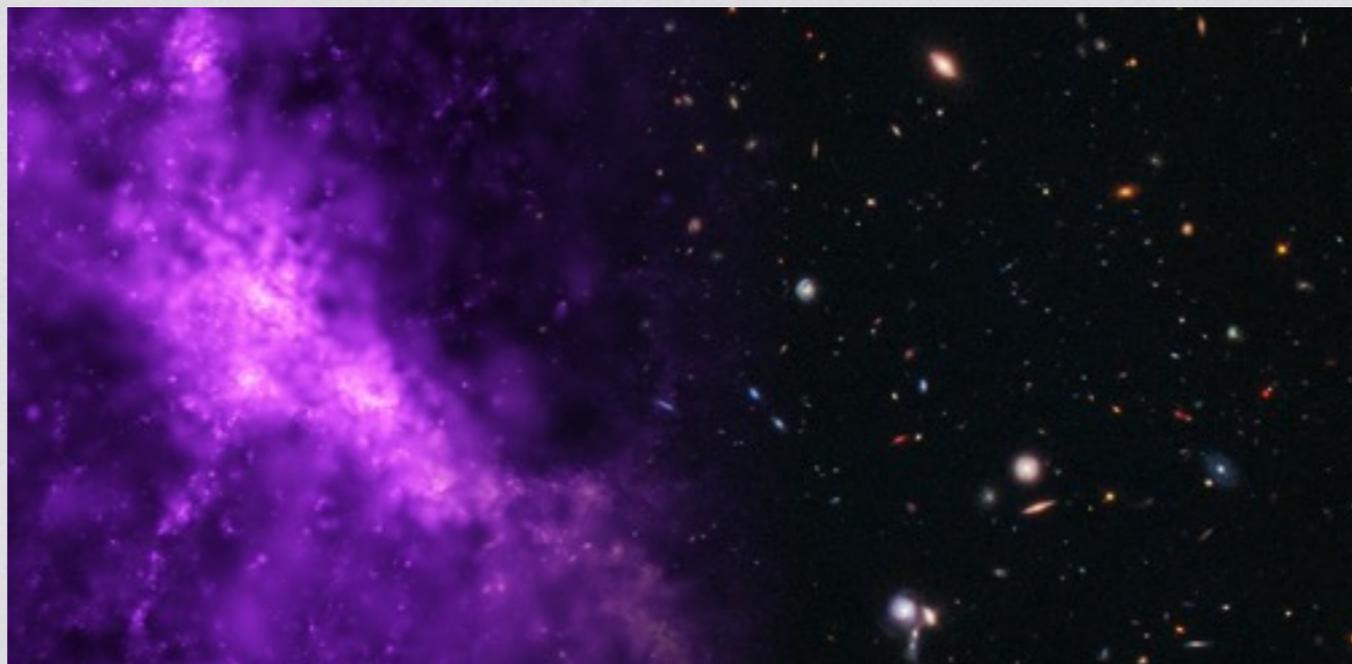


A Global View of the First Galaxies



Michele Trenti
The University of Melbourne



Subaru Partnership Science & Instrumentation Workshop

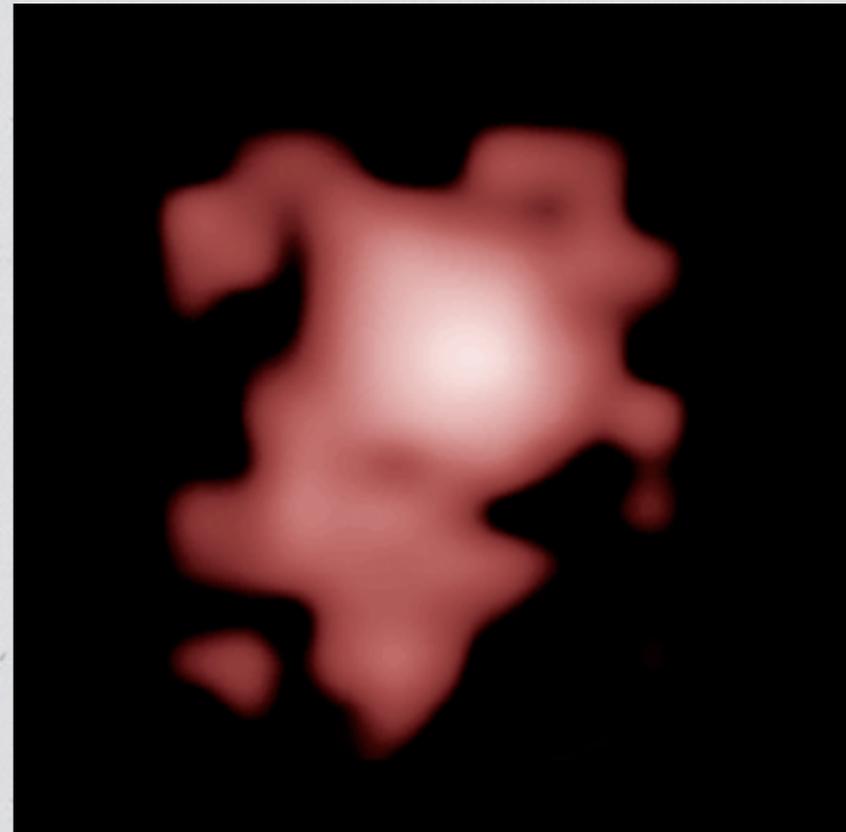
NAOJ - 22-24 March, 2017

Star formation: now and then

★ Was star formation different?



