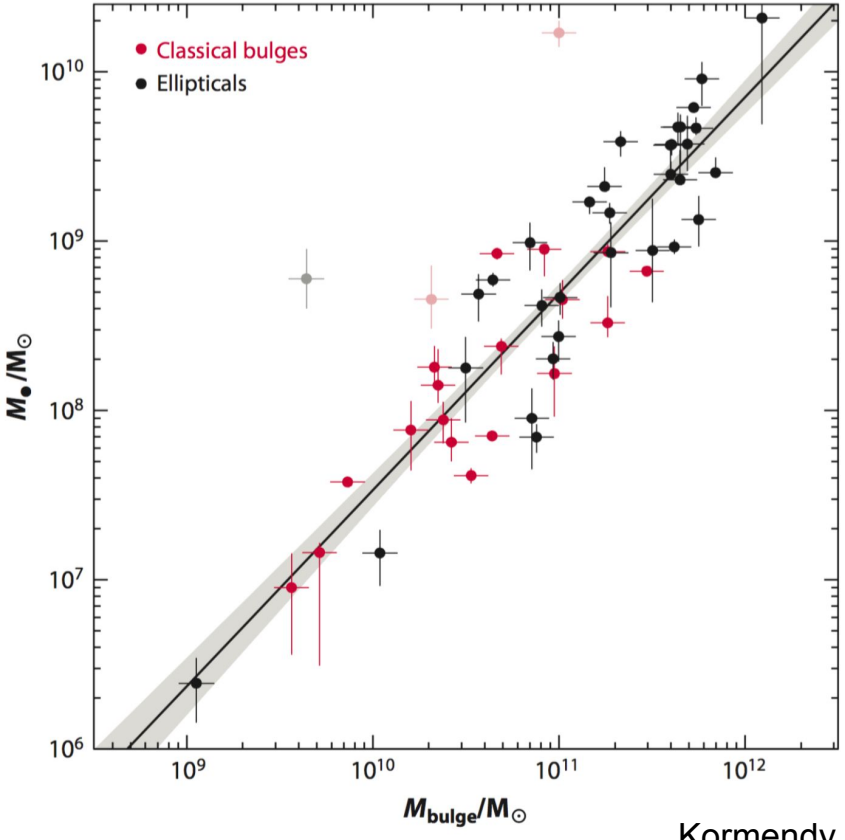
Problem: BHAR-$M_\star$ relation does not explain

