The BH mass of nearby QSOs

A comparison of the bulge luminosity and virial methods

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BH mass determinations

Dynamical method: VIRIAL THEOREM

- Local Universe:

  stars orbiting around the SMBH ⟶ only inactive galaxies

- Higher redshift:

  gas regions emitting the broad lines – BLR ⟶ **Type I AGN!**

The virial method for AGN

$$\mathcal{M}_{\rm BH} = G^{-1} R_{\rm BLR} v_{\rm BLR}^{\ 2}$$

$$R_{\rm BLR} = (22.4 \pm 0.8) \left[\frac{\lambda L_\lambda(1350\text{Å})}{10^{44}\ \text{erg s}^{-1}}\right]^{0.61\pm0.02} \ \text{lt} - \text{days}$$

(Pian et al. 2004)
From Reverberation Mapping

$$v_{\rm BLR} = f \cdot \text{FWHM}$$

Doppler Effect

$$\mathcal{M}_{\rm BH} = f^2 \cdot 4.4 \cdot 10^6 \left[\frac{\lambda L_\lambda(1350\text{Å})}{10^{44}\ \text{erg s}^{-1}}\right]^{0.61} \left(\frac{\text{FWHM}}{1000\,\text{km s}^{-1}}\right)^2 \mathcal{M}_\odot$$

- MBH can be inferred from spectral measures (line width, nuclear luminosity)
- f = unknown factor related to the BLR geometry

M_{BH} and global properties of the host galaxy

Elliptical galaxies ↔ SMBHs

Locally:

- Velocity dispersion σ;
- Galaxy Luminosity: (Bettoni et al. 2002)

$$\log(\mathscr{M}_{\rm BH}/\mathscr{M}_{\odot}) = -0.50 M_R - 2.60$$

→ Coevolution of SMBHs and host galaxies

M_{BH} for close-by quasars

- Virial method
- Host galaxy luminosity method

Sample: available HST WFPC2 images

$\rightarrow M_R$

available HST FOS spectra

$\rightarrow$ FWHM (C IV)

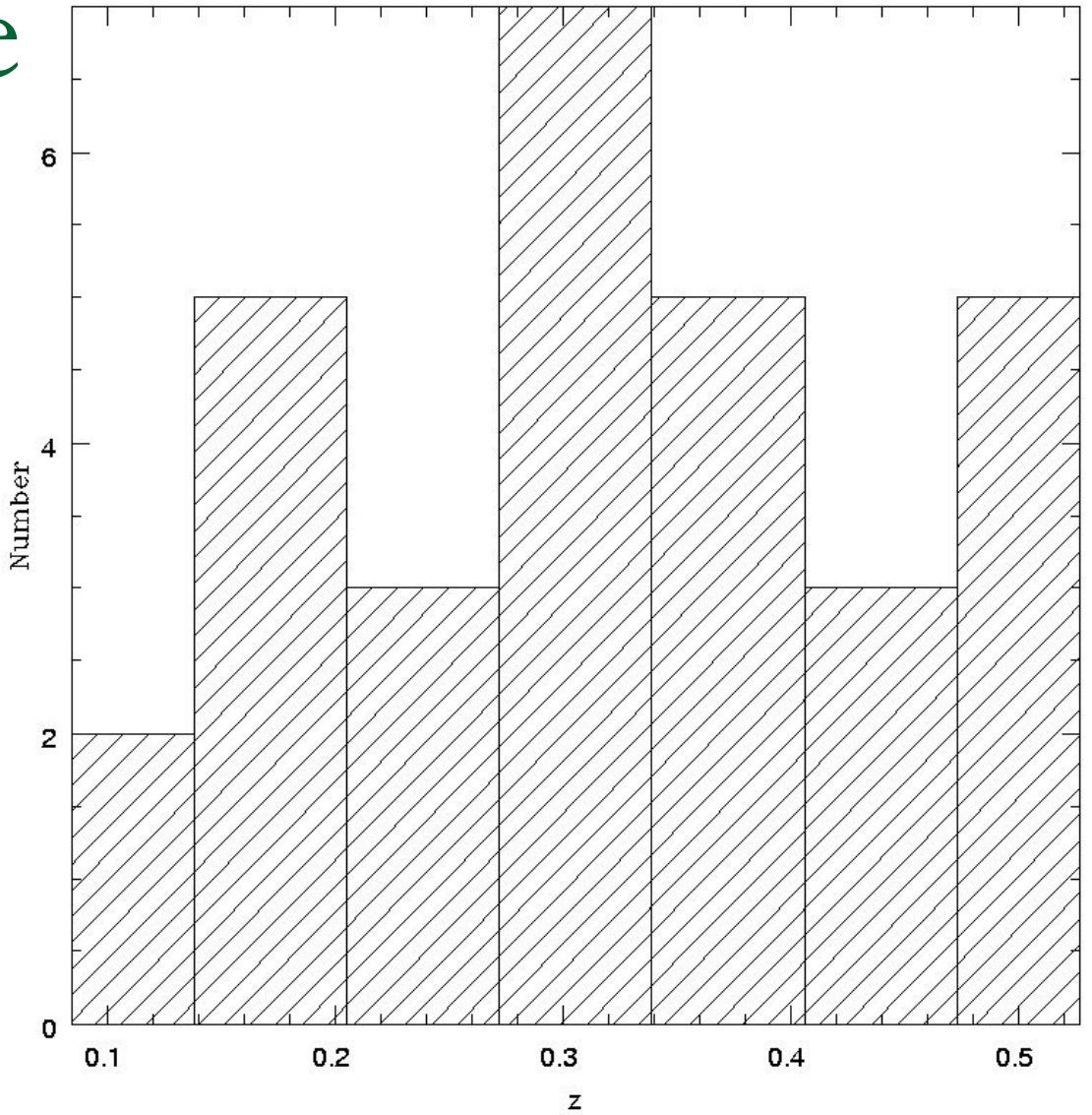
L_λ(1350 A)

