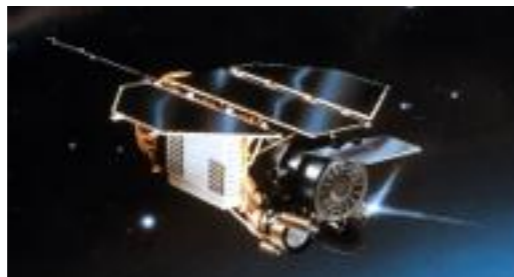


What drives the growth of supermassive black holes?

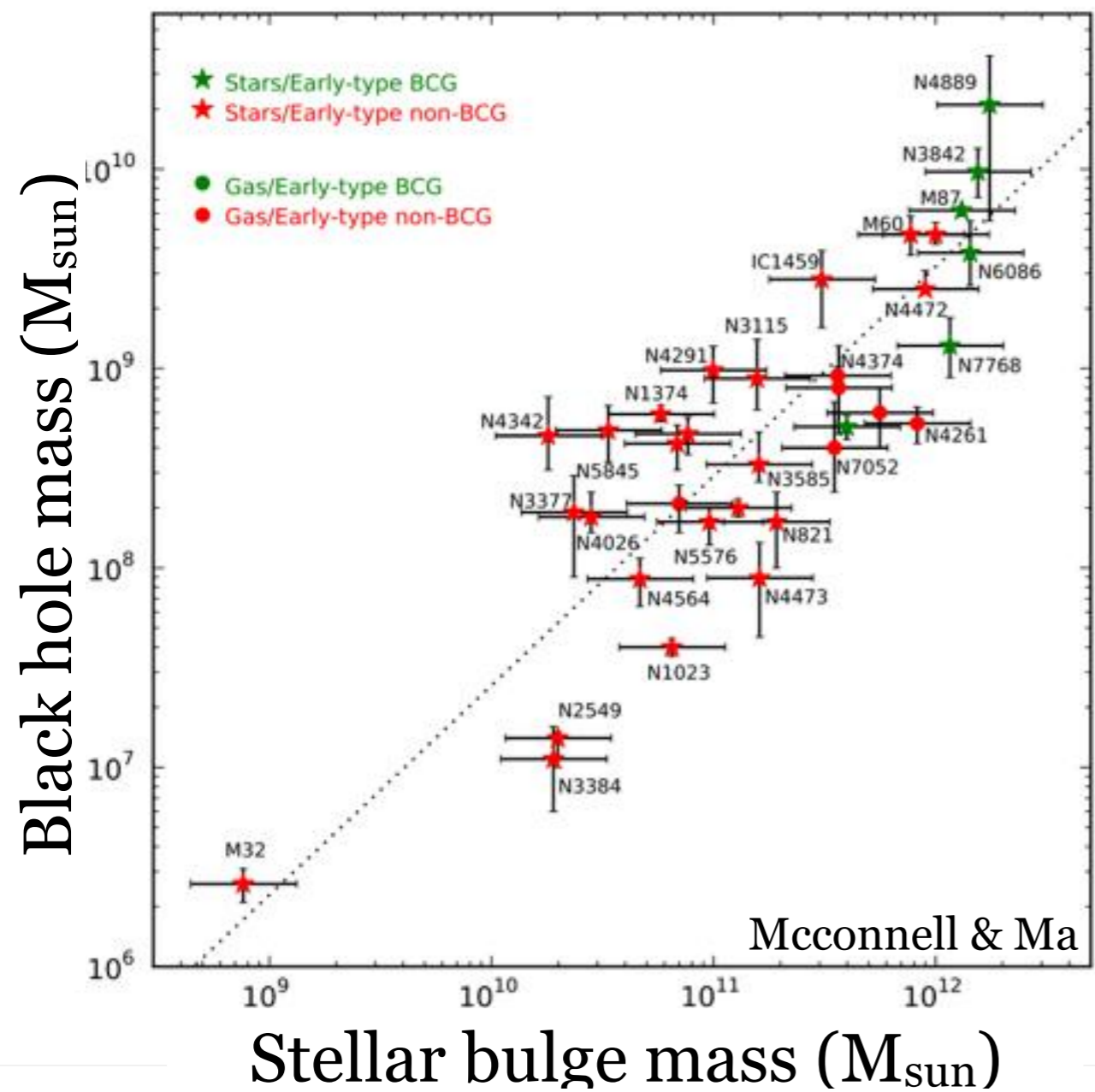
Akos Bogdan¹ & Andy Goulding^{1,2}

