The QSO–morphology connection

Is there one?

and: do we care?

Or: way too much fame for bulges and mergers?

Knud Jahnke (MPIA)

+ Katherine Inskip, Matt Mechtley, Liyu Ambachew (MPIA),

Mauricio Cisternas (IAC), John Silverman (IPMU) + COSMOS

The role of QSOs

- AGN feedback?
  - Maintenance (=radio) mode:

    → in clusters, ok, elsewhere?
  - Quenching (=QSO) mode:

    → ??? → dependency on M, env., z?

- Conditions for QSO activity?
  - Environment → non-cluster
  - Mass
  - Morphology → what about bulges?

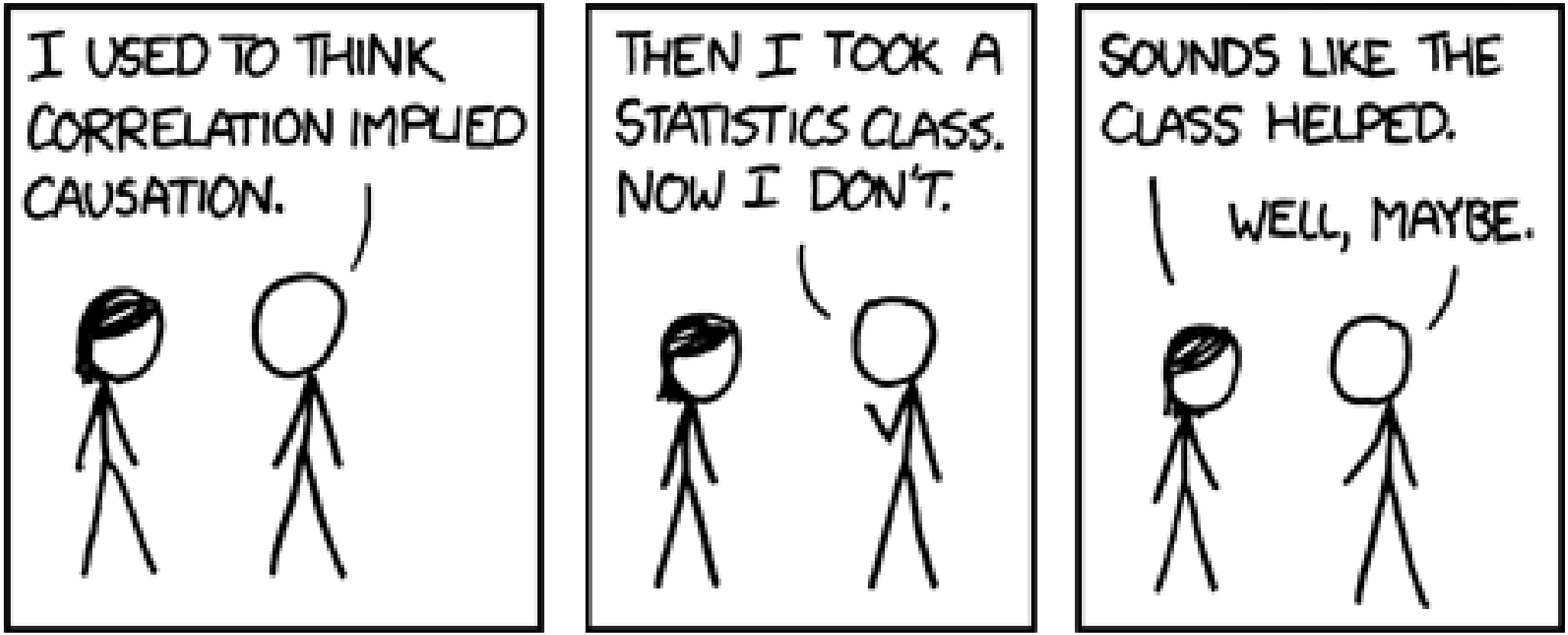
The role of QSOs

What are the ...

… properties of AGN (QSO) host galaxies?

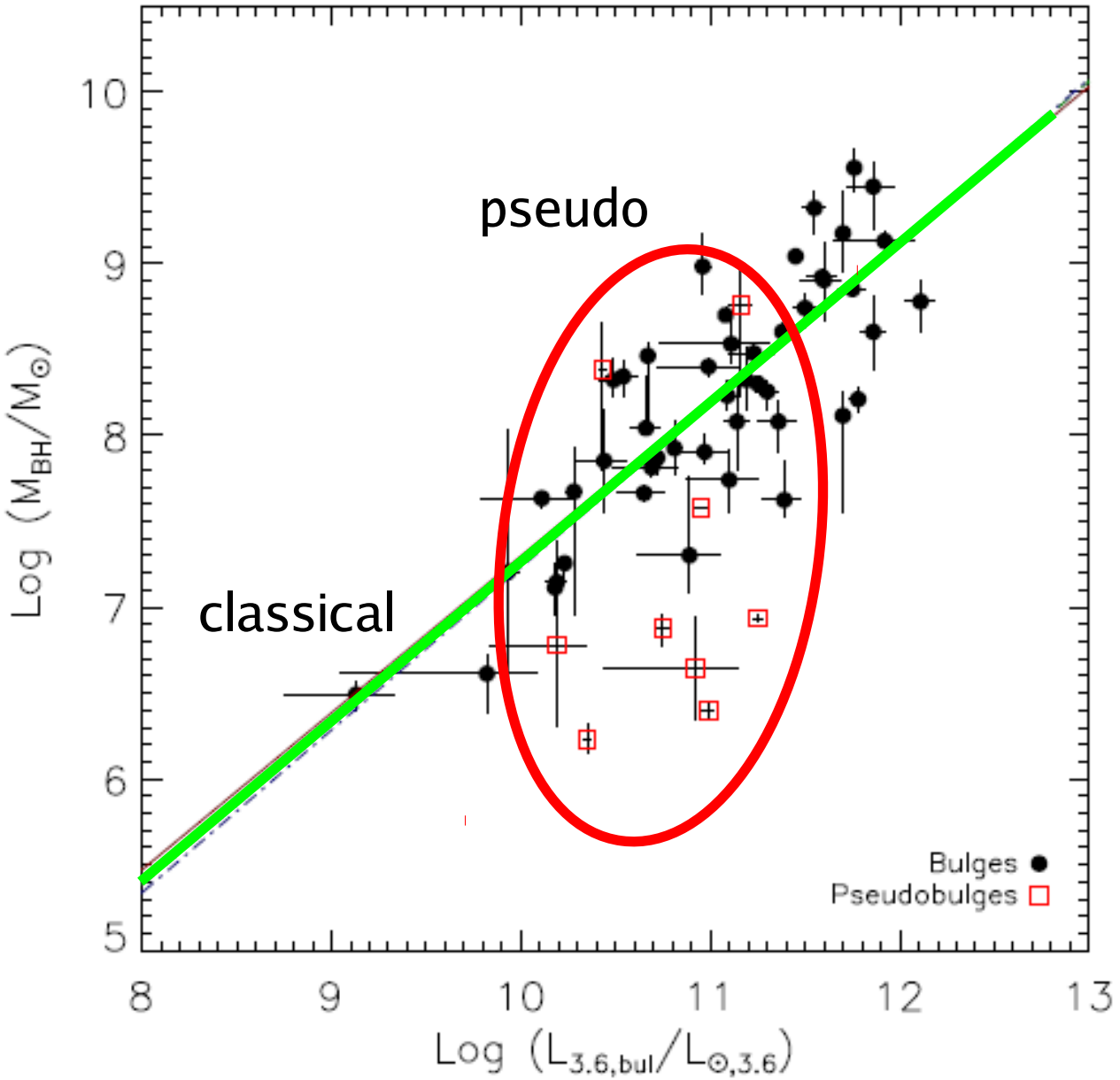
… conditions for fueling massive Black Holes?

