



Morphology, Secular Evolution & Black Hole Growth from $z \sim 2$ to today

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GALAXY ZOO



~50,000 images • 95% have $z \leq 3$

WFC3 *H* (*F160W*) < 25.5



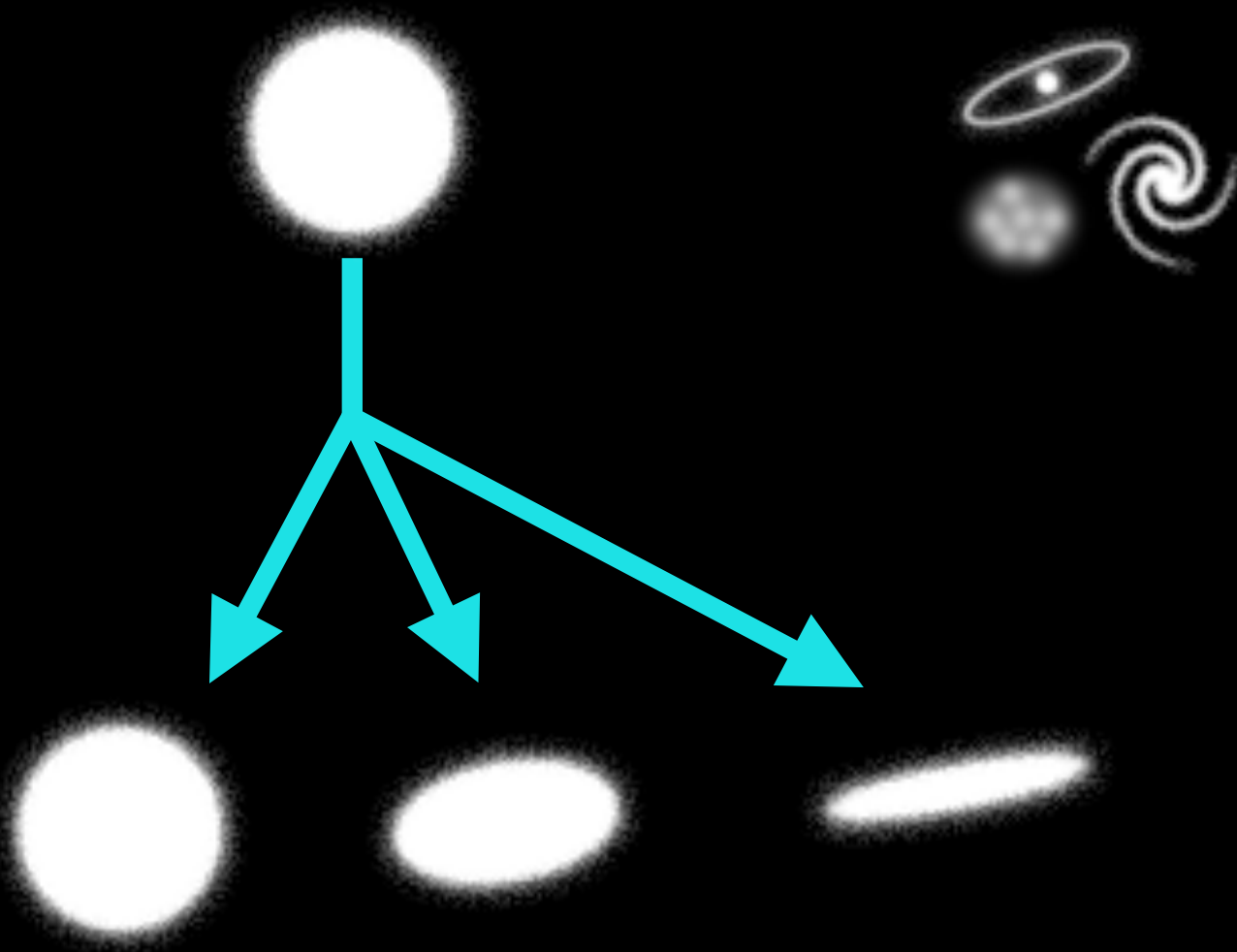
Smooth • Features • Artifact



Smooth • Features • Artifact



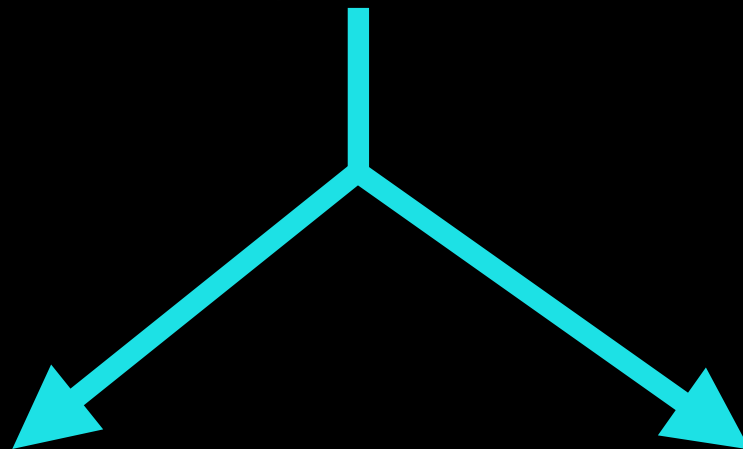