¹Harvard-Smithsonian Center for Astrophysics

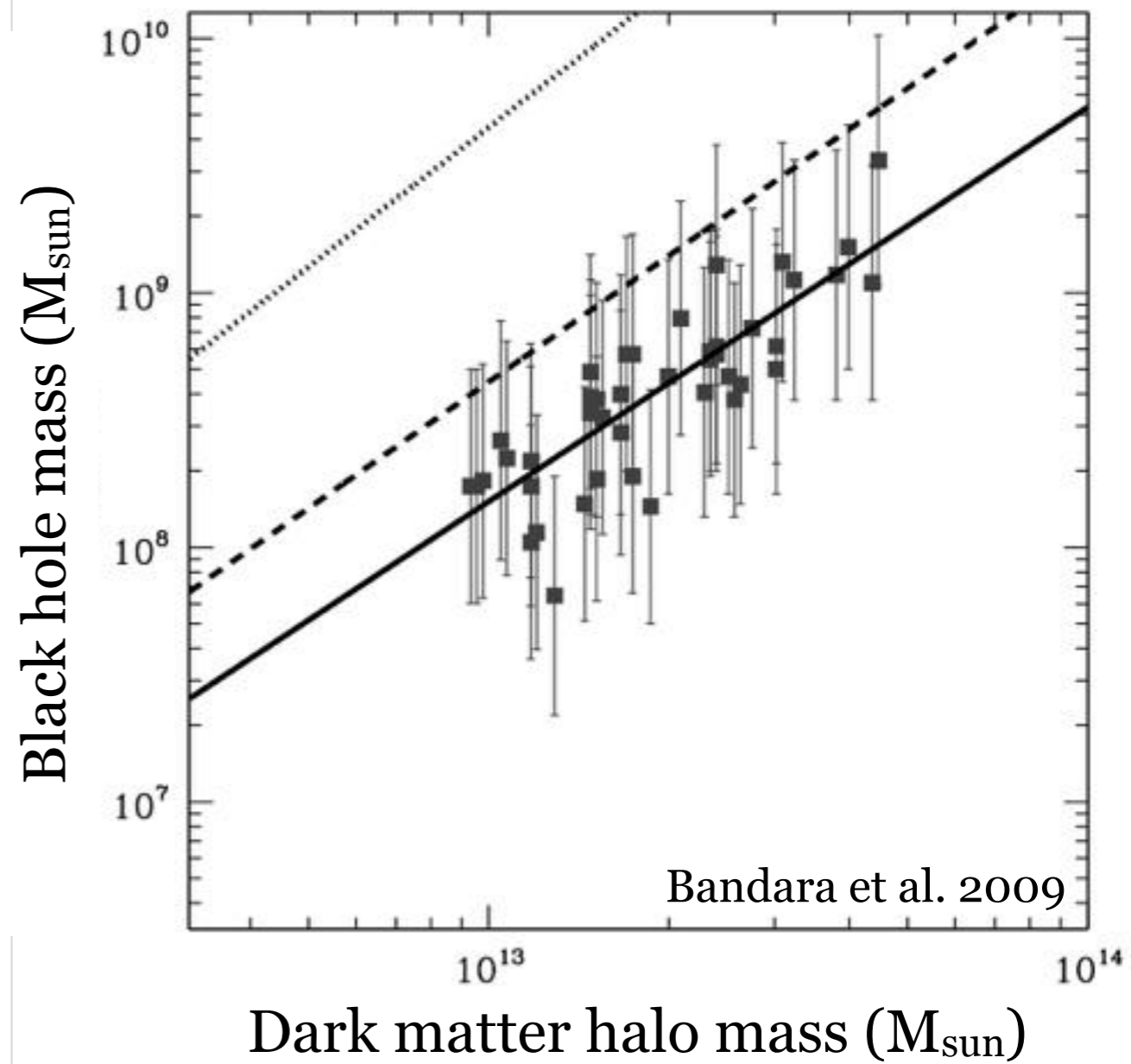
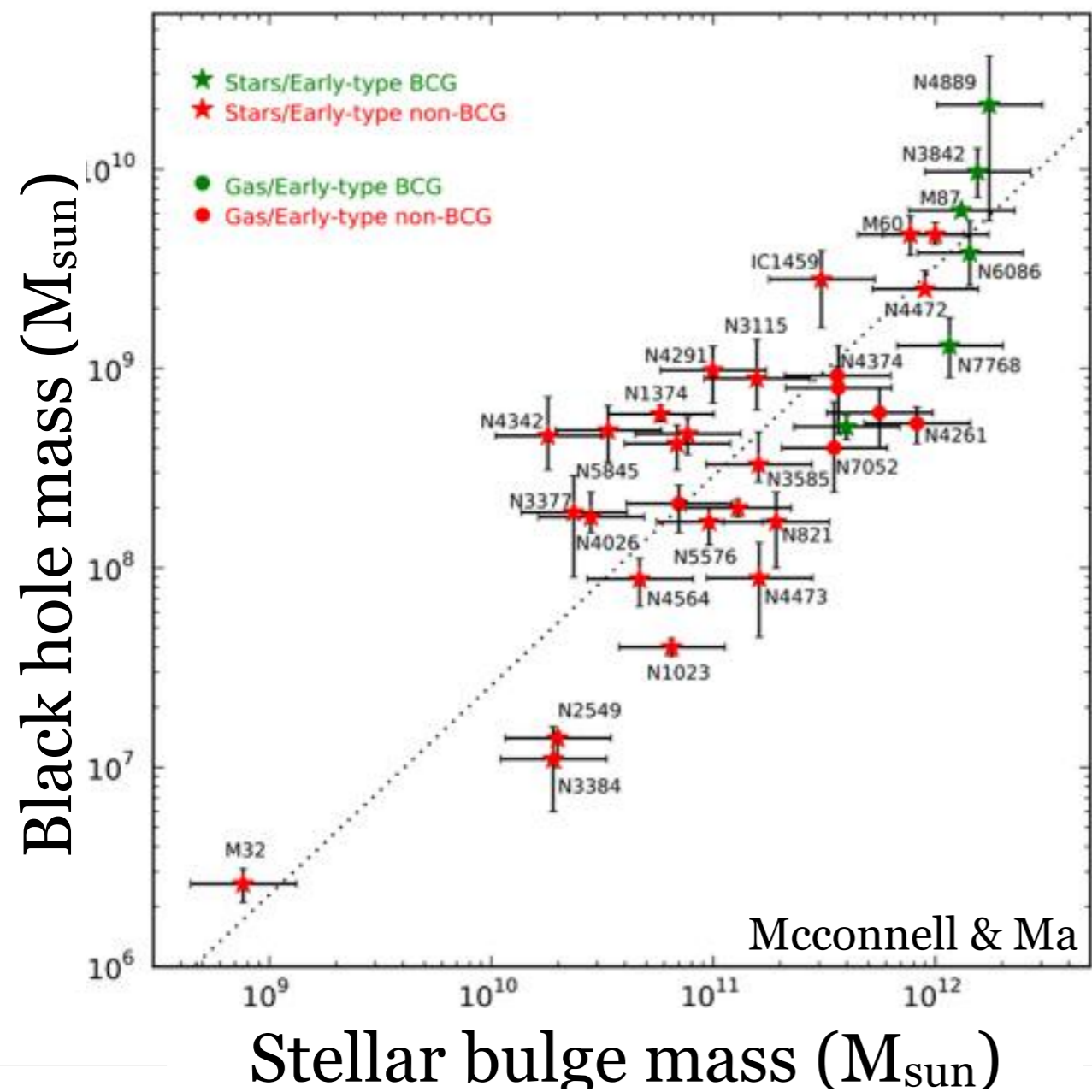
²Princeton University