today



~13.4 Gyr ago

Image credits: NASA/ESA

Diverse probes of star formation physics in the young Universe



★ Galaxies



★ Quasars

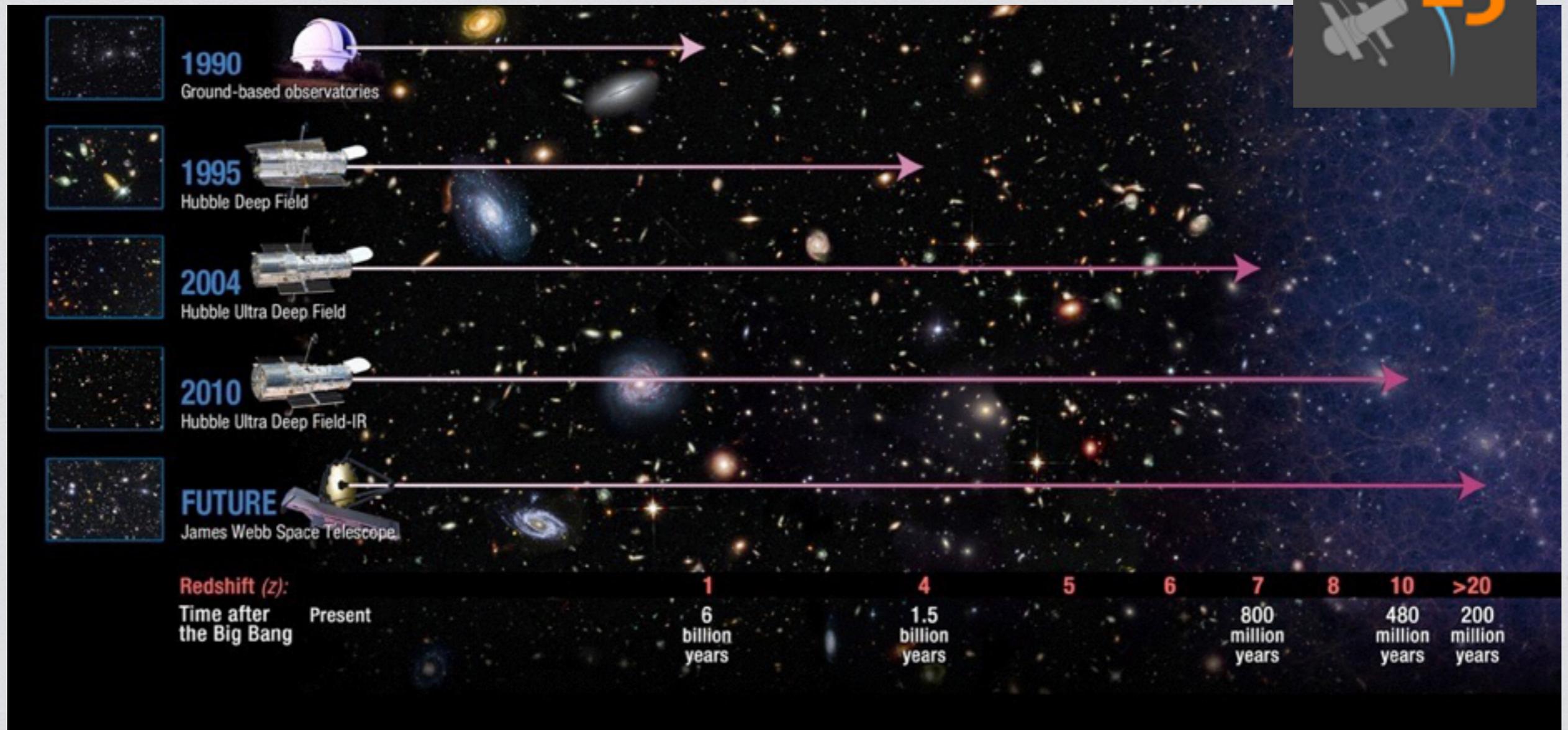


★ Gamma Ray Bursts (GRBs)

+ Theory/Modeling

Exploring the young Universe

The need for (and success) of space telescopes



NASA/ESA

Finding high redshift galaxies

- ★ Spectroscopy is challenging, but photometric redshift techniques from broad-band imaging have proven success