Fundamental pitfall



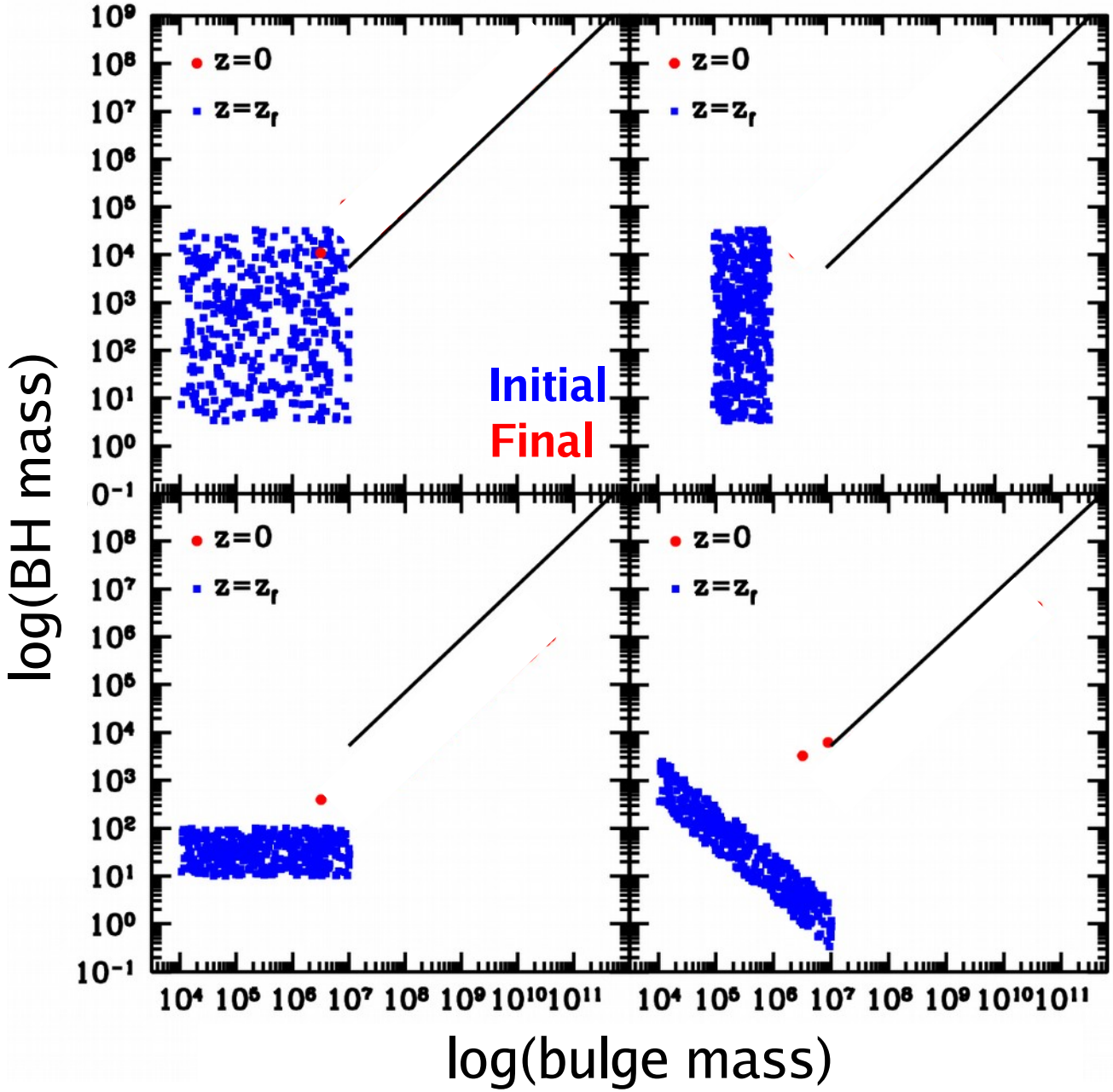
xkcd.com/552

BH-galaxy scaling relations



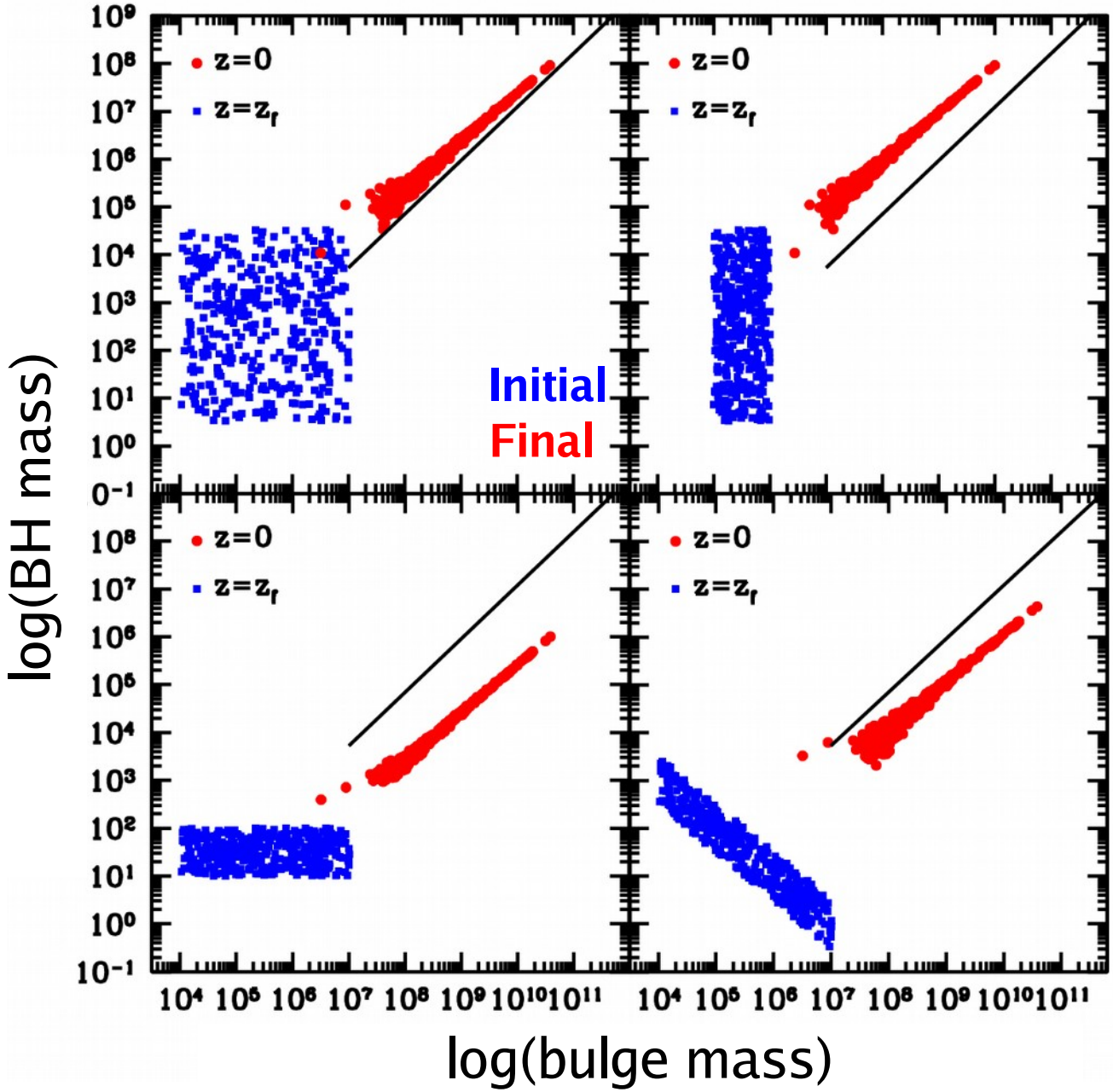
Sani+ 2011

