The Merger-Free Co-Evolution of Galaxies and Supermassive Black Holes

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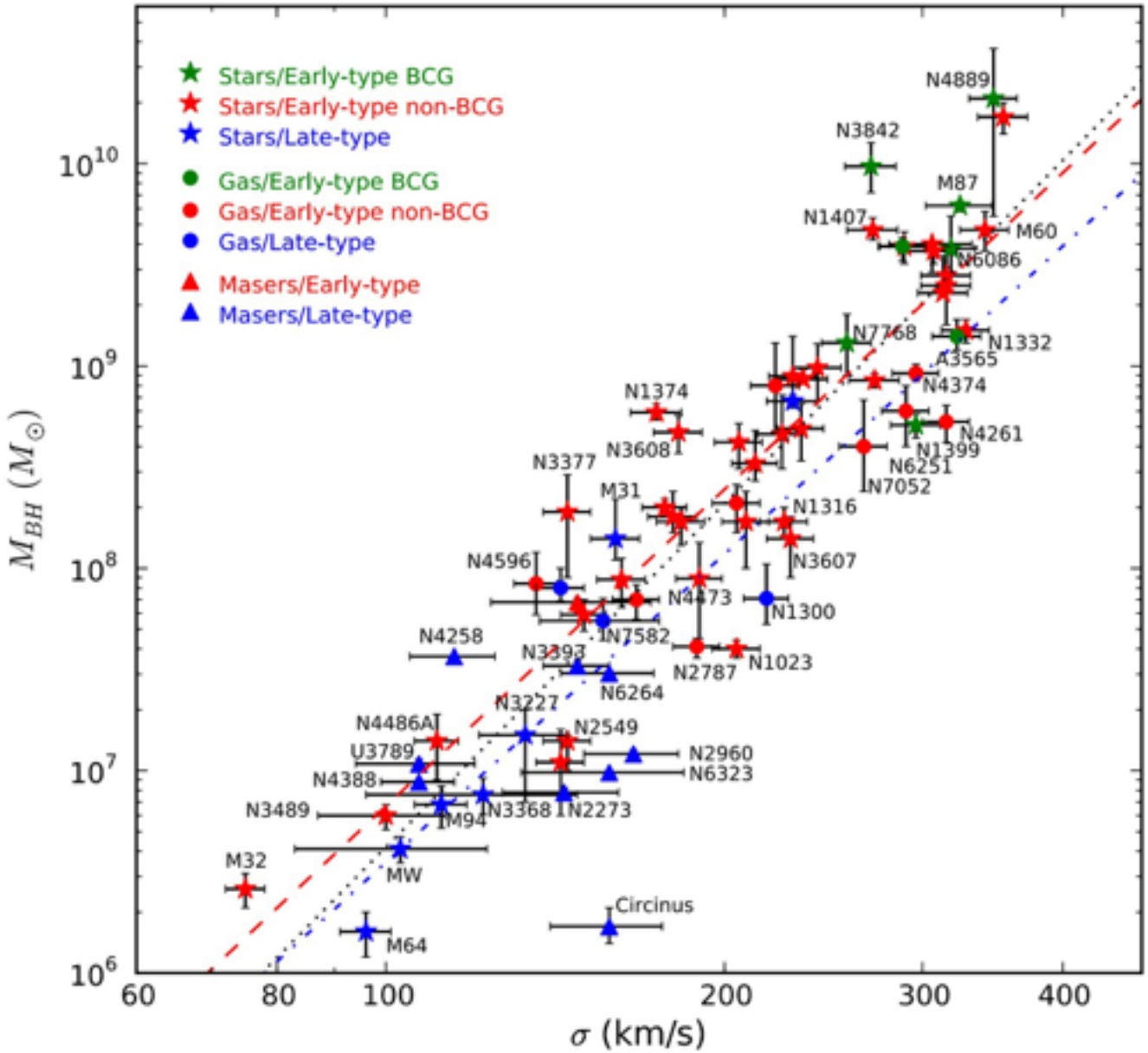
UC San Diego

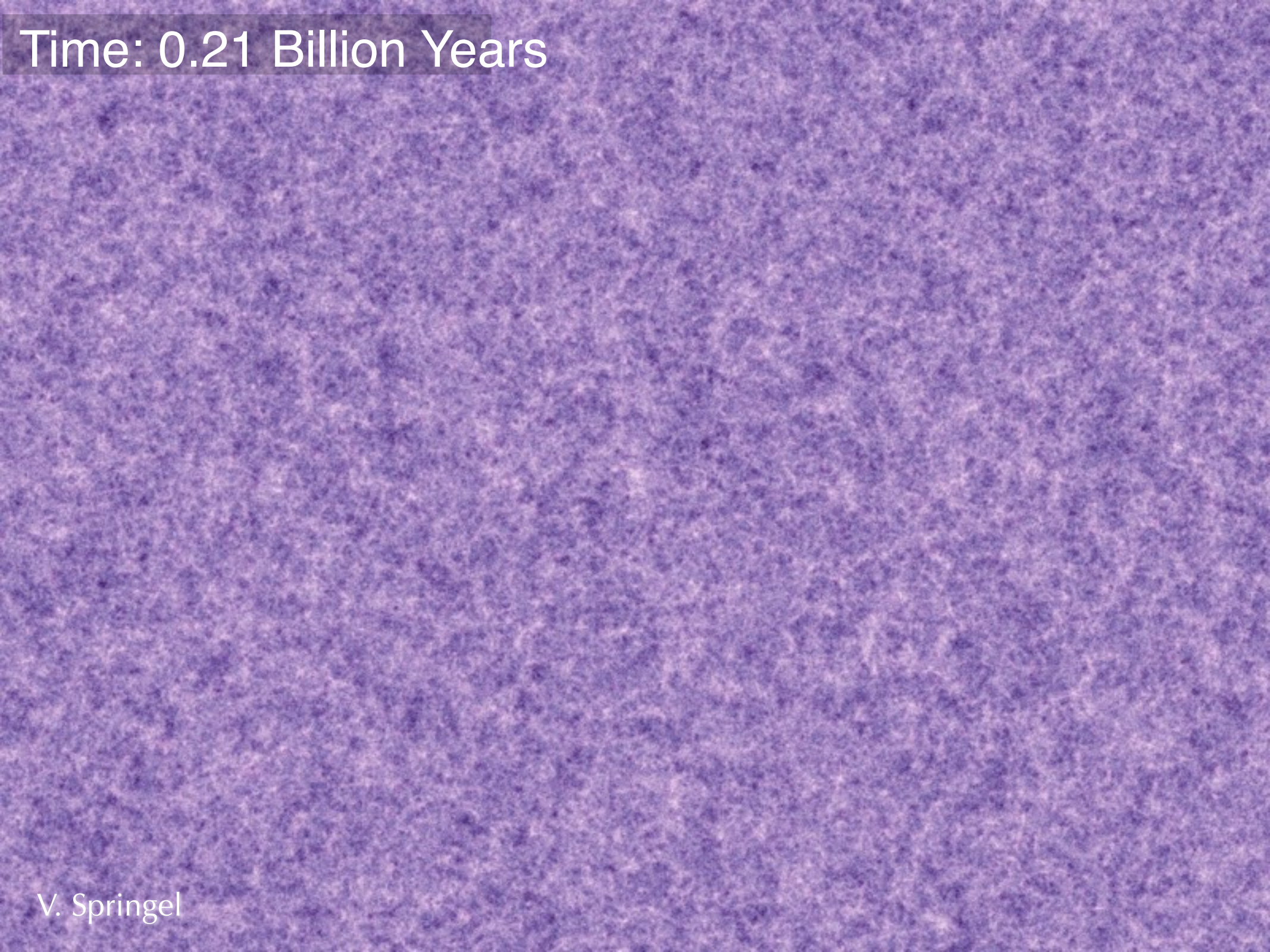
Note: talk originally given October 18th, 2016; date at bottom right of some slides reflects date talk was exported to PDF.

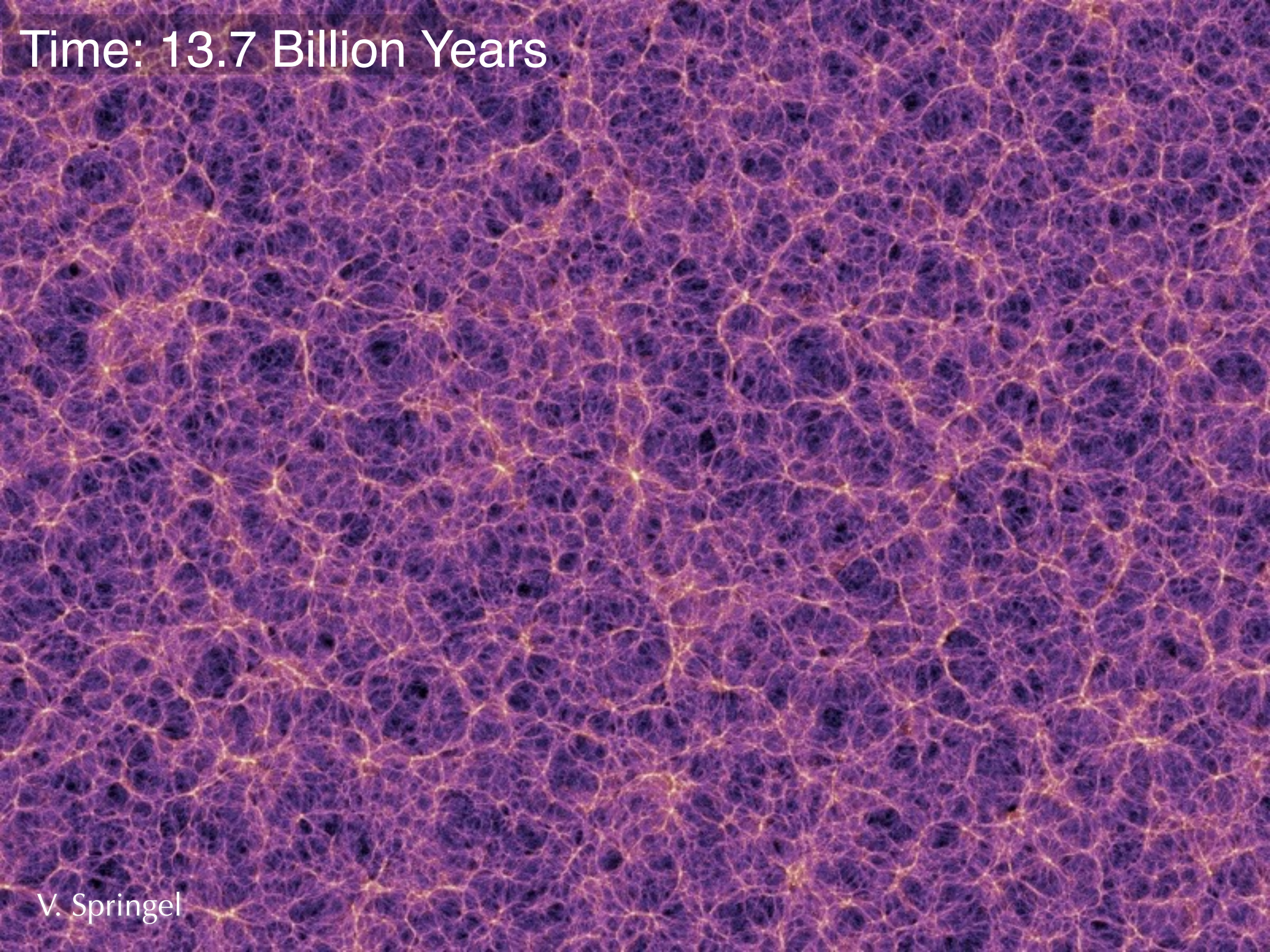
Galaxies come in a diverse array of shapes, sizes, evolutionary histories.
And yet…

