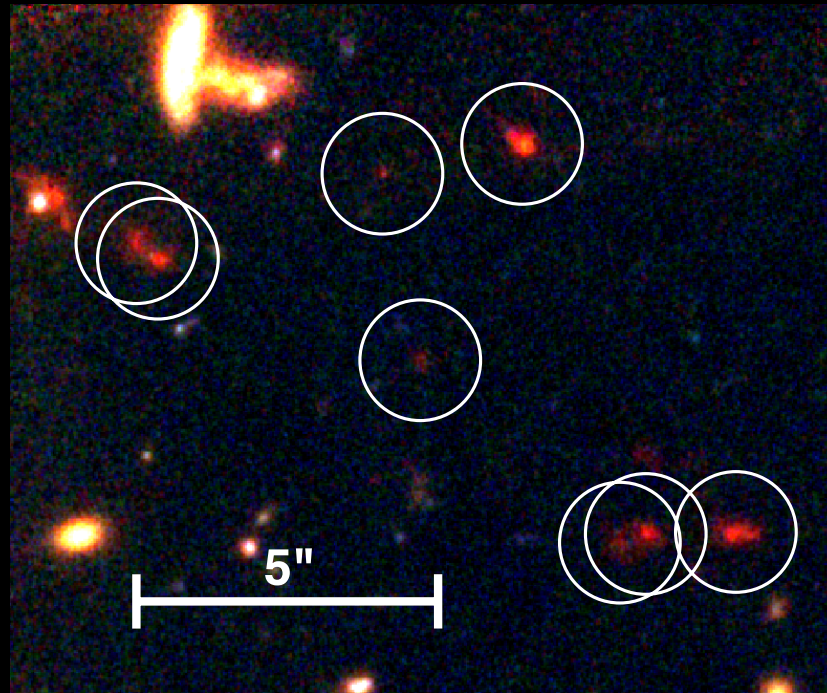


Very Compact Dense Galaxy Overdensity with $\delta \sim 130$ Identified at $z \sim 8$ in HFF



arXiv:1509.01751
Accepted for ApJ

Masafumi Ishigaki, Masami Ouchi, Yuichi Harikane,
Ryota Kawamata, Masamune Oguri
(University of Tokyo)

Hubble Frontier Fields (HFF) program

Observations of 4 cluster+parallel fields are complete (PI: J. Lotz)

