



# No Accounting for Taste: Black Holes Will Eat Anything

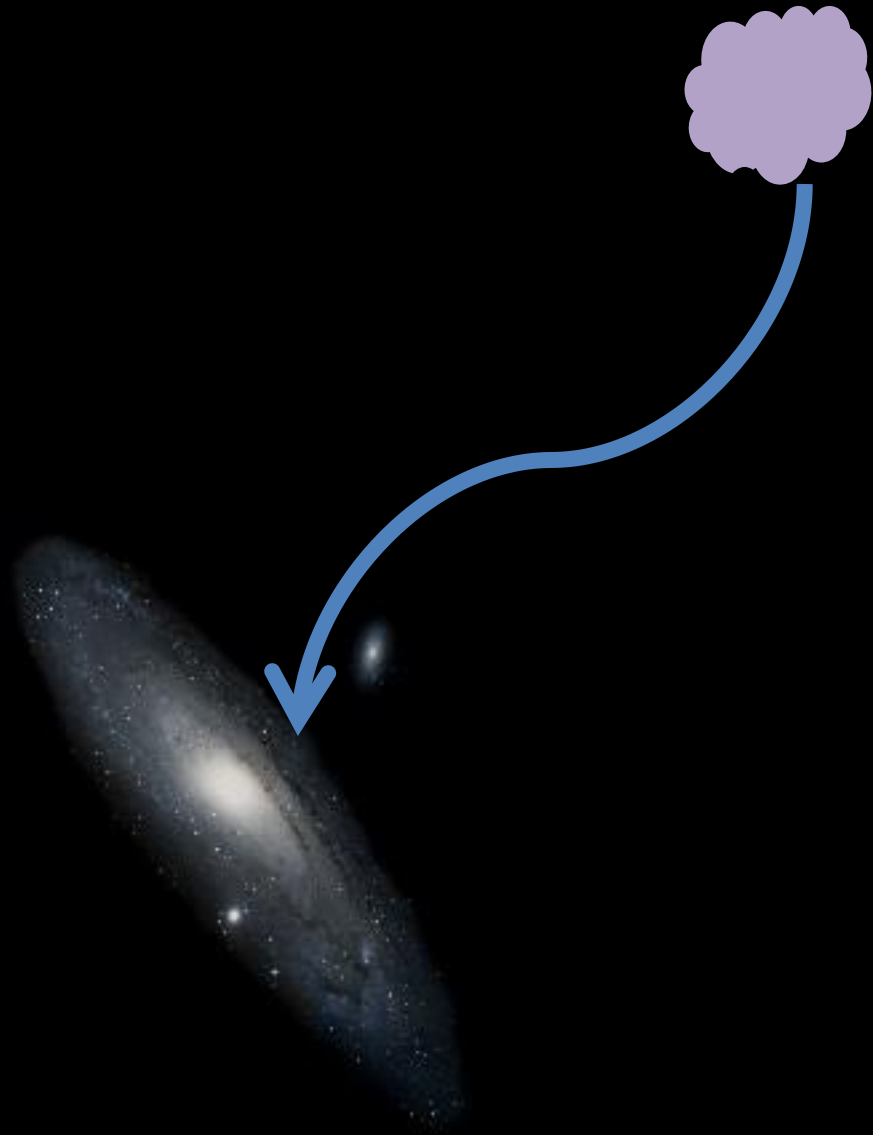
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# What do Black Holes Eat?

Gas!

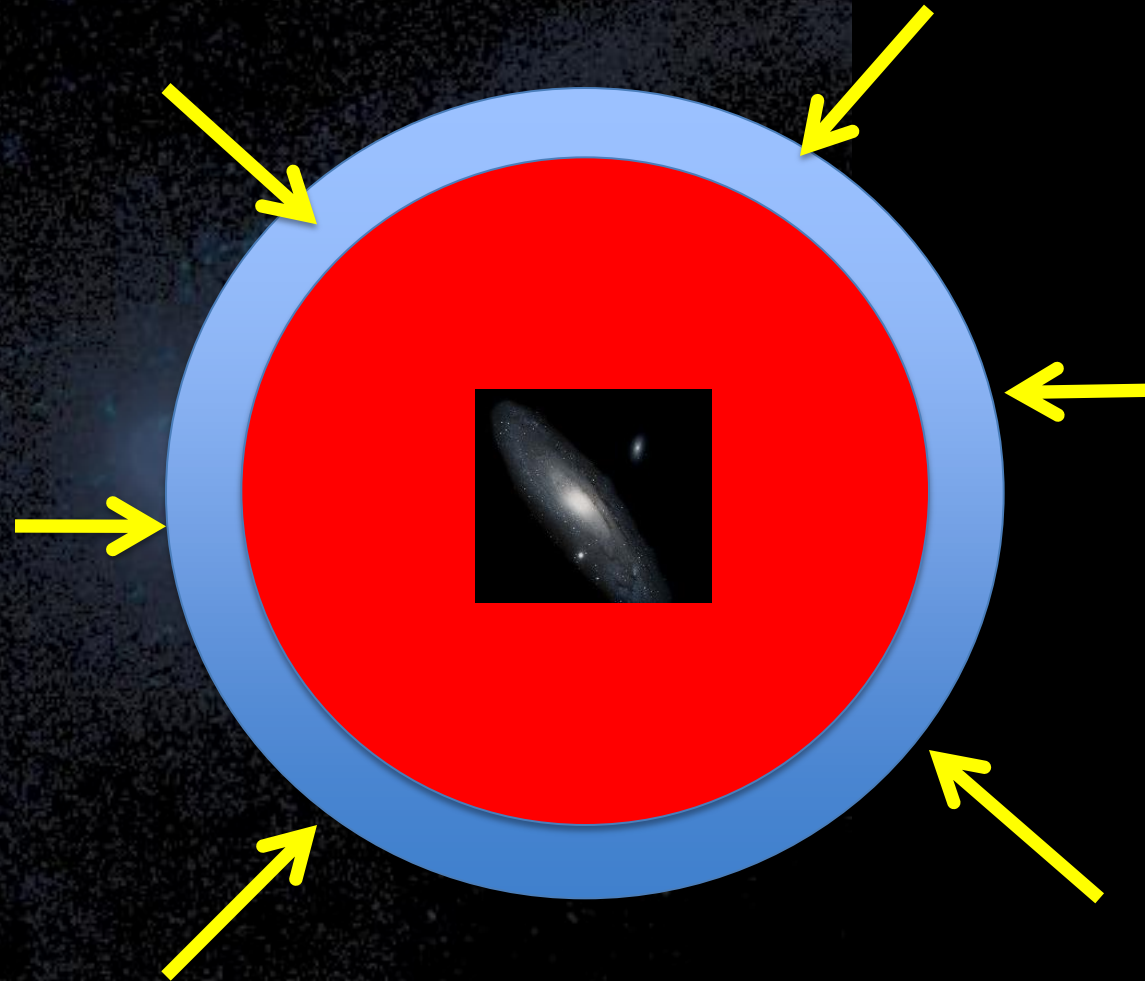
- Where does it come from?
- How does it get to the black hole?