Black Holes & Galaxies Co-Evolve



B. Simmons McConnell & Ma (2013) Nov 2, 2016


Time: 0.21 Billion Years
V. Springel


Time: 13.7 Billion Years
V. Springel

Time: 13.7 Billion Years

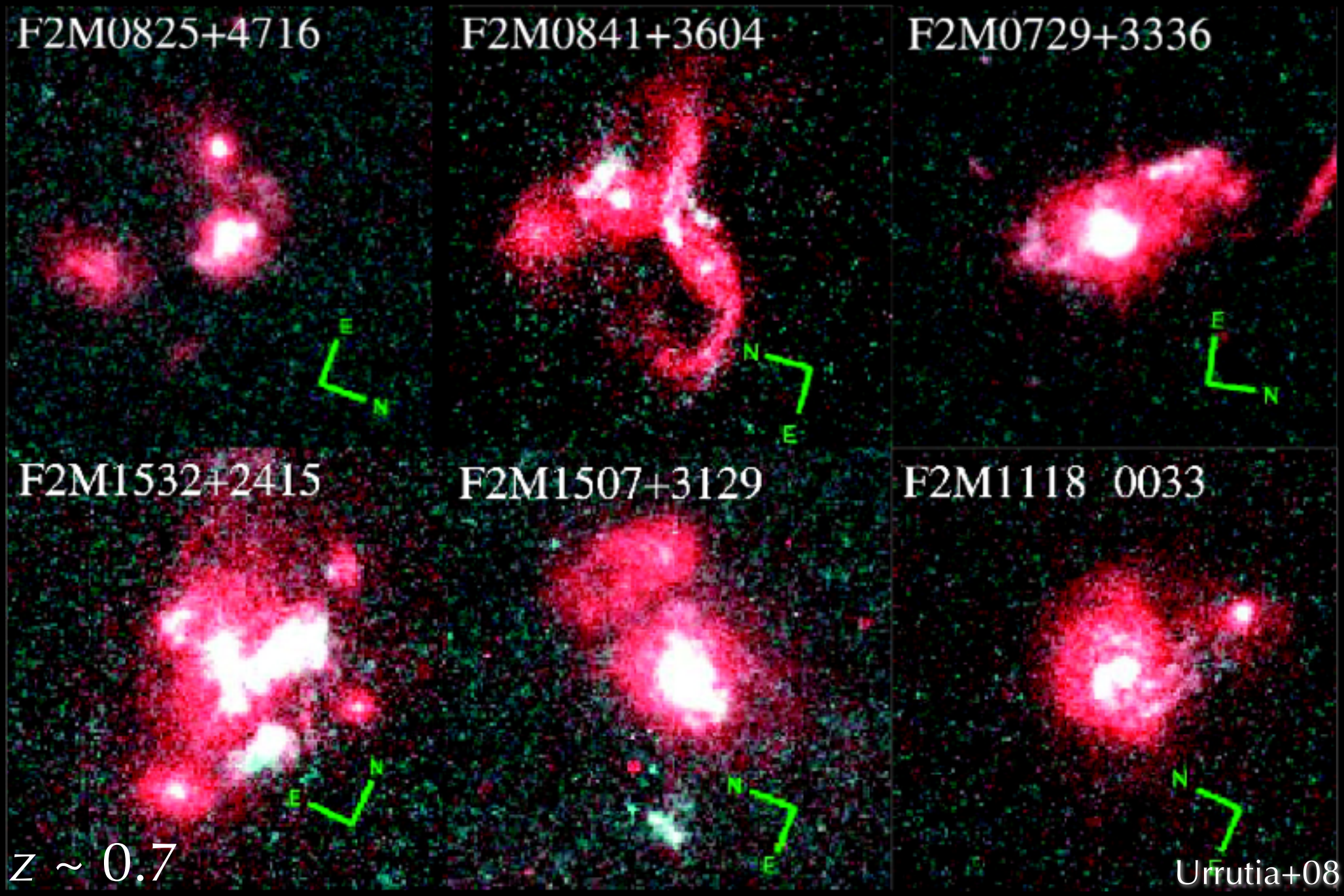
V. Springel

Do Mergers Drive Co-Evolution?

Credit: HST/NASA/STScI/ESA

See: Sanders+88, Hopkins+05,06 etc.

Quasars: Trainwreck Mergers?



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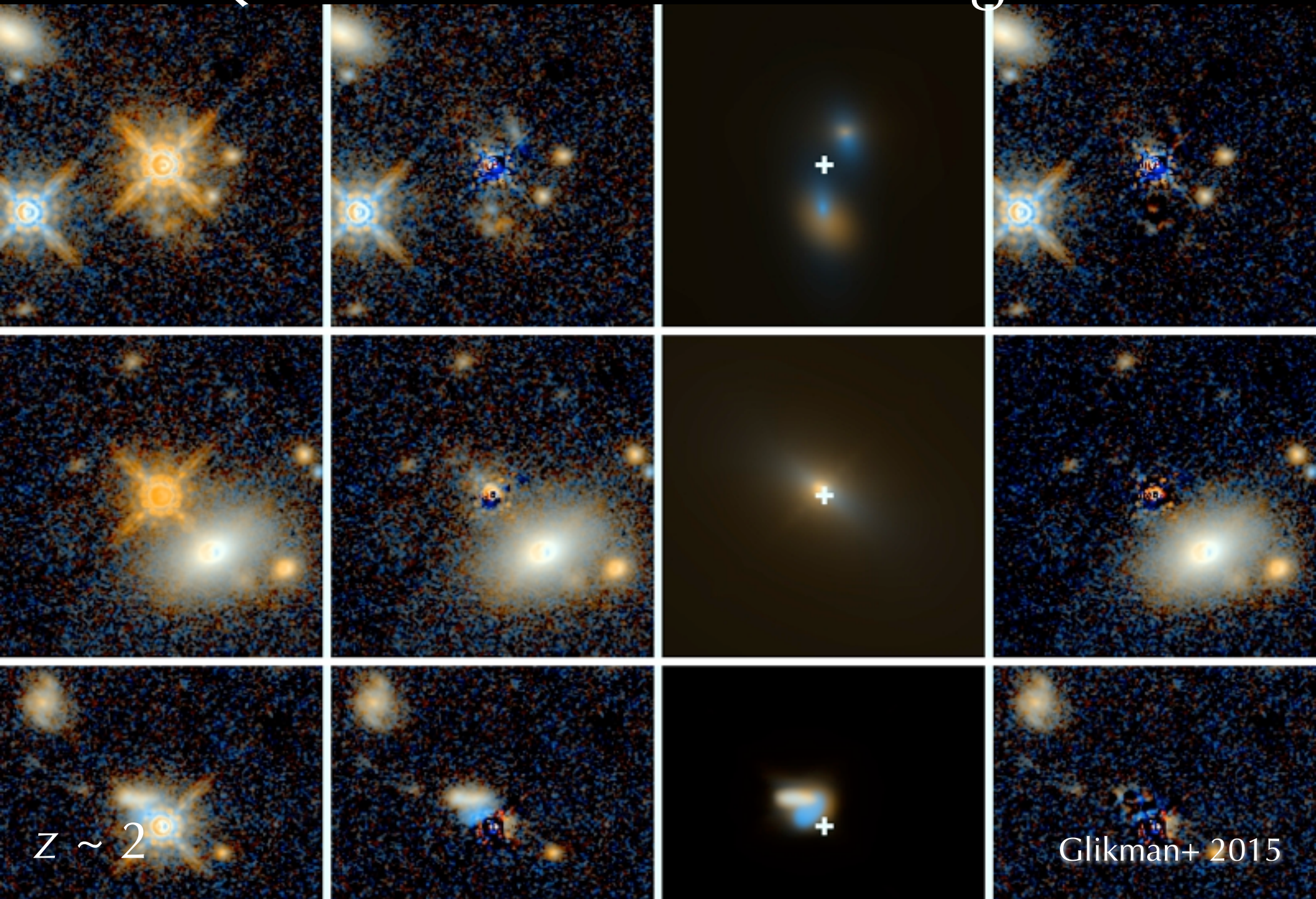