Smooth • Features • Artifact



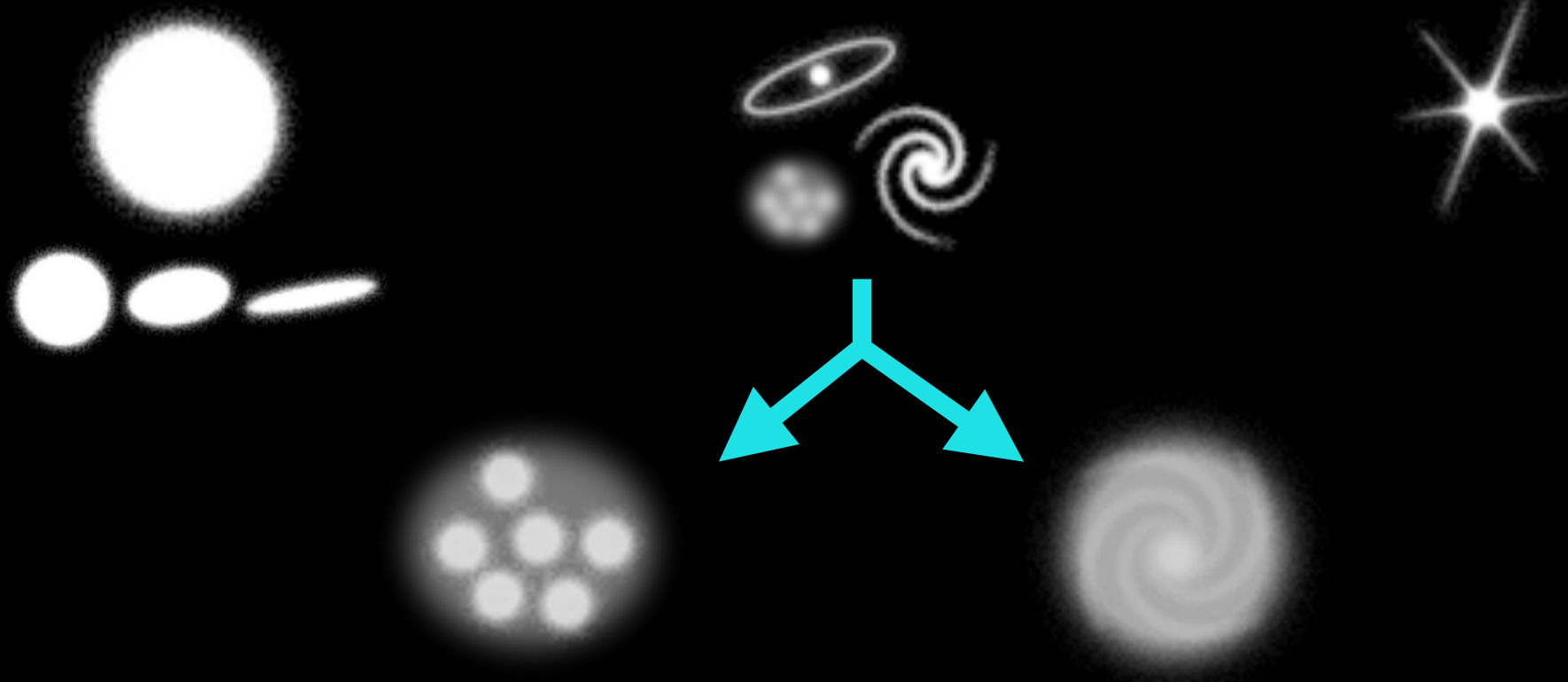
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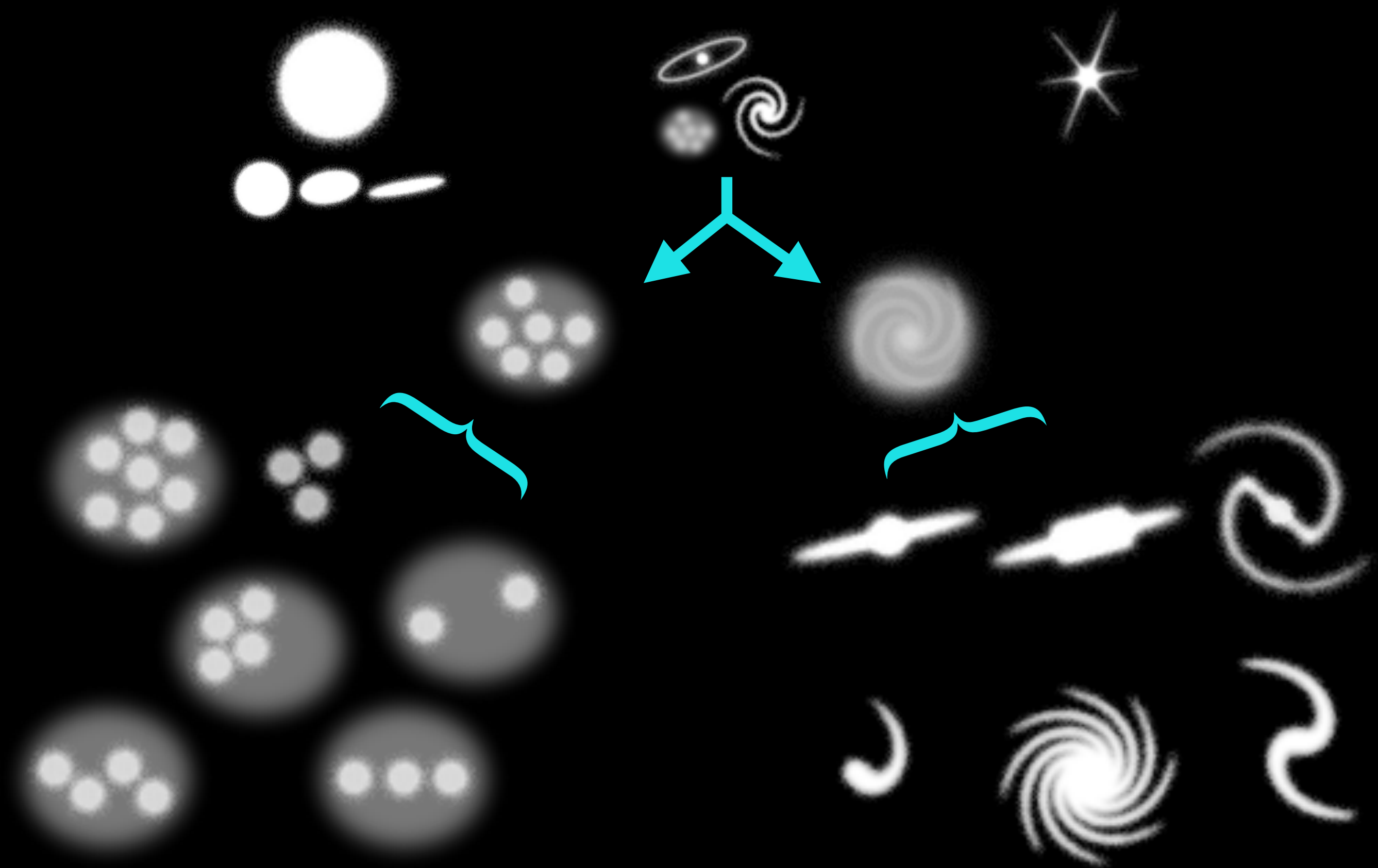
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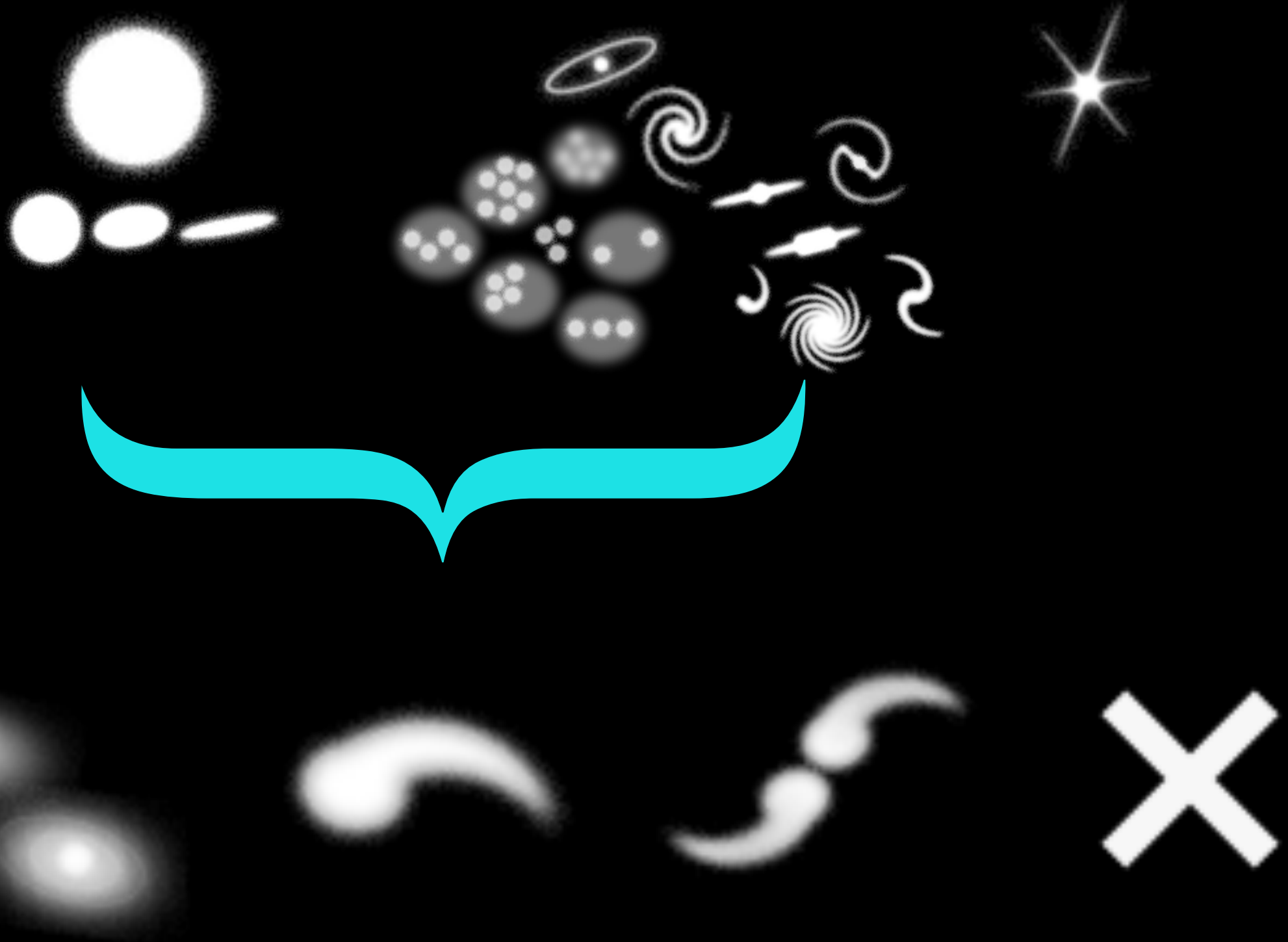
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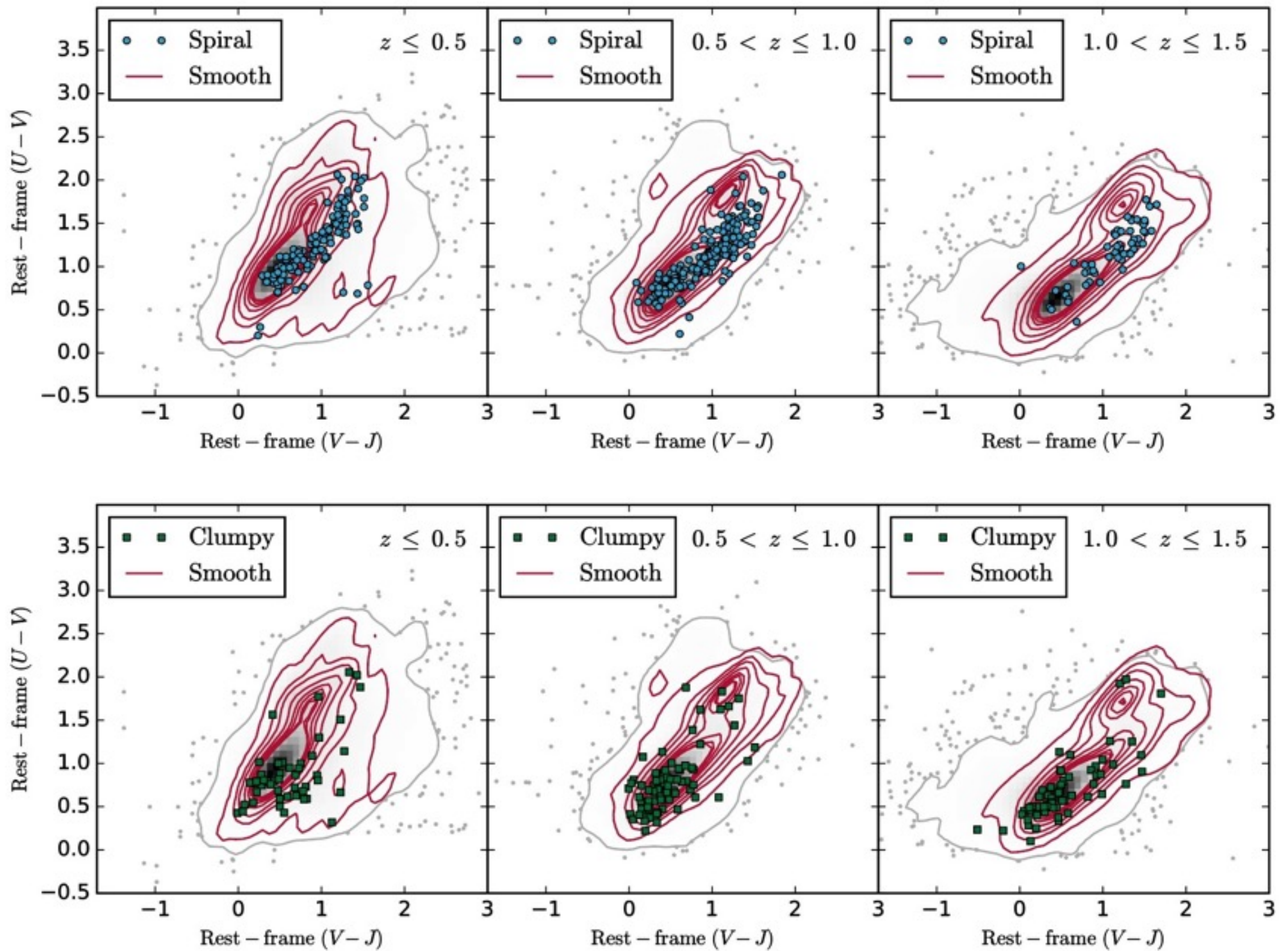


