Connecting SFG and DH at z=4-7 by the Clustering Analysis of Subaru/HSC & Hubble Data

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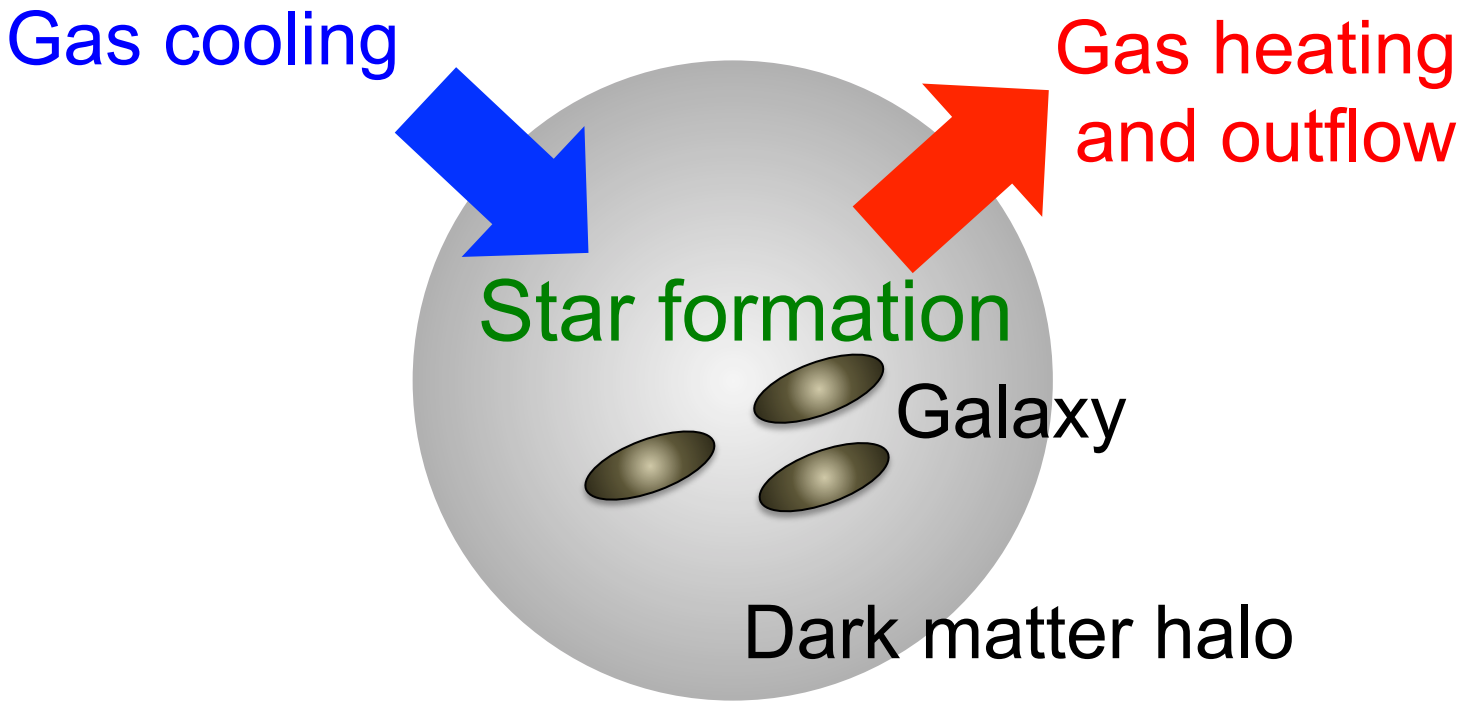
Outline

- Introduction of SHMR
- Hubble & HSC Data and LBG Selection
- Clustering Analysis with HOD Model
- Results of Halo Mass, SHMR, BCE
- Future Prospect with HSC