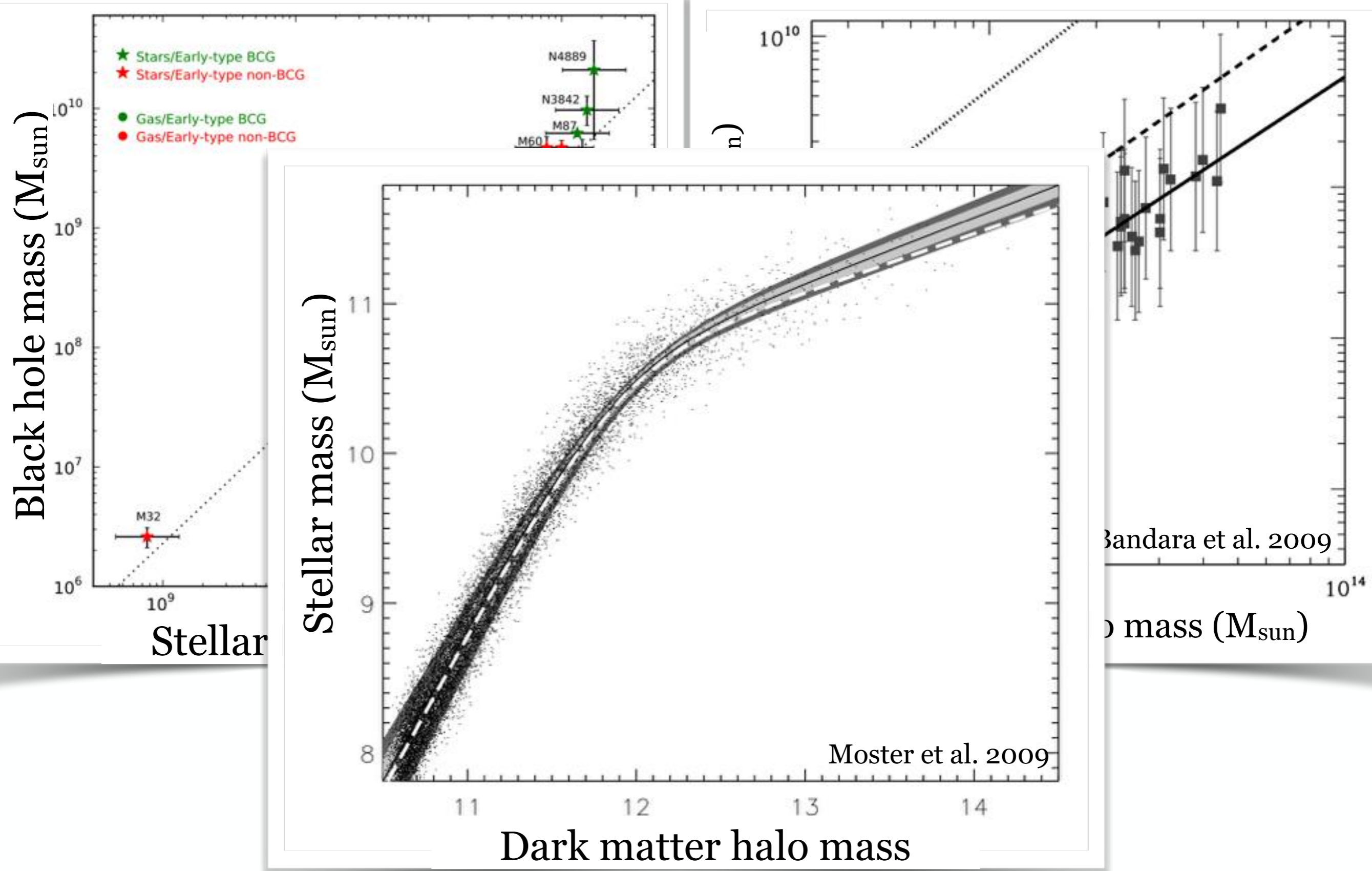
Correlations



Correlations



Correlations



Bandara et al. 2009

Moster et al. 2009

Which scaling relation is fundamental?

Dark matter halo vs stellar bulge



- ★ Difficulties with local galaxies:
 - » Measuring M_{BH} is difficult
 - » Measuring M_{halo} is difficult
 - » Degeneracy due to $M_{\text{stellar}} - M_{\text{halo}}$ relation



Very difficult to disentangle the importance of bulges and dark matter halo

Study a large galaxy sample

★ Tracers:

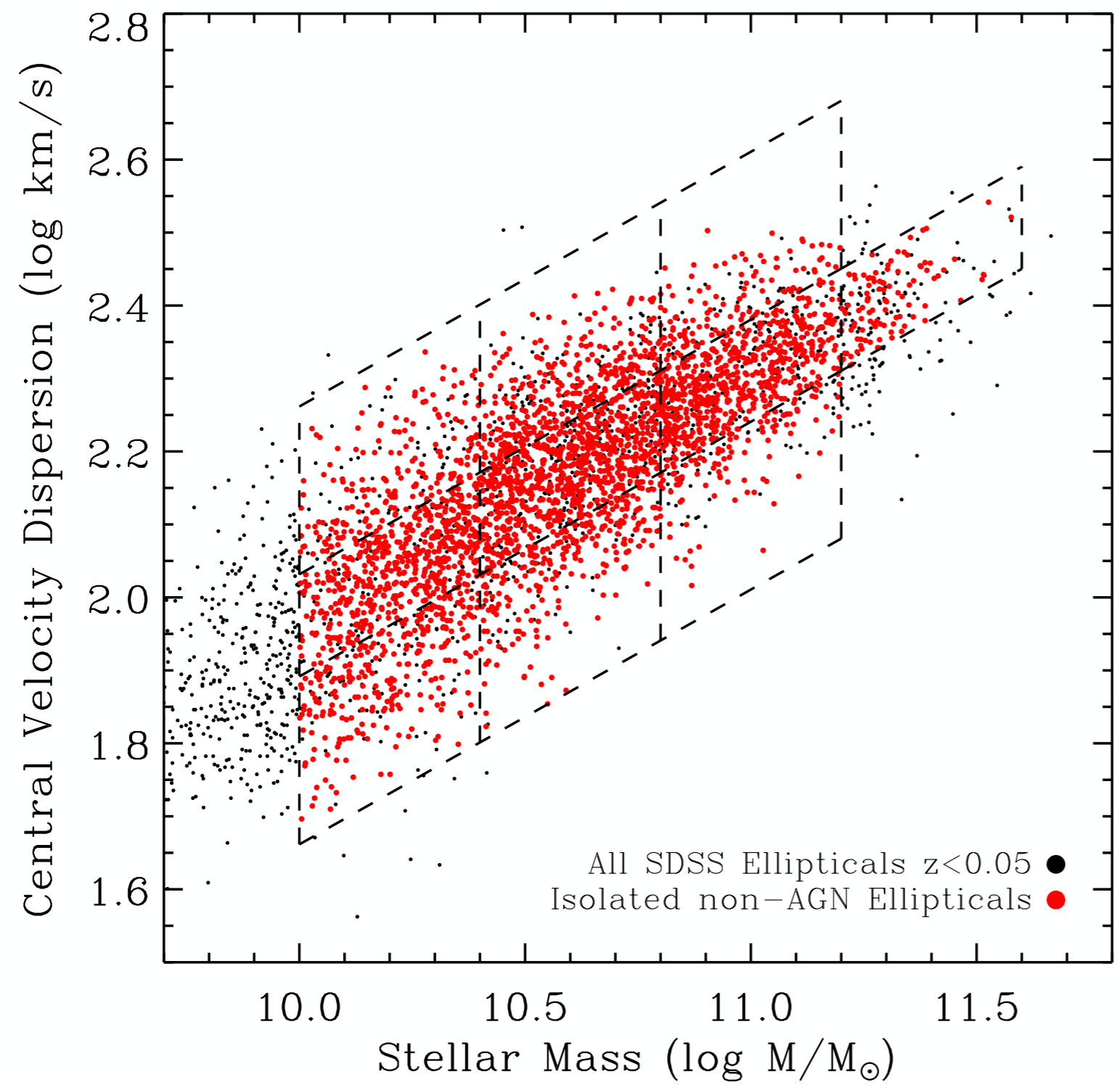
- » Velocity dispersion for M_{BH}
- » Gas X-ray luminosity for M_{halo}

★ Statistical sample:

- » Sloan Digital Sky Survey
- » Galaxy Zoo
- » ROSAT X-ray all sky survey

Velocity dispersion vs stellar mass

- ★ SDSS elliptical galaxies within $0.01 < z < 0.05$
- ★ **3130 clean elliptical galaxies selected**