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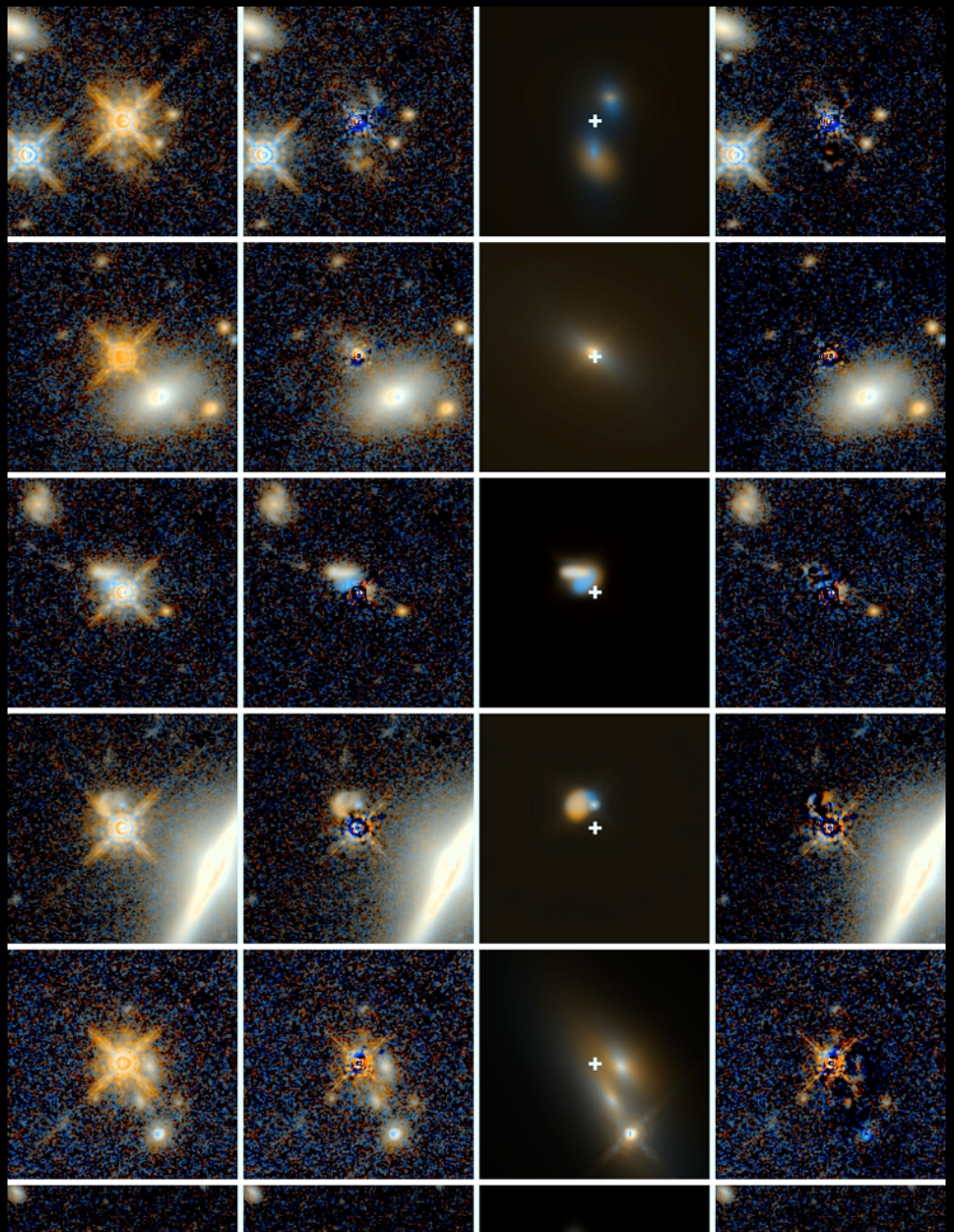
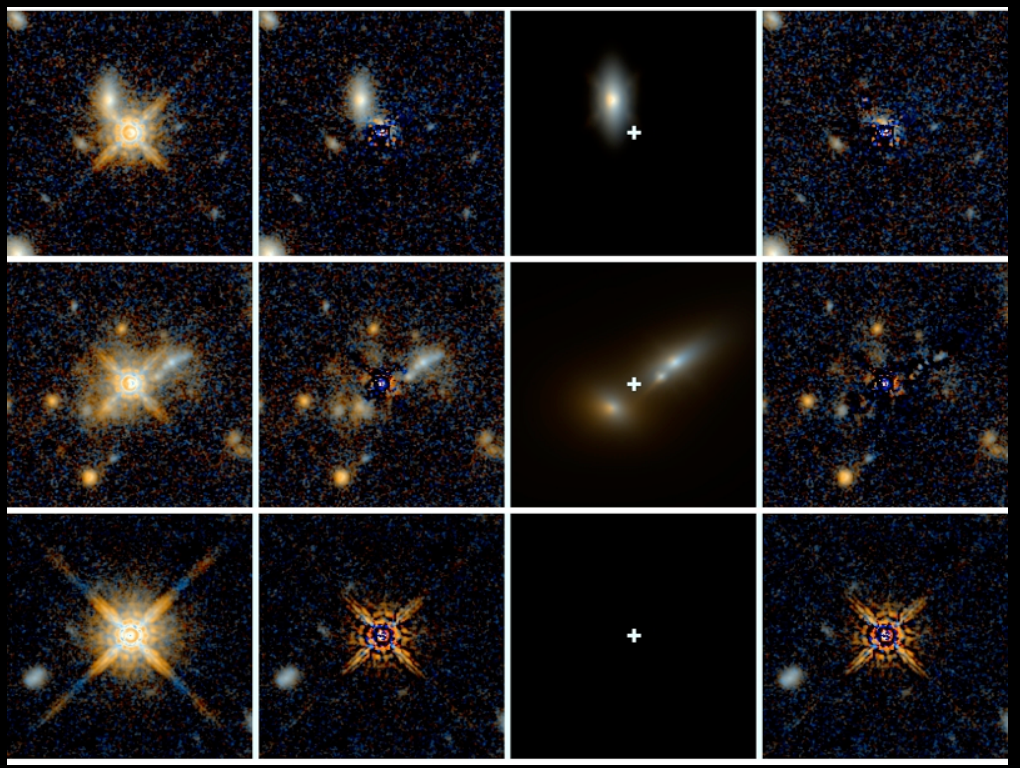
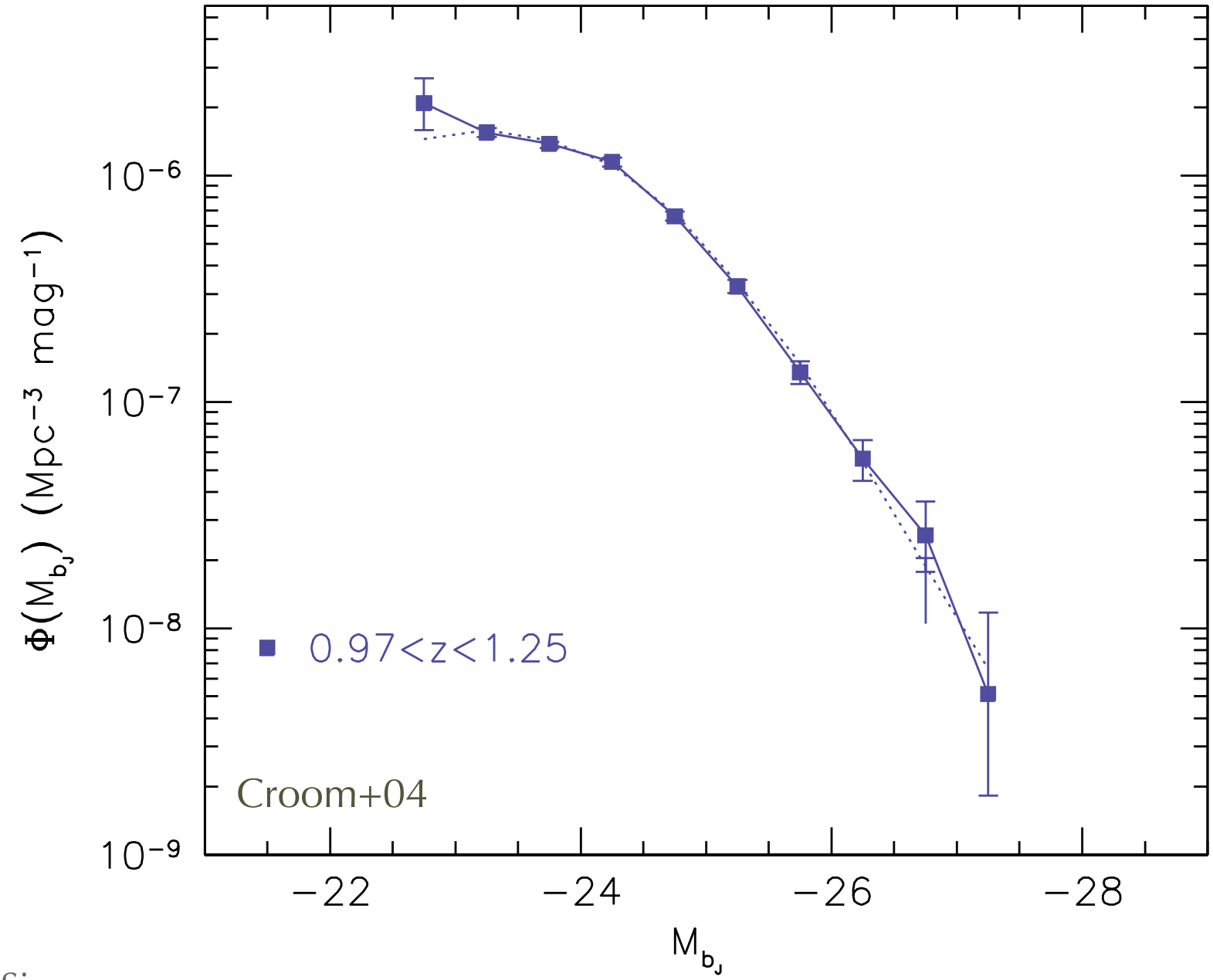