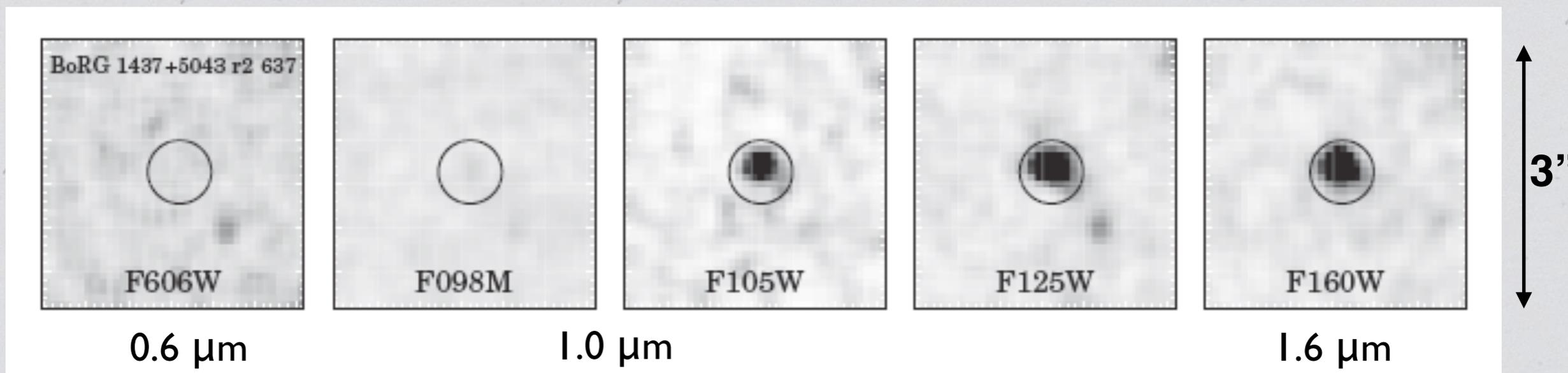
NASA, ESA, M. Trenti (University of Colorado, Boulder and University of Cambridge), L. Bradley (STScI), and the BoRG team

At the limit of Hubble



★ Discovery frontier at epoch of reionization,
but sources only marginally resolved

A galaxy brighter than the Milky Way just ~650
Myr after Big Bang from multi-band imaging



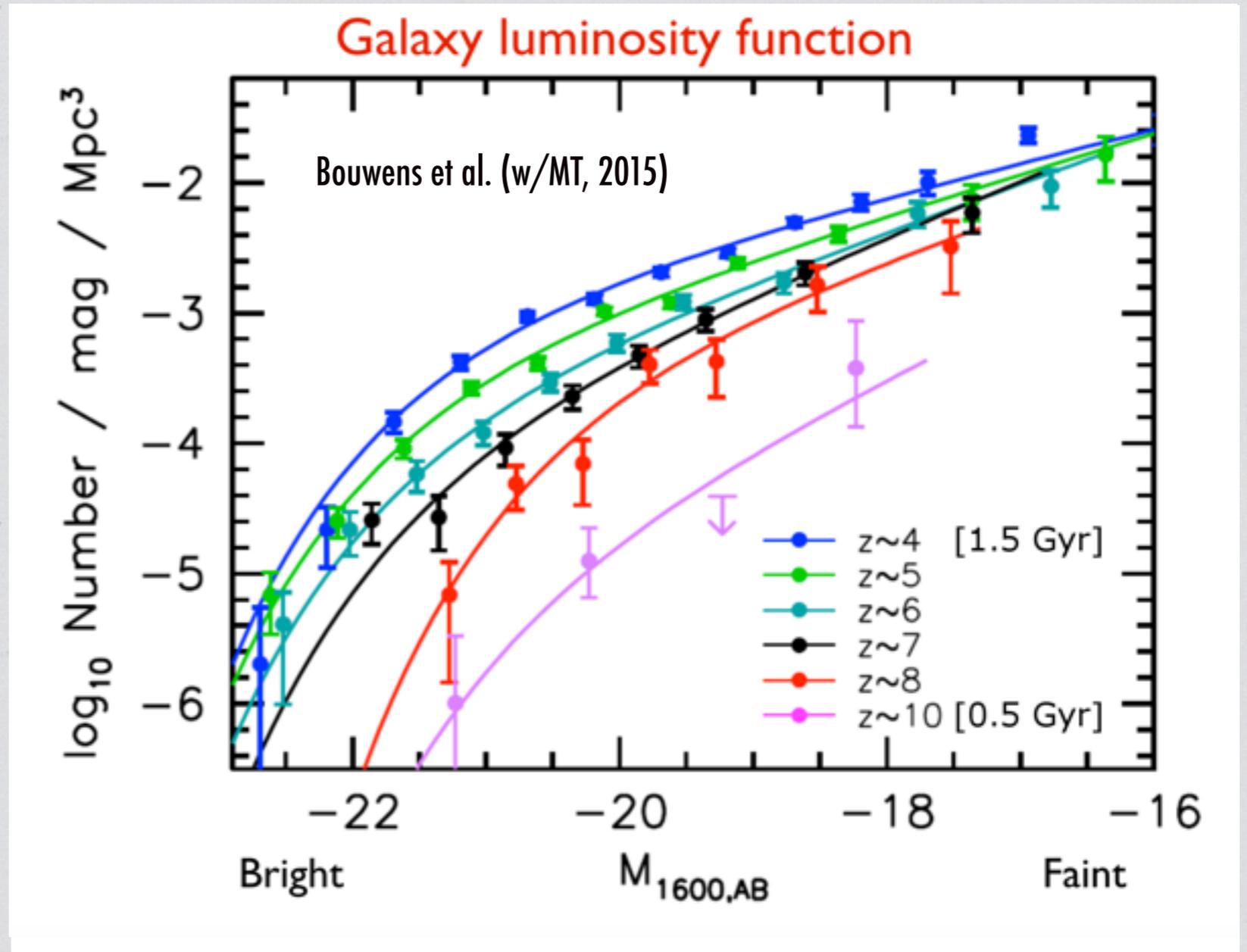
Trenti et al. (2012); Calvi et al. (2016)

