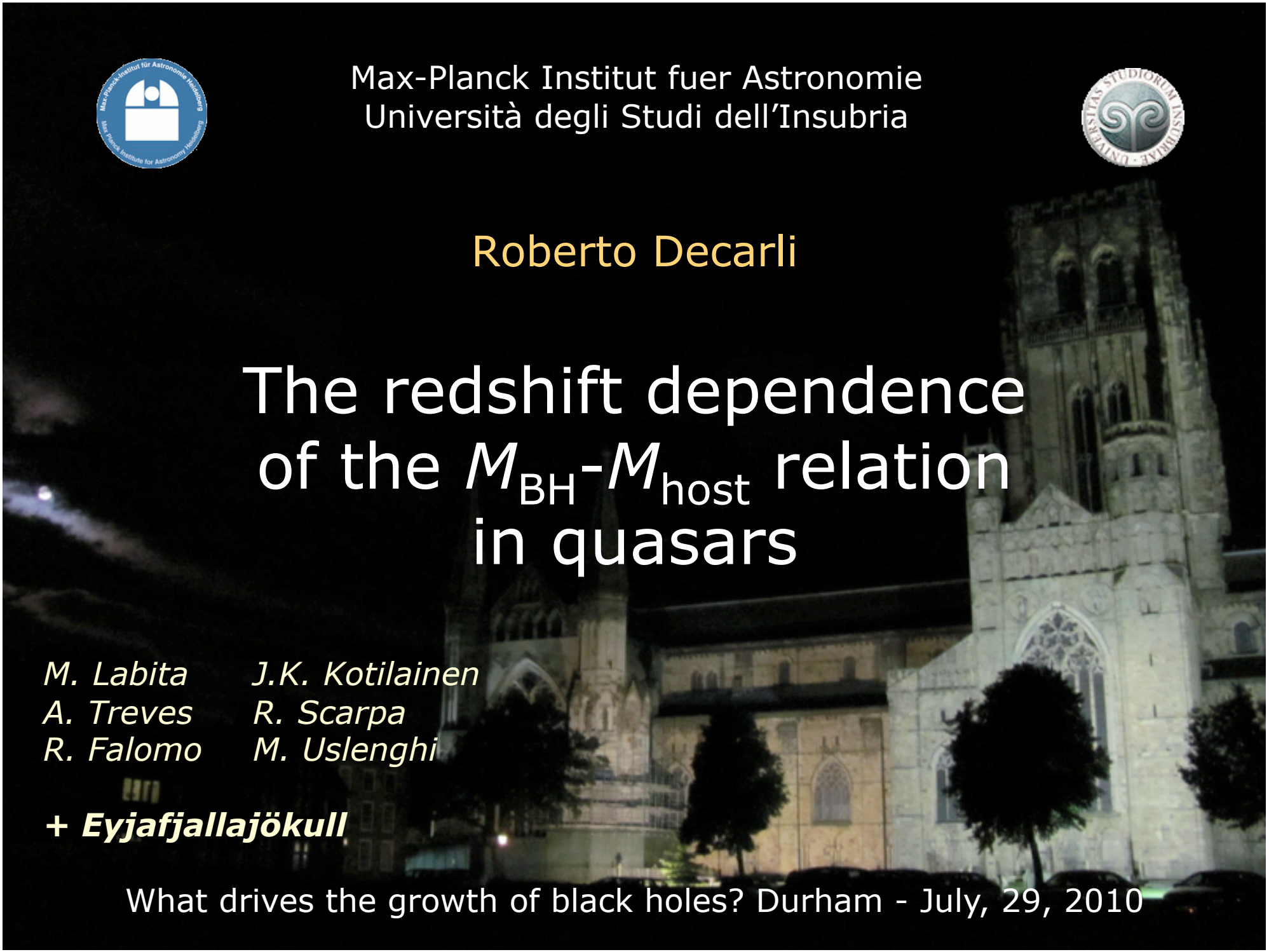


Max-Planck Institut fuer Astronomie
Università degli Studi dell'Insubria

Roberto Decarli

The redshift dependence of the M_{BH}-M_{host} relation in quasars

M. Labita *J.K. Kotilainen*
A. Treves *R. Scarpa*
R. Falomo *M. Uslenghi*

+ Eyjafjallajökull

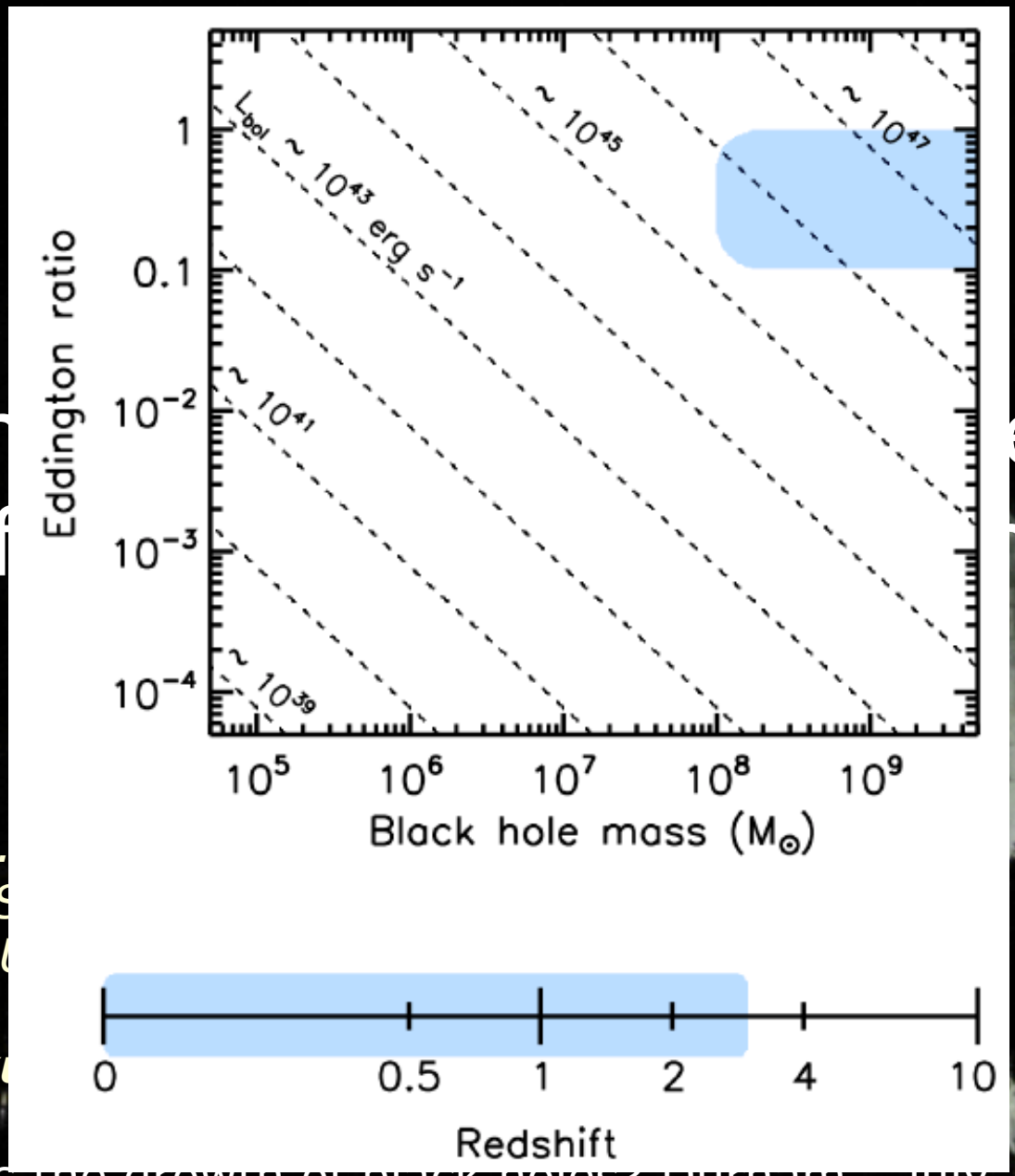
What drives the growth of black holes? Durham - July, 29, 2010

Max-Planck Institut fuer Astronomie

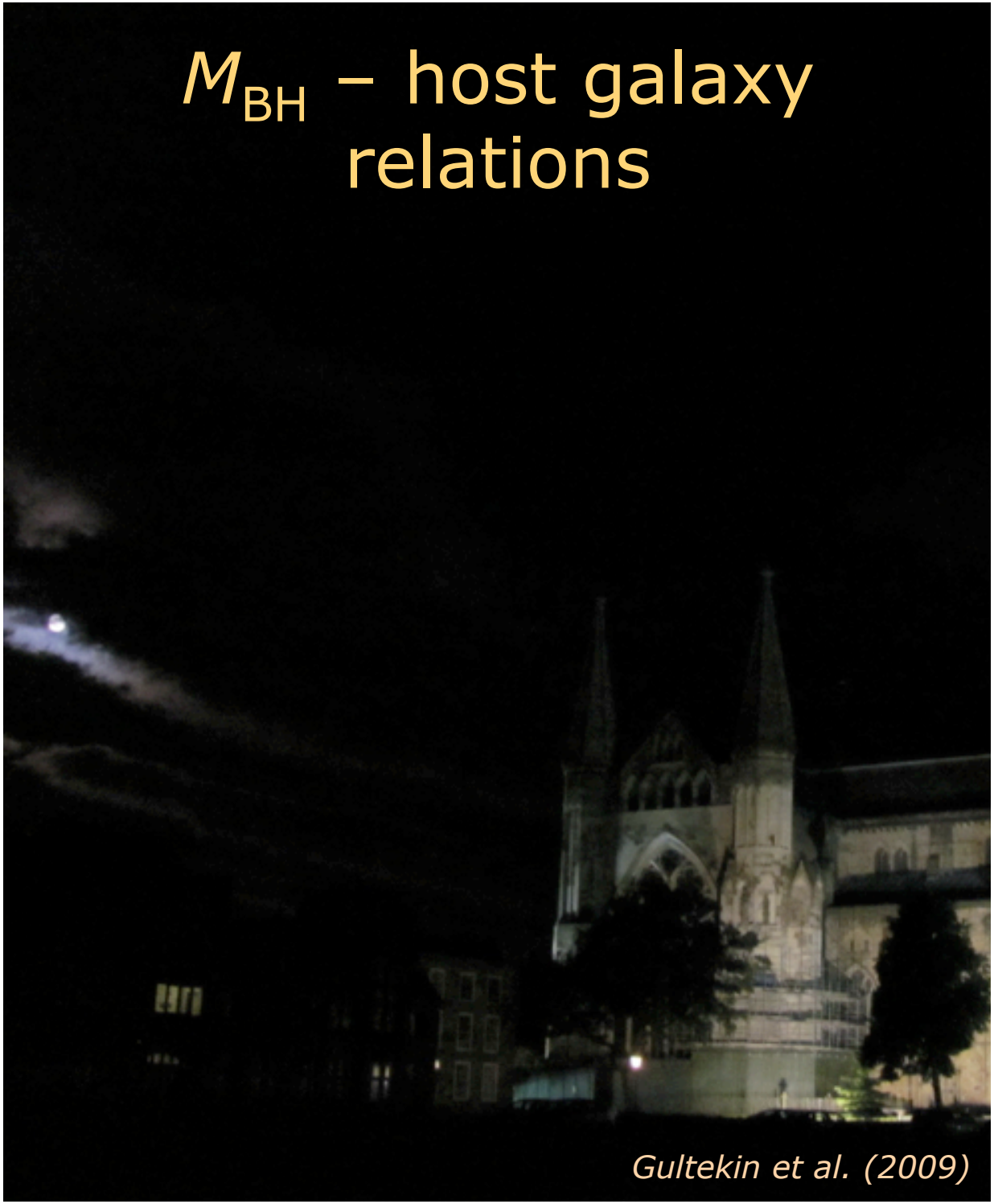
Th… e
of … n

M. Labita *J.K.*
A. Treves *R. S*
R. Falomo *M. L*

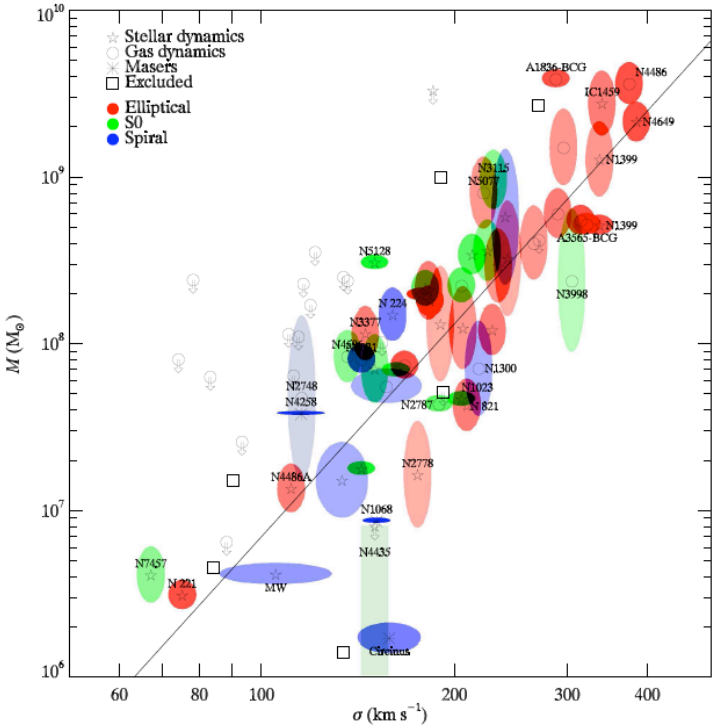
+ Eyjafjallajök

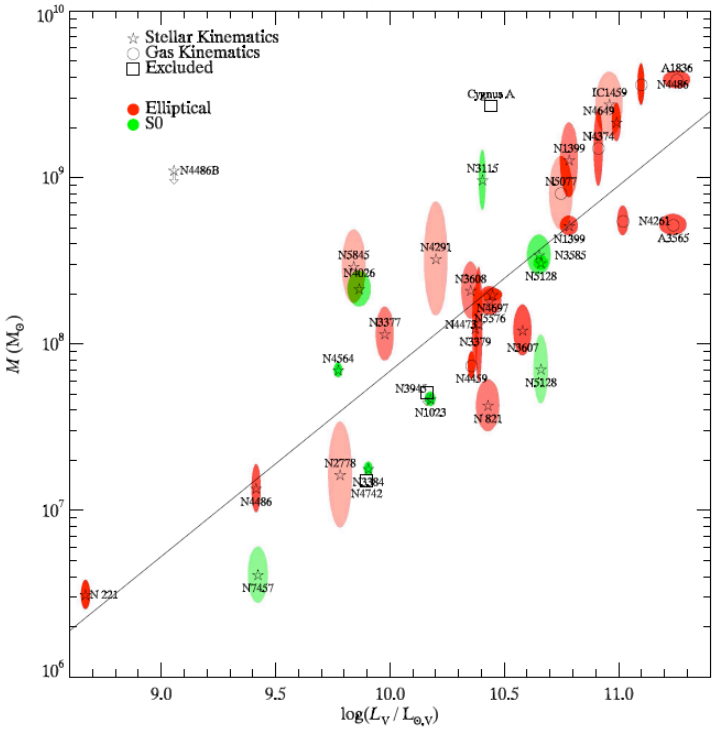


M_{BH} – host galaxy relations



Gultekin et al. (2009)





M_{BH} – host galaxy relations

Black holes

BLR

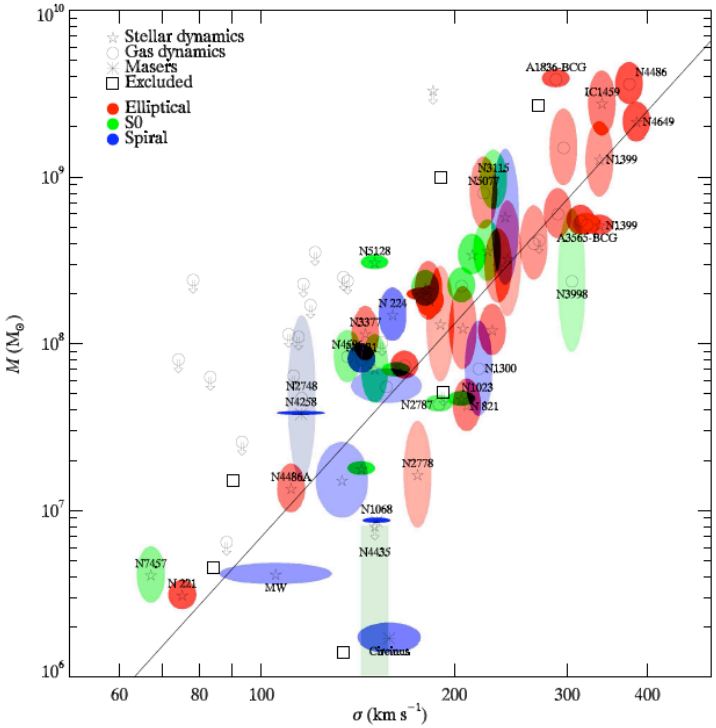
$R_{inf} = G\, M_{BH} / \sigma_*^2$
$\sim 0.001\, R_{host}$