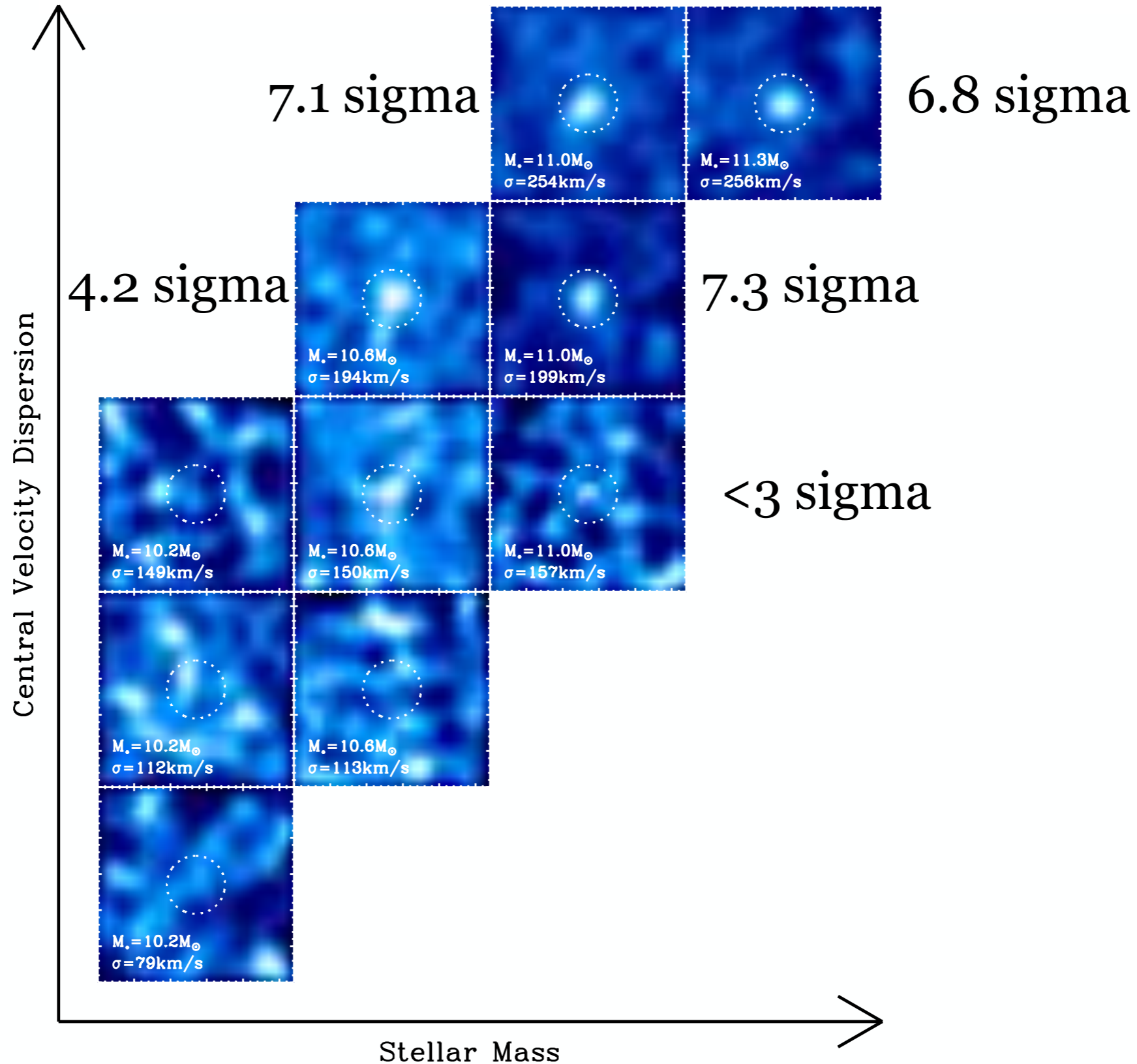


- ★ No AGN
- ★ No interaction
- ★ No rich clusters/groups
- ★ No foreground/background objects