Hubble: Galaxies at cosmic dawn

Unprecedented $z > 6$ samples from near-IR WFC3

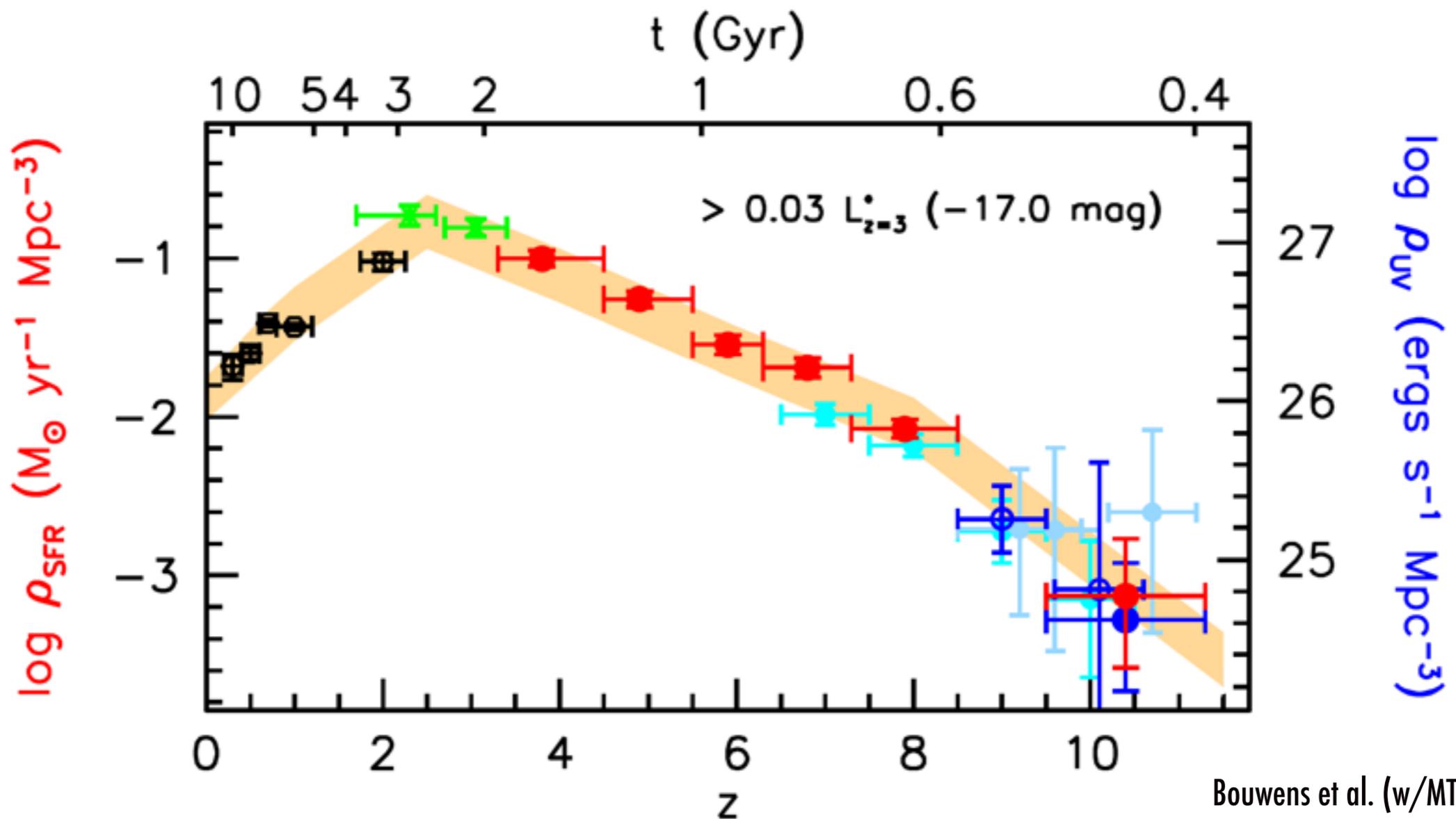
★ Almost 1000 dropout galaxies identified in the epoch of reionization