Trace  
accreted gas  
**backwards** to  
determine its  
origins

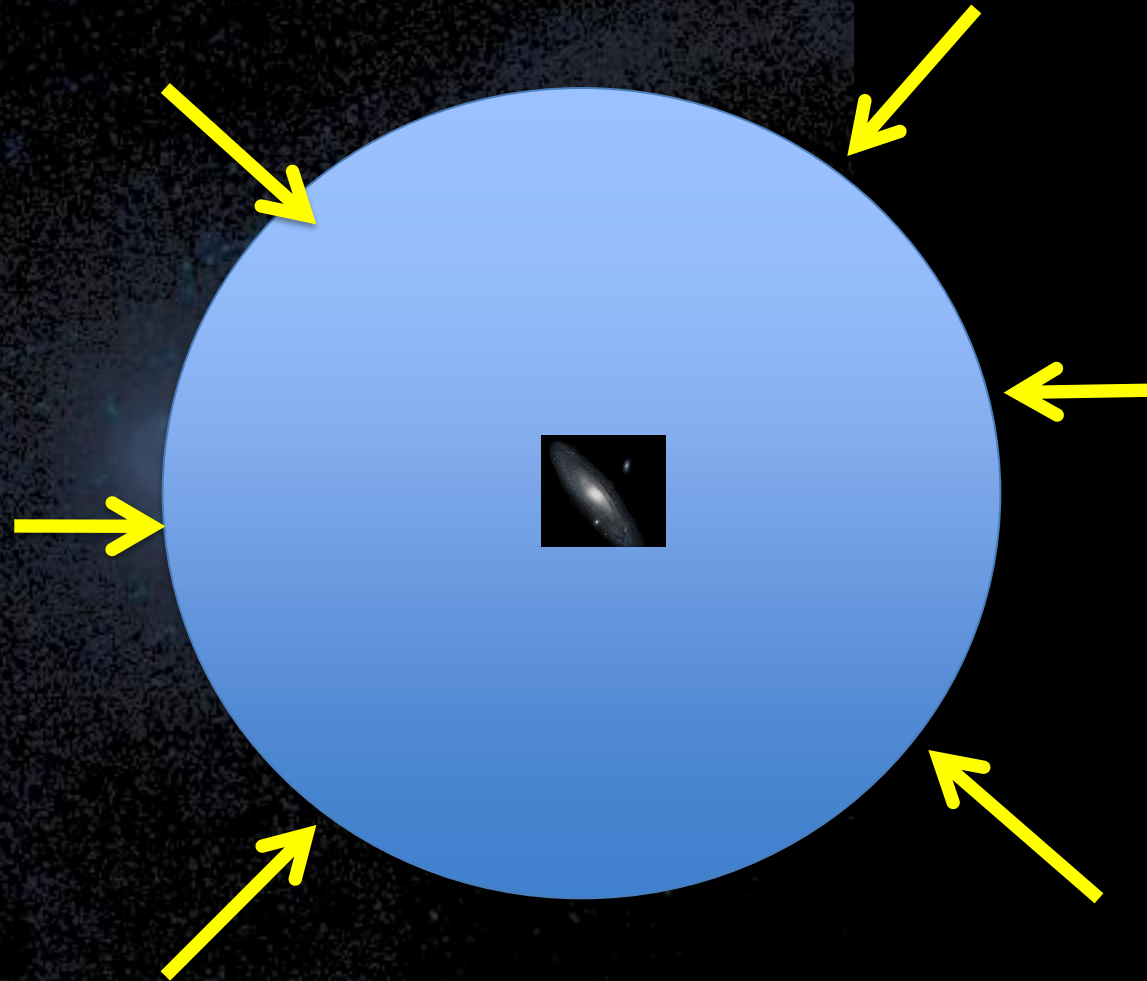
# How do galaxies get their gas?

Gas enters the virial radius, **shocks**, and falls in to the disk



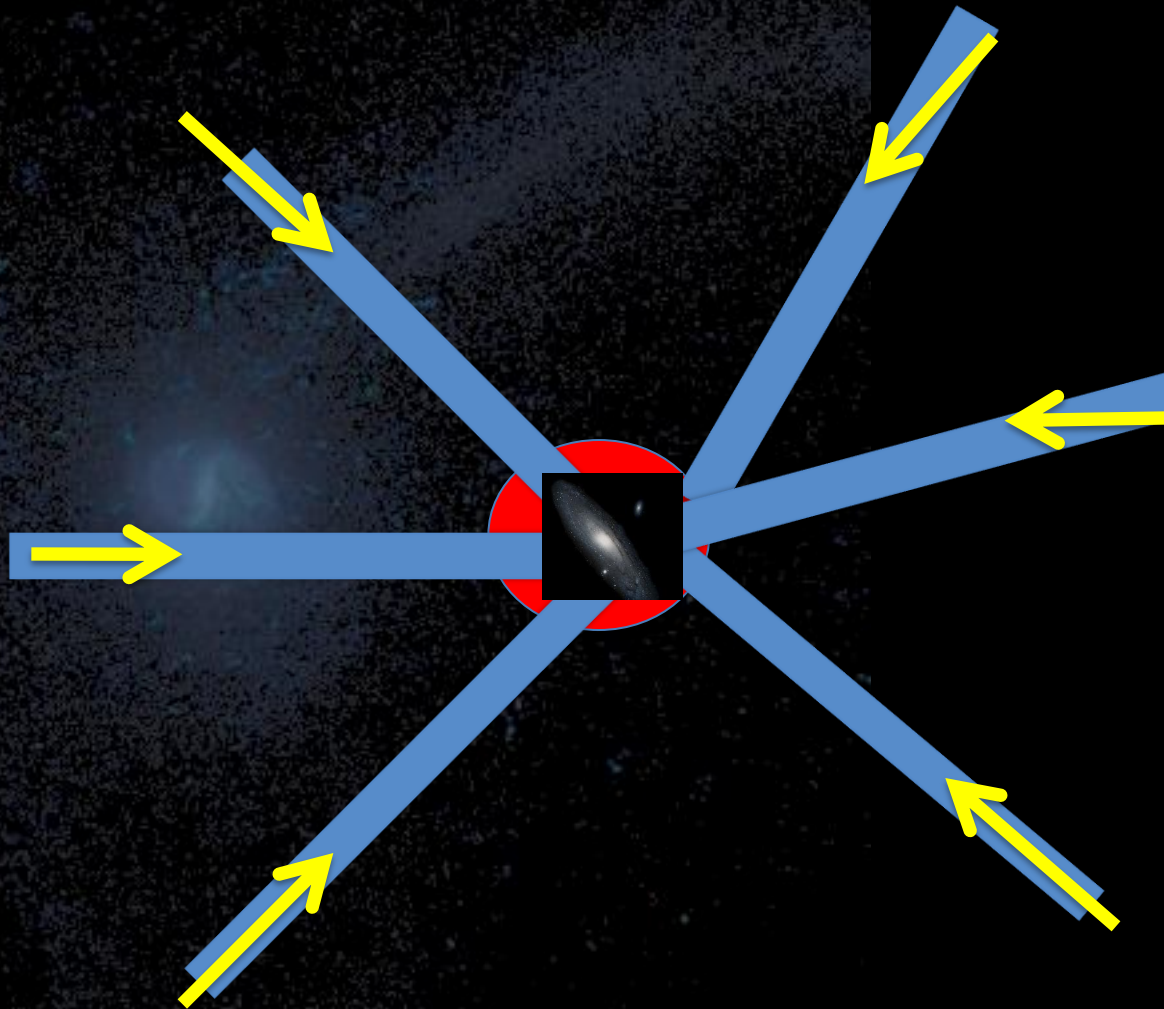
# How do galaxies get their gas?