Smooth • Features • Artifact

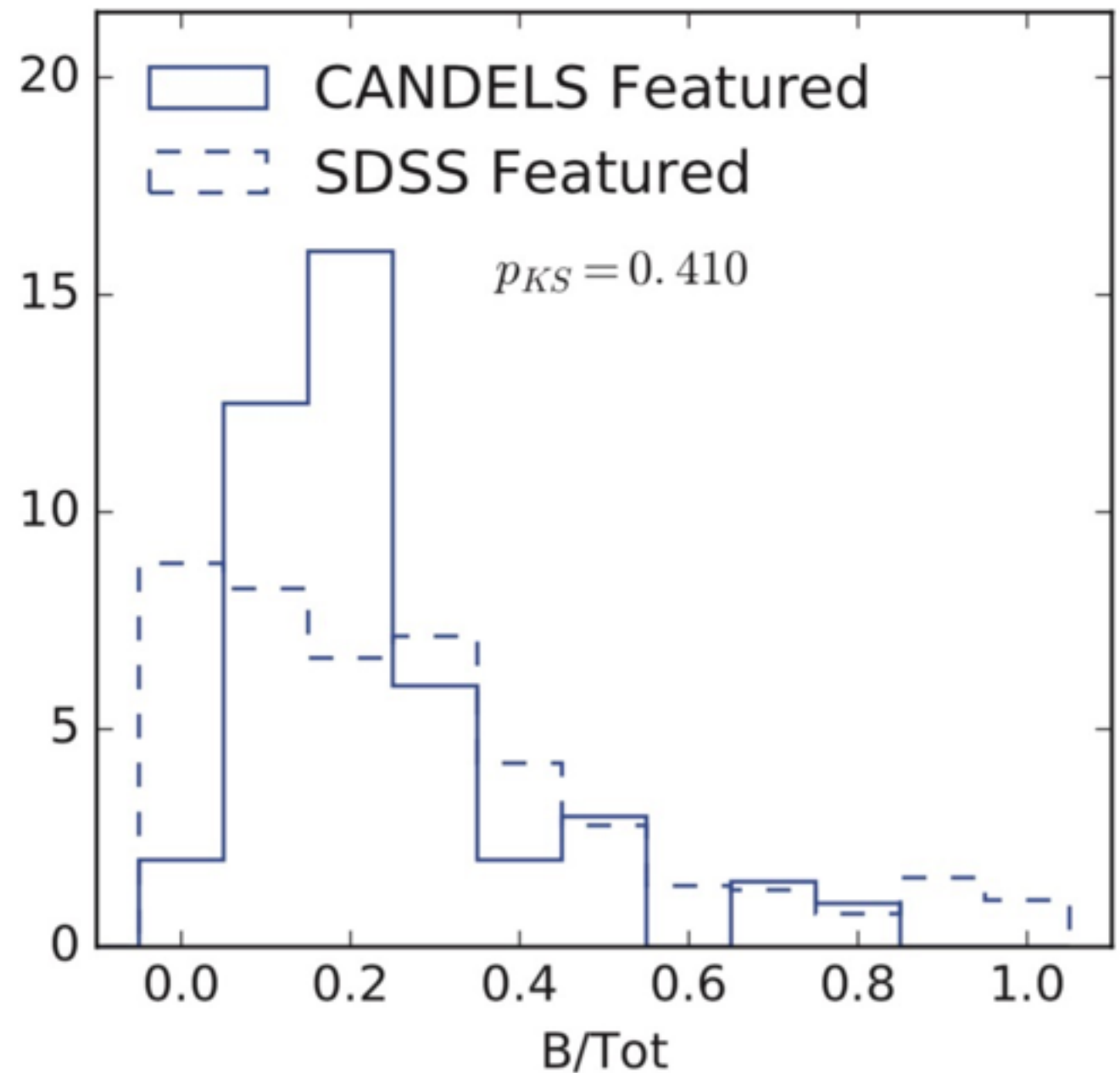
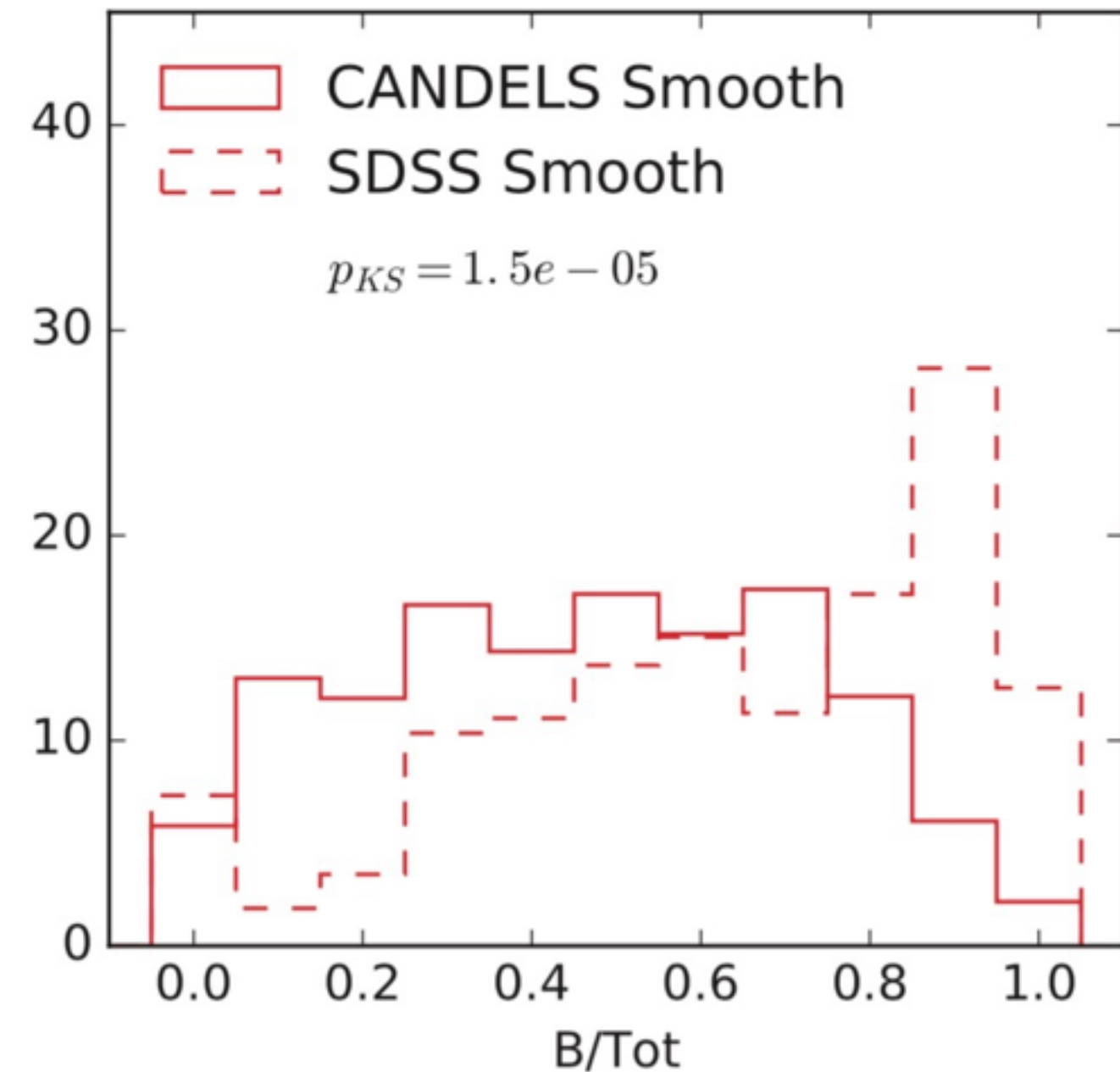


