Studies on high-z QSO host galaxies using high resolution deep imaging

Yiping Wang

National Astronomical Observatories of China

ypwang@bao.ac.cn

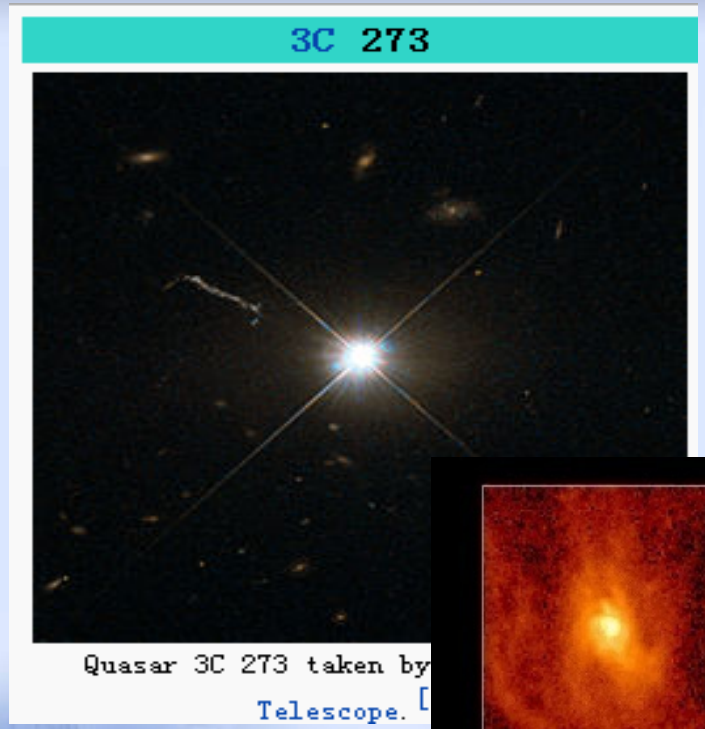
2014/07/18 @Tucson

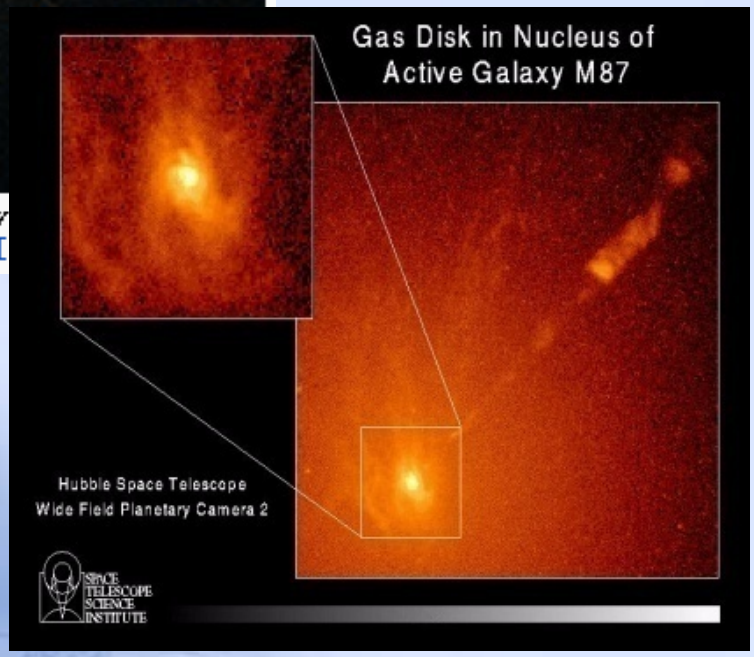
Outline

1) BH growth and host galaxy formation
2) Studies on QSO host galaxies
3) AO deep imaging of z~3 QSO fields

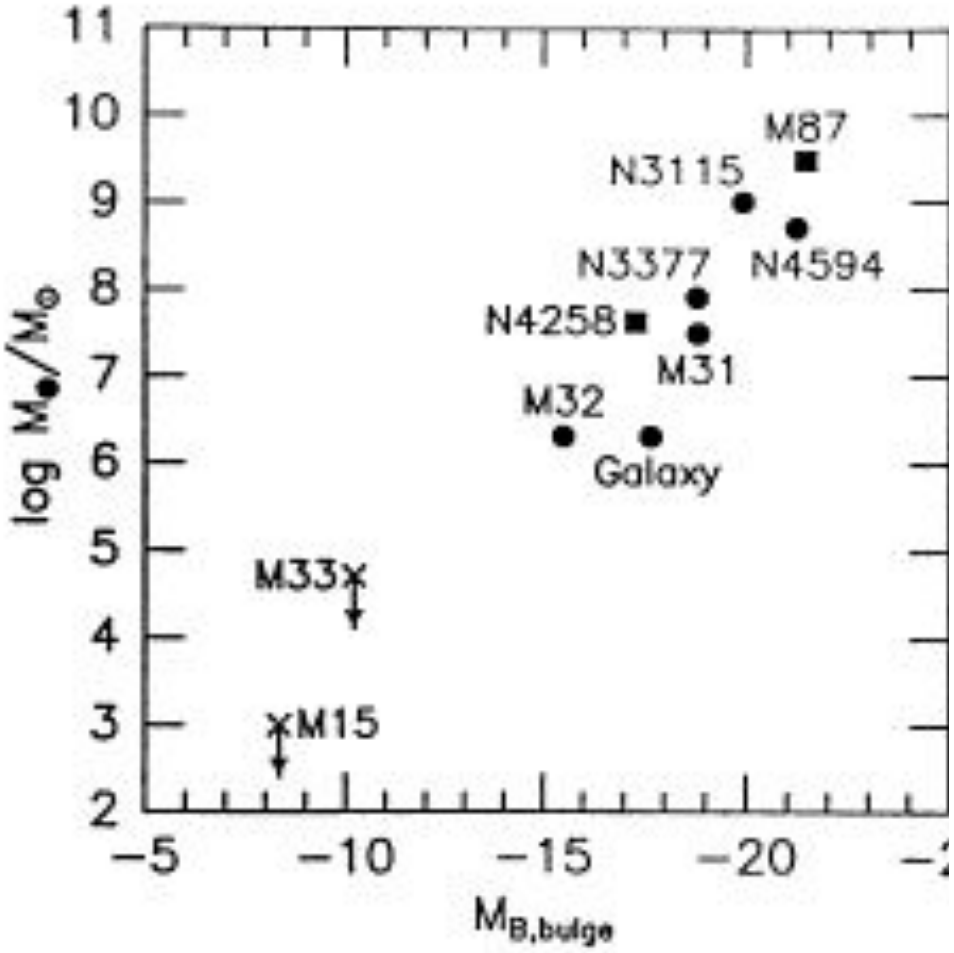
Where comes the fuel to feed BH?

How to power the central engine?

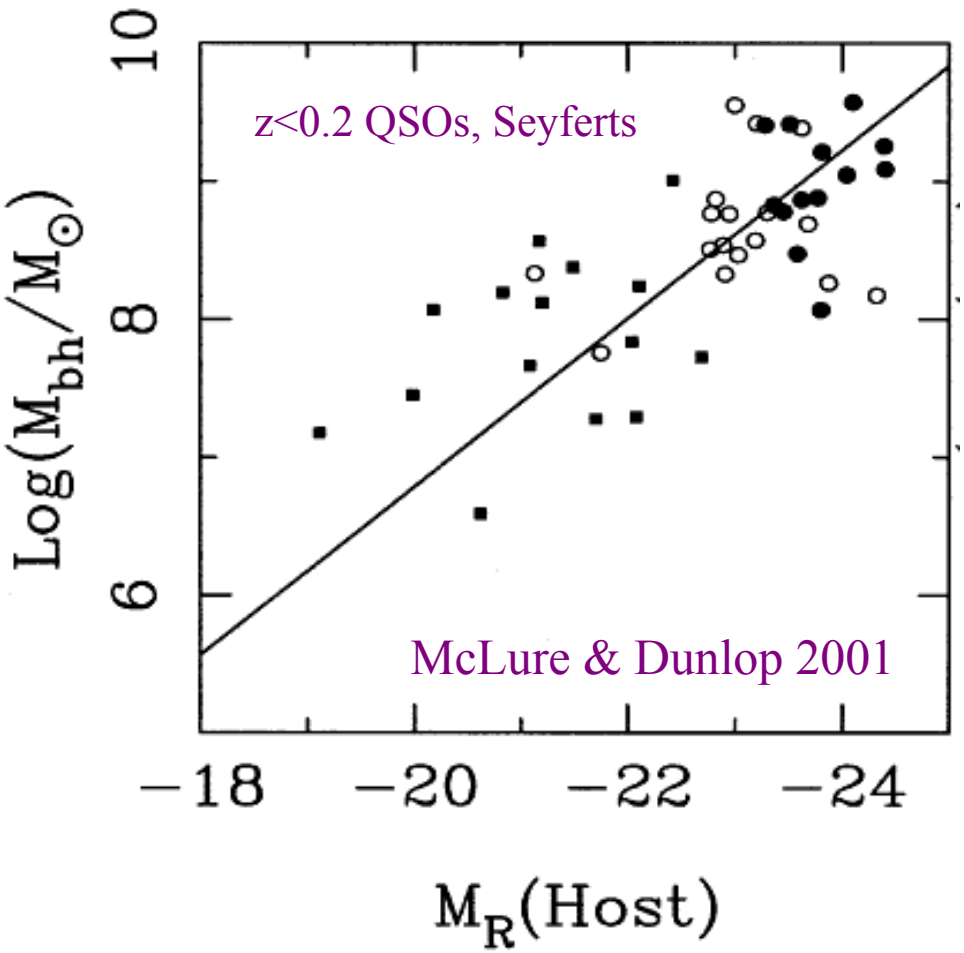




Local scaling relation for inactive galaxies and active galaxies:



Kormendy & Richstone 1995



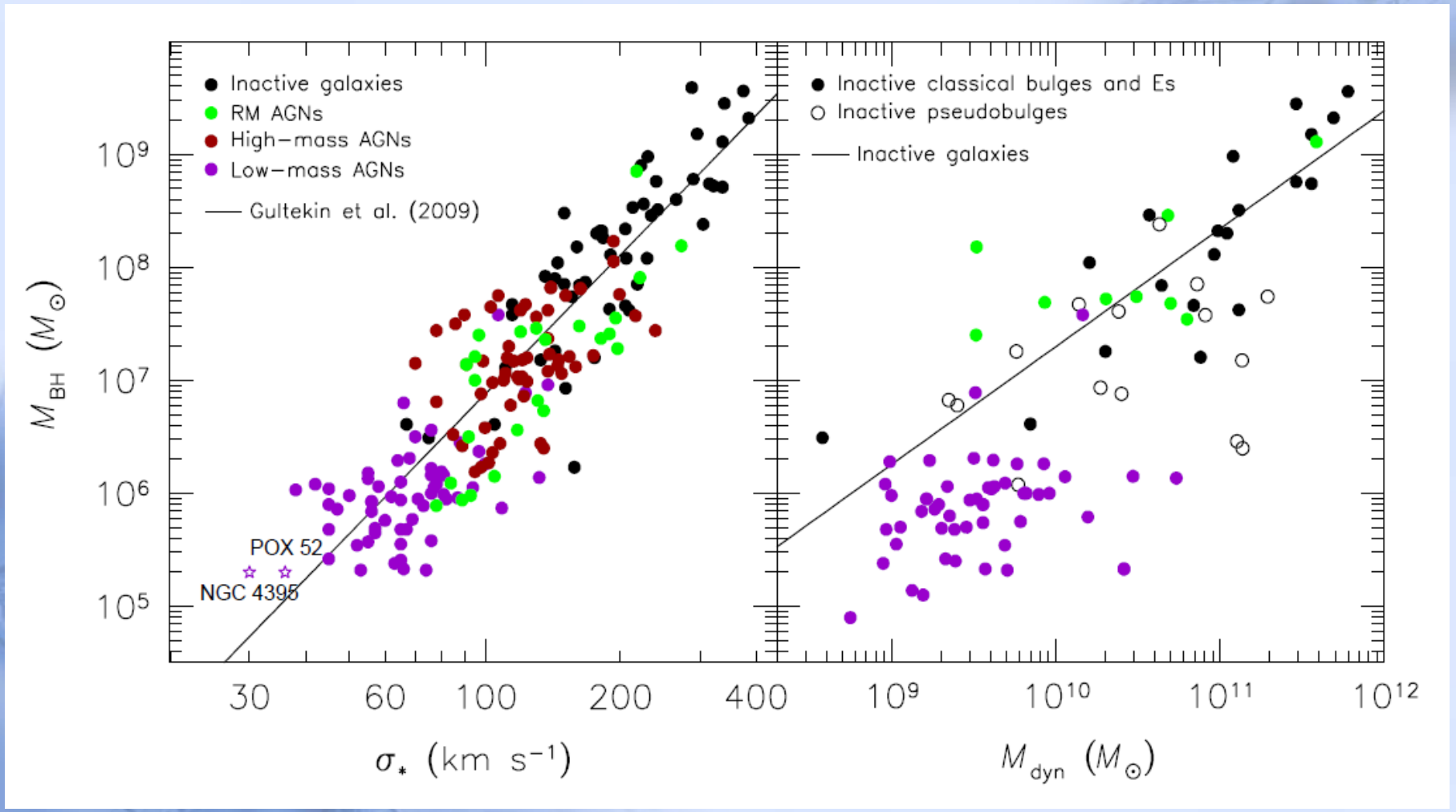
questions:

(I) SMBH formation and growth, how?
(II) demographics of SMBH, BH growth and host galaxy formation co-evolve?

methods:

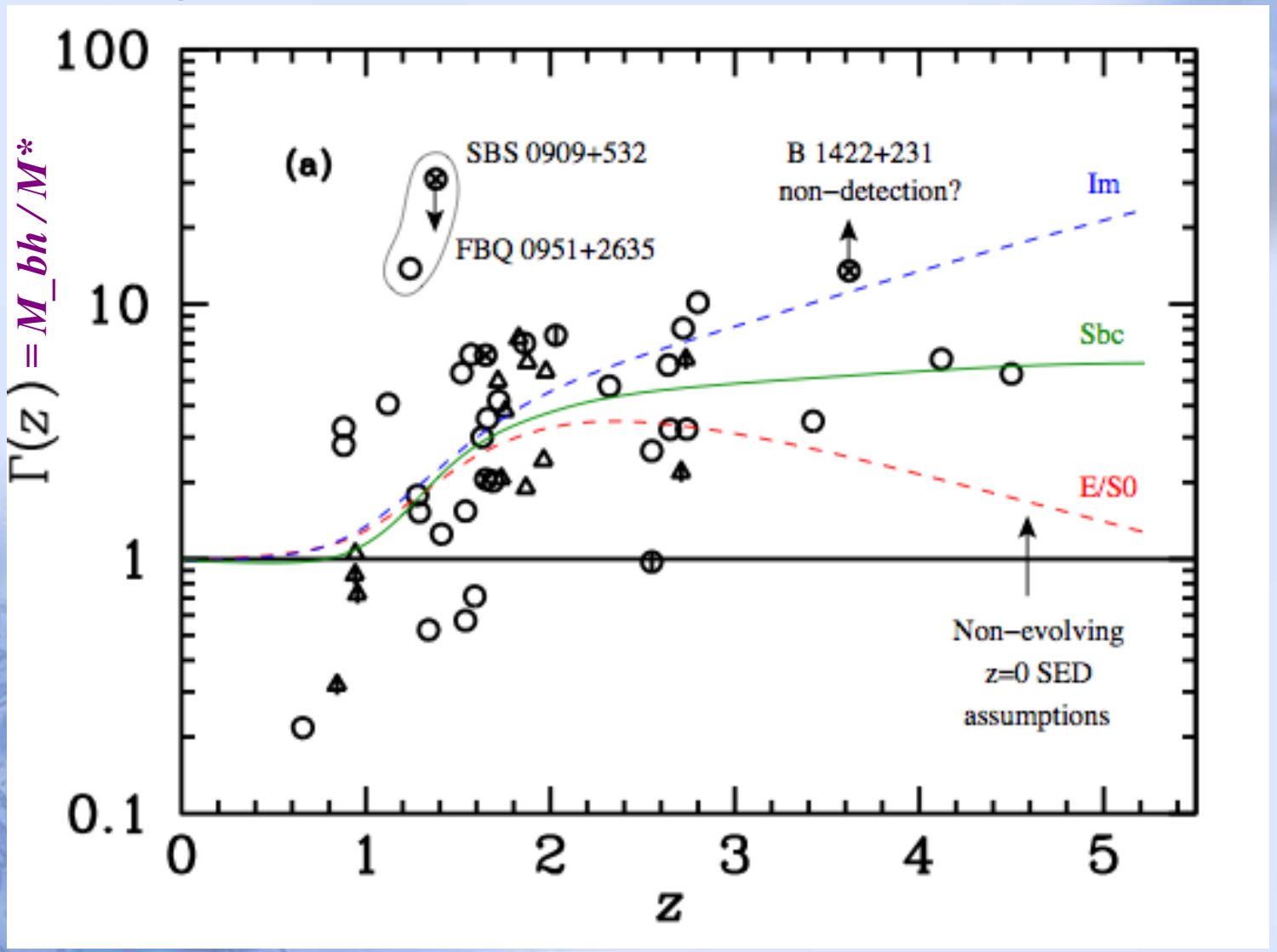
(I) BH mass measurement
(II) Host galaxy properties