Low-mass  
galaxies  
simply accrete  
cold gas



# How do galaxies get their gas?

Even when a **shock** develops, cold filaments can penetrate the shock



# How do galaxies get their gas?



Of course,  
mergers  
deliver gas as  
well (clumpy)



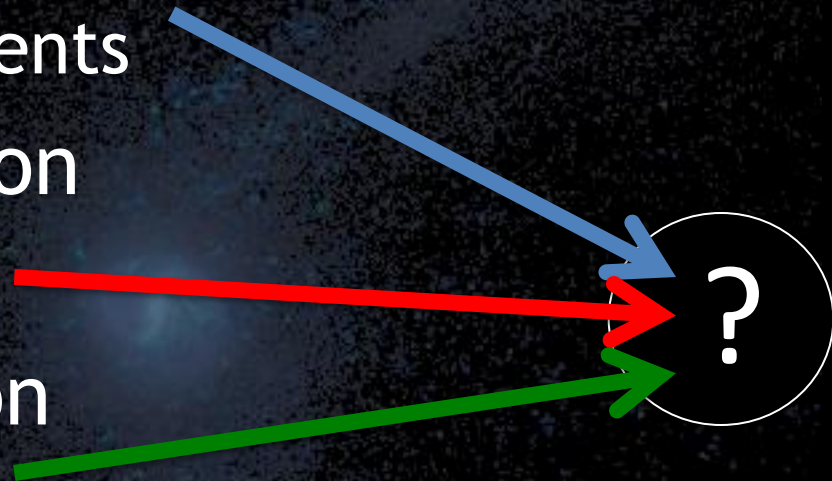
# How do galaxies get their gas?

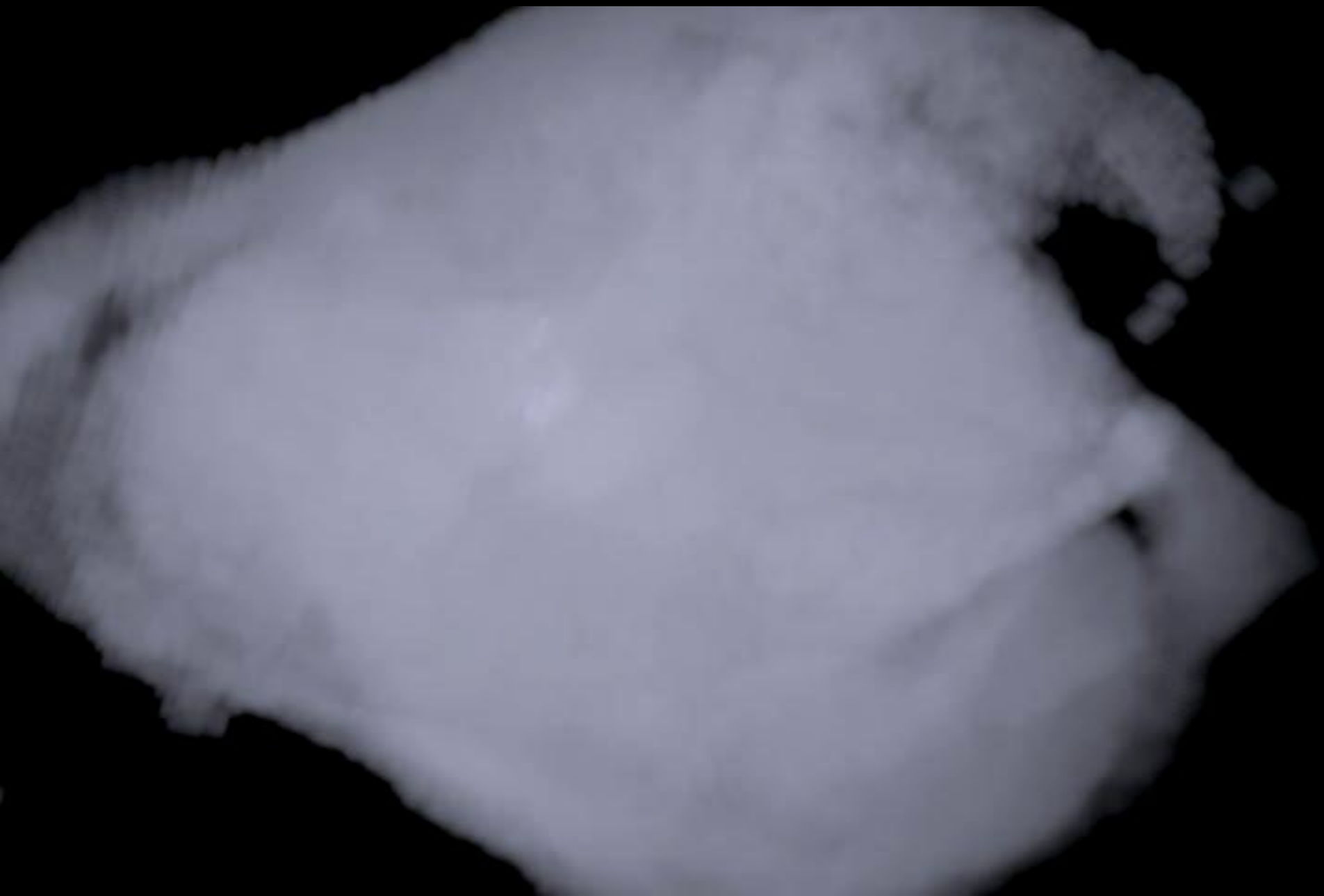
- Cold accretion
  - low mass, filaments
- Shocked accretion
  - high mass
- Clumpy accretion
  - mergers