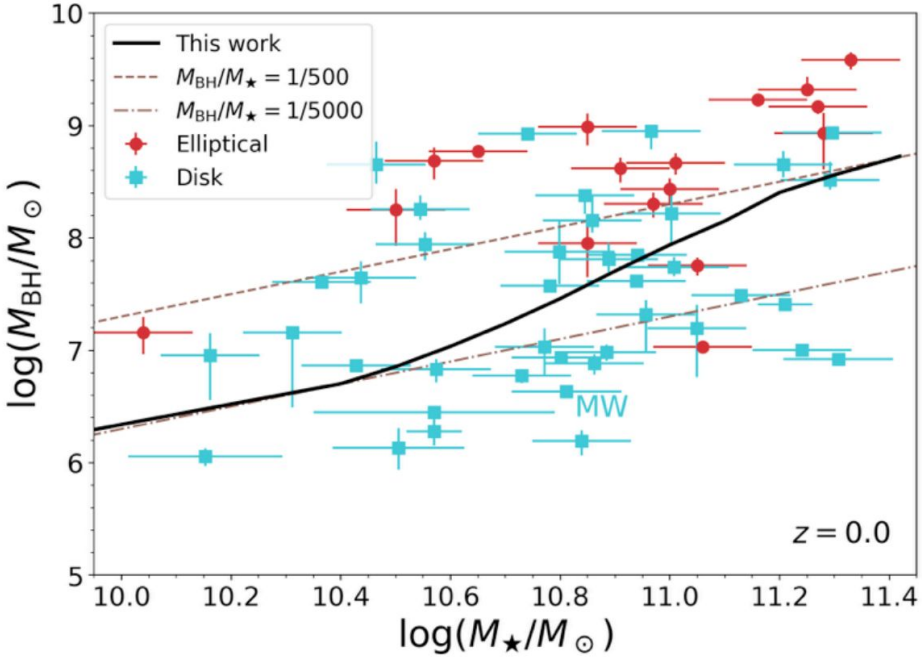
why M_{BH}-M_{bulge} relation is tight



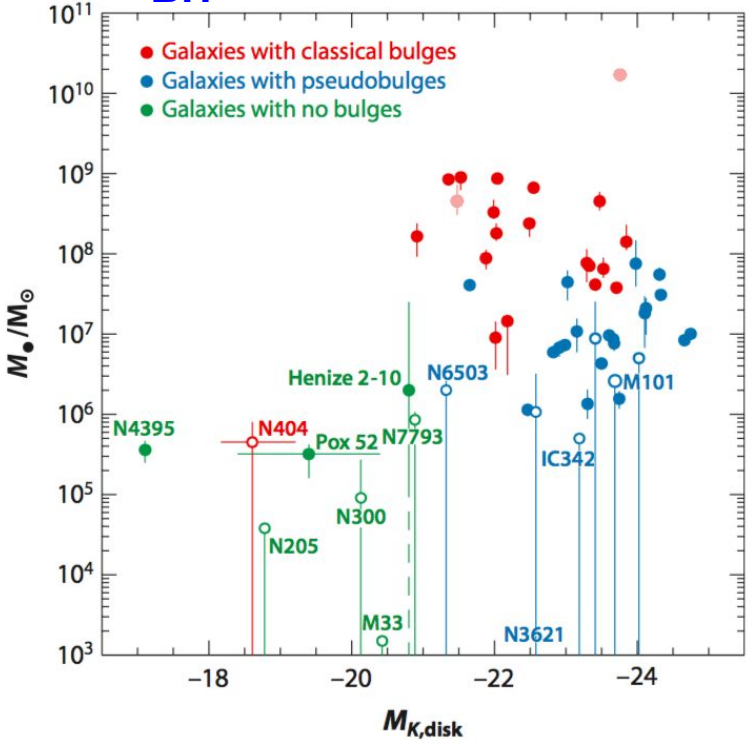
Kormendy & Ho (2013)

Morphology might be the key!

M_{BH} not related to $M_\star$

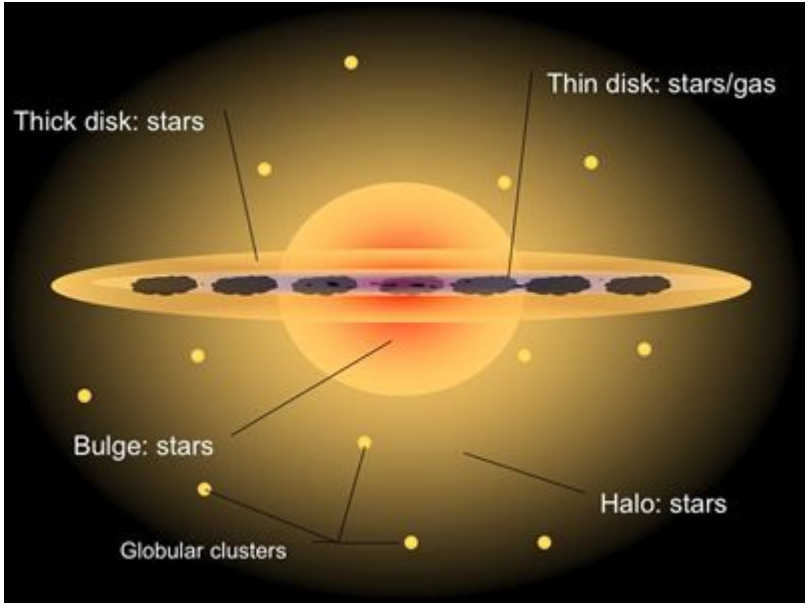


M_{BH} not related to disk



Kormendy & Ho (2013)