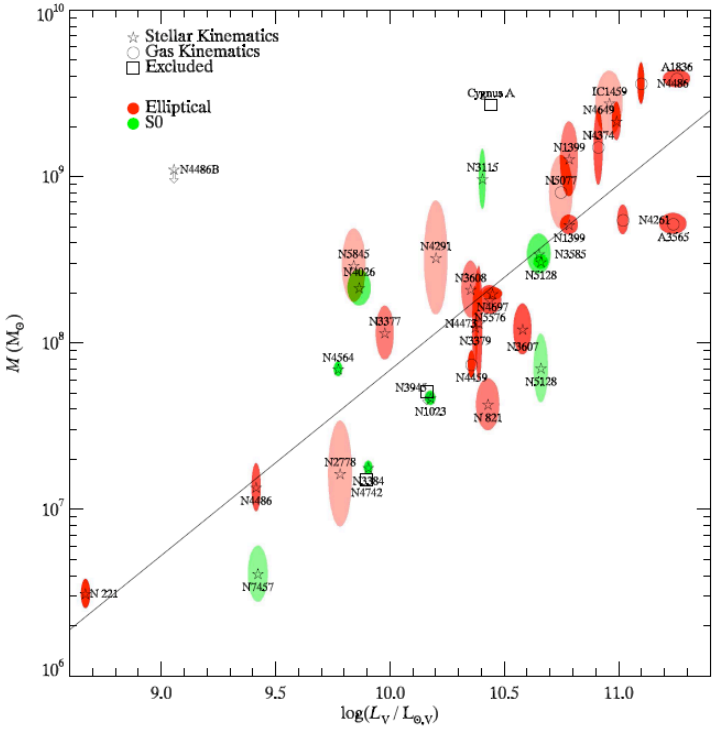
Host galaxies

[pc]

10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5} 10^{6} 10^{7}

Gultekin et al. (2009)





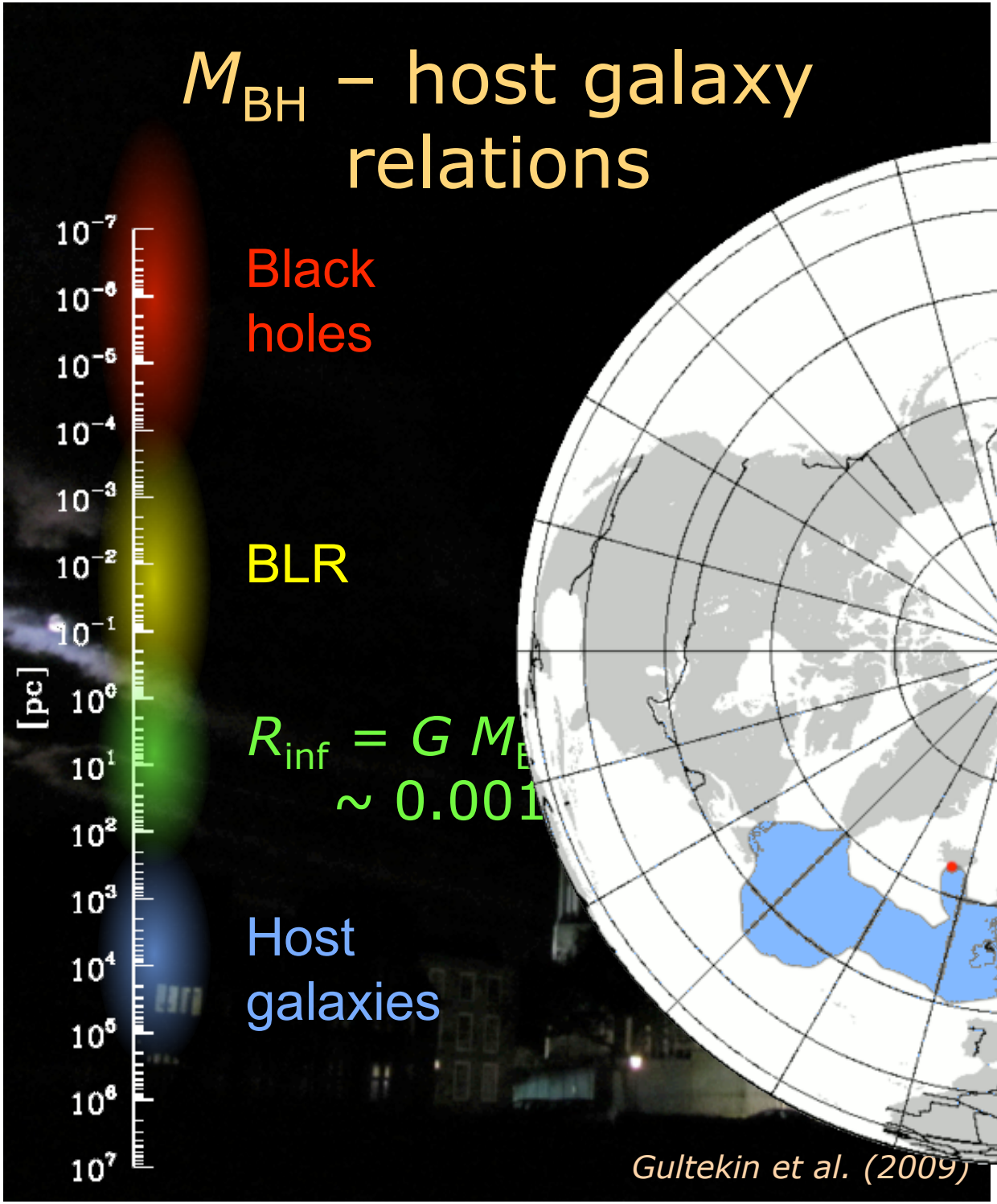
M_{BH} – host galaxy relations

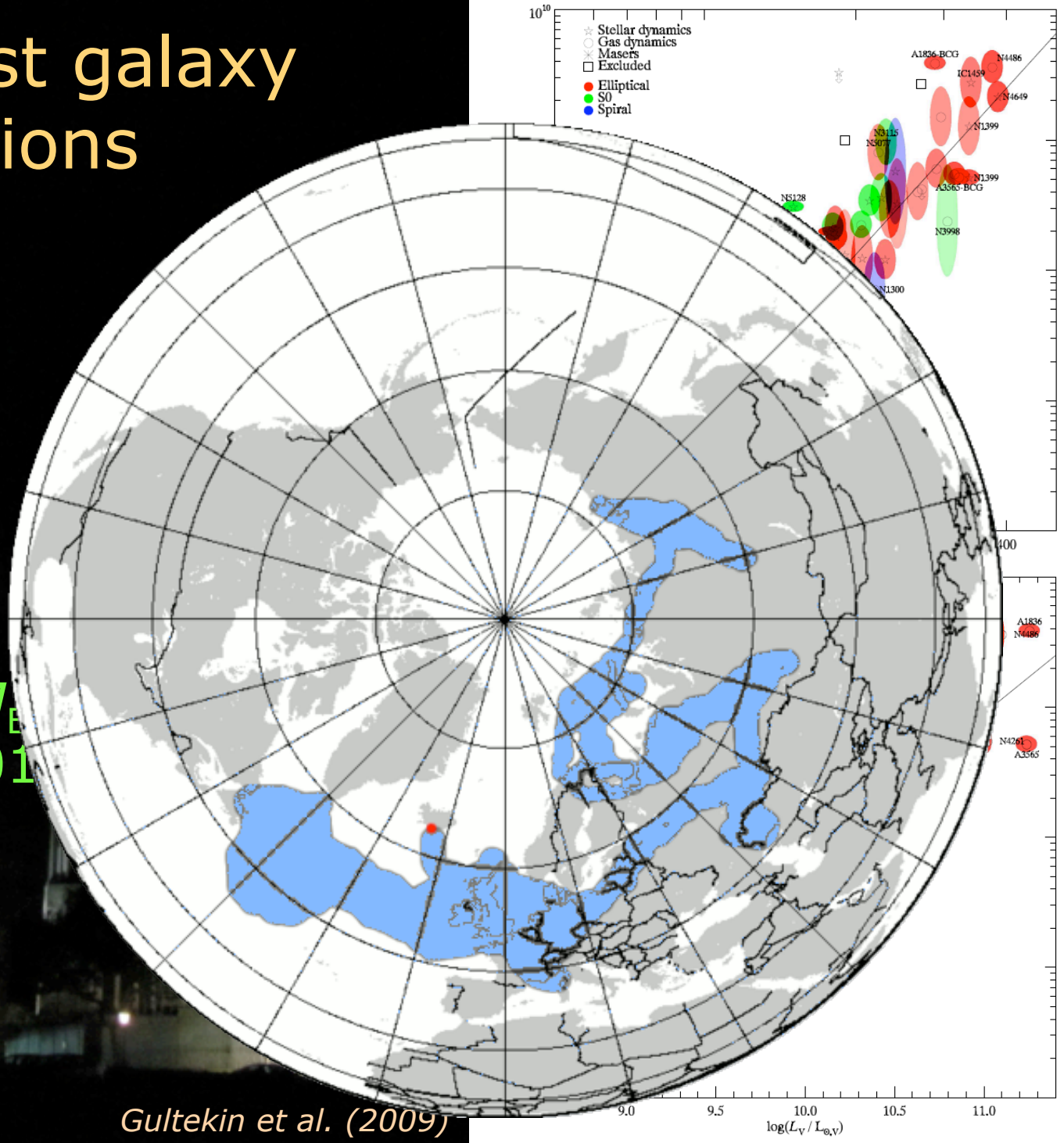
Black holes

BLR

$R_{inf} = G M_B$
~ 0.001

Host galaxies





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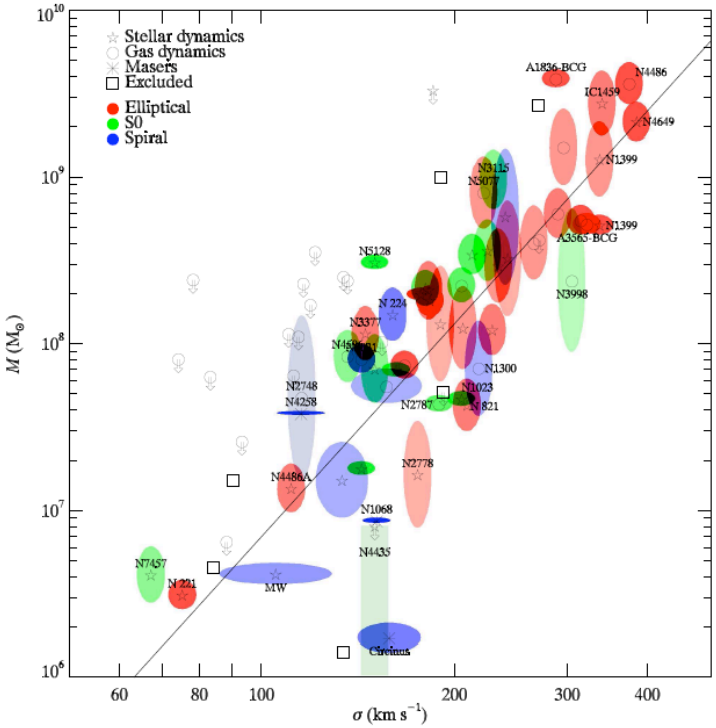

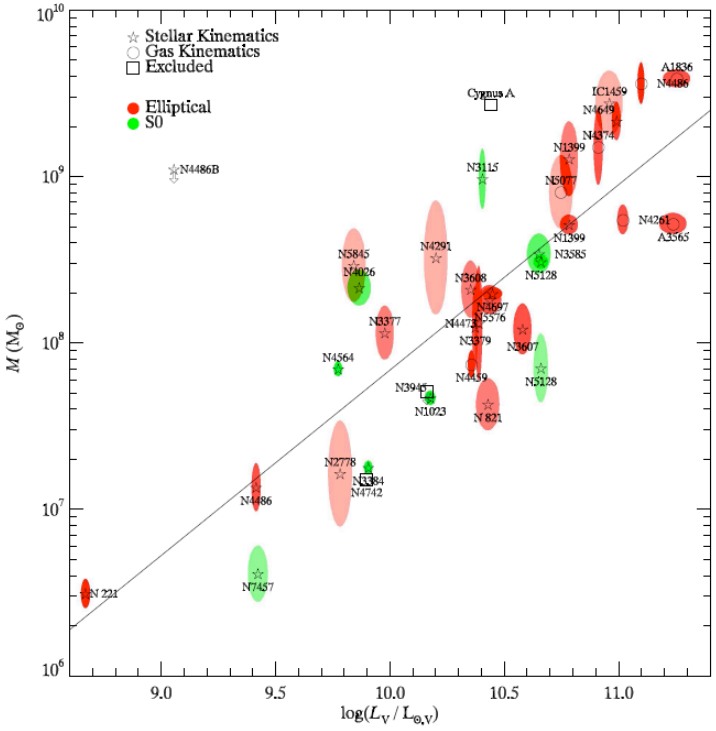

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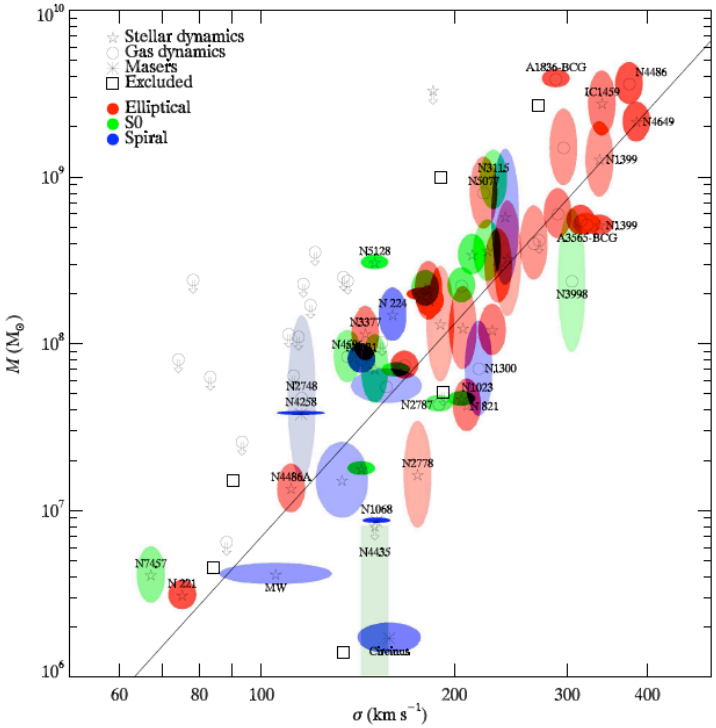
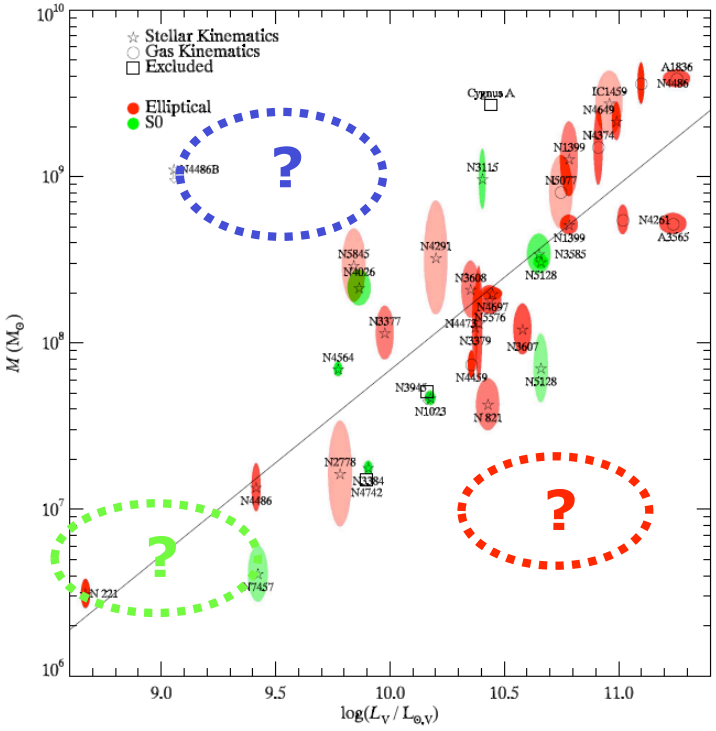
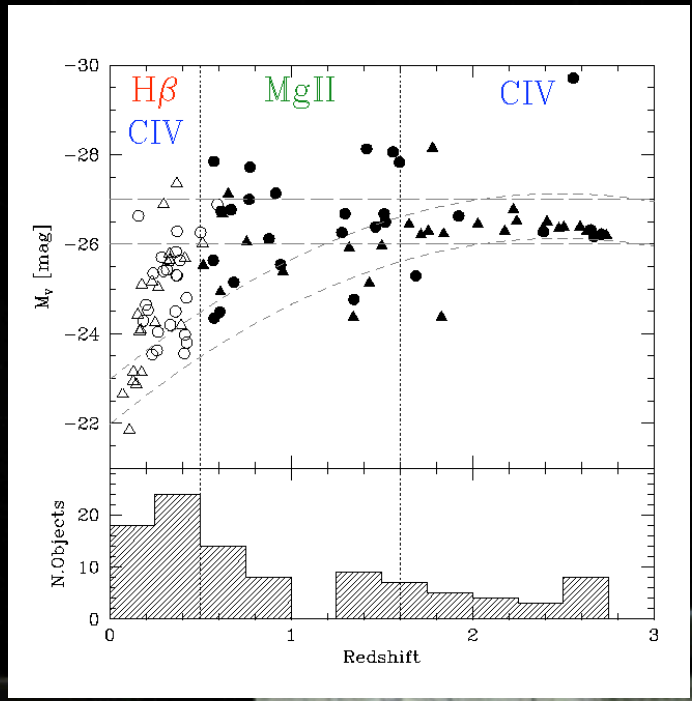