Smooth • Features • Artifact



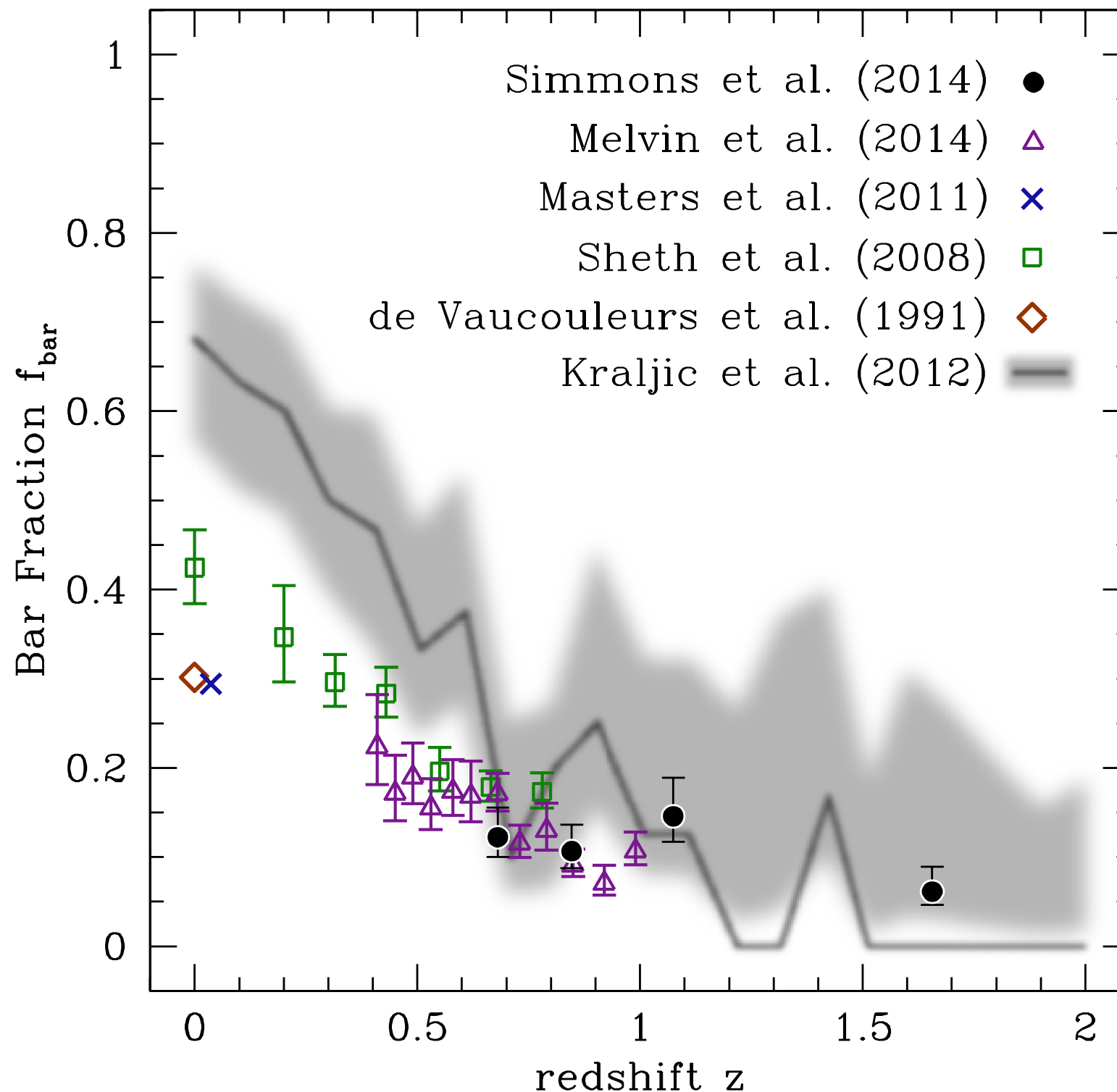


Featureless disks at $z > 1$

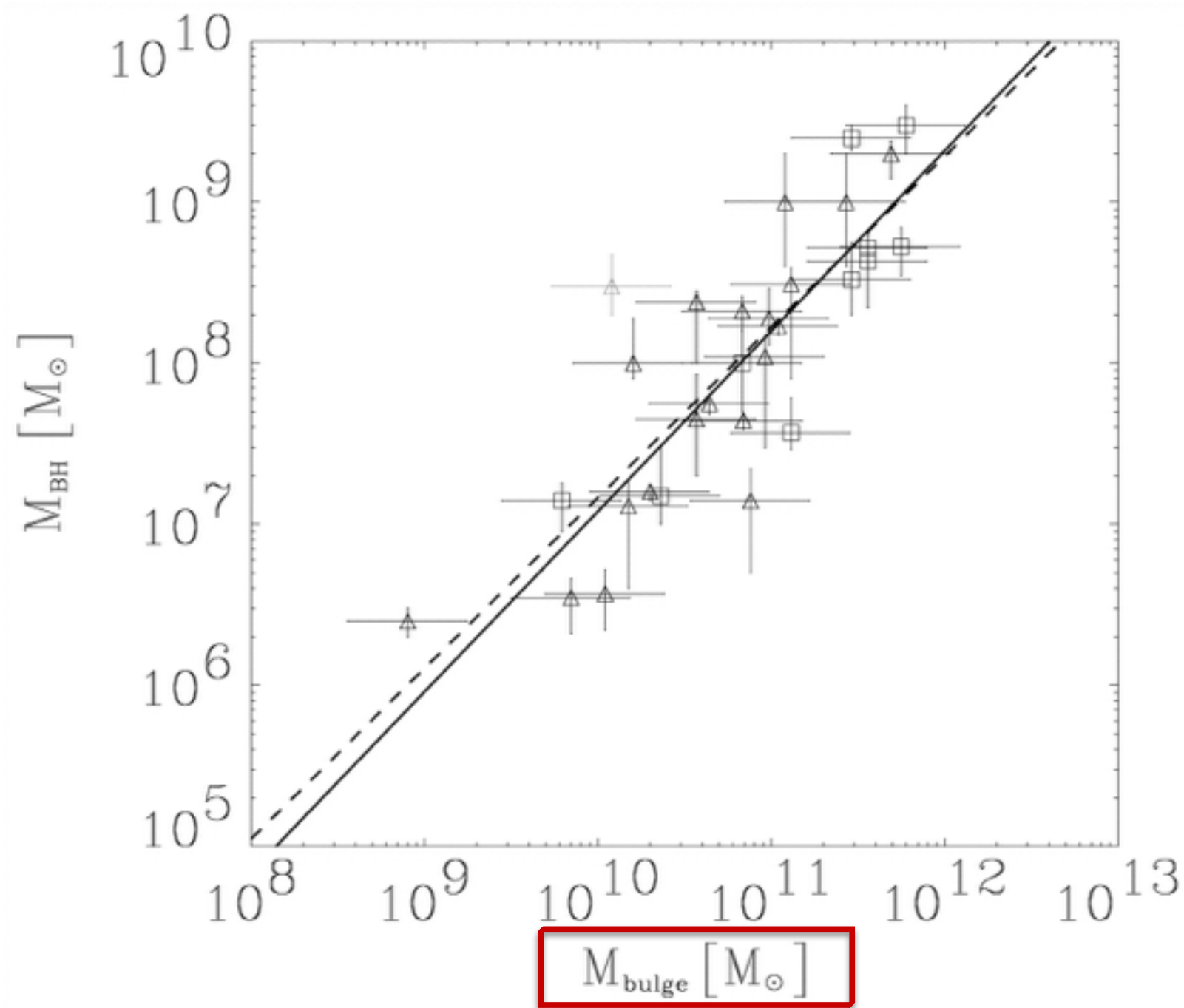


Featureless disks at $z > 1$

and the settling of disk galaxies as the Universe evolves

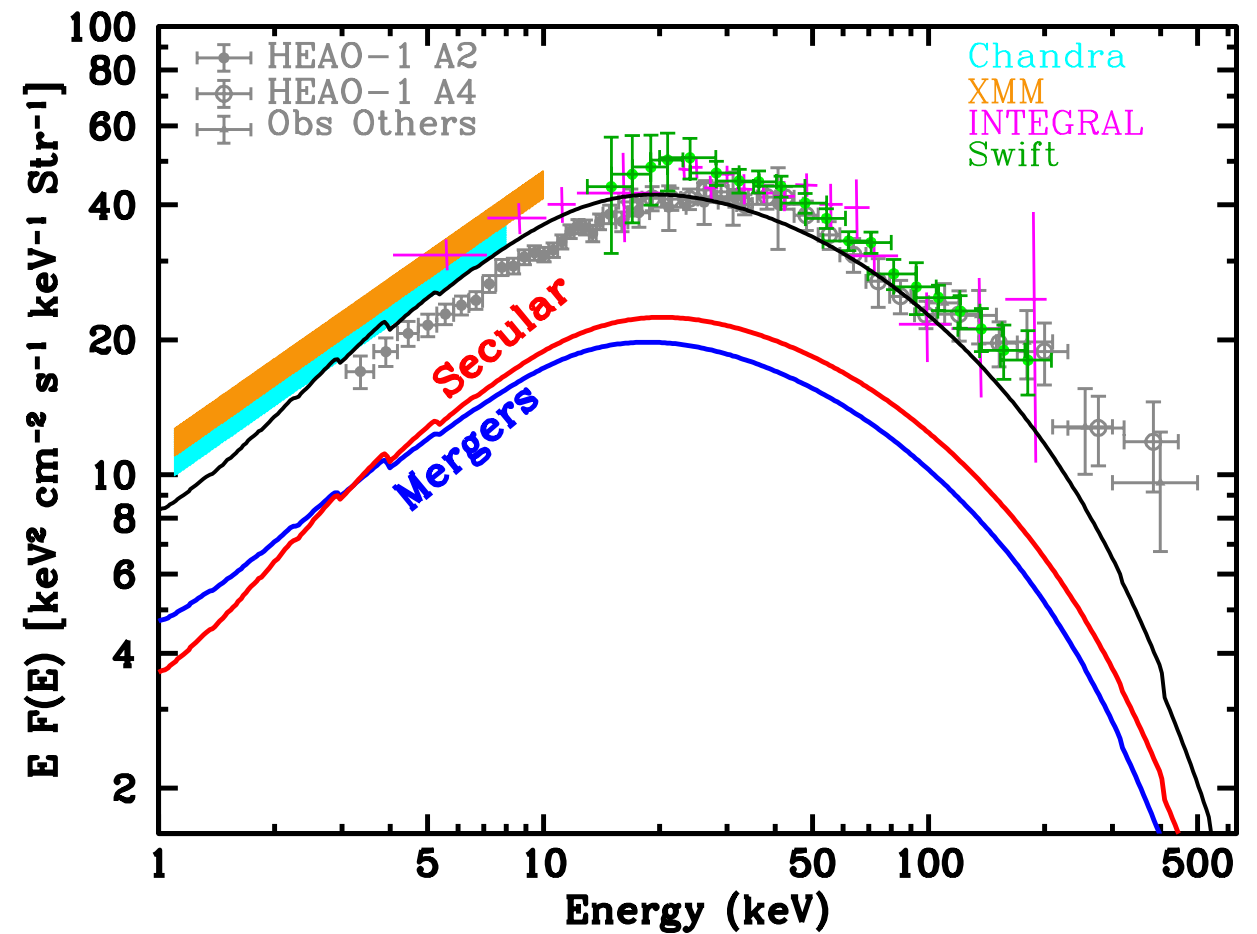
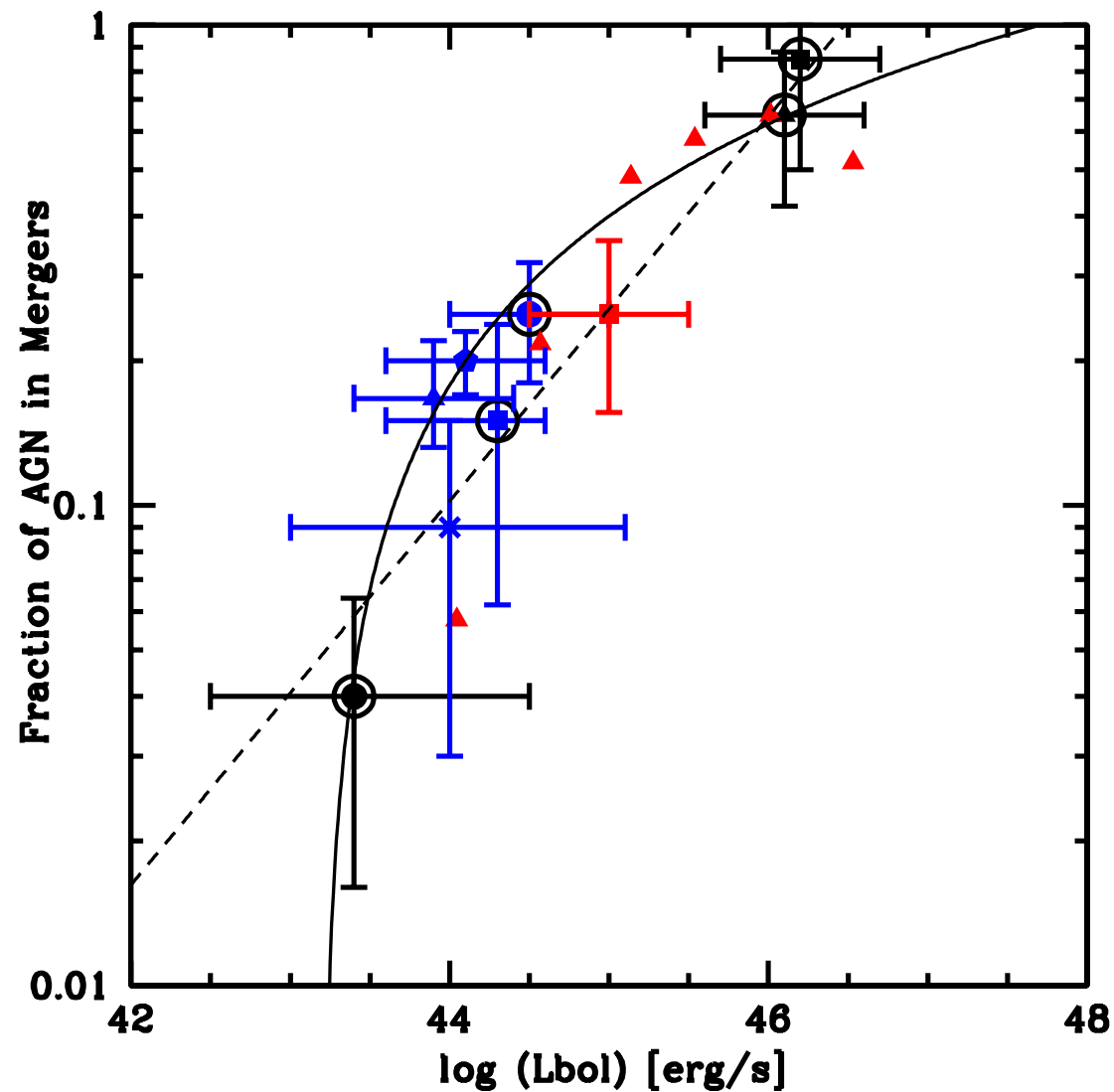