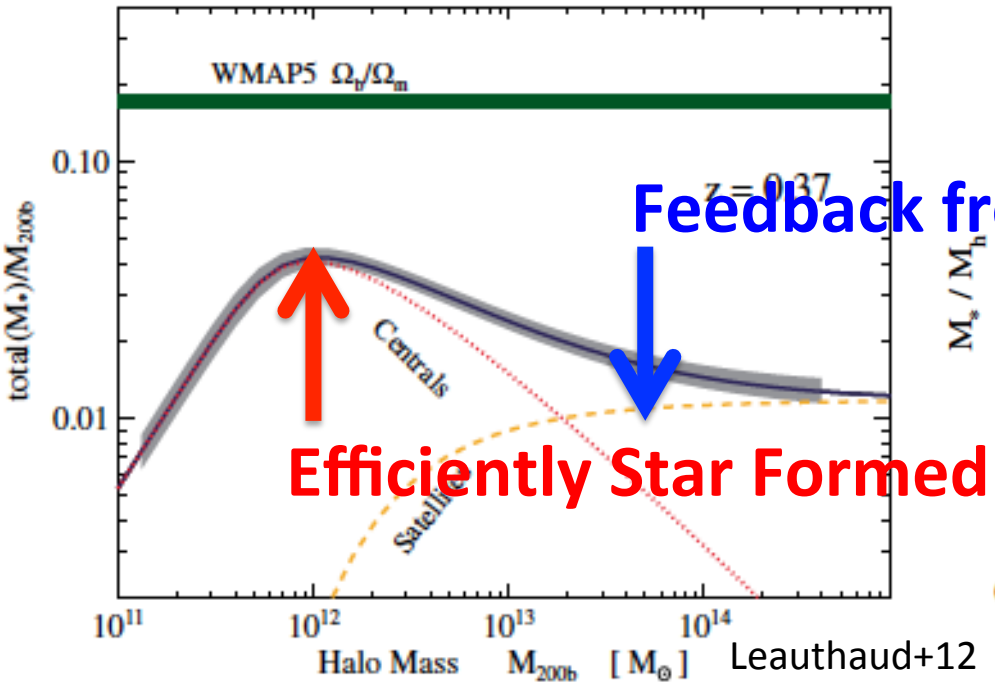
Galaxy-Dark Matter Connection: SHMR

- Dark matter halo is important in galaxy formation.
  - Gas cooling is efficient in 10^{10}-10^{13} M_{sun} halo.
  - SN and AGN feedback in low and high mass halo.



Galaxy-Dark Matter Connection: SHMR

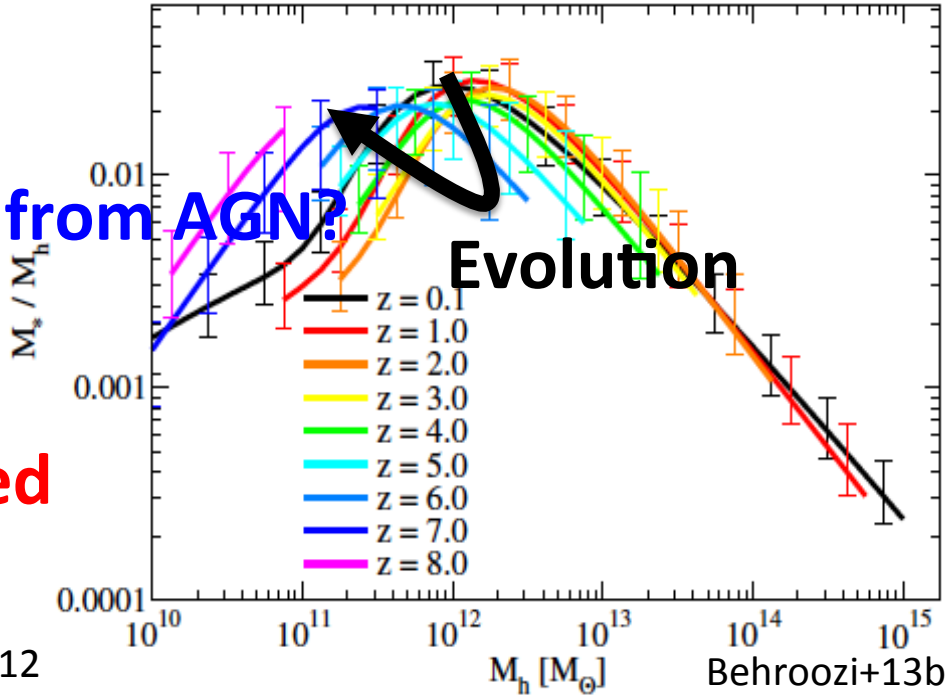
- Stellar-to-halo mass ratio (SHMR=M_*/M_h) can probe galaxy-dark matter connection.
- SHMR @ z>2 is not investigated by galaxy clustering.