Our study

- **96** quasars (48 RQQs, 48 RLQs) with 0<*z*<3 (2x the sample by *Peng et al., 2006* and 3x *McLure et al., 2006*)
- Host galaxy luminosity from high res. images
- Black hole masses from spectra



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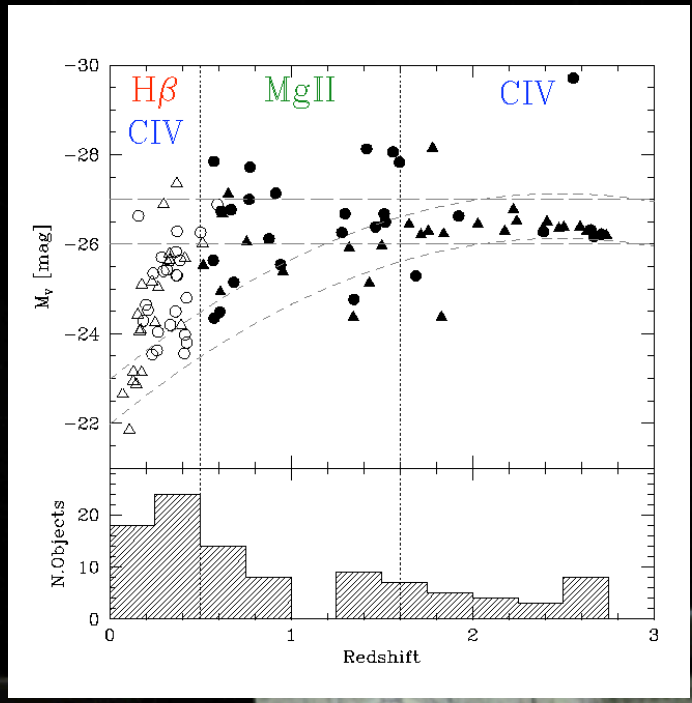
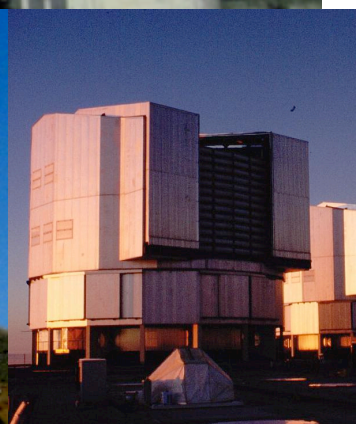


- For low-*z* quasars, images in the HST-WFPC2, spectra from the SDSS and HST-FOS and from on-purpose observations at the Asiago 1.82m Telescope.
- For *z*>0.5 targets, images taken at the NOT and the ESO/VLT, spectra from the NOT and ESO/3.6m Telescope.

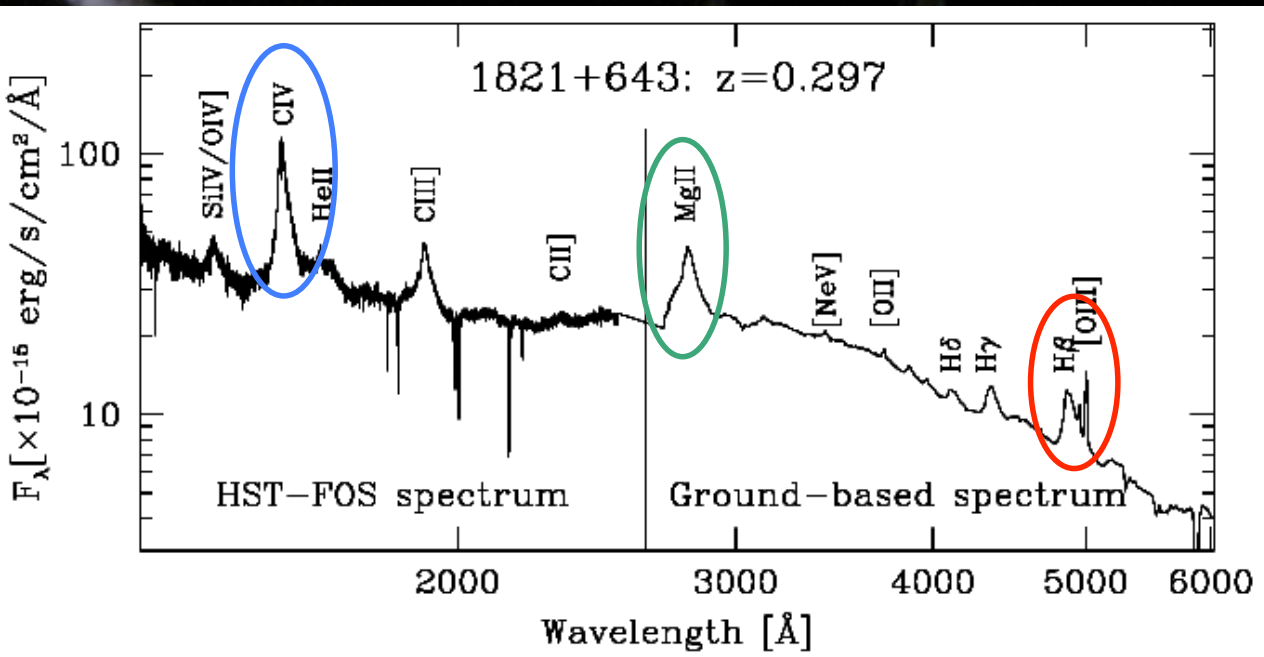




Virial estimate of M_{BH}

- $M_{BH} = G^{-1} R_{BLR} v_{BLR}^2$
- $R_{BLR} \sim \lambda L_\lambda^{\alpha}$
- $v_{BLR} = f$ FWHM



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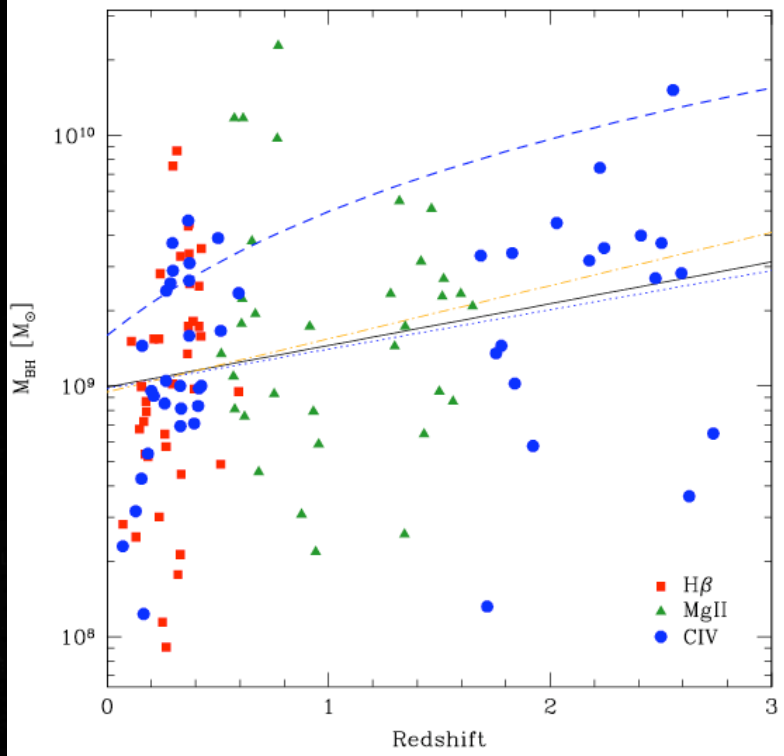
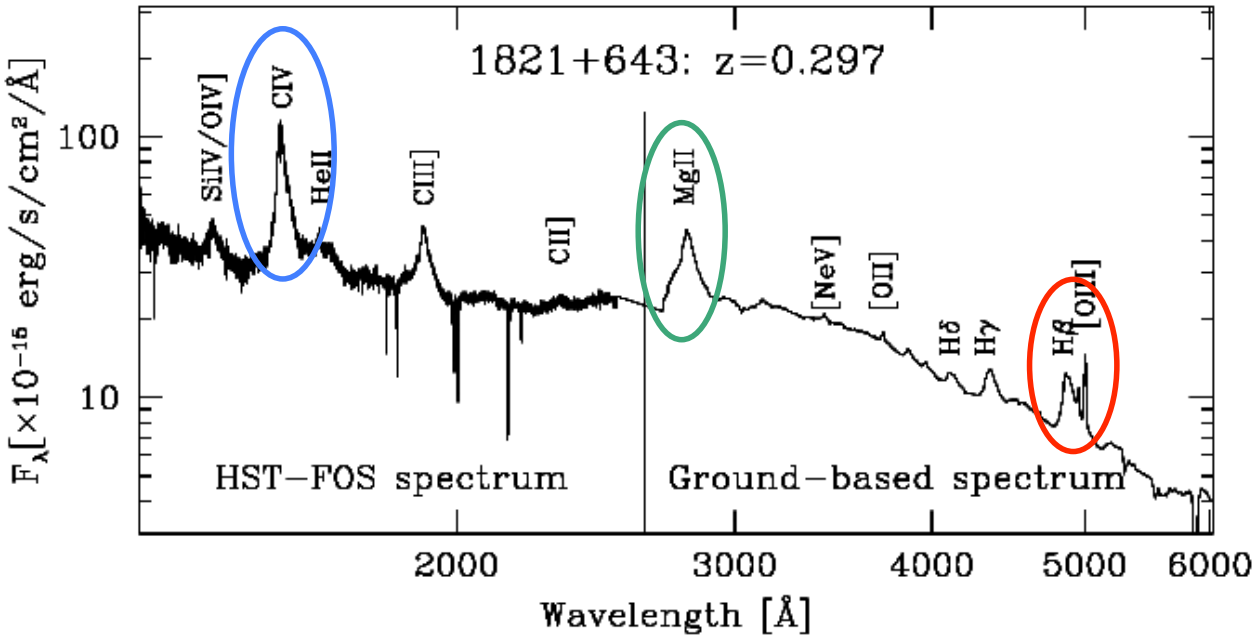
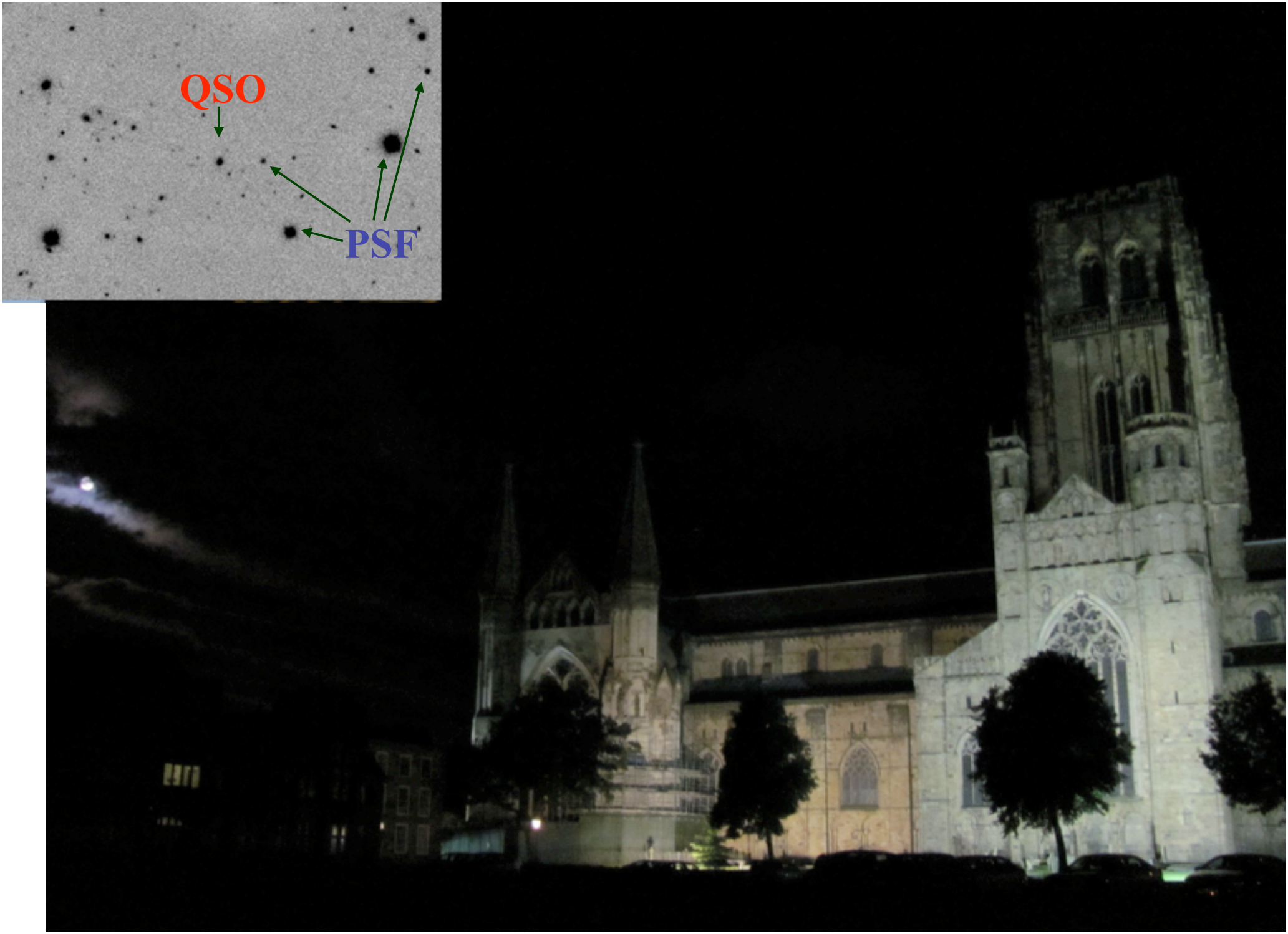
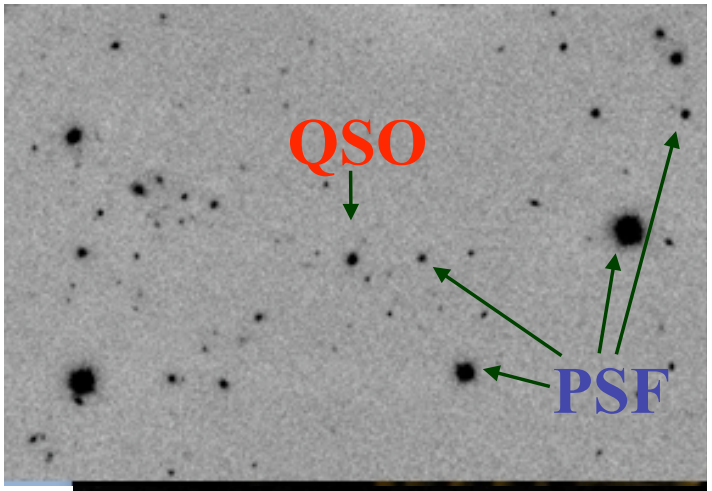
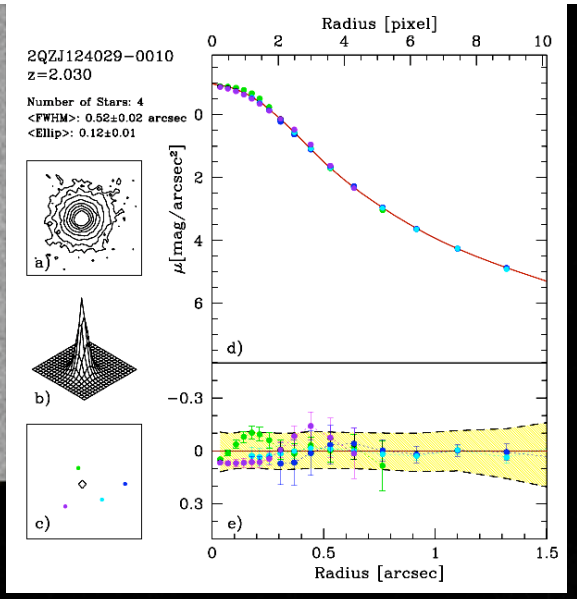
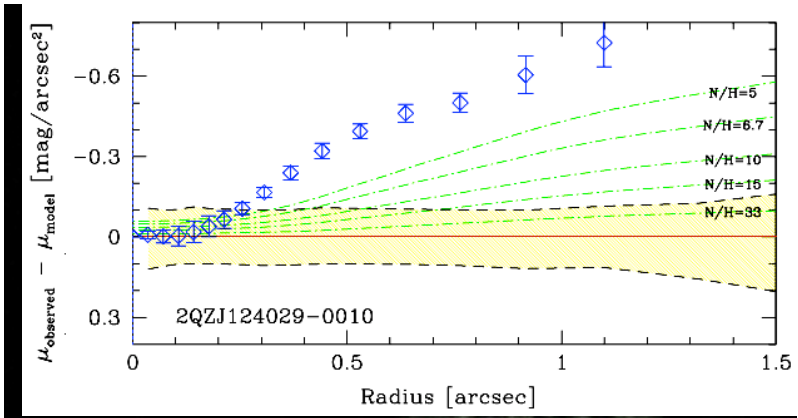