Scaling relation in mass domain



Kormendy & Ho 2013

Scaling relation over cosmic time



Peng et al. 2006

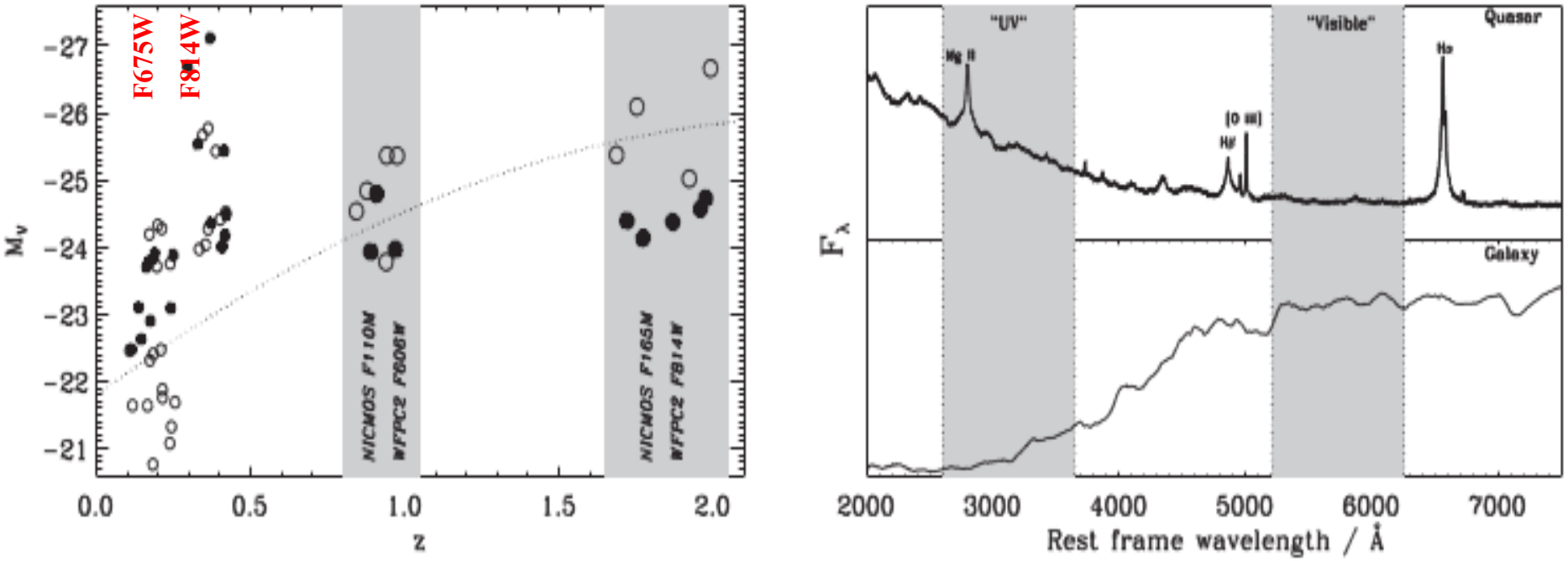
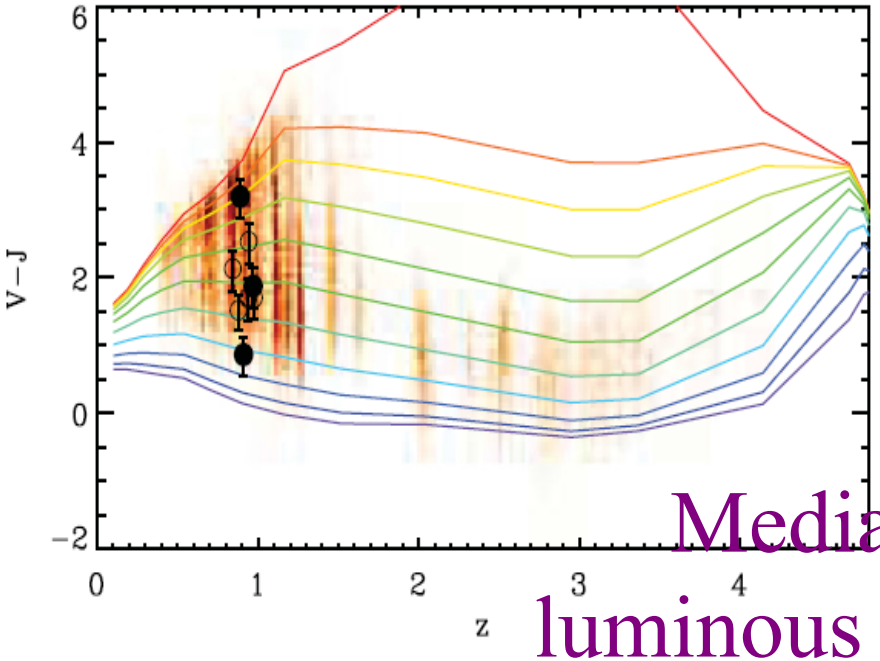
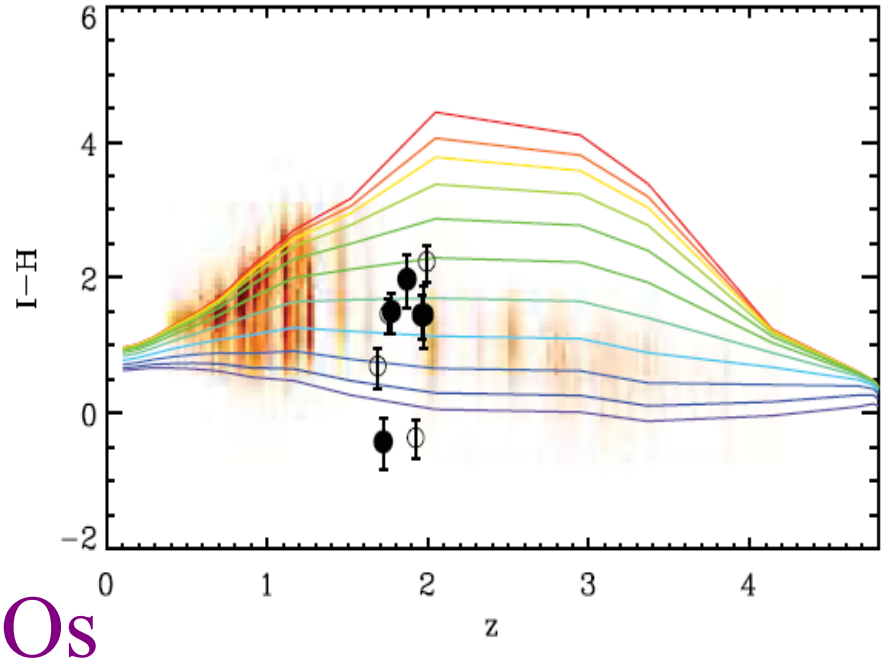


Figure 1. Left: absolute *V* magnitude versus redshift for the quasars in our host galaxy studies out to $z \approx 2$. The filled circles represent RQQs, while the open circles represent RLQs. Objects in the present WFPC2 study at $z \approx 1$ and 2 are shown using large symbols, compared to our lower redshift objects (M99; D03; F04). Our sample spans the knee of the quasar luminosity function at each redshift: the dotted line indicates M_V^* for the 2QZ quasar luminosity function at each redshift (Croom et al. 2004). See Section 2.1 for notes on the sample selection. Right: illustration showing generic spectra for a quasar nucleus (upper panel) and an early-type galaxy (lower panel), with our approximate rest-frame bandpasses marked. We have tailored our filter selection to target the rest-frame *U* and *V*-band, thus sampling the SED of the host on either side of the break feature at 4000Å. While the Mg II quasar emission line is admitted, we avoid prominent galaxy emission lines (Section 2.2).