Filters: F435W, F606W, F814W, F105W, F125W, F140W, F160W

Depth (5σ): 28.5 – 29.0 mag

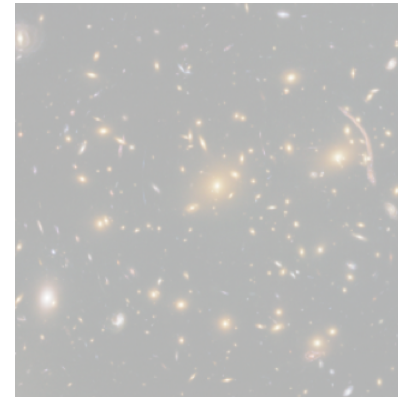
Abell 2744



MACSJ0416.1- 2403



Abell 370



MACSJ0717.5+3745



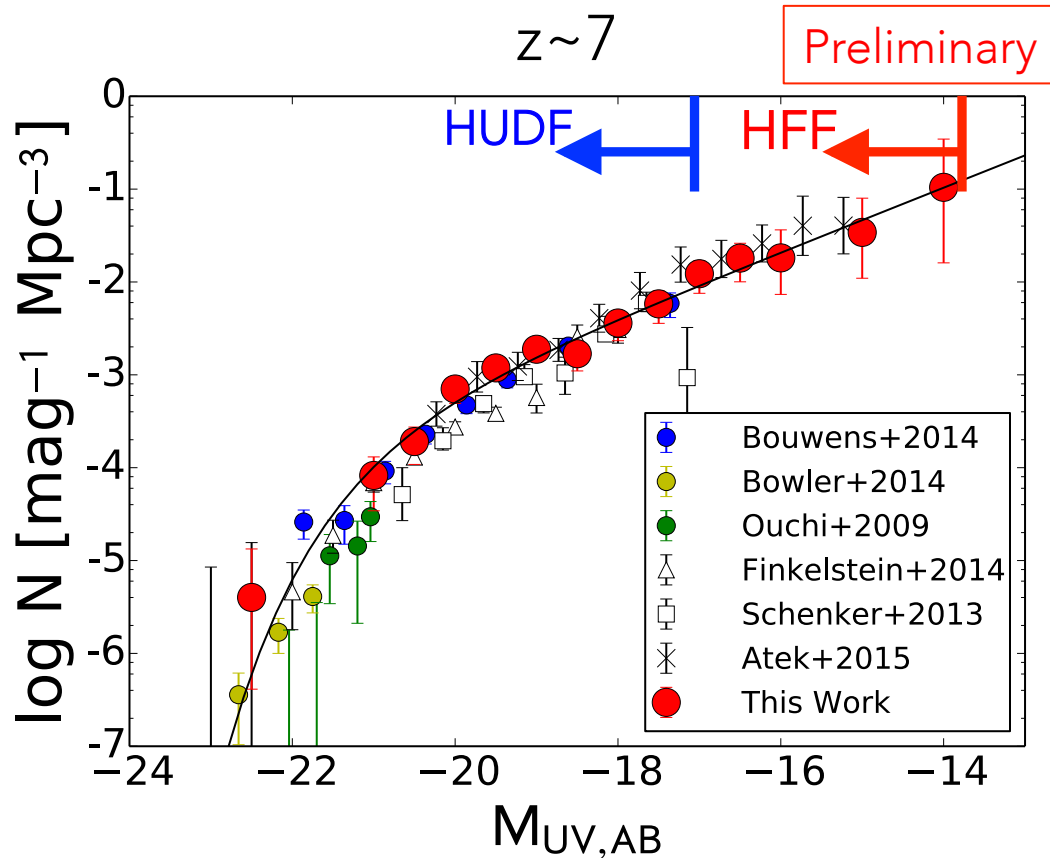
MACSJ1149.5+2223



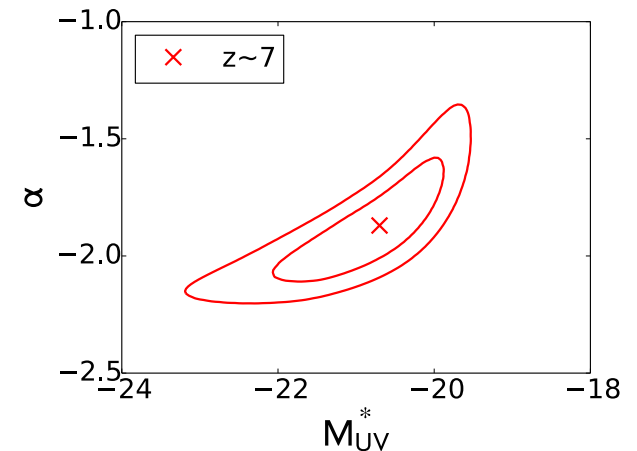
Abell S1063



High-z galaxies in HFF

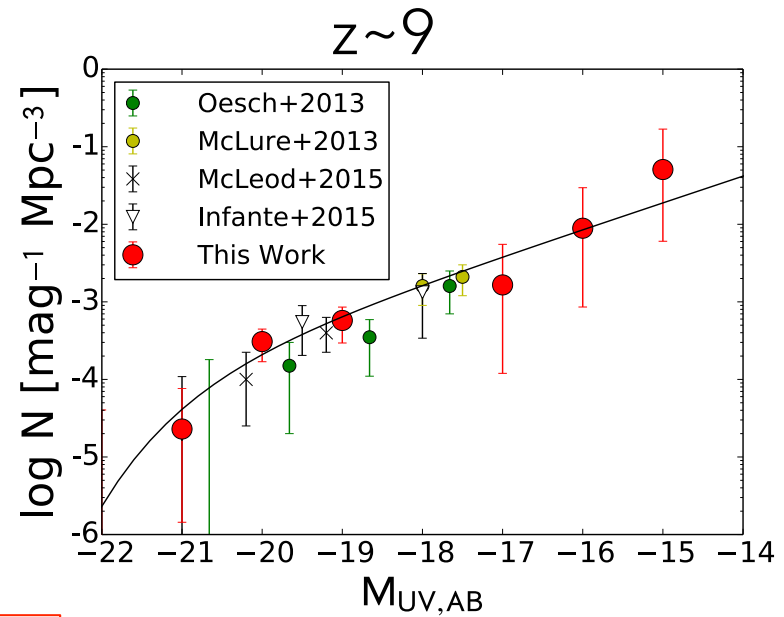
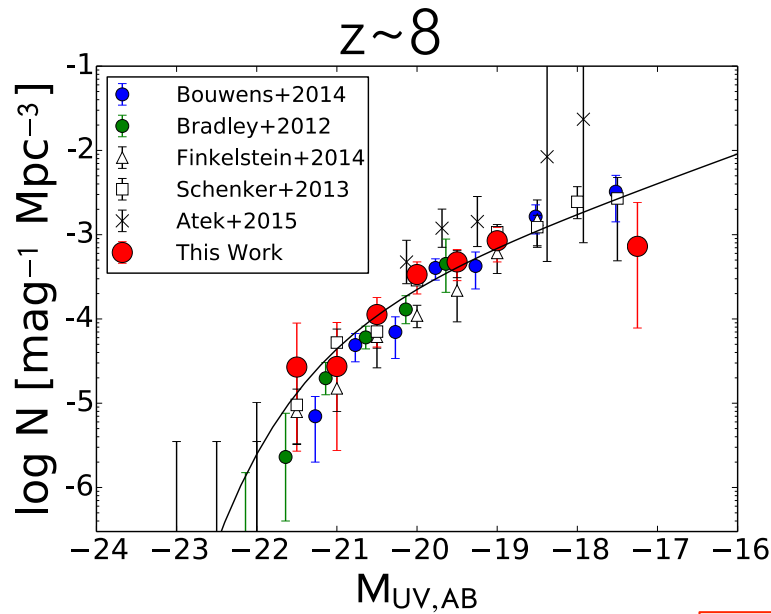