Leauthaud+12

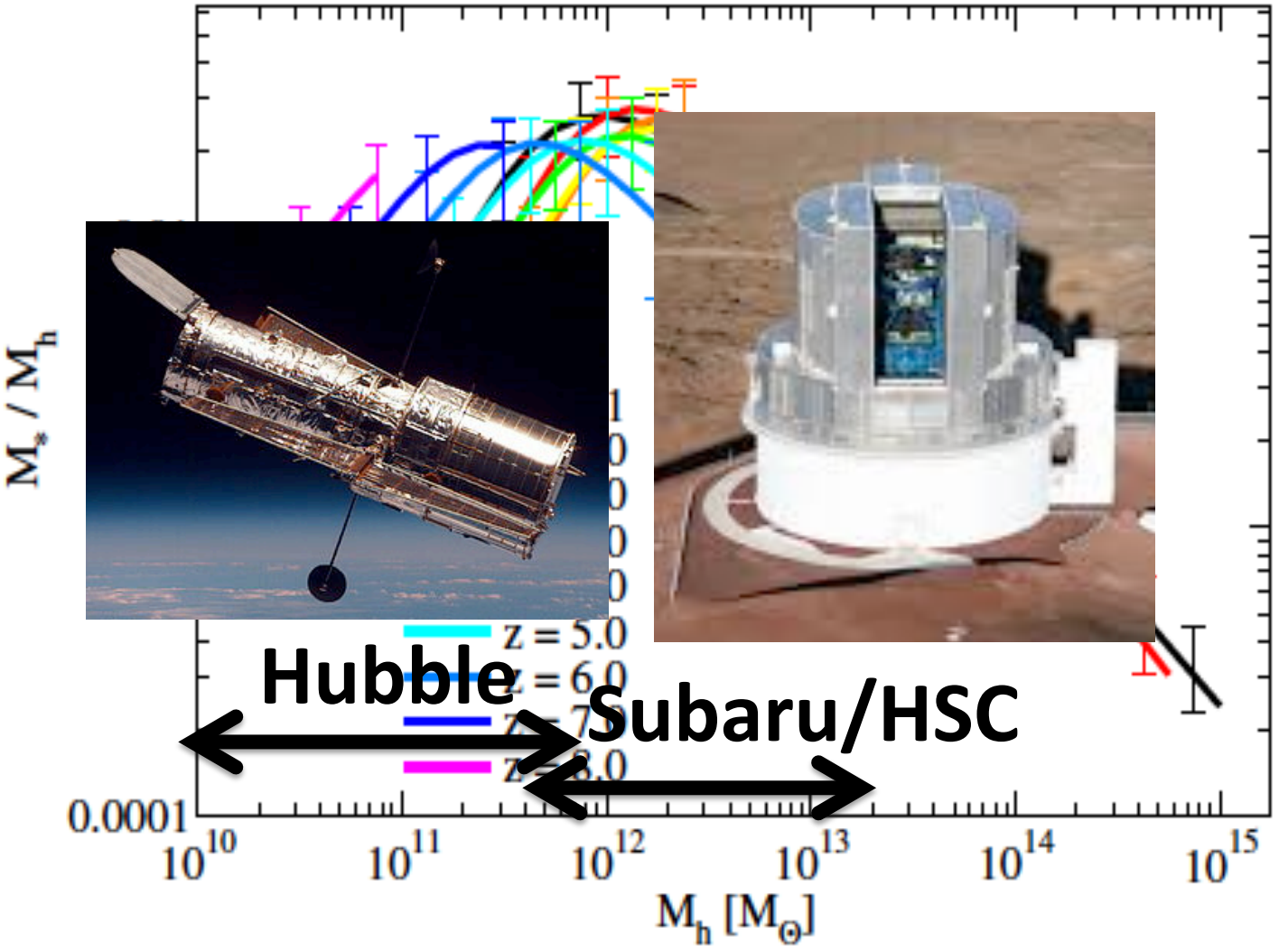
Efficiently Star Formed

Feedback from AGN?



Behroozi+13b

Our Strategy



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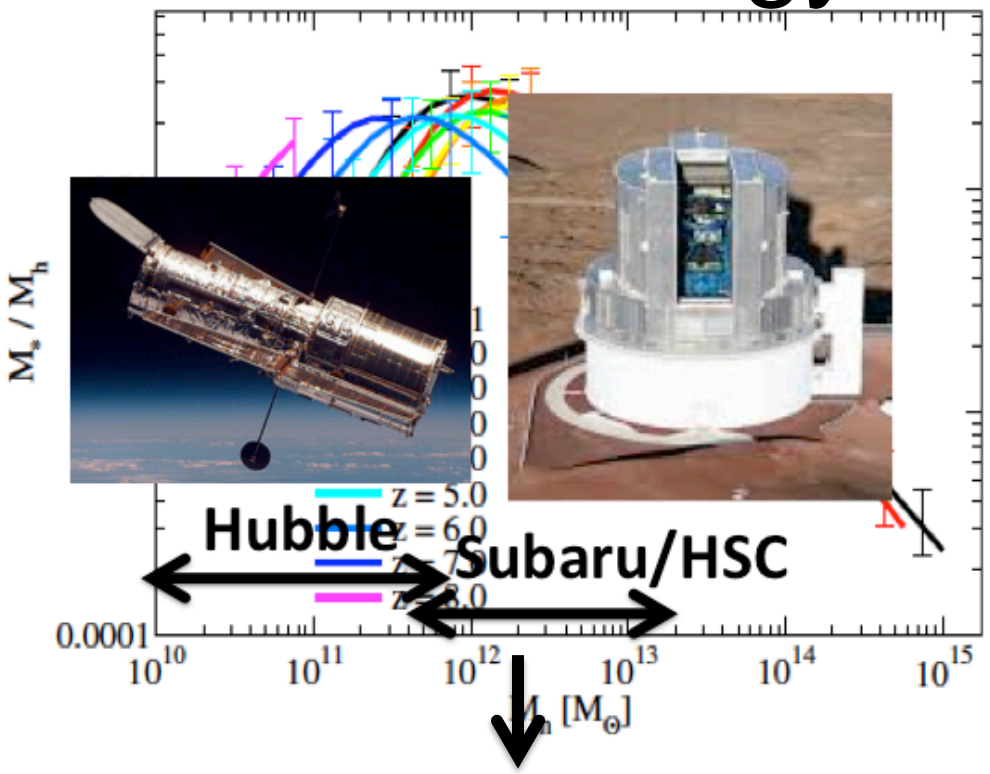
Our Strategy