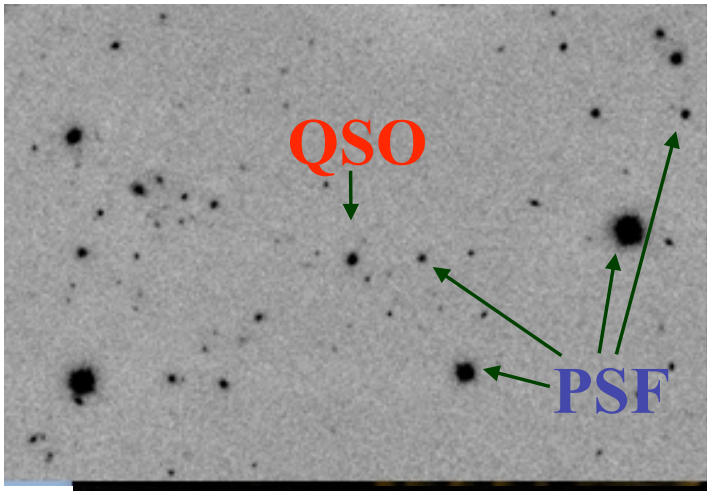


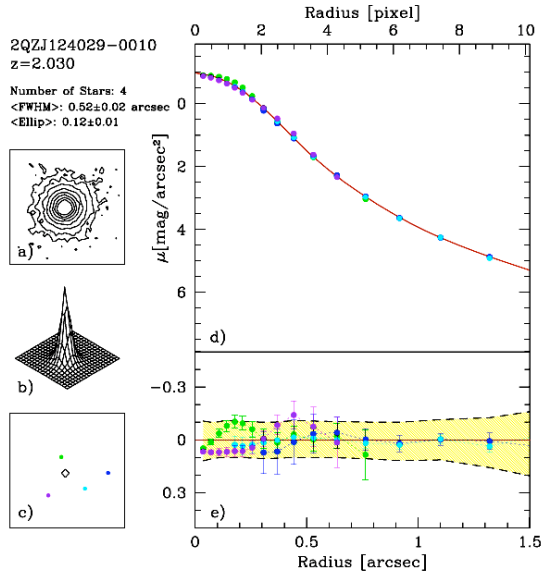

QSO
PSF


QSO
PSF


2QZJ124029−0010
z=2.030
Number of Stars: 4
<FWHM>: 0.52±0.02 arcsec
<Ellip>: 0.12±0.01
a)
b)
c)
d)
e)
Radius [pixel]
μ[mag/arcsec²]
Radius [arcsec]


N/H=5
N/H=6.7
N/H=10
N/H=15
N/H=33
2QZJ124029−0010
μobserved − μmodel [mag/arcsec²]
Radius [arcsec]


QSO
PSF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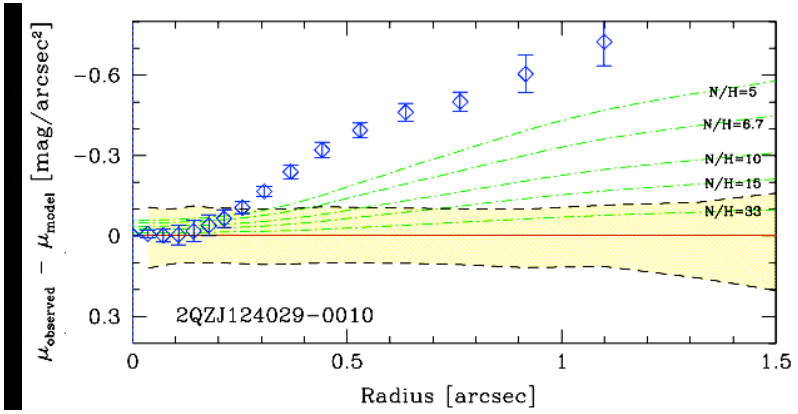
$\mu_{observed} - \mu_{model}$ [mag/arcsec²]
N/H=5
N/H=6.7
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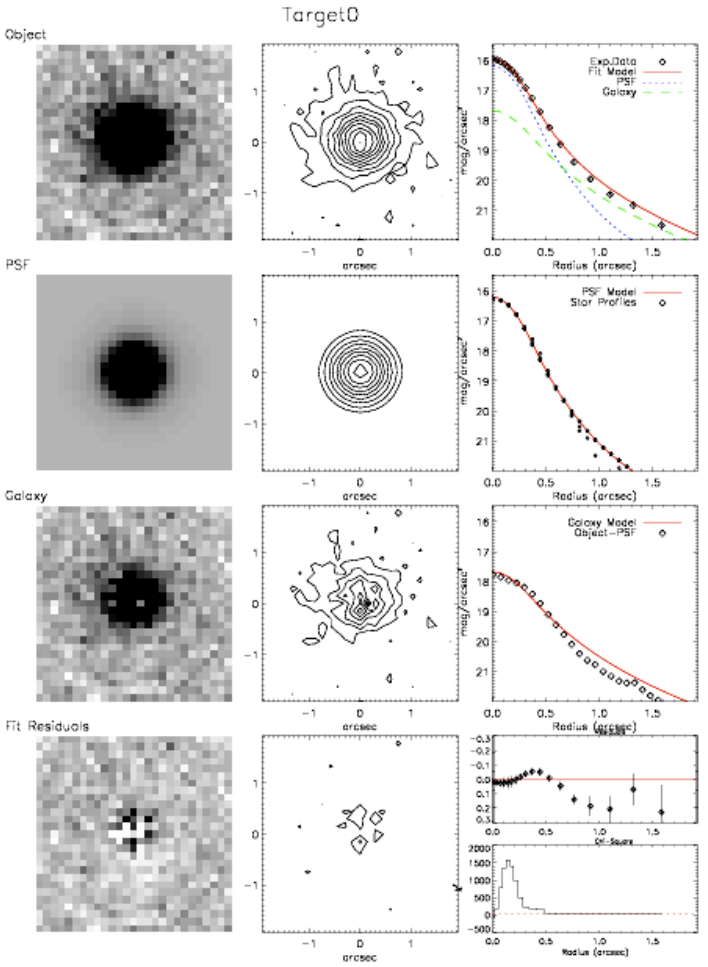
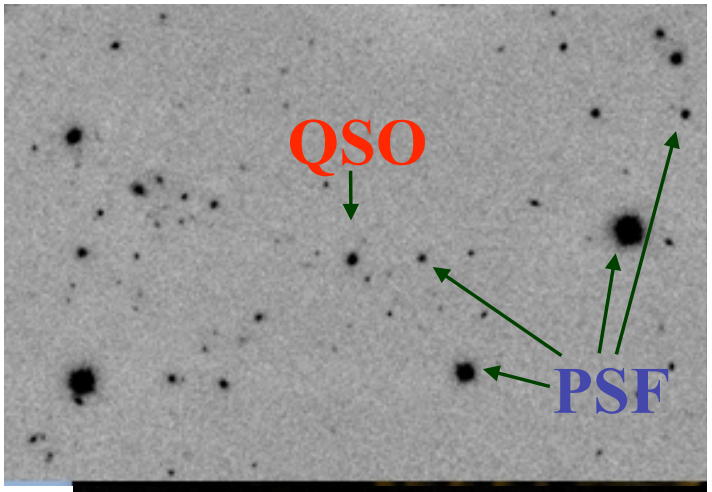
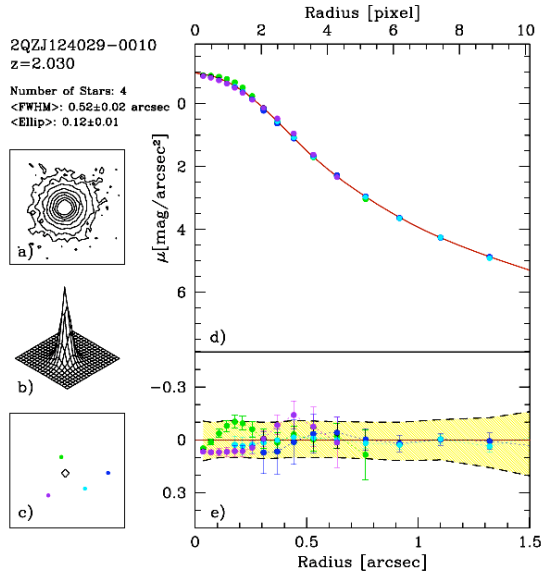
N/H=15
N/H=33
2QZJ124029−0010
Radius [arcsec]


Target0
Object
PSF
Galaxy
Fit Residuals
Radius (arcsec)


QSO
PSF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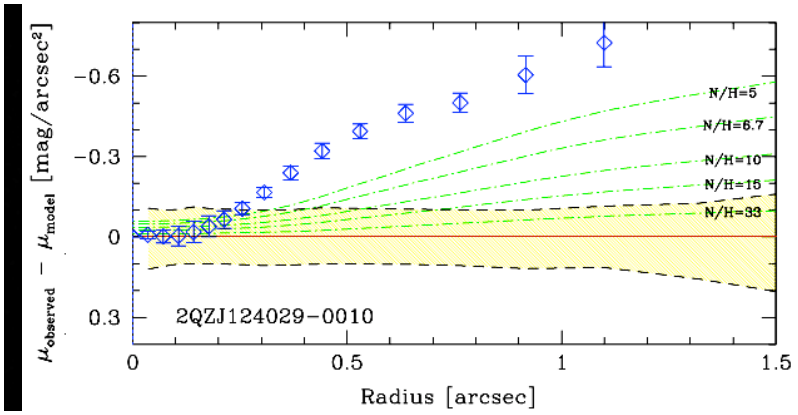
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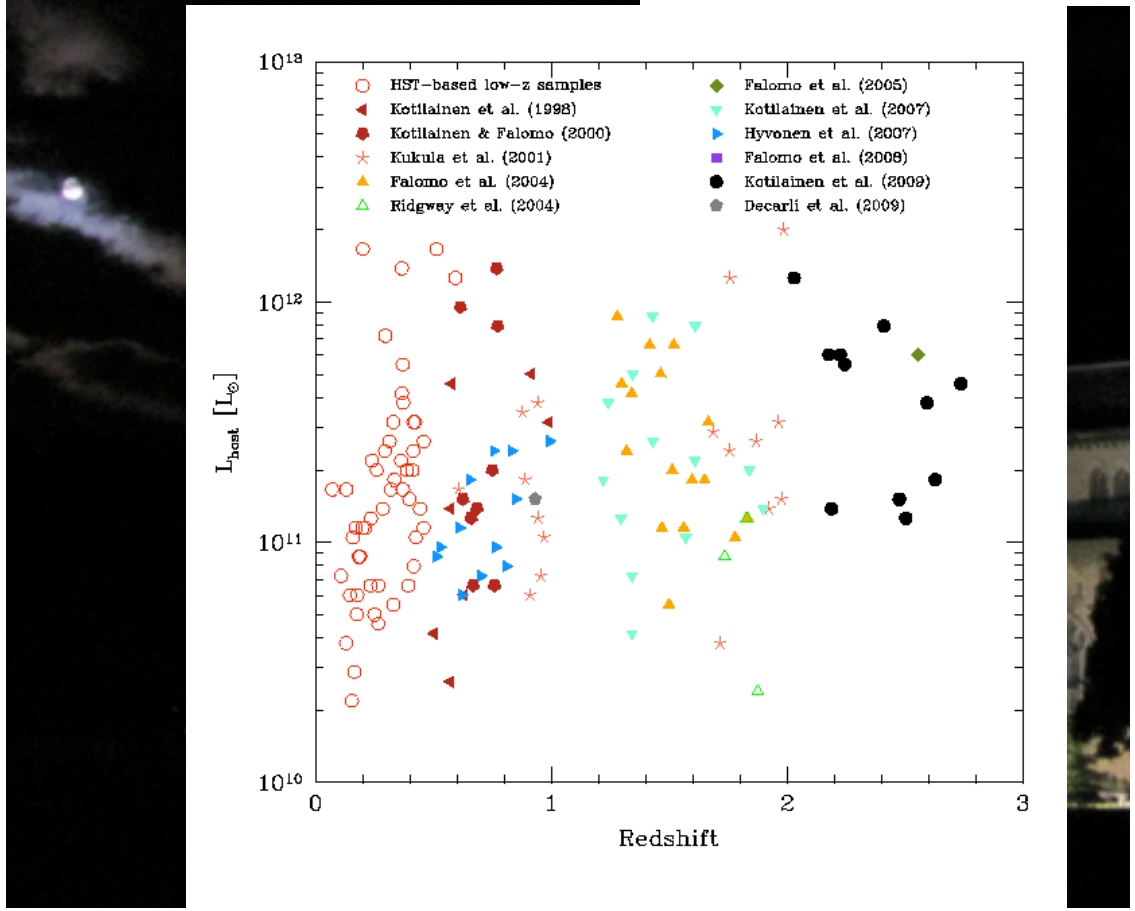
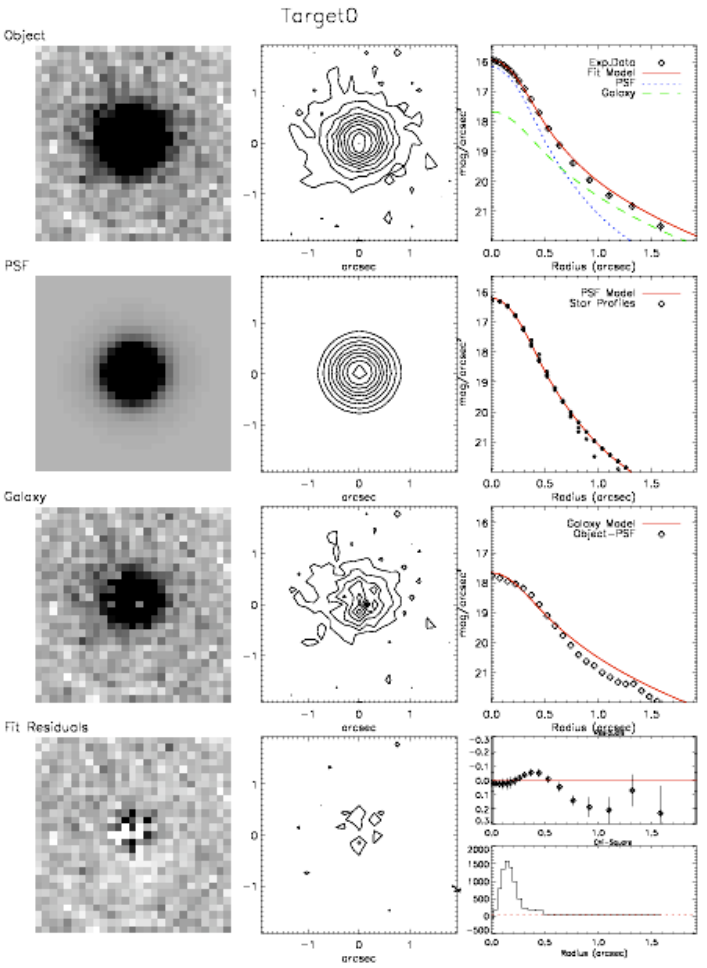
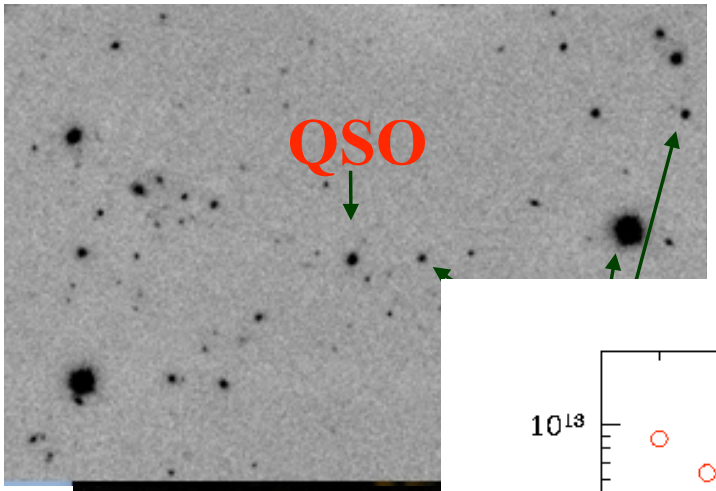
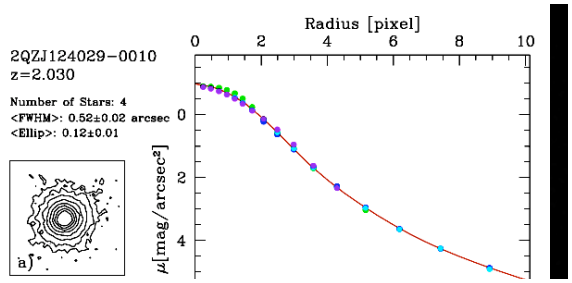
N/H=15
N/H=33
2QZJ124029−0010
Radius [arcsec]


HST−based low−z samples
Kotilainen et al. (1998)
Kotilainen & Falomo (2000)
Kukula et al. (2001)
Falomo et al. (2004)
Ridgway et al. (2004)
Falomo et al. (2005)
Kotilainen et al. (2007)
Hyvonen et al. (2007)
Falomo et al. (2008)
Kotilainen et al. (2009)
Decarli et al. (2009)
Redshift