~~Bulges~~ Galaxies & black holes



Haring & Rix (2004)

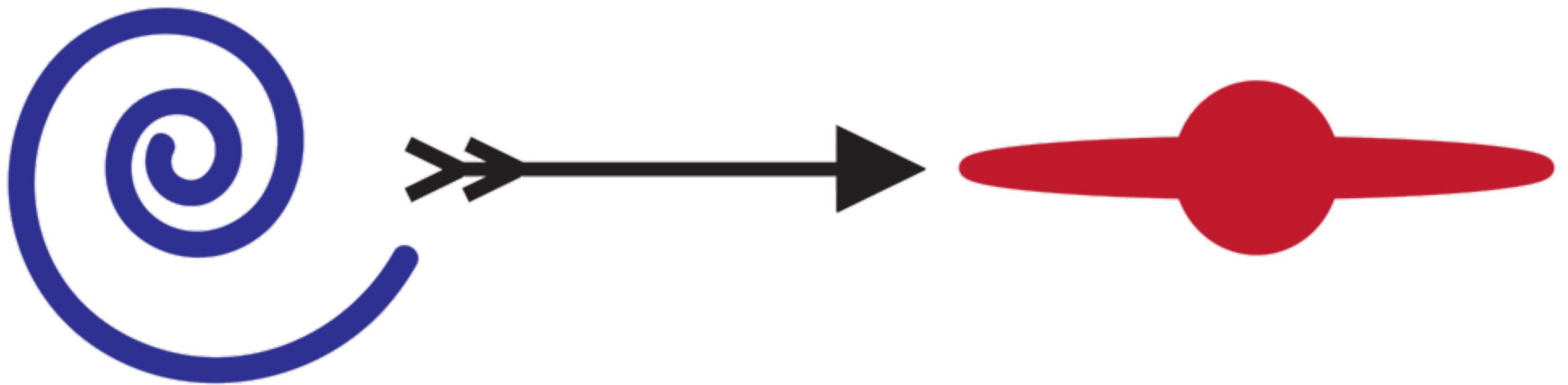
Merger-Free BH growth is important



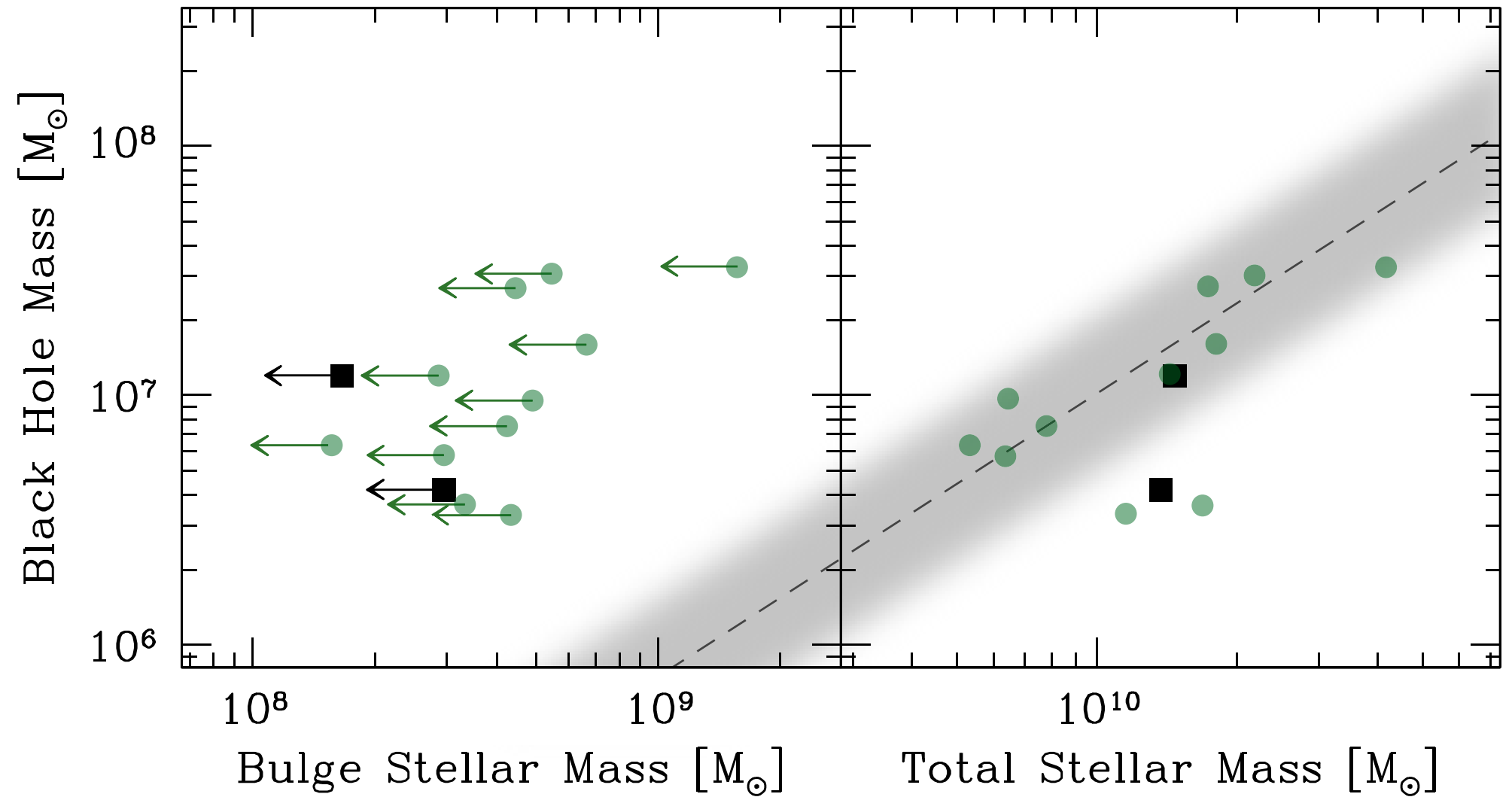
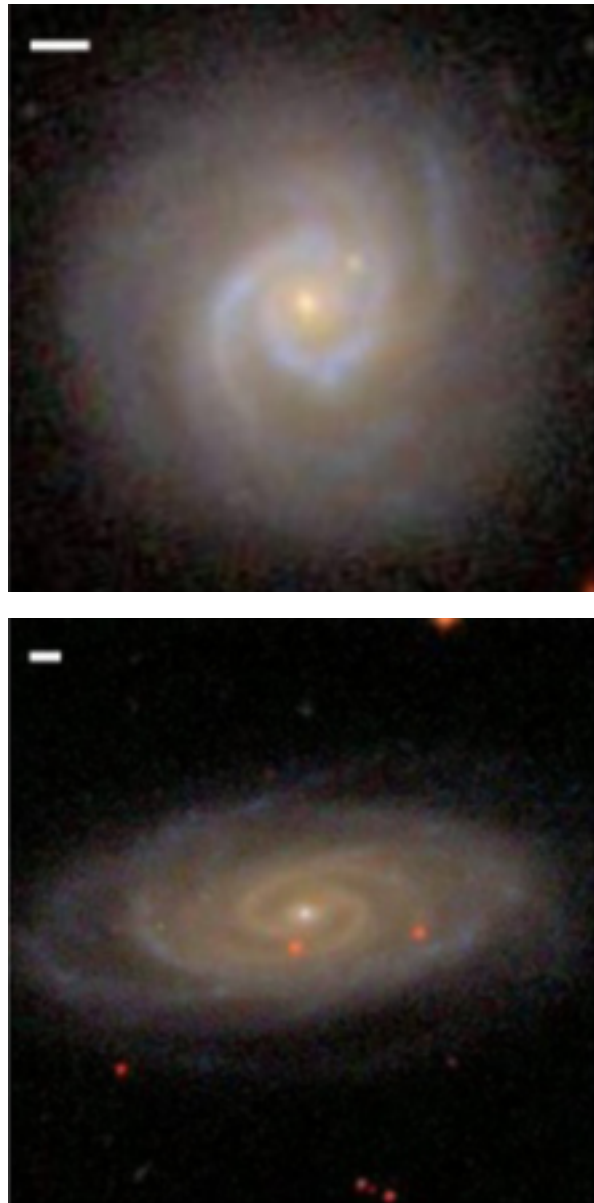
Treister et al. (2012)

Once a bulge, always a bulge

(or something dynamically heated)