# How do Black Holes get their gas?

- Cold accretion
  - low mass, filaments
- Shocked accretion
  - high mass
- Clumpy accretion
  - mergers





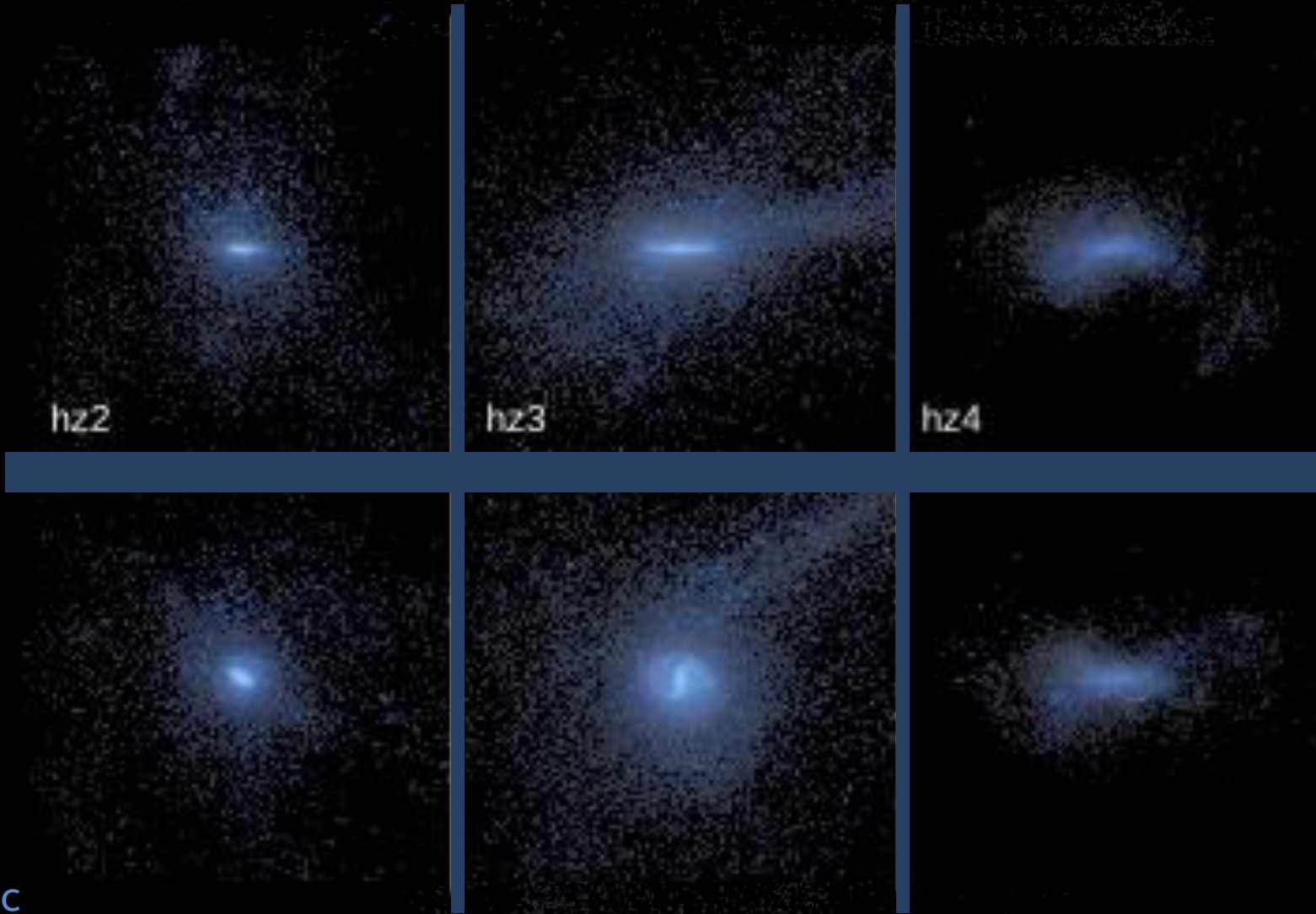
# $z = 4$ simulated galaxies

hz2

hz3

hz4

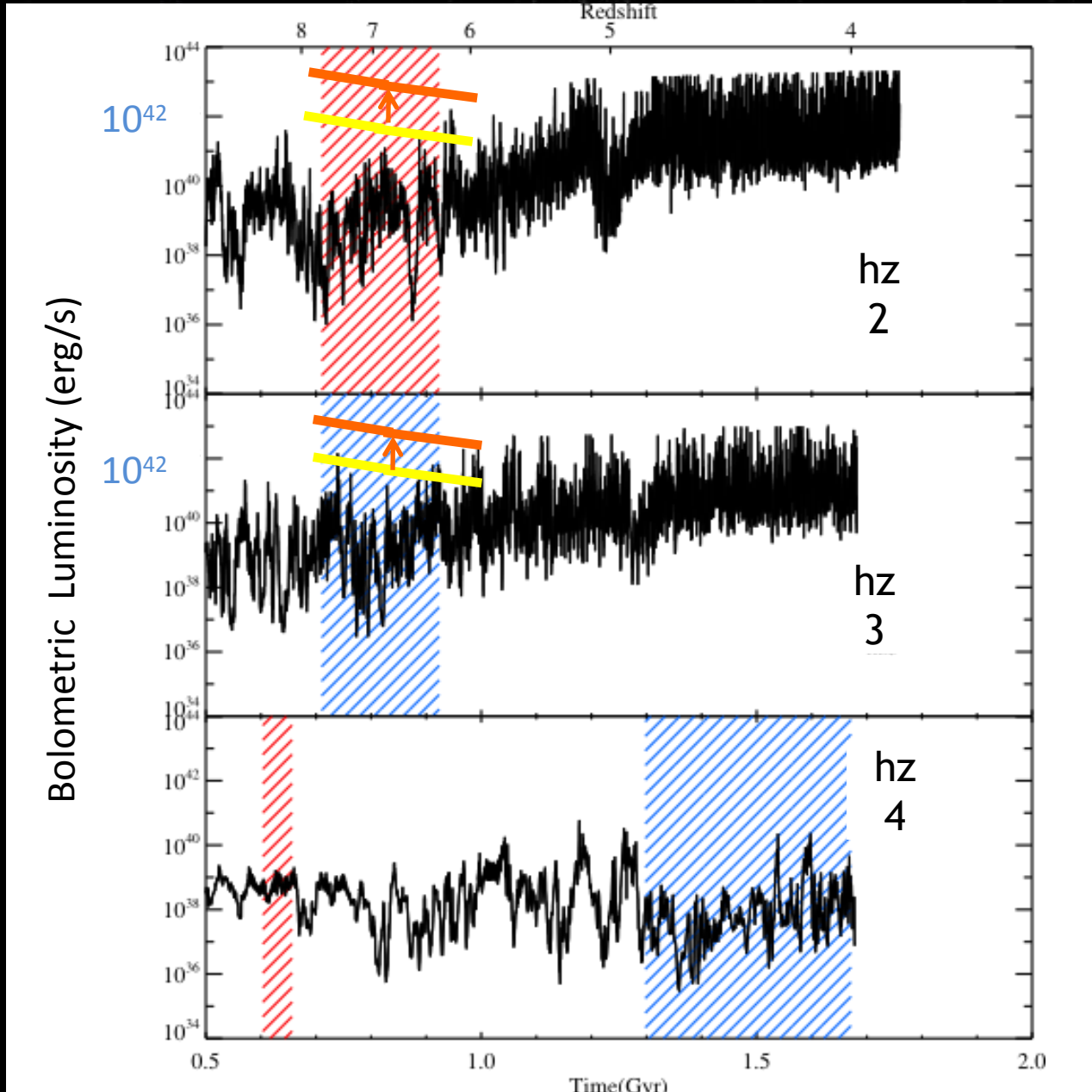
5 kpc



# $z = 4$ Galaxy Properties

	hz2	hz3	hz4
Stellar mass	$1.63 \times 10^{10}$	$2.06 \times 10^{10}$	$9.64 \times 10^8$
Gas mass	$2.36 \times 10^{10}$	$3.62 \times 10^{10}$	$7.53 \times 10^9$
Rest frame B magnitude	-23.6	-24.0	-20.9