The sample

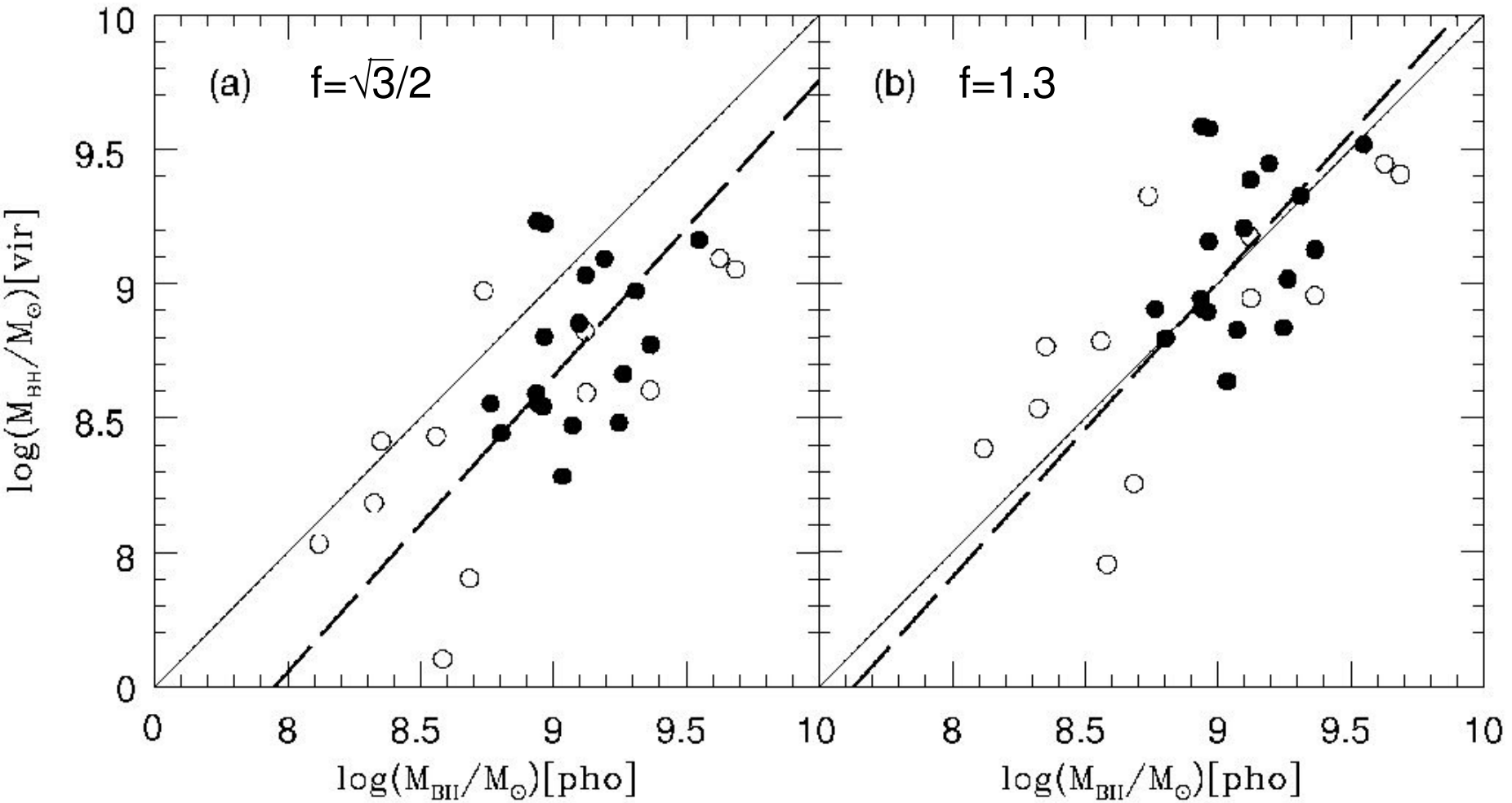
30 QSOs

- 18 RLQs
- 12 RQQs

0.1< z <0.6



BH mass comparison

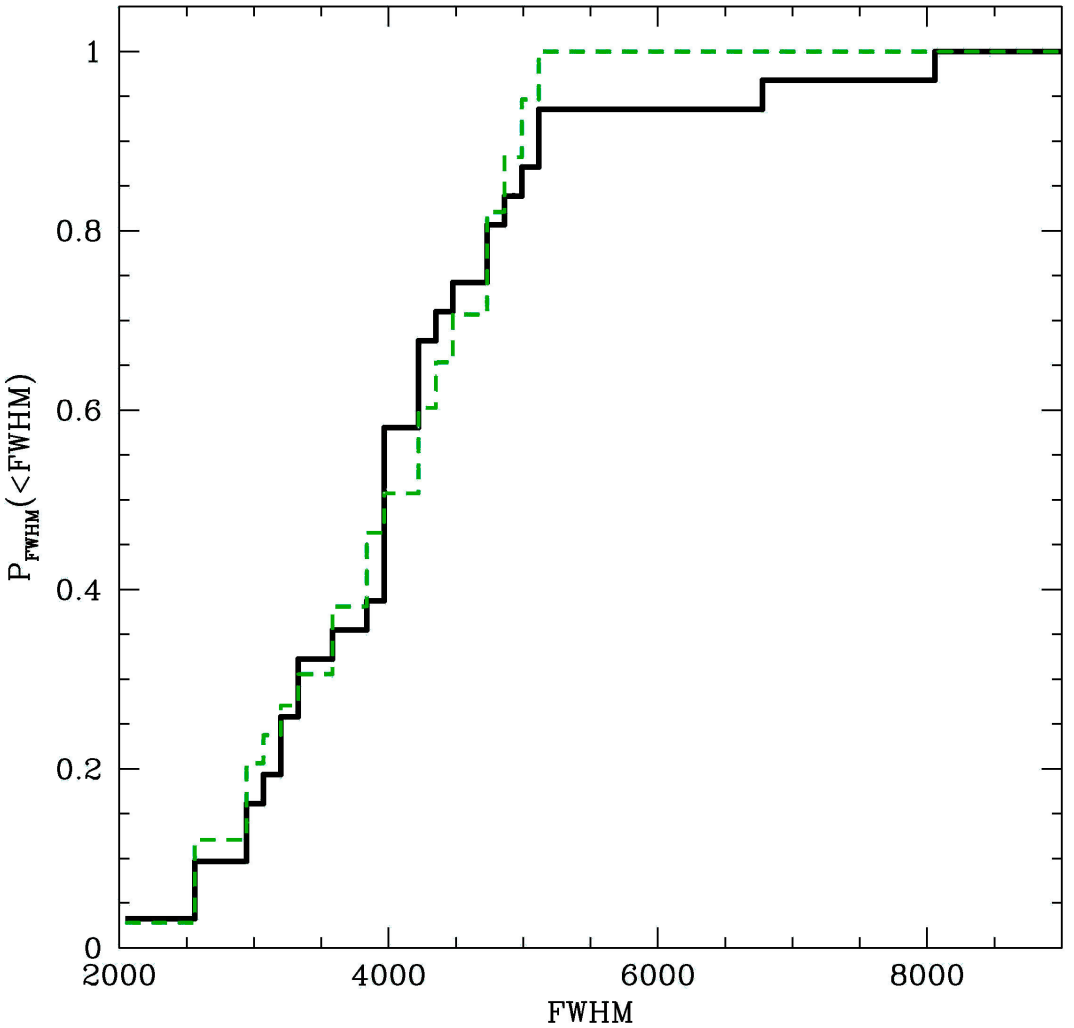


FWHM cumulative distribution