BH-galaxy scaling relations



KJ & Maccio 2011
(see Peng 2007)

BH–galaxy scaling relations



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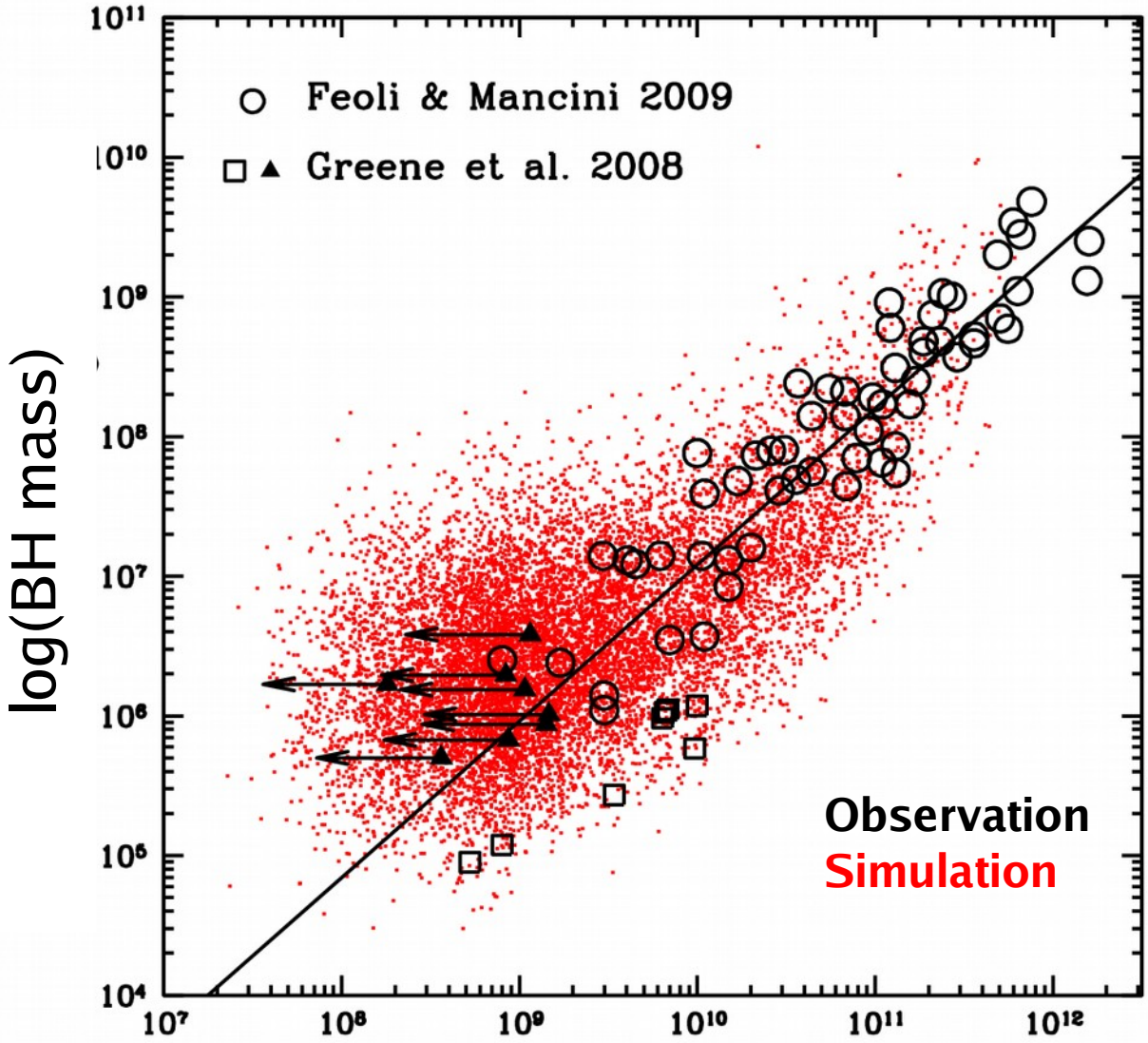