Target0
Object
PSF
Galaxy
Fit Residuals


QSO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Number of Stars: 4
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Radius [pixel]
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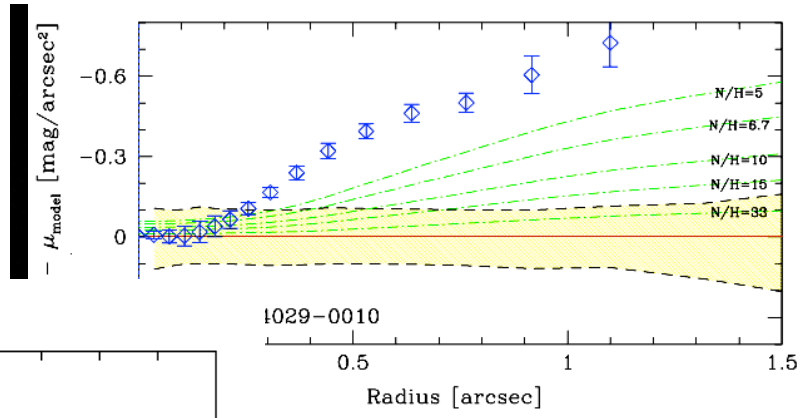
− μmodel [mag/arcsec²]
N/H=5
N/H=6.7
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N/H=15
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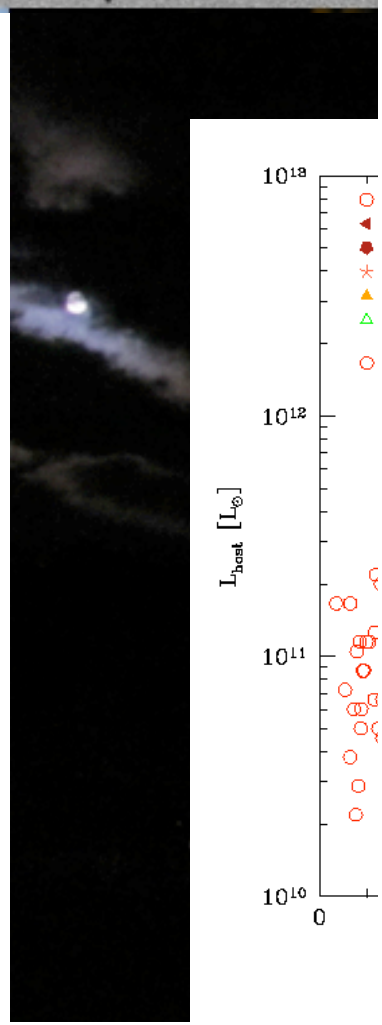
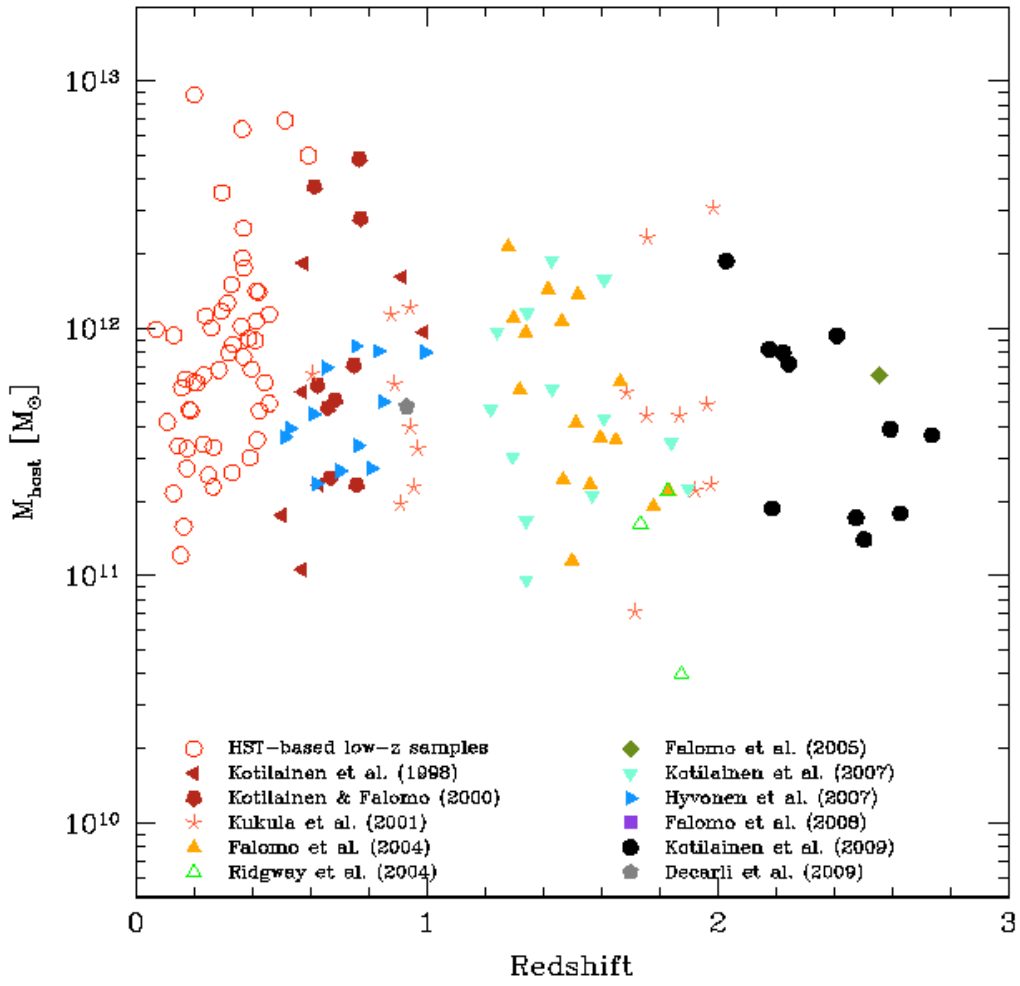
Radius [arcsec]



Lhost [L⊙]
Redshift


Mhost [M⊙]
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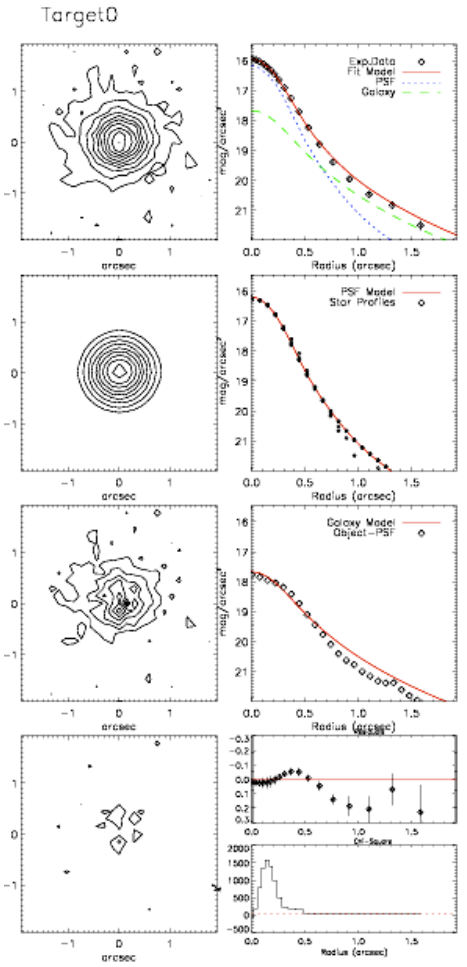
Redshift

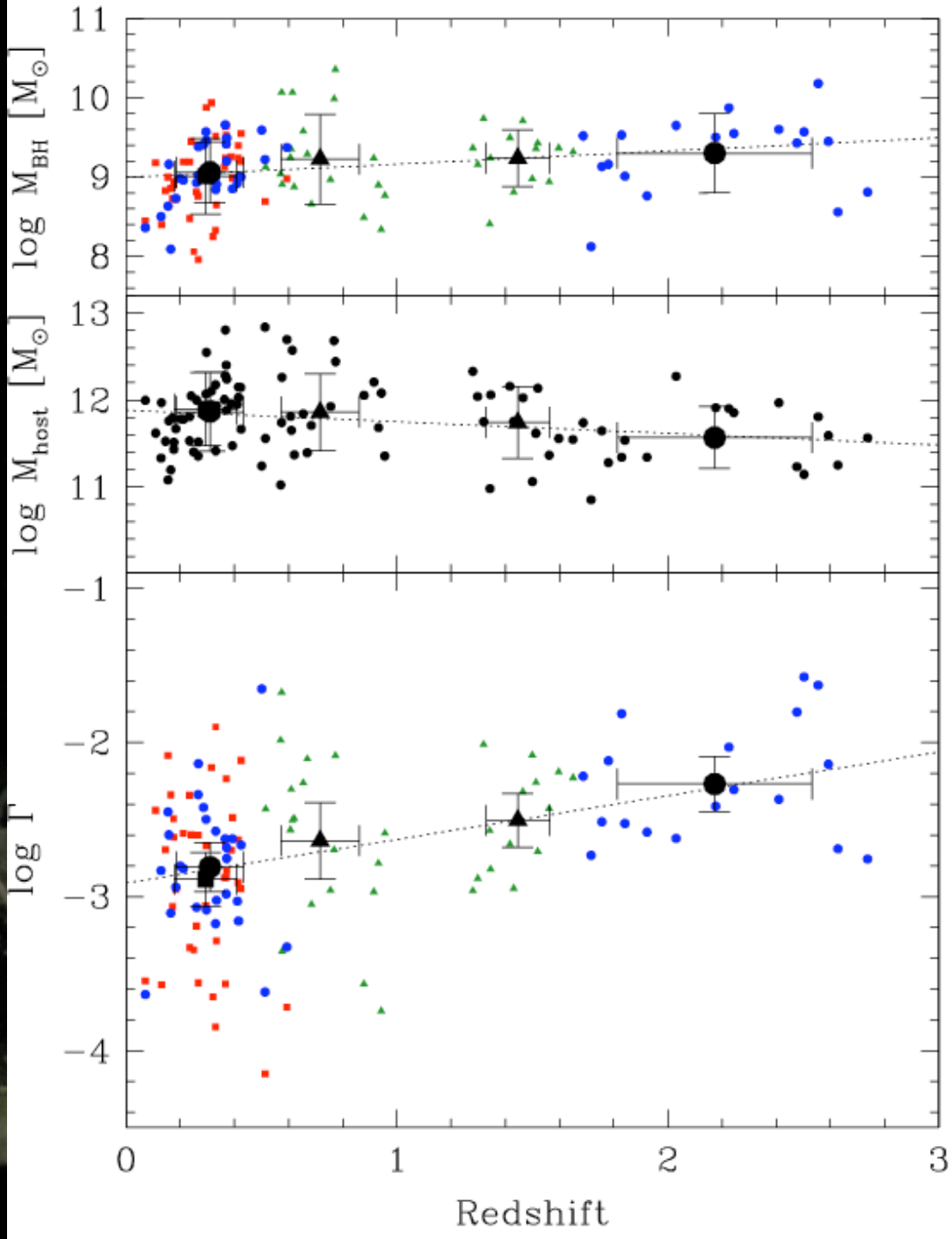

Target0
Exp.Data
Fit Model
PSF
Galaxy
PSF Model
Star Profiles
Galaxy Model
Object−PSF
Radius (arcsec)

The M_{BH}–M_{host} ratio as a function of z

$\Gamma \equiv M_{BH}/M_{host}$ increases of a factor ~7 from z=0 to z=3

$\log \Gamma = (0.28 \pm 0.06)\, z + -(2.91 \pm 0.08)$

Decarli et al (2010 a,b)



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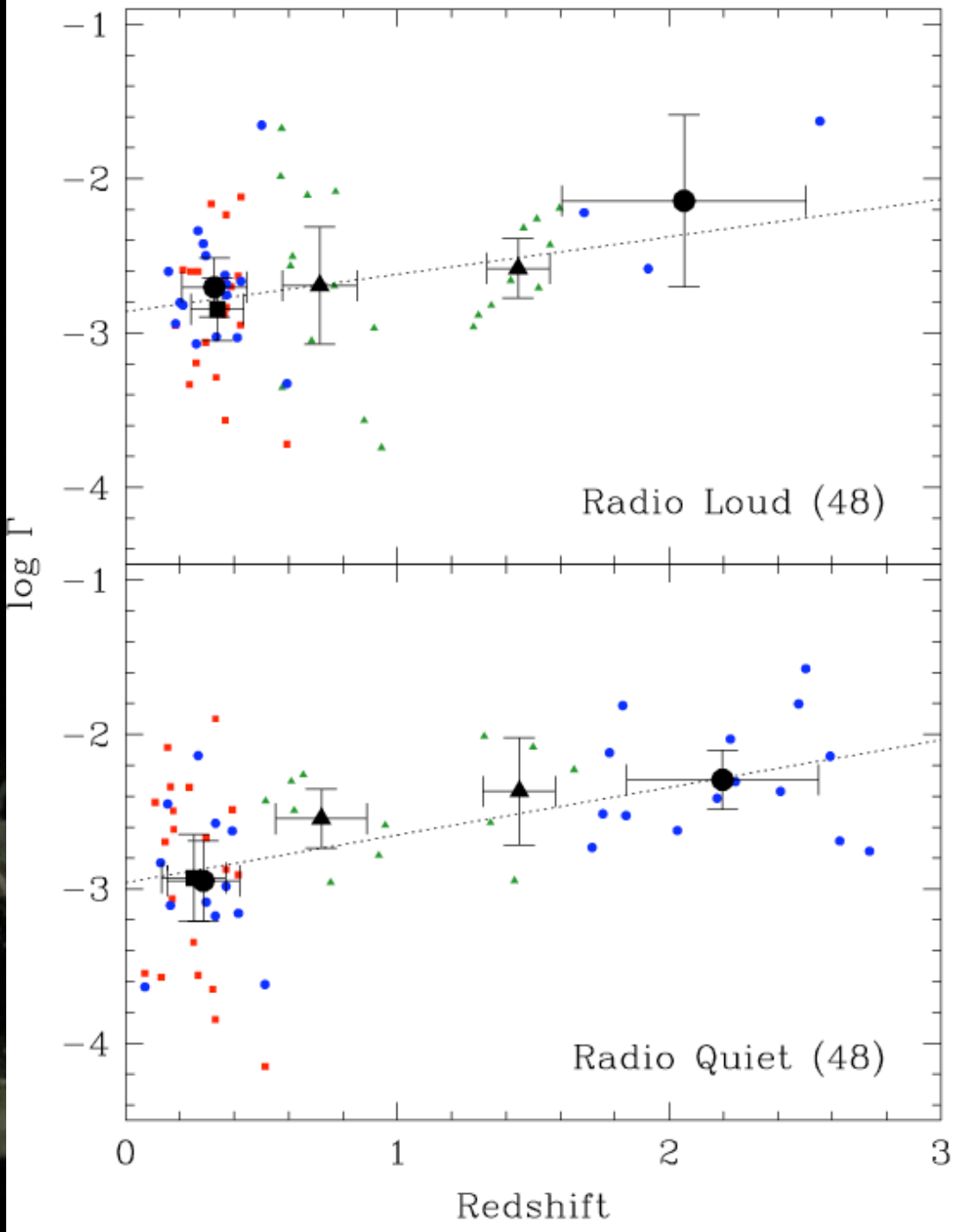
Decarli et al (2010 a,b)