★ Strong redshift evolution



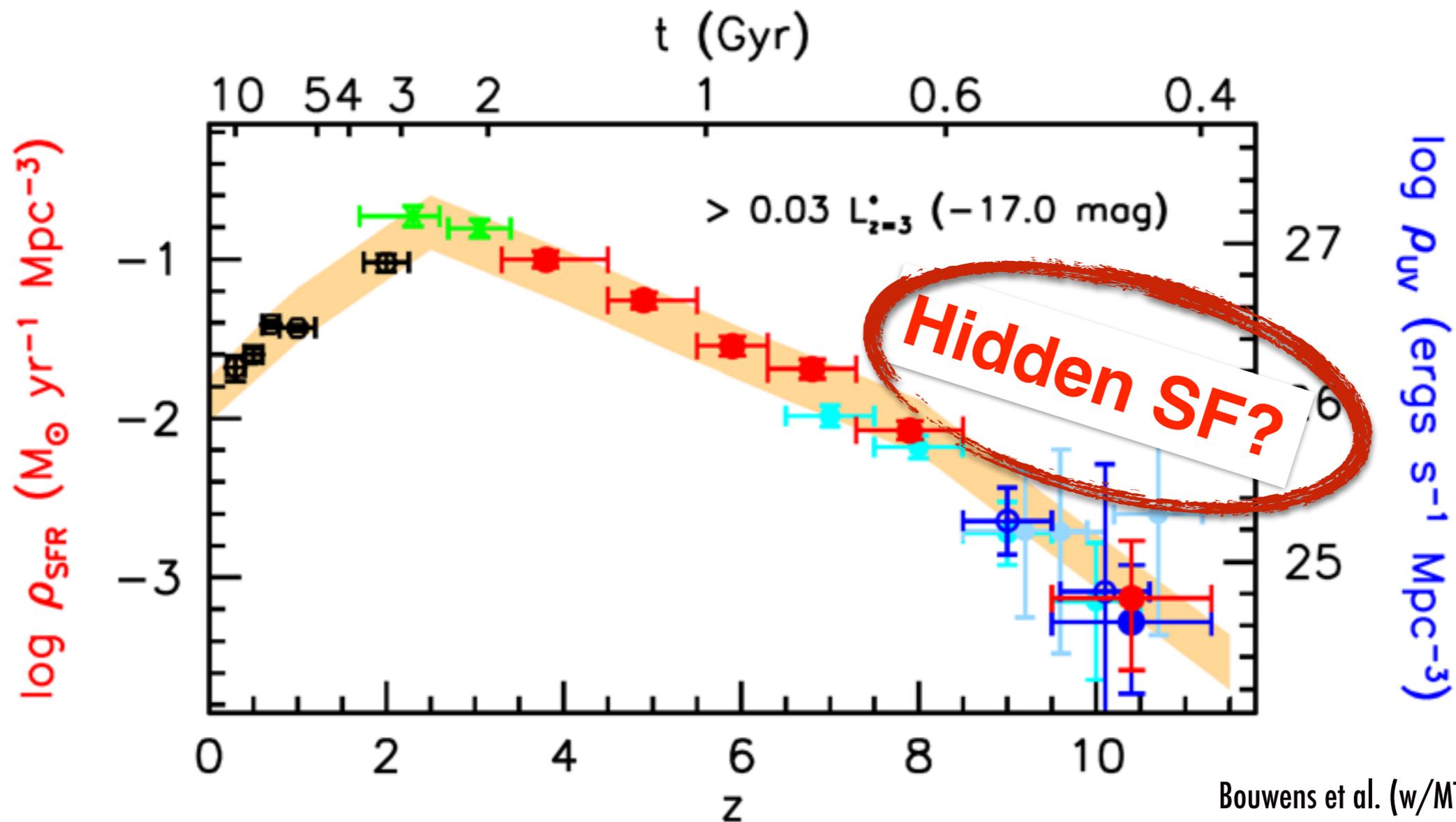
From light to star formation rate

★ **Observed** star formation rate drops at high z



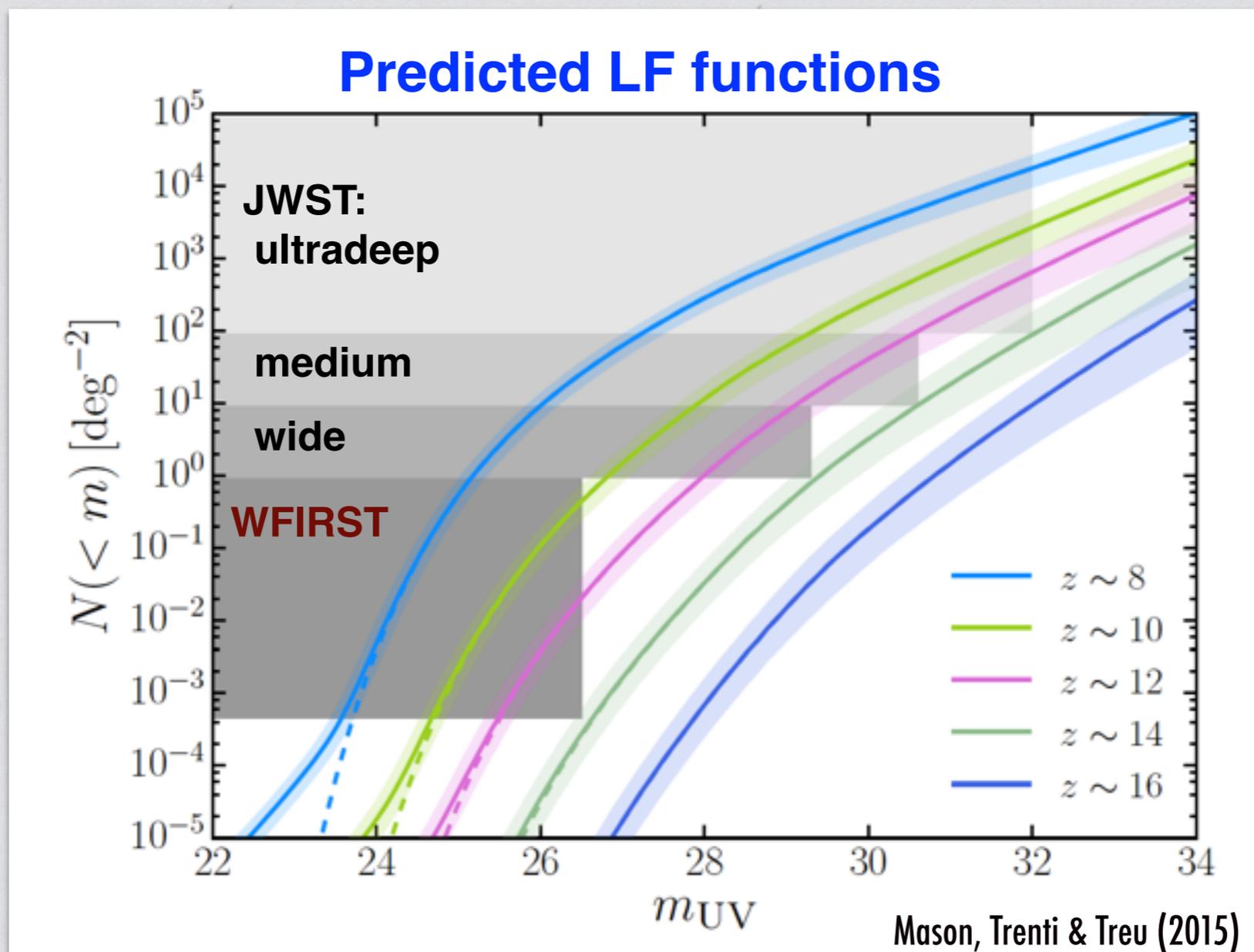
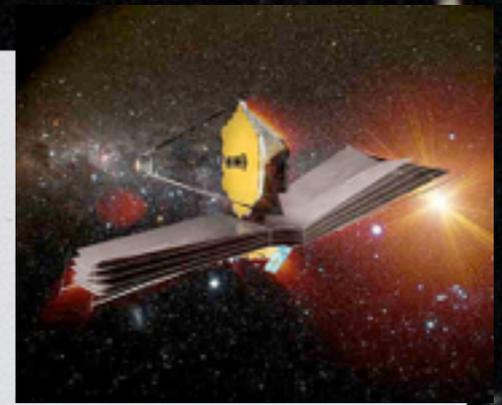
From light to star formation rate

- ★ But **steep luminosity function**:
Star formation may be hidden in faint dwarfs!