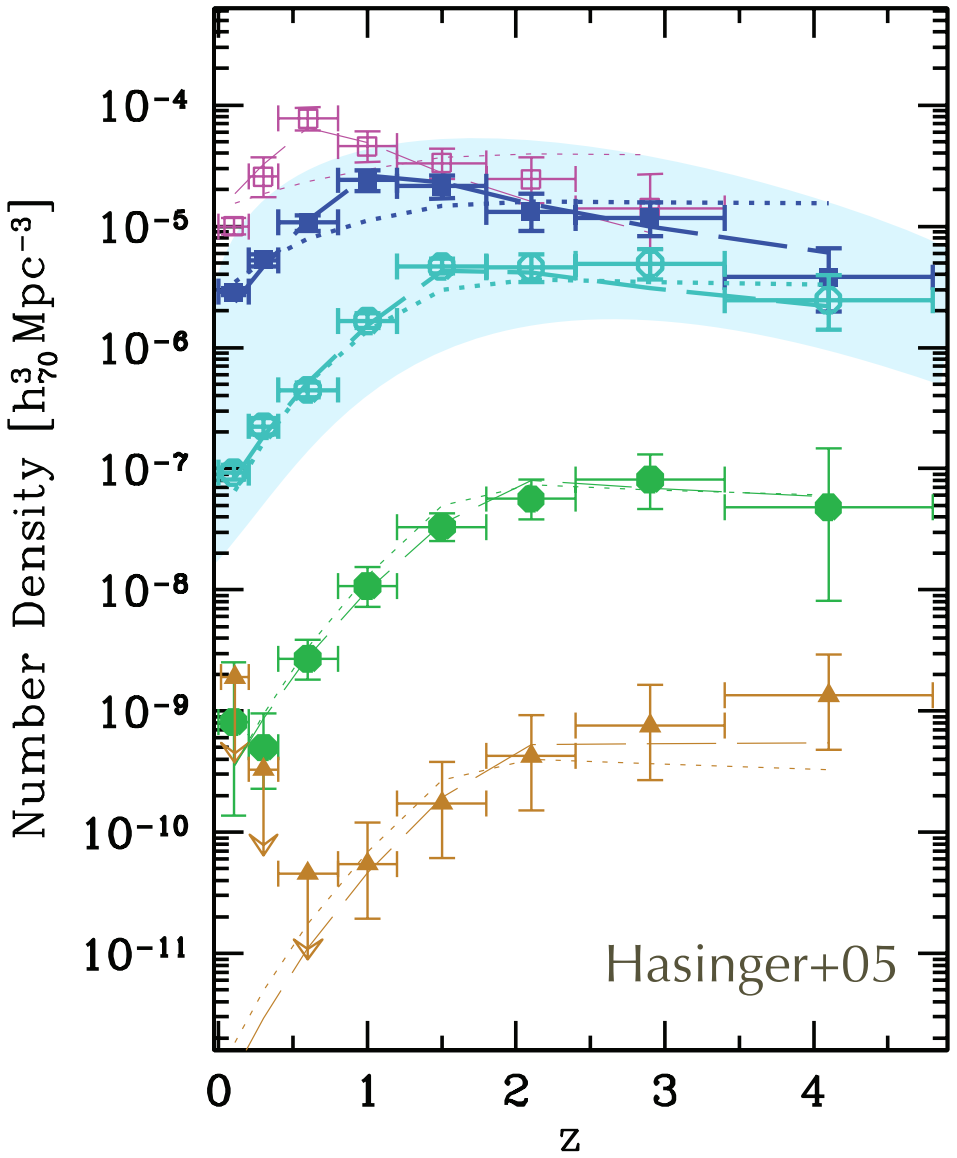
Glikman+15

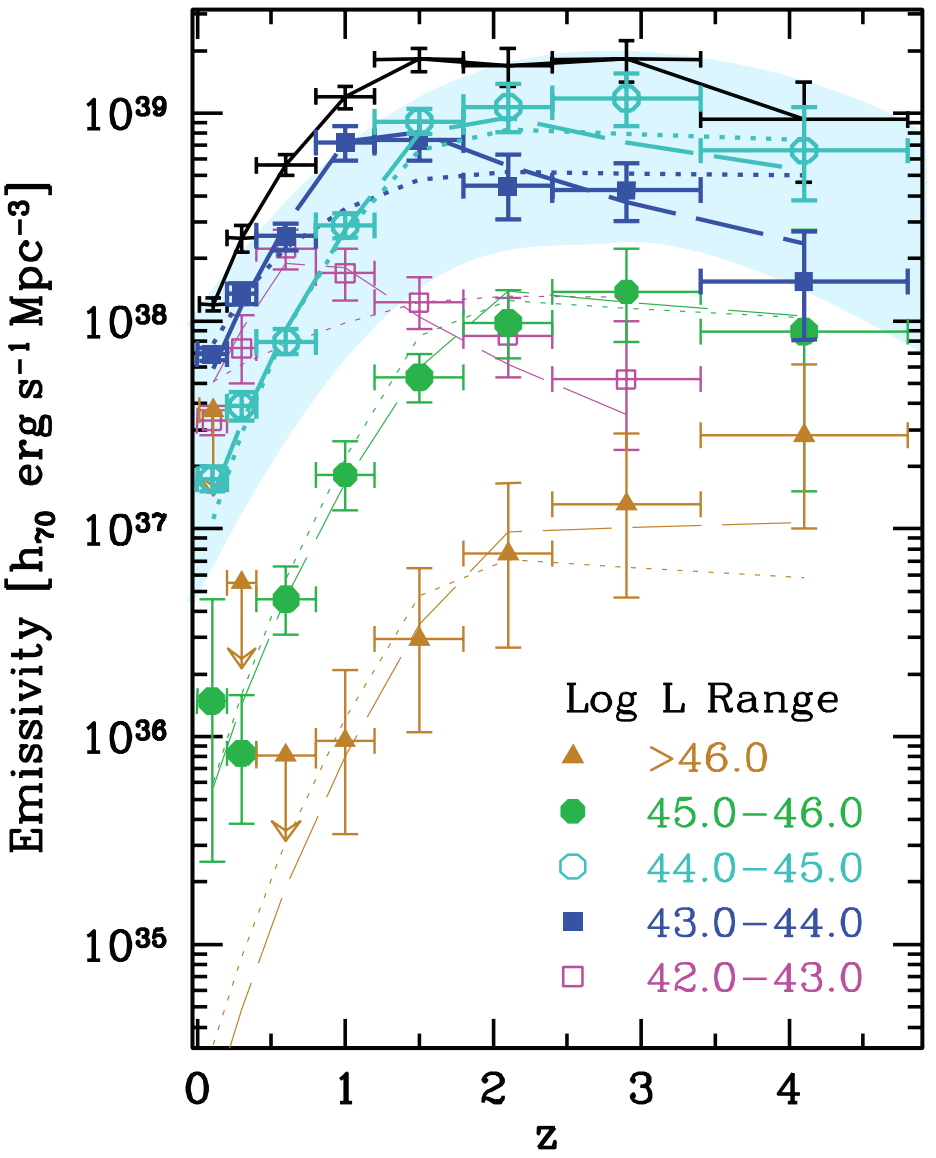
Nov 2, 2016

AGN: A Diverse Population

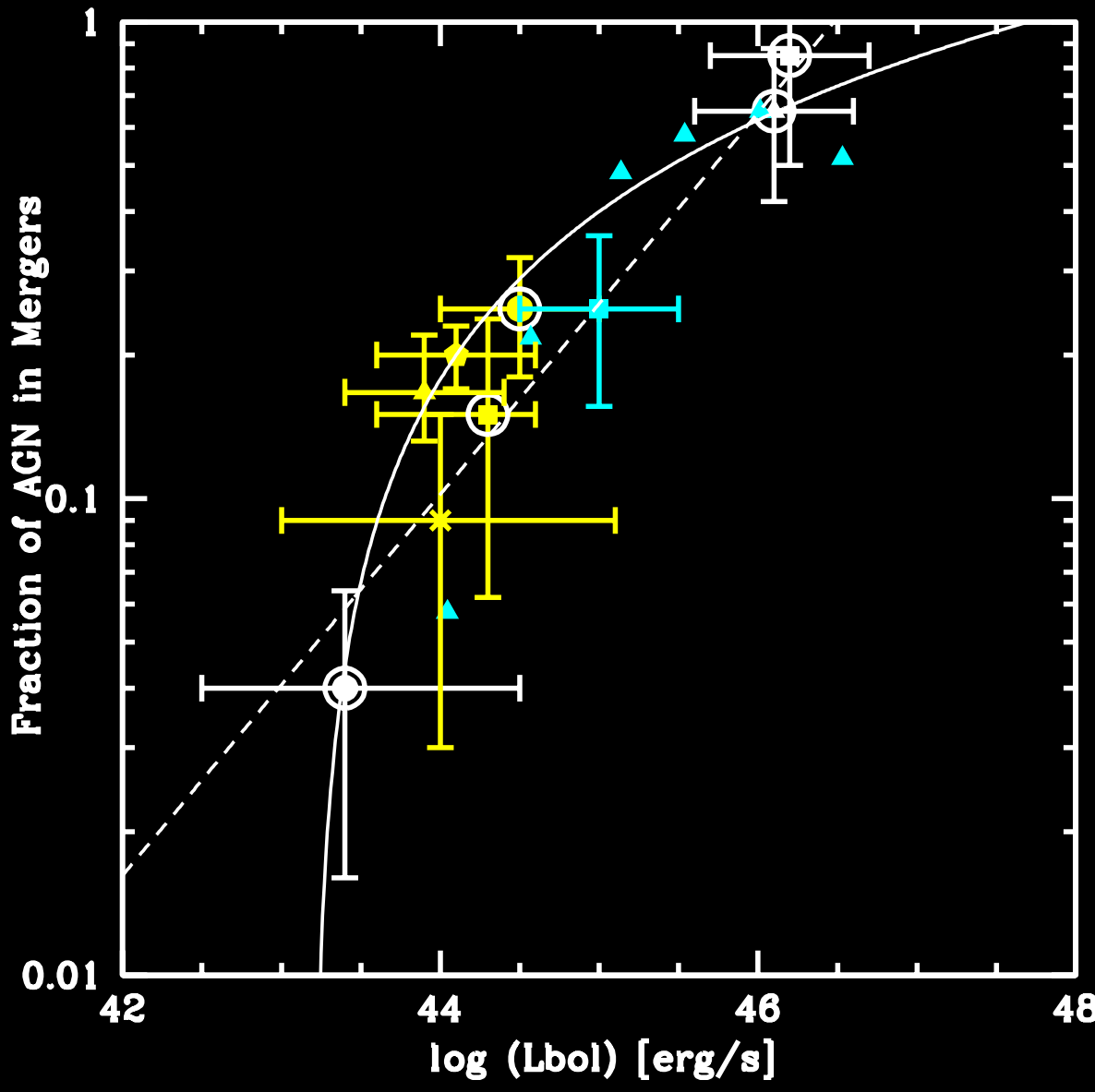


Don't Dismiss Moderate-Luminosity AGN



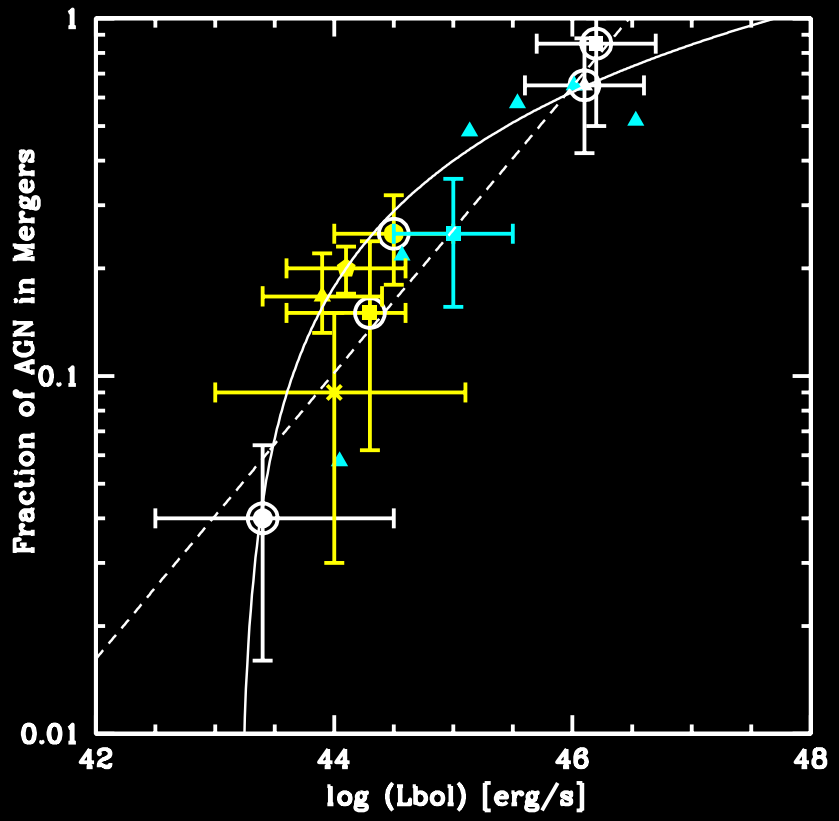


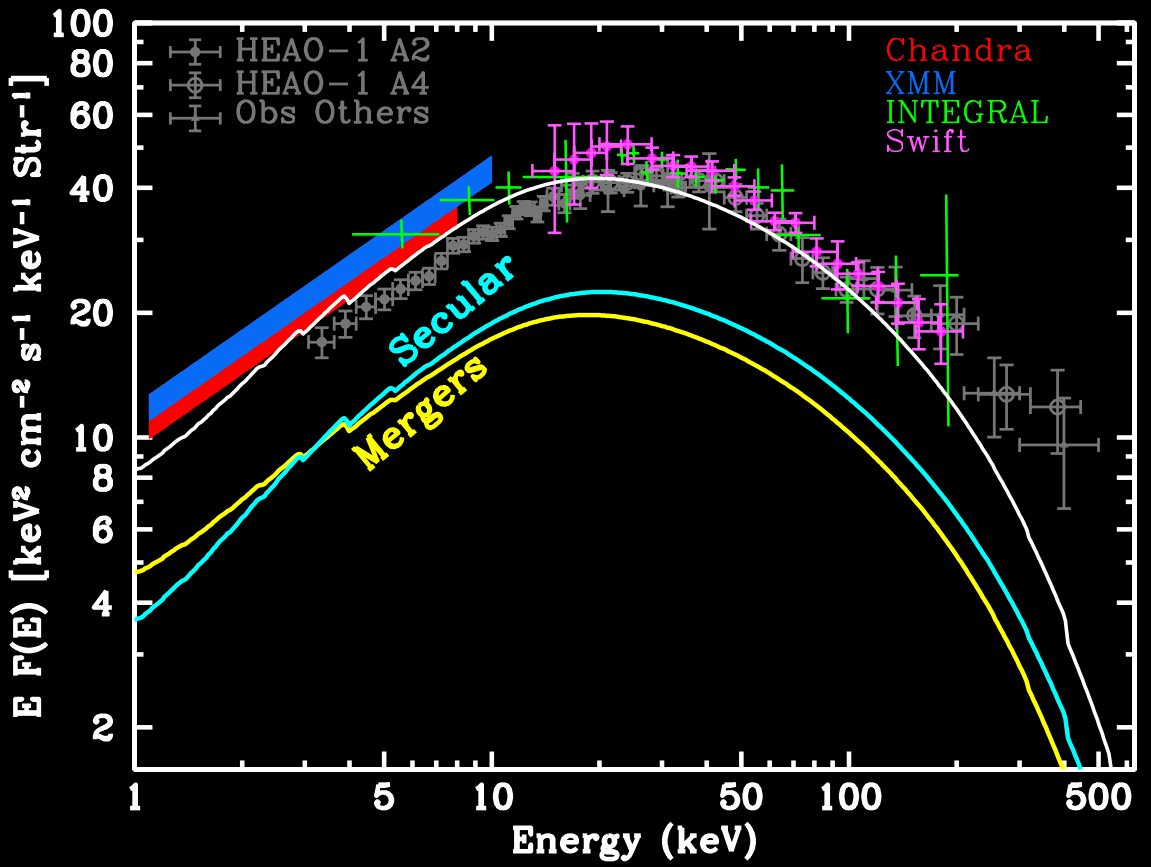
Major mergers only trigger luminous AGN



Treister+12

Major Mergers Only Trigger Luminous AGN

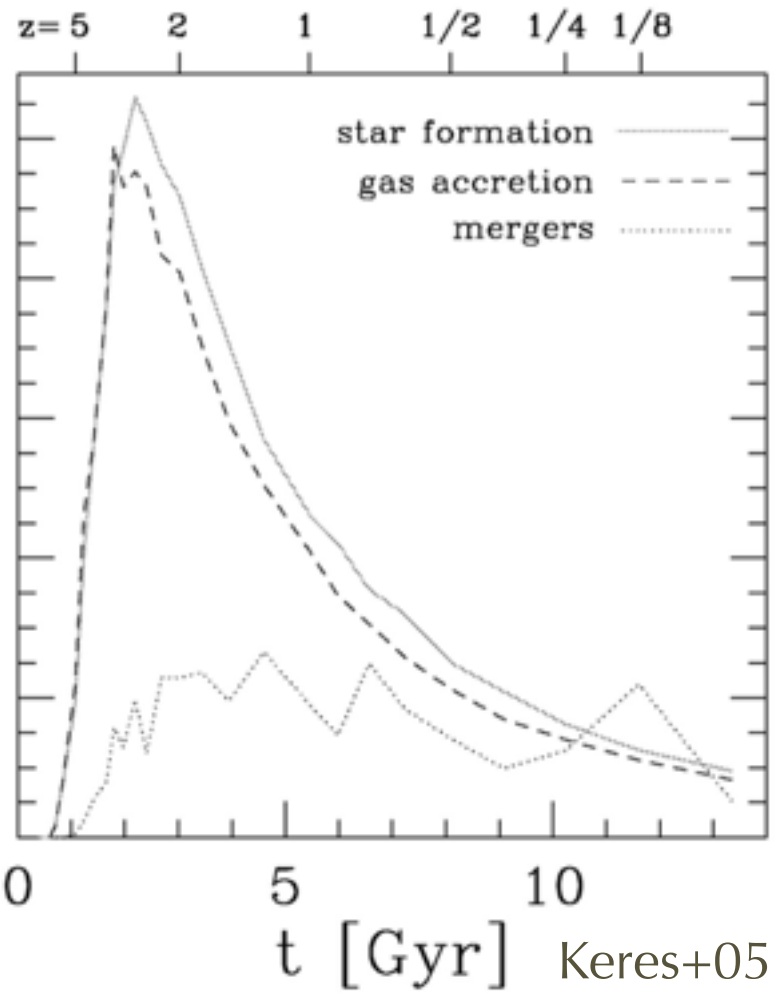




Treister+12

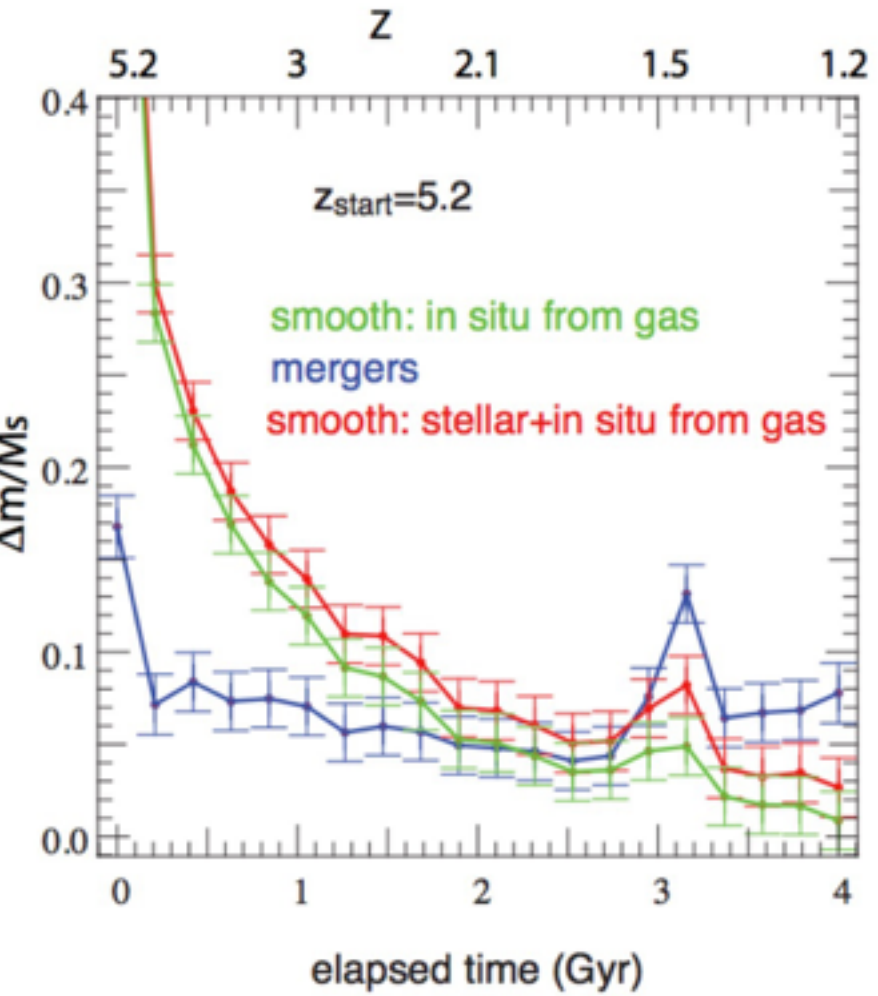
Merger-Free galaxy growth: cold accretion

Mass accretion rate *or* SFR



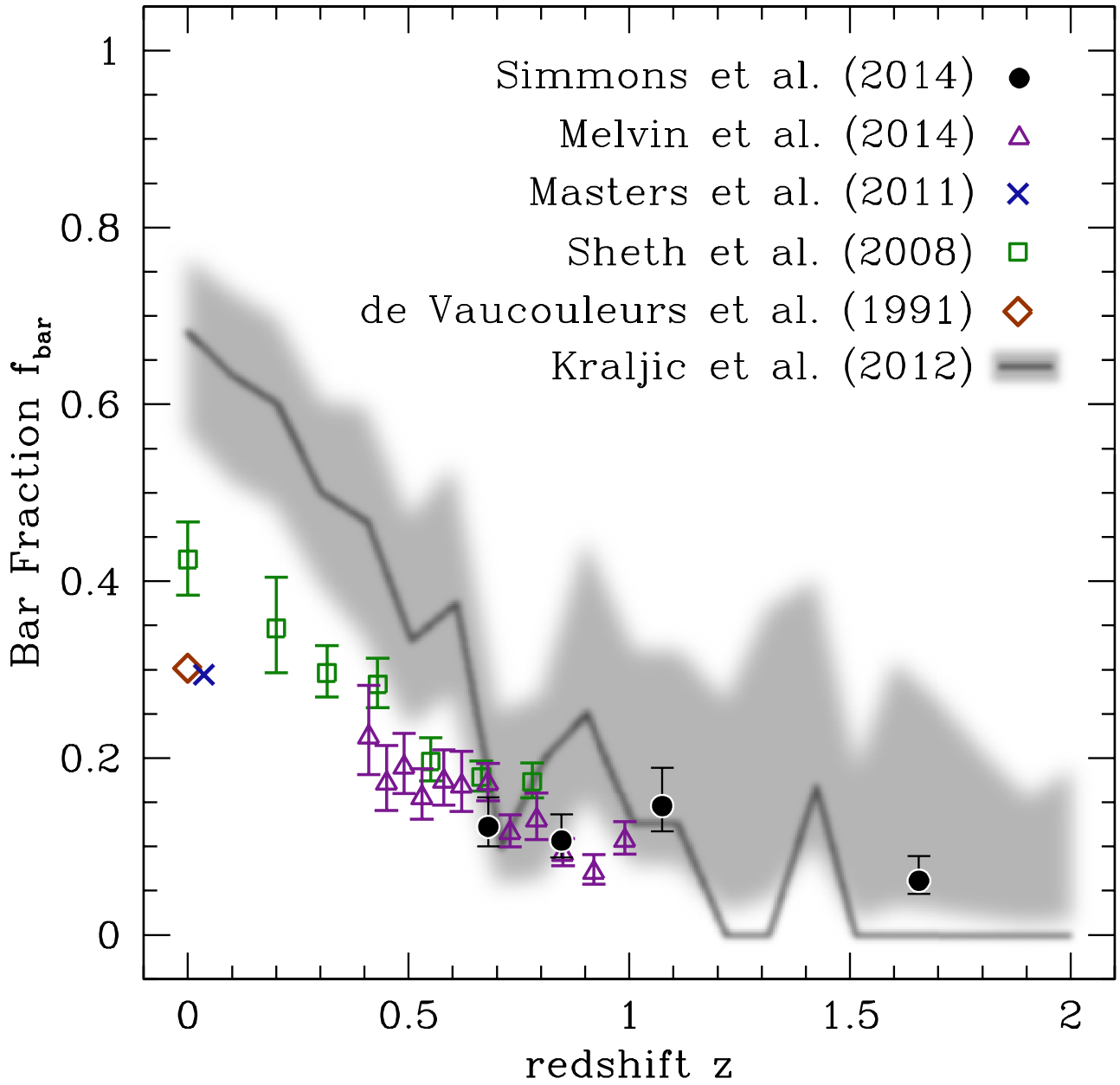