LARGE sample covering WIDE luminosity range

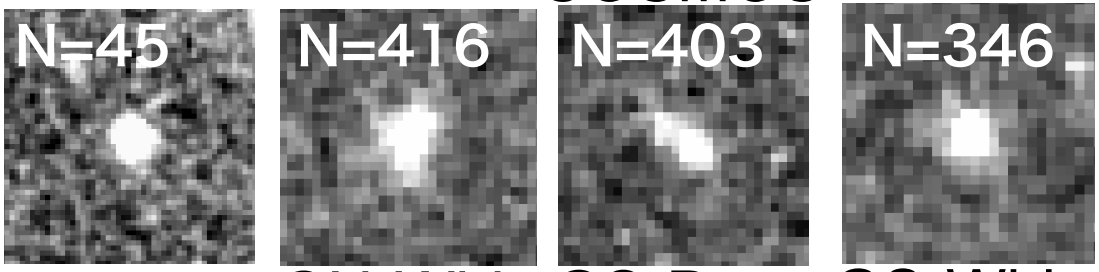
Clustering Analysis w/ HOD

SHMR evolution

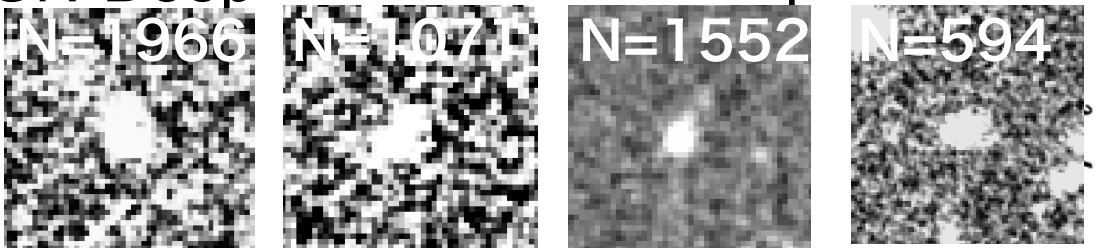
Data & Sample Selection

Lyman break galaxy (LBG) selection @z~4, 5, 6, 7

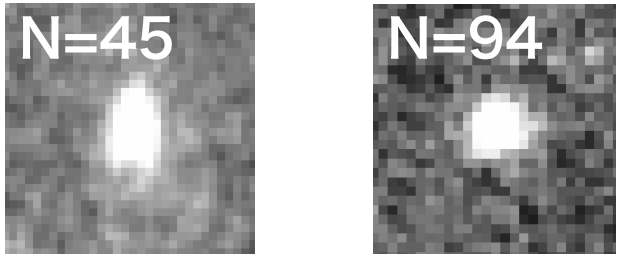
UDF12 N=45 | AEGIS N=416 | COSMOS N=403 | UDS N=346



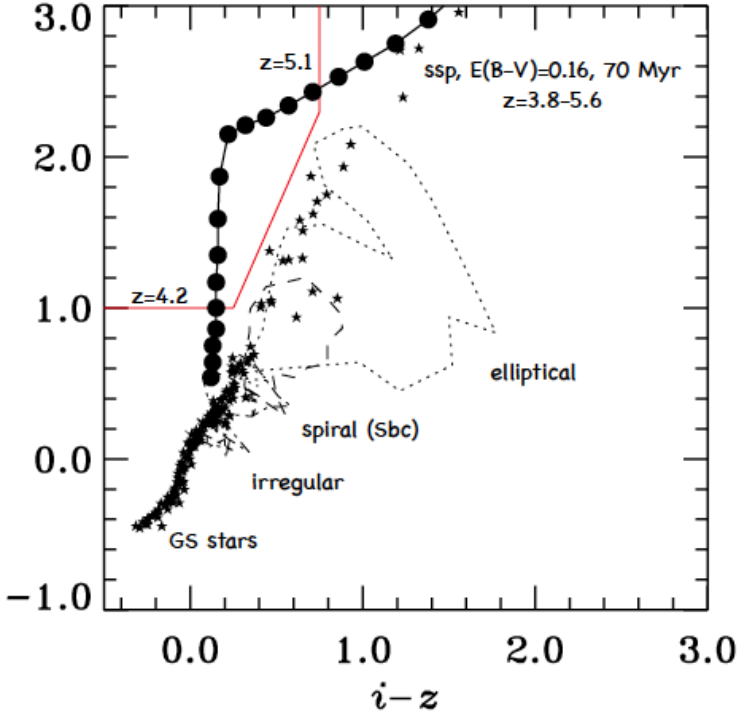
GN-Deep N=1966 | GN-Wide N=1071 | GS-Deep N=1552 | GS-Wide N=594