KJ & Maccio 2011

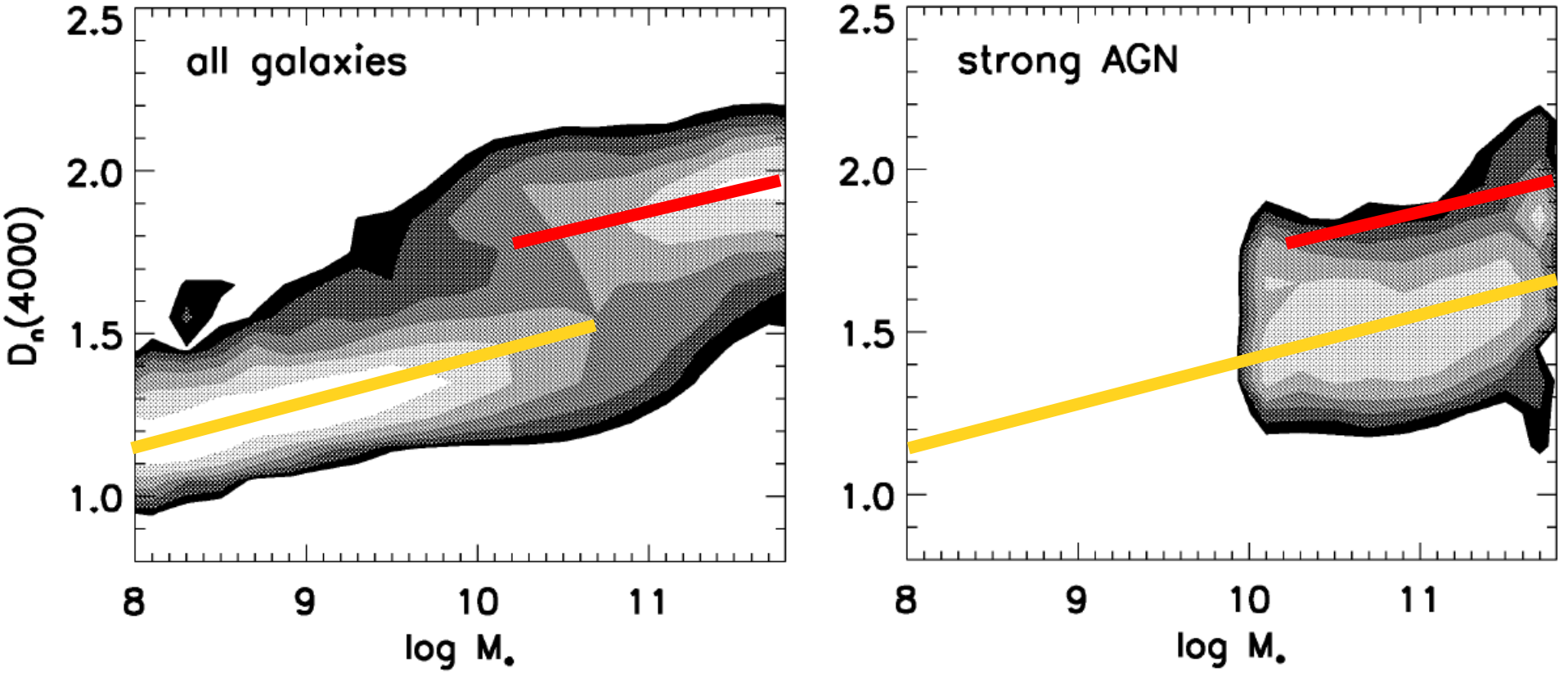
BH–galaxy scaling relations

- What does this mean?
  - BH scaling relations consequence of LCDM assembly
  - No feedback needed
  - Modification by self-regulation and normalization → open
  - Historical misunderstanding: all BH fueling recipes successful

- In Q+Q context: *The bulge is not (necessarily) an active player*

No AGN–starburst relation

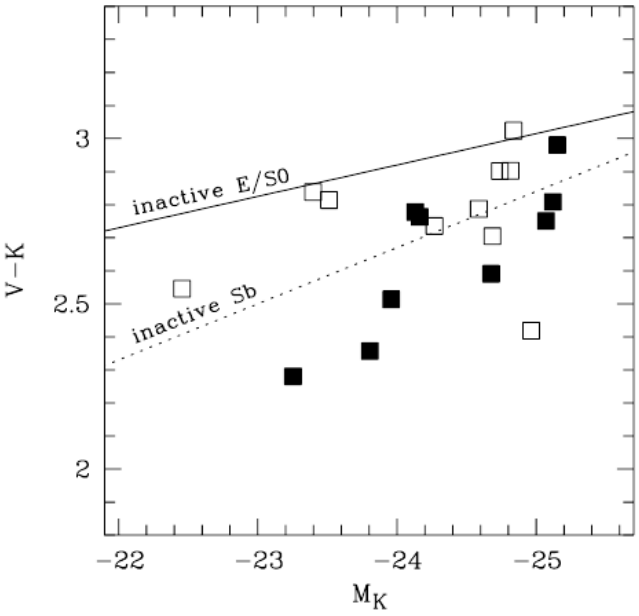
Type 2 AGN, Kauffmann+ 2003

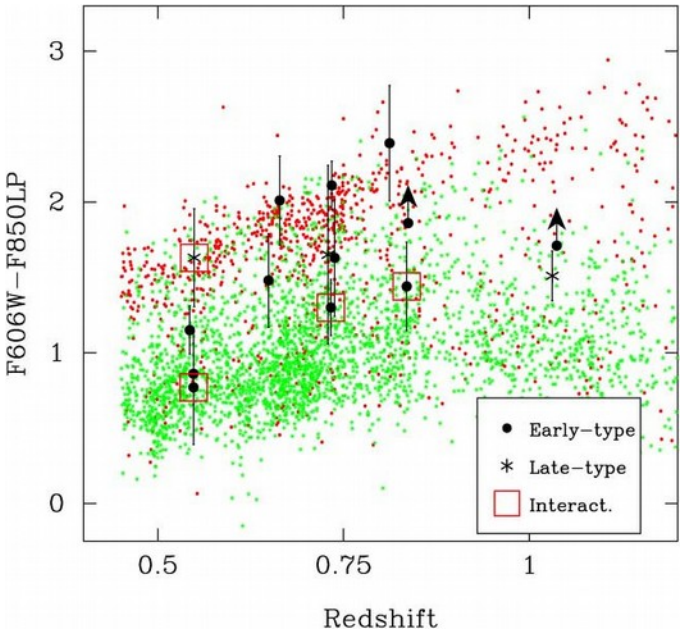


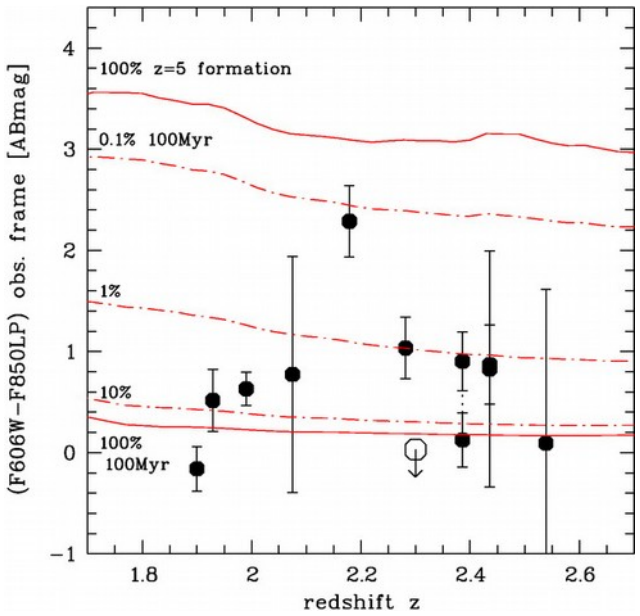
Luminous AGN: same stellar ages as SF galaxies

No AGN–starburst relation

KJ+ 2004a,b; Sanchez, KJ+ 2004







z~0.1
col–mag

0.4<z<1.3
col–z

1.7<z<2.5
col–z

+Herschel (Santini+ 2012):

Luminous AGN are normal SF galaxies, not starbursts

The role of QSOs

What are the ...