Keres+05

M* growth by each process



Welker+16

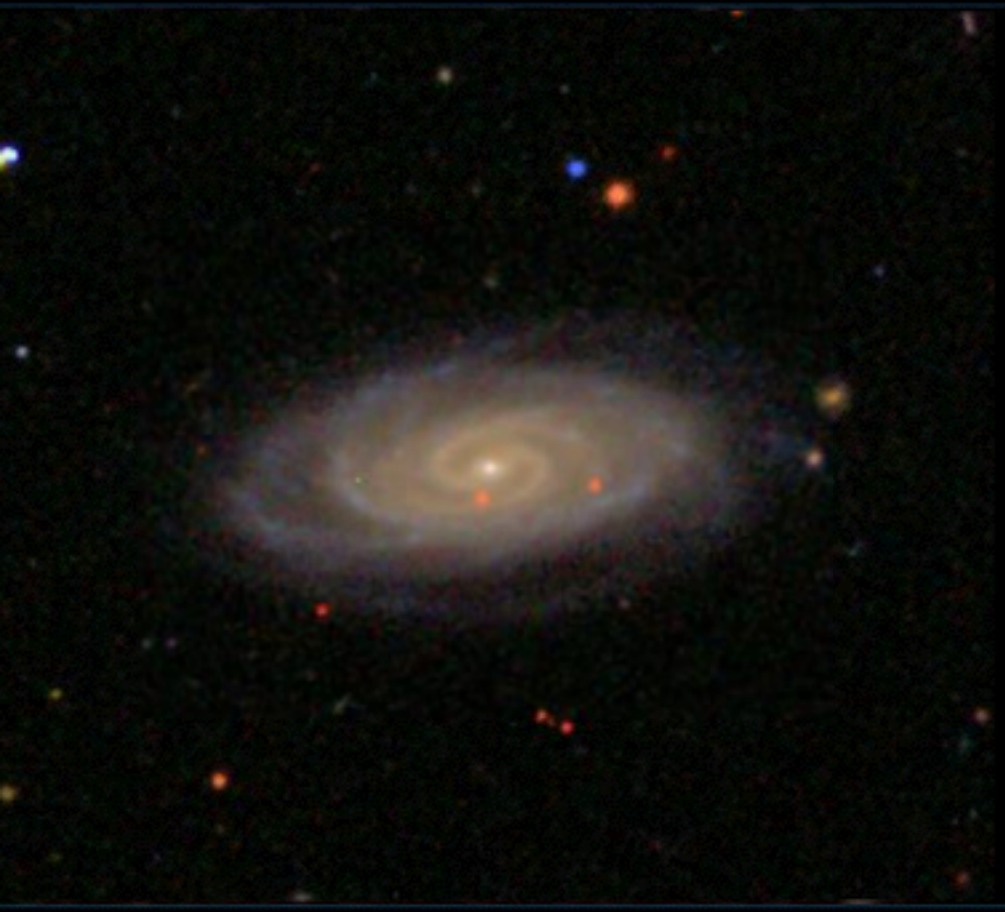
Populations of settling disks since z ~ 2



Disentangling growth histories

Morphologies / *Evolutionary Processes*	 Bulgeless	"Pseudo"-bulge	"Classical" bulge
Calm Merger-Free: No dynamical heating	✓	✓	✓
Violent Merger-Free: Some dynamical heating	✗	✓	✗
Merger-driven: Significant dynamical heating	✗	✗	✓

CLASSIFY SCIENCE STORY GALAXY ZOO ASTRONOMERS DISCUSS PROFILE



Classify SDSS Favourite Invert Help Restart

BULGE

How prominent is the central bulge, compared with the rest of the galaxy?