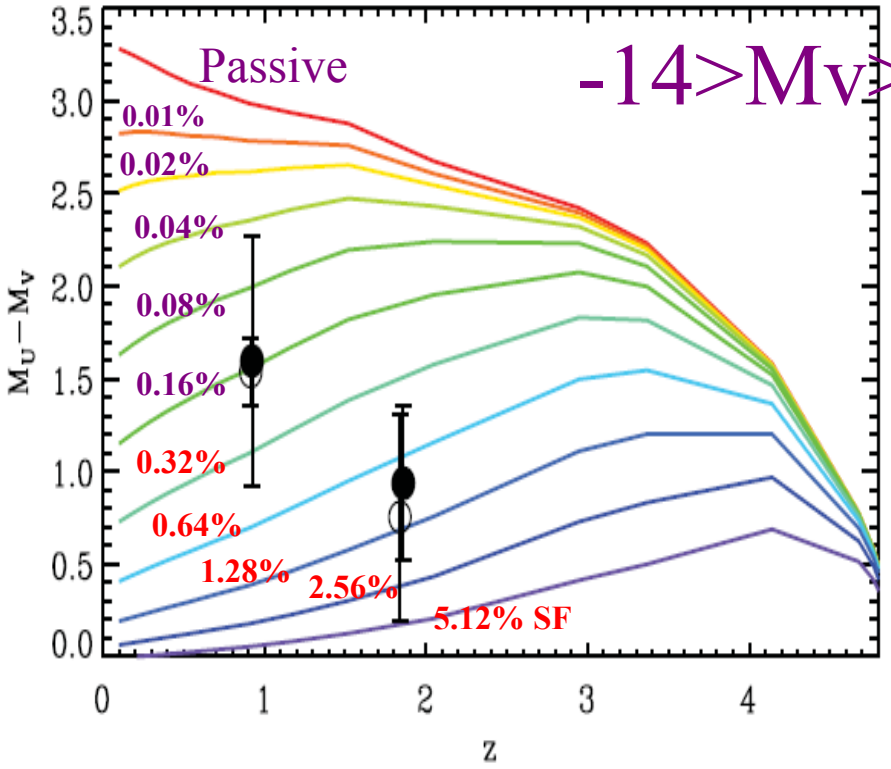
Floyd et al. 2013, MNRAS 429, 2

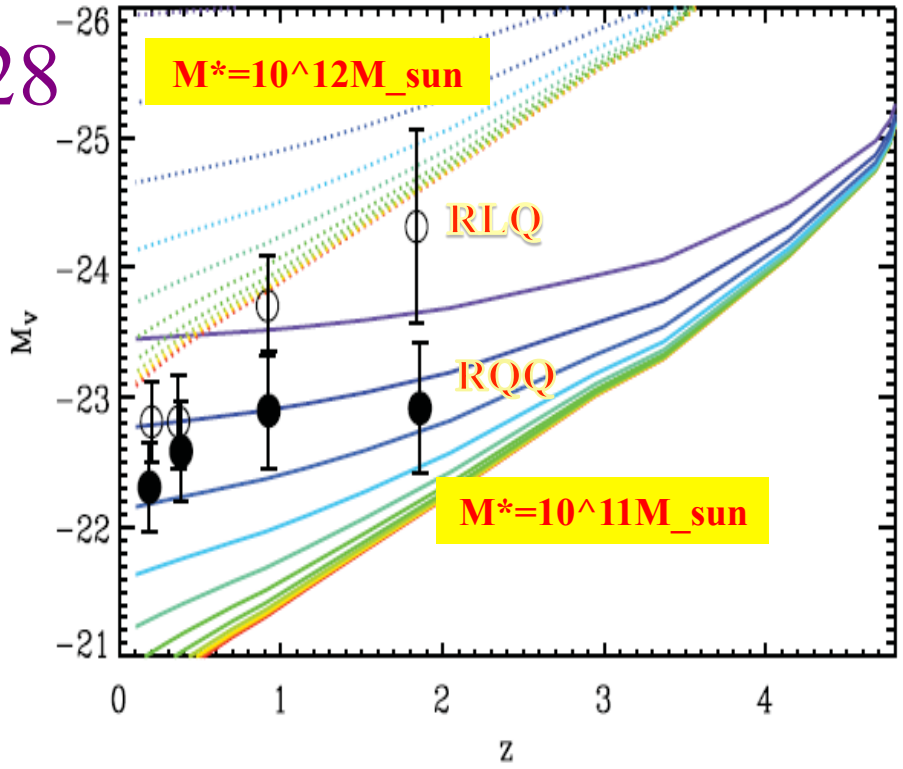




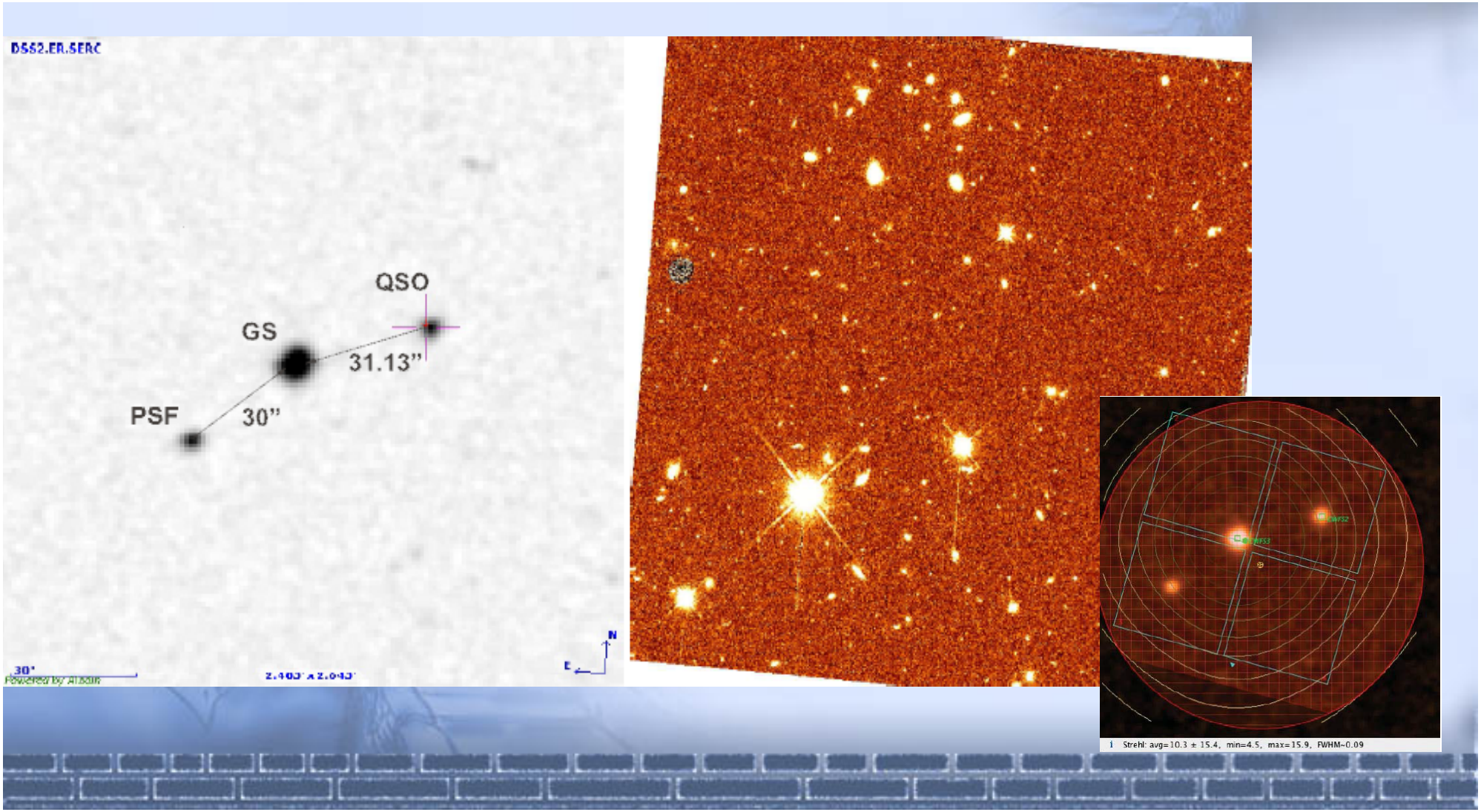
Mediate luminous QSOs

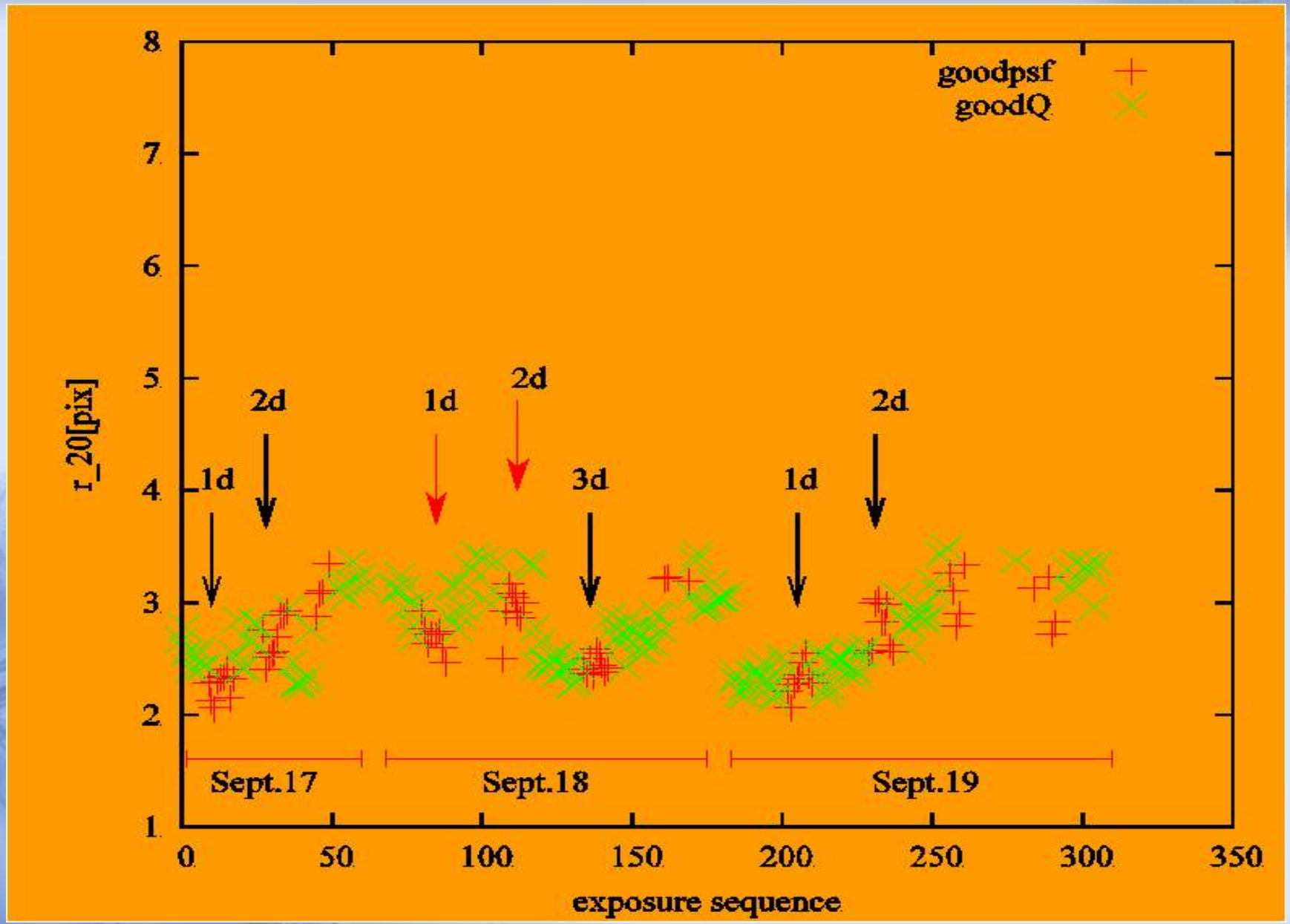
-14>Mv>-28





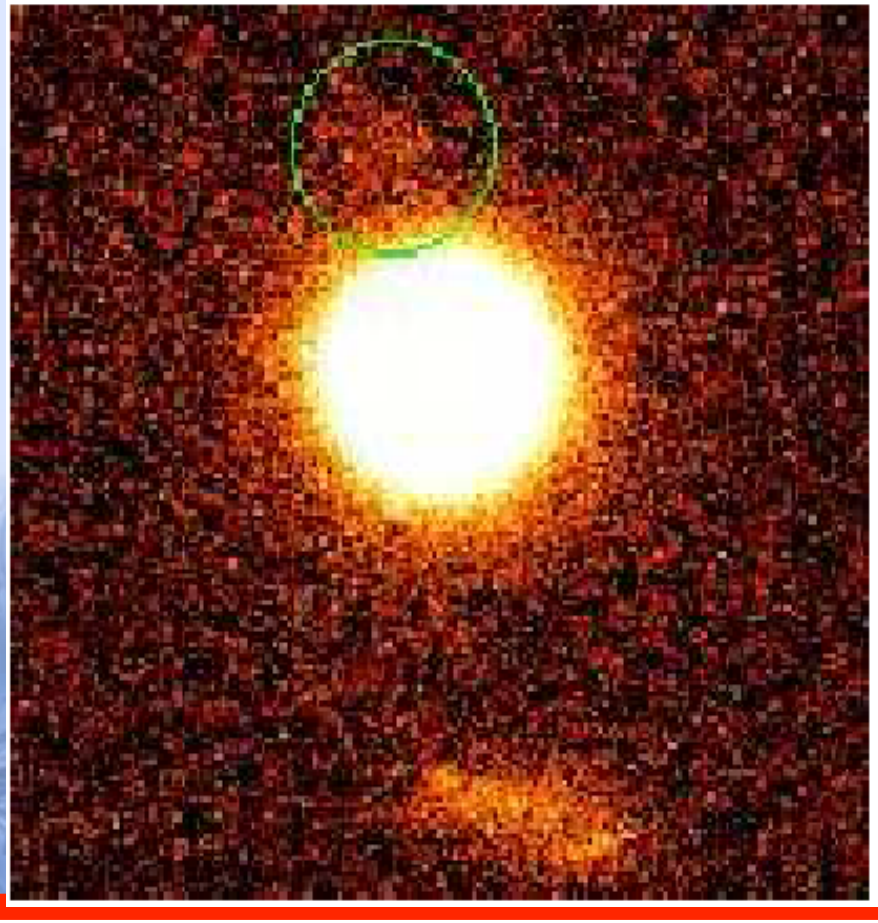
Obj.	Type	RA(J2000)	DEC(J2000)	z	R_{mag}