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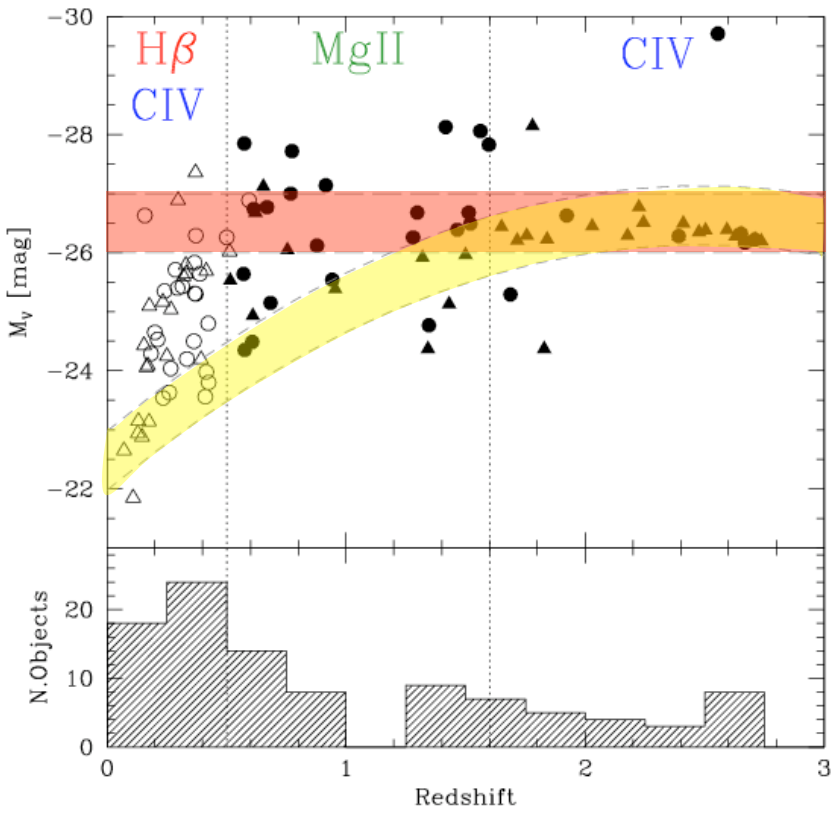
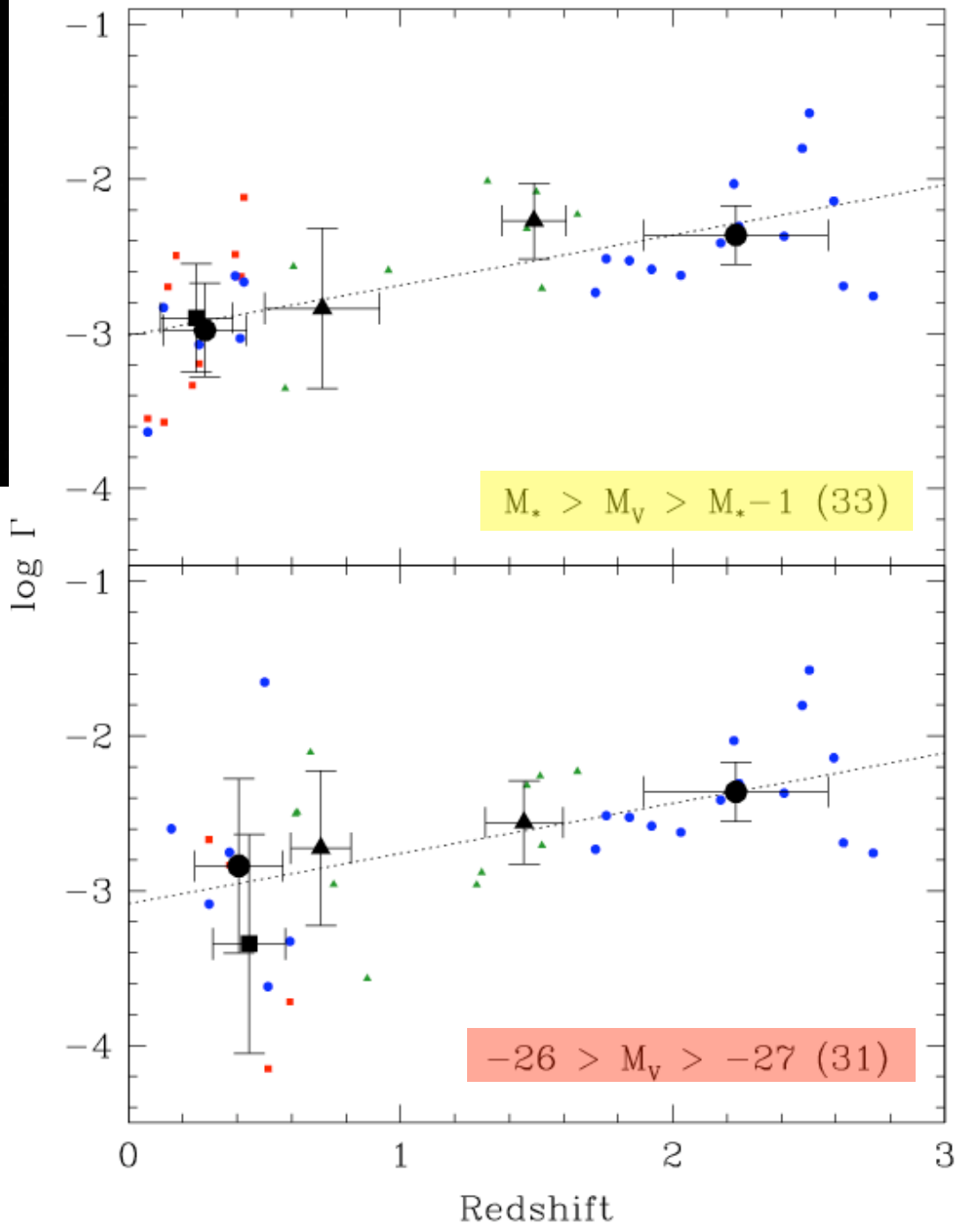
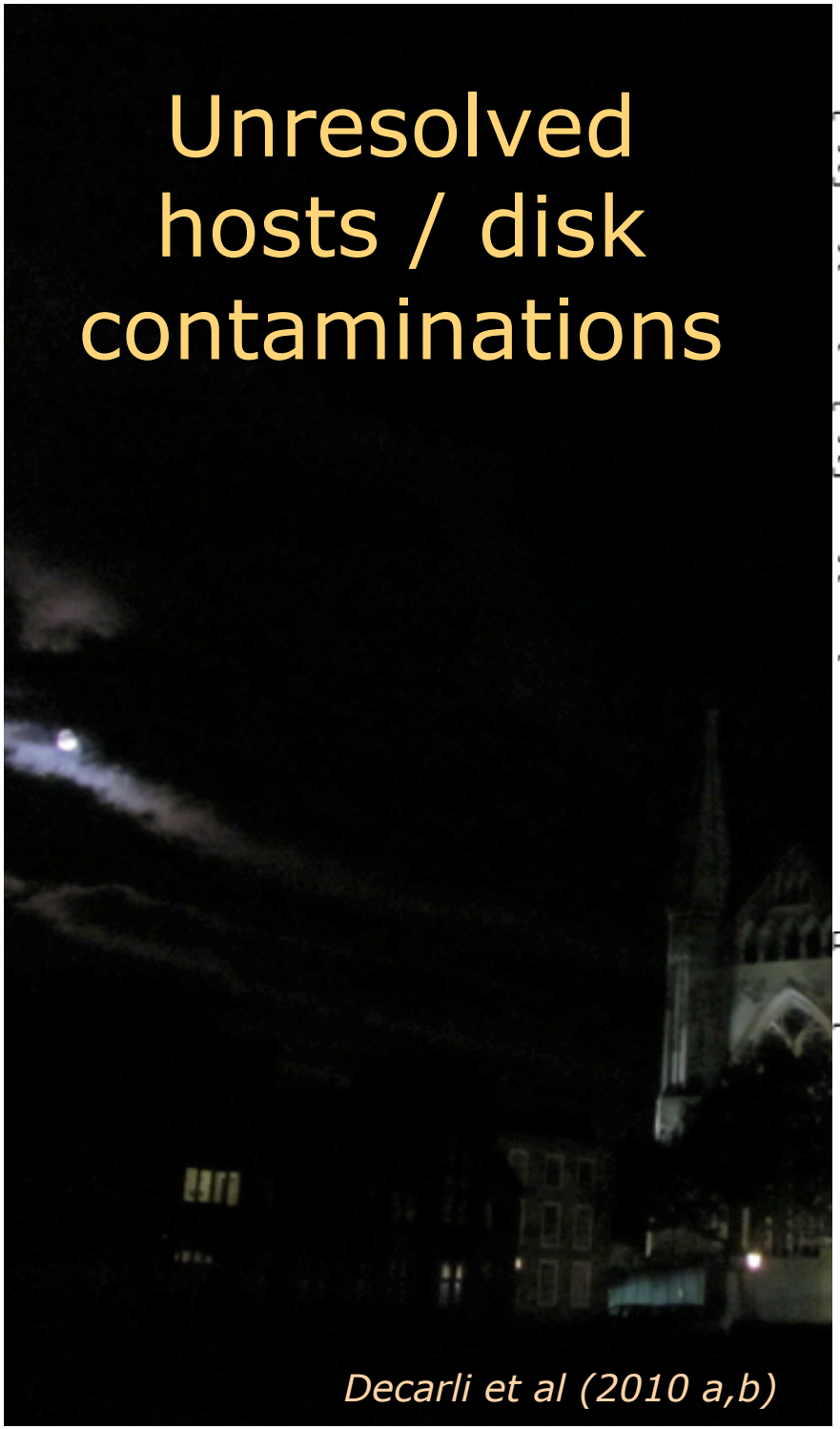
$\Gamma \equiv M_{BH}/M_{host}$ increases of a

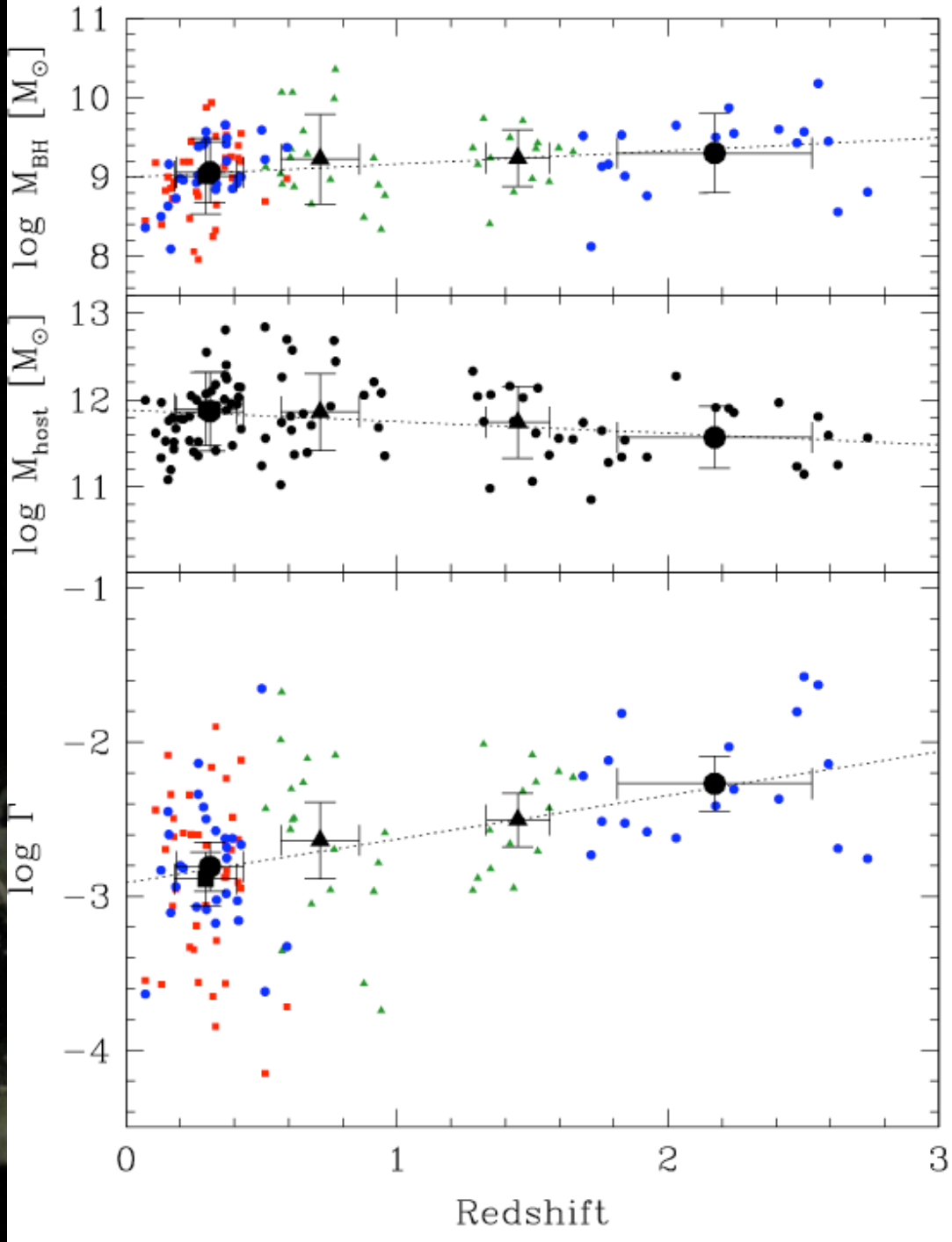




Unresolved hosts / disk contaminations



Decarli et al (2010 a,b)