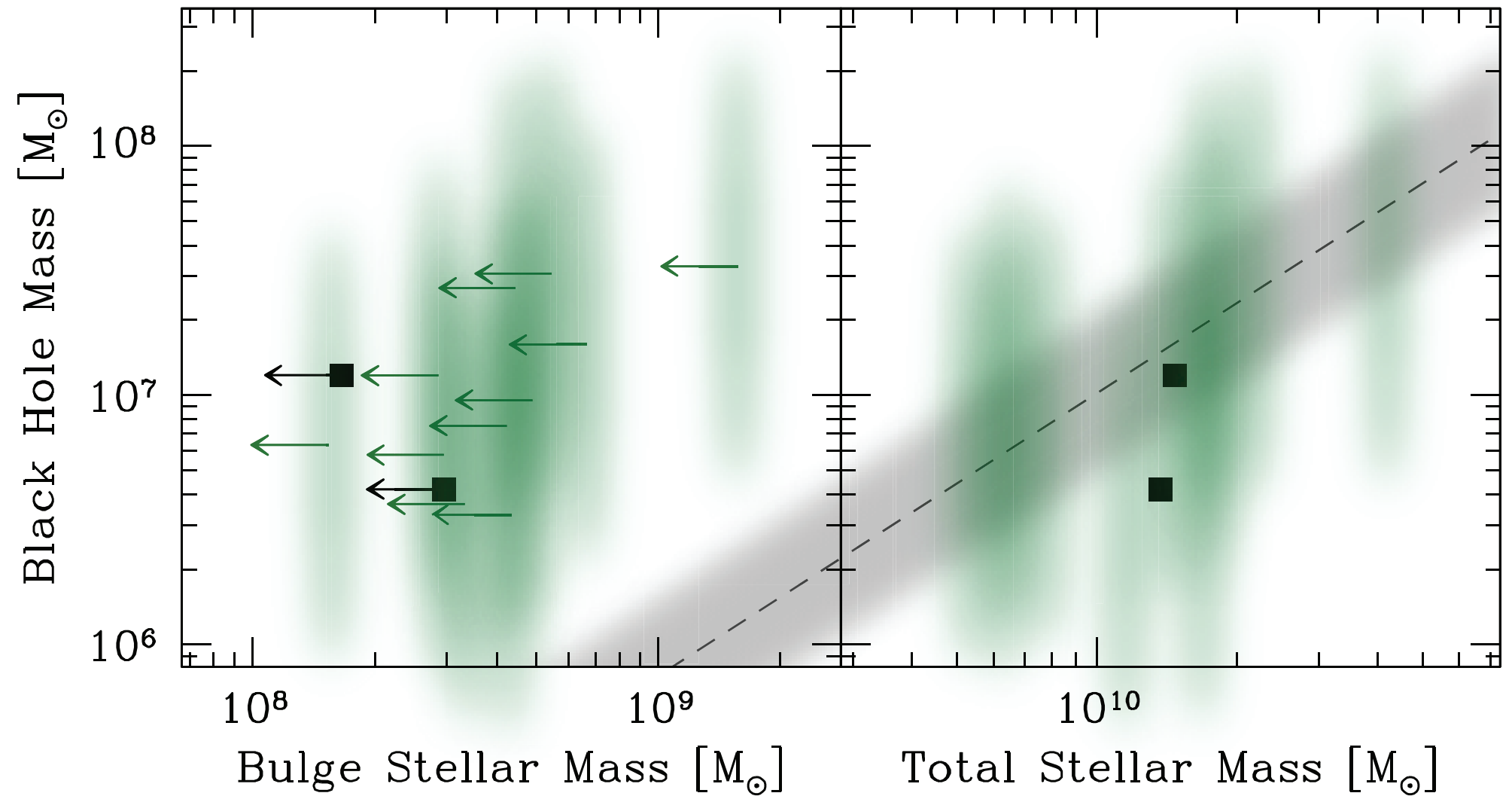
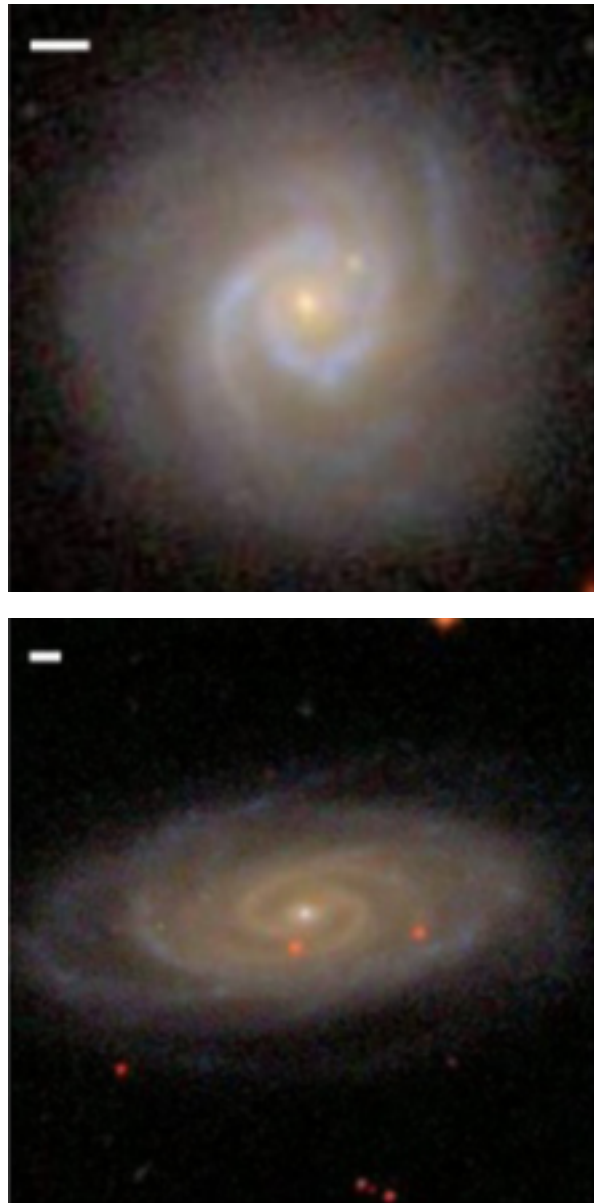


Merger-Free AGN & Host Galaxies



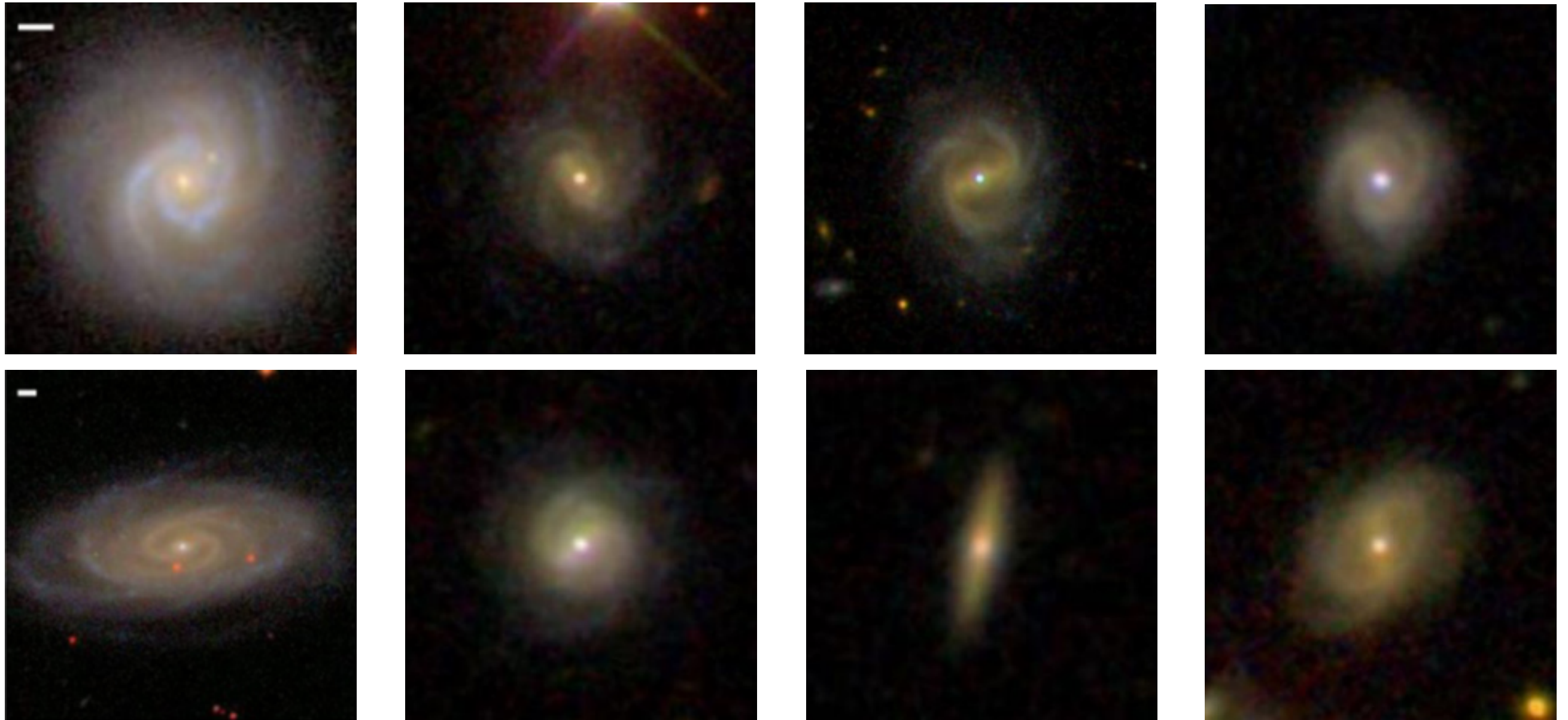
Simmons et al. (2013)