observed FWHM

cumulative distribution

expected cumulative distribution in a disc-like BLR geometry picture

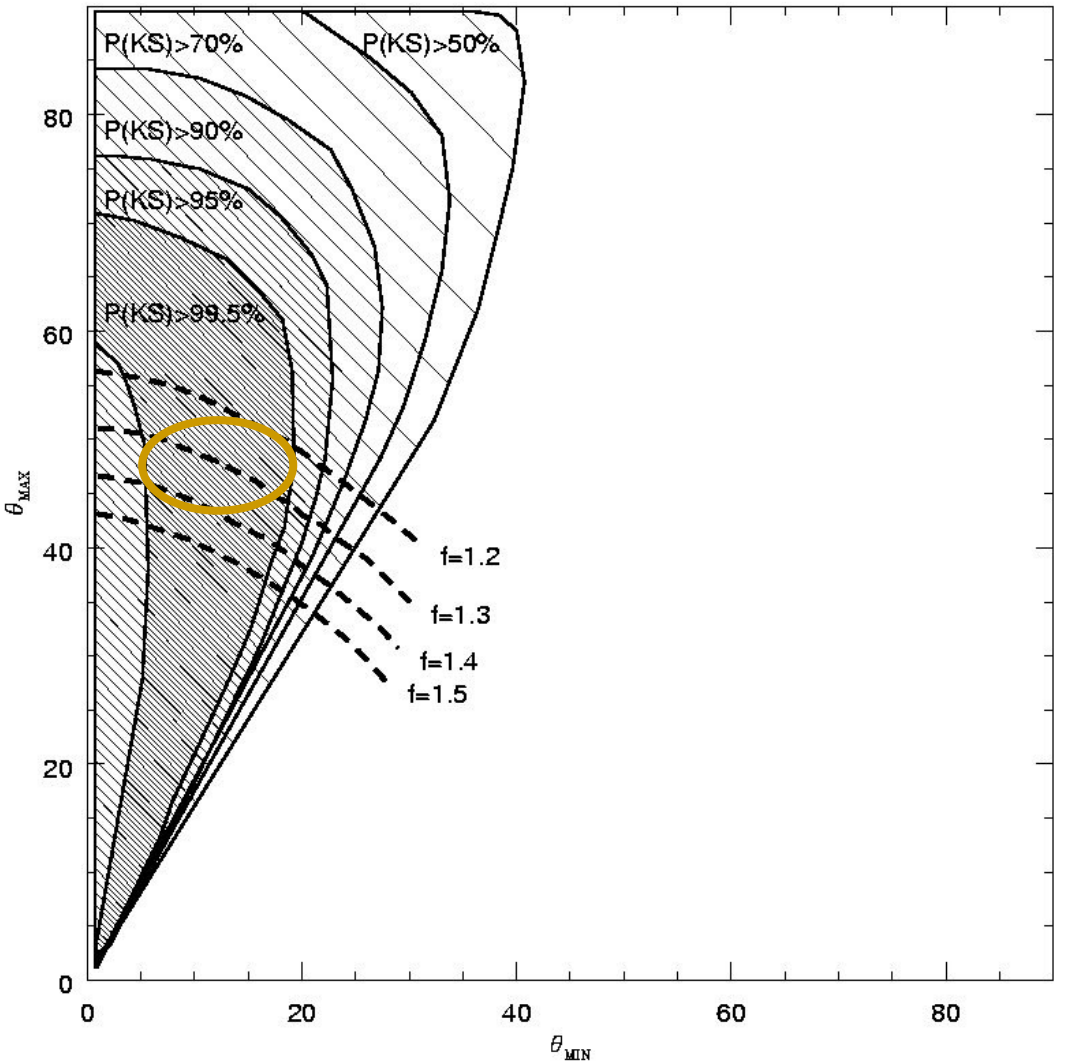


QSOs inclination angles

Kolmogorov – Smirnov test of compatibility:

$12° < i < 48°$

Good agreement with the Unified Model for AGN!



Main results

- f ~ 1.3 i.e. disc-like BLR geometry
  with QSO inclination angles 12° < i < 48°.