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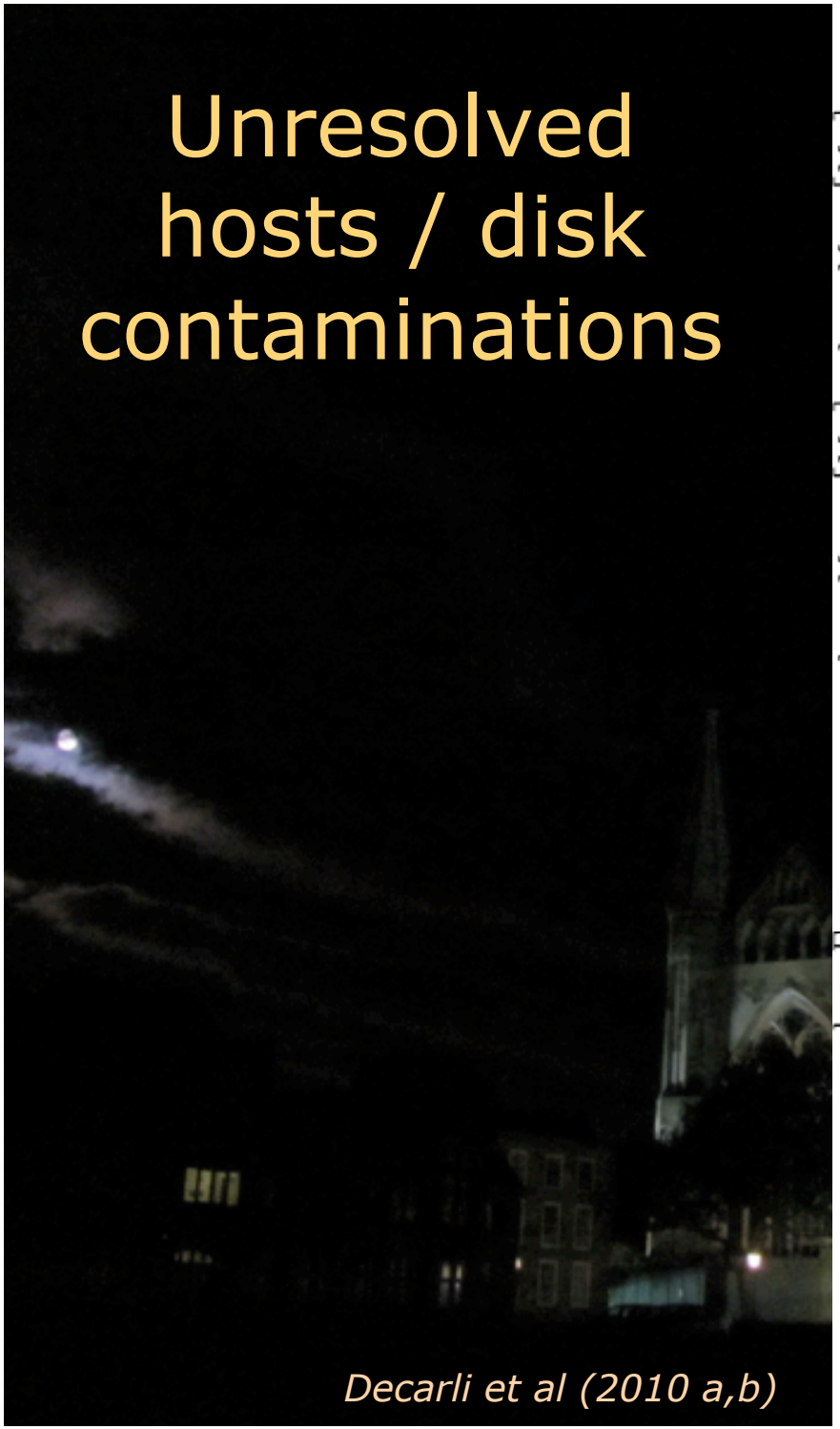
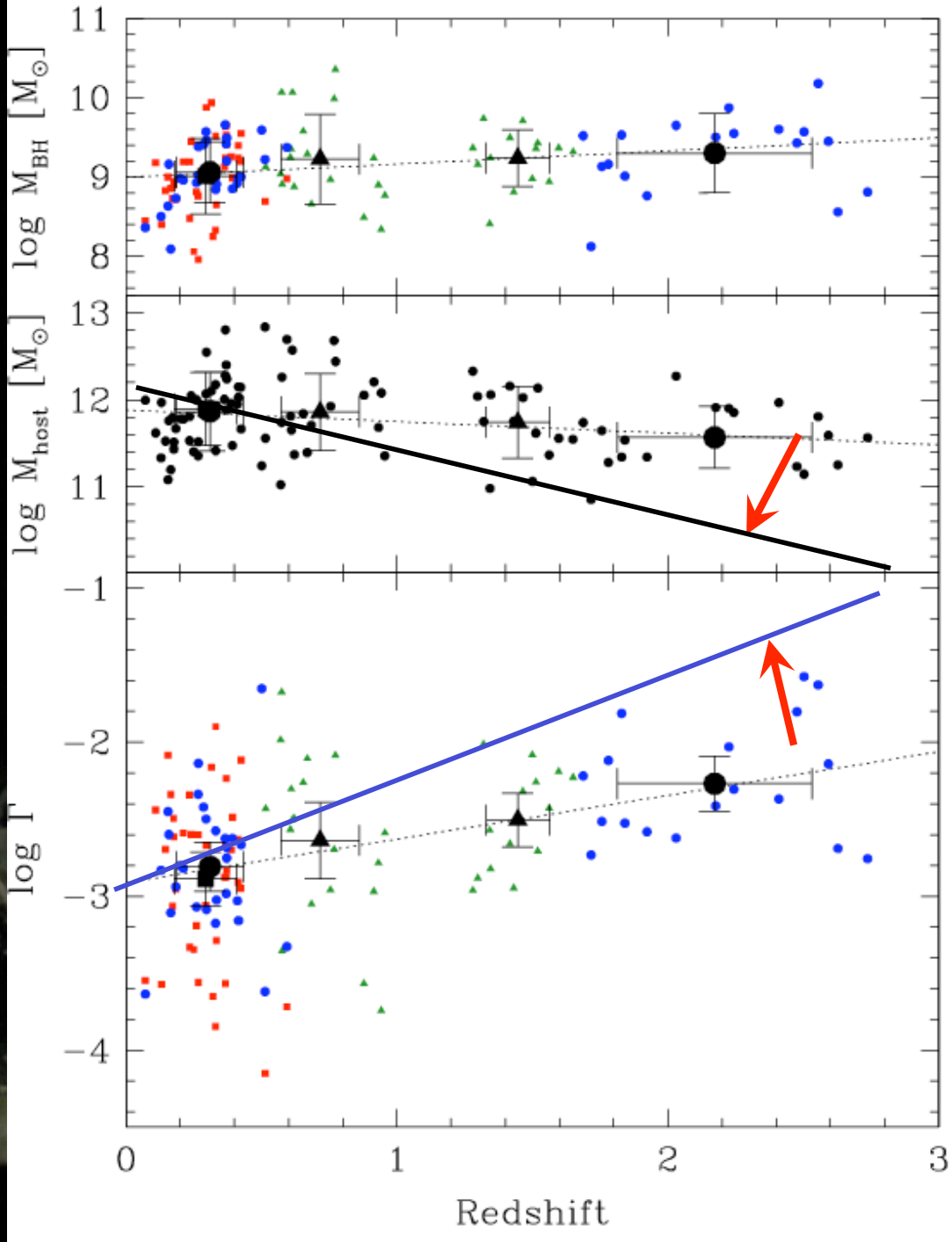
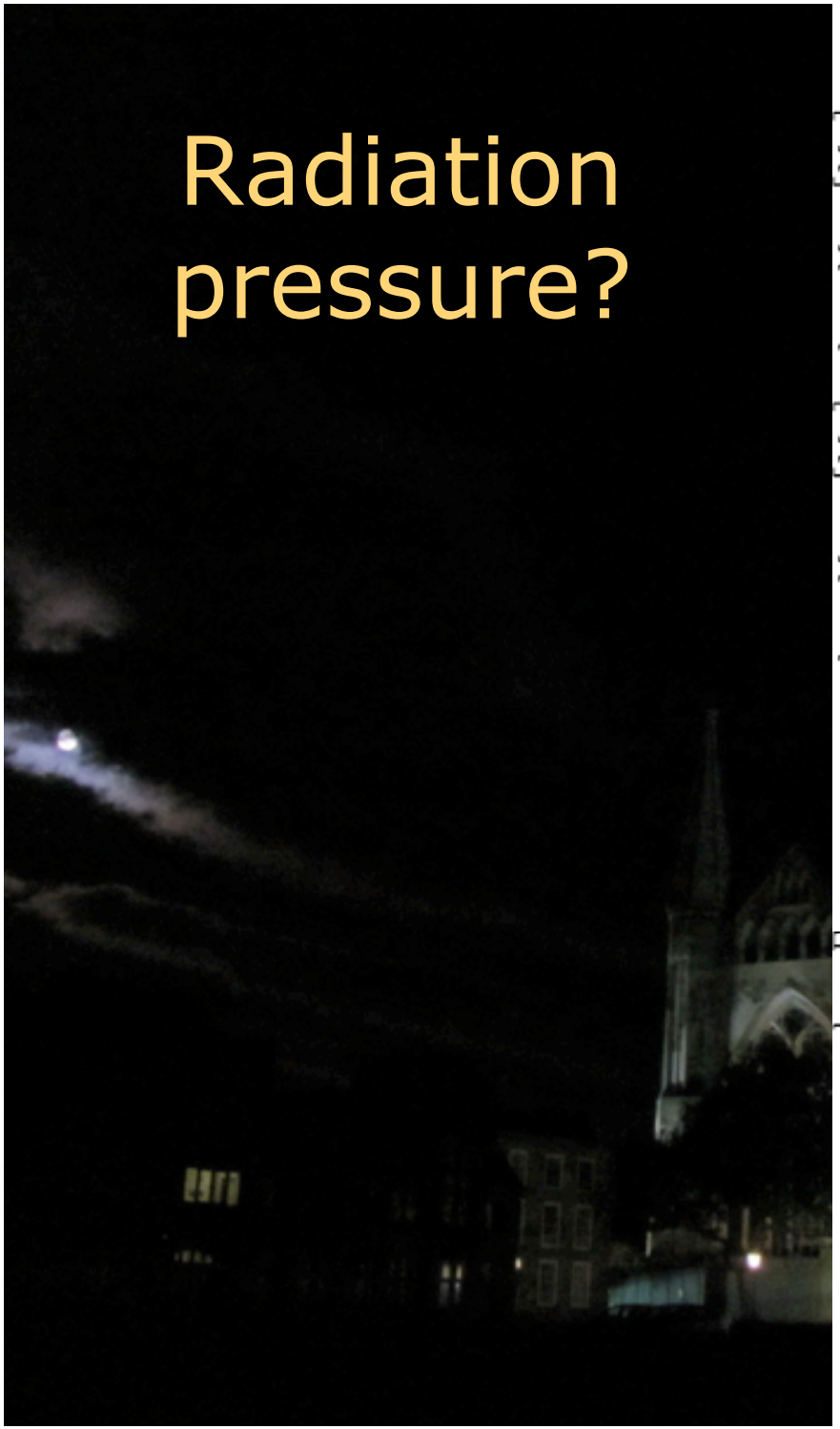
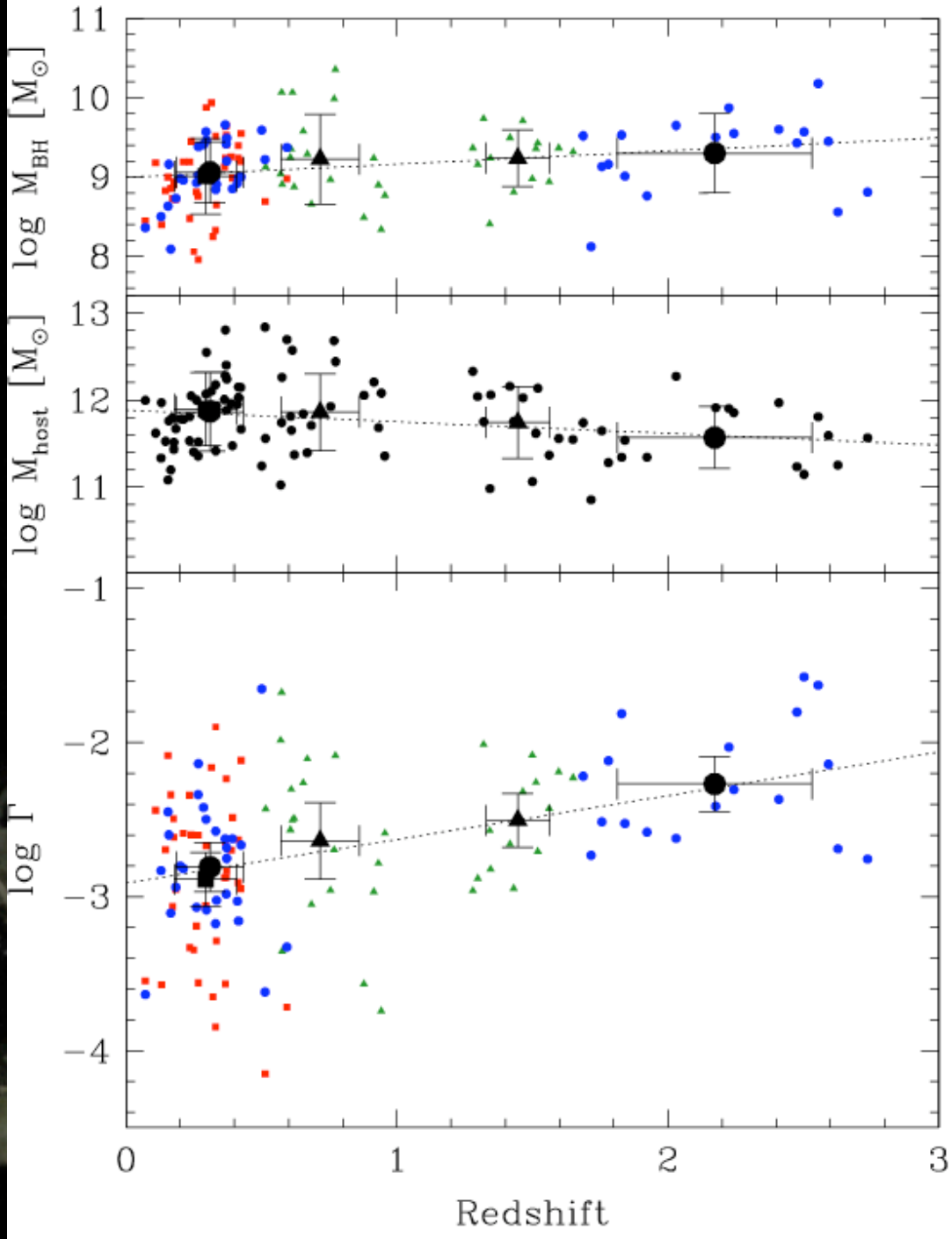


Decarli et al (2010 a,b)

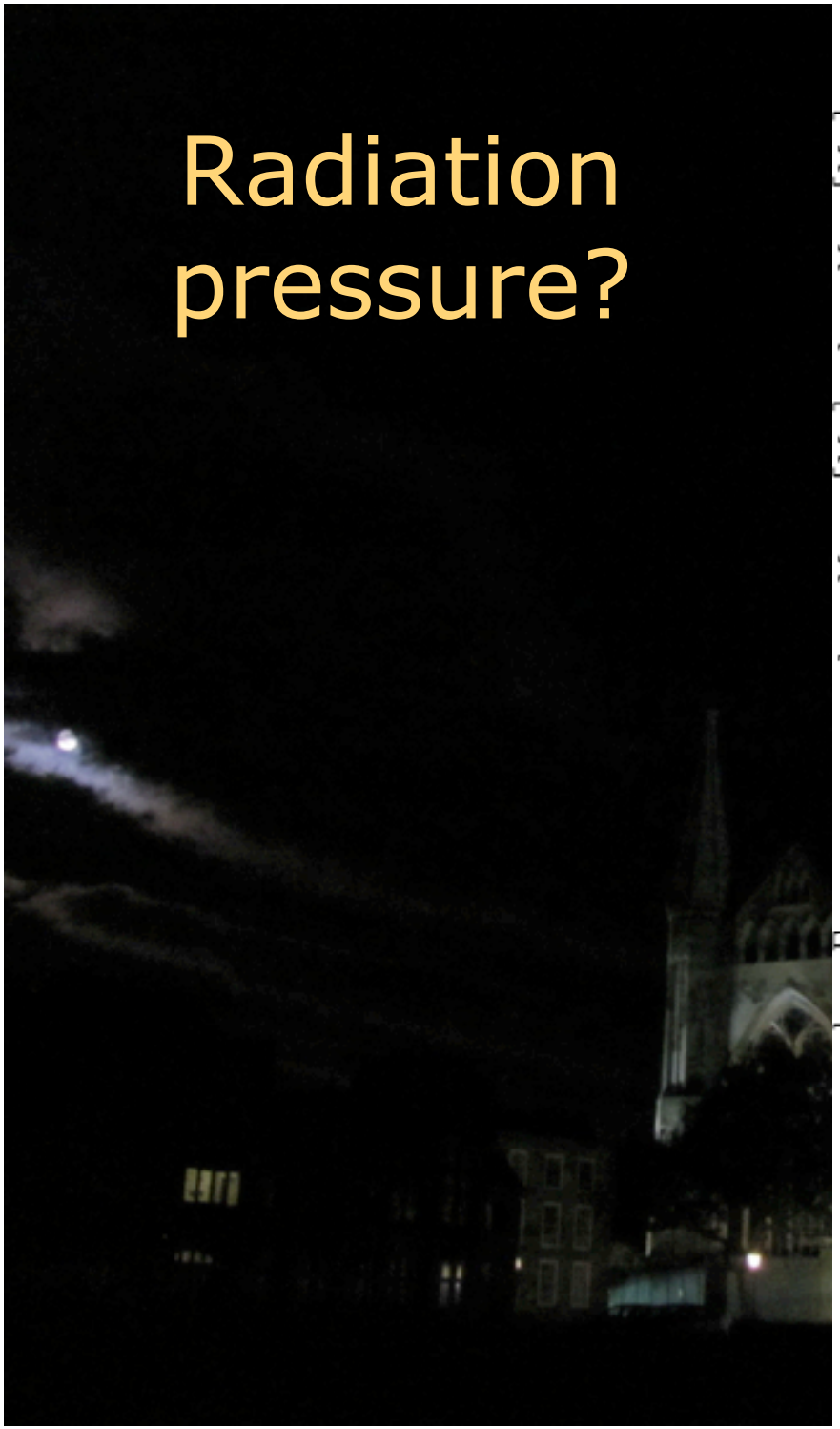


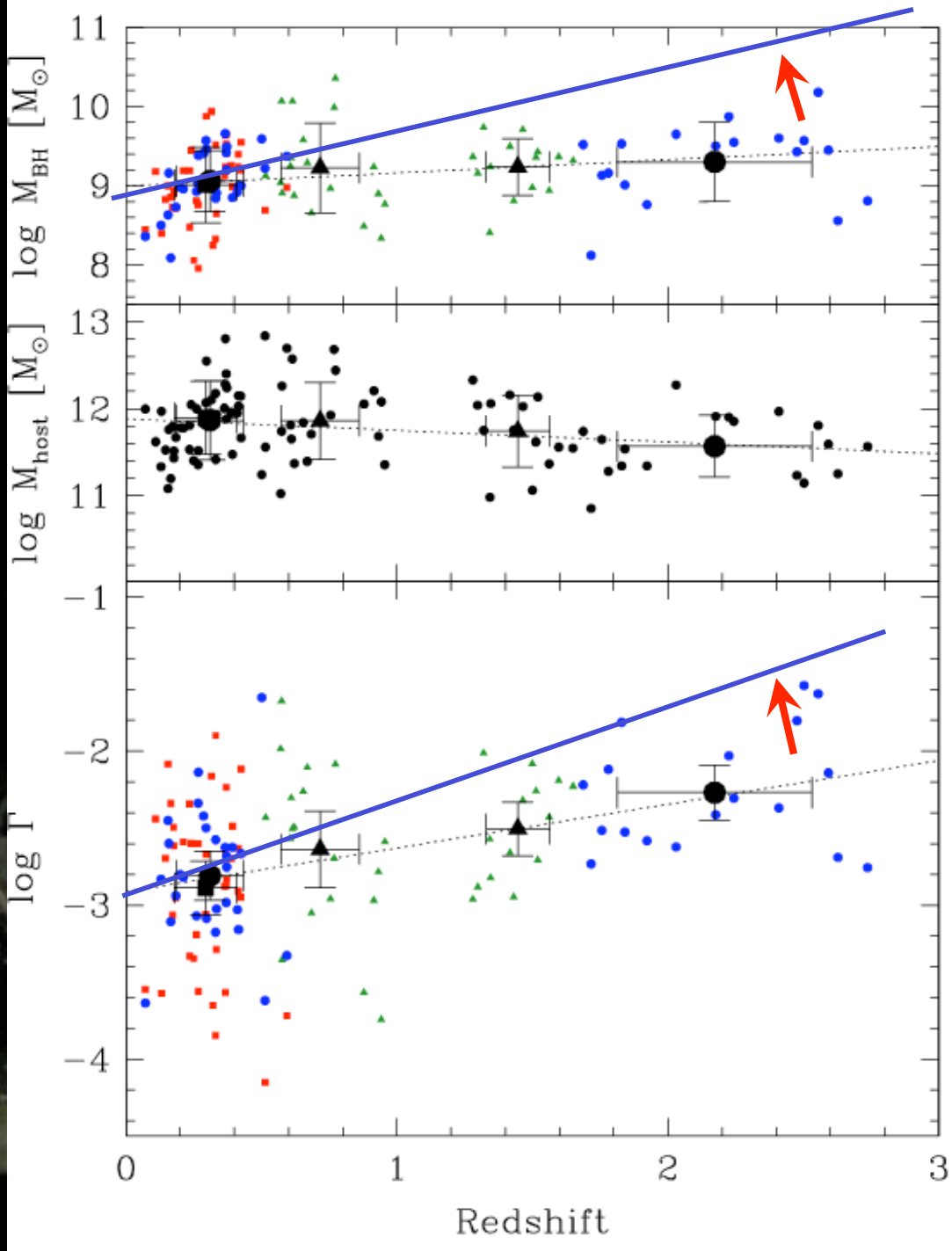
Radiation pressure?



