No evolution in the M_{BH}-$M_{*,total}$-relation over the last 9 Gyrs

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Galaxy–Black Hole Coevolution

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0 intro & summary

We investigate 10 QSO host galaxies at 1<z<2 in the COSMOS field, observed with the HST in both ACS/WFC I-band and NICMOS/NIC3 H-band. We combine stellar masses derived from host luminosities and M/L ratios based on (B-V) rest-frame colors, with virial black hole mass estimates from COSMOS. As a result we find the *total* galaxy mass scales with black hole mass identically to *bulge* mass and black hole mass in the local universe. This sets limits on the importance of AGN feedback in the creation of the M_{BH}–M_{bulge}-relation.

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1 data

COSMOS provides ~550 broad-line AGN from the XMM-Newton survey of the field (Hasinger et al. 2007, Cappelluti et al. 2009). For 10 of these images from both HST ACS F814W and HST NIC3 F160W parallels are available (Scoville et al. 2007), as well as virial black hole mass estimates from the COSMOS Magellan/IMACS (Trump et al. 2009) and the zCOSMOS surveys (Lilly et al. 2007, Merloni et al. 2009).

Note: All public released COSMOS data can be obtained from http://irsa.ipac.caltech.edu/data/COSMOS/

2 analysis

We extract host galaxy luminosities, modelling the two-dimensional light distribution of galaxy and AGN using GALFIT (Peng et al. 2002). The models are composed of a Sérsic component for the host galaxy and a point source for the AGN. To avoid biases the Sérsic index n is kept identical for ACS I-band and NIC3 H-band (see Fig. 1 for extracted NIC3 host galaxies).

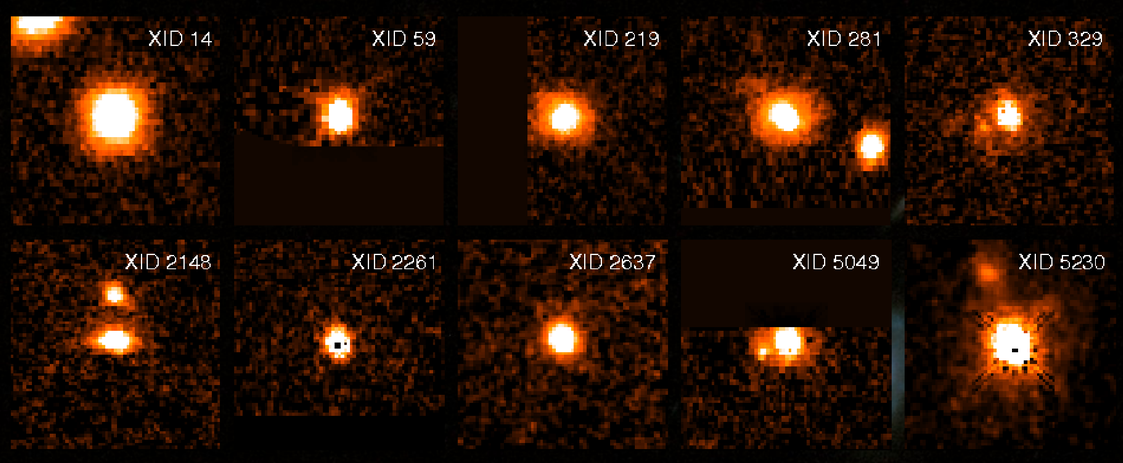

Figure 1: Extracted host galaxies from NIC3 F160W images (H-band). Image sizes are 7”x7”. Some QSOs lie near the edges of NIC3 tiles.

3 results

10/10 of the host galaxies are resolved in the NIC3 H-band and 7/10 also in the ACS I-band. For these galaxies GALFIT process provides an observed H-band magnitude and an (I-H) color from the best-fit model parameters.

Magnitude and color are converted to restframe M_V and (B-V) using interpolation templates (Bruzual&Charlot 2003, Chabrier IMF, solar metallicity). For the three galaxies unresolved in I-band we assume two extreme colors that should bracket the actual value. Stellar masses are then computed from M_V and (B-V) using the calibration by Bell & deJong (2001).

The resulting relation between black hole mass vs. *total* stellar mass is shown in Fig. 2 below.

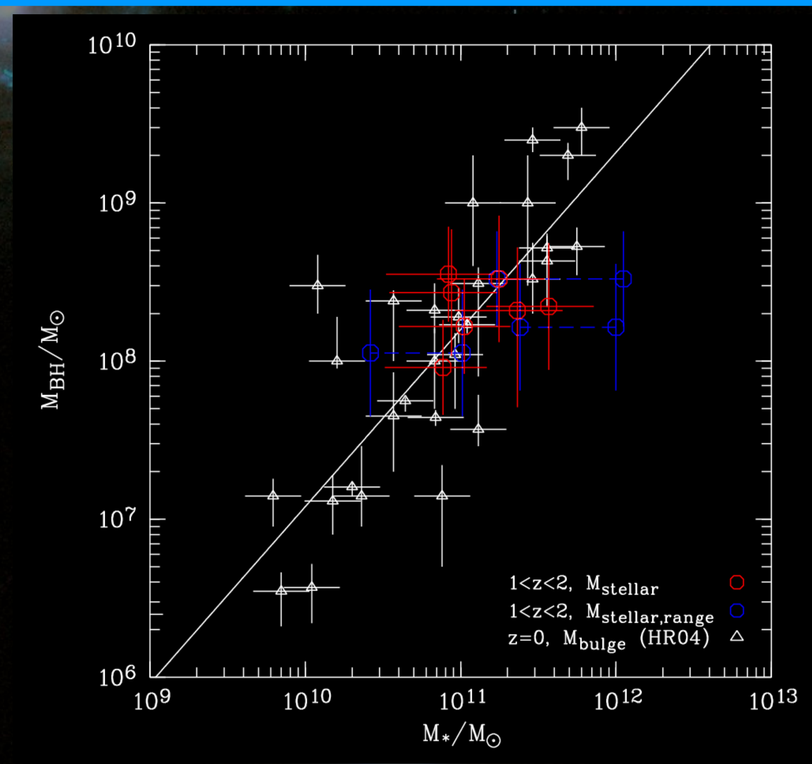

Figure 2: Black hole vs. stellar mass. Shown are the BH to bulge mass relation at z~0 of Häring & Rix (2004) in white, and our total stellar masses at z~1.4 in red. Blue points and lines bracket the masses for the three host galaxies unresolved in I-band.

4 Discussion & interpretation

We find that our galaxies with mean z=1.4 follow the local M_{BH}–M_{bulge}-relation exactly – however, not with an explicit bulge mass, but with their total stellar mass. This allows for two interpretations:

(1) If the galaxies are bulge-dominated, the M_{BH}–M_{bulge}-relation has not changed over the last 9 Gyrs, for galaxies of $\log(M_{stellar})=11.3$ or $\log(M_{BH})=8.2 M_{sun}$.

(2) Since we have indications that the galaxies contain substantial disk components (e.g., images in Fig. 1, Sérsic index distribution, B/T of similarly massive galaxies locally, morphological mix for these masses at z>1), the interpretation is different: Since the objects have to evolve towards the local M_{BH}–M_{bulge}-relation (with their bulge mass), but follow this relation at z=1.4 with their total stellar mass, all mass-buildup of the bulge has to be fed from converting disk to bulge stars, induced by mergers or disk-instabilities, and not by star formation.

Black hole and bulge formation are disjoint and AGN feedback is likely neither a required nor possible ingredient to create the local M_{BH}–M_{bulge}-relation at these masses.

5 references

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