HFF-A2744P N=45 | HFF-M0416P N=94



z~5 selection

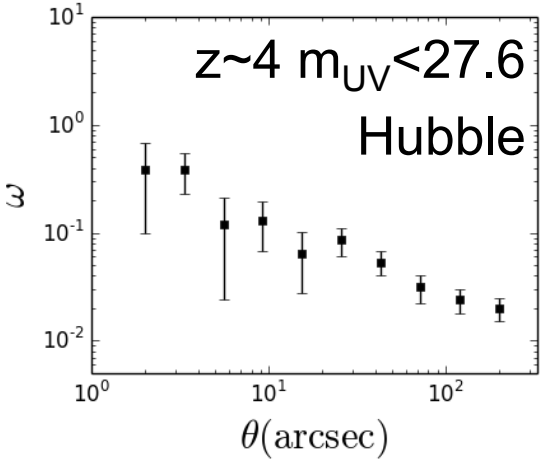


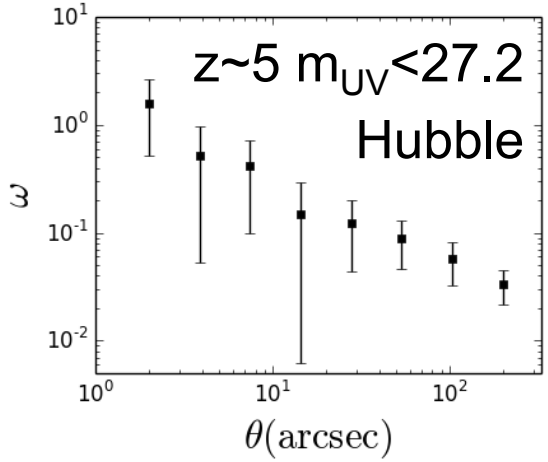
Ono, Y. in prep

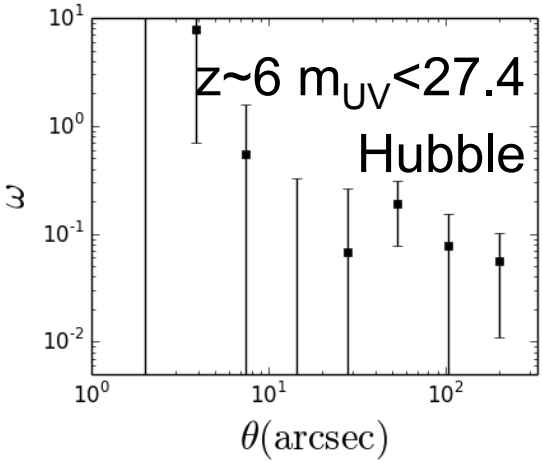
Total of ~7000 LBGs @z=4-7 !!

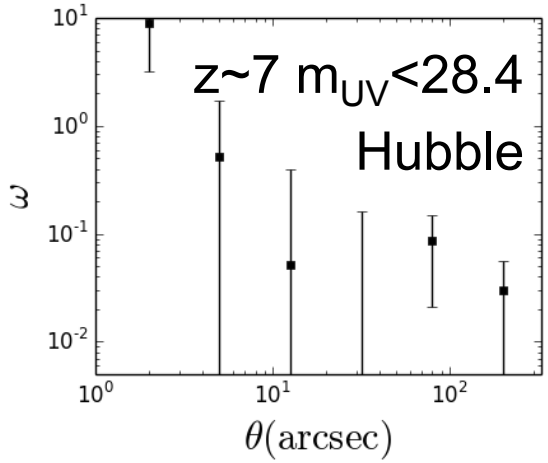
Clustering Analysis w/ HOD Model

Calculate Angular Correlation Function in Each Sample Bin









Clustering Analysis w/ HOD Model

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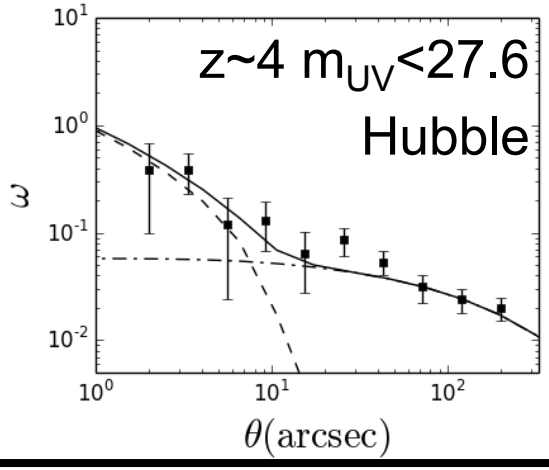
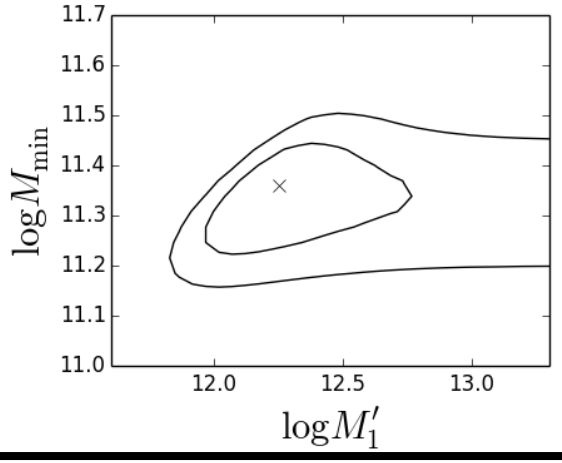