# Are they visible as AGN?



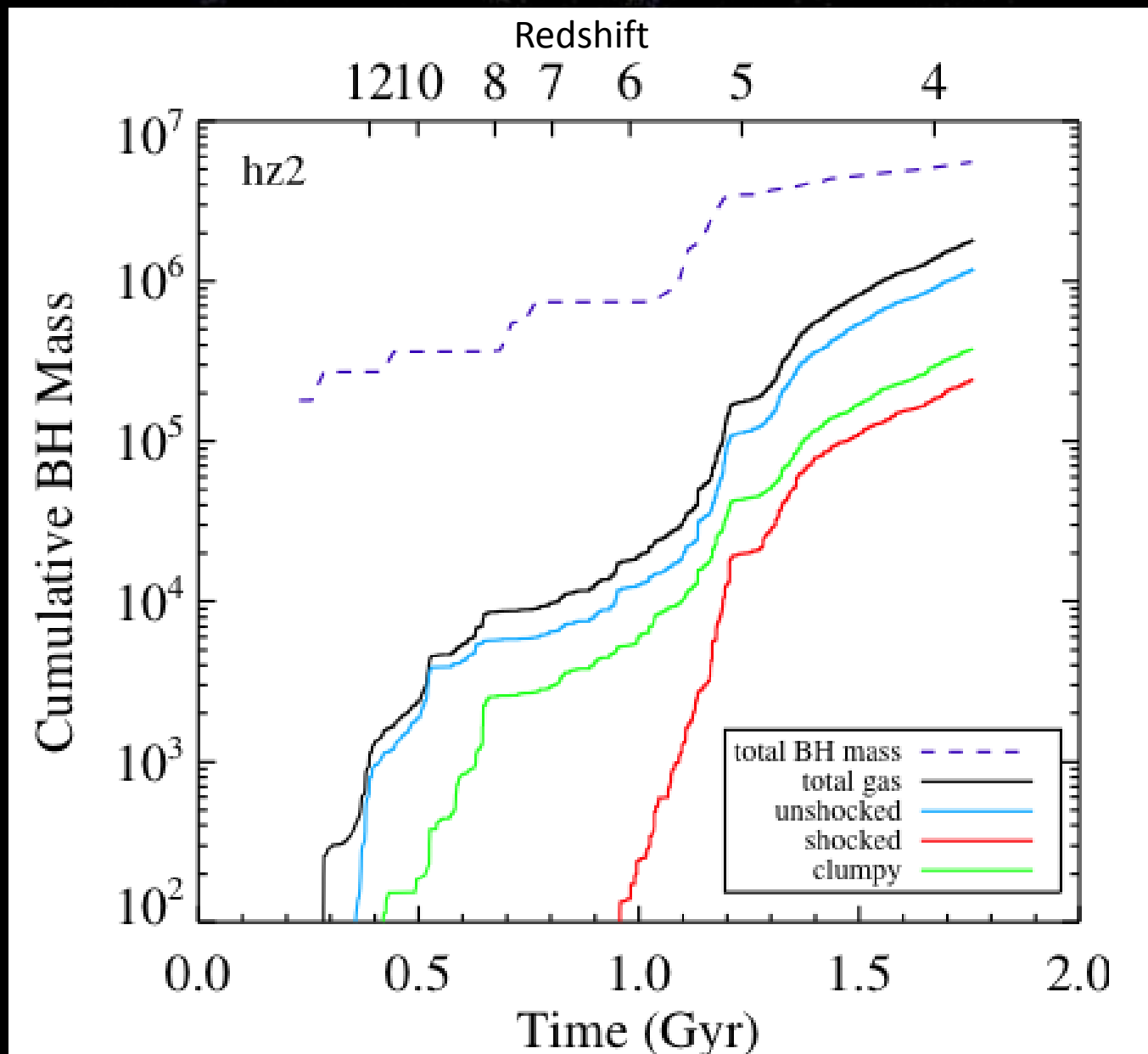
Major  
mergers

Minor  
mergers

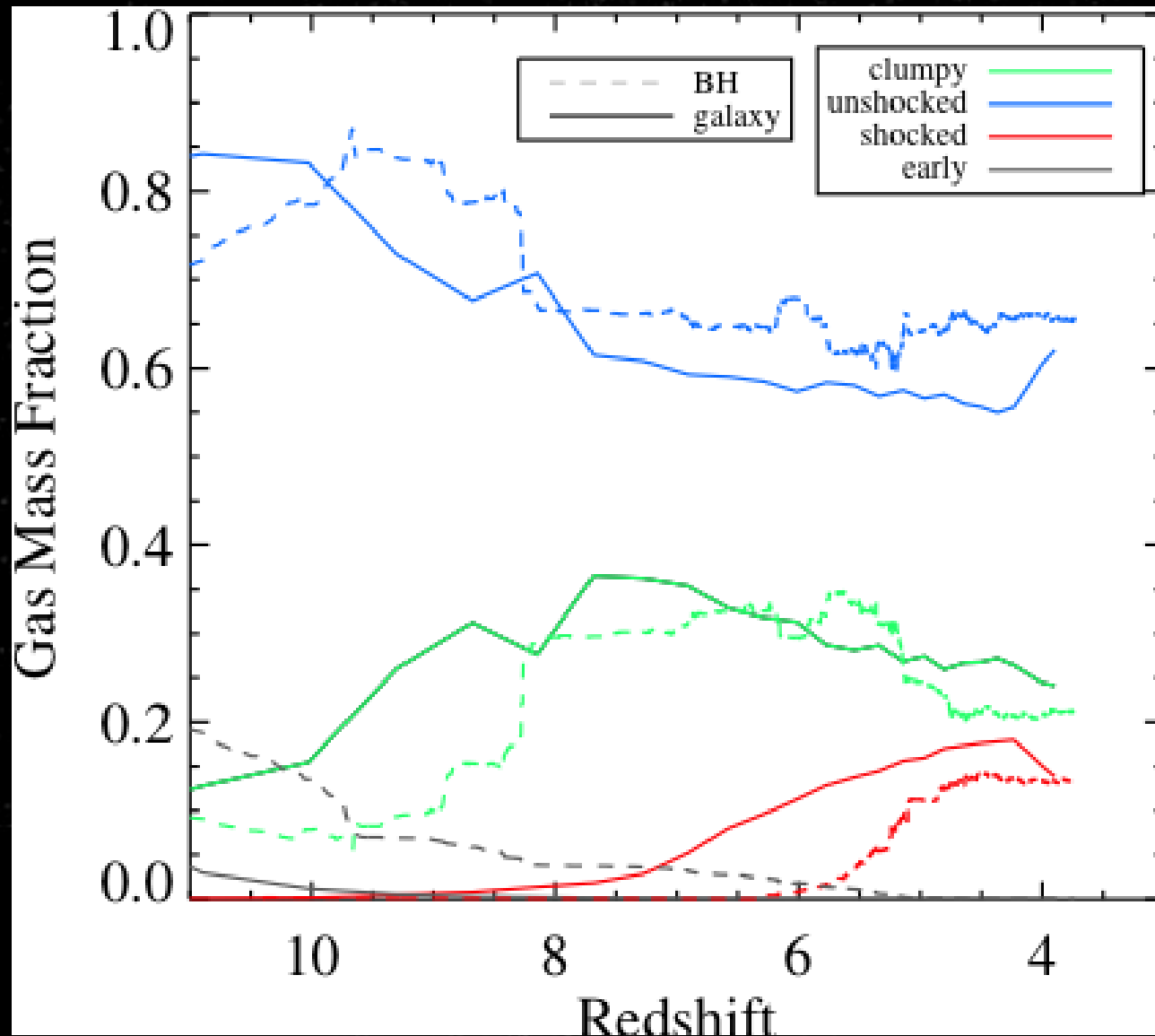
Kevin's soft  
X-ray  
upper  
