

Supermassive Black Hole Feedback in the Next Generation Illustris Simulations (IllustrisTNG)

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The IllustrisTNG simulations

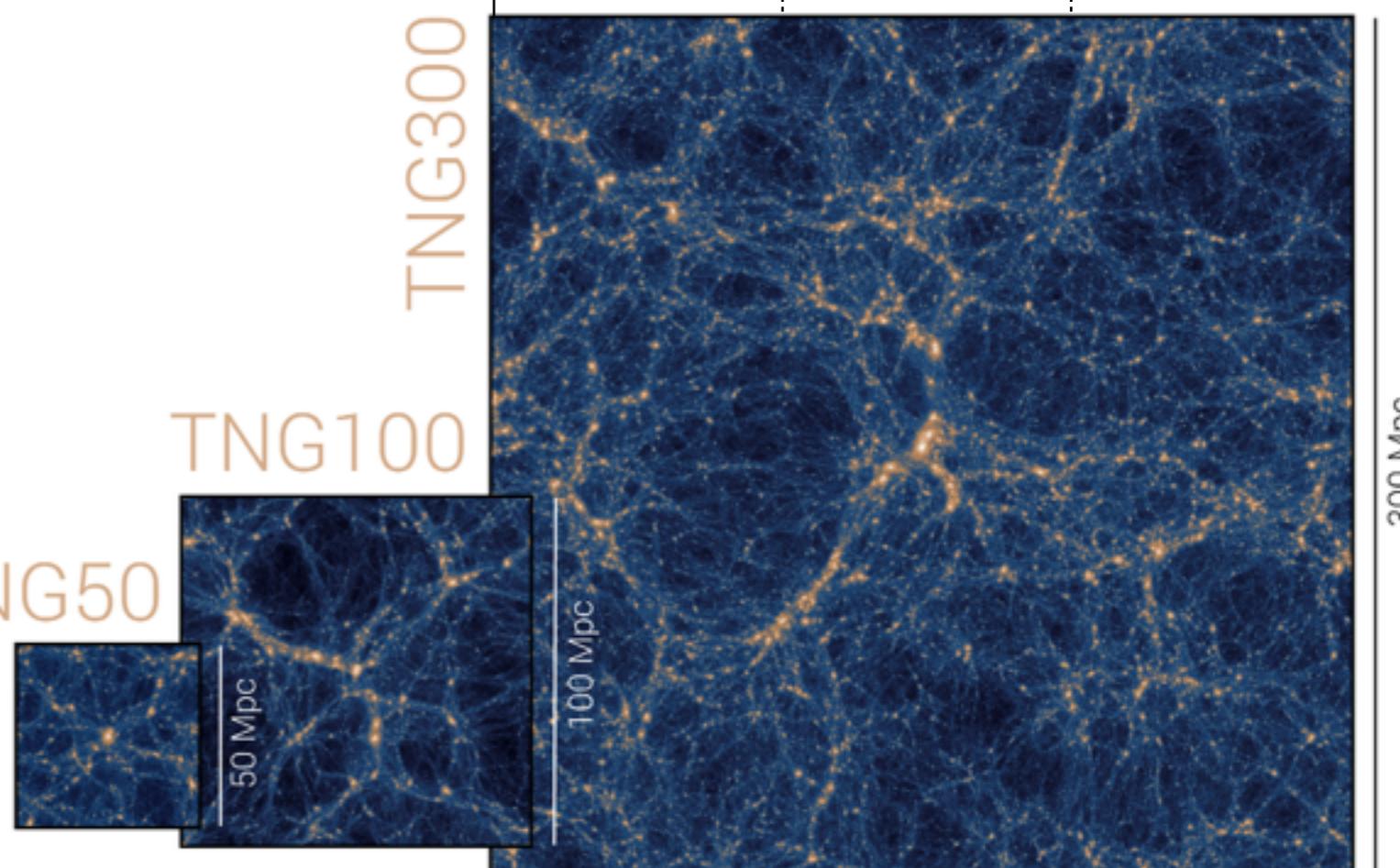
model papers:

- Pillepich et al. (subm.)
- Weinberger et al. (2017)

simulation papers (submitted):

- Springel et al: baryonic effect on large scale structure
- Pillepich et al: stellar profiles of group and cluster size halos
- Nelson et al: galaxy color distribution
- Marinacci et al: magnetic field and radio emission in galaxy clusters
- Naiman et al: element abundance: Mg and Eu
- Vogelsberger et al: gas metallicity profiles in galaxy clusters
- Genel et al: galaxy sizes of different galaxies