Fit w/ Halo Occupation Distribution (HOD) Model Prediction

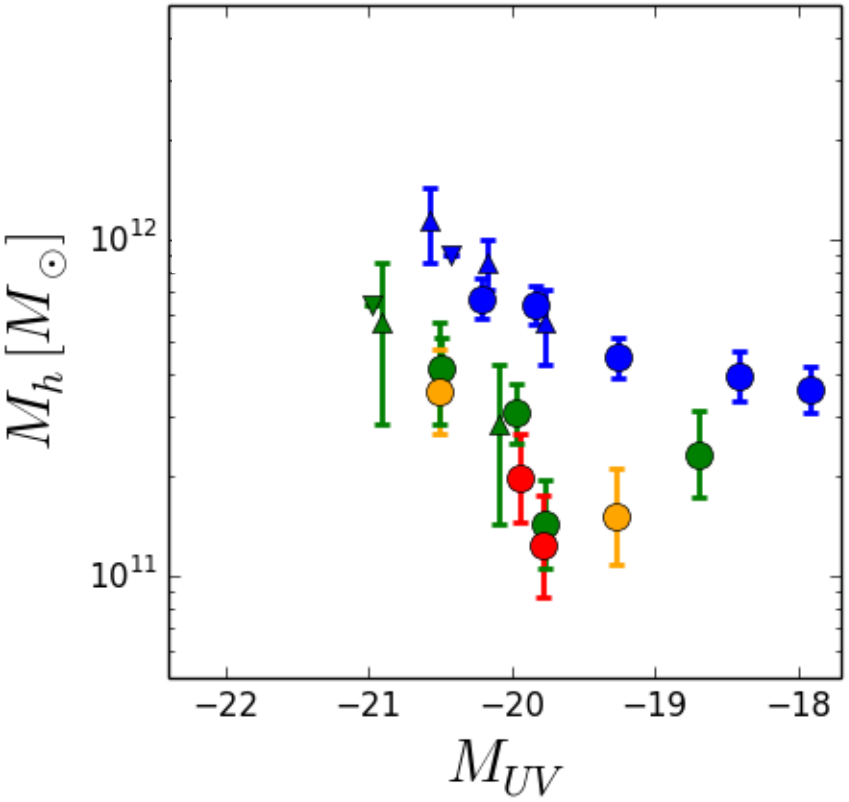
$$P_g^{1h} = \frac{1}{n_g^2}\int dM \left[N_s(M)N_s(M)u^2(k,M) + 2N_s(M)N_c(M)u(k,M)\right]\frac{dn}{dM}(M,z)$$

$$P_g^{2h} = P_m(k,z)\left[\frac{1}{n_g}\int dM N(M)\frac{dn}{dM}(M,z)b_h(M,z)u(k,M)\right]^2$$

Estimate Dark Halo Mass

Results: Dark Halo Mass

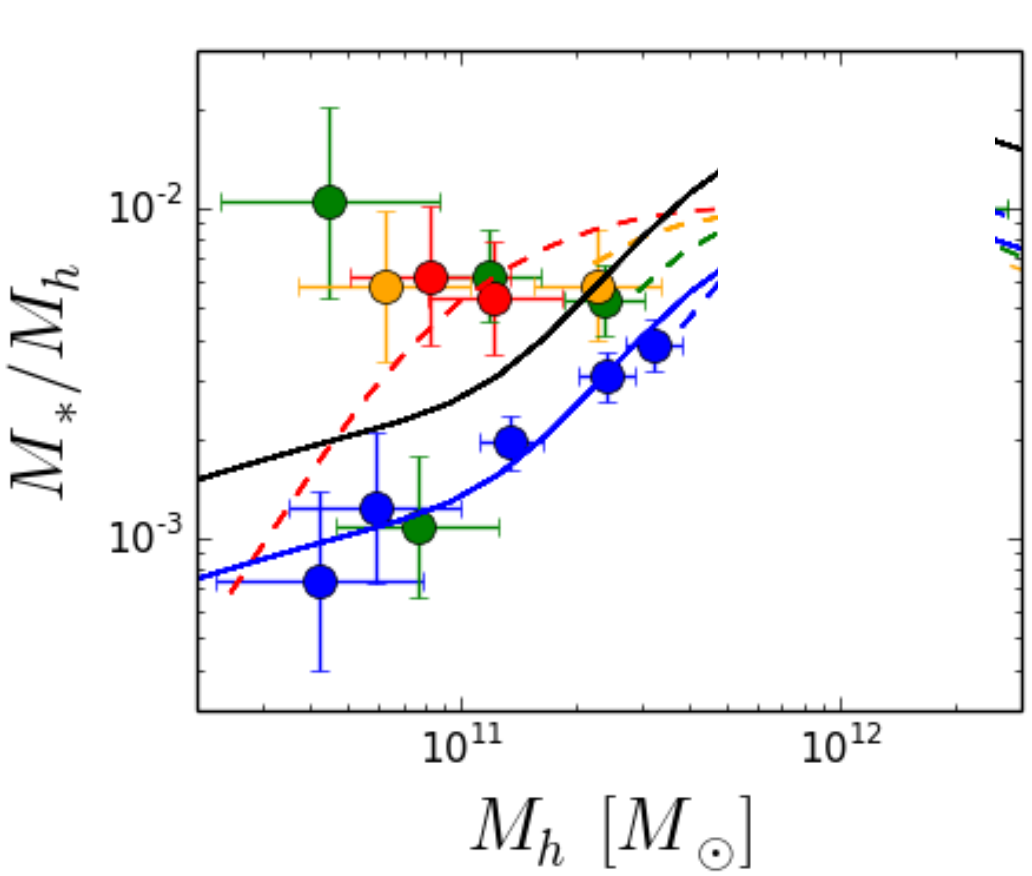
- Dark halo mass is consistent with previous clustering results (Lee+06, Hamana+04).