limits

Nope.

# Cold Flows Dominate SMBH Accretion



# Composition of galaxy = composition of SMBH



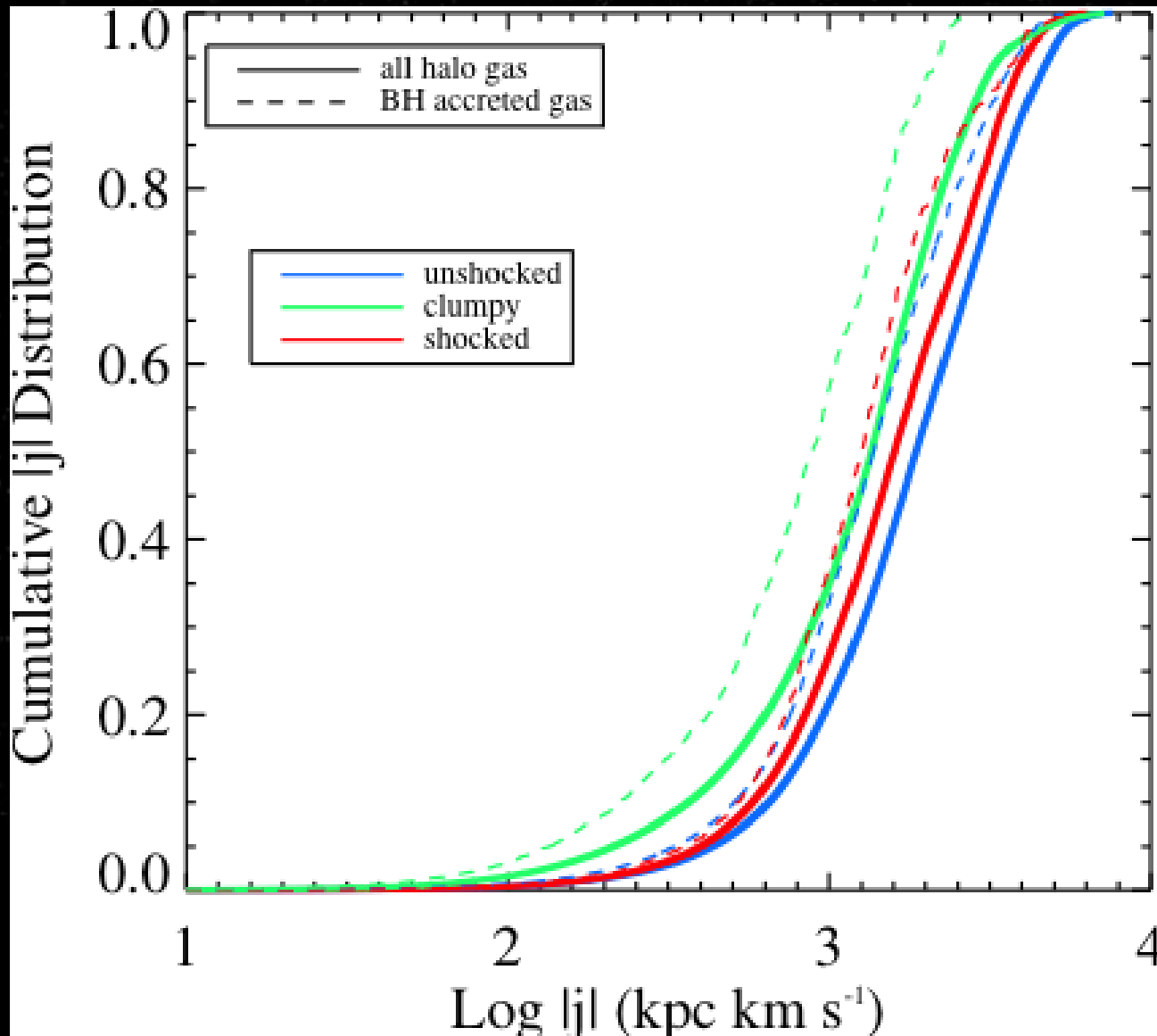
# What does it all mean...