Constrain the LF
down to $M_{\text{UV}} \sim -14$



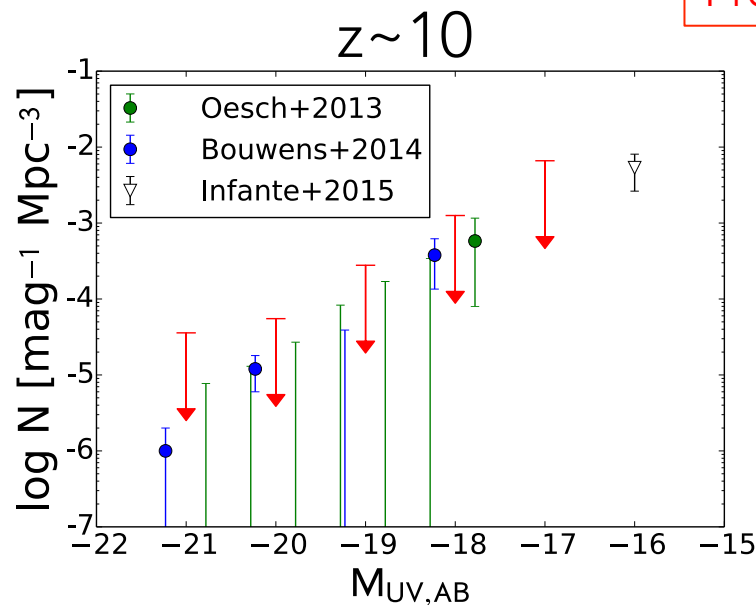
Kawamata+2015b, Ishigaki+ in prep

High-z galaxies in HFF



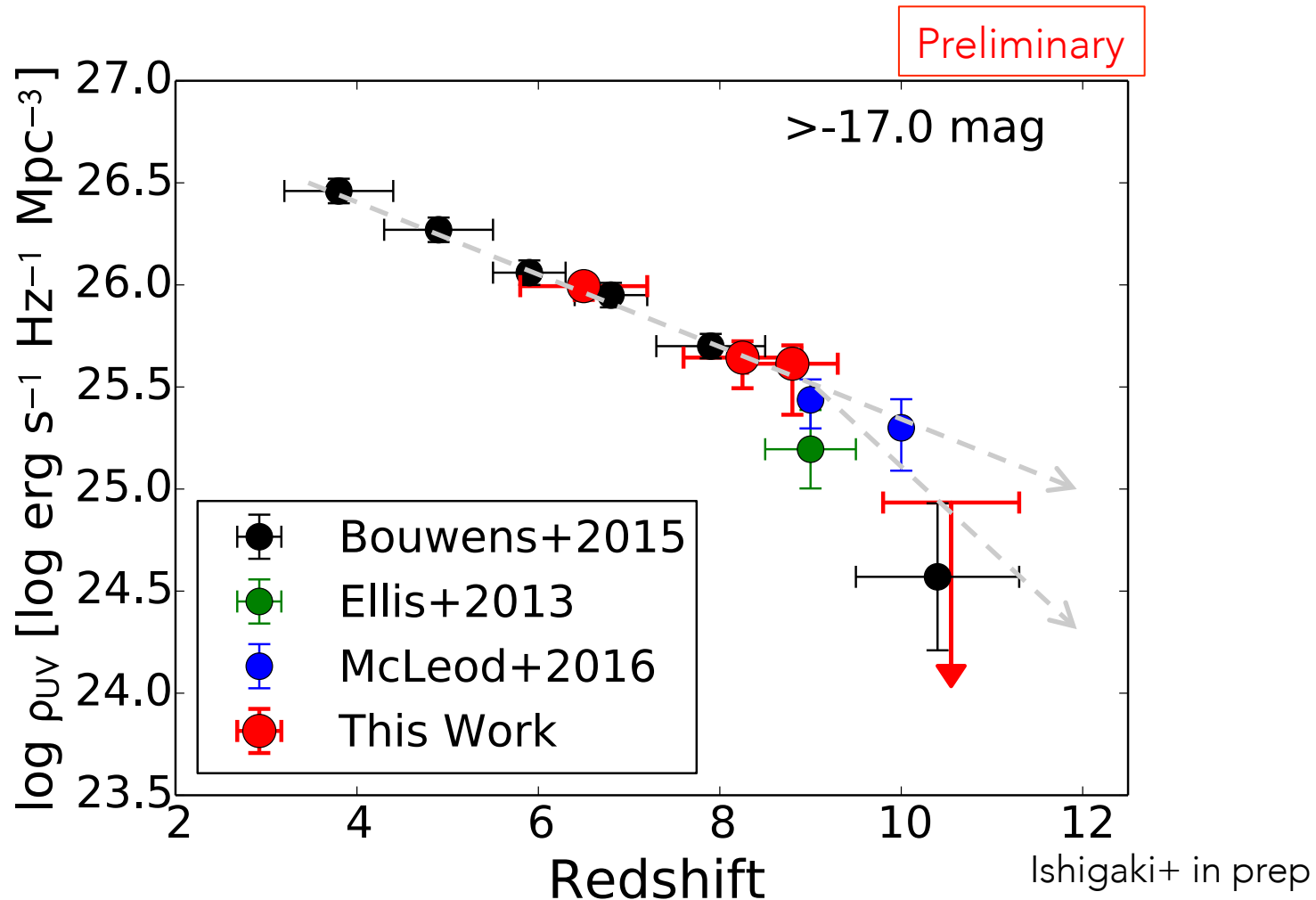
Preliminary