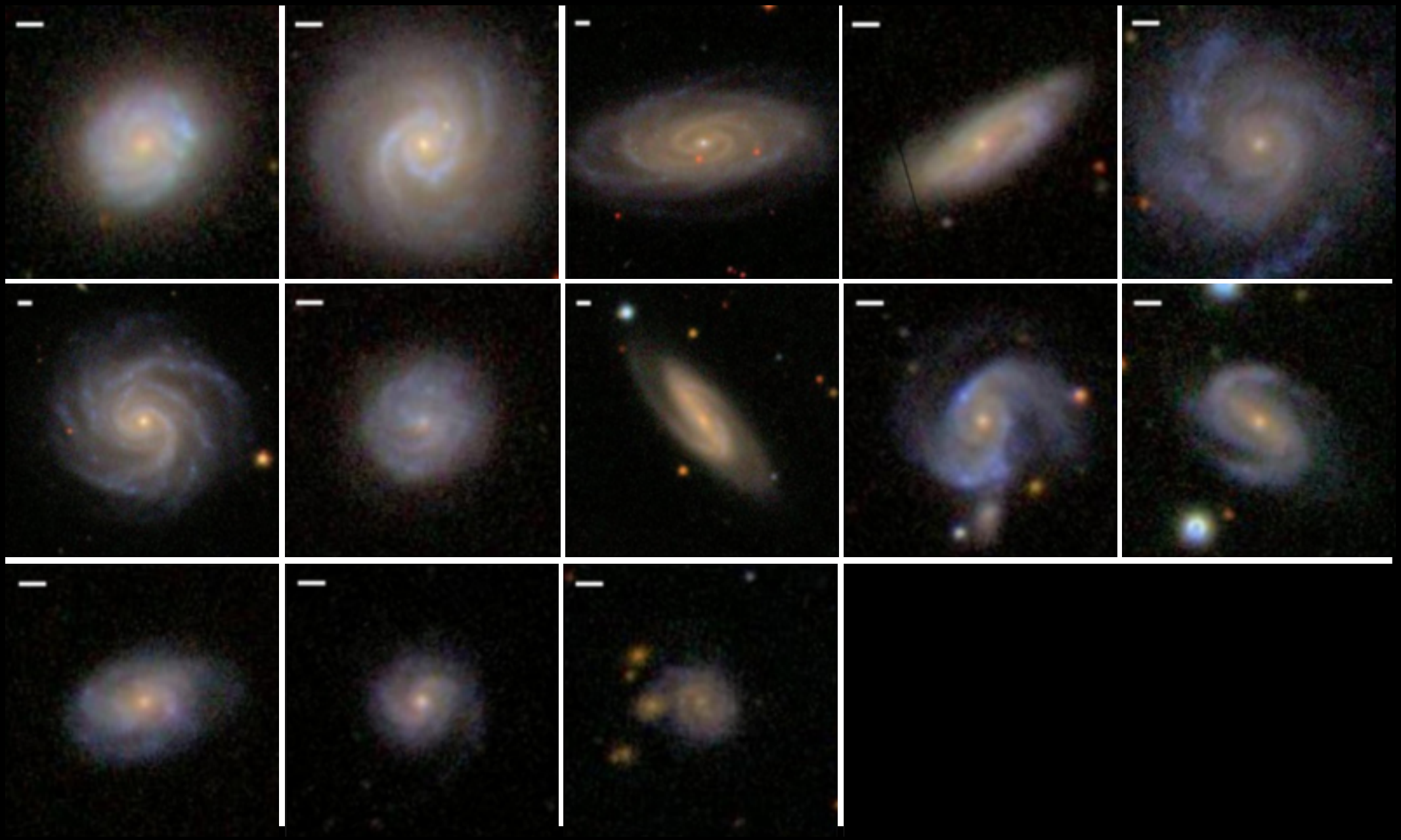

No bulge


Just noticeable


Obvious

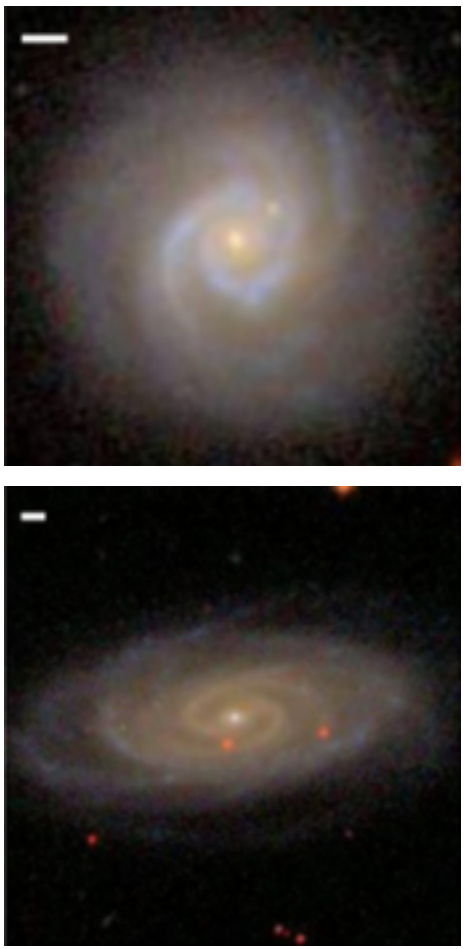

Dominant

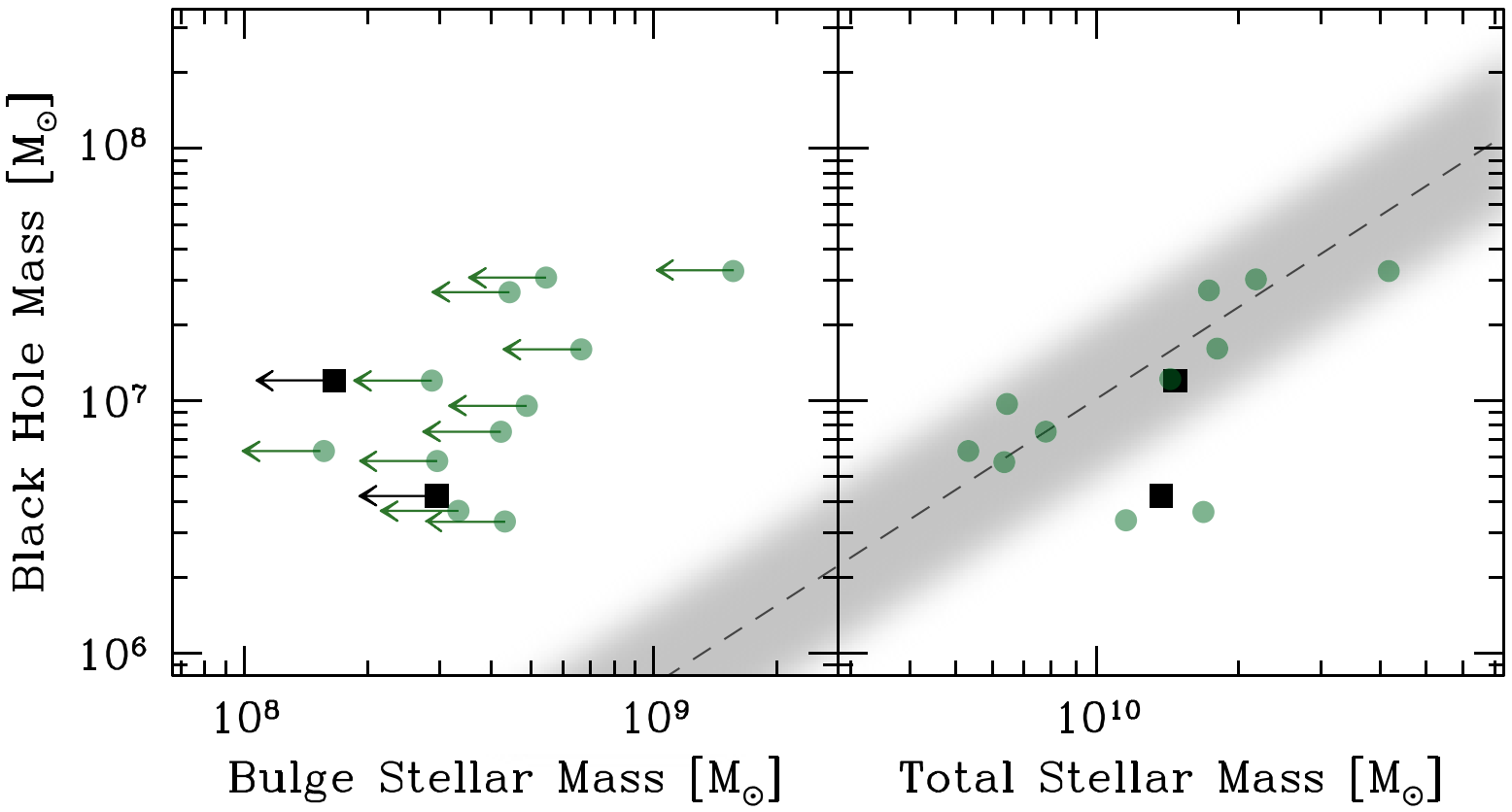
Bulgeless Galaxies with Growing Black Holes