Extending the frontier

★ JWST and WFIRST imaging will push exploration further



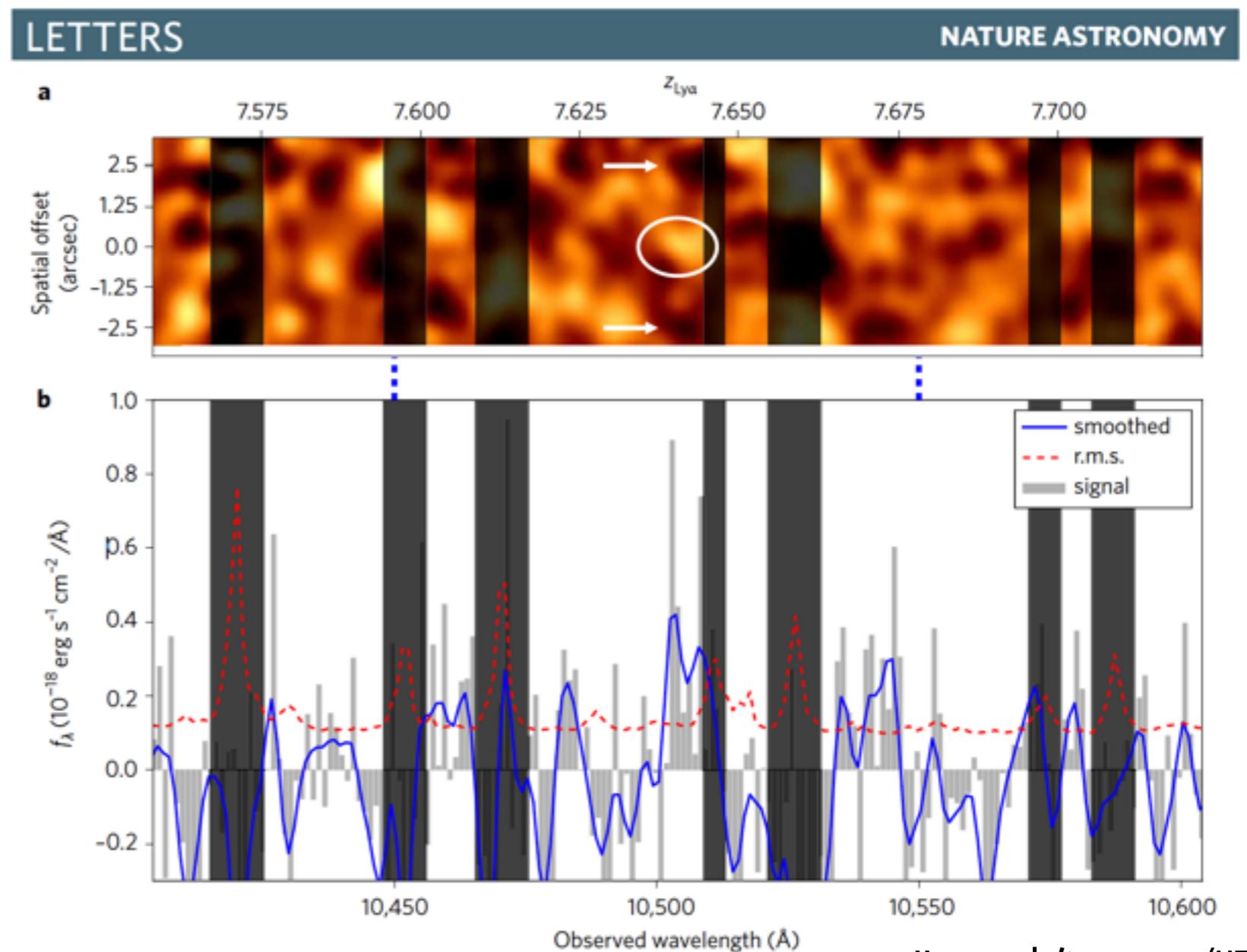
Ground-space synergy

Ground telescopes ideal for follow-up studies

★ Keck:
Pioneering
spectroscopy
at $z > 7.5$

★ But hard &
limited to
RARE bright
(or lensed)
galaxies

Ly α detection at $z=7.64$



Hoag et al. (in press; w/MT)

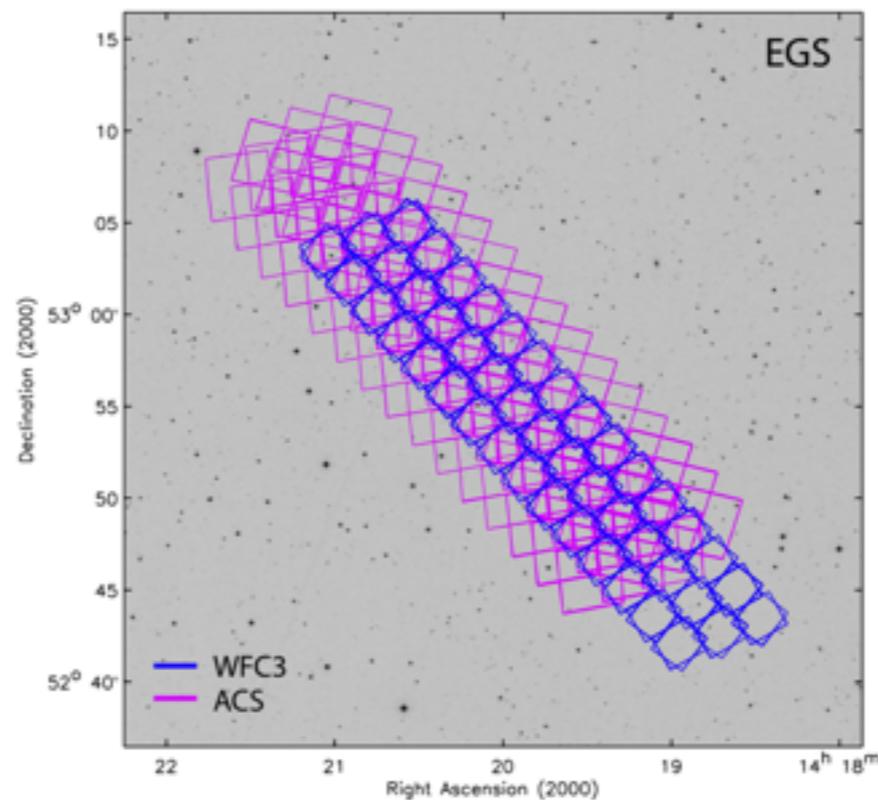
The Subaru advantage

★ Large field of view ideal for systematic follow-up of next-generation surveys from space

★ **PFS**
(+ULTIMATE)