Galaxy morphology (shape)

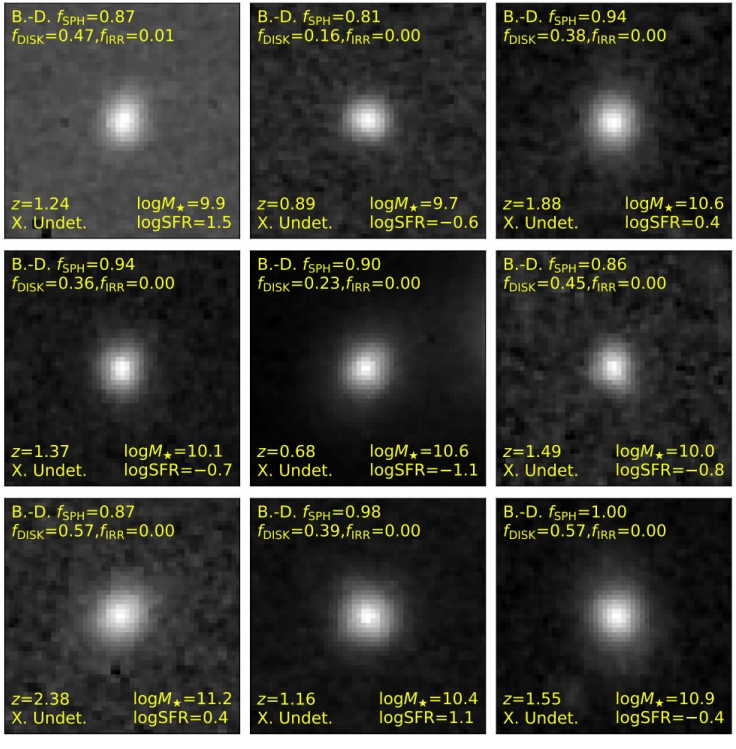


Does BH and bulge coevolve?

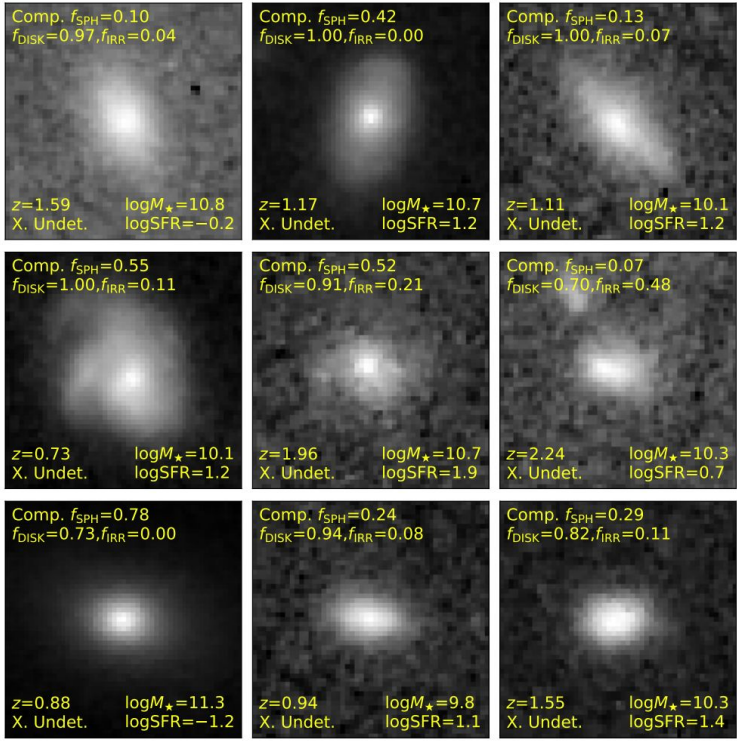
- Aim: study BHAR vs. **bulge SFR**
- Problem: **infeasible to separate bulge SFR from the total SFR**
- Solution: focus on **bulge-dominated** galaxies, where **bulge SFR ~ total SFR**