Merger-Free AGN & Host Galaxies

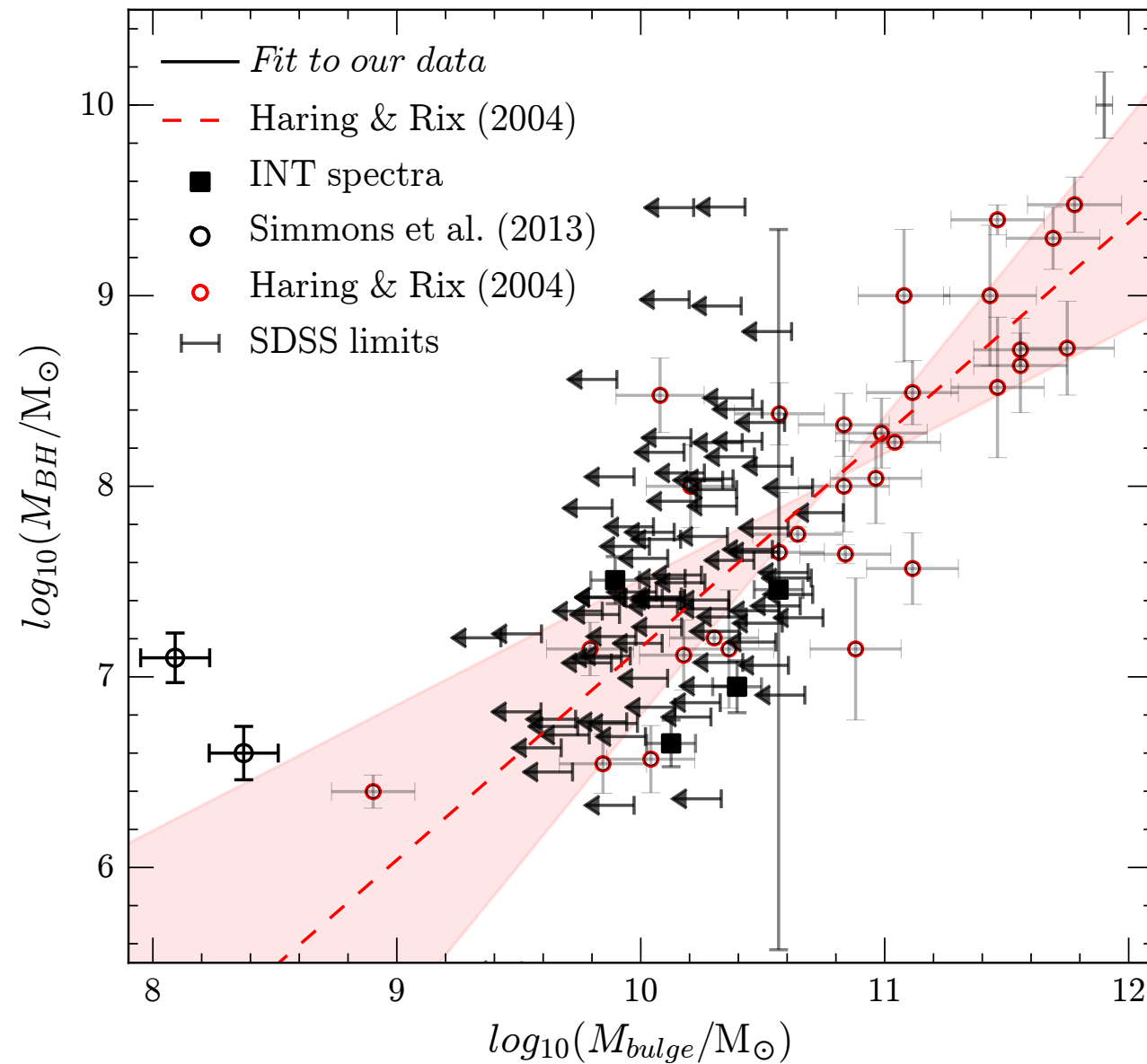


Simmons et al. (2013)