UM 402	RQQ	02 09 50.71	-00 05 06.6	2.855	15.8
PSF star		02 09 54.51	-00 05 34.0		16.6
Guide star		02 09 52.84	-00 05 15.2		13.8

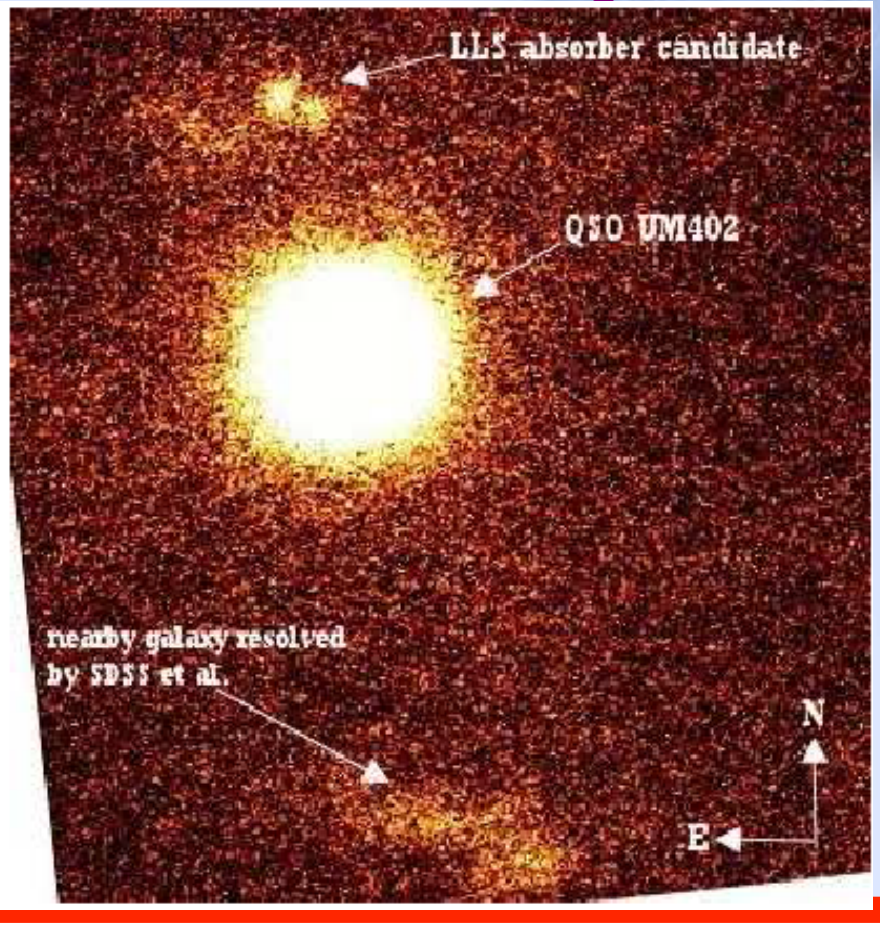



goodpsf
goodQ
r_20[pix]
exposure sequence
1d
2d
1d
2d
3d
1d
2d
Sept.17
Sept.18
Sept.19
0
50
100
150
200
250
300
350
1
2
3
4
5
6
7
8