CANDELS: Deep HST Imaging

Bulge-dominated (~25%)



Comparison (~75%)

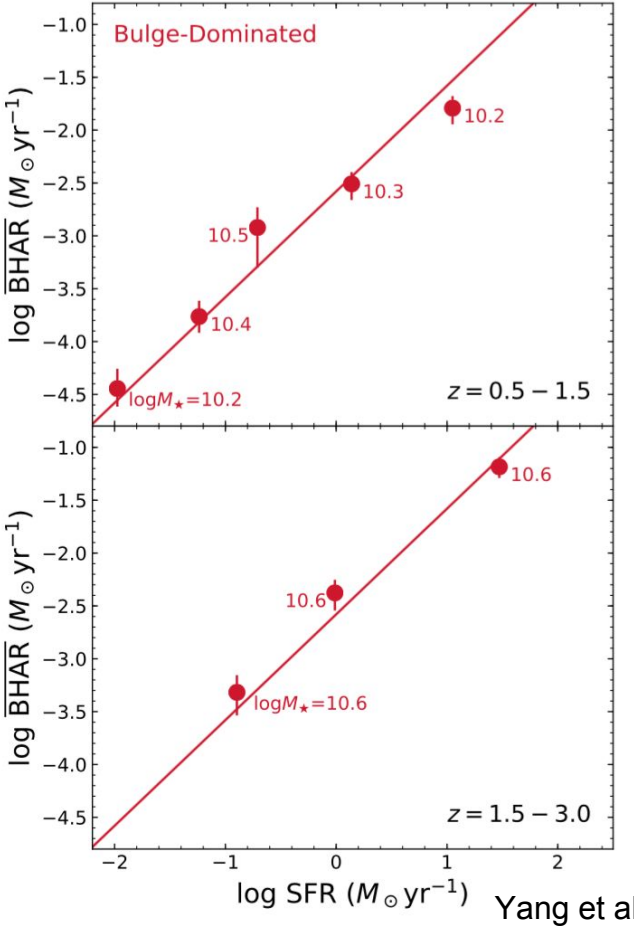


Machine-learning based classification (Huertas-Company 2015)

Yang et al. (submitted)

Bulge-dominated sample

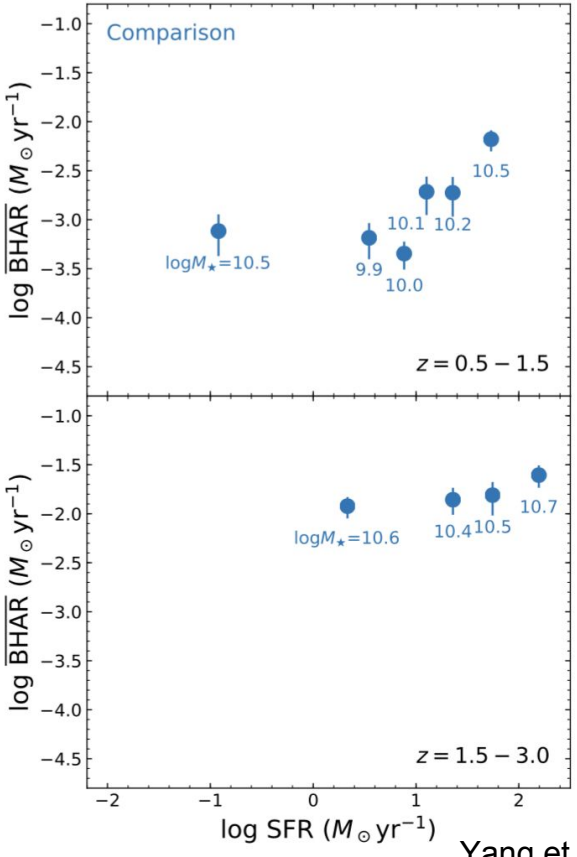
- BHAR-SFR: **significant** (10σ)
- BHAR-$M_\star$: **not significant** (2σ)
- Best-fit BHAR/SFR ~ $10^{-2.5}$, similar to local M_{BH}/M_{bulge} = $10^{-2.5}$–$10^{-2.3}$