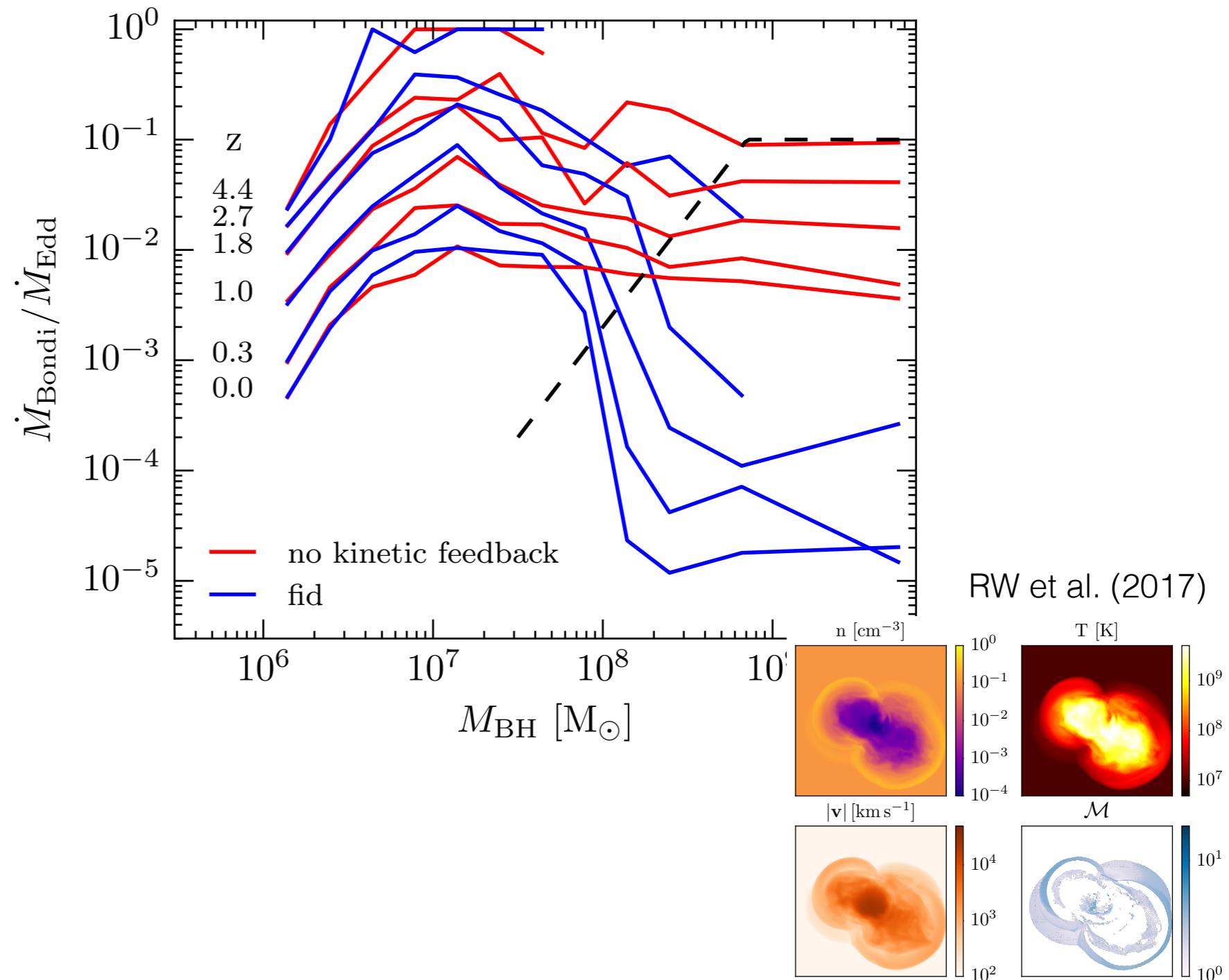
	TNG50	TNG100	TNG300
L	52 Mpc	106 Mpc	303 Mpc
N	2160	1820	2500
dm-softening	0.3 kpc	0.7 kpc	1.5 kpc
target mass	$8 \times 10^9 M_{\odot}$	$1.3 \times 10^{10} M_{\odot}$	$10^{10} M_{\odot}$



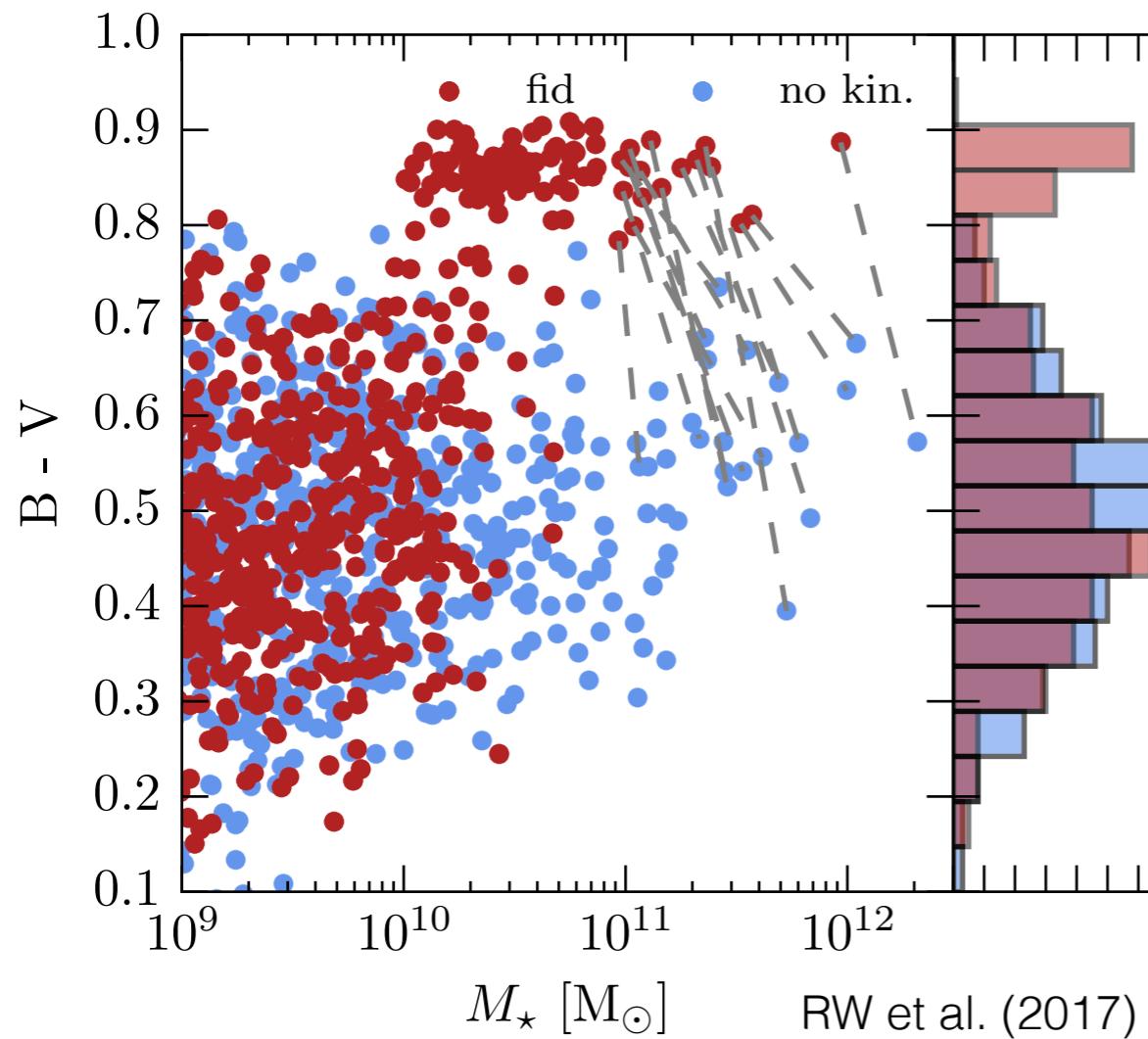
The IllustrisTNG simulations — the black hole model