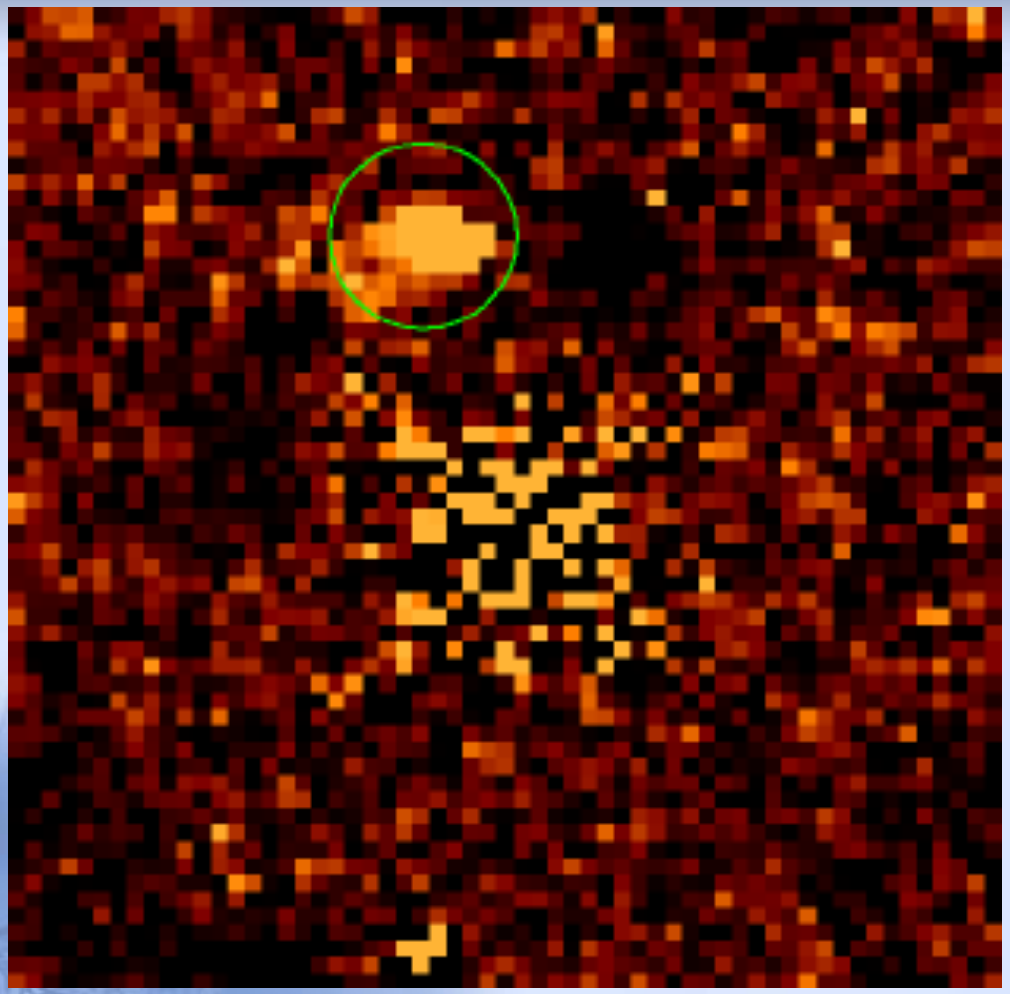
IRCS+AO observation of UM402 at z~3

Wang et al. 2013





1) 2".4 north of the QSO sightline. The candidate is indicated in the image.
2) impact parameter of ~ 19.6 kpc, if at z~2.53.
3) apparent K-magnitude m=21.91+/-0.26, as well as a red color J-K~1.6



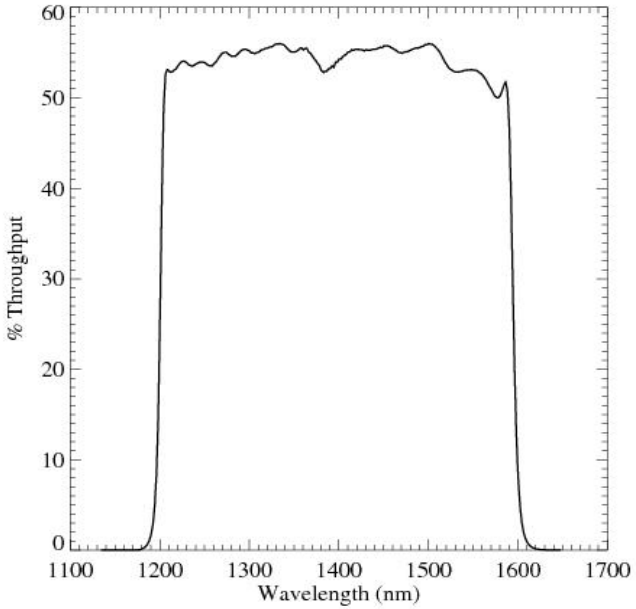
WFC3/F140W archive images :

2 orients X 2 dithers / single orbit

Pixel scale 0.13”

Total exposure: 811.736s

Figure A.217: Integrated system throughput for F140W.

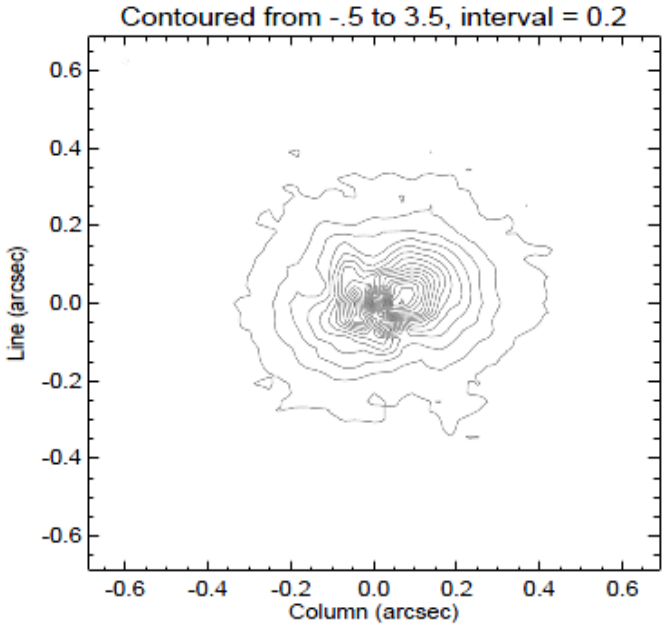


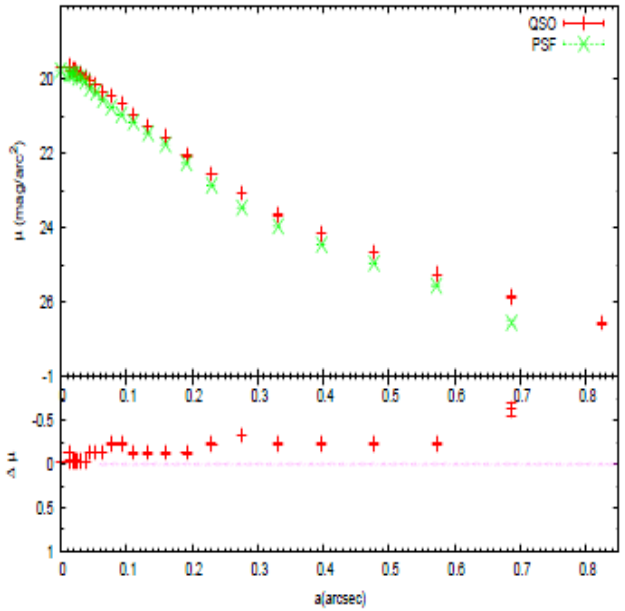
Critical for the QSO host galaxy studies: the PSF