Kawamata+2015b, Ishigaki+ in prep



See also
McLeod+2016, Laporte+2016,
Infante+2015, Atek+2015

UV luminosity density evolution

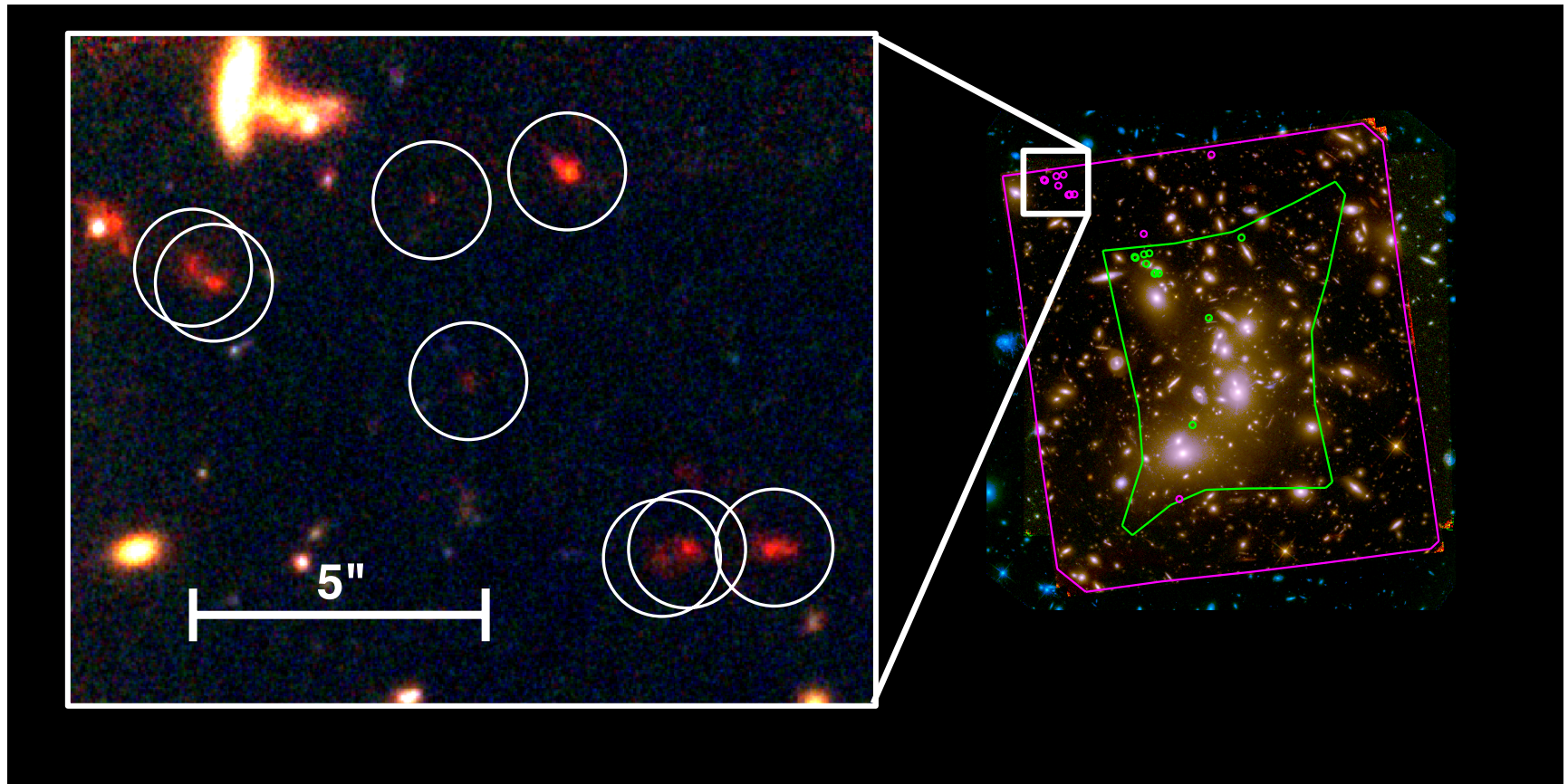


Rapid decrease from $z \sim 9$ to $z \sim 10$?

