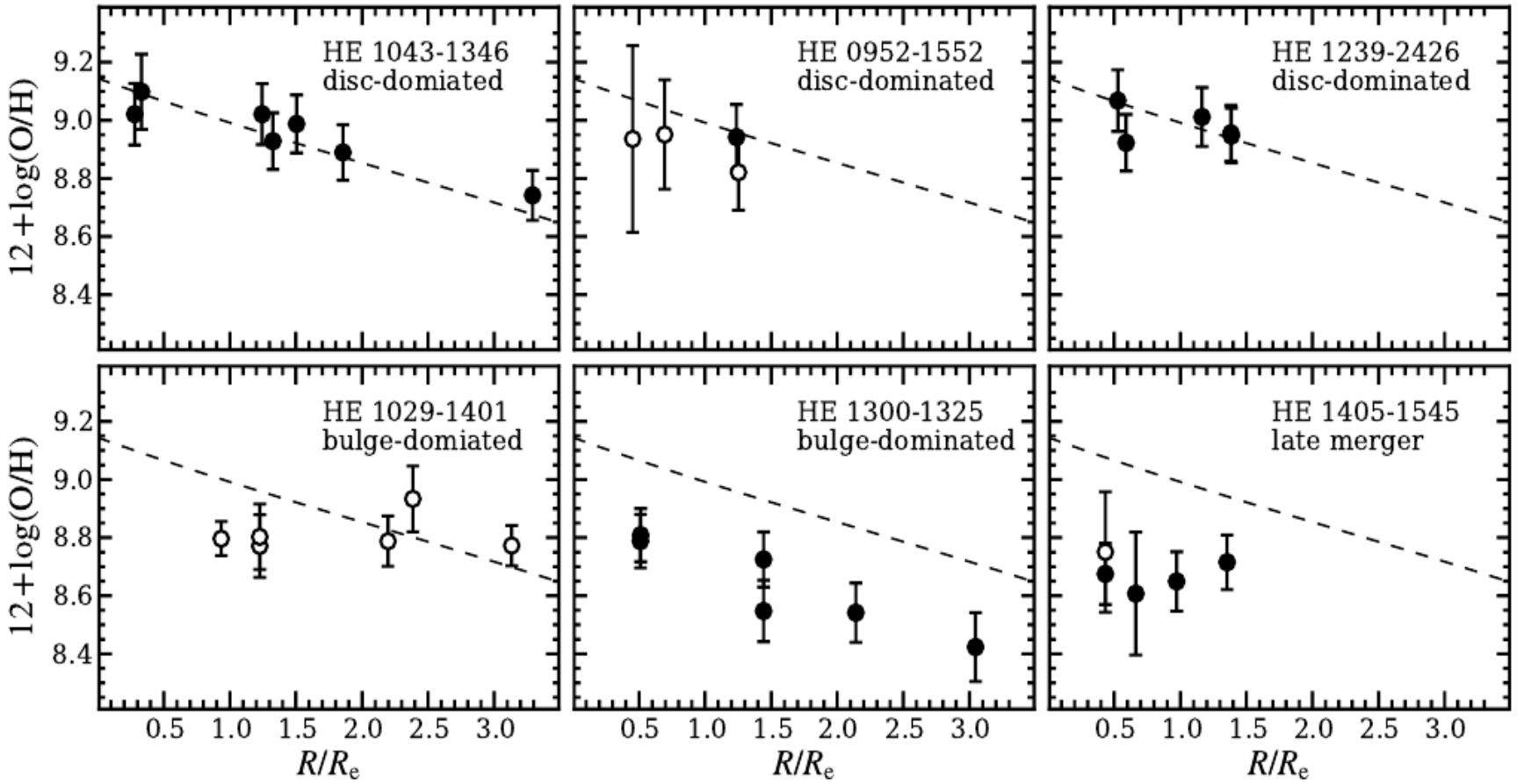


AGN cont. Luminosity

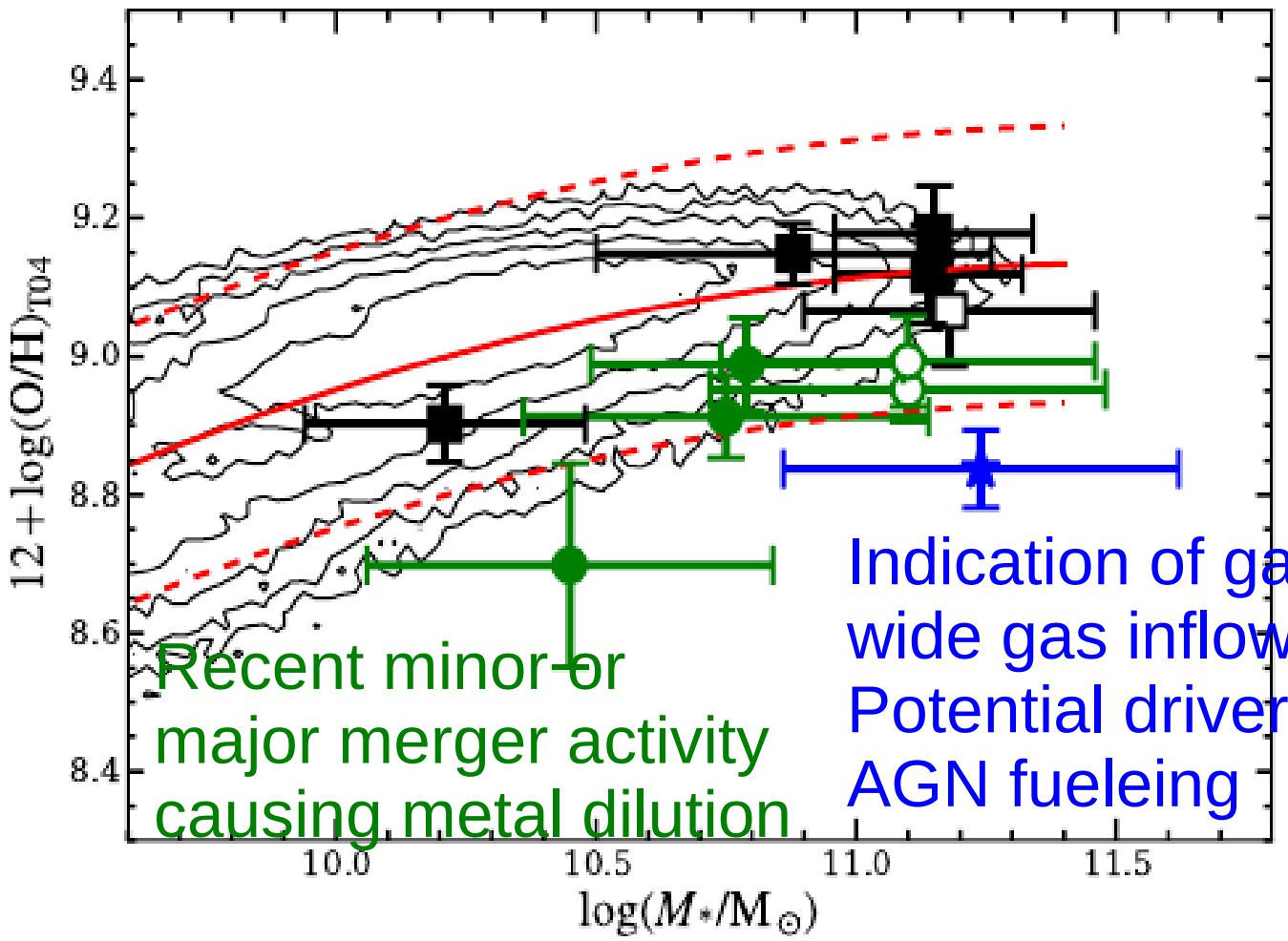
- Flux limited sample
- Blue bulge dominated QSO hosts
- Disks, ellipticals, interacting, mergers
- 27"x27" FoV, sampling 0.66"


Bulges
Merger
Disks
−9.0
−9.5
−10.0
−10.5
−11.0
−11.5
−12.0
−12.5
log(sSFR/[yr^{-1}])
9.5
10.0
10.5
11.0
11.5
log(M_*/M$_\odot$)

Oxygen abundance gradients



Oxygen abundance gradients



Recent minor or major merger activity causing metal dilution

Indication of galaxy wide gas inflows: Potential driver for AGN fueleing

Summary

- At least critically sampled GLAO to study selection bias free samples of high redshift AGN host to probe BH-host co-evolution (broad & narrow band imaging)
- BH formation and growth through NB or IFU studies of low-mass Bhs
- Redshift evolution of: ENLR, ionization origin and resolved gas phase metalicites of AGN host galaxies