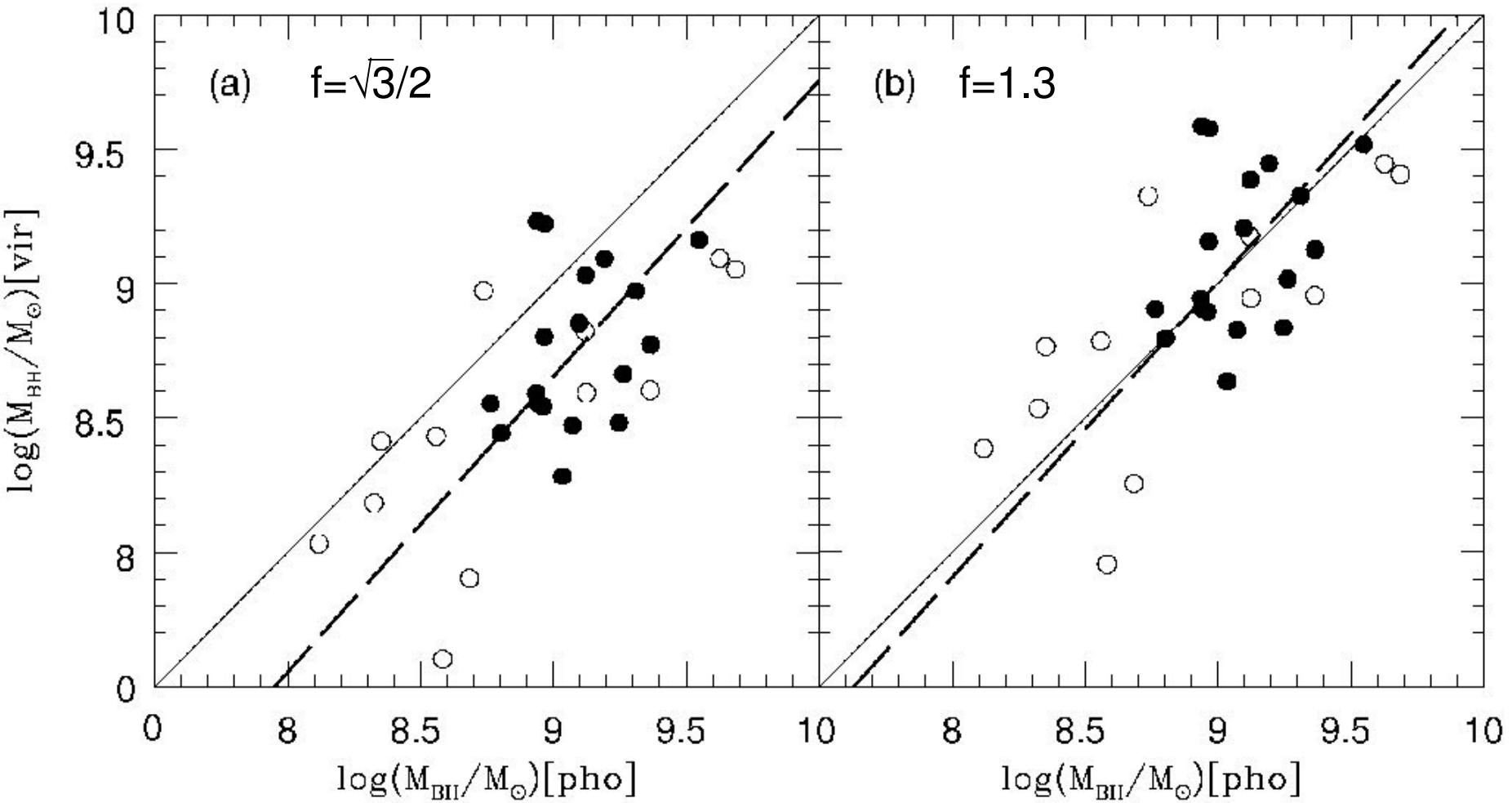
  (cfr. McLure & Dunlop 2002)

- RQQs are distributed in the whole mass range
  (10^{8}-$10^{9.7}M_{sun}$);
  RLQ masses exceed $10^{8.6}M_{sun}$.

- $M_{BH} - L_{bulge}$ correlation obtained locally can be extrapolated to z ~ 0.4.

… (see Labita et al. 2006, MNRAS submitted)

BH mass comparison



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The next step: QSOs at higher z