Galaxy Overdensity in A2744C field

- Galaxy overdensity at $z \sim 8$ identified in Zheng+2014, Atek+2014, and Ishigaki+2015
- 8 galaxies in a circle of 6" radius

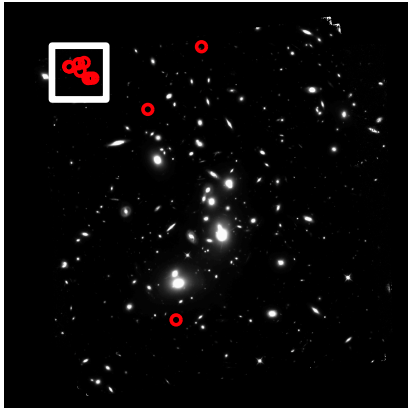
Ishigaki+2015b



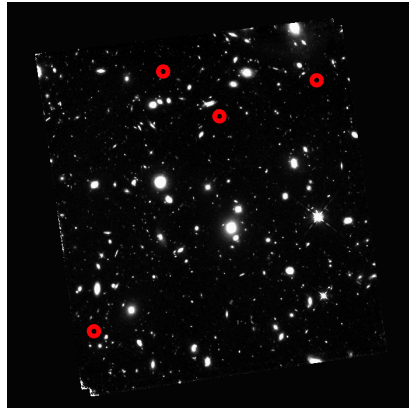
Galaxy Overdensity in A2744C field

Ishigaki+2015b

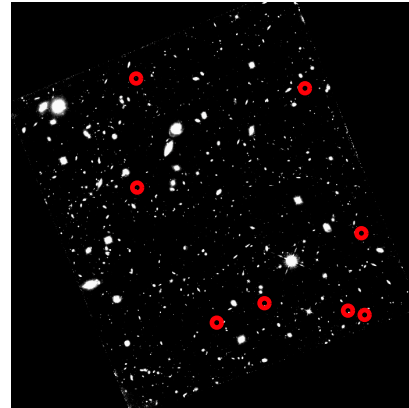
A2744C



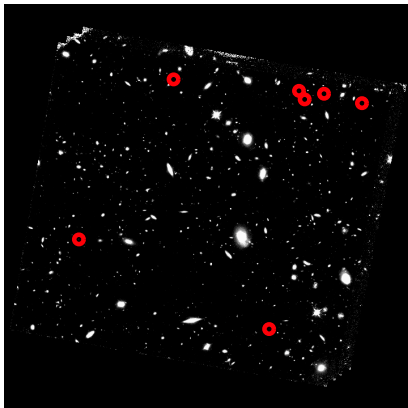
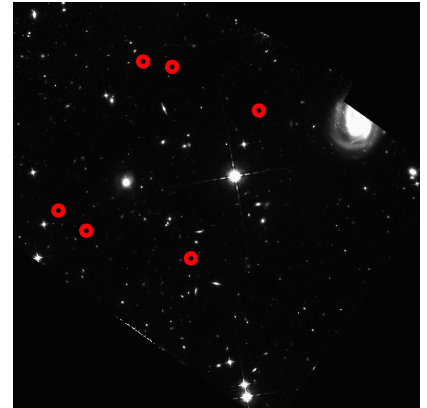
A2744P