… properties of AGN (QSO) host galaxies?

… conditions for fueling massive Black Holes?

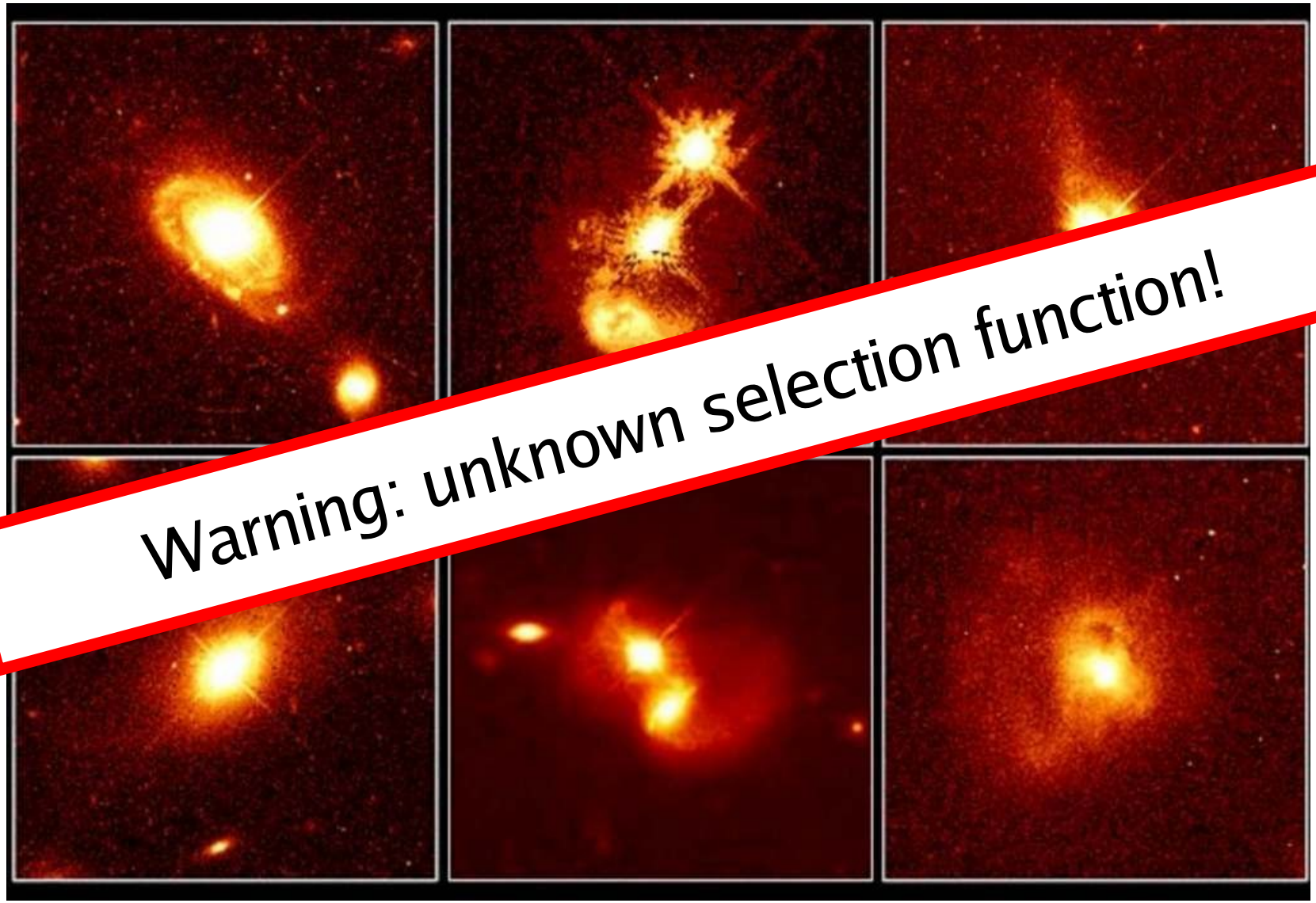
How to feed a ~~monster~~ BH

- Presence of gas → see SF

- Need for a "trigger"?
  - Favorite mechanism: major merging

    - SAMs → Rachel S.
    - SPH → Di Matteo/Phil H./Springel
    - Analytics → Andrew K.

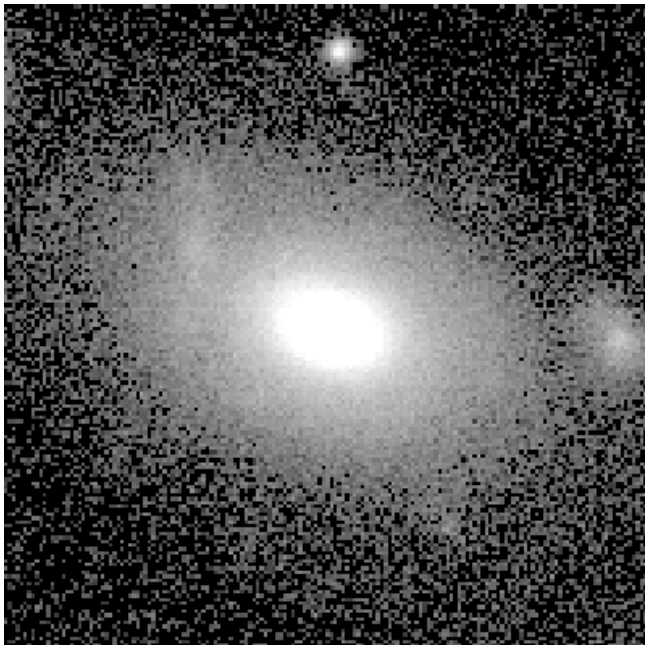
QSOs = Major Merging?