Yang et al. (submitted)

Comparison sample (not bulge-dominated)

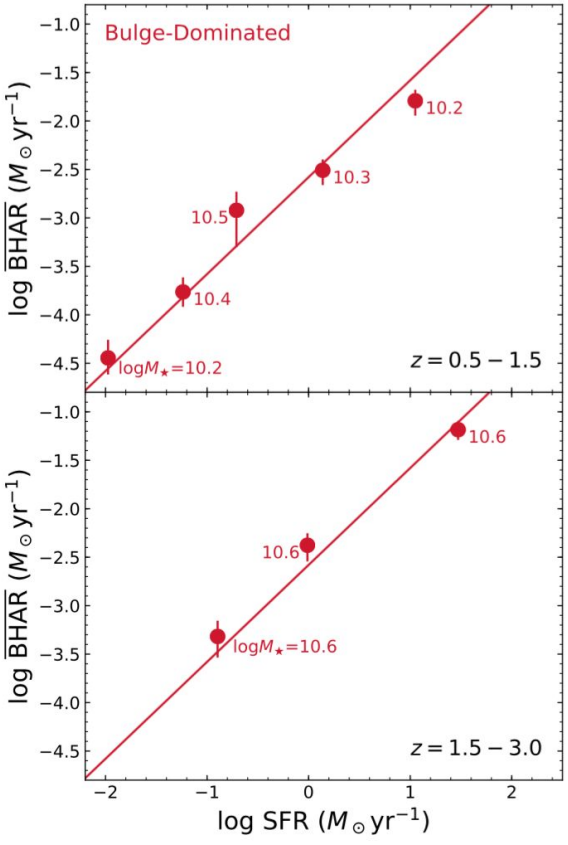
- BHAR: mainly related to $M_\star$ not SFR (Yang et al. 2017)
- **BHs co-evolve with bulges, not entire galaxies!**



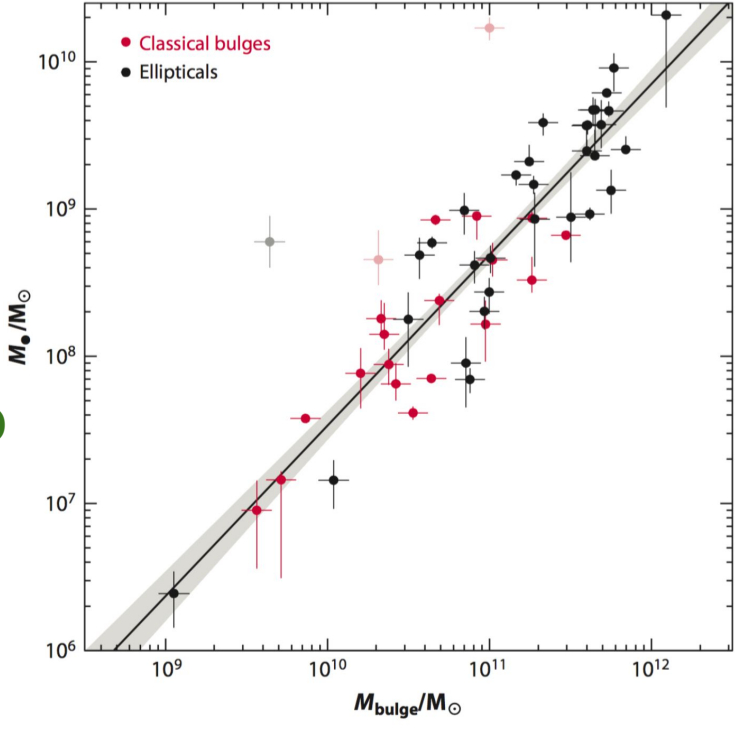
Yang et al. (submitted)

Summary

BH and bulge growth are in lockstep



LEADS TO



Kormendy & Ho (2013)

Yang et al. (submitted)