two-mode AGN feedback

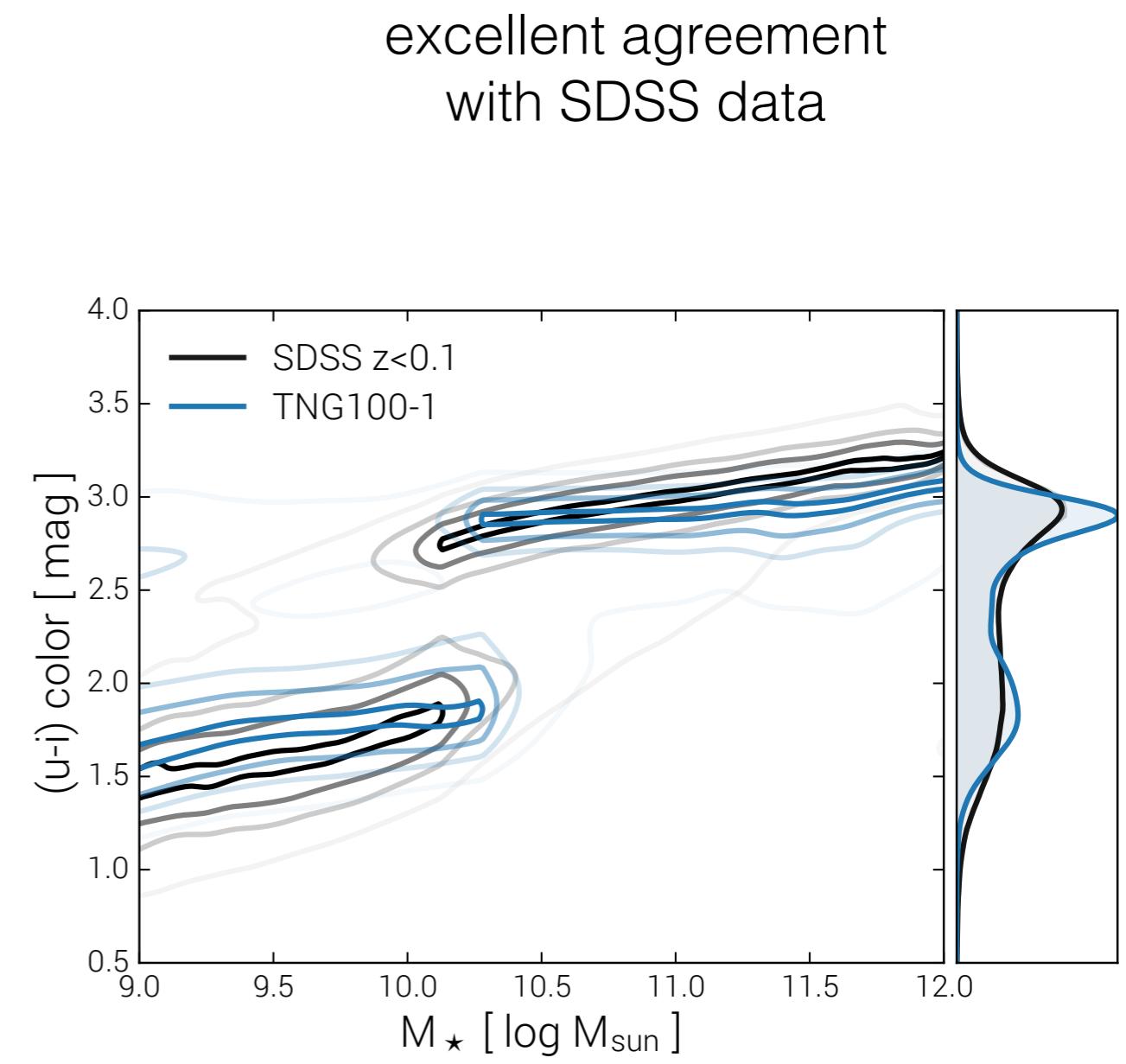
- low mass, high accretion rate:
thermal
(rather inefficient)
- high mass, low accretion rate:
kinetic
(very efficient)