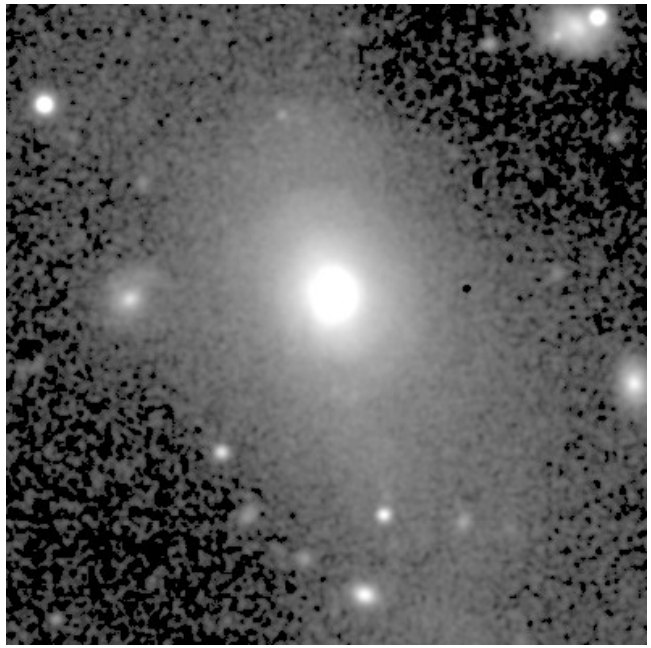
QSO host galaxies, HST: Bahcall+ 1997

QSOs = Major Merging?

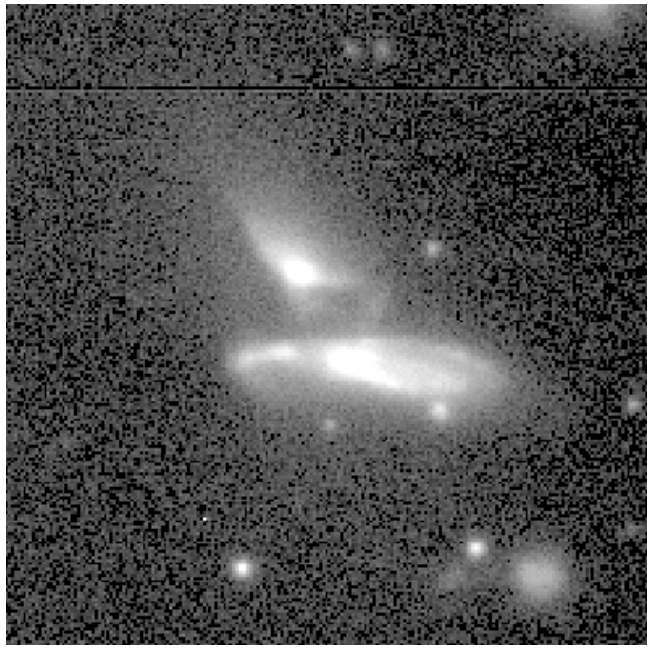
Low-z, high mass: P91, VLT/FORS, 0.6", 28 QSOs $\log M_{BH} \sim 9.0$
+ 28 comparison galaxies



HE 1514−0606,
$\log M_{BH}=8.9$



inactive

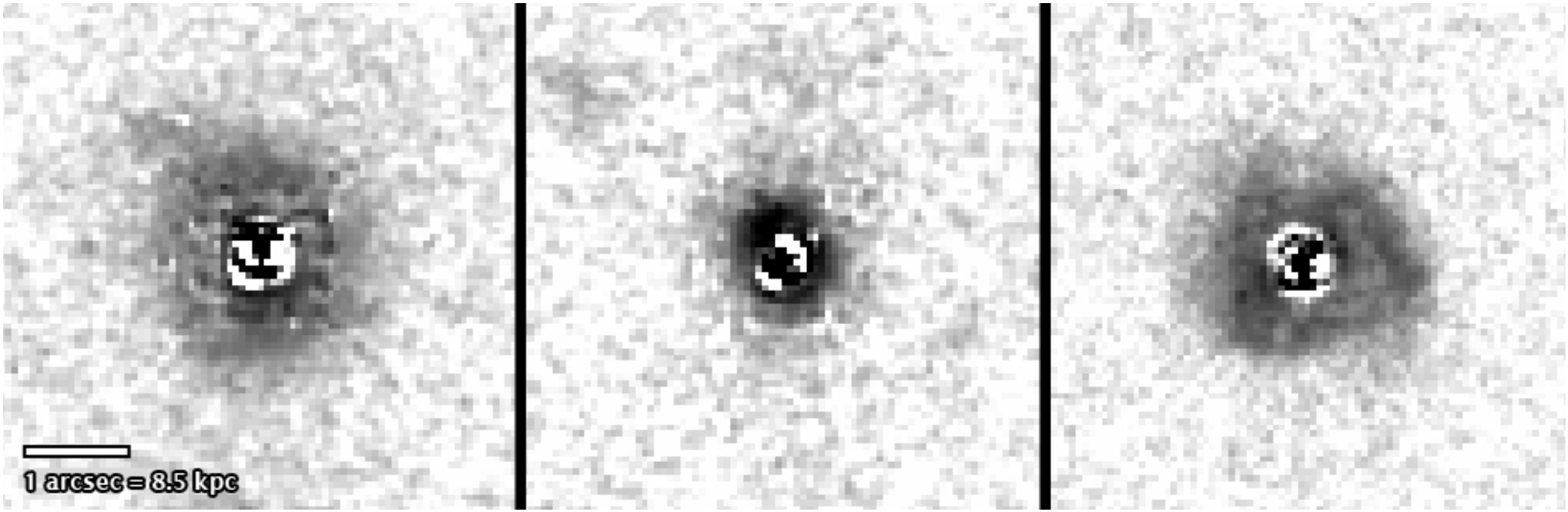


inactive

Ambachew, KJ+, in prep.

QSOs = Major Merging?