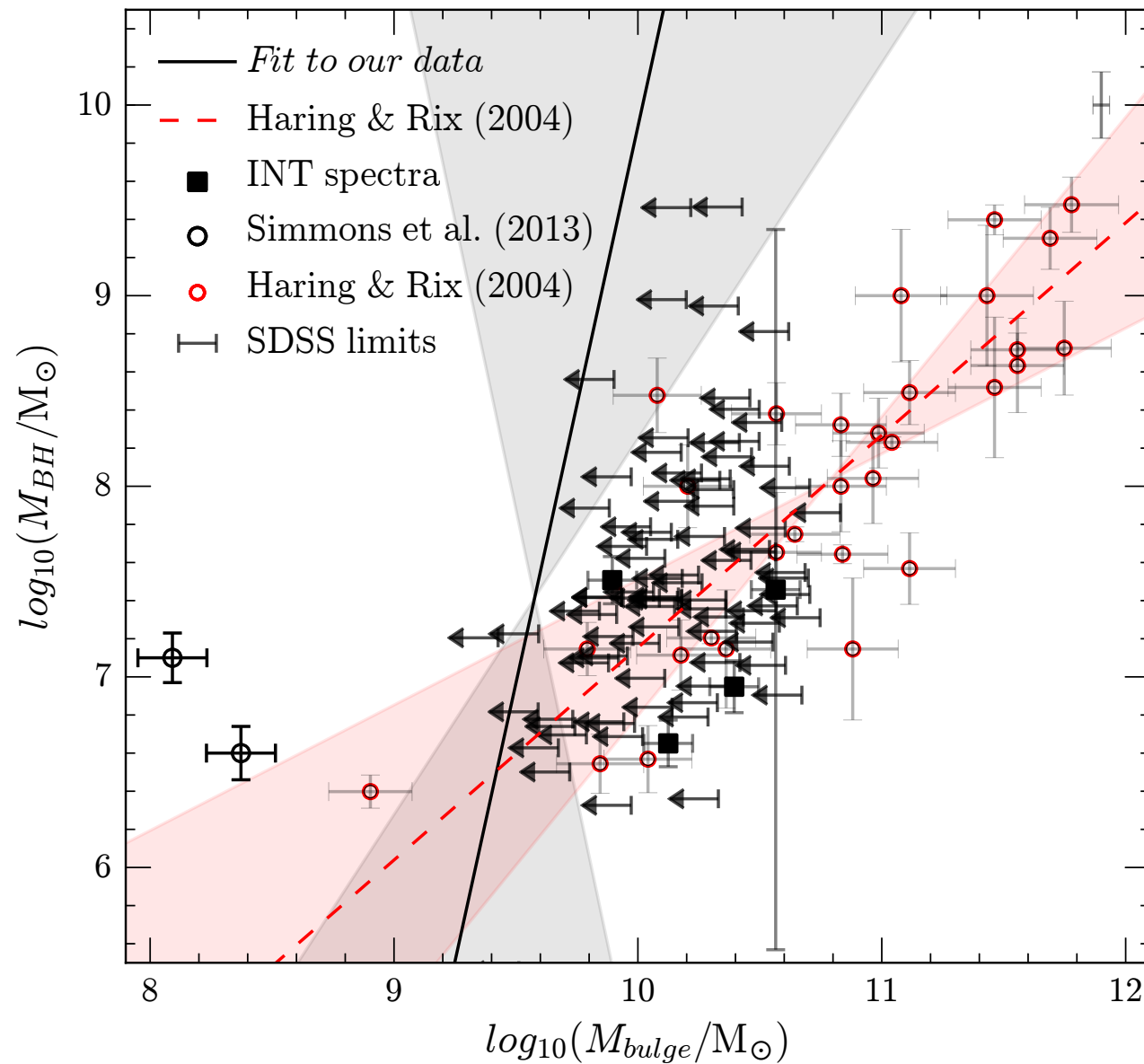
Merger-Free AGN & Host Galaxies



Merger-Free AGN & Host Galaxies

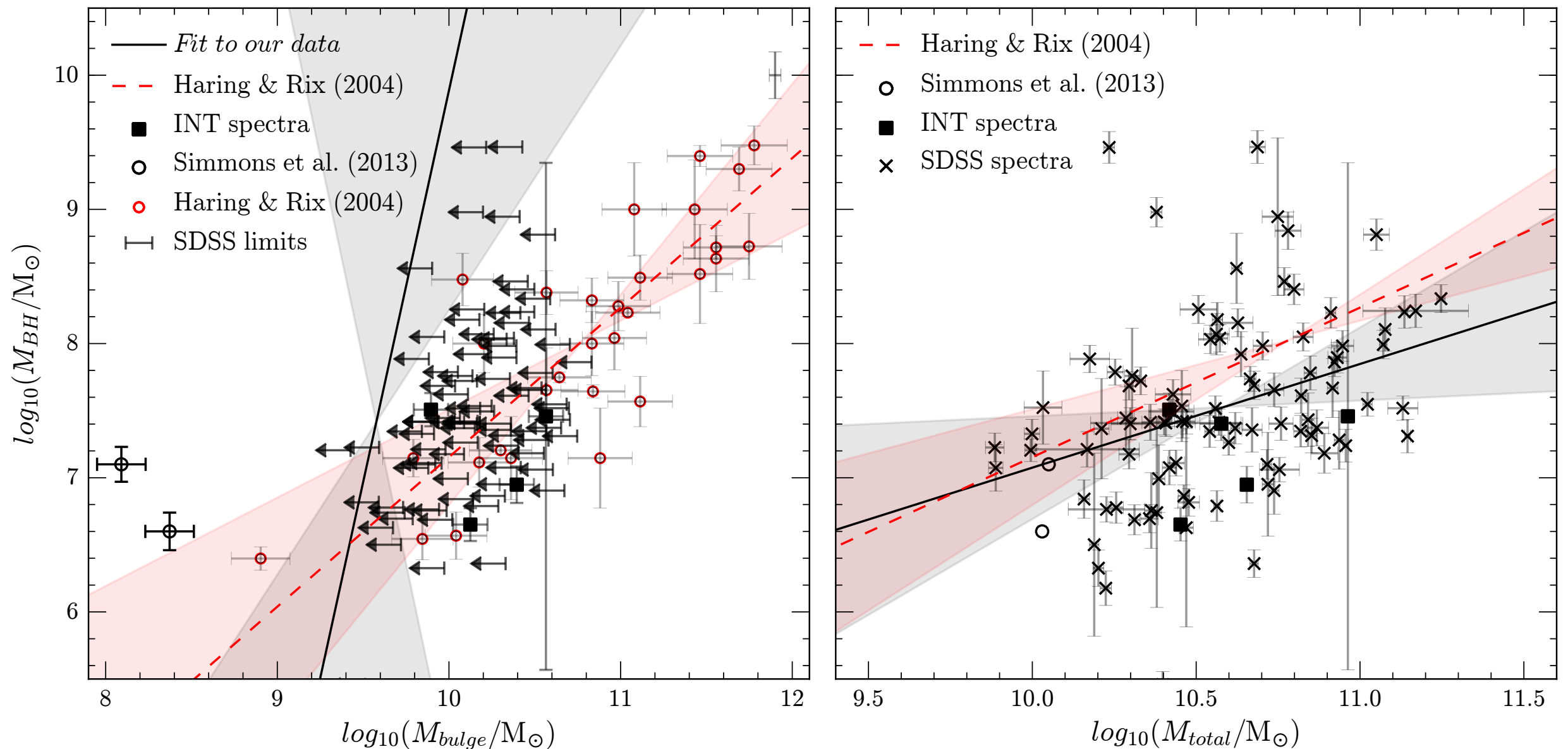


Merger-Free AGN & Host Galaxies



Merger-Free AGN & Host Galaxies

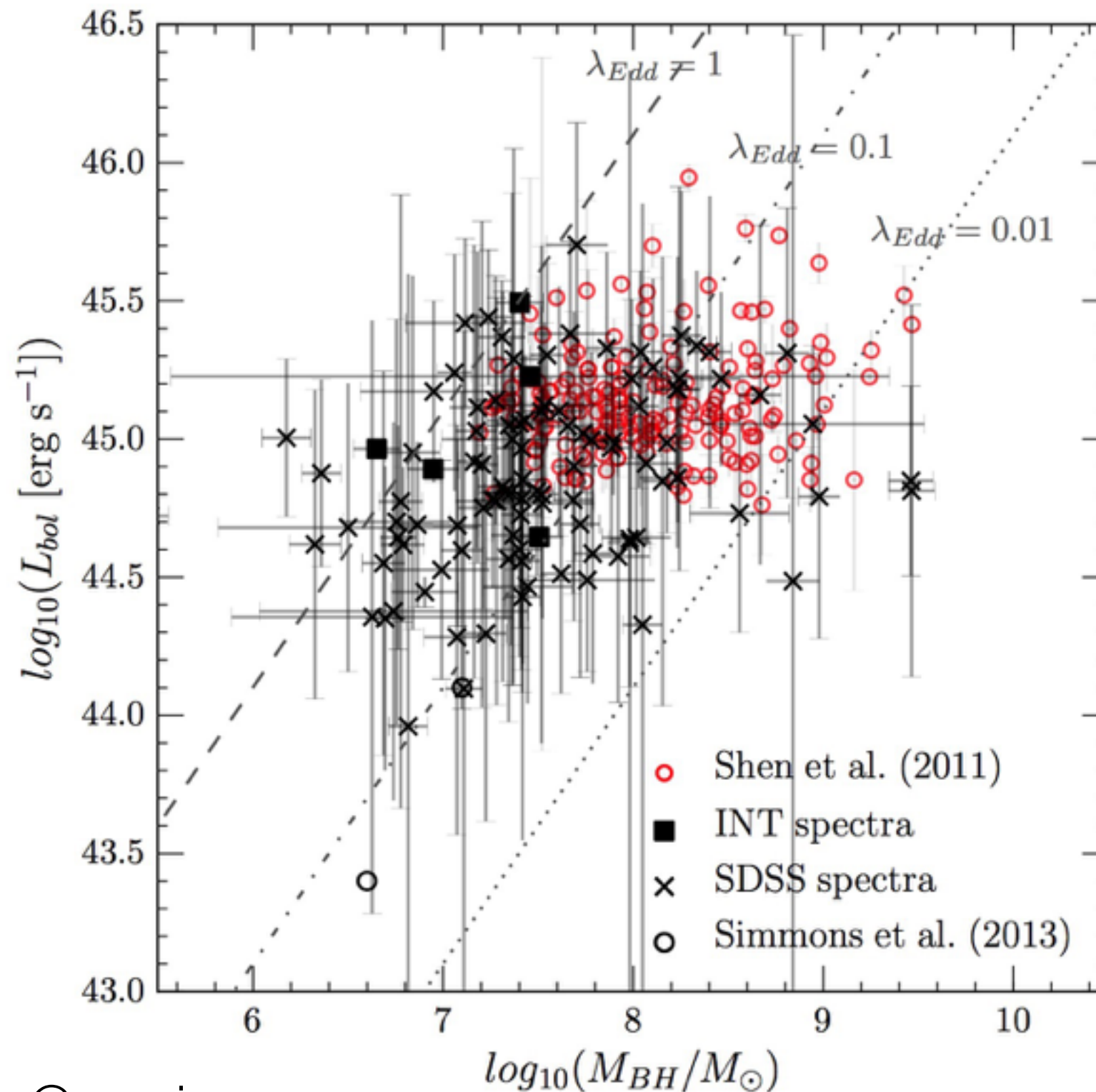
Secular processes can drive BH-galaxy co-evolution



Simmons, Smethurst & Lintott (in prep)

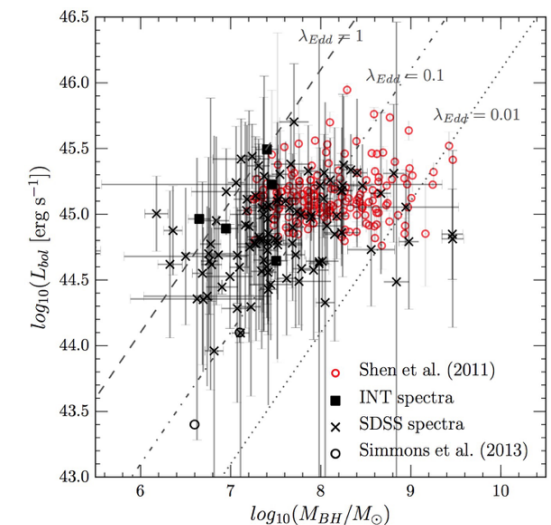
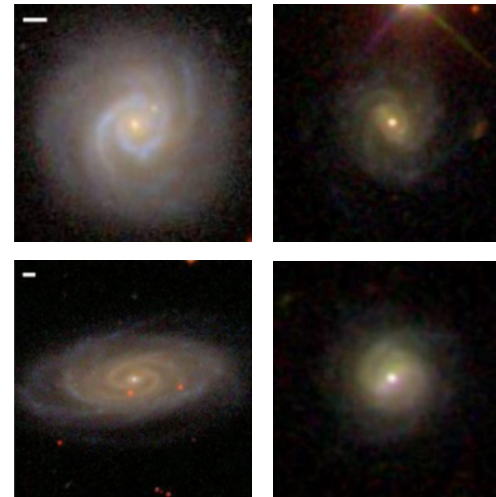
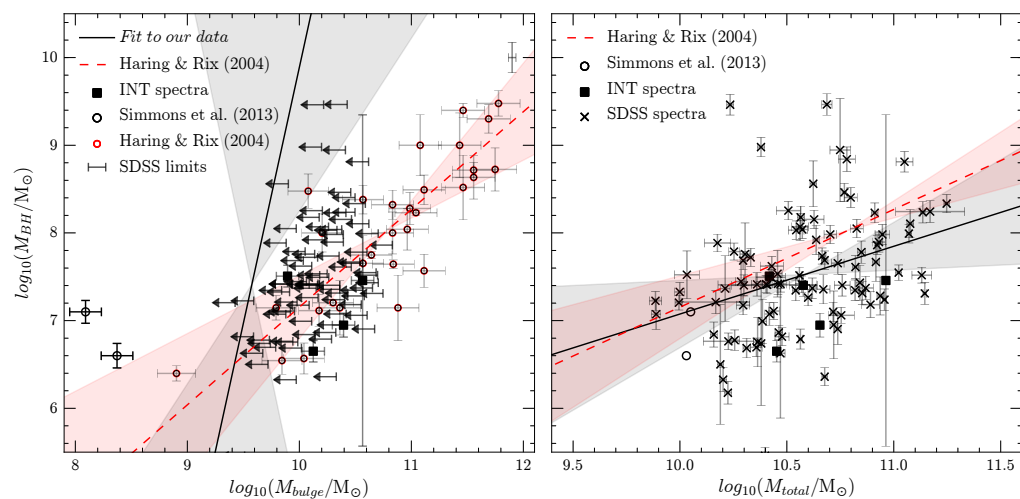
Merger-Free AGN & Host Galaxies

Substantial BH growth can occur in the absence of mergers

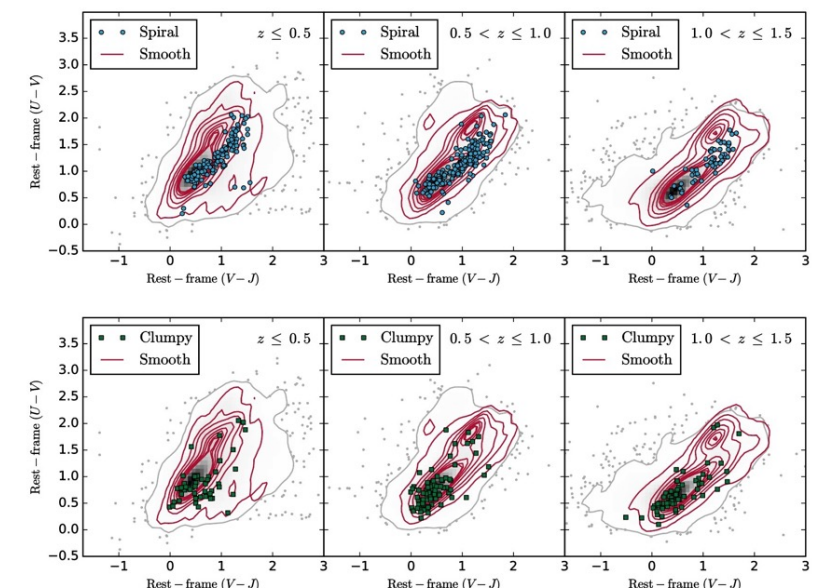
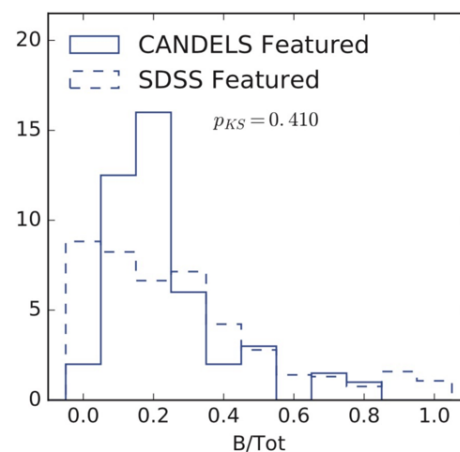
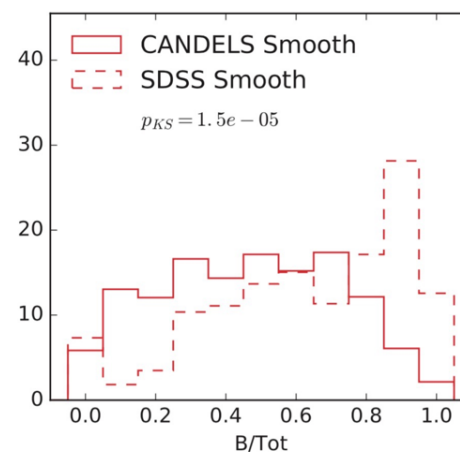
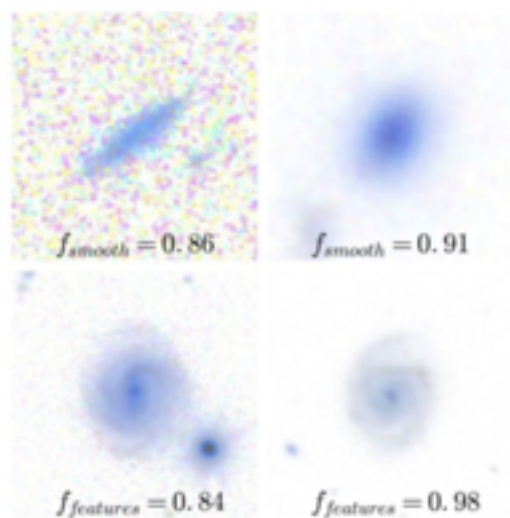


Summary

Substantial BH growth can occur in the absence of mergers;
merger-free BHs still appear to co-evolve with galaxies



Galaxy Zoo CANDELS classifications will soon be at
data.galaxyzoo.org: if you want them sooner, ask @vrooje!



B. Simmons - @vrooje