The IllustrisTNG simulations — galaxy colors



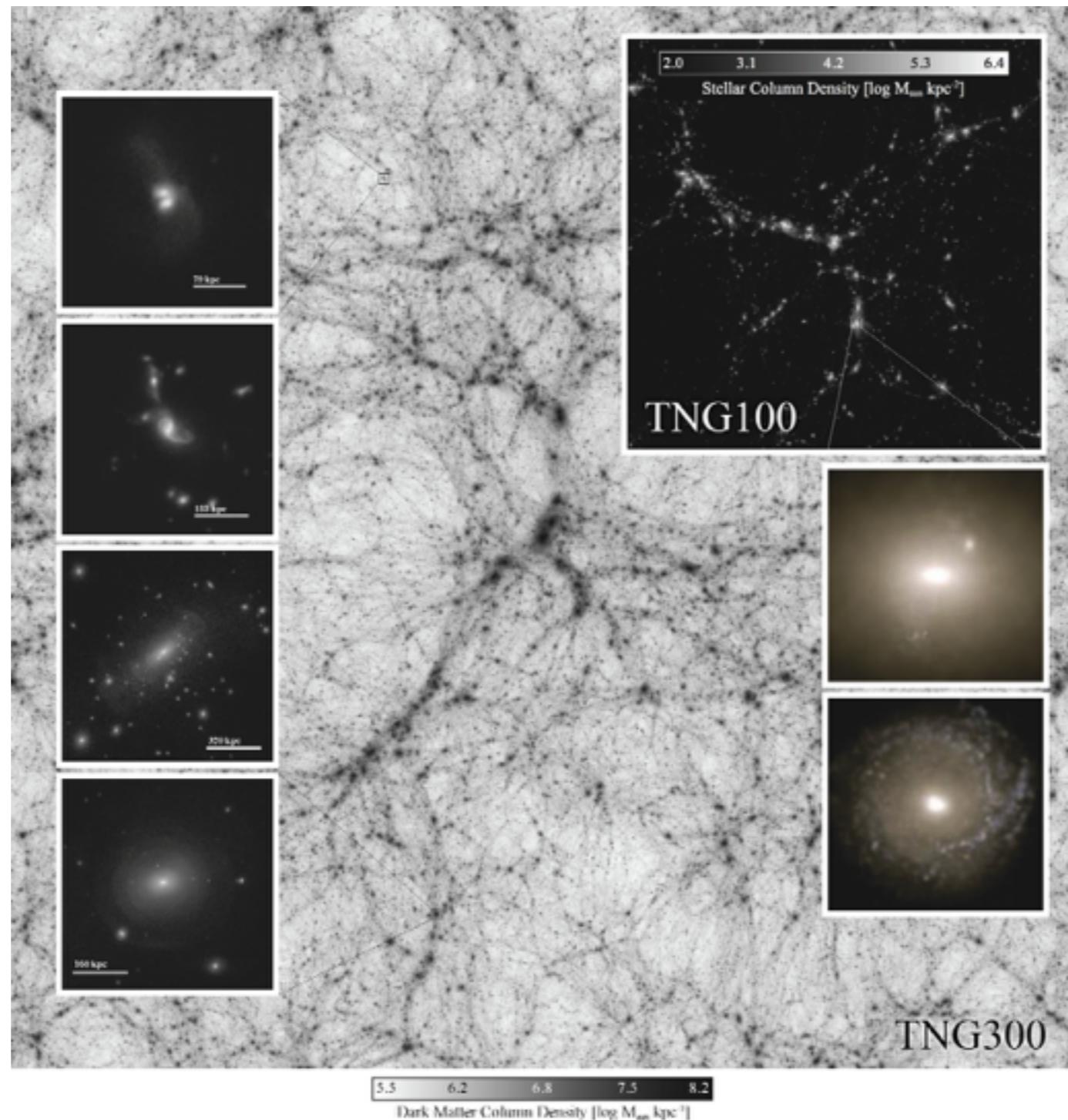
no color bimodality
without kinetic feedback



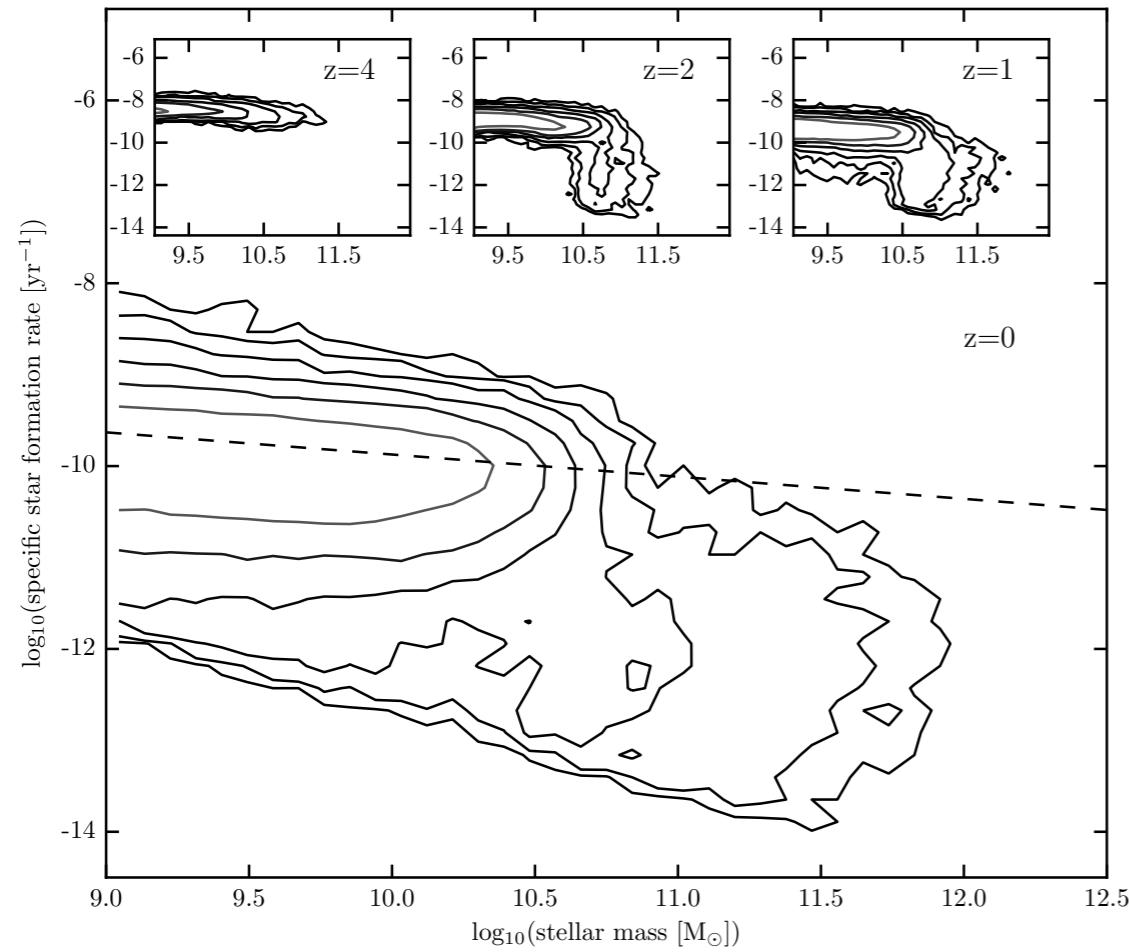
Nelson et al. (2017)