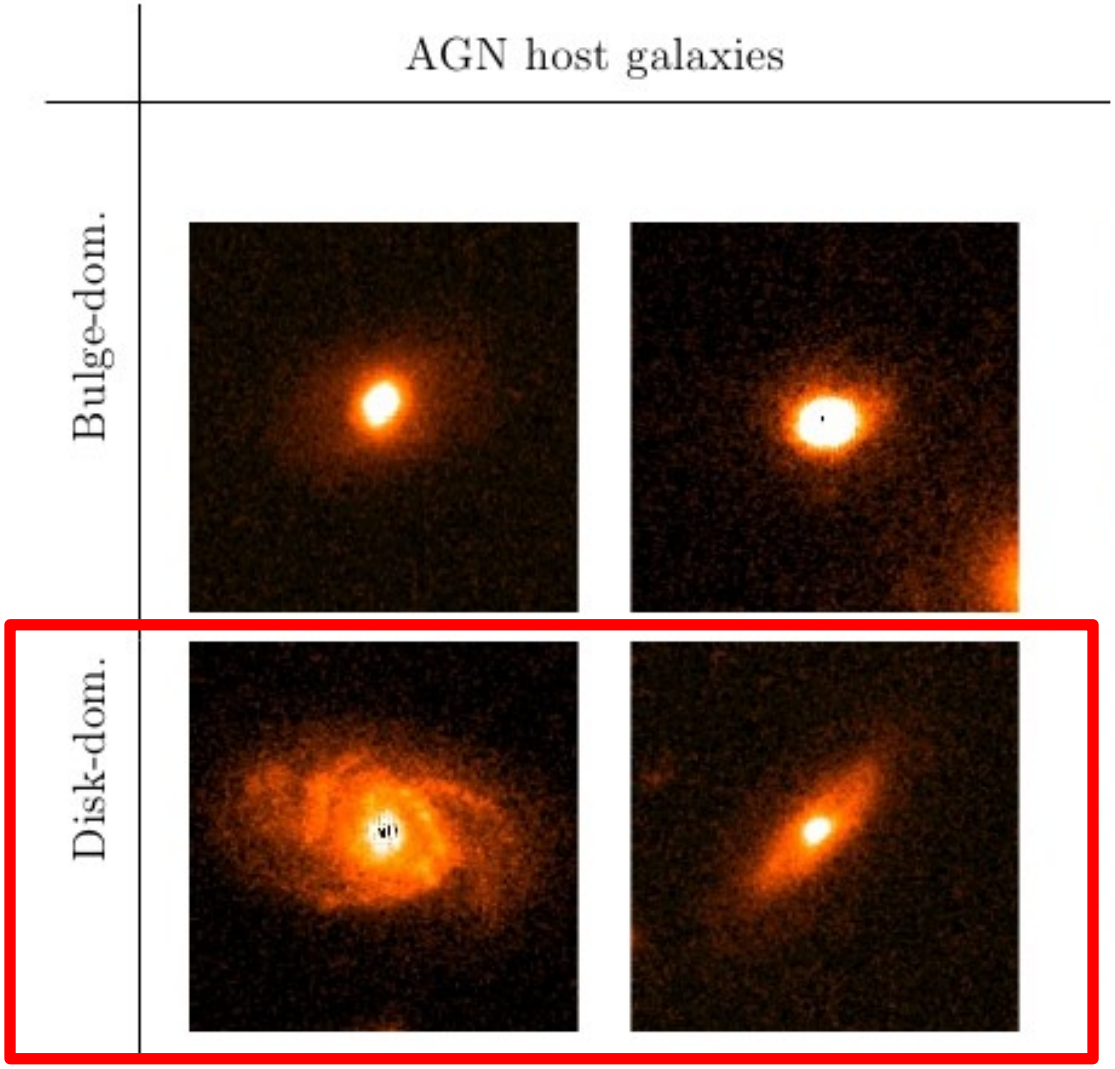
z=2, high mass: HST WFC3/IR, 19 QSOs, $\log M_{BH} \sim 9.5$



QSO QSO inactive

Mechtley, KJ+, in prep.

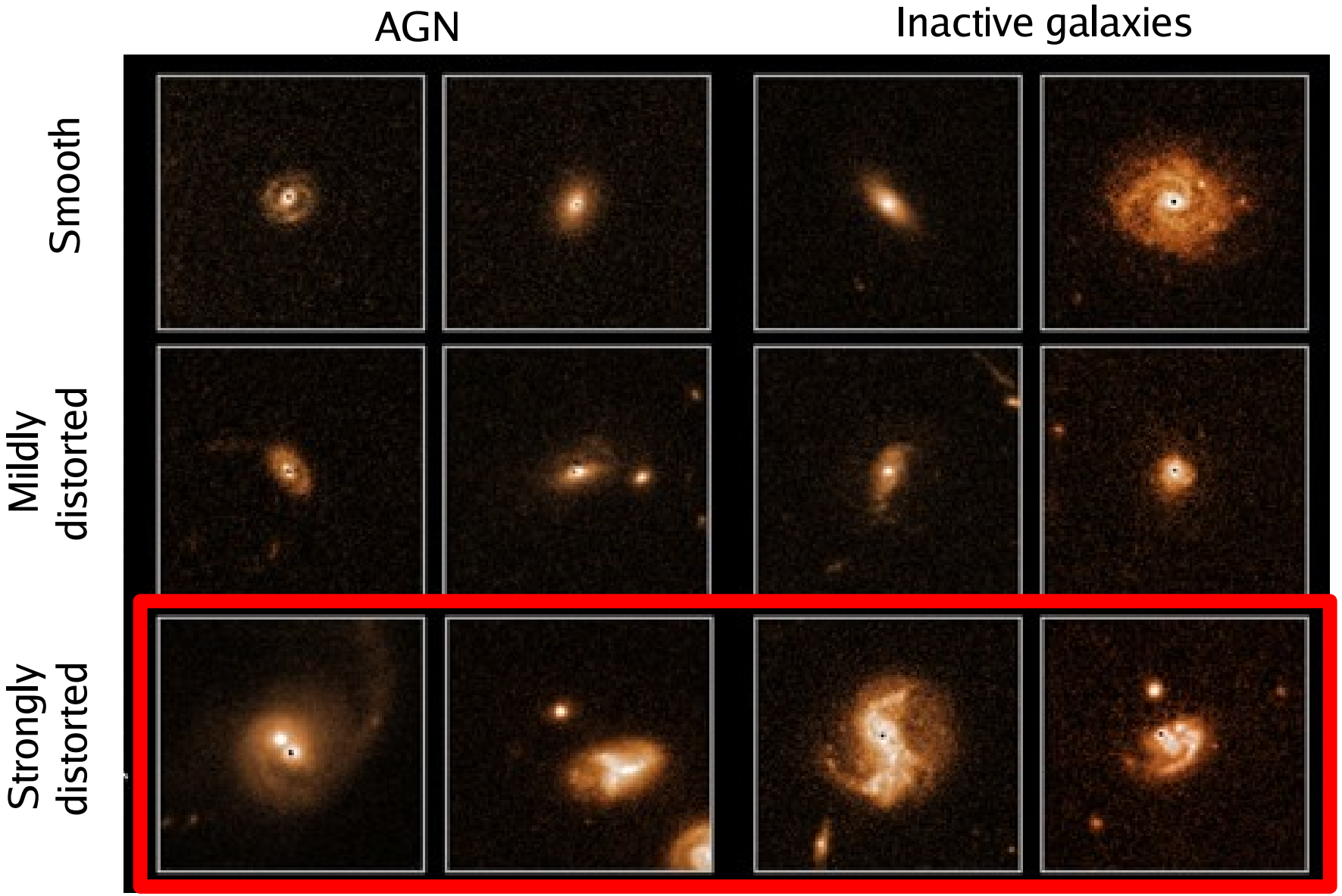
QSOs = Major Merging?