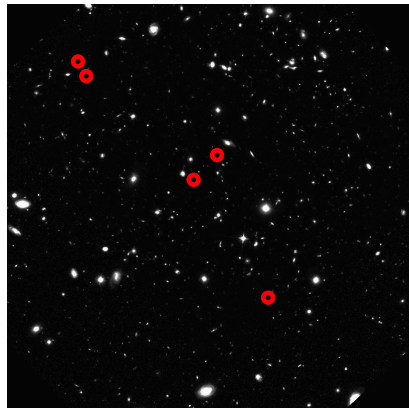
M0416P



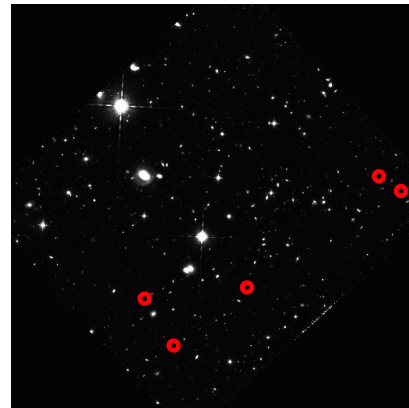
M0717P



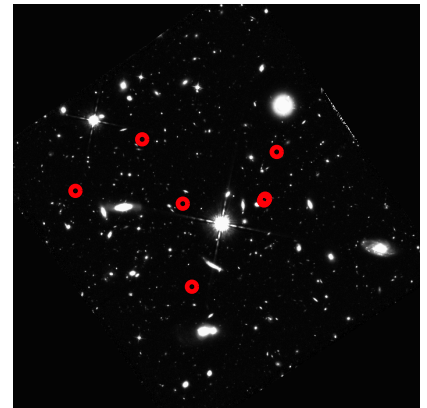
M1149P



UDF12



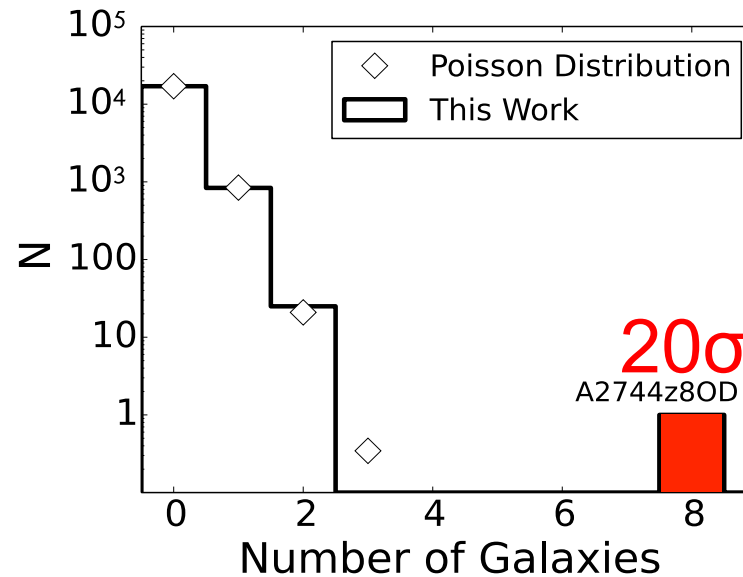
UDFP1



UDFP2

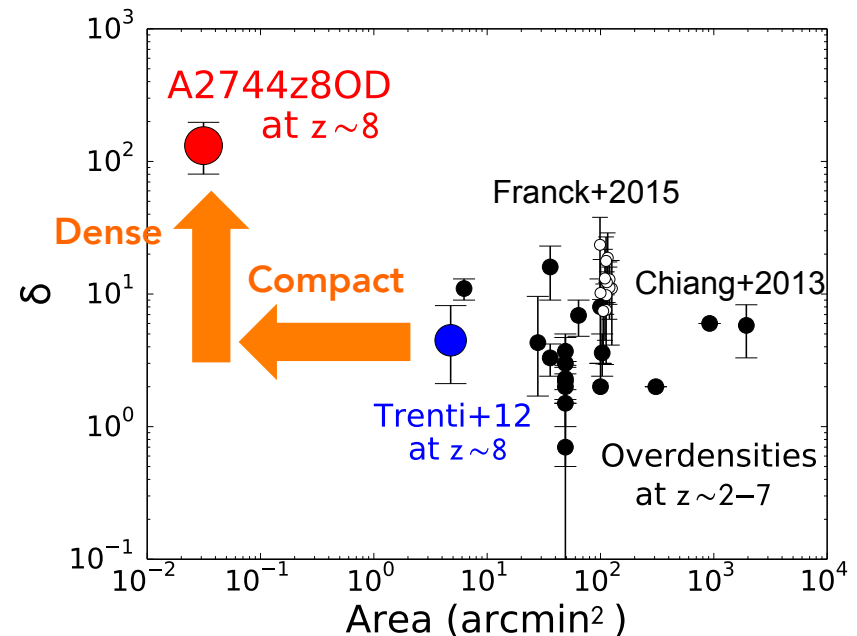
Overdensity

$$\delta = (n - \langle n \rangle) / \langle n \rangle$$
$$\sim 130$$

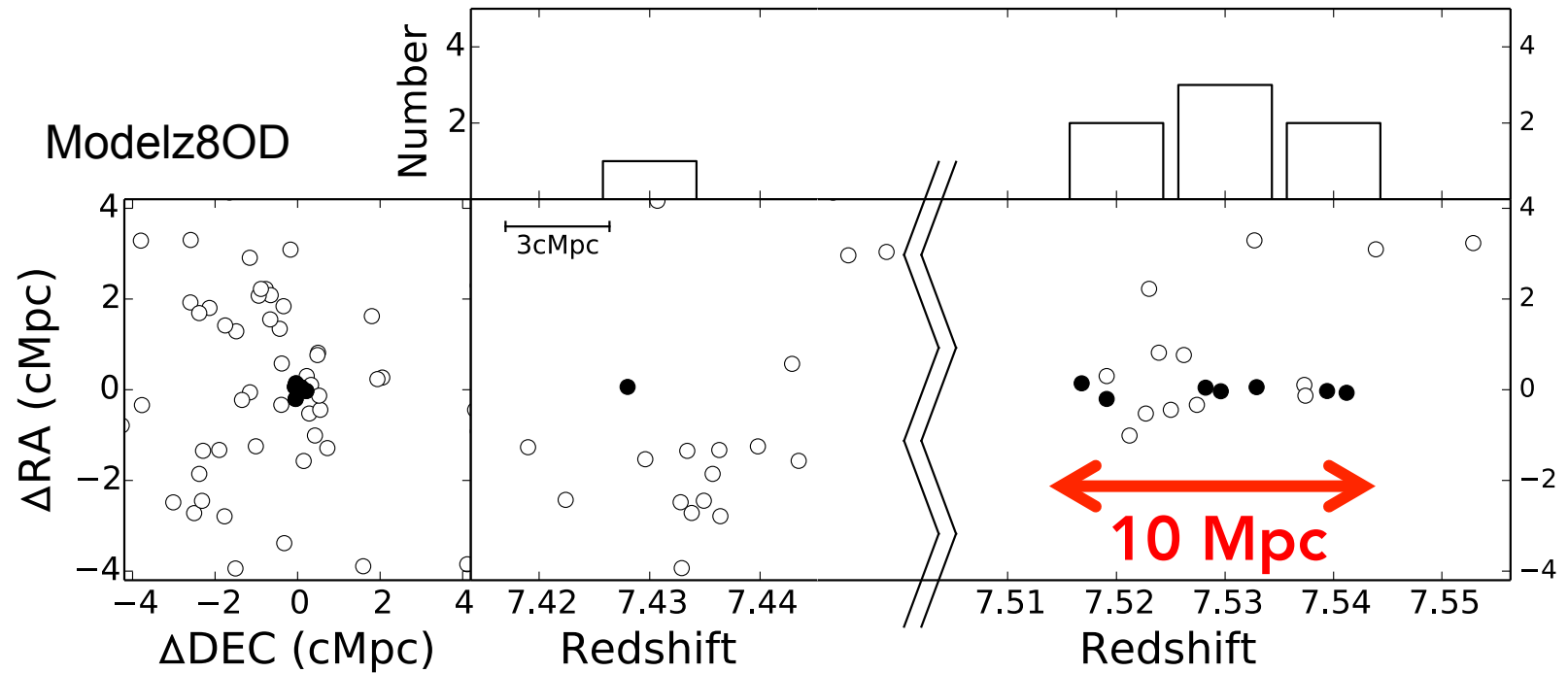


Ishigaki+2015b

More Compact and Dense
than overdensities in previous
studies