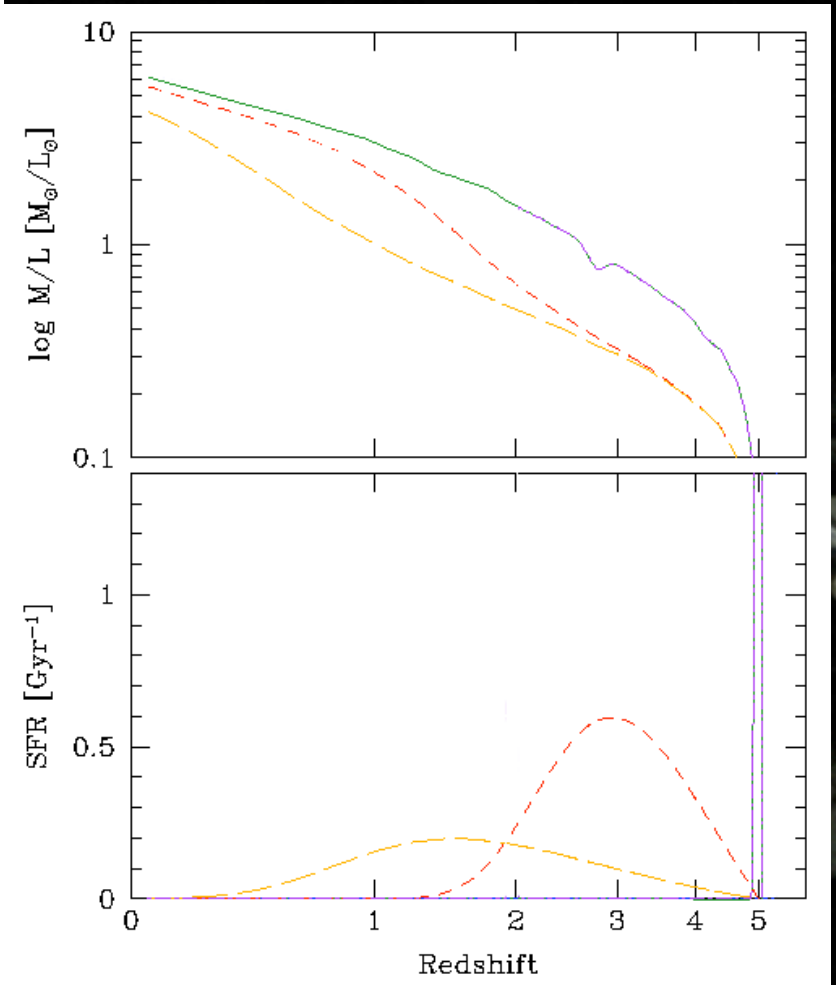


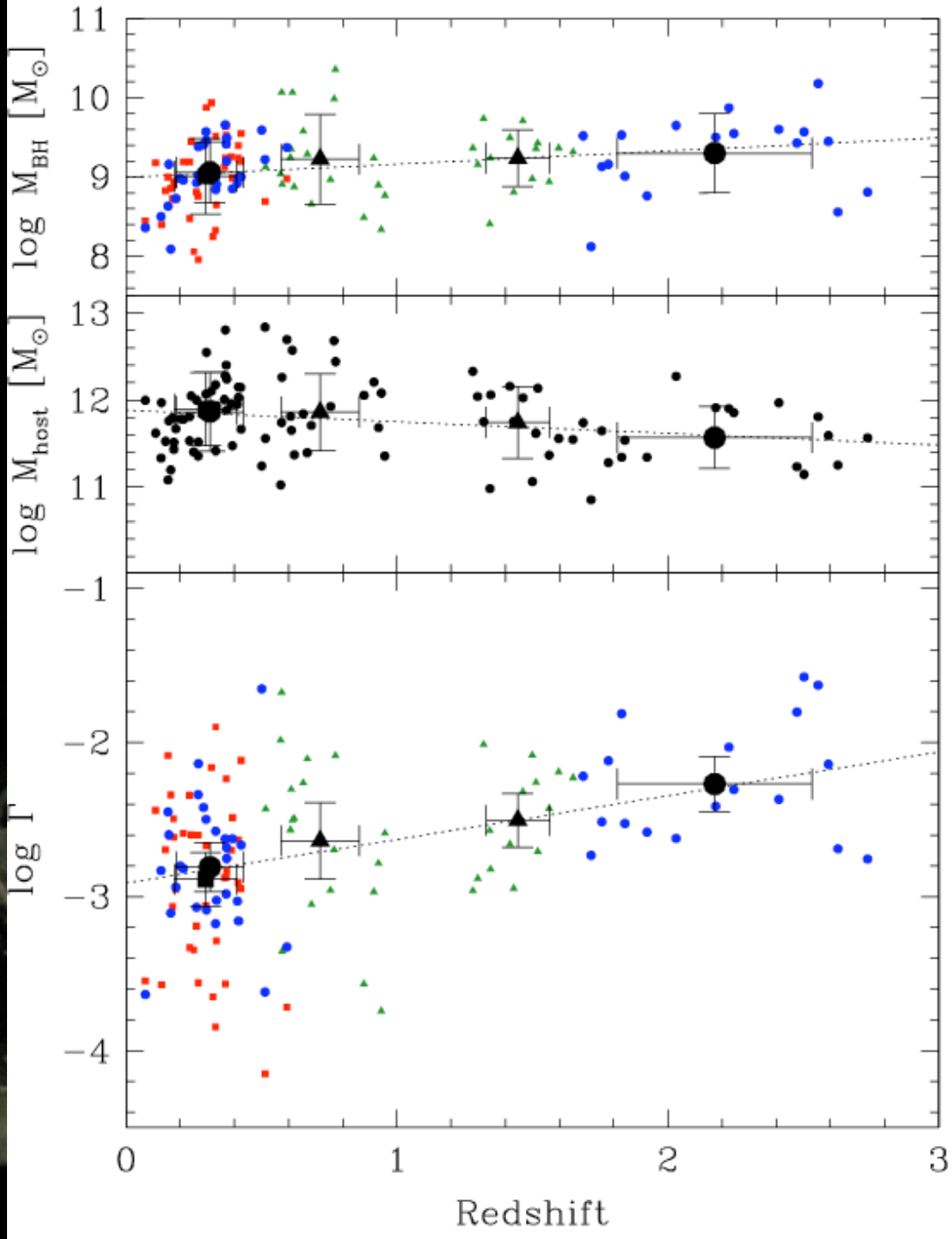
Radiation pressure?



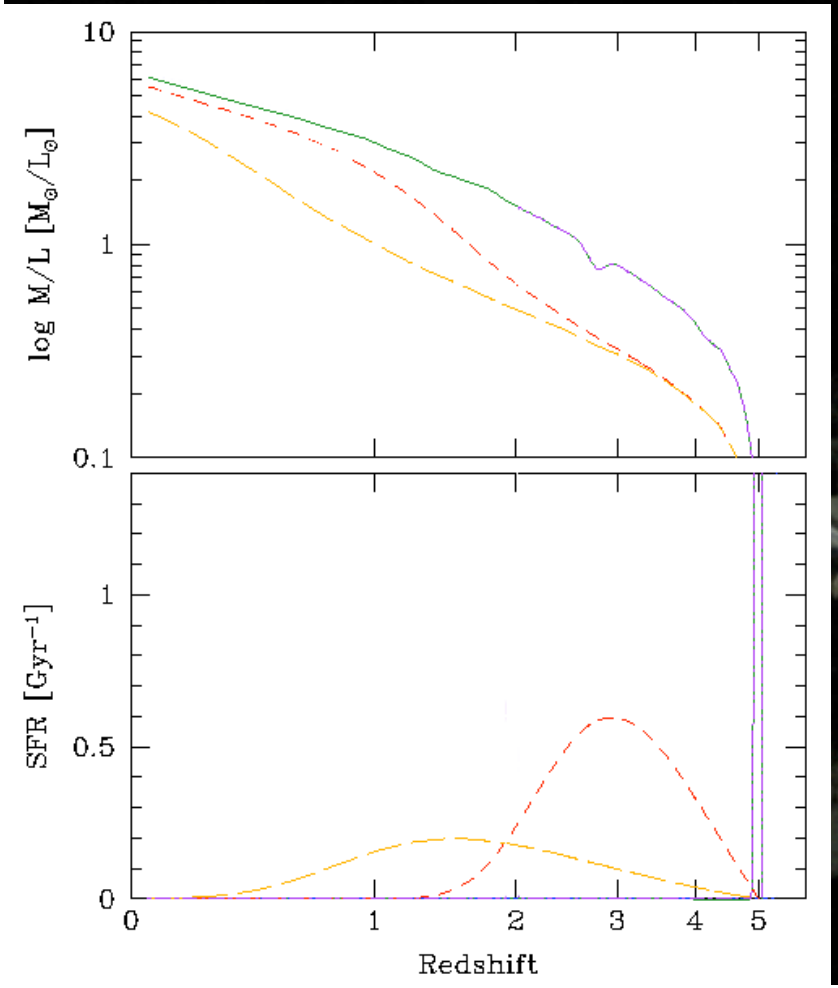


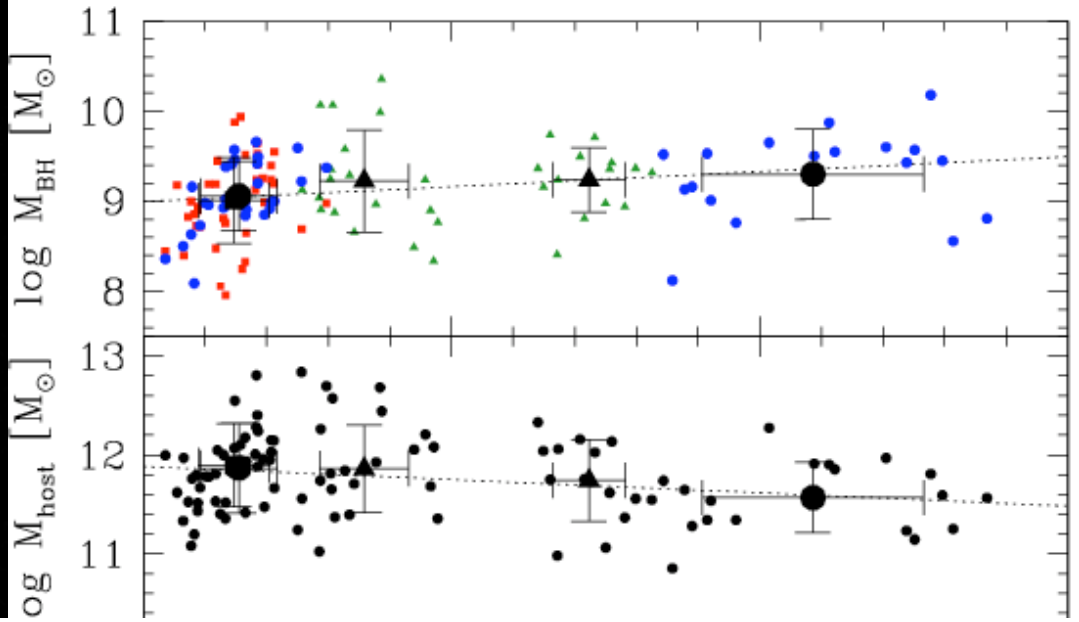
Different SFHs

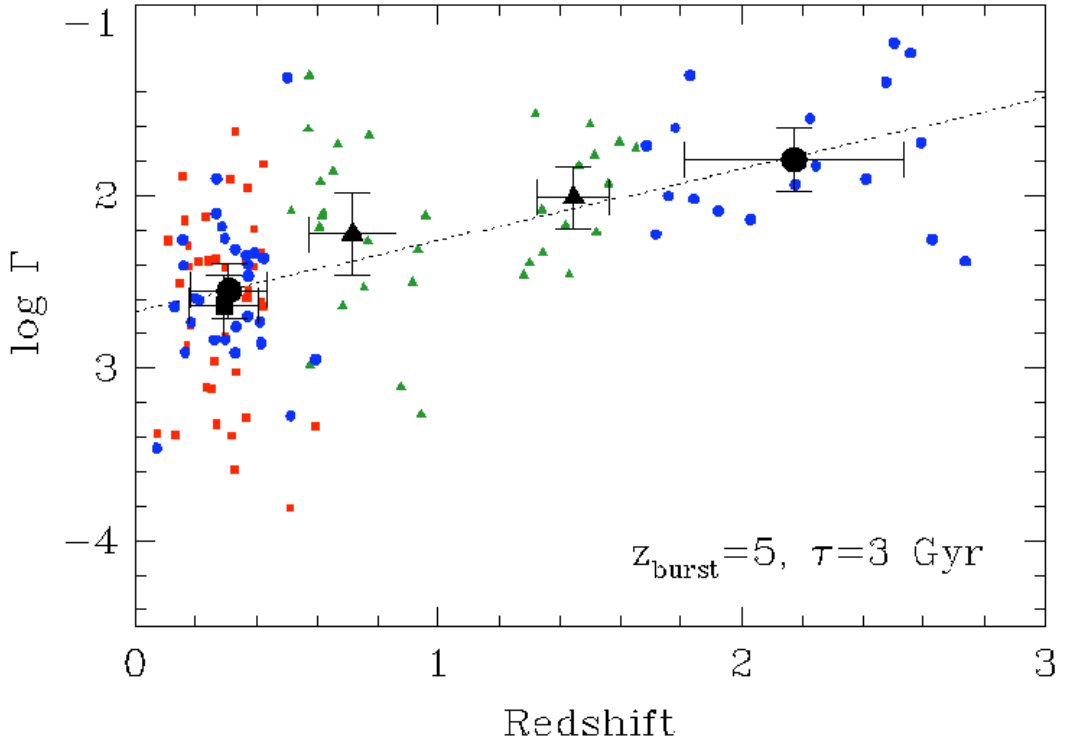




Different SFHs





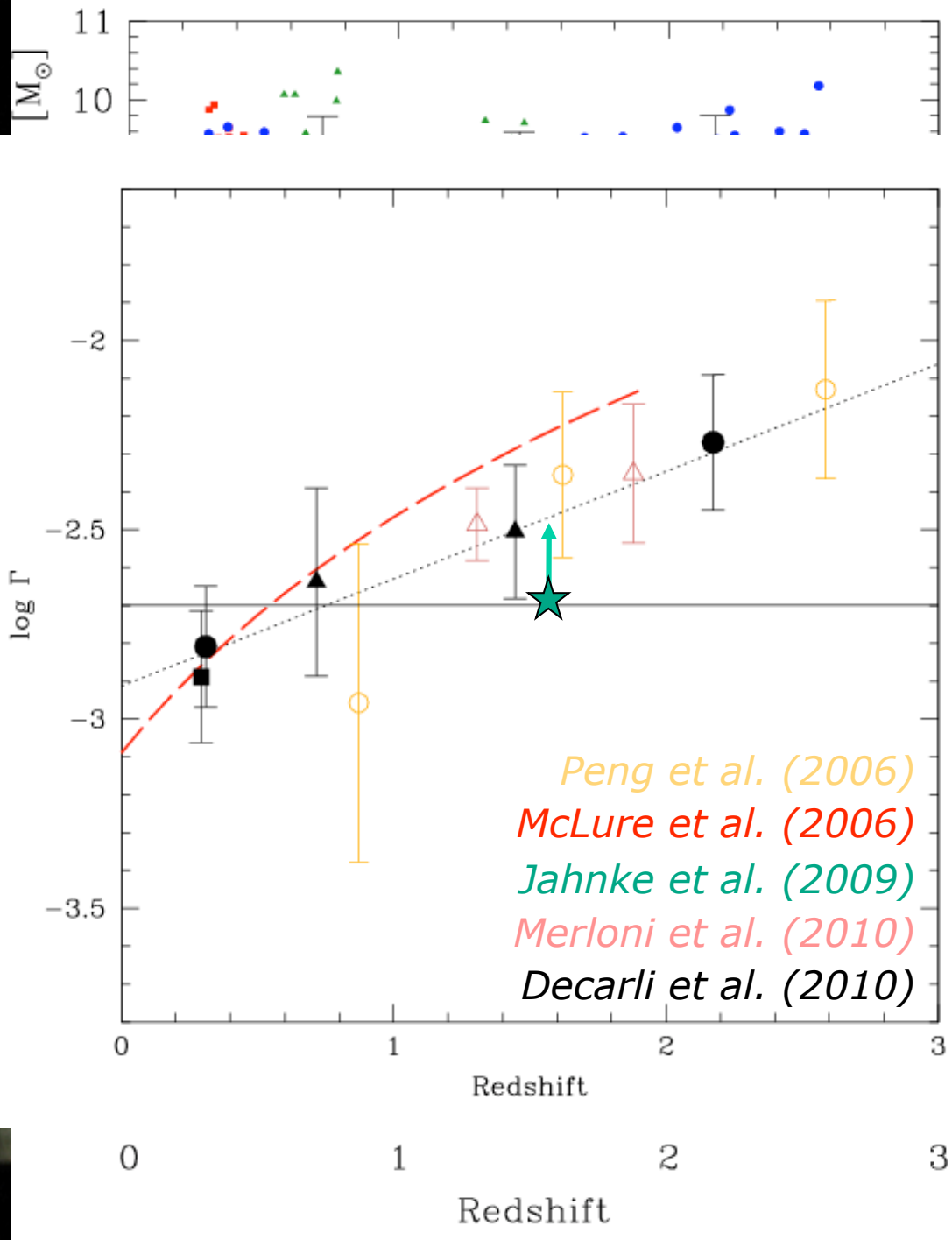


The M_{BH}–M_{host} ratio as a function of z

$\Gamma \equiv M_{BH}/M_{host}$ increases of a factor ~7 from z=0 to z=3

$\log \Gamma = (0.28 \pm 0.06)\, z + -(2.91 \pm 0.08)$

Decarli et al (2010 a,b)



Conclusions

- We probed the M_{BH}-M_{host} relation up to z=3, both for RLQs and RQQs
- The M_{BH}-L_{host} is practically constant
- Once we correct for the evolution of the M/L ratio, Γ increases of a factor ~7 from z=0 to z=3, similarly for RLQs and RQQs