- z~4 (this work)
- z~5 (this work)
- z~5 (this work; HSC)
- z~6 (this work)
- z~7 (this work)
- z~4 (Lee+06)
- z~5 (Lee+06)
- z~4 (Hamana+04)
- z~5 (Hamana+04)

*Hamana+04 provides no error about M_h in paper

Results: SHMR



- z~0 (AM; Behroozi+13)
- z~4 (this work)
- z~5 (this work)
- z~5 (this work; HSC)
- z~6 (this work)
- z~7 (this work)
- z~4 (AM; Behroozi+13)
- z~5 (AM; Behroozi+13)
- z~6 (AM; Behroozi+13)
- z~7 (AM; Behroozi+13)

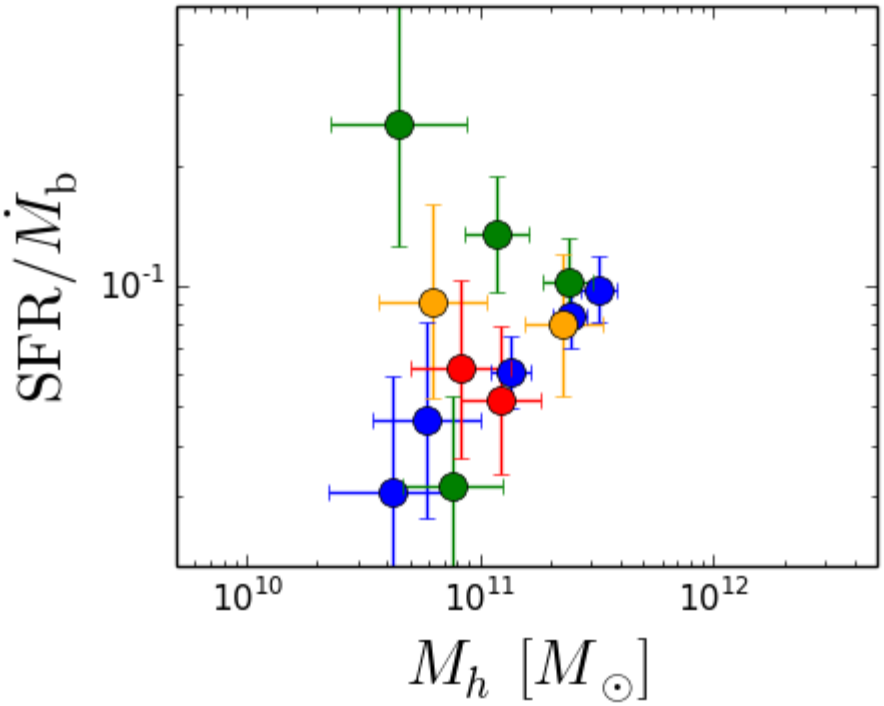
- Decrease from z~0 to z~4.
- Increase from z~4 to z~7 ?
- SHMR evolution confirmed by clustering.

Results: Baryon Conversion Efficiency

Baryon conversion efficiency (BCE) = $\mathrm{SFR}/\dot{M}_\mathrm{b}$

$\dot{M}_\mathrm{b} = f_\mathrm{b}\dot{M}_h \quad f_b = \Omega_\mathrm{b}/\Omega_\mathrm{m}$

$\dot{M}_h$ is calculated by N-body simulation results (we use the formulation in Behroozi+13).



- z~4 (this study)
- z~5 (this study)
- z~5 (this study HSC)
- z~6 (this study)
- z~7 (this study)

Results: Baryon Conversion Efficiency

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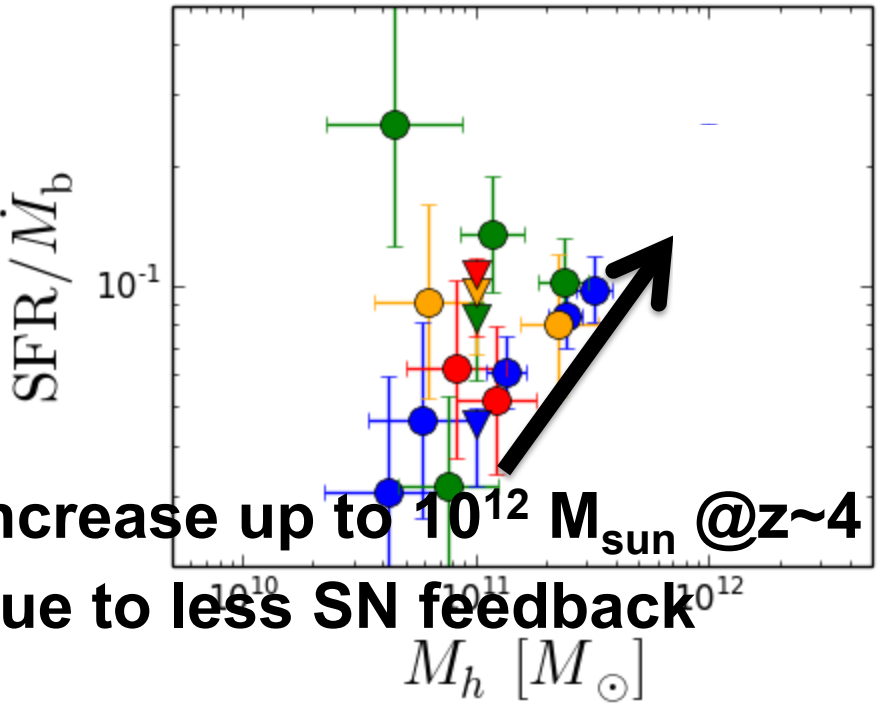
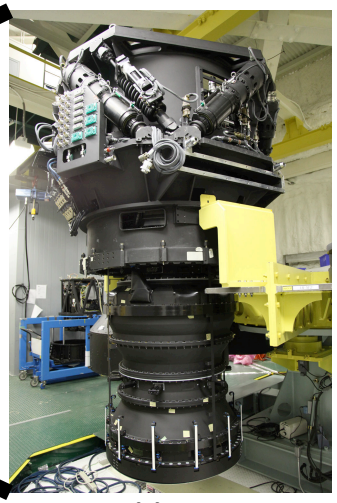