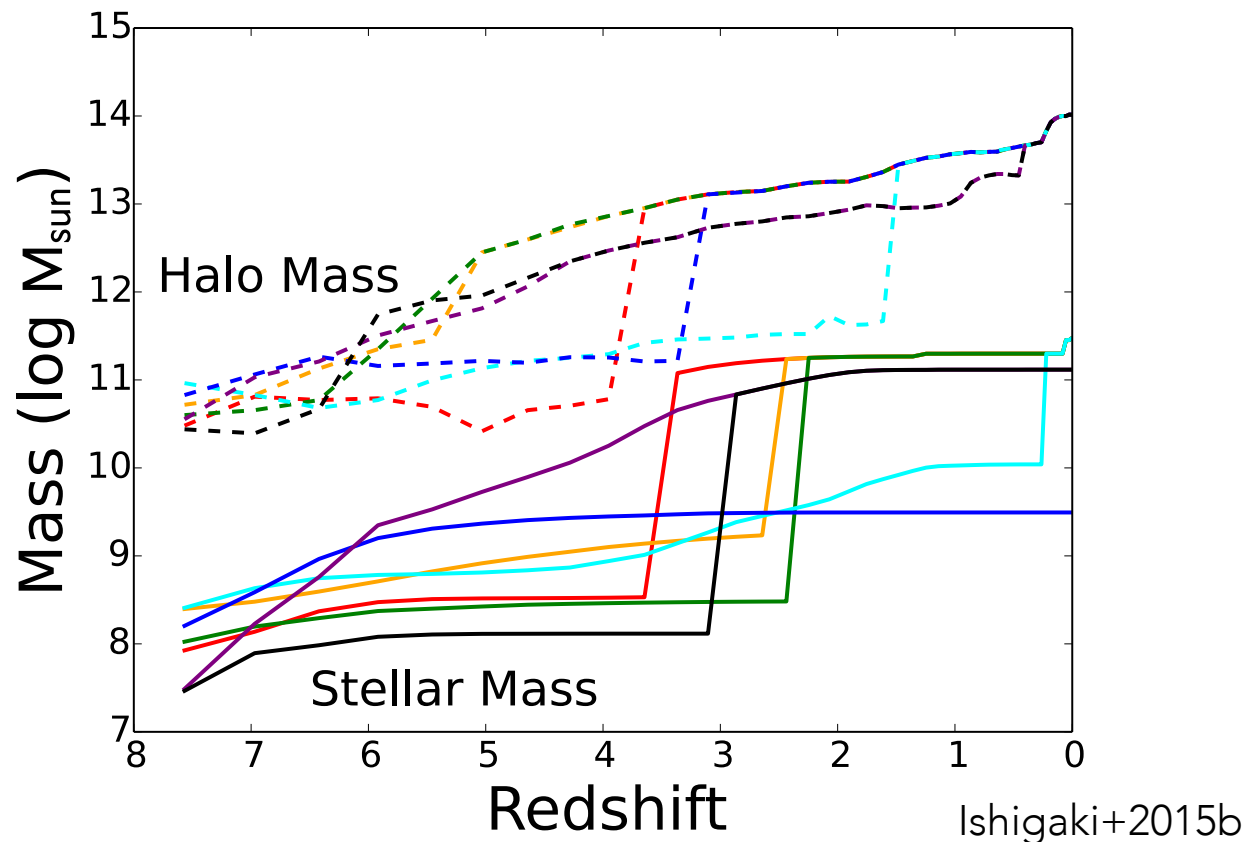


$z \sim 8$ galaxies in Millennium Simulation Henriques model



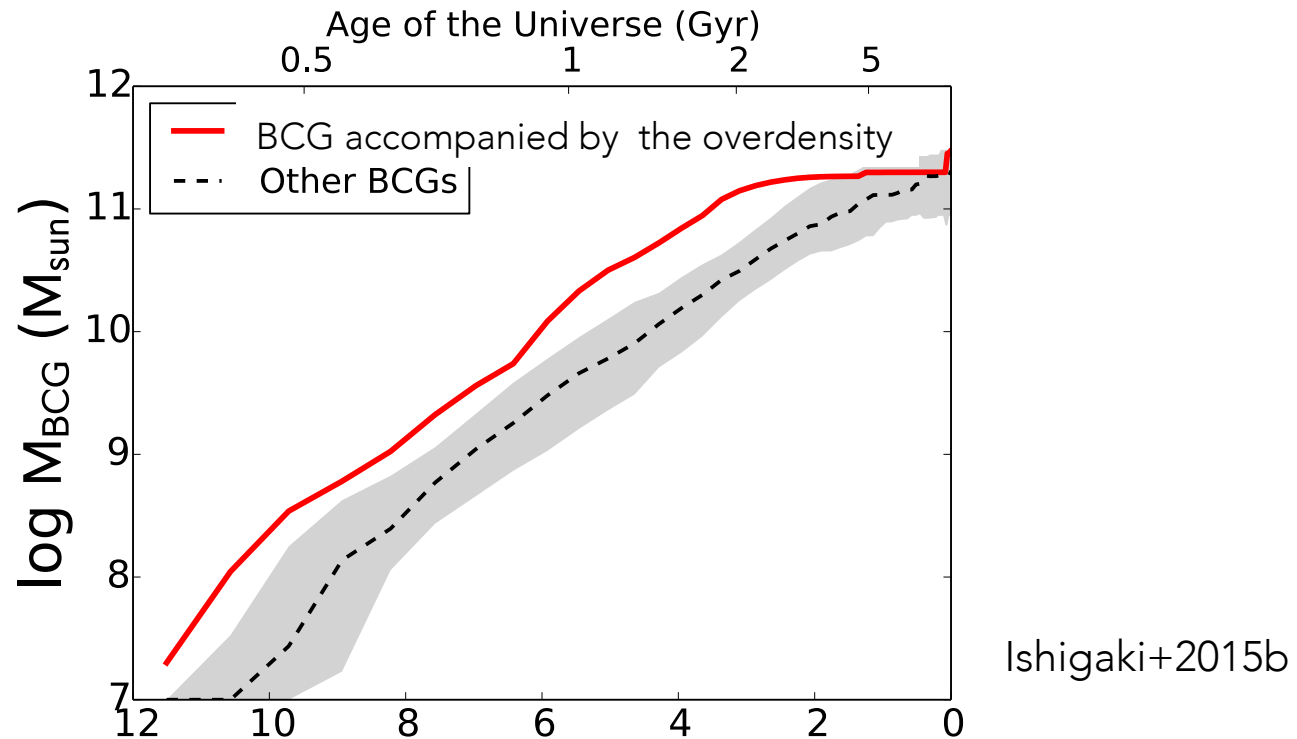
Evolution of the Mass of the model overdensity

- 7 galaxies are progenitors of a cluster with $M_h \sim 10^{14} M_{\text{sun}}$
- 4 galaxies merge into the brightest cluster galaxy (BCG)



Evolution of BCG mass

The BCG is a rare ($\sim 2\sigma$) massive system at $z > 4$, but the mass growth slows down at $z \sim 2$



Compact overdensity would be a progenitor of BCG,
which starts the star formation at the very high redshift

Summary

1. We find a $z \sim 8$ galaxy overdensity in the A2744 cluster field
2. Henriques2014 model has a similar compact overdensity
3. The model overdensity merges into a BCG in the today's cluster
4. Compact overdensities would be the tracer of early cluster cores
5. Future wide-field observations such as Subaru/Hyper Suprime-Cam surveys will open up the studies of compact overdensities