excellent agreement
with SDSS data

The IllustrisTNG simulations galaxy morphologies



The importance of feedback in galaxy formation



RW et al. (in prep.)

- cooling (non SF)
- stellar
- thermal AGN
- kinetic AGN

Stellar feedback:

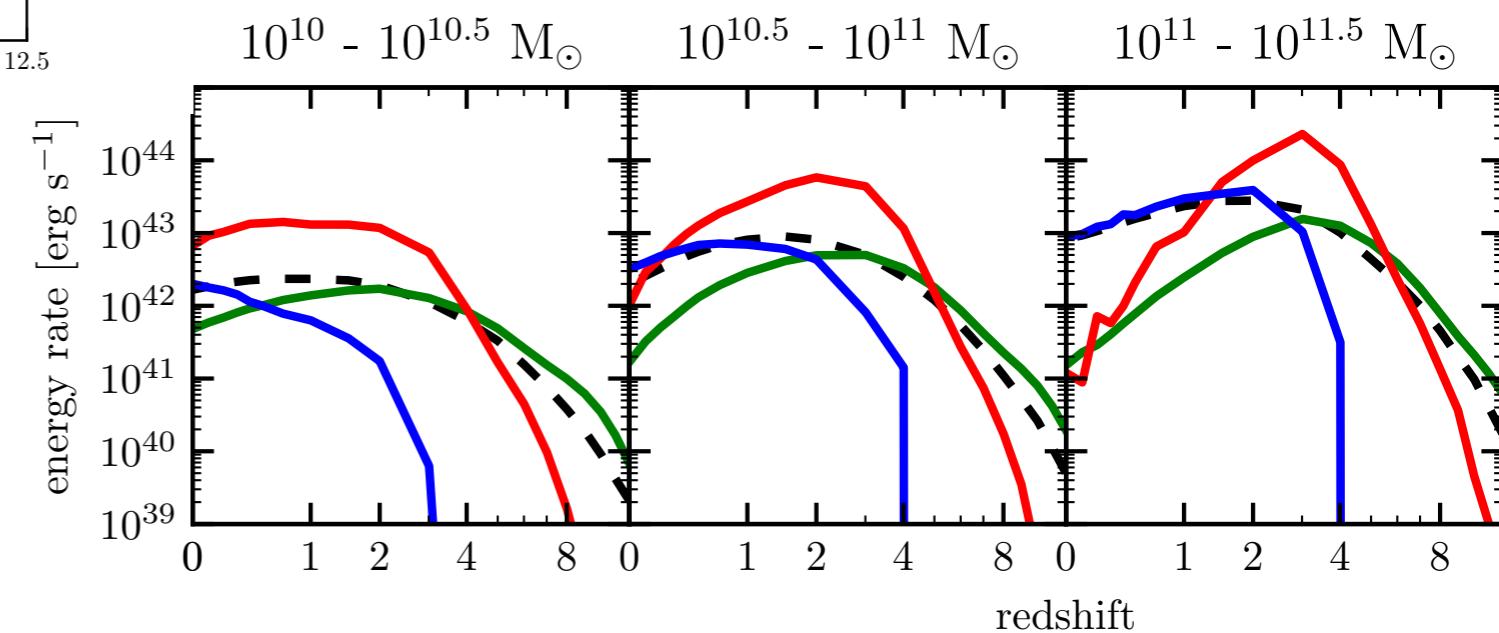
- low mass, high redshift

AGN quasar-feedback:

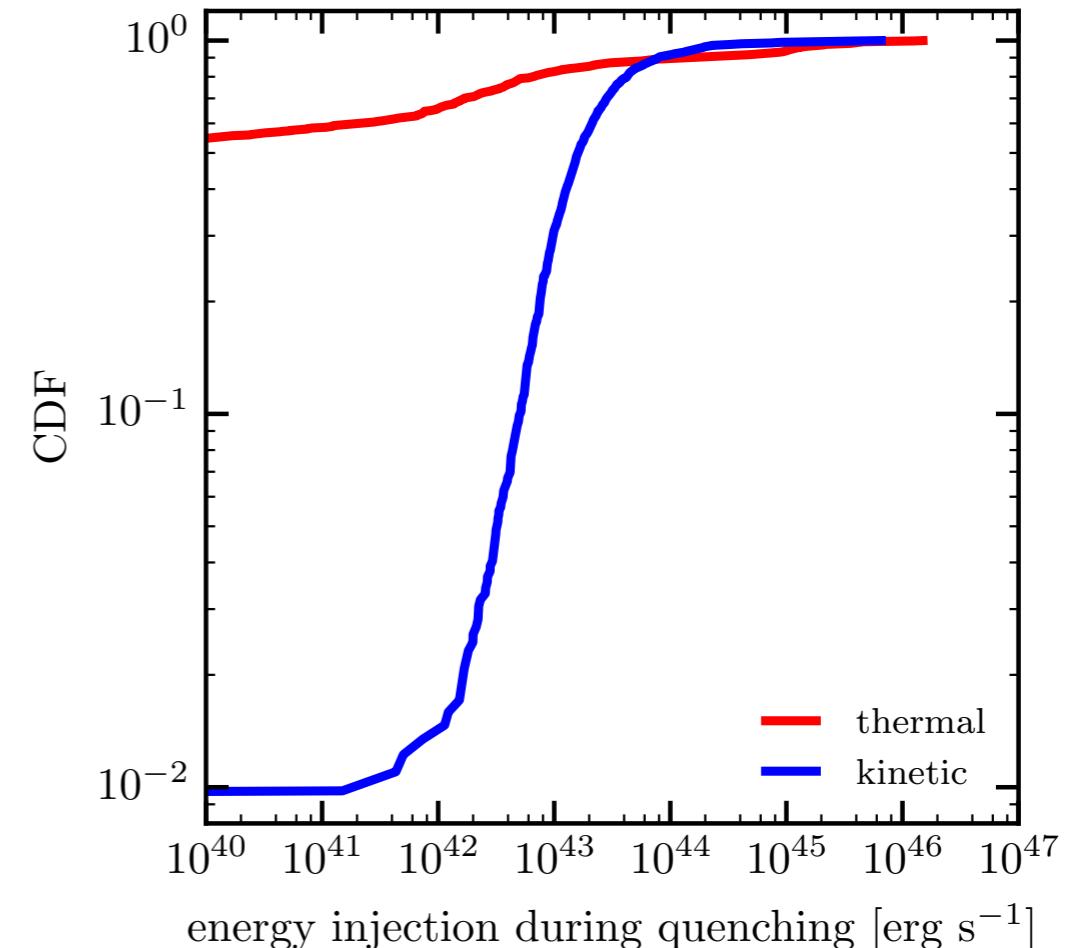
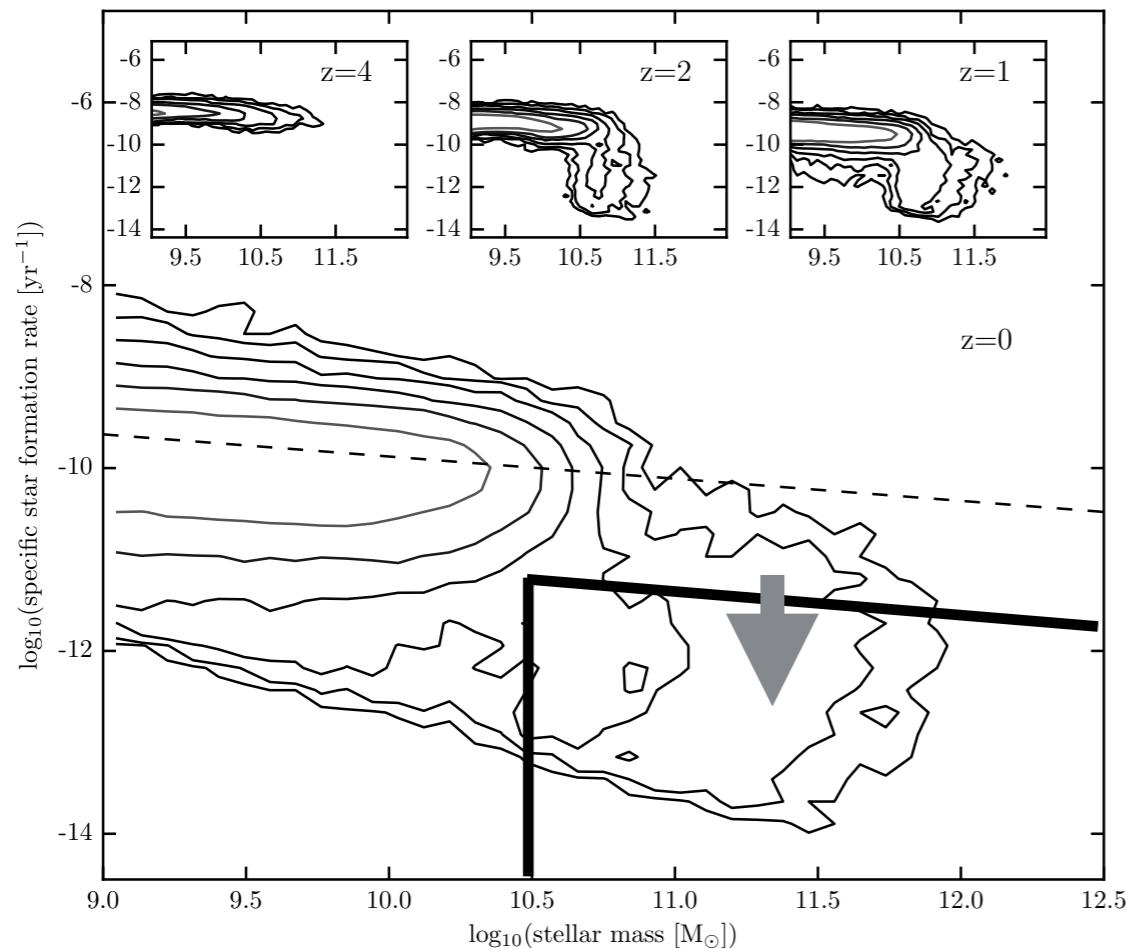
- intermediate mass, low redshift,
- high mass, high redshift

AGN kinetic-feedback:

- high mass halos at low redshift



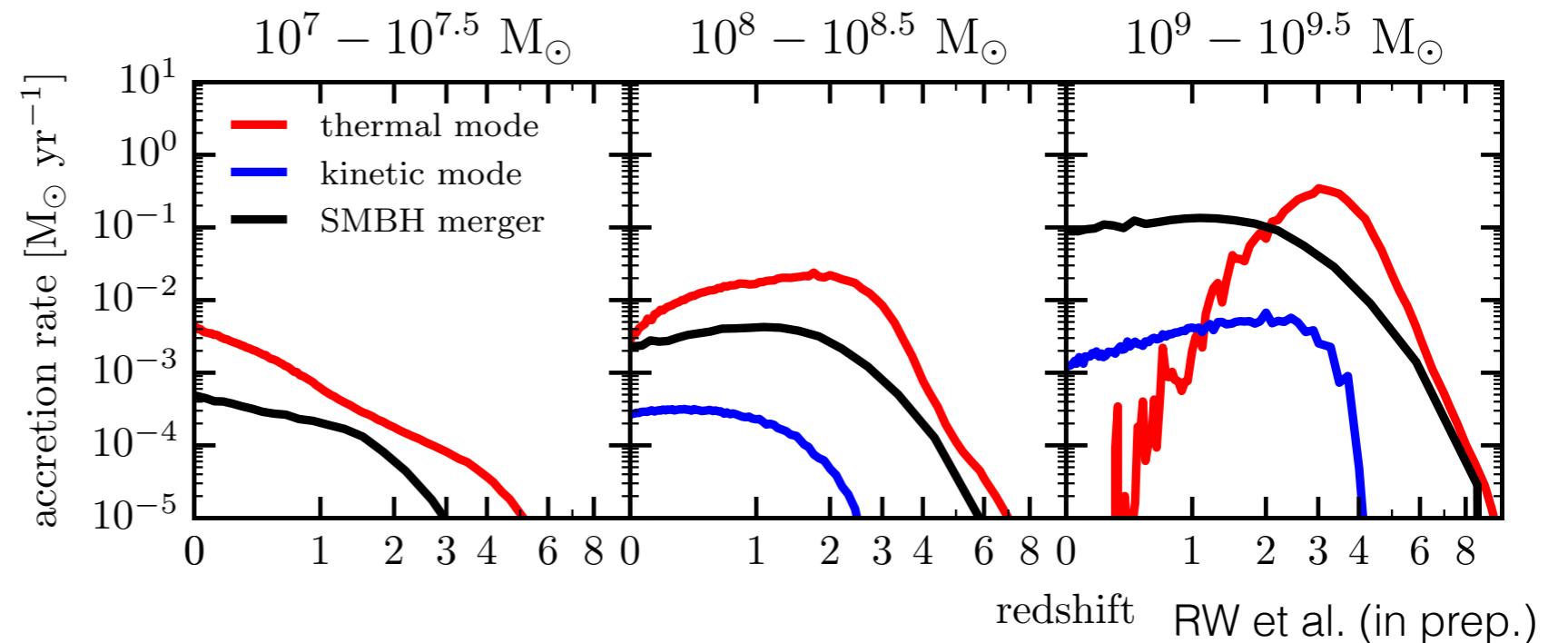
The importance of feedback in galaxy formation



RW et al. (in prep.)