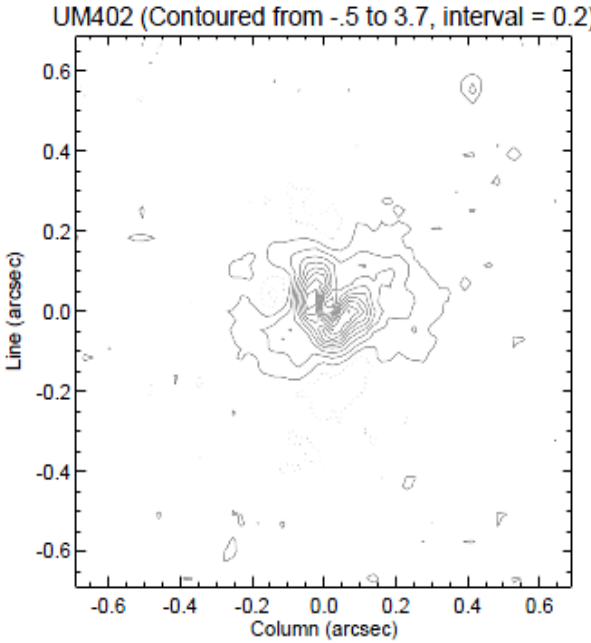
PSF variability: spatial and time variability

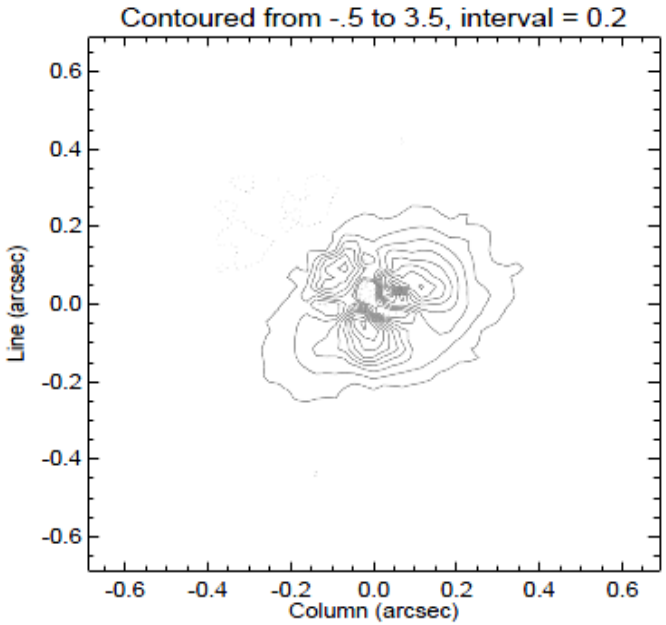
PSF reconstruction:

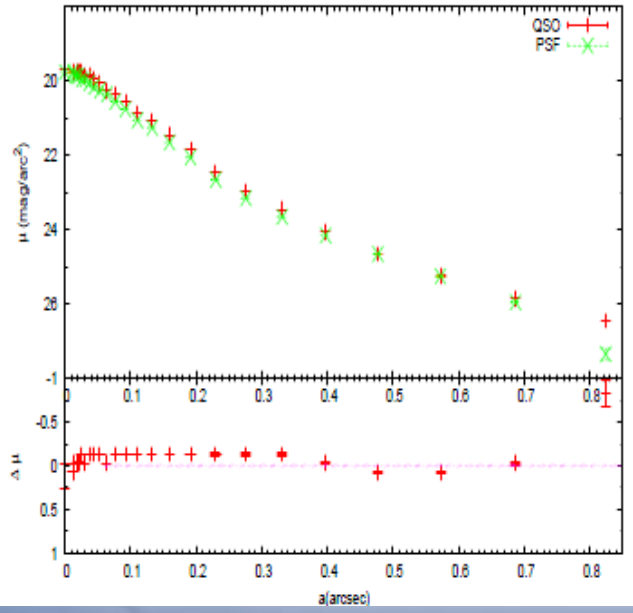
1) Classical median or averaged PSF from the series of PSF calibration star
2) Model PSF
3) PCA based on K-L transform

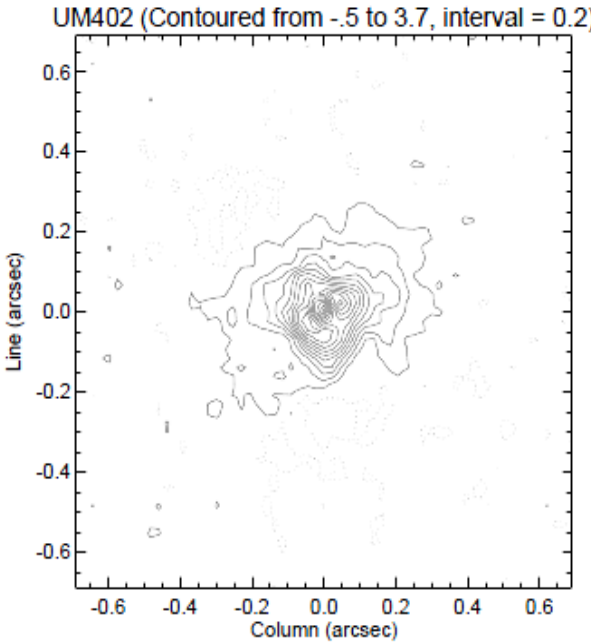

Contoured from -.5 to 3.5, interval = 0.2
Line (arcsec)
Column (arcsec)

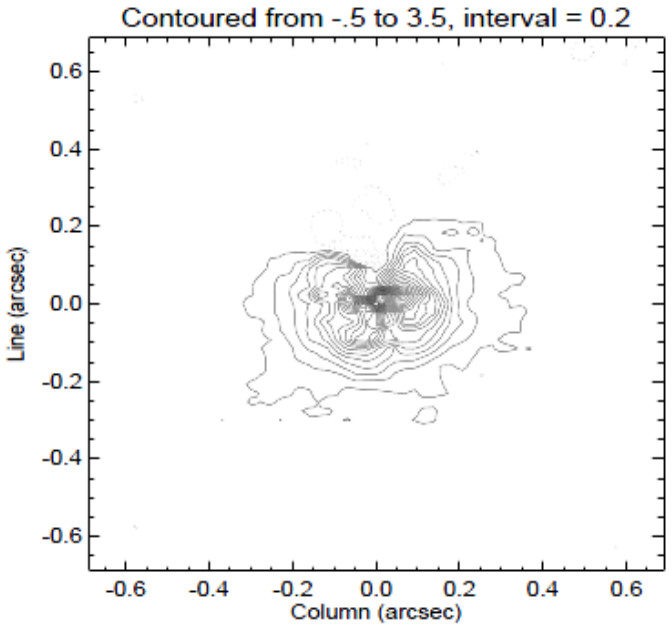

QSO
PSF
μ (mag/arc²)
Δ μ
a(arcsec)

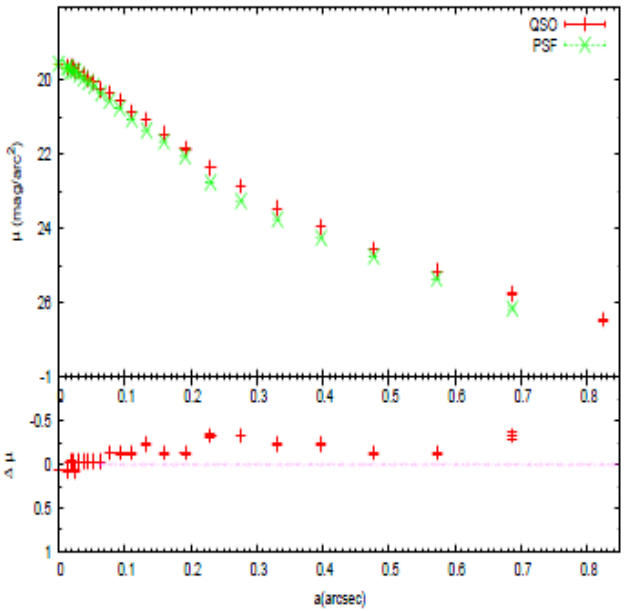

UM402 (Contoured from -.5 to 3.7, interval = 0.2)
Line (arcsec)
Column (arcsec)