AGN: >50% disks
(massive end: open)

COSMOS z<1: Cisternas, KJ+ 2011
(see also Kocevski+ 2012,
Schawinski+ 2011/12)

QSOs = Major Merging?



Cisternas, KJ+ 2011

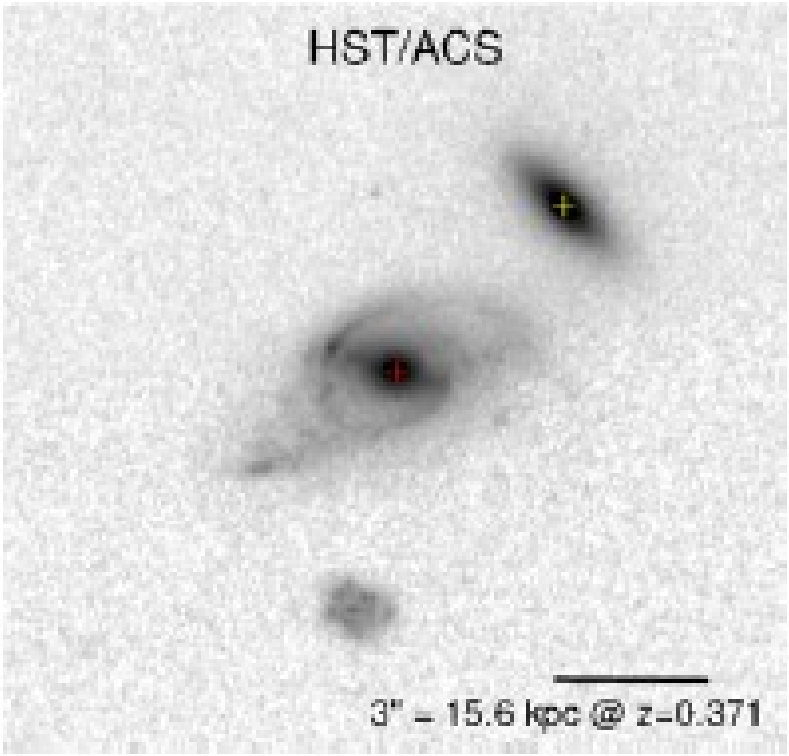
QSOs = Major Merging?

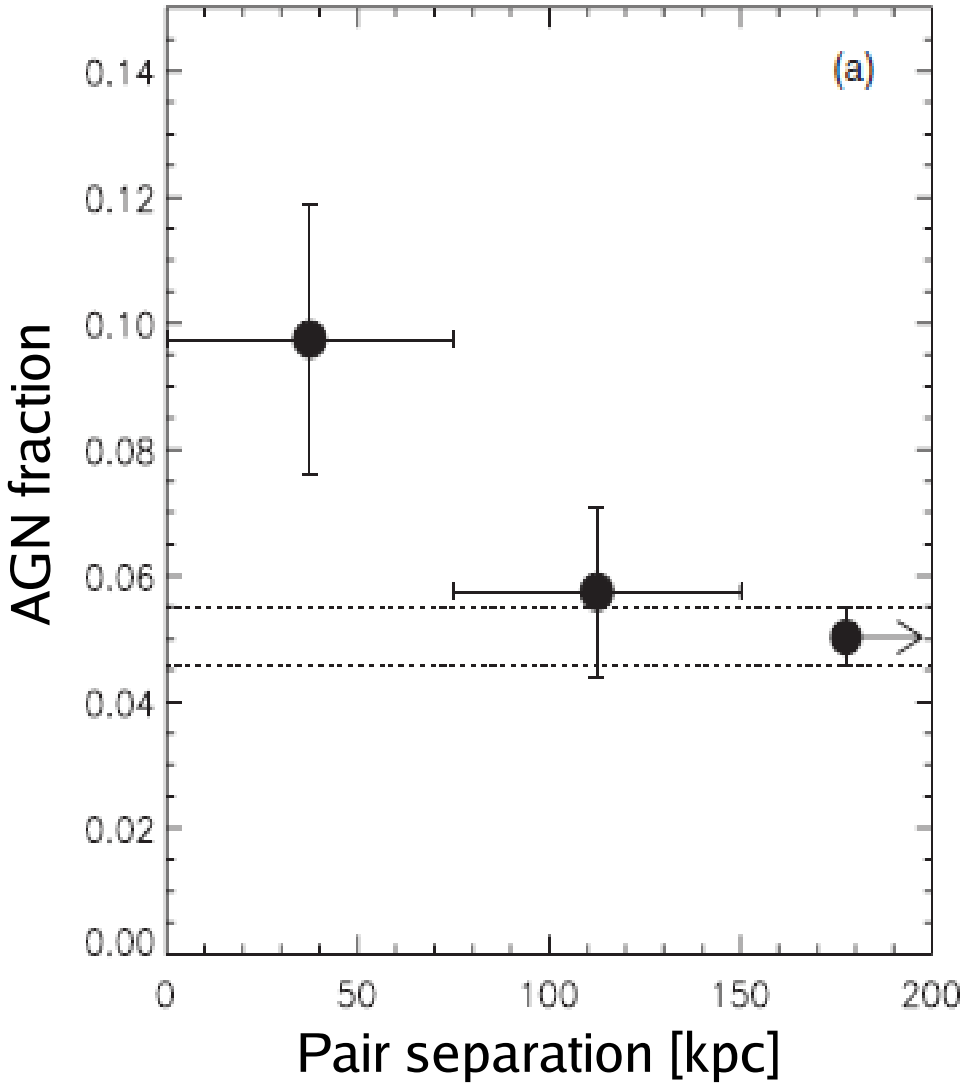
- In brief:
  - z<2: many many disk host galaxies
  - z<1: <~25% of BH accretion due to merging
  - z~2: no merger triggering for lower-L half of BH accretion

QSOs = Major Merging?

- Further diagnostics:
  - Close pairs (Silverman+KJ+ 2011, Ellison+ 2011, Lackner+KJ+ 2014)

QSOs = Major Merging?





COSMOS/HST: Silverman, Kampczyk, KJ+ 2011

QSOs = Major Merging?

- In brief:
  - z<2: many many disk host galaxies
  - z<1: <~25% of BH accretion due to merging
  - z~2: no merger triggering for lower-L half of BH accretion

→ *Most of BH accretion not triggered by major merging*

So?

→ QSO phase != morphology change phase

→ modelers?

Summary

For AGN/QSOs...

- ...the bulge is not (necessarily) an active ingredient

  → if you still want this, find a first principle reason, please!

- ...host galaxies are normal starforming galaxies

  → no AGN–starburst connection; avoid ULIRG–QSO picture

- ...major merging is subdominant for AGN at z<2

  → so why is this still in models?