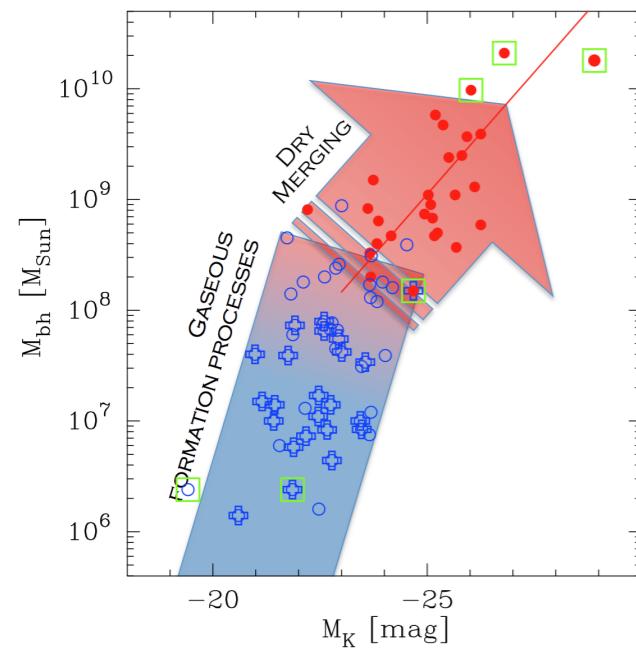
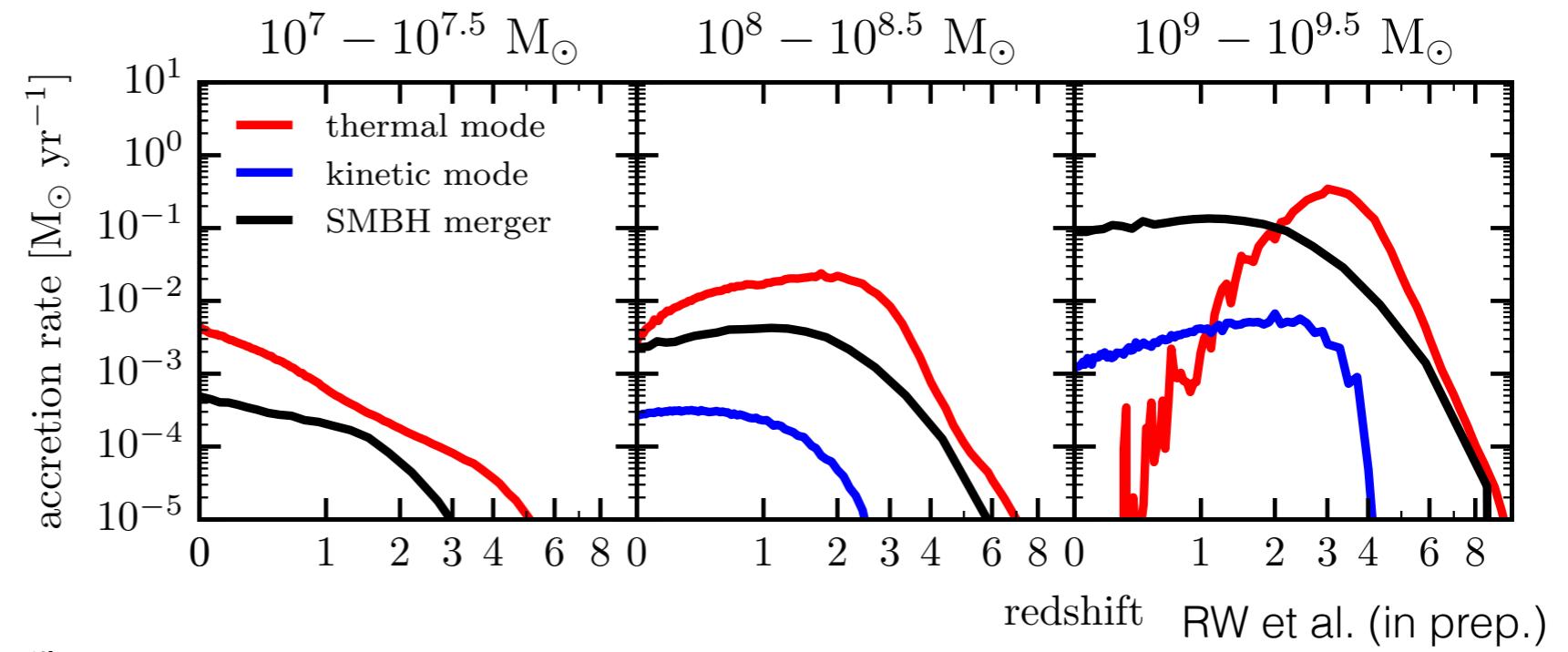
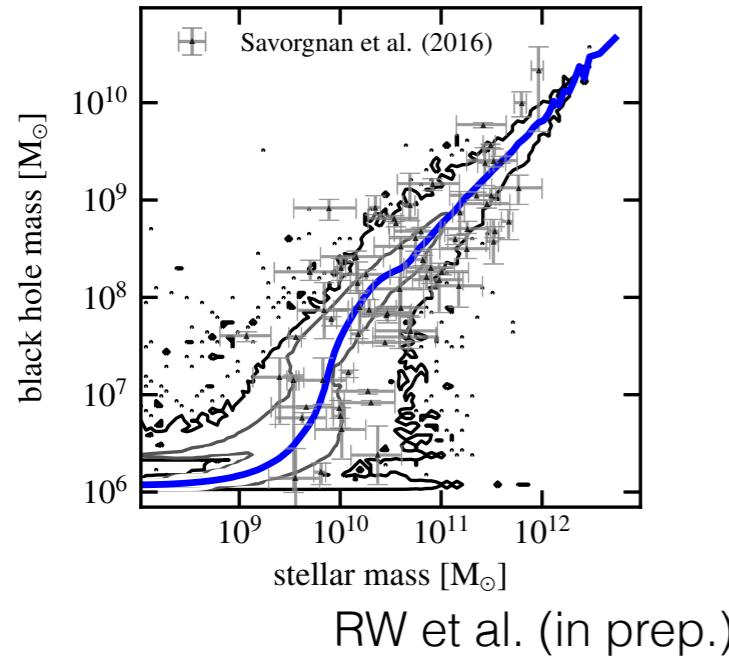
kinetic feedback quenches galaxies

The SMBH growth history

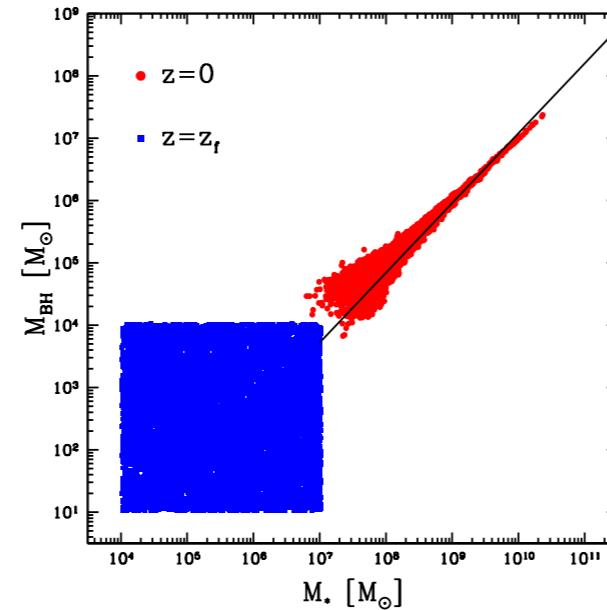


- Accretion dominates over merging at low masses
- Kinetic feedback lowers accretion rate, SMBH mergers dominate mass growth

The SMBH growth history



Graham+Scott (2013)



Jahnke+Macciò (2011)

Conclusions*

- Two-mode AGN feedback can quench high-mass galaxies/galaxy clusters sufficiently while keeping Milky-Way size galaxies realistic
- Kinetic feedback mode quenches and keeps the SMBH accretion rate low
- Growth via accretion for low-mass SMBH, via mergers for high-mass SMBHs
- Luminous AGN are not responsible for quenching

***for this simulation**