	hz2 halo	hz2 BH
Cold	62%	66%
Clumpy	25%	21%
shocked	13%	14%

Black holes are not picky



# Incoming angular momentum matters more!



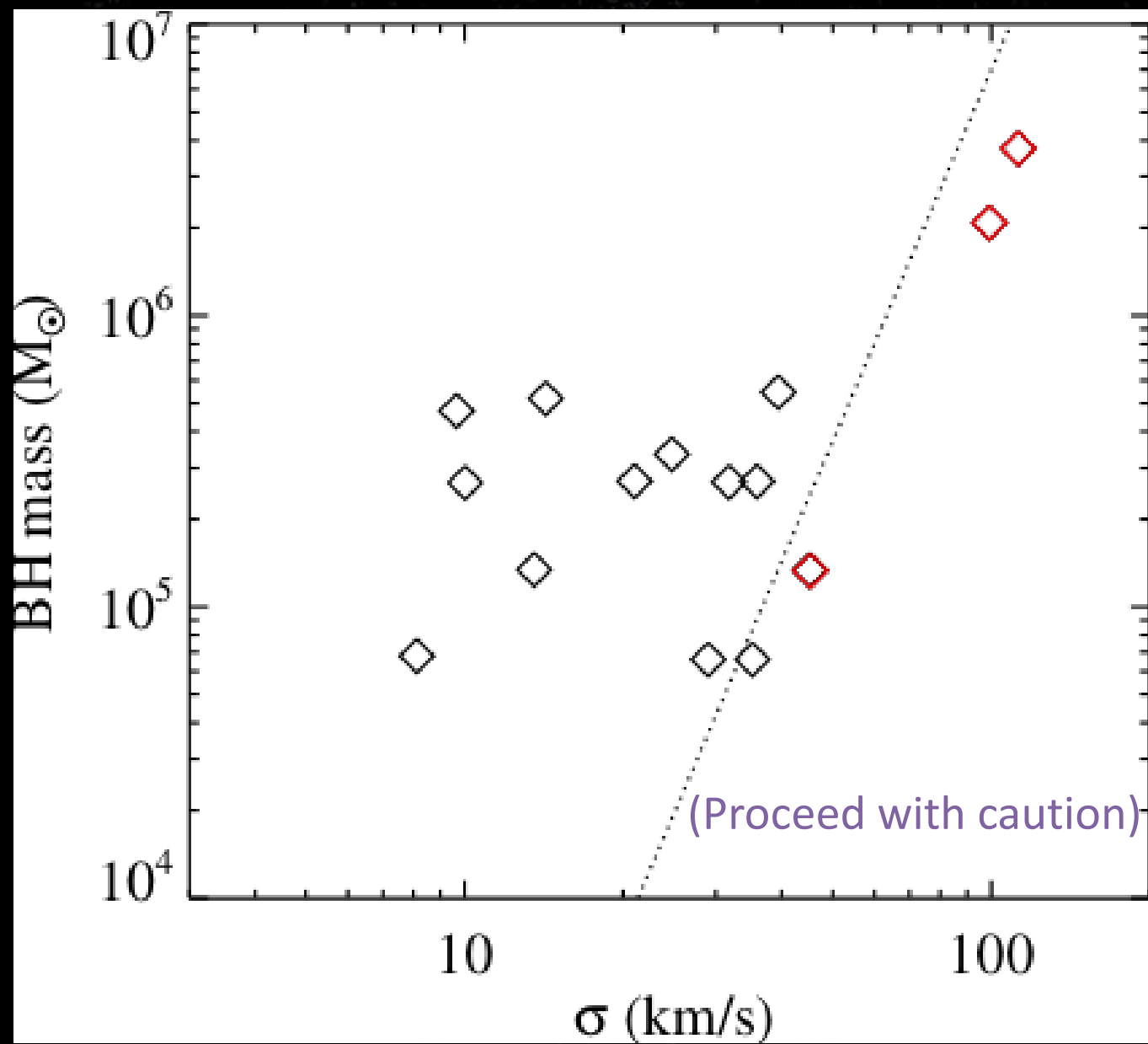
# The Main Points

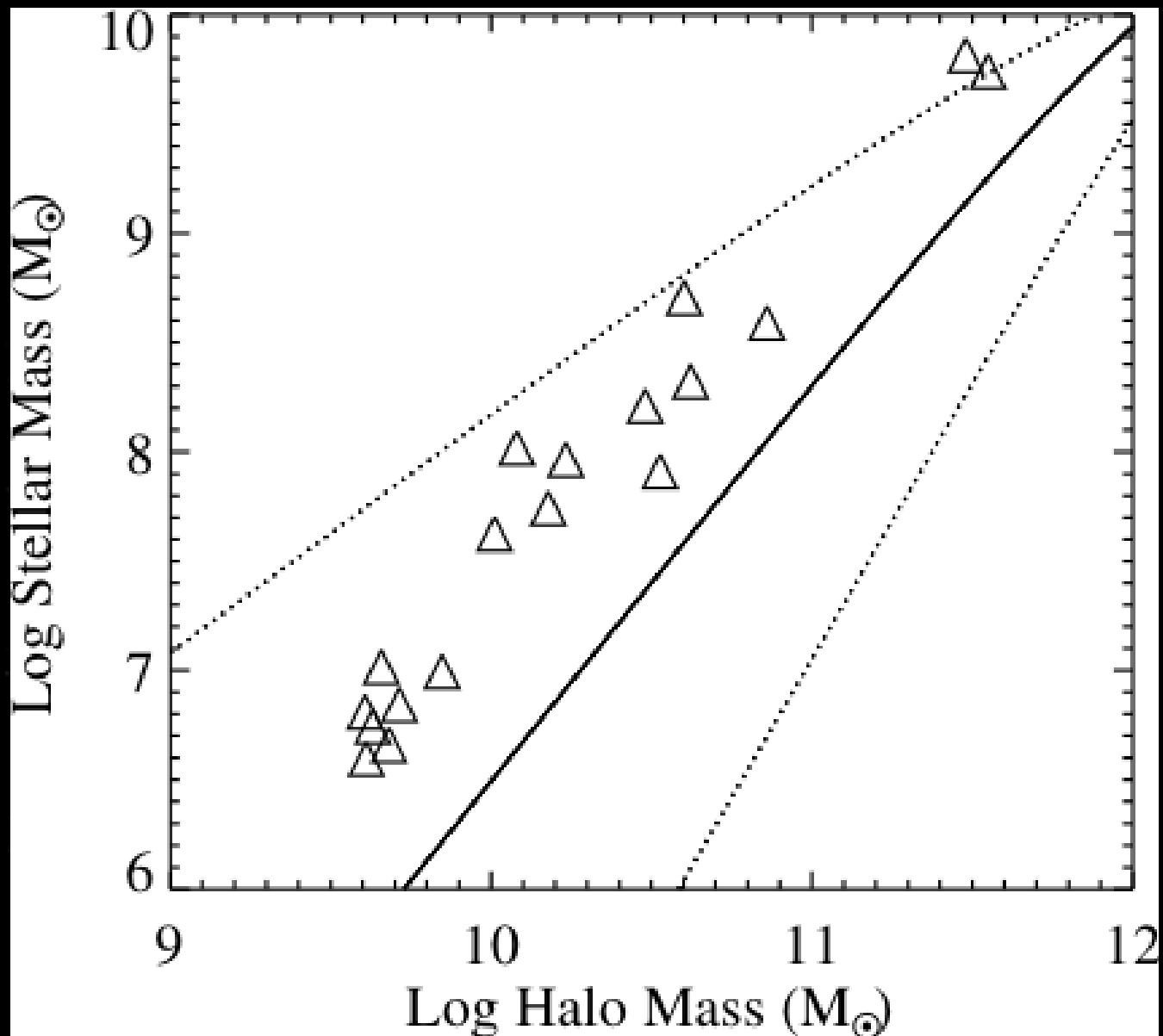
- Massive-ish  $z=4$  galaxies may not have tons of SMBH activity
- SMBHs and their host galaxies have the same composition
- Incoming angular momentum likely critical

# Open Questions

- What happens during  $0 < z < 4$ ?
- Where do Kevin's galaxies fit in?