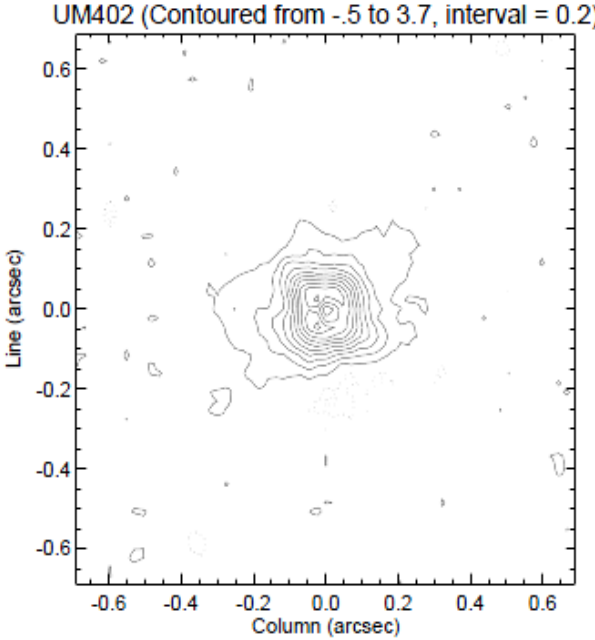

Contoured from -.5 to 3.5, interval = 0.2
Line (arcsec)
Column (arcsec)

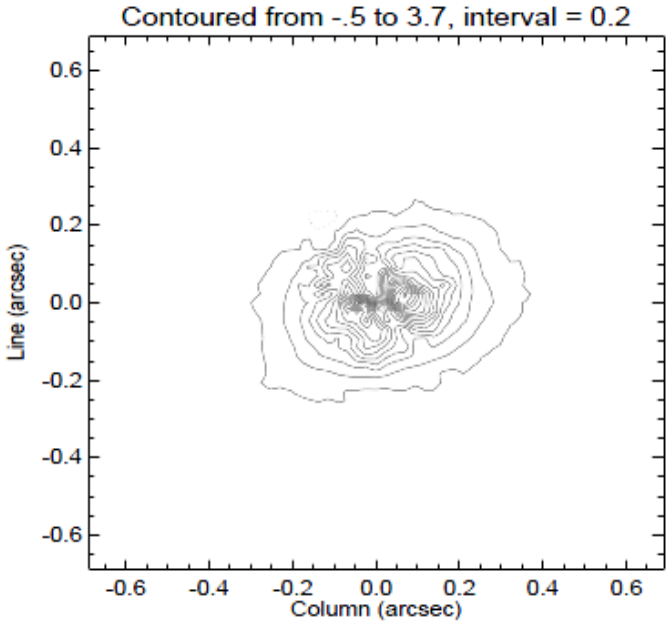

QSO
PSF
μ (mag/arc²)
Δ μ
a(arcsec)

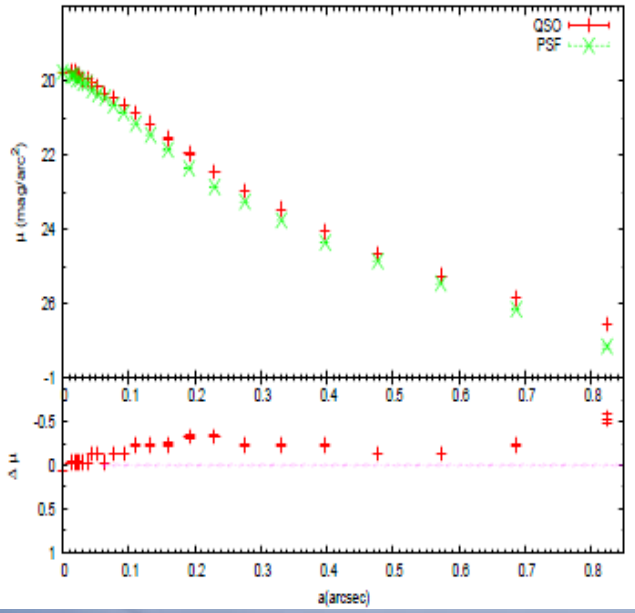

UM402 (Contoured from -.5 to 3.7, interval = 0.2)
Line (arcsec)
Column (arcsec)

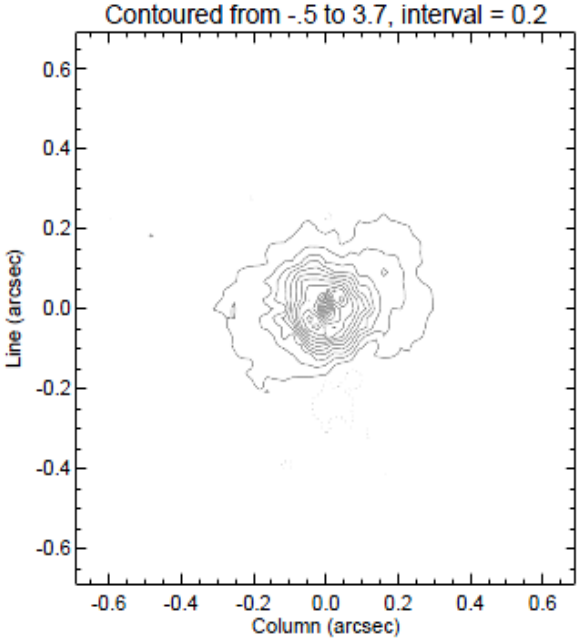

Contoured from -.5 to 3.5, interval = 0.2
Line (arcsec)
Column (arcsec)


QSO
PSF
μ (mag/arc²)
Δ μ
a(arcsec)

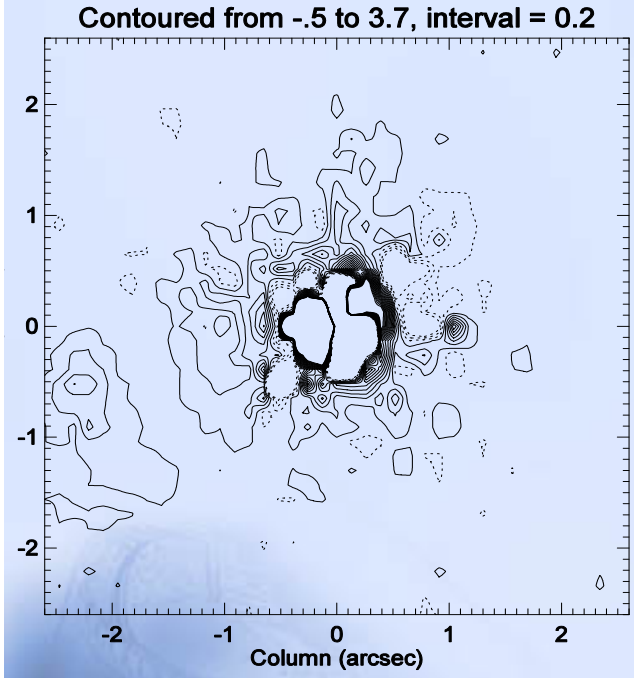

UM402 (Contoured from -.5 to 3.7, interval = 0.2)
Line (arcsec)
Column (arcsec)


Contoured from -.5 to 3.7, interval = 0.2
Line (arcsec)
Column (arcsec)

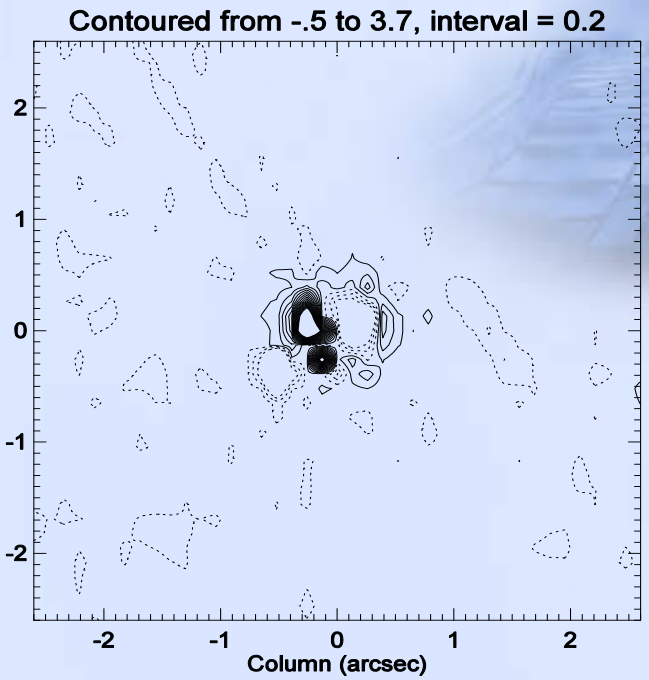

QSO
PSF
μ (mag/arc²)
Δ μ
a(arcsec)


Contoured from -.5 to 3.7, interval = 0.2
Line (arcsec)
Column (arcsec)

QSO - GS



PSF star -GS



QSO host galaxy studies in the 2020s:

1)A sufficiently large sample of QSOs towards the the peak epoch of SF/AGN activities, and beyond

2)A comprehensive understanding on the interwined BH growth and galaxy formation scenario across the QSO luminosity vs. redshift plane