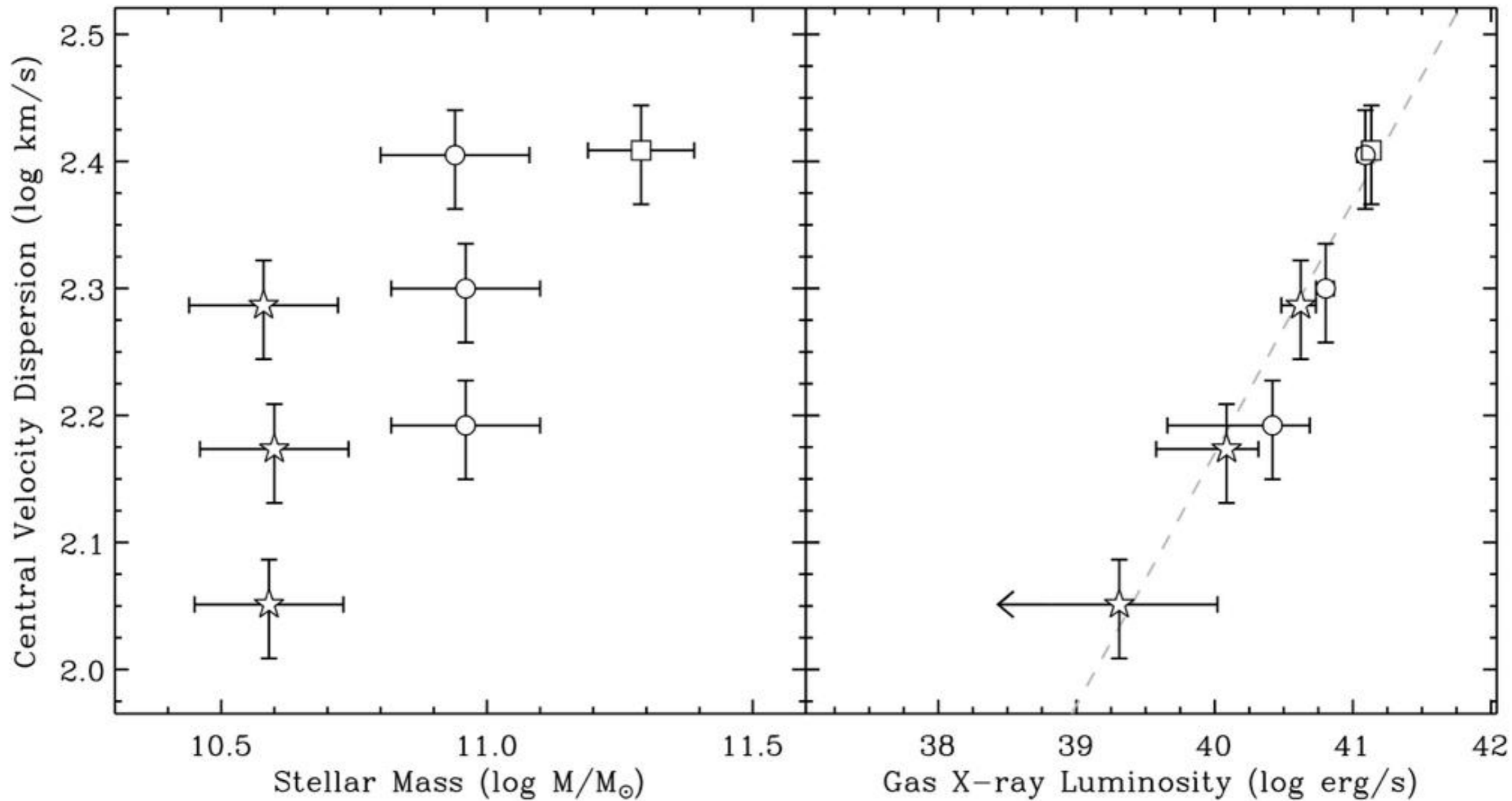
All SDSS Ellipticals $z < 0.05$ ●
Isolated non-AGN Ellipticals ●