- What is the angular momentum evolution of the gas as it approaches the SMBH?
- Are there any observational signatures of these growth modes?
- What are the repercussions for  $M-\sigma$ ?

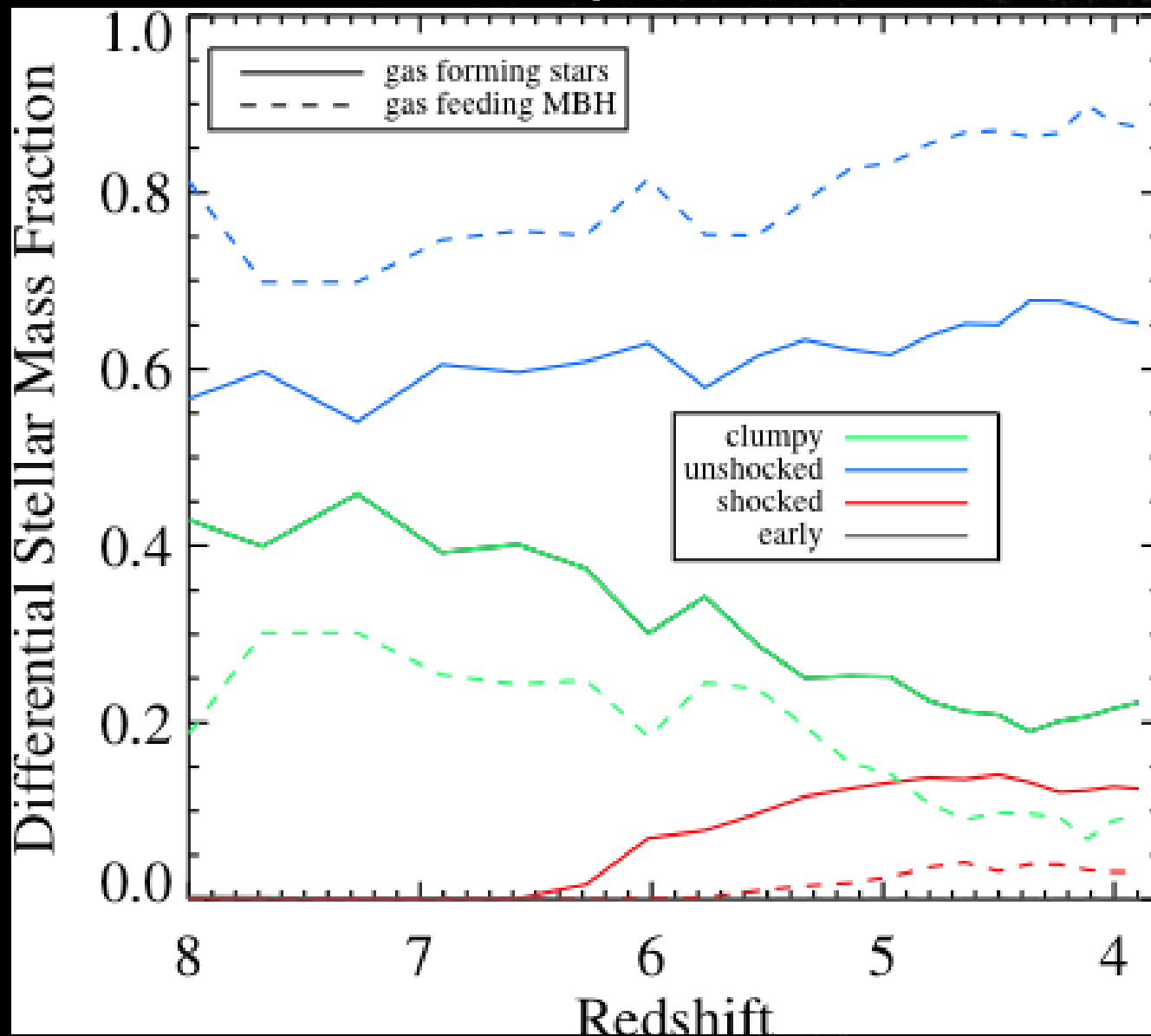
# The $z = 4$ $M$ - $\sigma$ relation..





$z = 3.5$  relation from Moster+ 2010

# Composition of young central stars ~ composition of SMBH



50 Myr time bins

Stars formed in  
central 0.5 kpc

Gas accreted  
by SMBH  
during that  
time