Simmons+13

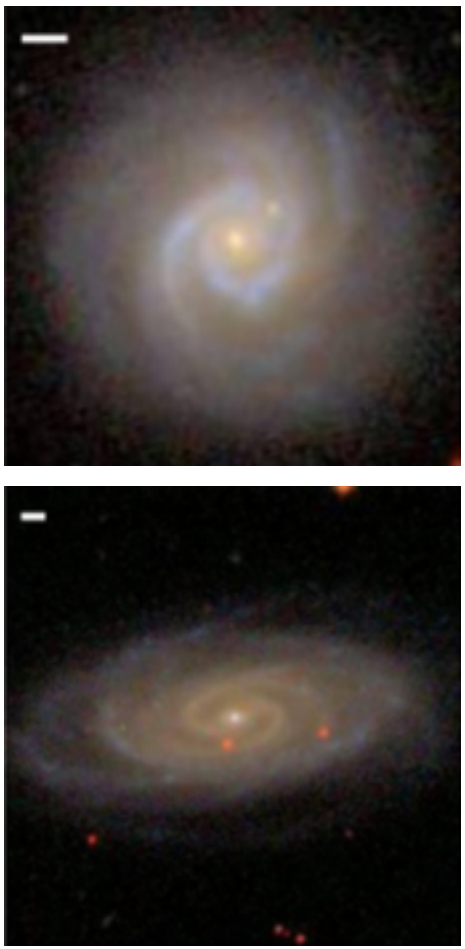
Merger-Free AGN & Host Galaxies

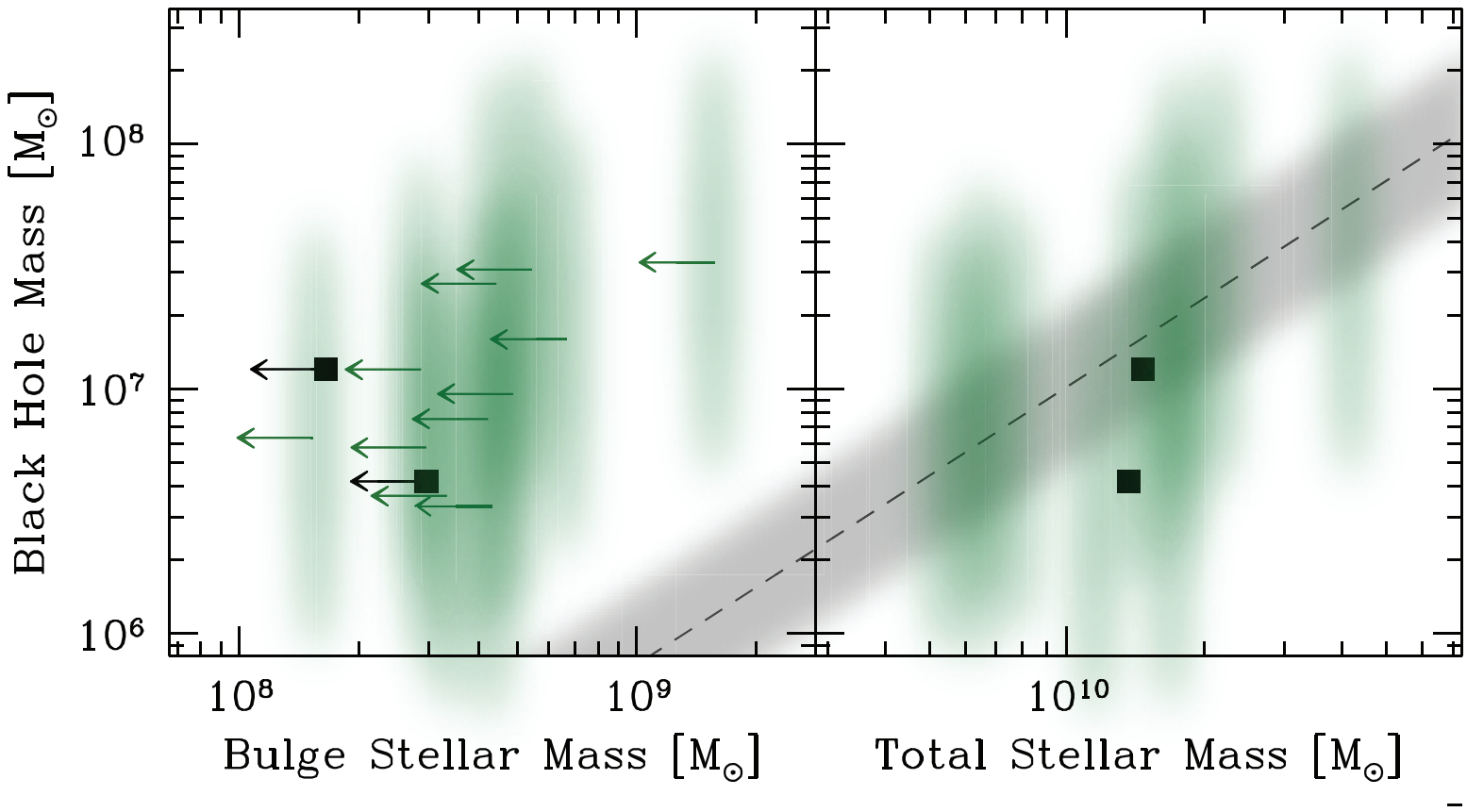




Simmons et al. (2013)

Merger-Free AGN & Host Galaxies



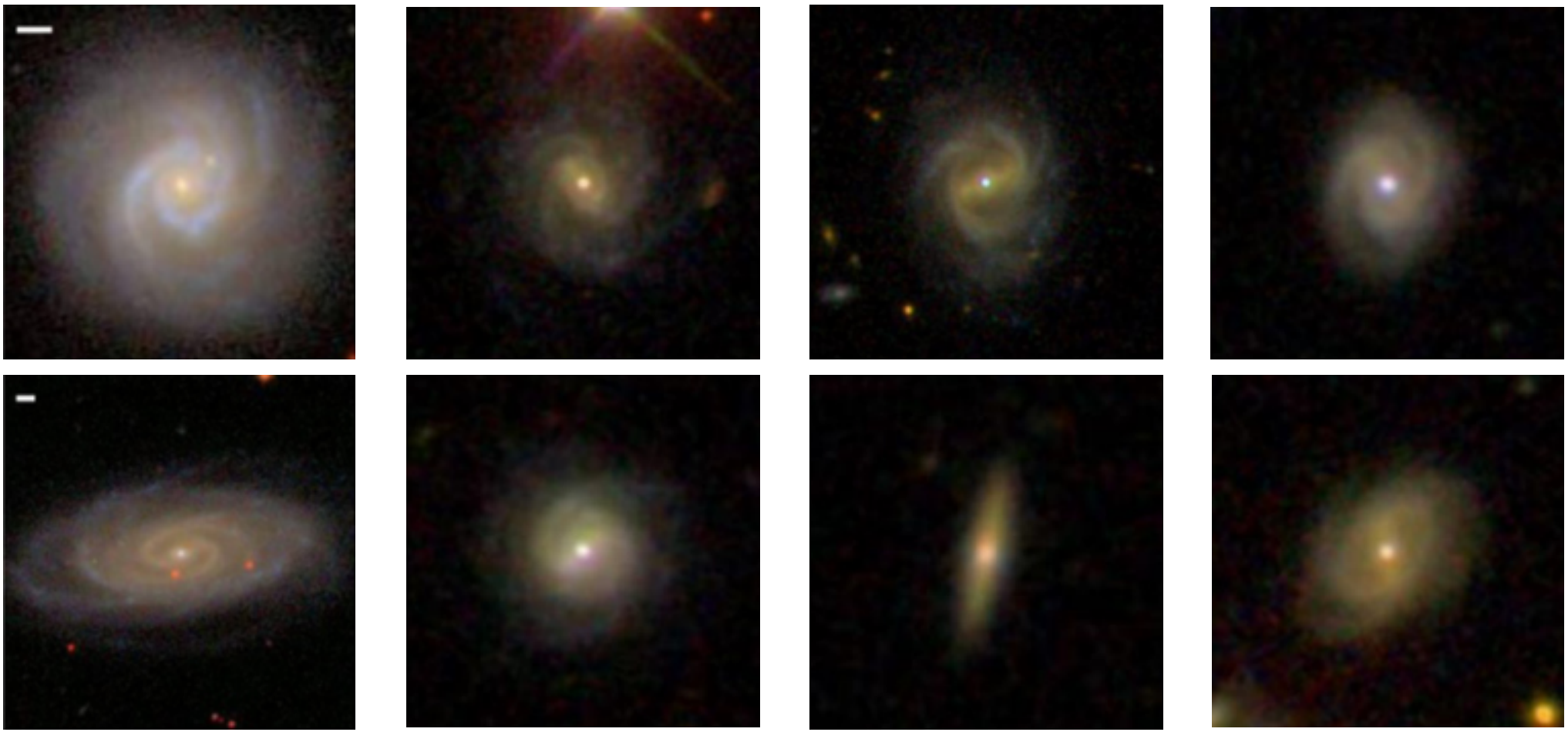


Simmons et al. (2013)

More realistic uncertainties versus the previous slide.

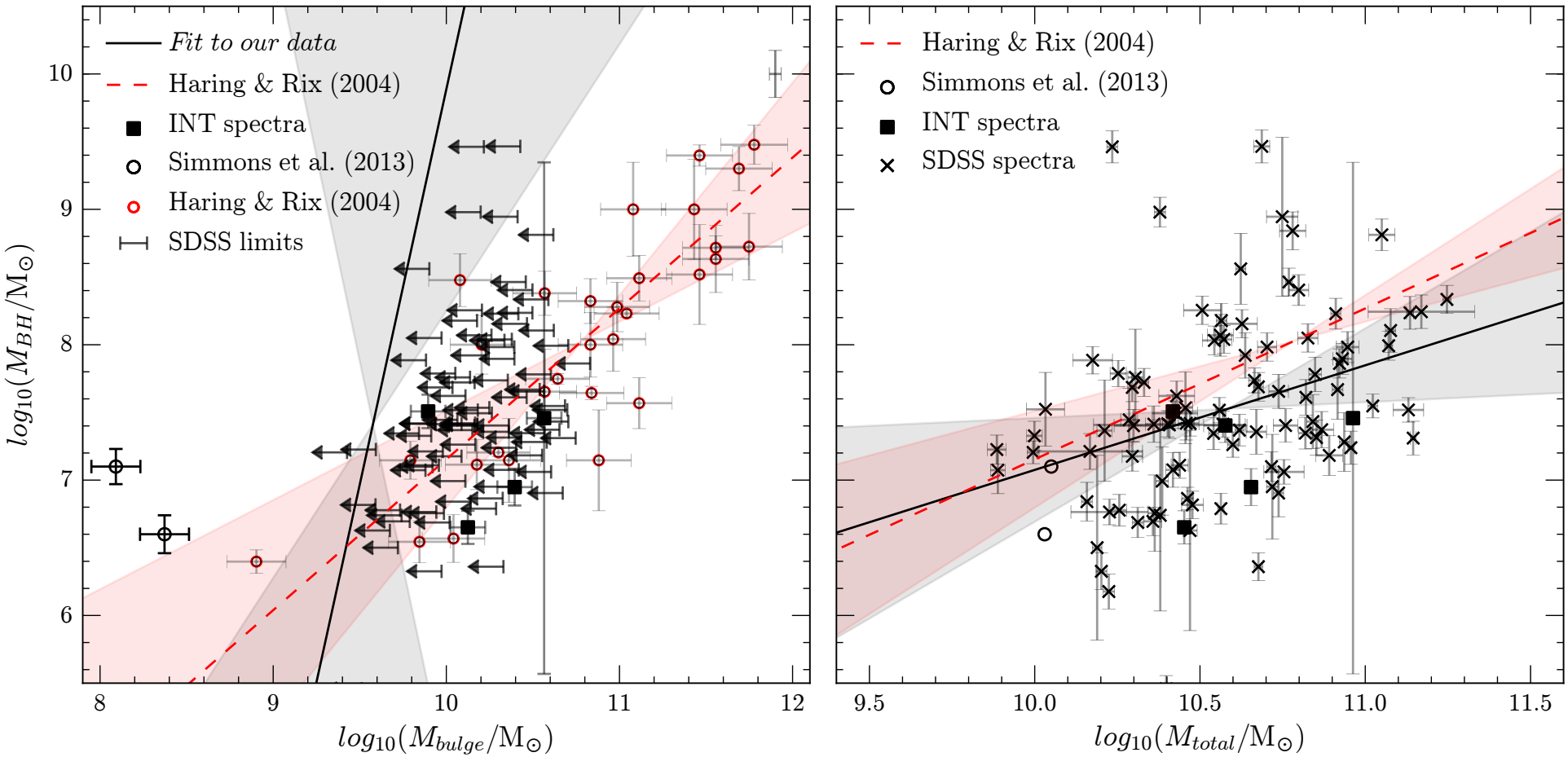
B. Simmons - @vrooje

Merger-Free AGN & Host Galaxies



Merger-Free AGN & Host Galaxies

Secular processes can drive BH-galaxy co-evolution



Simmons+ (in prep)