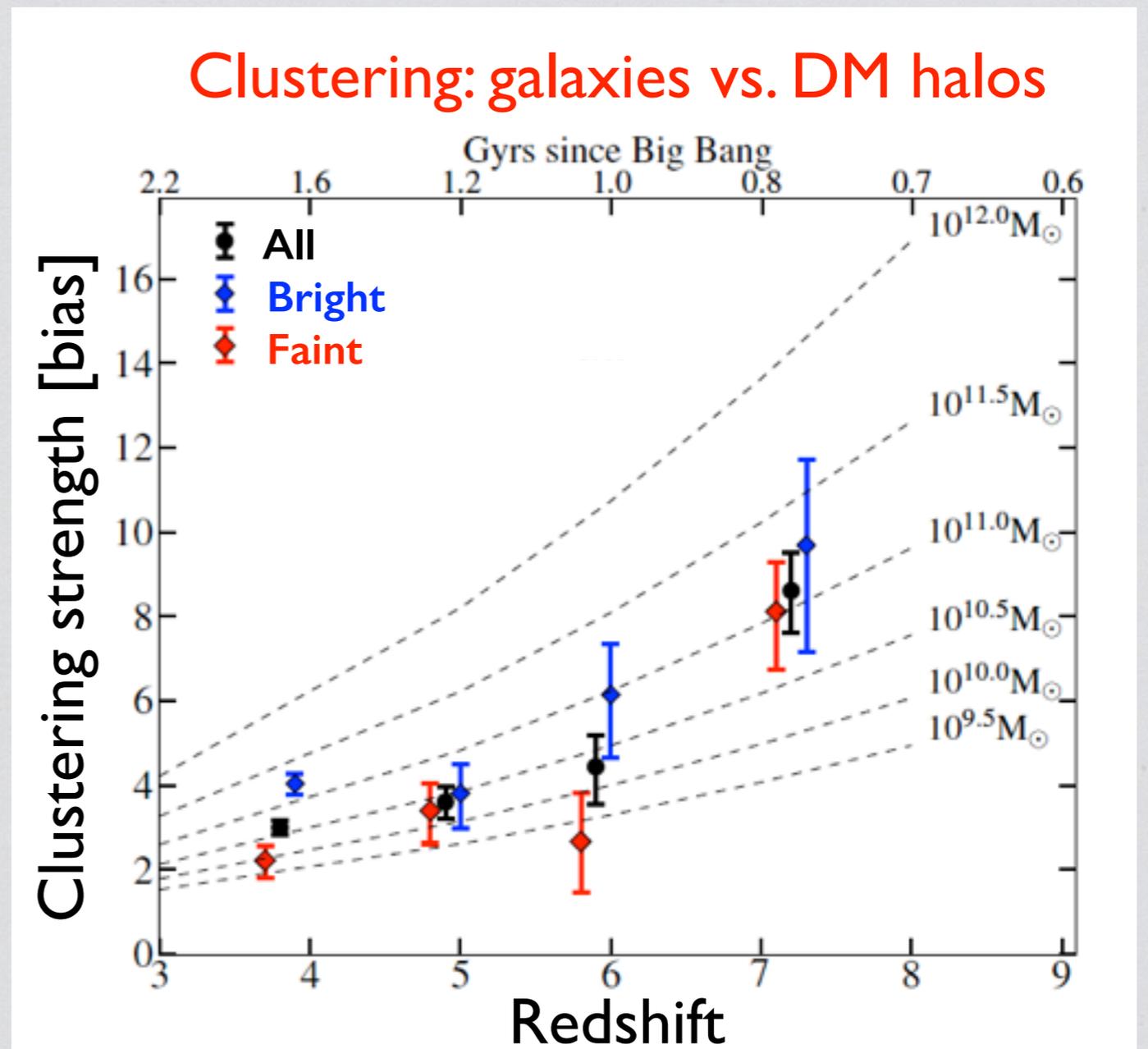
Subaru/
PFS

 Keck/MOSFIRE



Ground-space synergy for galaxy clustering studies

- ★ Small scales: First measure of galaxy clustering at $z > 7$ (HST/CANDELS data)
- ★ Very promising early results from HSC for large scales (see Harikane et al. 2016)



Barone-Nugent, Trenti et al. (2015)

High-z star formation from GRBs

★ Gamma Ray Bursts unique probes for

★ High-z star formation

★ IGM properties

★ Australia's SkyHopper mission

12U CubeSat (PI Trenti; phaseA funded)

★ Ultra-rapid near-IR follow-up of
transients like GRB afterglows

★ Exoplanets around brown dwarfs



High-z star formation from GRBs

★ Synergy with ground/JWST for spectroscopy



★ Strengthening Subaru's capabilities for Target of Opportunity Observations will be crucial for full exploitation of time-domain astronomy

Summary

- Hubble transformed our view of galaxy formation in the first Gyr
- Characterization of luminosity function evolution (galaxy counts)
- Strong space-ground synergy to investigate galaxy properties (spectra, clustering)
- JWST/WFIRST + wide-field ground will be next giant leap forward
- Multiple opportunities for collaborations on frontier science