Increase up to 10^{12} M_{sun} @z~4 due to less SN feedback

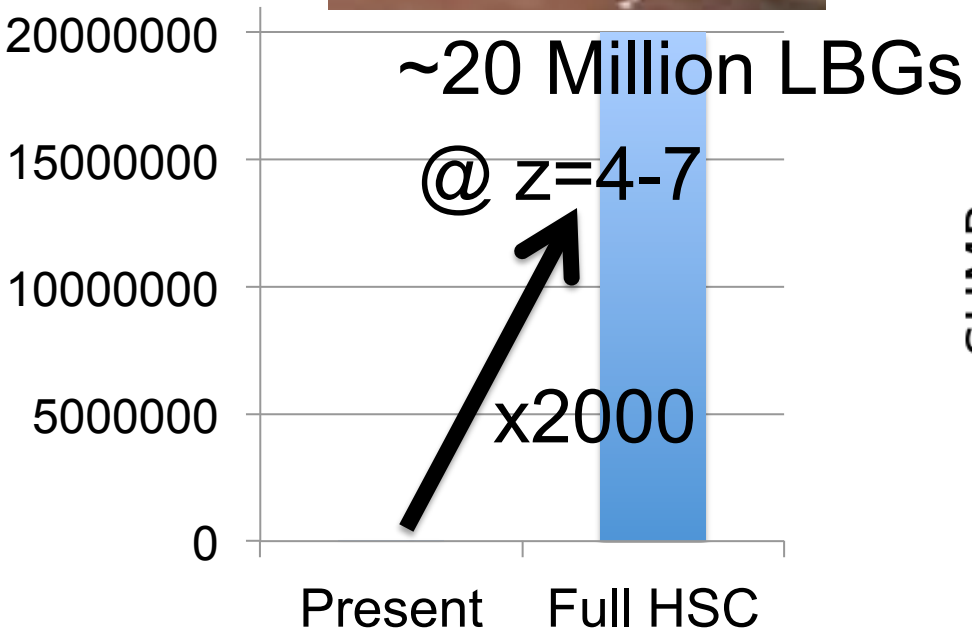
- z~4 (this study)
- z~5 (this study)
- z~5 (this study HSC)
- z~6 (this study)
- z~7 (this study)
- z~4 (AM; Behroozi+13)
- z~5 (AM; Behroozi+13)
- z~6 (AM; Behroozi+13)
- z~7 (AM; Behroozi+13)

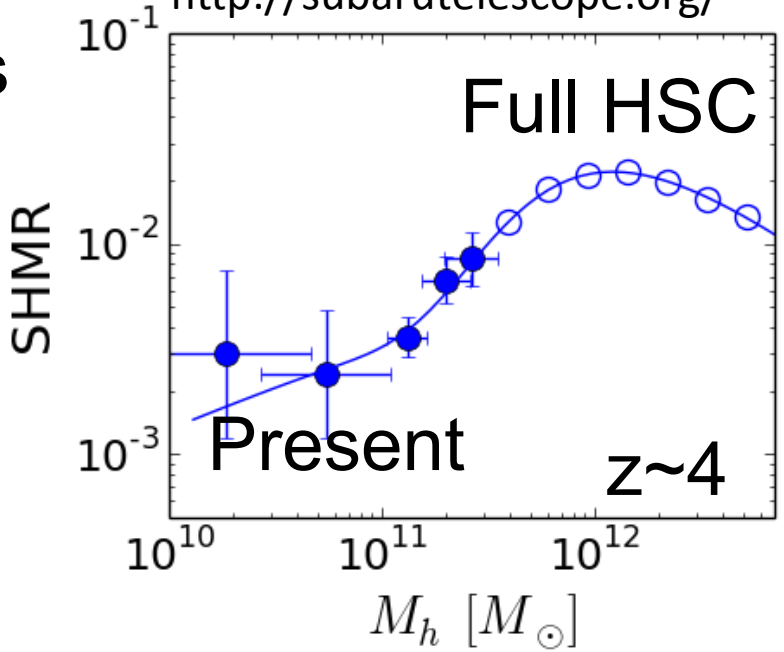
Future Prospects



HSC

http://subarutelescope.org/





Summary

The SHMR evolution is confirmed by the clustering.

- SHMR decreases @z~0→4 and increases @z~4→7.

BCE increases with increasing M_h up to 10^{12} M_{sun} z~4.

- Star formation is more efficient at higher halo mass due to less SN feedback.