Morphology tells a tale of formation history

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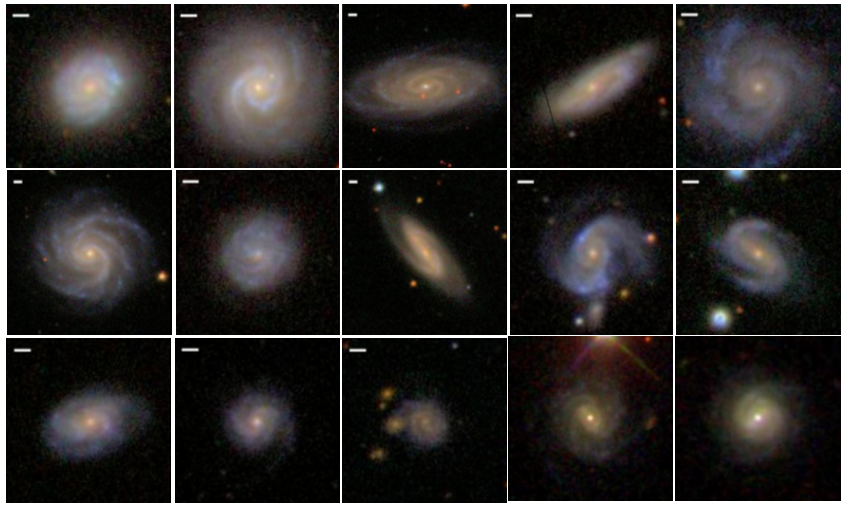
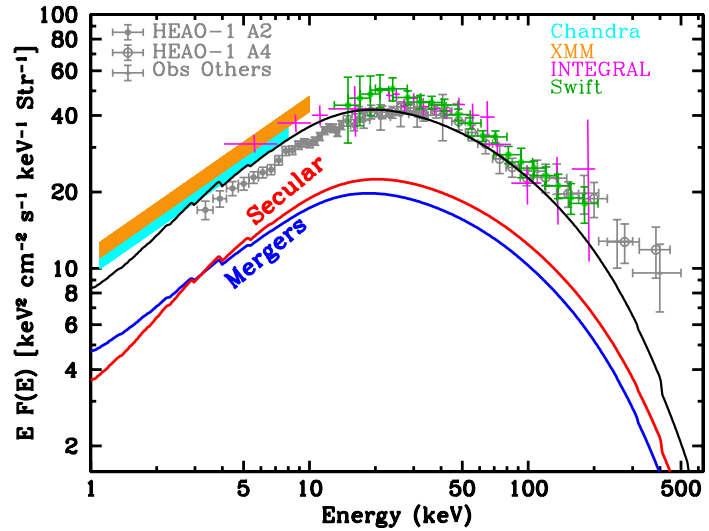
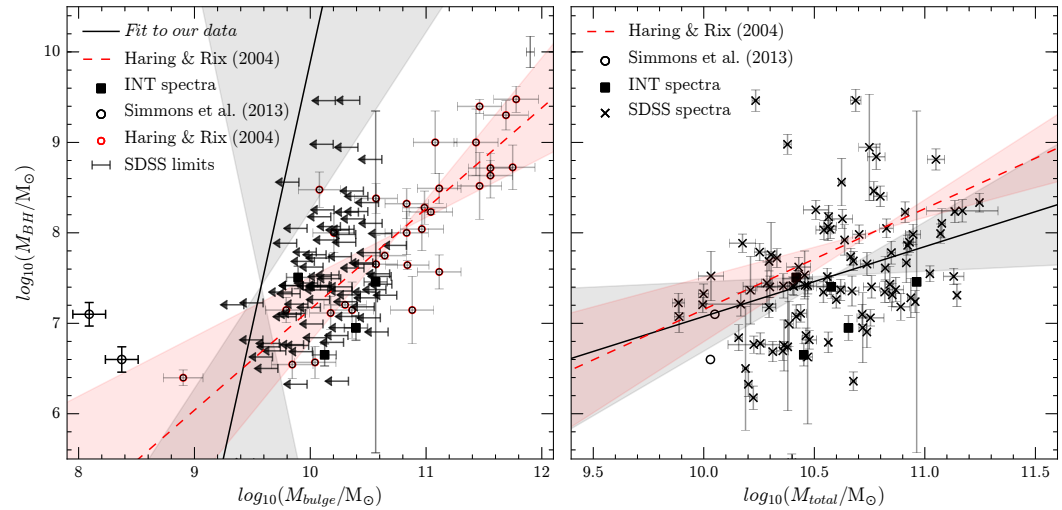
Summary

Substantial BH growth can occur in the absence of mergers.

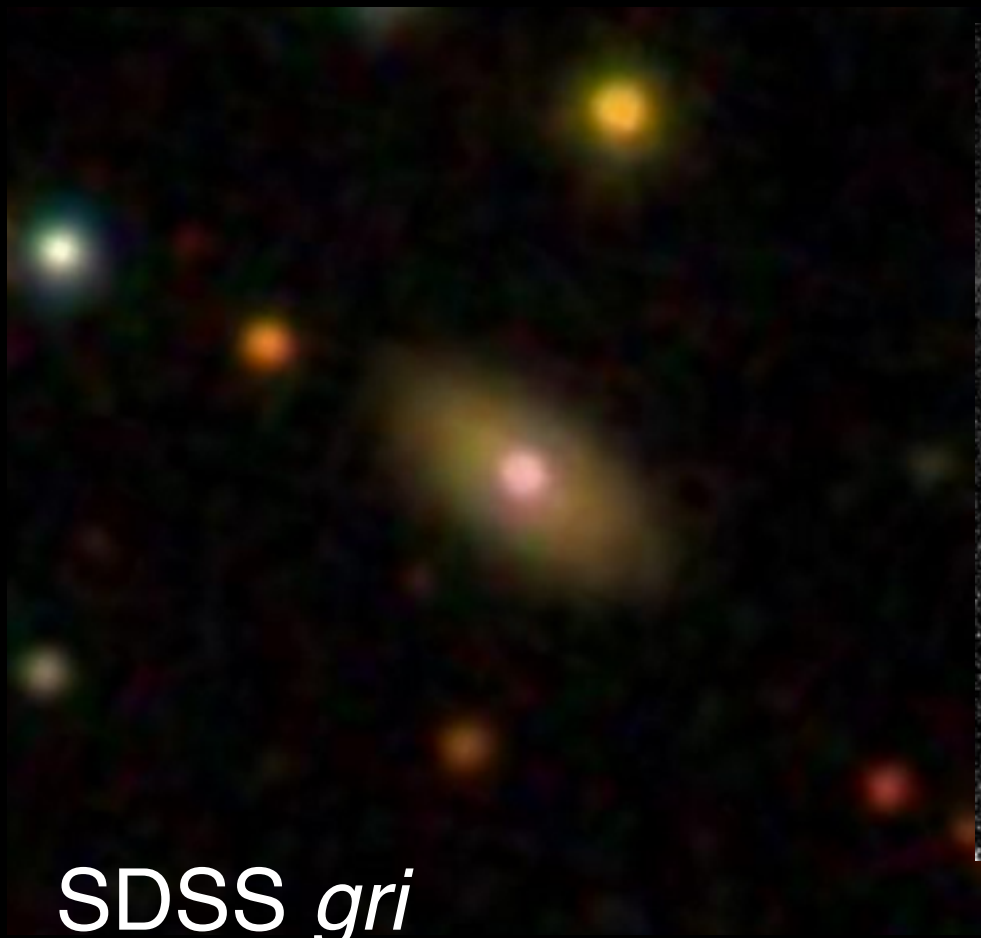




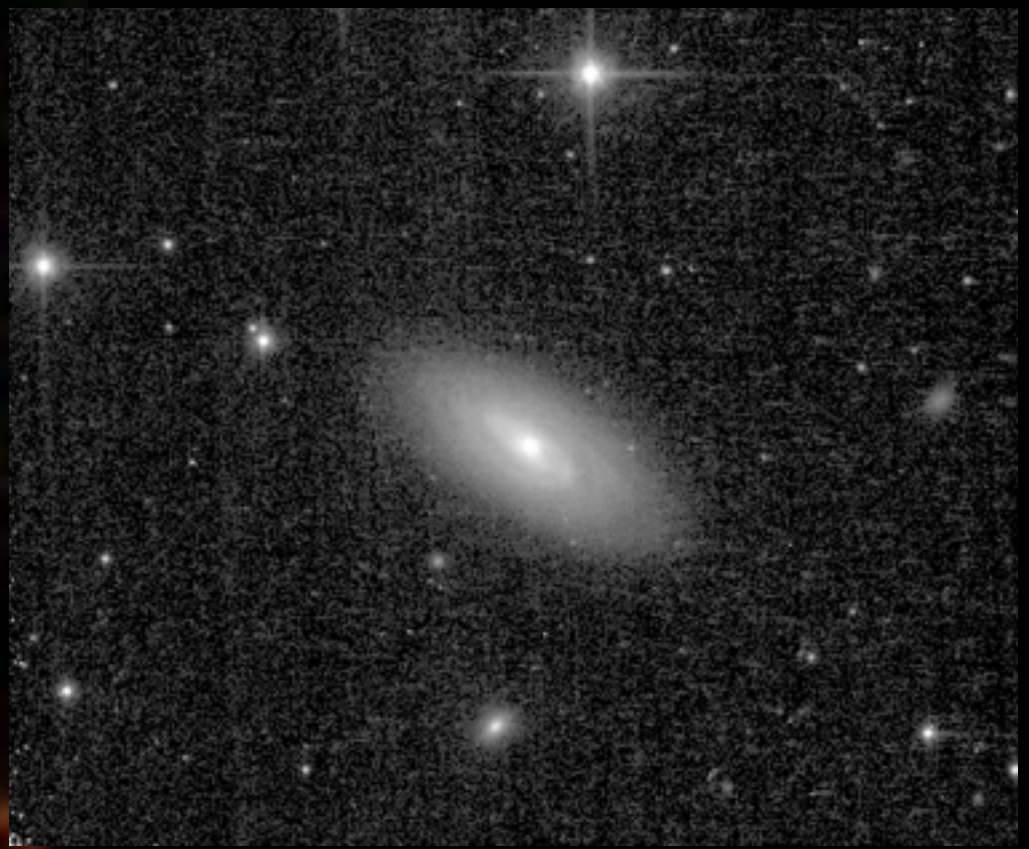
Merger-free BHs appear to co-evolve with galaxies - co-evolution may be more fundamental than mergers.



Fresh Off The Telescope



SDSS *gri*



HST F814W

We found more disk-dominated galaxies and HST gave us lots of time: this is the first observation of the survey.