Statistically significant detections with ROSAT

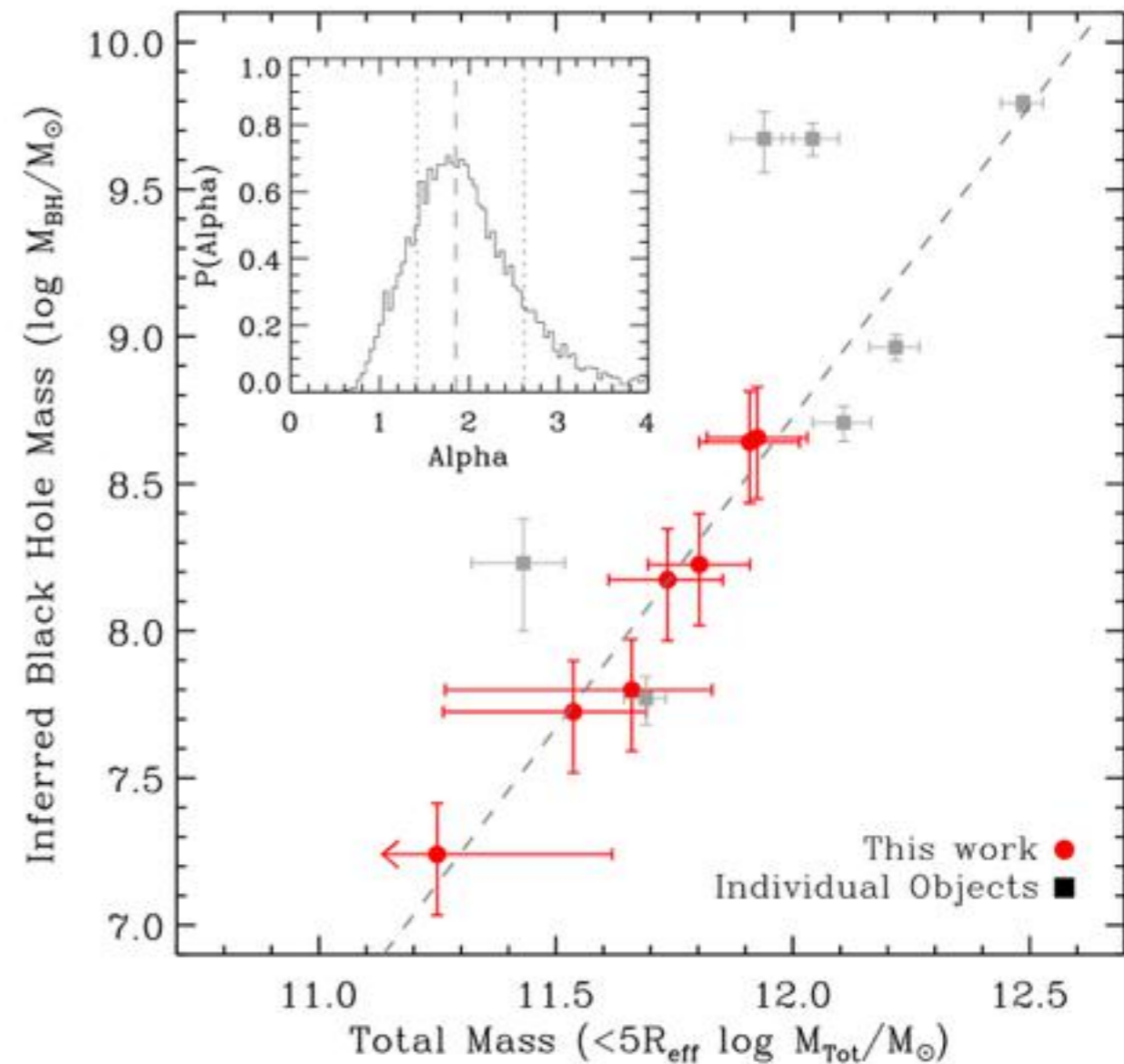
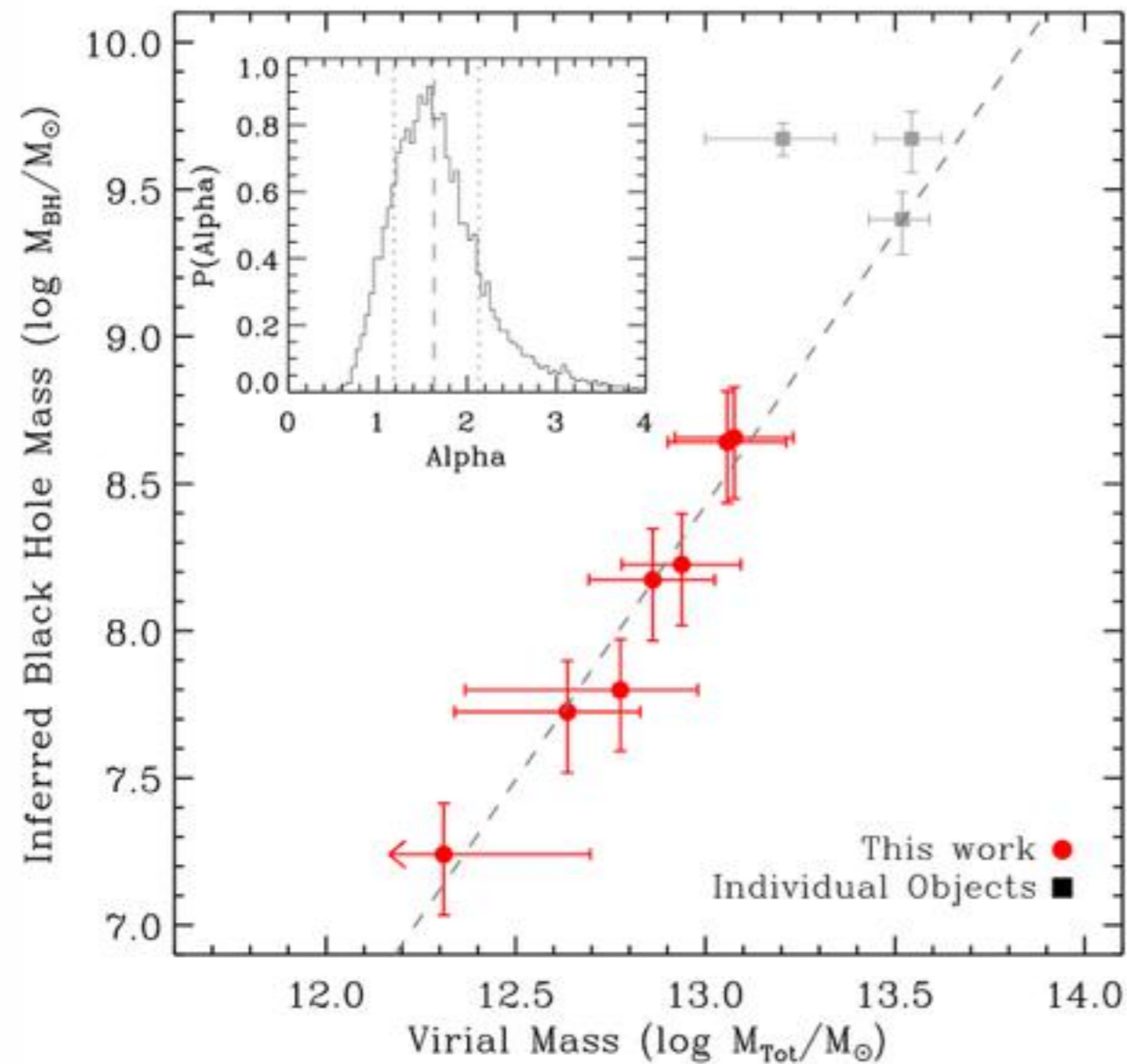
★ Caveat: No exposure correction!



Tight sigma-LX relation



Tight inferred BH—DM mass relation



In elliptical galaxies...

1. $\sigma_c - L_X$ tighter than $\sigma_c - M_{\text{bulge}}$
2. Central gravitational potential tightly connected to DM halos
3. BH mass may be (indirectly) set by DM halo mass

Thank You!